Summary of UBC REACT Lab Study:

Travel Behaviour and Greenhouse Gas Impacts of the Saanich E-Bike Incentive Program

The study found that the Saanich pilot was effective in increasing e-bike adoption, spurring mode shift to active transportation, and reducing vehicle trips, vehicle kilometers travelled (VKTs), and travel-related greenhouse gas (GHG) emissions. The larger incentives were more cost effective in advancing these goals.

The researchers recommend future e-bike incentive programs prioritize larger and income-qualified purchase rebates in order to deliver equity benefits and cost-effective GHG emission reduction. Future programs could also work with researchers to test other variables.

The Final Report, "Travel Behaviour and Greenhouse Gas Impacts of the Saanich E-bike Incentive Program", is available at reactlab.civil.ubc.ca/saanich-ebike-incentives.

Researchers Dr. Alex Bigazzi, Principal Investigator, and Amir Hassanpour and Emily Bardutz, Graduate Research Assistants at the University of British Columbia's (UBC) Research on Active Transportation (REACT) Lab established a study on the Saanich Community E-bike Incentive Pilot Program with funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) and support letters and funding from the District of Saanich, the Capital Regional District (CRD), the Community Social Planning Council (CSPC), and One Earth.

The objectives of the study were to determine:

1. The GHG mitigation impacts of e-bike adoption across different segments of the population; and
2. The cost-effectiveness of e-bike purchase incentives as a GHG mitigation strategy.

Participants in the study were drawn from three groups:

1. Saanich e-bike incentive pilot program participants

Control groups consisting of:

2. Recent purchasers of e-bikes in the CRD who did not receive an incentive.
3. Recent purchasers of conventional (non-electric) bikes in the CRD who did not receive an incentive.

All groups were surveyed three times:

- **Wave 1:** Survey issued as close as possible to the time of bicycle purchase
- **Wave 2:** Survey issued 3 months after purchase
- **Wave 3:** Survey issued 12 months after purchase

Each wave records data on use of the purchased bicycle, travel activity of all modes, and household information including vehicle ownership.

Mode shift information was collected using two methods:

- **Method 1:** Asked the survey respondent which alternative modes (such as driving, transit, walking, conventional bike, or not making the trip) they would have used for the last three trips taken by the purchased bicycle.
- **Method 2:** Calculated changes in typical weekly travel habits between survey waves. The travel mode shifts are then translated into GHG impacts by applying lifecycle GHG emission rates by the distance travelled with each mode. Physical activity estimates are also collected based on the duration of travel by each mode. Regression analysis was conducted and details are available in the Final Report.

SUMMARY OF UBC STUDY RESULTS AND DISCUSSION

The study recruitment achieved the target sample of at least 300 participants at Wave 1 and at least 100 participants at Wave 3. The Saanich program response rate of 42% is relatively high, with anticipated drop off rates over the course of the study. See **section 3.1.1 of the Final Report** for details.

KEY FINDINGS

E-bikes were used frequently:

All e-bike users in the study on average rode their e-bikes 3 to 4 days a week and 30 to 70 km per week (see **section 3.4 in the Final Report** for details).

3-4 days /week

30-70 km /week

E-bike incentives reduced vehicle use and GHG emissions:

- Incentive recipients reduced their auto use by 48 km per week between the first and final survey due to using e-bikes instead for trips and broader shifts in weekly travel habits (e.g. changes in numbers and distances of trips or using other modes reflecting lower vehicle dependence overall). Roughly half the GHG savings were from direct substitution of the e-bike for vehicle trips and the other half were from broader shifts in weekly travel habits.
- Incentive recipients reduced their GHG emissions from travel by 43% between purchase (Wave 1) and the 3 month survey (Wave 2). After the one year survey (Wave 3), this savings was 38%, showing good long-term retention of the GHG mitigation effect.
- The average GHG reduction from personal travel for Saanich e-bike incentive recipients was approximately 16 kg CO_2e/week. The GHG reductions were larger for those receiving the larger rebates. Specifically, without considering marginality, the GHG reductions in kg CO_2e/week were: 7.5 kg CO_2e/week for the $350 rebate, 17.3 kg CO_2e/week for the $800 rebate, and 28.3kg CO_2e/week for the $1600 rebate. Additional information is available in **section 3.8 of the Final Report**.

GHG

E-bikes were more effective at reducing driving than conventional bikes:

- The largest share of e-bike trips were for the commuting to work or school while the largest share of conventional bike trips was for exercise or leisure (see **Figure 22 in the Final Report**).
- Automobile was the travel mode most frequently replaced by e-bike trips, while conventional bicycle trips would more often have been made by a different conventional bicycle.
- Conventional bicycle trips were more likely to replace walking and transit trips than e-bike trips were, thus having less impact on transportation GHG emissions.

Incentives prompted new climate-friendly behaviours:

- At or near e-bike purchase, the incentive recipients in the study drove more than the control group and were more similar to the population at large than the control group in terms of their GHG emissions from travel. This meant that the incentives reached an audience that hadn't already adopted climate-friendly transportation habits (see **section 4.1 in the Final Report** for more information).
- The program attracted a large portion of new e-bike purchasers (23% to 76%, increasing with rebate level – see **Figure 2 below**). These were people who would not have purchased an e-bike were it not for the incentive program, also known as "marginal purchasers". In other words, marginal purchasers are the opposite of program "free-riders" who would have purchased an e-bike whether or not there was an incentive. Reducing free-ridership and increasing marginal participants makes an incentive program more effective since it prompts new climate-friendly behaviour rather than simply rewarding climate friendly behaviour that was already going to occur. The survey asked about likelihood on a scale of 0-100% rather than a yes or no question. For more details, see **section 3.2.2 of the Final Report**.

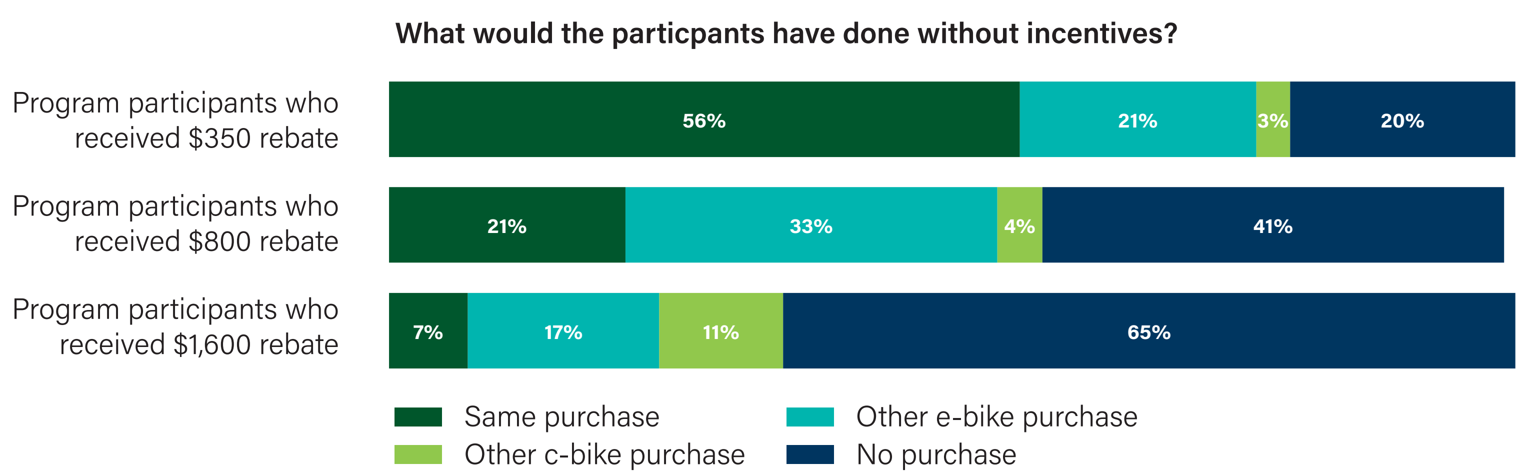
Centering income equity in design improved effectiveness:

- Larger incentives for income qualified households were associated with greater auto travel reduction due to higher pre-purchase auto use by lower income participants, and therefore higher GHG reductions than for the higher income participants (see **sections 3.4 and 3.8.1 in the Final Report** for more details).
- Larger incentives for income qualified households resulted in a higher rate of "marginal purchasers", or reduced free-ridership rates, and therefore a better cost per ton for GHG emissions reduction than for non-income qualified participants (see **section 3.8.1 of the Final Report** for details).

High satisfaction rates were achieved.

Survey respondents reported more enjoyment/fun and safety than they expected, and that lasted over the 12 months following purchase (see **section 3.3.1 in the Final Report** for details).

Figure 2: Mean self-reported likelihood of alternative behaviours without incentive by rebate amount



Participation by households with children was achieved.

The percentage of households with children in the surveyed incentive recipients (31%) is similar to the percent of households with children in Saanich (32%) based on the survey responses and 2021 census respectively (see **section 3.1.2 of the Final Report**). Therefore, despite not including a higher rebate for cargo/family bikes, the Saanich pilot had a proportional representation of households with children.

Vehicle ownership remained steady while GHGs shrank.

The average household vehicle ownership rates of all study participants stayed relatively the same throughout the 12 months of study. Average number of motor vehicles in the households among survey participants who took all 3 surveys is 1.55 in Wave 1, 1.51 in Wave 2, and 1.52 in Wave 3.

Program delivered multiple co-benefits including:

- Increased physical activity levels for transportation. At least 150 minutes of moderate or vigorous physical activity per week are recommended for adults, and average participants in all study groups achieved this physical activity level from travel in all three waves, and experienced a net increase in physical activity during travel one year after bicycle purchase, despite some substitution of walking and cycling with e-bike trips (see **section 3.7 of the Final Report** for details)
- Each rebate induced an average of $813 in new consumer spending for local bike stores that wouldn't otherwise have occurred (see **section 3.8.2 of the Final Report** for details). This translates to $1.31 in induced spending per $1 in rebates.

Not explored in the study but anticipated other benefits likely include:

- Reduced travel costs for households (due to substituting e-bikes for car trips, which have much lower per kilometer costs)
- Reduced local air pollution
- Impact of e-bike purchasers on their networks to encourage greater e-bike adoption in the community.

Program delivered cost-competitive GHG savings:

The calculated GHG abatement costs are $190 per tonne (without considering marginality), which is cost-competitive with other types of transportation subsidies. As outlined in **Table 1 of this report**, when including marginality, the larger incentives are more cost-effective than the smaller incentives, but the overall cost per ton is higher.

Program exceeded predicted GHG and avoided "vehicle kilometers travelled" (VKT) savings:

The program has achieved significant GHG and VKT reductions, as shown in **Table 1 below**. These savings are better than the savings anticipated in the feasibility study.

- Note that the Table 1 presents rounded numbers but the calculations were done with additional decimals. The totals column is weighted by number of rebates in each tier in the program. The GHG reductions include vehicle and bicycle lifecycle emissions (see **section 3.6.1 of the Final Report** for details). It assumes (based on CRD Origin Destination survey data), that vehicle occupancy is 1.35, whereas e-bike occupancy is 1, and therefore the person kilometers travelled and the vehicle kilometres travelled are adjusted by that factor. It further assumes that an e-bike lifespan is 5 years, based on average battery lifespans. This lifespan is conservative because the program may establish new behaviour patterns, with participants not simply returning to pre-e-bike travel behaviour in vehicles once the e-bike battery is at end of its useful life. It also may encourage participants' networks to adopt e-bikes.

Table 1: GHG and VKT savings from program by incentive tier

		$350 rebate	$800 rebate	$1600 rebate	Total
	Number of incentives	183	105	101	**389**
Without marginality adjustment					
Per incentive	GHG reduction (kg CO_2e/week)	7	17	28	**16**
	Auto PKT reduction (PKT/week)	23	53	87	**48**
	Annual GHG reduction (kg CO_2e)	387	898	1,472	**807**
Overall Program	Annual GHG reduction (tonnes CO_2e)	71	94	149	**314**
	Annual VKT reduction	164,451	215,690	339,746	**719,887**
	Lifetime GHG reduction (tonnes CO_2e)	354	471	743	**1,569**
	Lifetime VKT reduction	822,253	1,078,451	1,698,730	**3,599,434**
	Lifetime cost per tonne GHG abatement	$181	$178	$217	**$190**
With marginality adjustment					
Per incentive	GHG reduction (kg CO_2e/week)	1	6	21	**8**
	Auto PKT reduction (PKT/week)	4	17	64	**23**
	Annual GHG reduction (kg CO_2e/year)	66	294	1,090	**393**
Overall Program	Annual GHG reduction (tonnes CO_2e)	12	31	110	**153**
	Annual VKT reduction	28,407	70,454	250,462	**349,323**
	Lifetime GHG reduction (tonnes CO_2e)	60	154	550	**765**
	Lifetime VKT reduction	142,035	352,271	1,252,310	**1,746,616**
	Lifetime cost per tonne GHG abatement	$1,060	$545	$294	**$722**