# Assessing the $CO_2$ Reduction Impact of E-Bikes

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# About me

Michael McQueen

- Civil and Environmental Engineering Masters Student, PSU exp. 2020
  - Advisor: Kelly Clifton, PhD
- B.S. Mechanical and Aerospace Engineering, CWRU 2016
- Studying E-Bikes since 2018 with John MacArthur at TREC
- Research Interests: Transportation data, travel behavior, micromobility

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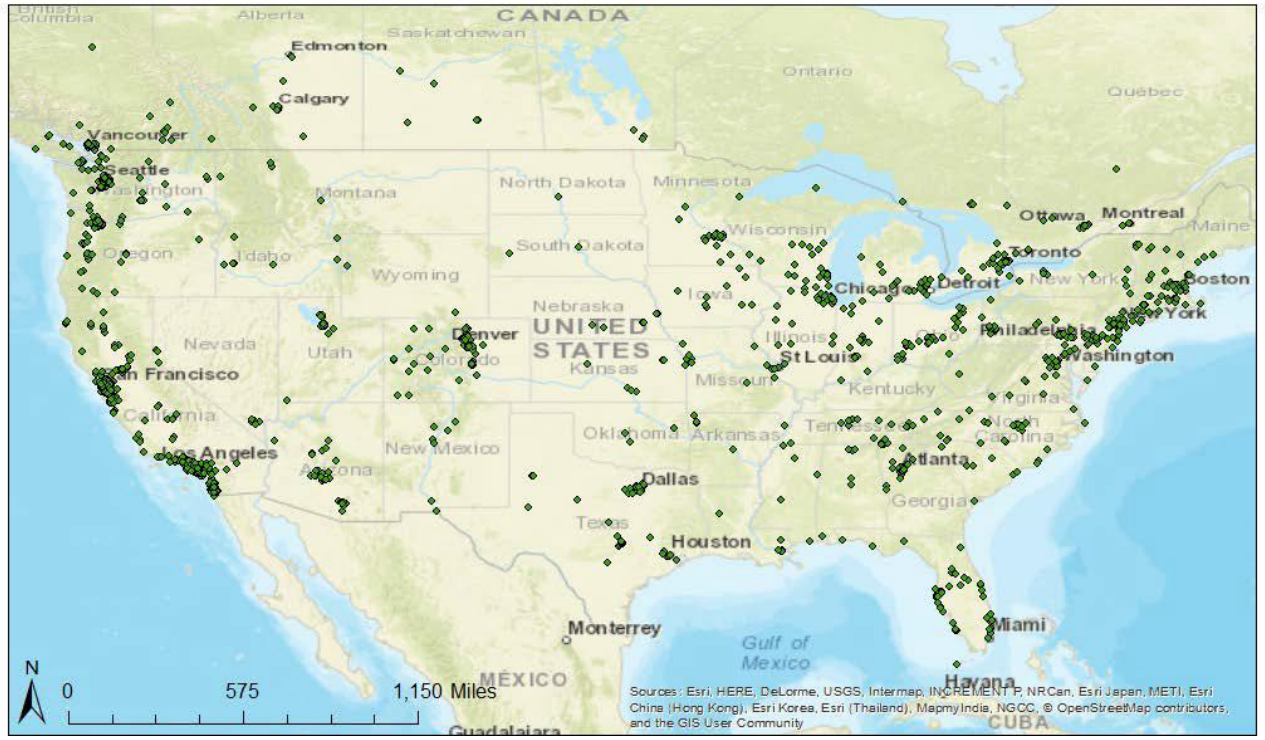
# Agenda

- **Previous Research**
  - North American Survey
  - Estimating the GHG/PMT Effect of E-bikes
  - E-Bike Incentive Programs
- **E-Vehicle Incentive Impact Tool**
  - Inspiration
  - Our Solution
  - Method
  - Case Study: Oregon

# Previous Research

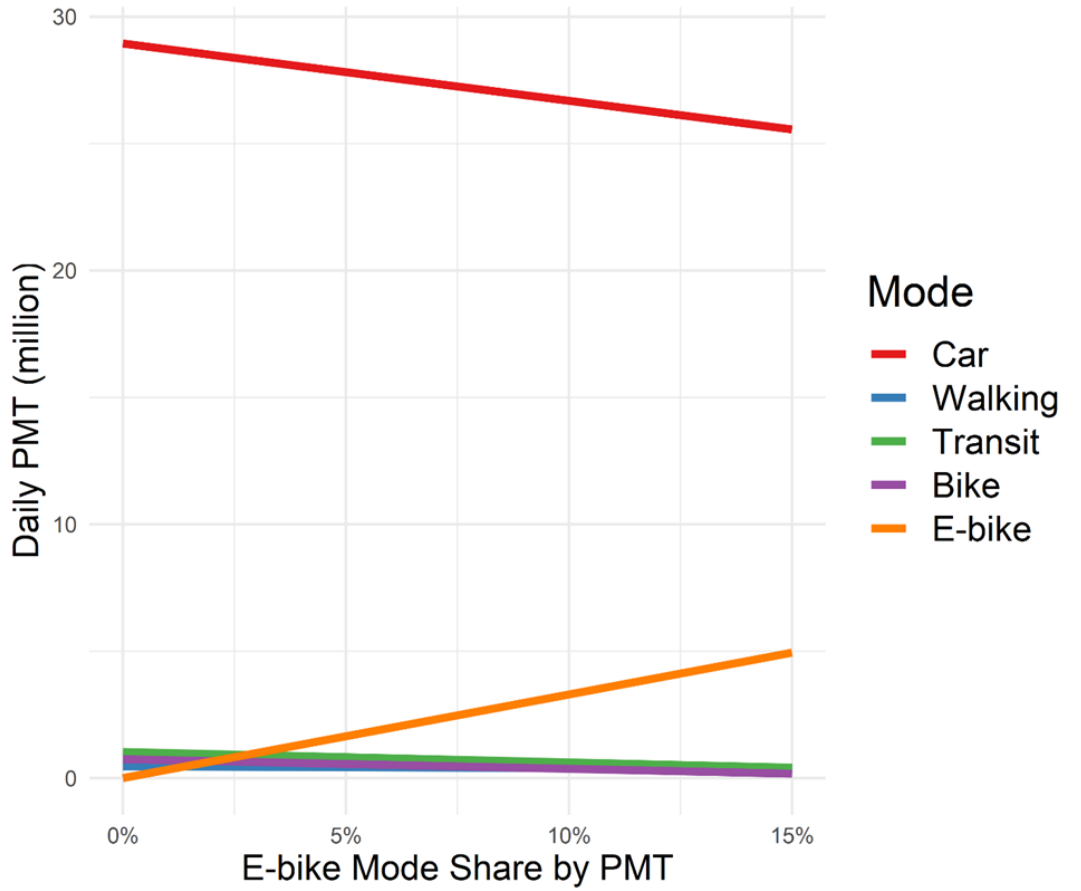
# A North American Survey of Electric Bicycle Owners (2018)

- Increase cycling frequency
- Increase cycle trip distance
- Reduce impact of barriers
  - Hills
  - Bringing along cargo/children
  - Physical limitations (joint, respiratory, weight, dexterity)
  - Sweat
- Primary use cases (% of recorded trips):
  - Recreation or exercise (35.6%)
  - Commute (32.7%)
  - Personal errands (19.9%)
- Enhance perceived safety and joy of riding



# Estimating the Effect of E-Bikes on Person Miles Travelled and Greenhouse Gas Emissions (2019)

- 15% PMT mode share leads to 12% reduction in $CO_2$ emissions
  - 8,079 metric tons to 7,088 metric tons $CO_2$ per day
  - Portland Metro excluding Clark County
- 1 e-bike saves 225 kg $CO_2$ per year
- Unchanging when considering "induced trips"
- Car trip mode share would be reduced from 84.7% to 74.8%
- Car PMT would be reduced from 28.9M to 25.5M per day



# How E-Bike Incentive Programs are Used to Expand the Market

- Existing incentive programs:
  - Partial purchase subsidies
    - Austin, TX
    - Burlington, VT
  - Vendor-funded discounts
    - Boulder County, CO
  - Employer Sponsored
    - UK
  - Government Sponsored Loan
    - Scotland
- Experience-based education works
- Consider program partners strategically
- Use preferred vendors
- Get creative with income streams

# E-Vehicle Incentive Impact Tool

# Inspiration

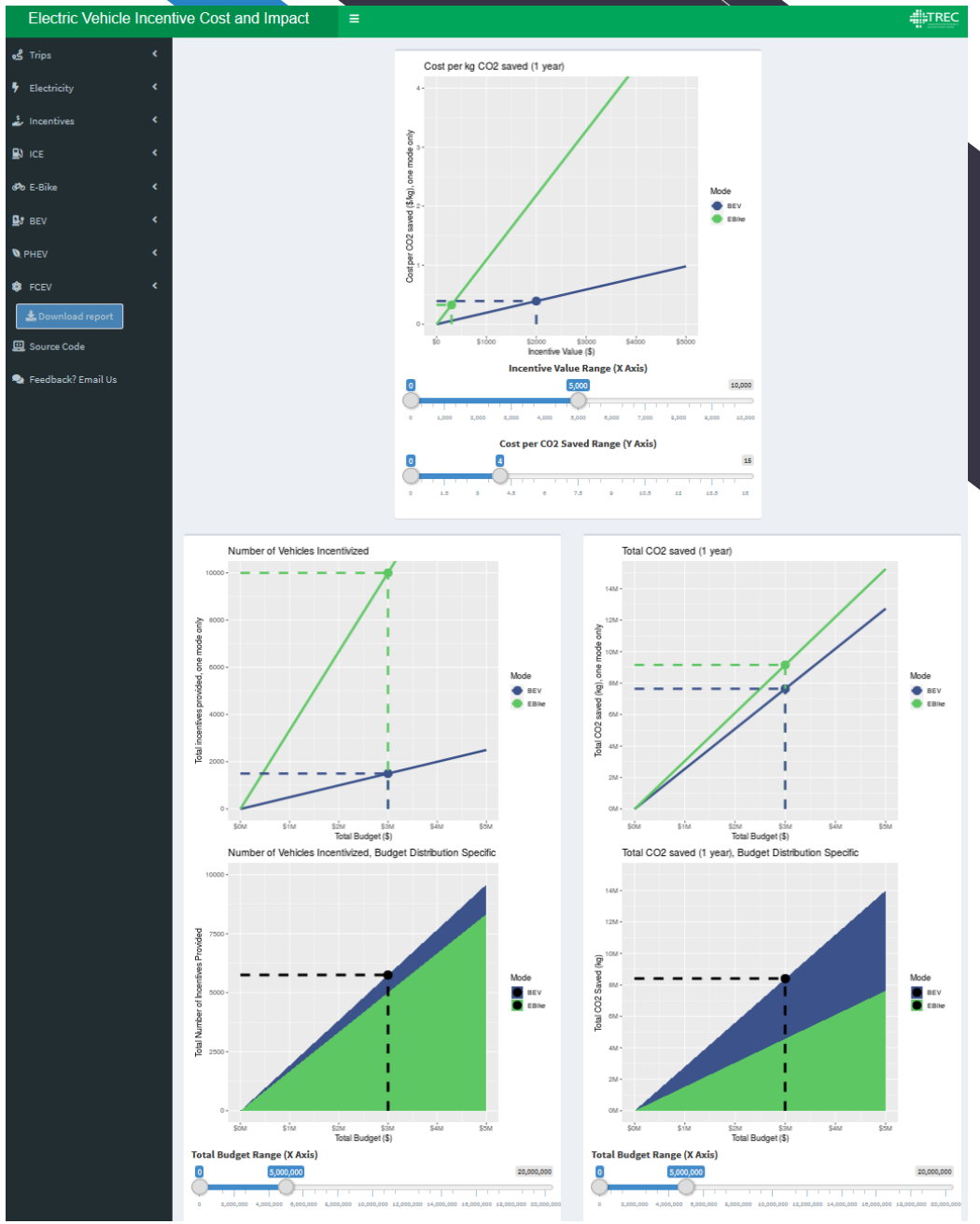
- "The Case for a UK Incentive for E-Bikes" Newson and Sloman (2019)
- Provided a metric for "cost per kg saved" ($/kg $CO_2$)

> *"An e-bike grant scheme would be more than twice as effective, per pound spent, as the current grants offered to buyers of some electric cars"*

- Could we calculate this for Oregon?

# Our Solution

- Online tool that anyone can use to estimate several things:
  - Cost efficiency ($/kg $CO_2$)
  - Total vehicles incentivized
  - Total $CO_2$ saved
- Exports a report that can be saved

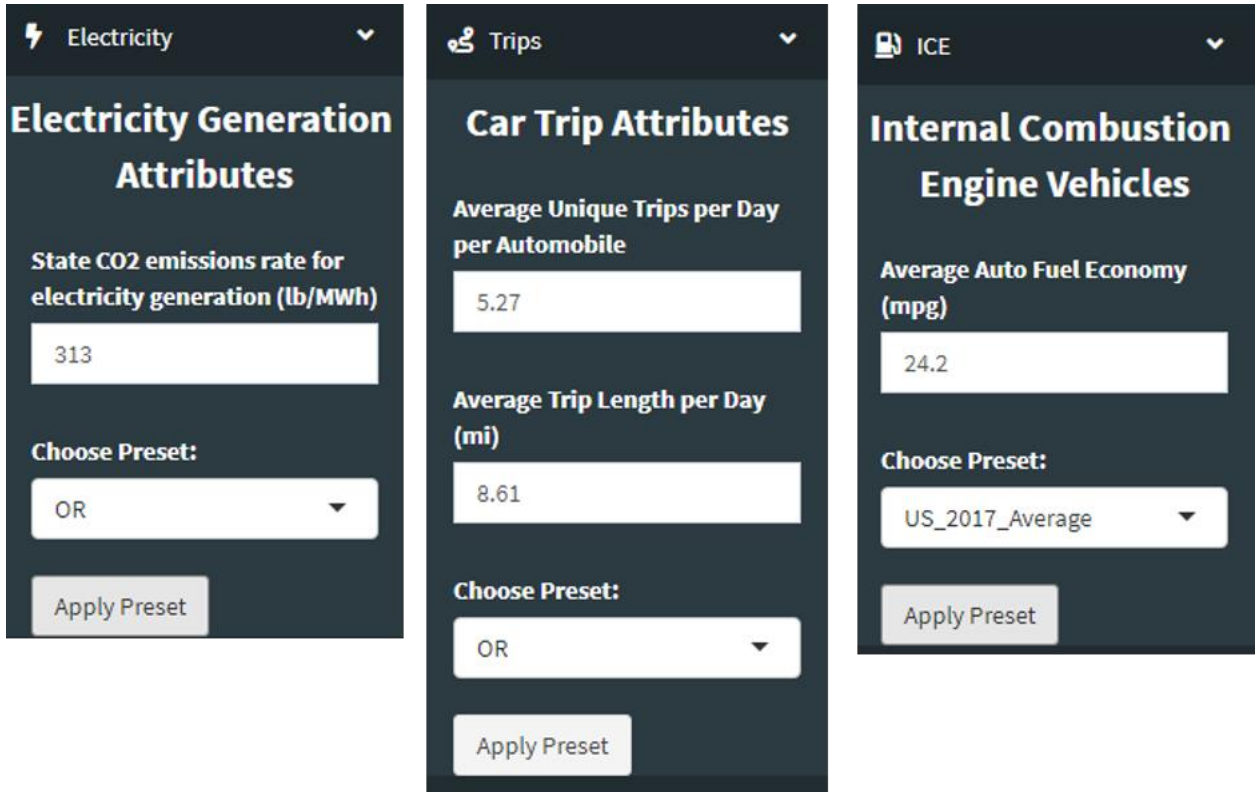


# Method

1. Calculate average ICE (gasoline) vehicle $CO_2$ emissions per year
2. Calculate average $CO_2$ emissions from electricity generation for e-bike, BEV, PHEV, and/or FCEV based on local electricity profile
3. **$CO_2$ saved = $CO_{2,ICE}$ – $CO_{2,EV}$**

(For E-Bike, we assume that the e-bike only replaces a portion of ICE miles. Default is 15%)

# Case Study: Oregon



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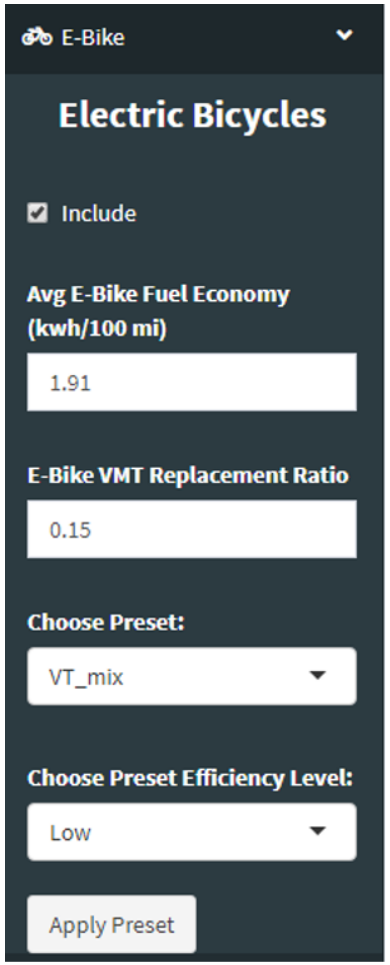


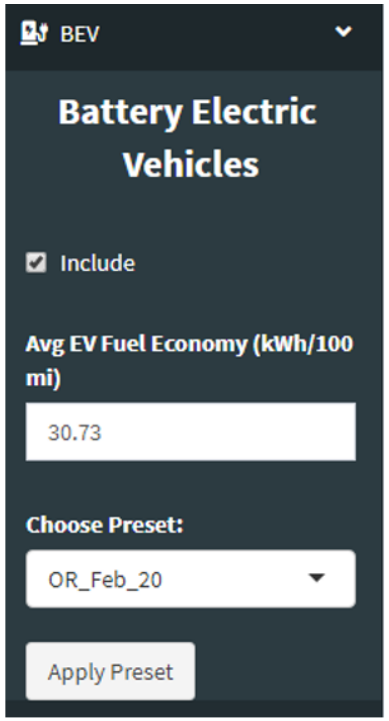


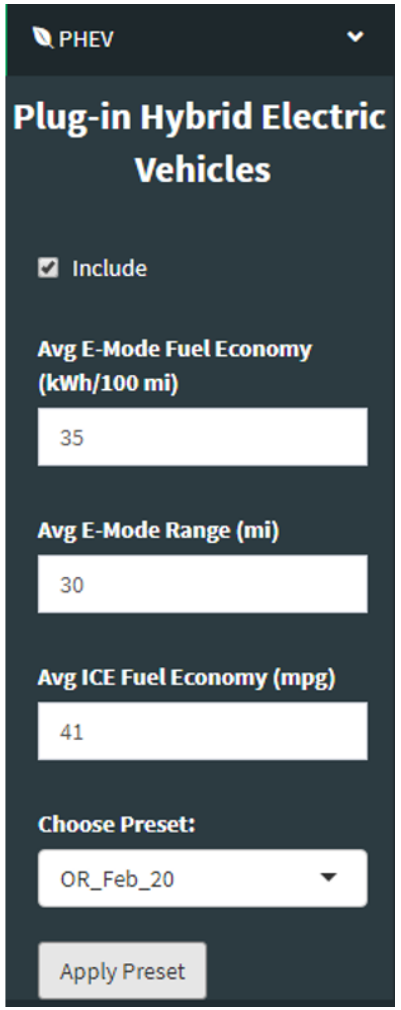

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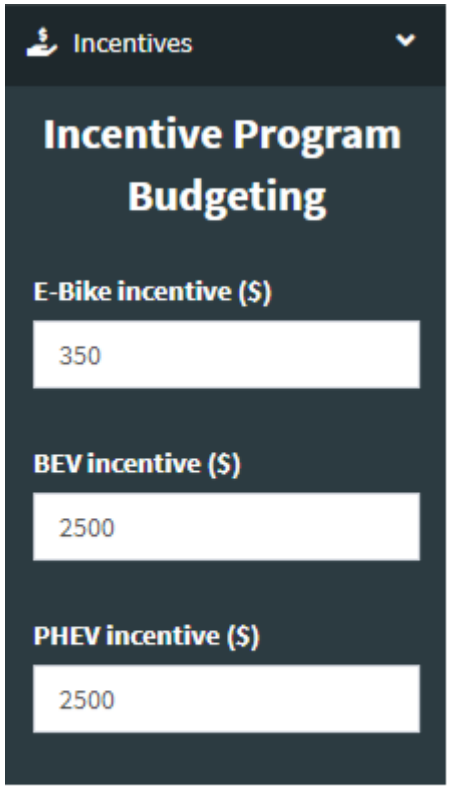


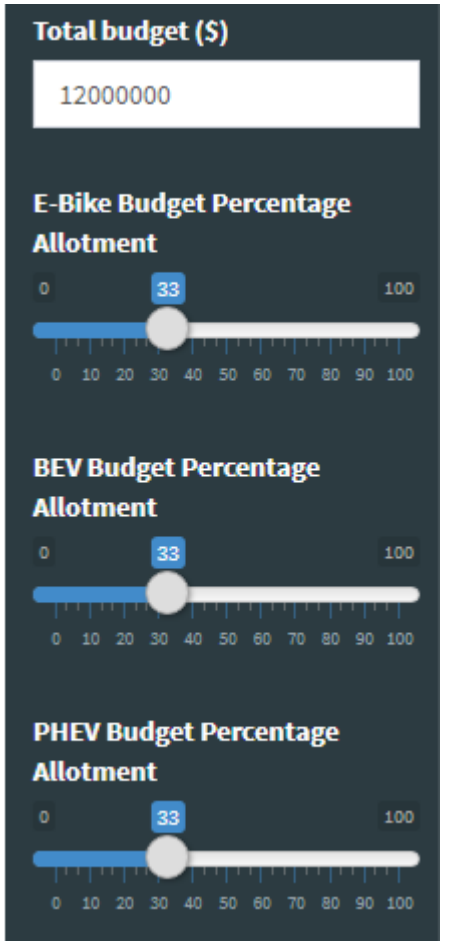

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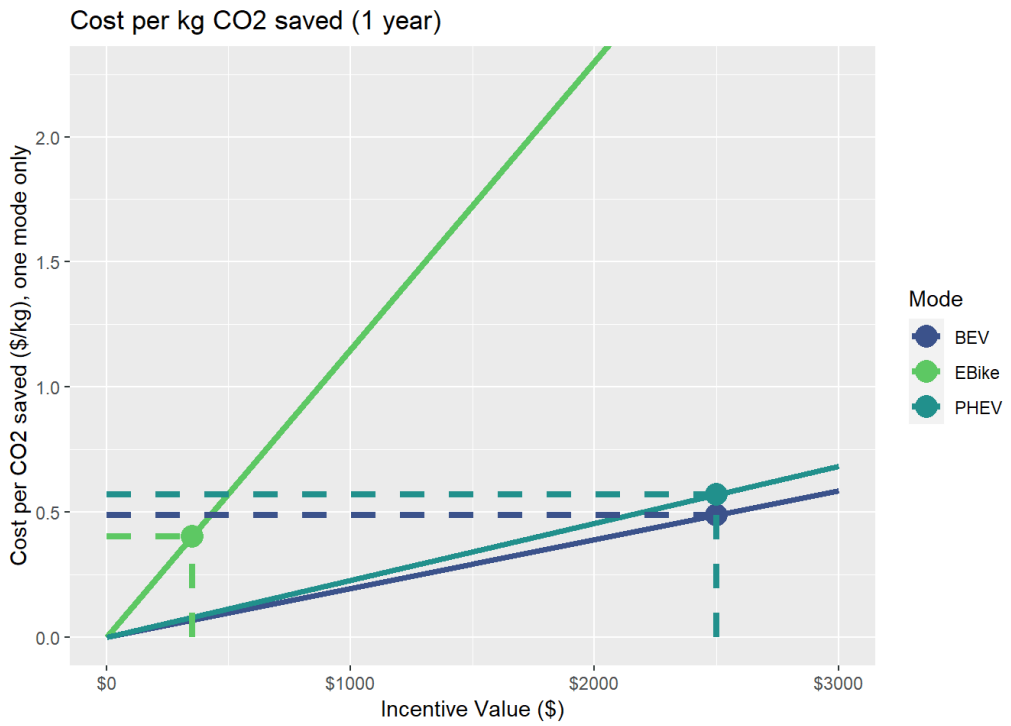


| Mode | Incentive Amount | CO2 saved per vehicle, per year | Cost per kg CO2 Saved |
|---|---|---|---|
| E-Bike | $ 350.00 | 869.36 kg | $ 0.40 |
| BEV | $ 2500.00 | 5118.08 kg | $ 0.49 |
| PHEV | $ 2500.00 | 4381.14 kg | $ 0.57 |

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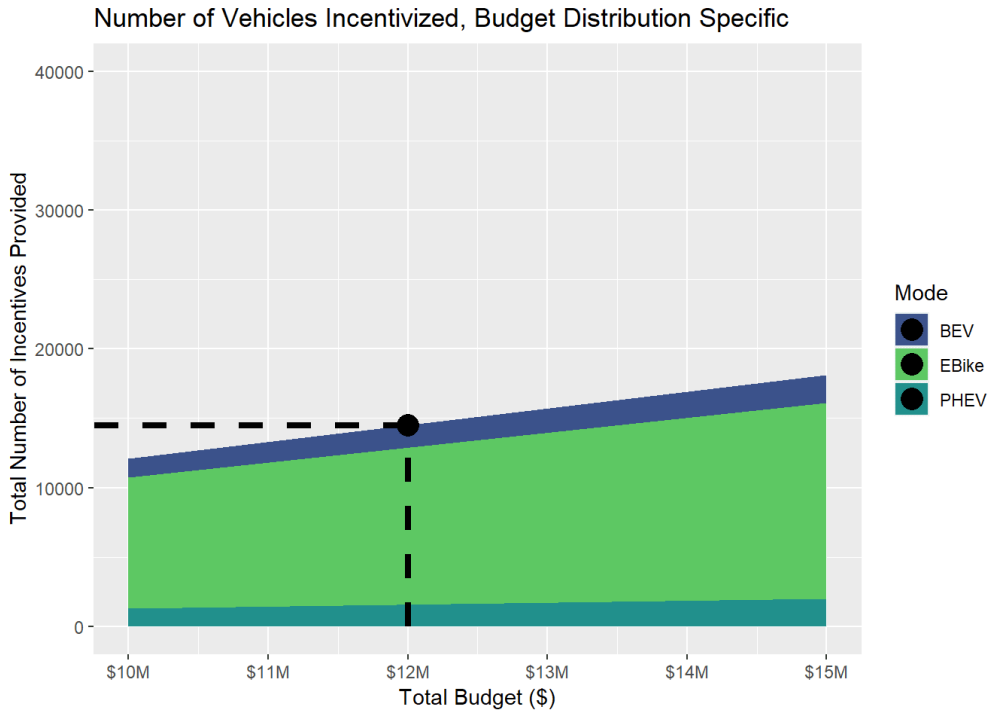


Total Budget ($)

| Mode | Allotted Percent of Total Budget | Allotted Portion of Total Budget | Number of Incentives |
|---|---|---|---|
| E-Bike | 33% | $ 4M | 11314 |
| BEV | 33% | $ 4M | 1584 |
| PHEV | 33% | $ 4M | 1584 |

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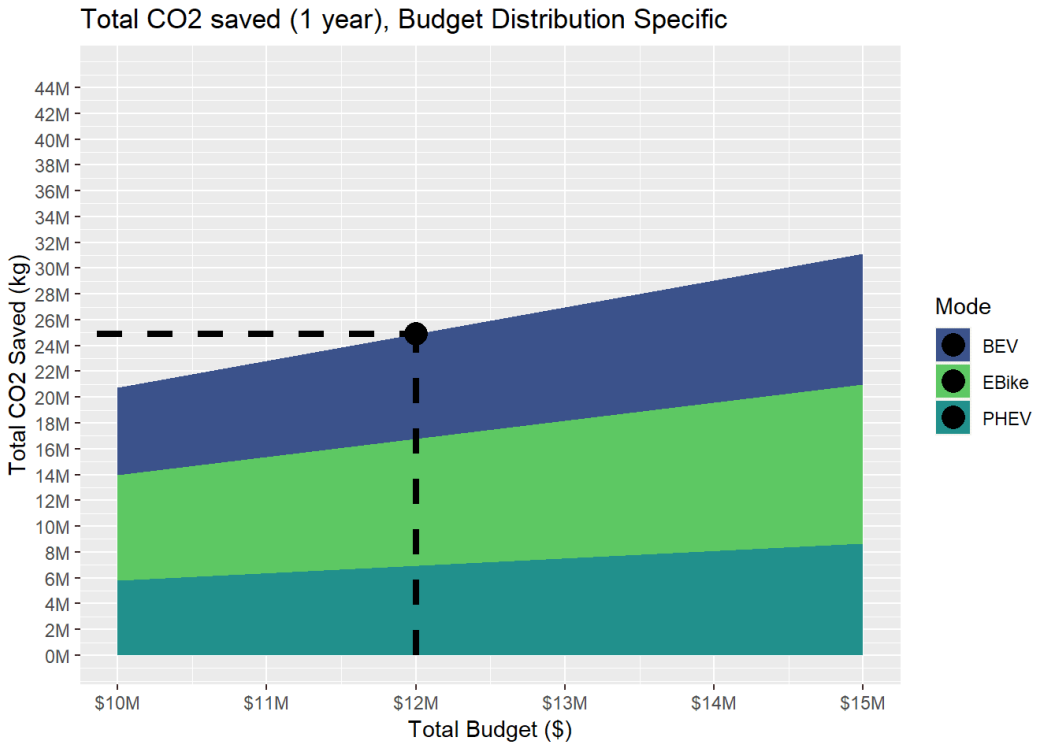


| Mode | Allotted Percent of Total Budget | Allotted Portion of Total Budget | Total CO2 Saved by this mode |
|---|---|---|---|
| E-Bike | 33% | $ 4M | 10.2M kg |
| BEV | 33% | $ 4M | 8.5M kg |
| PHEV | 33% | $ 4M | 6.8M kg |

# Thank You.

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photo: Petivut Kunadoonyakit, istockphoto.com

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