

# Insights about consumer preferences and latent demand for zero-emissions vehicles in Canada

**Christine Kormos, PhD**

Postdoctoral Researcher

Sustainable Transportation Action Research Team

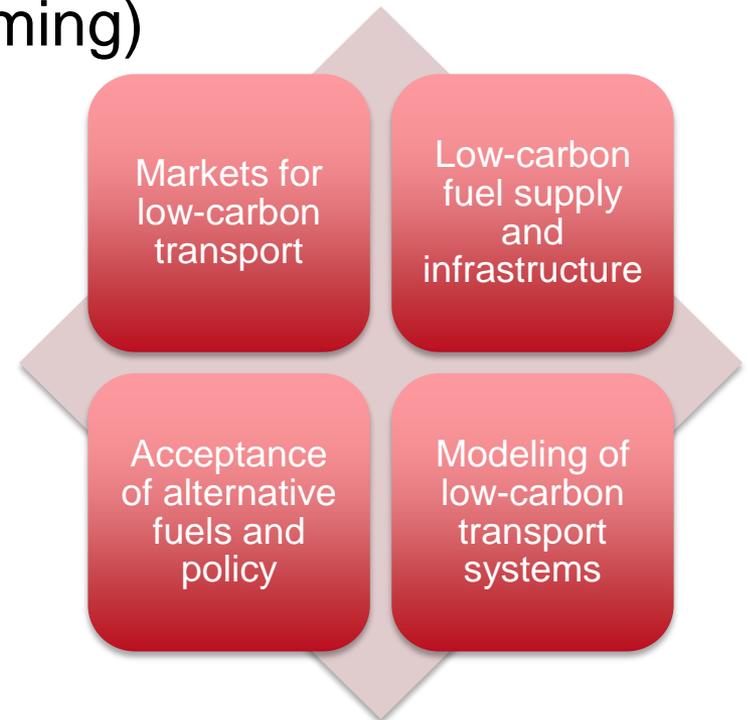
Simon Fraser University, British Columbia

Automotive Policy Research Centre's 2018 International Conference

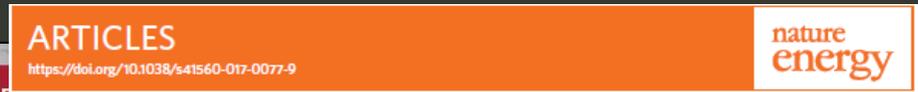
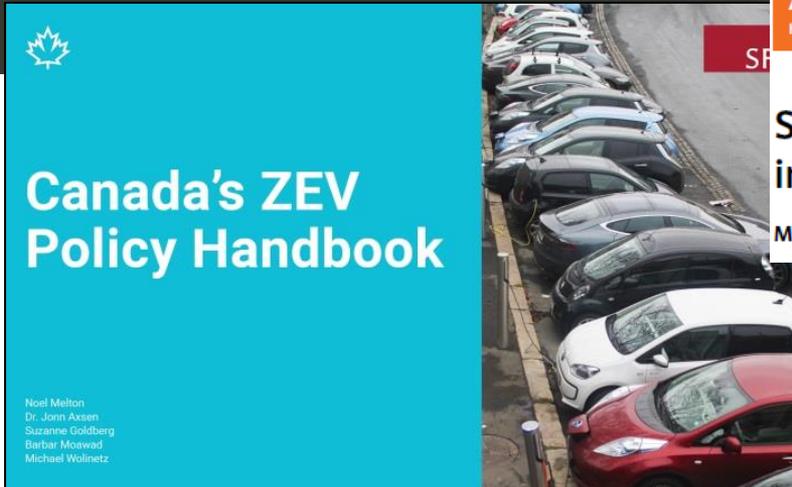
April 5 – 6, 2018

# What we do at START

- Explore technical, social, and policy aspects of sustainable transportation, including:
  - Zero-emissions vehicles (plug-in electric and hydrogen fuel cell vehicles)
  - Autonomous vehicles (upcoming)
- Assess four themes using:
  1. Surveys
  2. Interviews
  3. Modeling
  4. Policy analysis



# START outputs



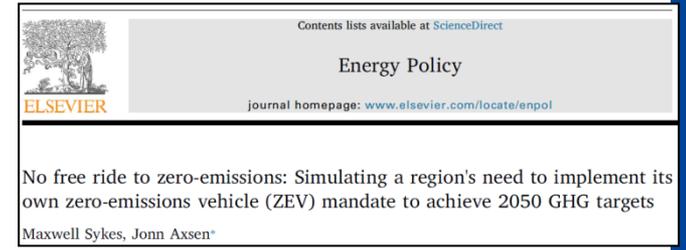
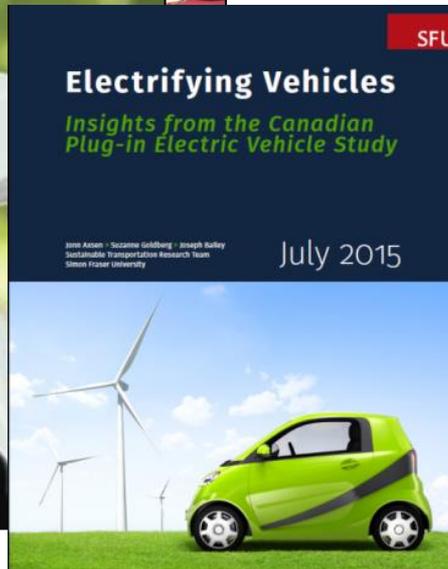
## Simulating the value of electric-vehicle-grid integration using a behaviourally realistic model

Michael Wolinetz<sup>1,2\*</sup>, Jonn Axsen<sup>2</sup>, Jotham Peters<sup>1,2</sup> and Curran Crawford<sup>3</sup>

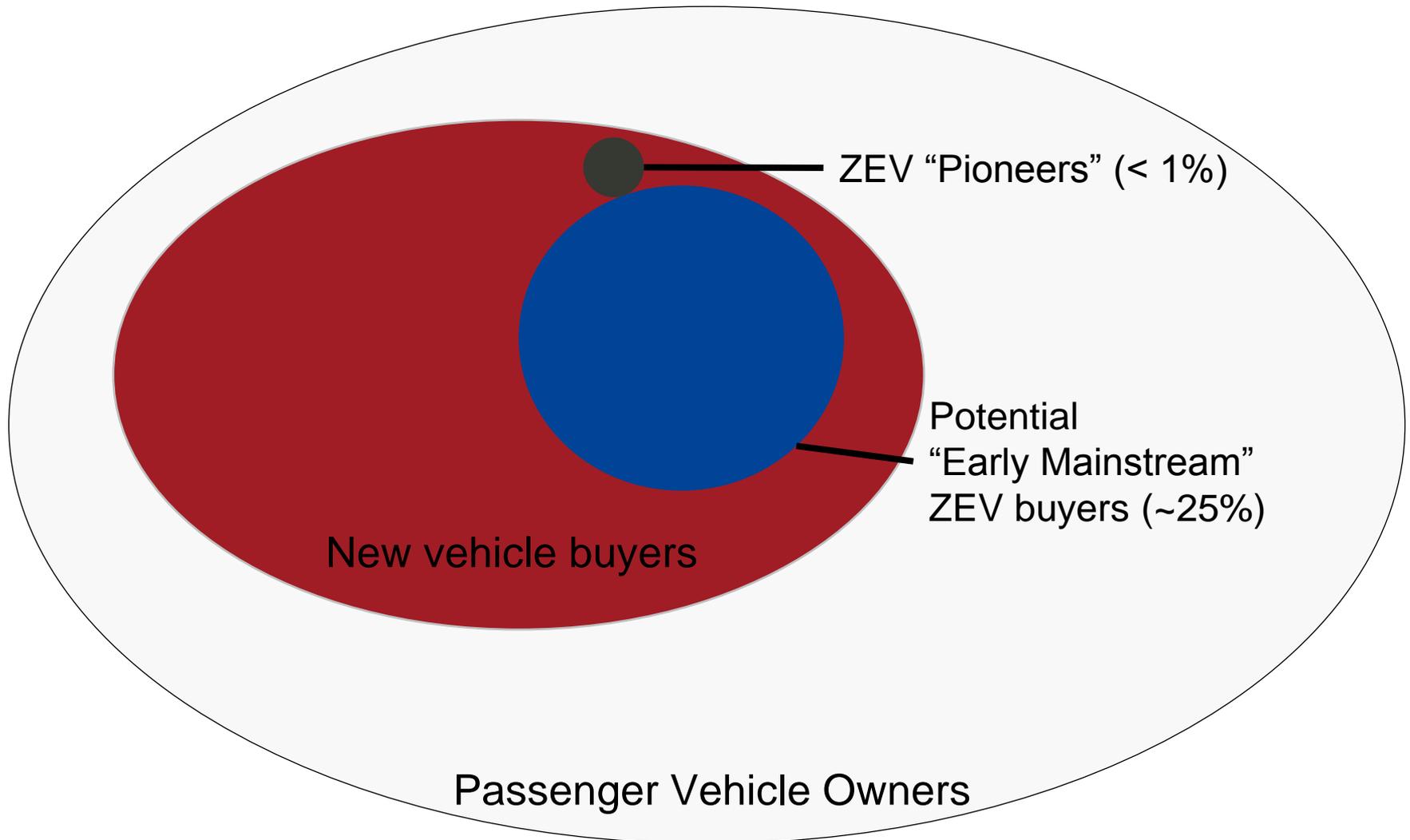


## Moving beyond alternative fuel hype to decarbonize transportation

Noel Melton<sup>1,2\*</sup>, Jonn Axsen<sup>2</sup> and Daniel Sperling<sup>3</sup>



# A focus on 'mainstream' buyers



# What is 'demand'?

- **Actual demand:** ZEV market share (< 1% total sales across Canada)
- **Latent demand:** “demand for a product or service that a consumer cannot satisfy because... the product or service is not available, or because they do not know that it is available.”
  - *Q1: What is the latent demand for ZEVs?*
  - *Q2: How can policy push sales towards latent demand?*

# **CANADIAN ZERO-EMISSIONS VEHICLES SURVEY (CZEVS)**

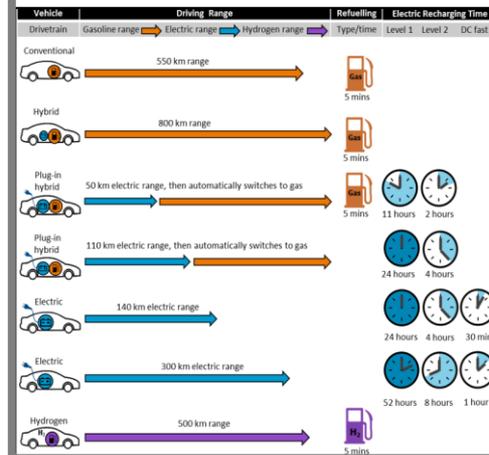
# Canadian Zero-Emissions Vehicle Survey (CZEVS) overview

## Background survey

- Household info.
- Vehicle info.
- ZEV awareness
- Charger access
- Lifestyle, values, and attitudes
- Demographics

## Consumer learning

- “Buyer’s Guide”
- Vehicle technologies
- Recharging/refueling
- FAQs



## Consumer preference survey

- Design exercises
- Stated choice experiment
- Perceptions of ZEVs
- Purchase intention

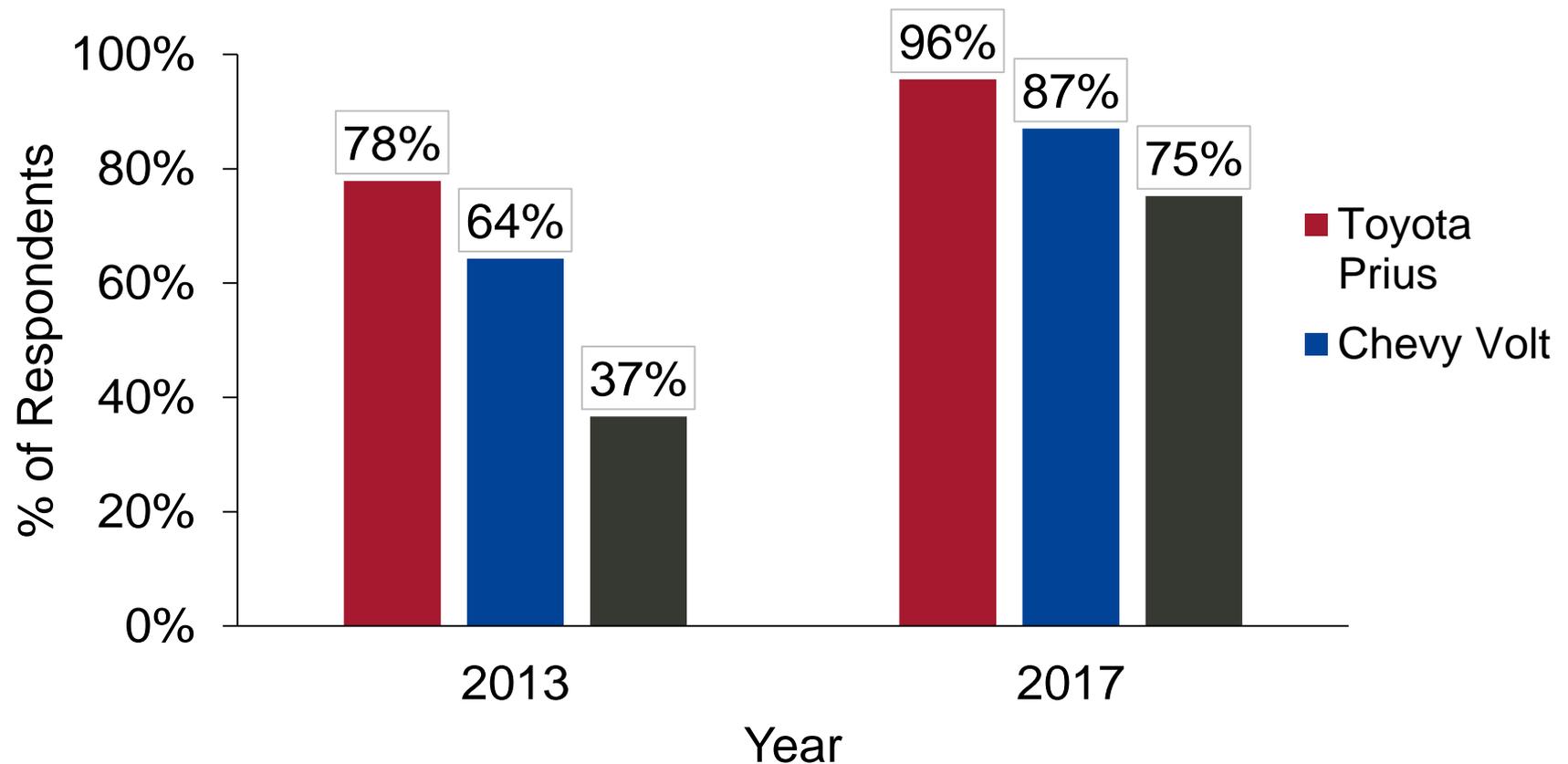
Vehicle type	Range	Recharge/ refuel time	Destination recharging	Fast recharging or H <sub>2</sub> refueling access	Fuel cost	Purchase price & <b>incentive</b>	I CHOOSE
	➔		Level 2 	or	\$	\$	
 A conventional RAM 1500 4X4 FFV	750 km gasoline	5 min.	-	-	\$100 / week	\$50000 -\$0 ----- \$50000	Conventional <input type="radio"/>
 A hybrid RAM 1500 4X4 FFV	750 km gasoline	5 min.	-	-	\$80 / week	\$57500 -\$0 ----- \$57500	Hybrid <input type="radio"/>
 A plug-in hybrid RAM 1500 4X4 FFV	First 110 km electric/ 690 km gasoline	Home: 48 hrs  Work: 8 hrs	1 in 10 destinations	At rest stops (every 50 km) on all major highways	\$30 / week	\$70000 -\$0 ----- \$70000	Plug-in hybrid <input checked="" type="radio"/>
 A electric only RAM 1500 4X4 FFV	140 km electric	Home: 46 hrs  Work: 7.5 hrs	1 in 10 destinations	At rest stops (every 50 km) on all major highways	\$50 / week	\$65000 -\$0 ----- \$65000	Electric <input type="radio"/>
 A hydrogen fuel cell RAM 1500 4X4 FFV	600 km hydrogen	5 min.	-	1 in 25 gas stations	\$115 / week	\$55000 -\$5000 ----- \$50000	Hydrogen <input type="radio"/>



# **KNOWLEDGE & AWARENESS**

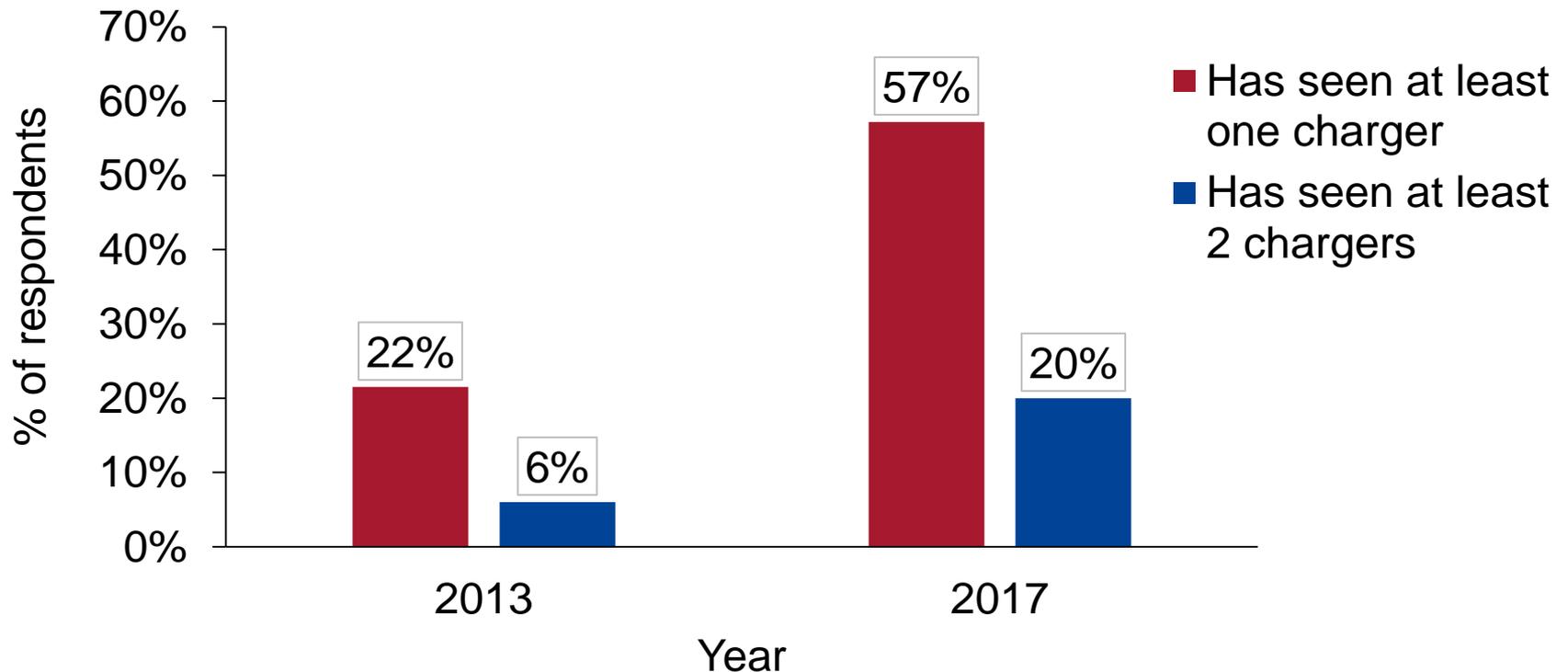
# “Awareness” of models is increasing

*“I have heard of this...”*



# And so is awareness of public chargers

*“Have you seen any electric vehicle recharge stations at the parking spots or spaces you use?”*



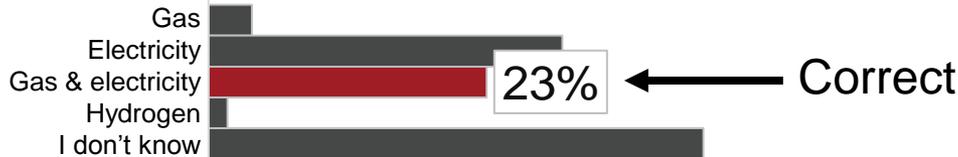
# But knowledge is still low...

*“How would you fuel this vehicle?”*

**Toyota Prius  
(Hybrid)**



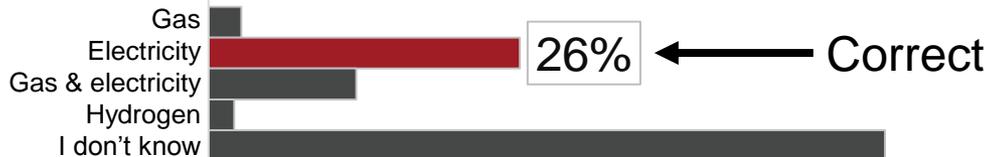
**Chevrolet Volt  
(PHEV)**



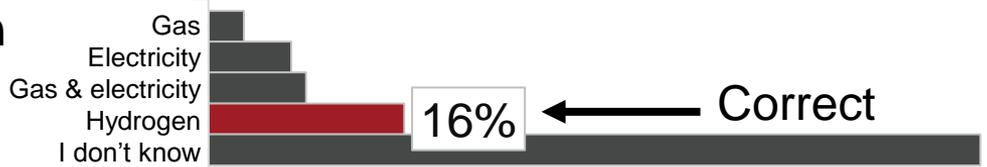
**Tesla Model S  
(BEV)**



**Nissan Leaf  
(BEV)**



**Hyundai Tucson  
Fuel Cell  
(HFCV)**



0% 20% 40% 60% 80%  
% of respondents

# **CONSUMER PREFERENCE SEGMENTS**

# Characterizing potential early mainstream ZEV buyers

Gas-orientation

ZEV-orientation

CV-oriented

23%

(base)

HEV-oriented

21%



ZEV-curious

21%



PHEV-oriented

22%



PEV-enthusiast

13%

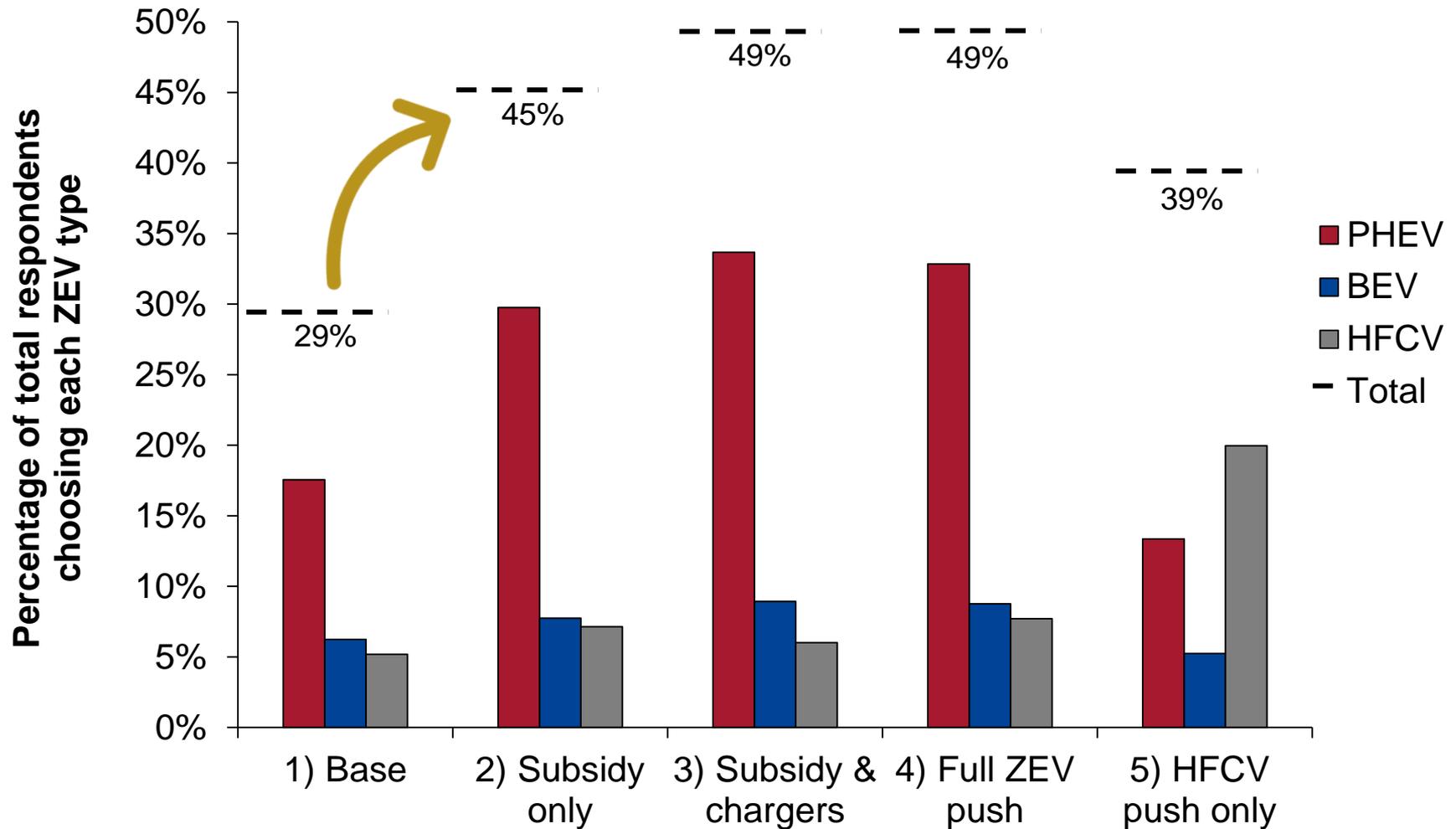


- ♥ = Altruistic values
- 🌍 = Environmental concern
- 🌿 = Environmental-oriented
- 🎓 = Higher education
- 🎂 = Younger age
- 💰 = Higher income

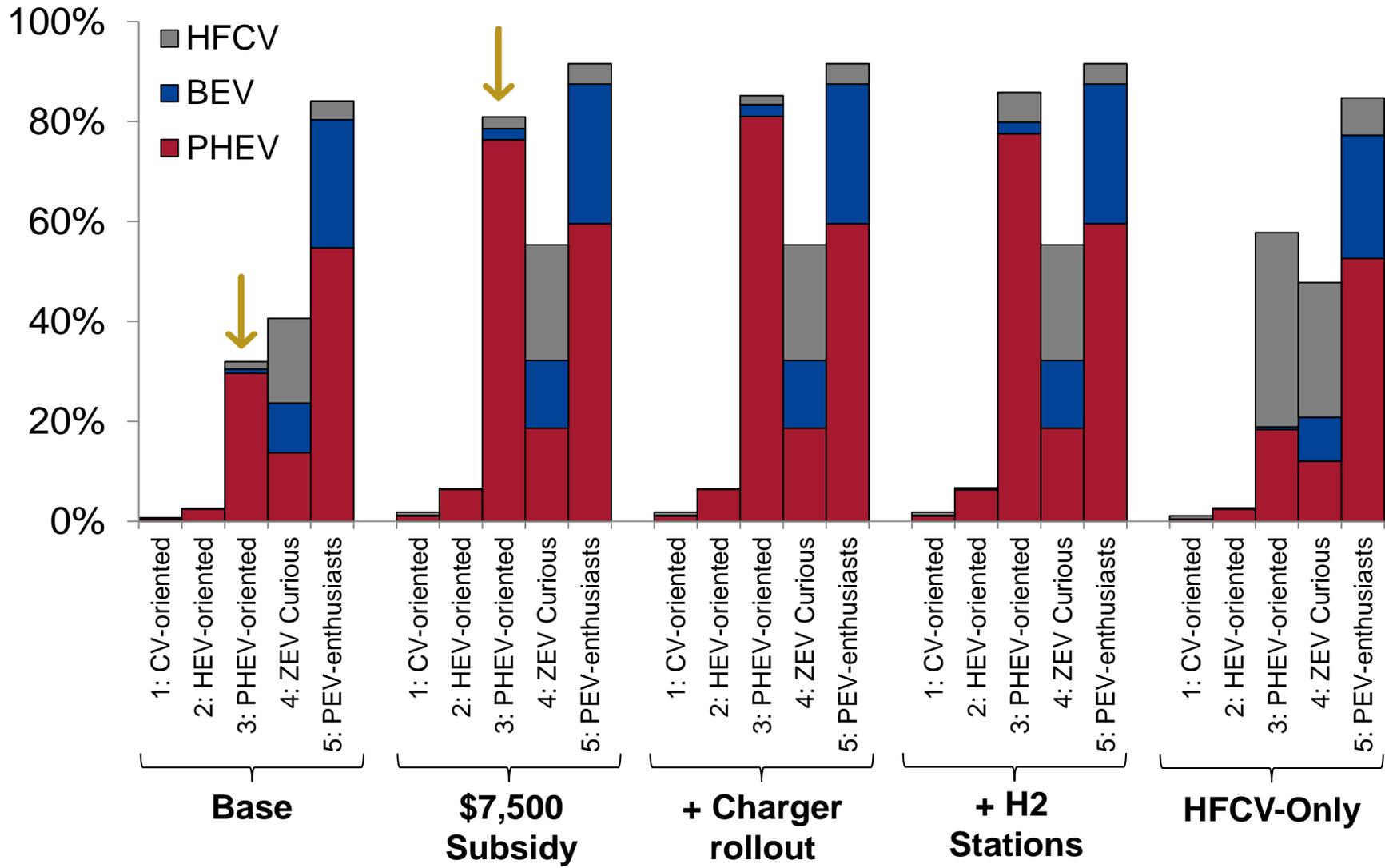
Willingness-to-pay for ZEVs

# **POLICY SIMULATIONS**

# Incentives are more important to latent demand than infrastructure



# Especially true for certain consumer segments

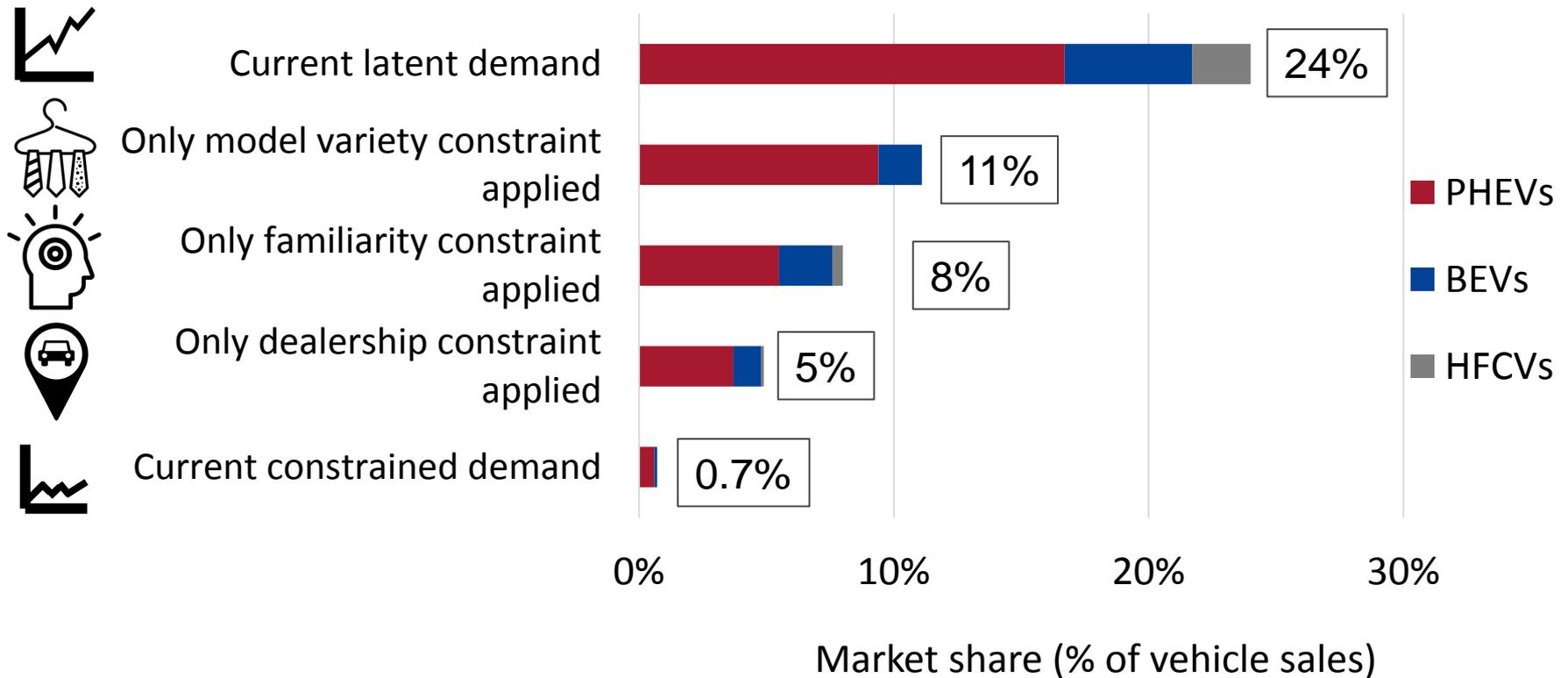


# **ACCOUNTING FOR REAL- WORLD CONSTRAINTS**

# REPAC Model: REspondent-based Preference And Constraints

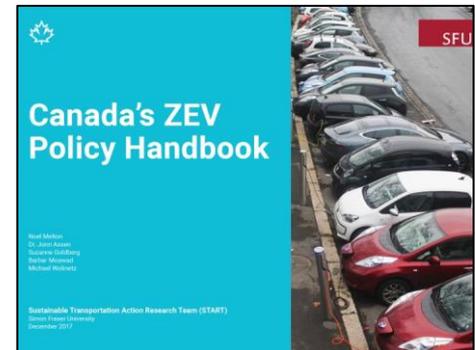


# REPAC results: 2017 market share under various constraints



# Canada's ZEV targets

- Government of Canada has committed to 30% of new vehicle sales being electric by 2030
- But Canada is not on track to meet adoption targets
- Current policies could result in new ZEV market share between 9%-17% by 2040
- Federal ZEV Strategy in the works
- ZEV Policy Handbook rated policies on 5 criteria:
  1. Effectiveness (market share using REPAC)
  2. Cost effectiveness (by government)
  3. Public support
  4. Simplicity
  5. Transformational signal



# Policy packages to help achieve Canada's climate mitigation targets

To achieve levels of ZEV uptake needed to meet Canada's longer-term climate targets (i.e., 40% of ZEV sales by 2040), can implement:

1. a demand-focused policy package that includes national long-term **incentives of \$6,000** per ZEV for 20 years;
  2. a supply-focused package centered on a **national ZEV mandate** requiring 40% ZEVs by 2040; or
  3. a supply-focused package with a **strengthened national vehicle emission standard** (decreasing fleet emissions to 71 gCO<sub>2</sub>e per km by 2040).
- *Note: All three packages also include increased public charging deployment and electric vehicle-friendly building codes adopted in all provinces.*

# Conclusions

- Latent ZEV demand is high among mainstream buyers
- Consumers are varied in their ZEV preferences, valuation of attributes, and response to policies
- Can reduce gap between actual and latent demand via:
  - Demand-focused policies (e.g., incentives)
    - Incentives appear to be more powerful than infrastructure at stimulating ZEV uptake
  - Supply-focused policies (e.g., a ZEV mandate)
- Absence of supportive policy will limit ability to realize latent demand for ZEVs and thus to help achieve Canada's long-term greenhouse gas reduction targets

# Thank you. Any questions?

Christine Kormos: [ckormos@sfu.ca](mailto:ckormos@sfu.ca)

START Director: Jonn Axsen: [jaxsen@sfu.ca](mailto:jaxsen@sfu.ca)

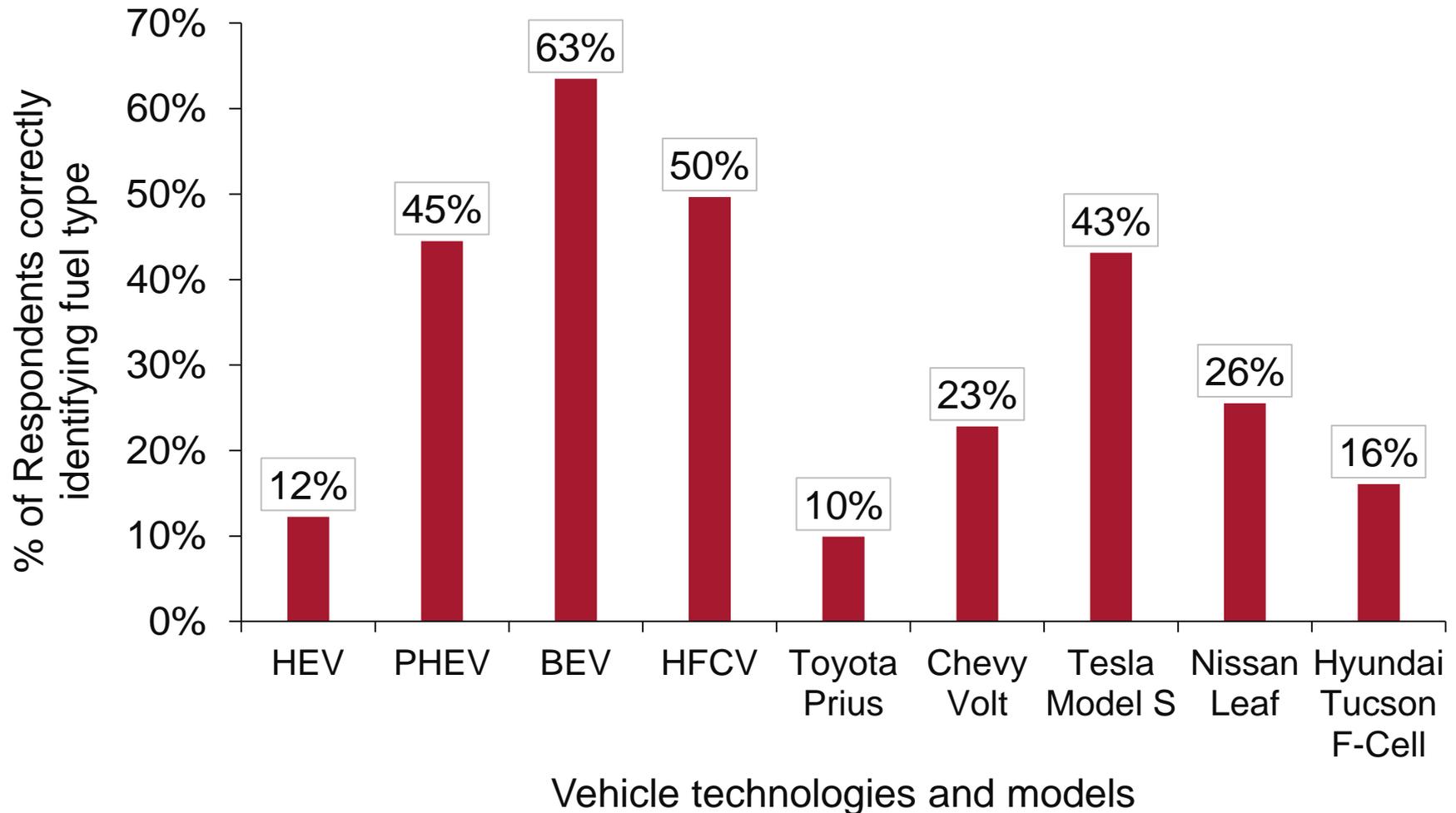
Research Manager: Zoe Long: [zoe\\_long@sfu.ca](mailto:zoe_long@sfu.ca)

# Design space exercise

- Higher and lower price scenario

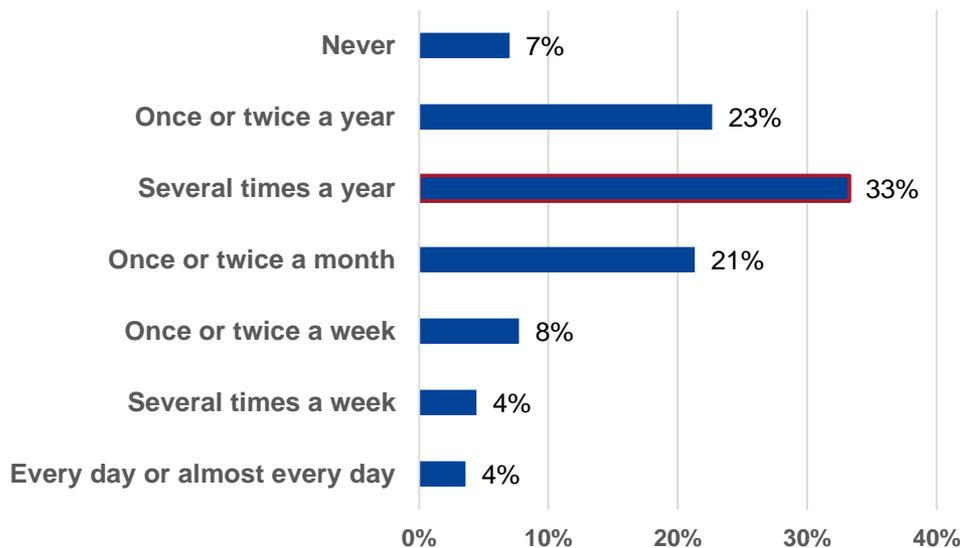
Vehicle type	Driving range	Gasoline fuel use	Refuel/ Home recharge time	Purchase price	I CHOOSE
 A conventional HYUNDAI SONATA	650 km gasoline	8.6 L/100 km	5 mins	\$23000	Conventional Please select ▼
 A hybrid HYUNDAI SONATA	850 km gasoline	5.8 L/100 km	5 mins	\$24700	Hybrid Please select ▼
 A plug-in hybrid HYUNDAI SONATA	Electric for the first: Please select your answer ▼	5.8 L/100 km	Time to fully charge empty battery at home Please select your answer ▼	\$0	Plug-in hybrid Please select ▼
 A electric only HYUNDAI SONATA	Electric only for: 100 km (+\$9300) ▼	None	N/A	\$32300	Electric 2nd Choice ▼
 A hydrogen fuel cell HYUNDAI SONATA	425 km hydrogen	None	5 mins	\$53400	Hydrogen 1st Choice ▼

# What is the level of “understanding” among the mainstream sample?

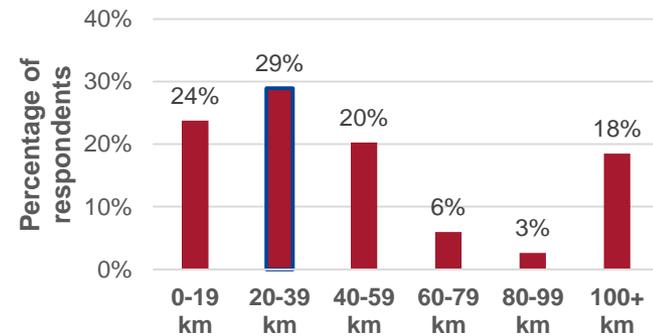


# Distance driven

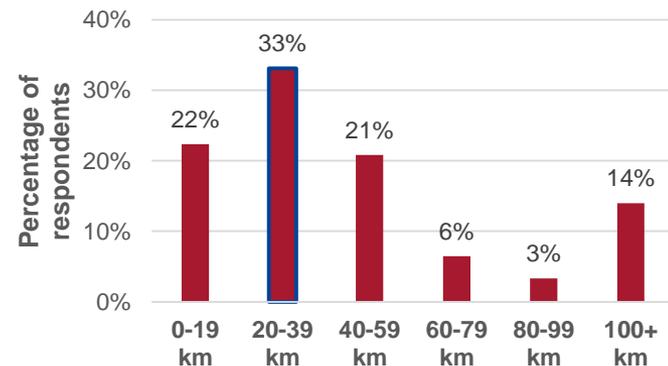
*“How often does someone in your household drive 100 km or more in a single trip?”*



Most common distance driven (in total) on a weekday

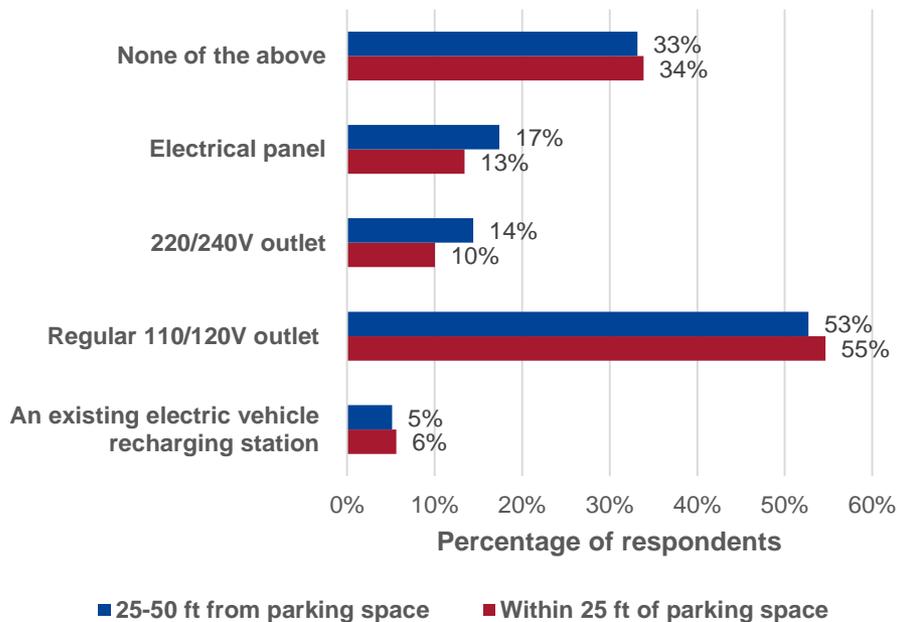


Most common distance driven (in total) on a weekend day

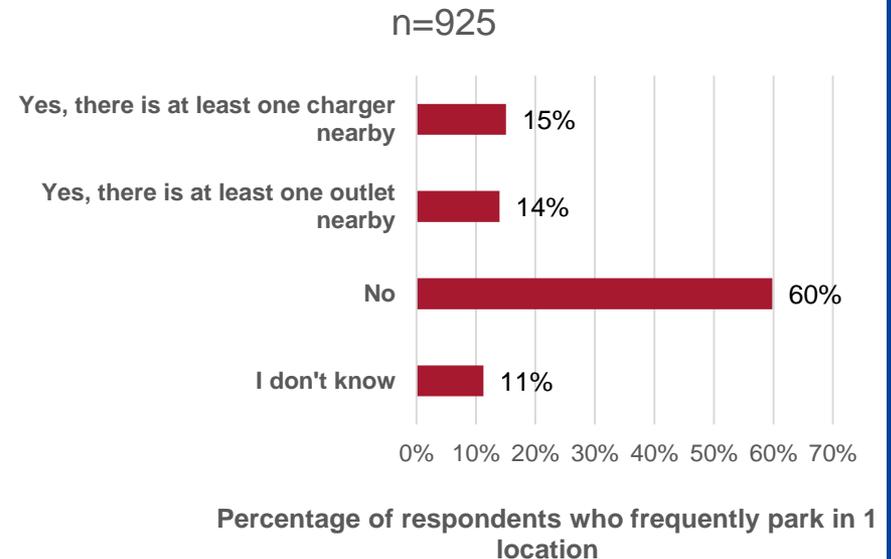


# Home and workplace charging access

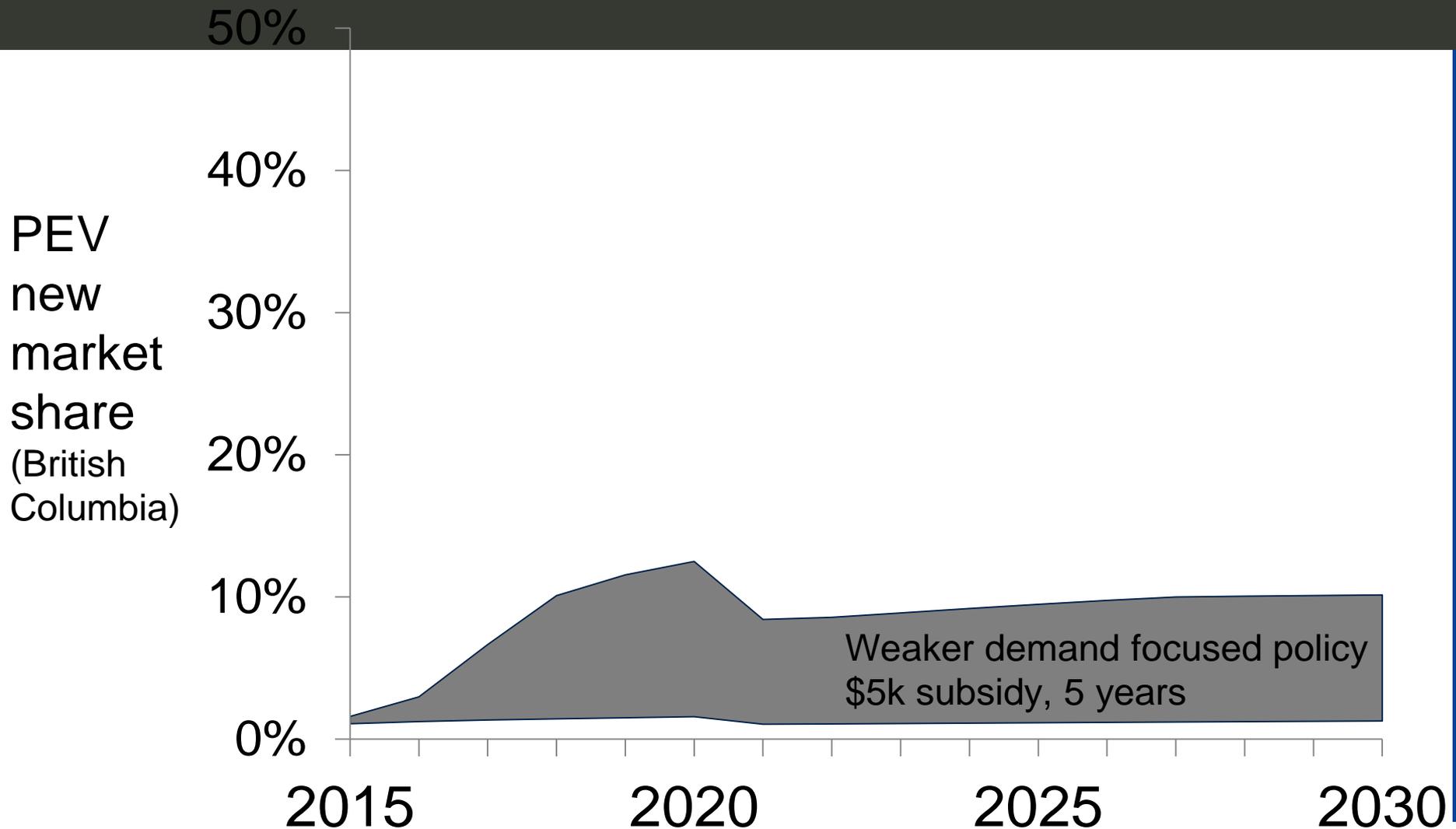
*“Do you have access to any of the following within 25 feet and 26-50 feet from where you plan to park your new vehicle?”*



*Does that primary work/school location currently have one or more parking spots with an existing electric vehicle charger OR outlets nearby? (n = 925)*

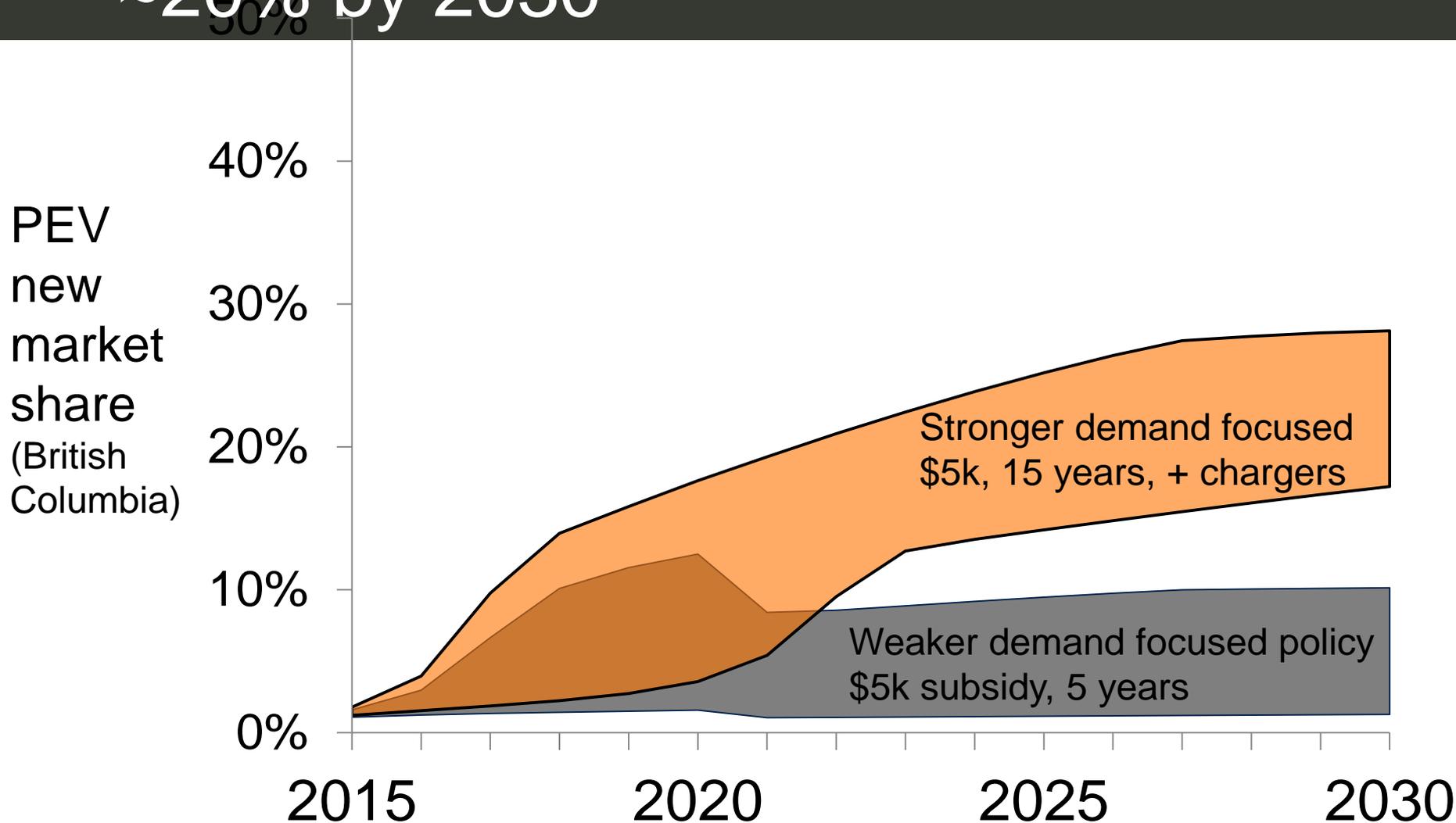


# “Weaker” demand-focused policies might get us to 1%-10% new market share...



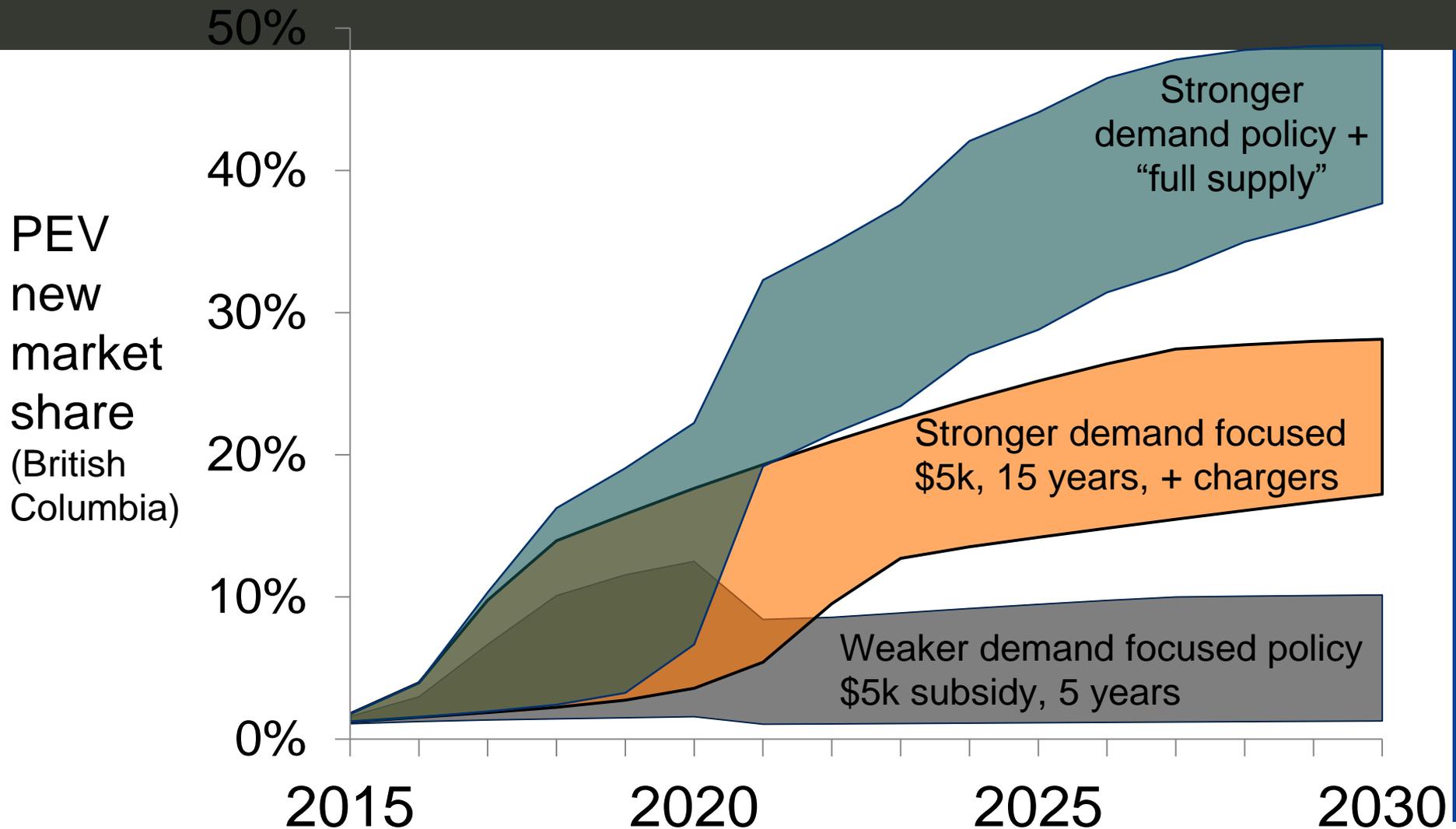
Source: Wolinetz & Axsen (2017), *Technological Forecasting & Social Change*

# Continuing aggressive incentives and charger deployment could get up to ~20% by 2030



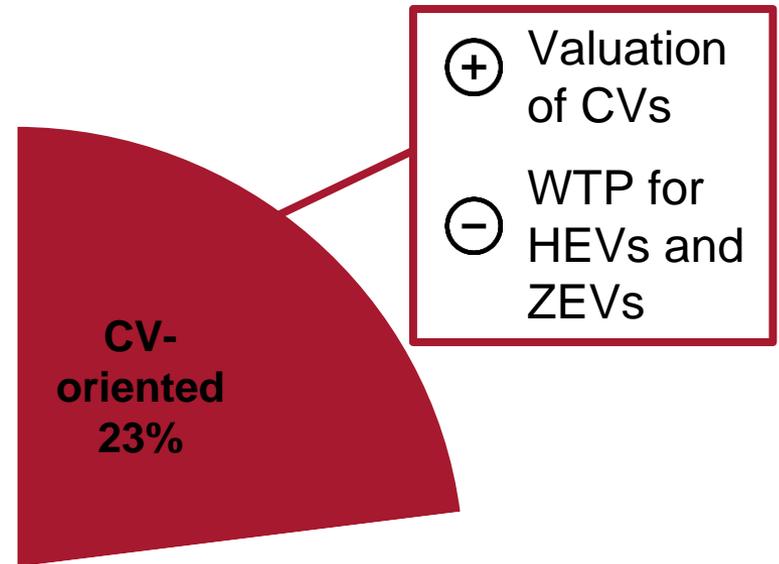
Source: Wolinetz & Axsen (2017), *Technological Forecasting & Social Change*

# “Full” PEV supply needed to get to 30% or higher

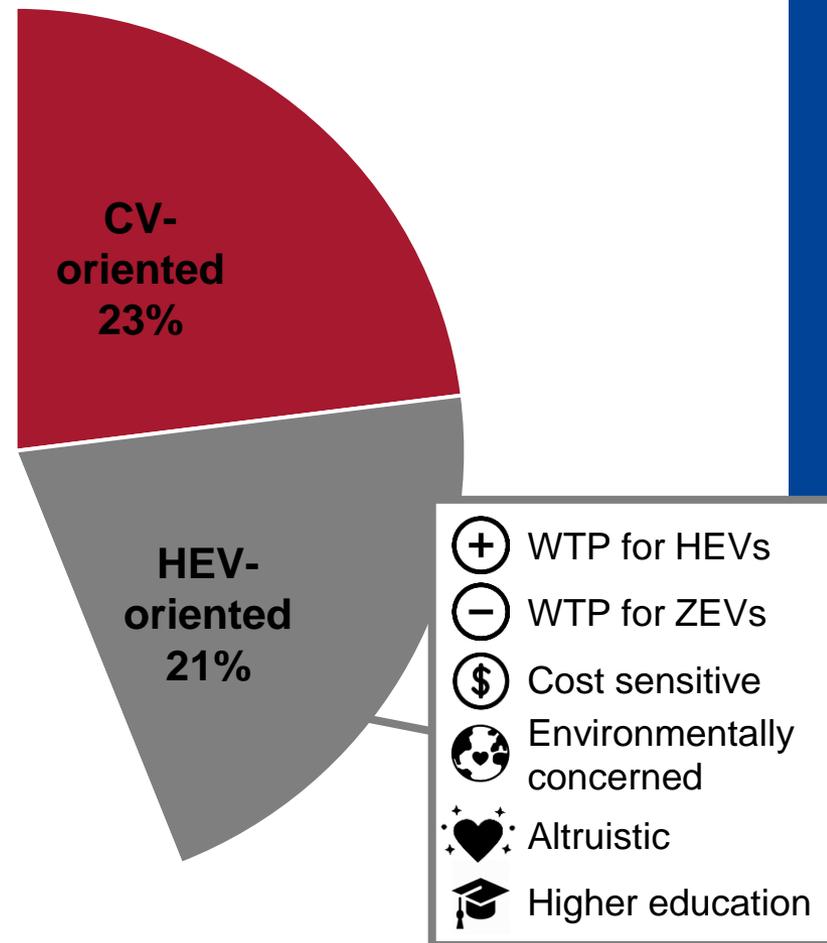


Source: Wolinetz & Axsen (2017), *Technological Forecasting & Social Change*

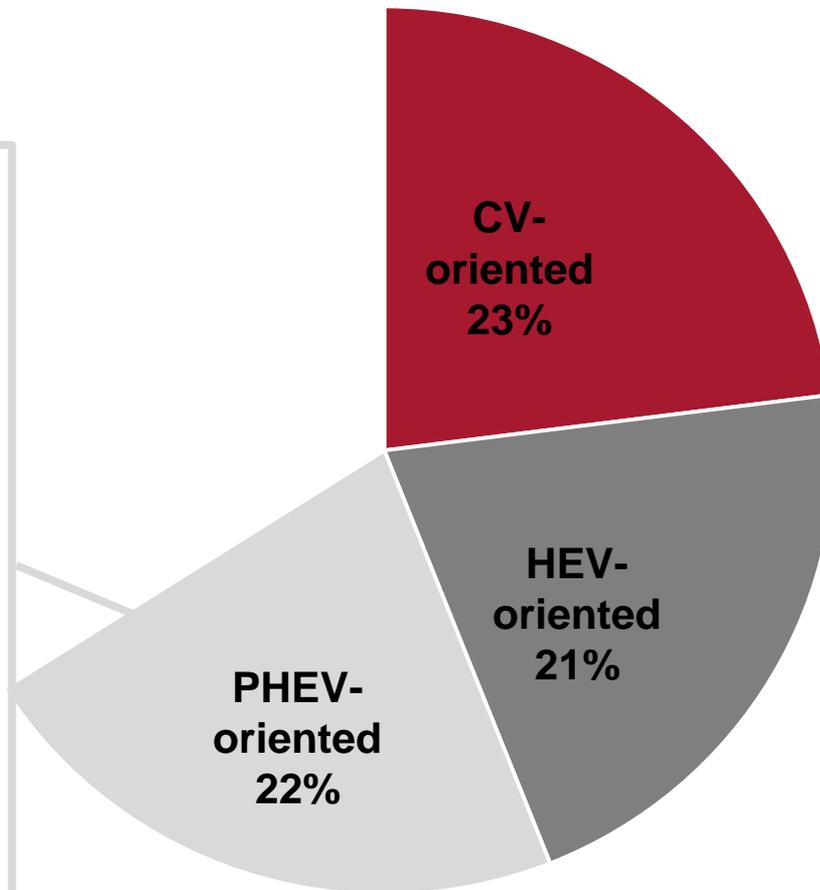
# Five distinct consumer segments



# Five distinct consumer segments



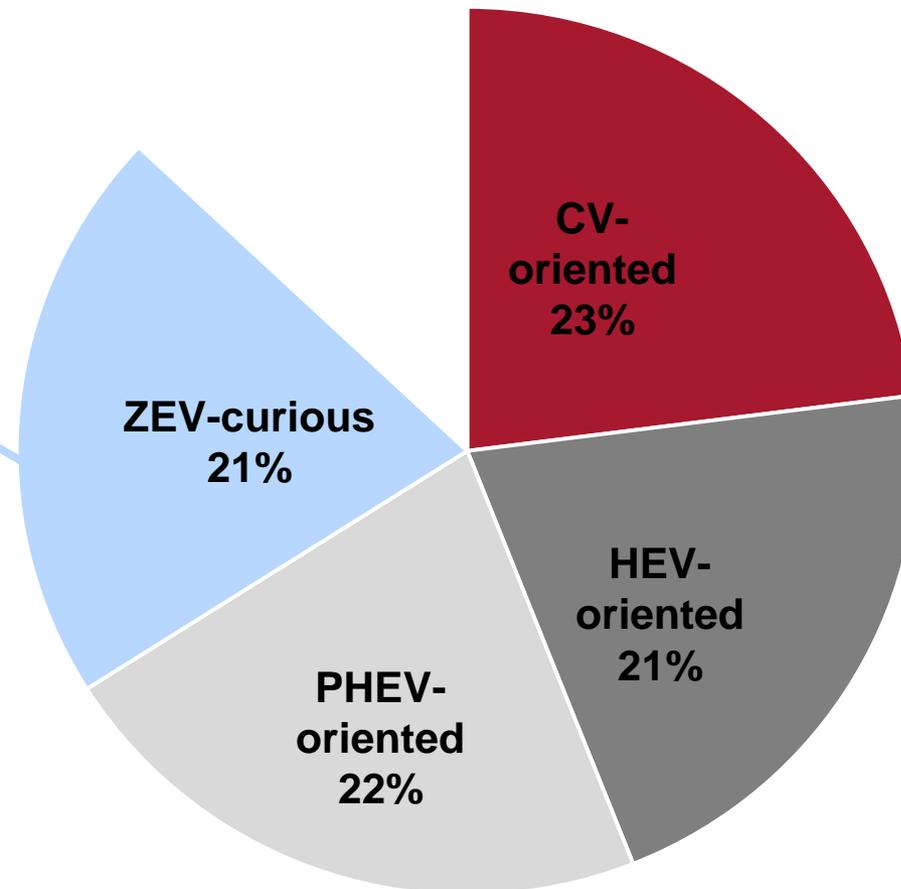
# Five distinct consumer segments



- ⊕ WTP for PHEVs, HEVs, and HFCVs
- ⊖ WTP for BEVs
- Range sensitive
- Value home charging, DC fast charging and H<sub>2</sub> refueling infrastructure
- 🌍 Environmentally concerned
- 🎂 Younger
- 🎓 Higher education

# Five distinct consumer segments

- ⊕ WTP for HEVs
- ⊖ WTP for PHEVs
- Range sensitive
- 🌍 Environmental lifestyle and concern
- 🎂 Younger
- 🎓 Higher education



# Five distinct consumer segments



High WTP for PHEVs,  
BEVs and HEVs



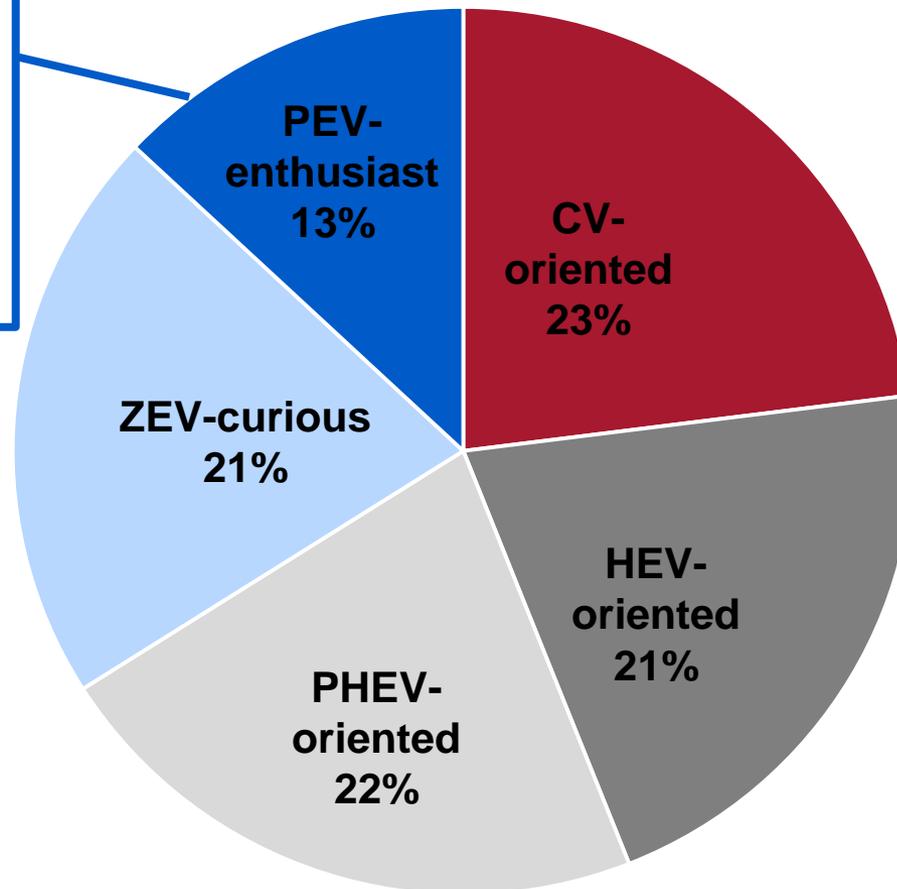
Environmental lifestyle  
and concern



Younger

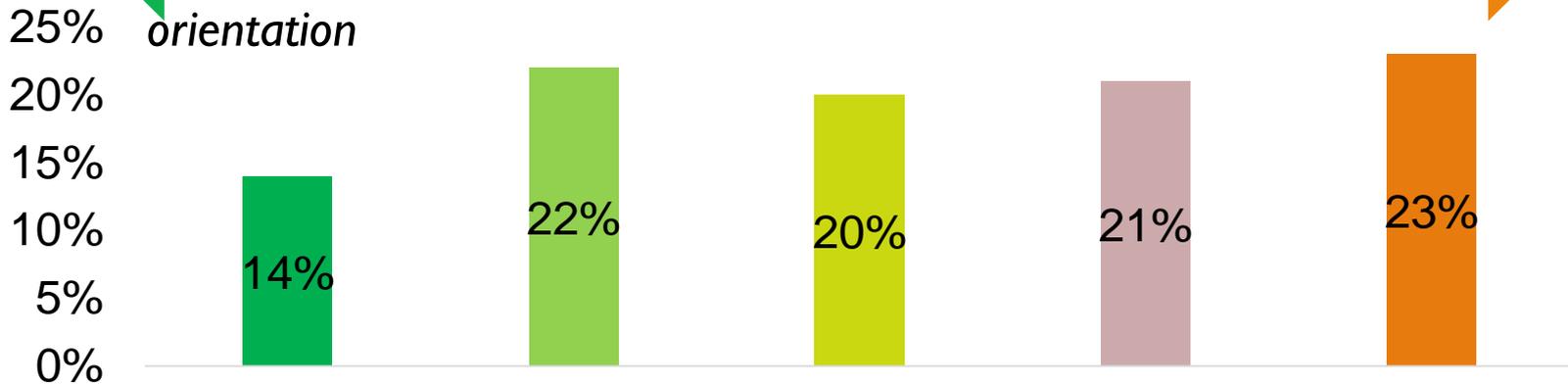


Higher education



EV-accepting

EV-rejecting



**PEV enthusiasts**

Strong environmental attitude and value EVs over other vehicles. **Most likely** group to buy EV as next car, especially with right incentives.

**PHEV-oriented**

Concerned about the environment, and **value the flexibility** of plug-in hybrids. Improved home and fast charging could increase their

**ZEV-curious**

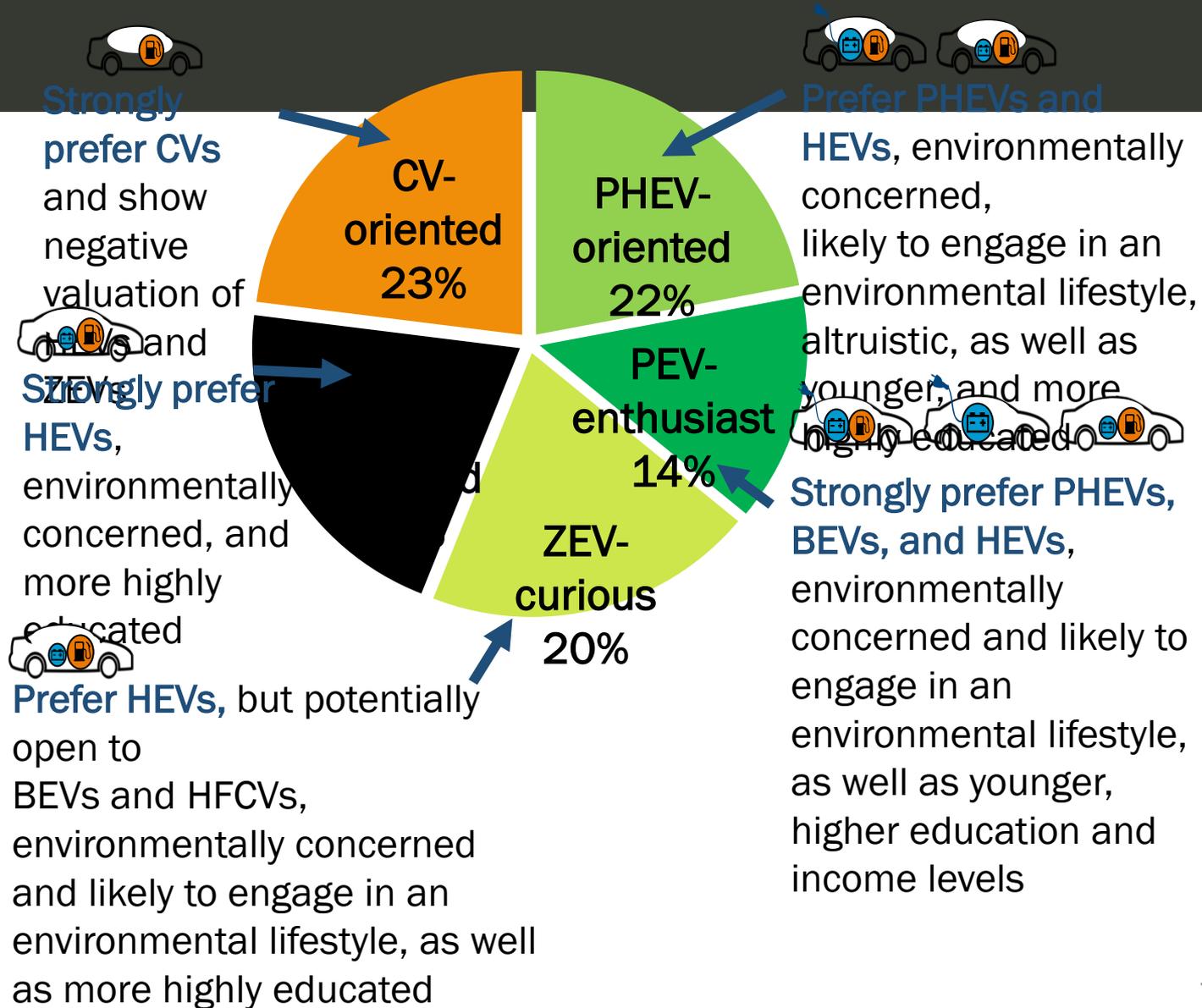
Environmentally conscious and prefer hybrids at the moment, but curious about EVs. **May consider** buying one once EV ranges are longer.

**HEV-oriented**

Environmentally conscious and strongly **prefer hybrids** but not EVs. Will likely adopt hybrids soon, or even plug-in hybrids with the right incentives.

**CV-oriented**

**Not interested** in hybrids or EVs and will likely be the last to adopt this new technology.



# Comparing PEV policies

## Demand-focused policy

- Purchase incentives
- Non-monetary incentives (HOV lane, etc.)
- Charger deployment

## Supply-focused policy

- ZEV mandate (sale requirements)
- Fuel efficiency standards
- Low-carbon fuel standards