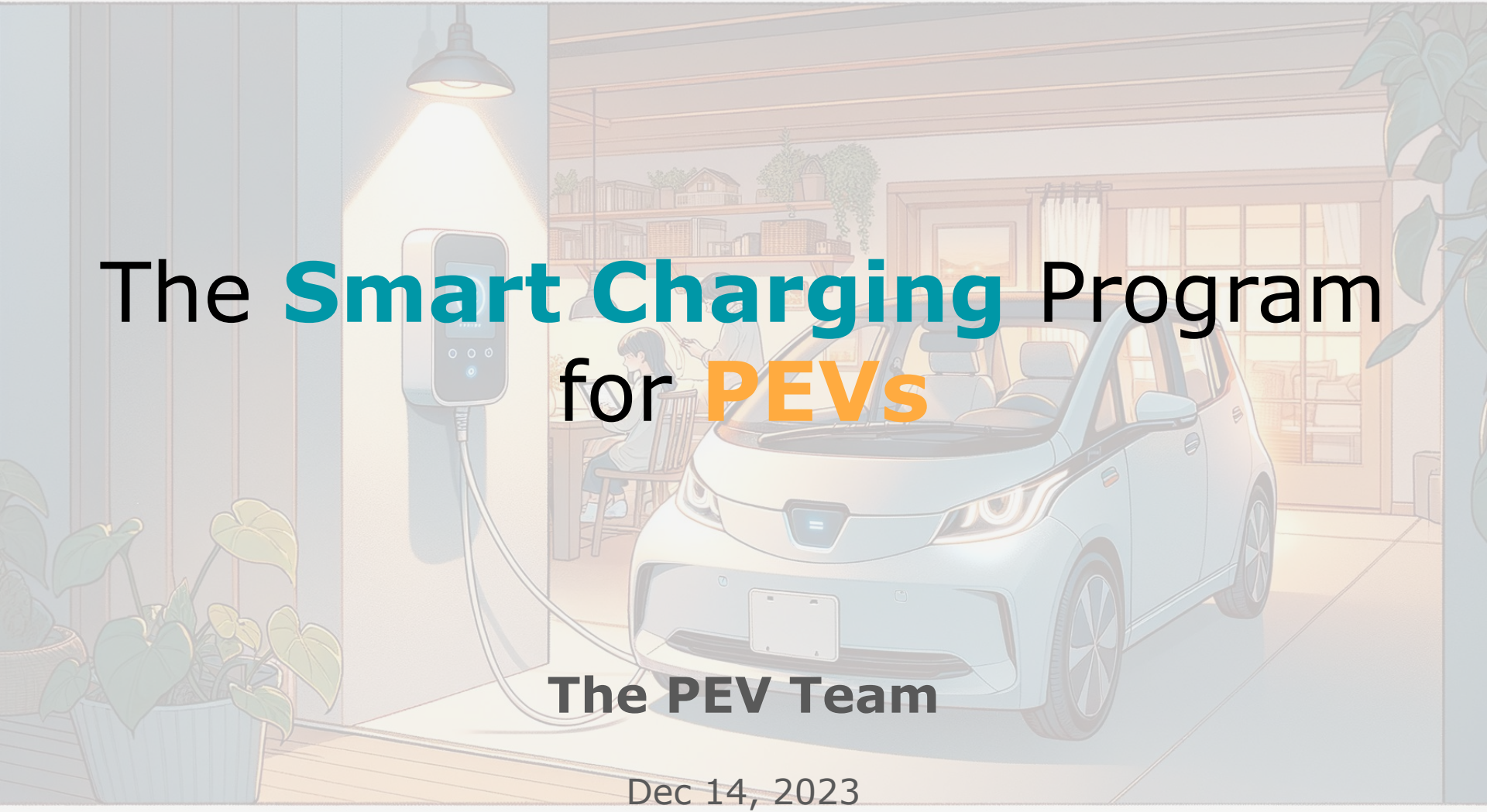

The **Smart Charging** Program for **PEVs**

The PEV Team

Dec 14, 2023

Smart Charging for PEVs

1. **Intro & Research Question**
2. Survey Part 1
3. Survey Part 2
4. Logit Models
5. Model Evaluation & Simulation
6. Recommendations

What if I tell you…

…that your electronic devices have already applied **smart charging** that helps smoothing grid output and saving battery life?

What if smart charging is applied to **PEVs**?

Research Question

How to use **conjoint survey** to quantify **benefits** and **constraints** of plug-in vehicles (PEVs) **smart charging** adoption?

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Survey Part 1: **Demographic** Questions

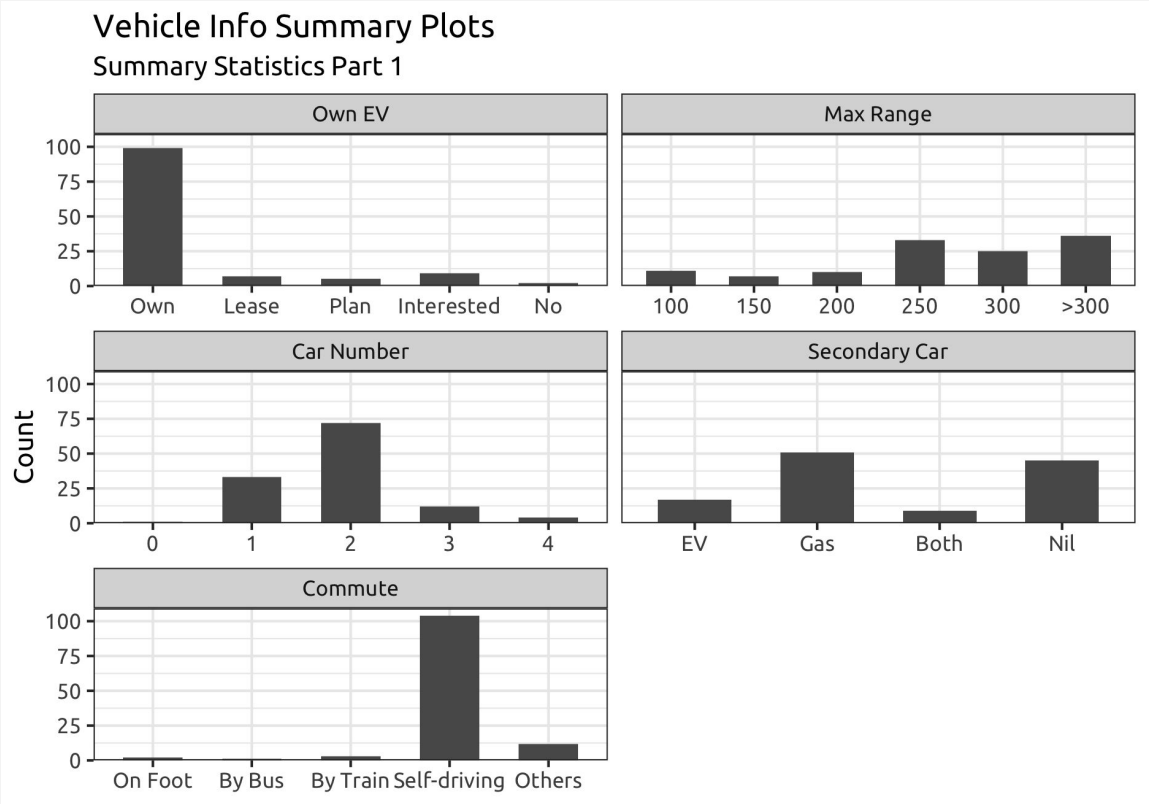
122 successful **responds**

Most people **own** EV as a **2nd** car

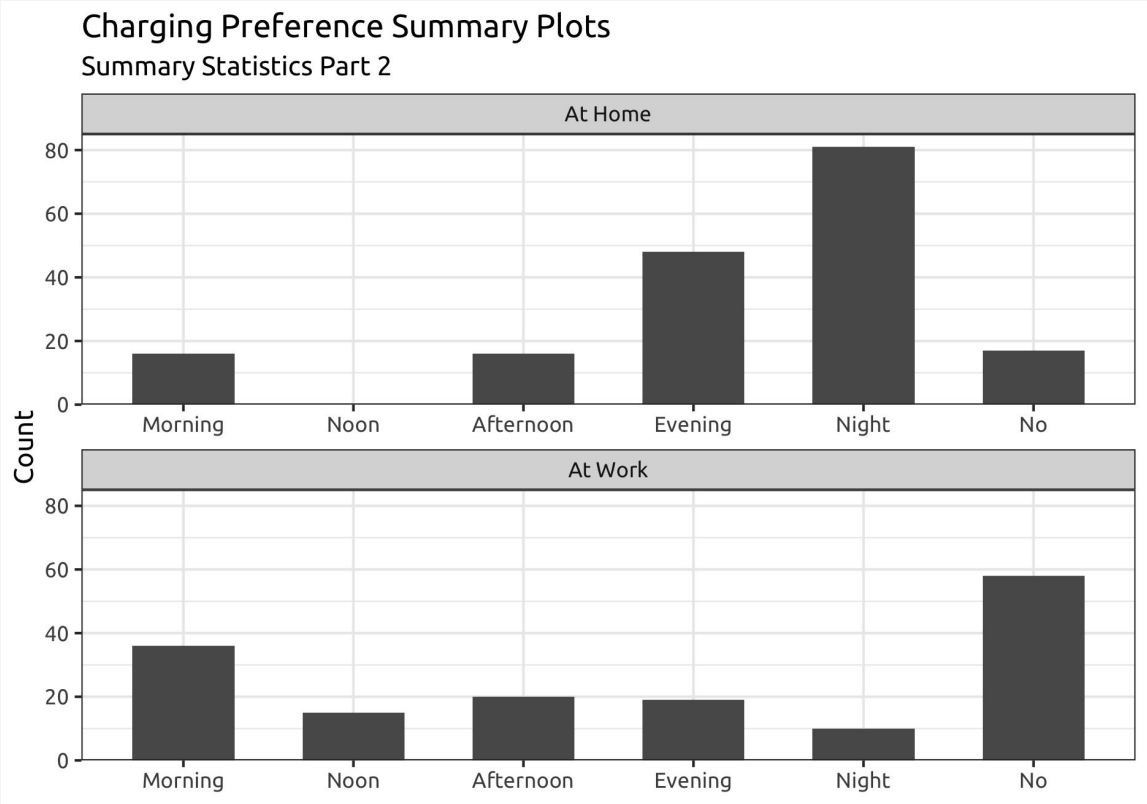
Most people have **home** charge at **night**

Most people are in the **middle class**

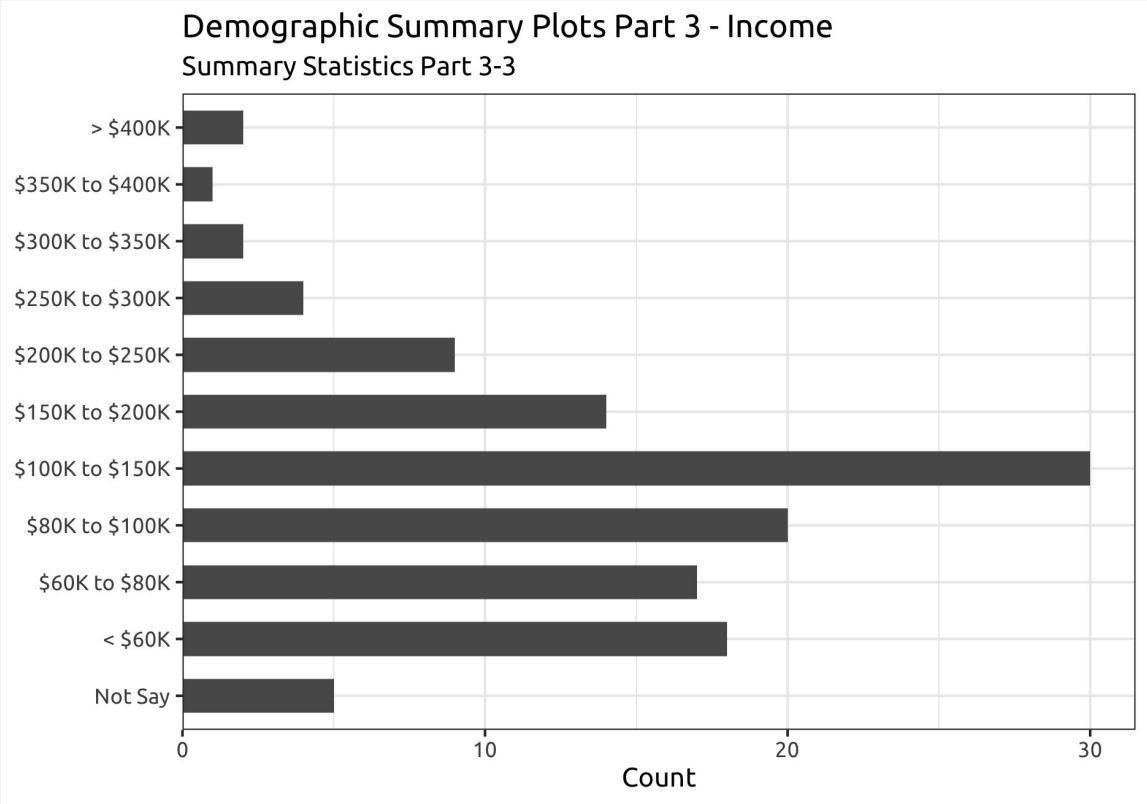
Vehicle Ownership Distribution



Charging Preference Distribution



Income Distribution



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Survey Part 2: **Conjoint** Questions

122 successful **responds**

8 **conjoint** questions for each survey

5 models of **preference** and **WTP** space

Full-factorial randomized design

What **utilities** do PEV owners care the most?

Monetary Rewards:

Beta **1** - Upfront Incentive ($100, $300, $500)

Beta **2** - Free Lv2 Charger (Yes or No)

Beta **3** - Electricity Price Discount (10%, 25%, 50%)

Flexibility Compromises:

Beta **4** - Override Window (0.5hrs, 1hr, 2hrs, 4hrs)

Beta **5** - Guaranteed Range (25%, 50%, 75%)

Conjoint Survey…

Options:	Option 1	Option 2
Upfront Incentive:	$100	$500
Free Level 2 Charger:	No	Yes
Electricity Price Discount:	25%	50%
Override Window:	0.5 hrs	4 hrs
Guaranteed Range if charged for 8 hrs:	100 miles	300 miles

…and also a "**Not Interested**" option.

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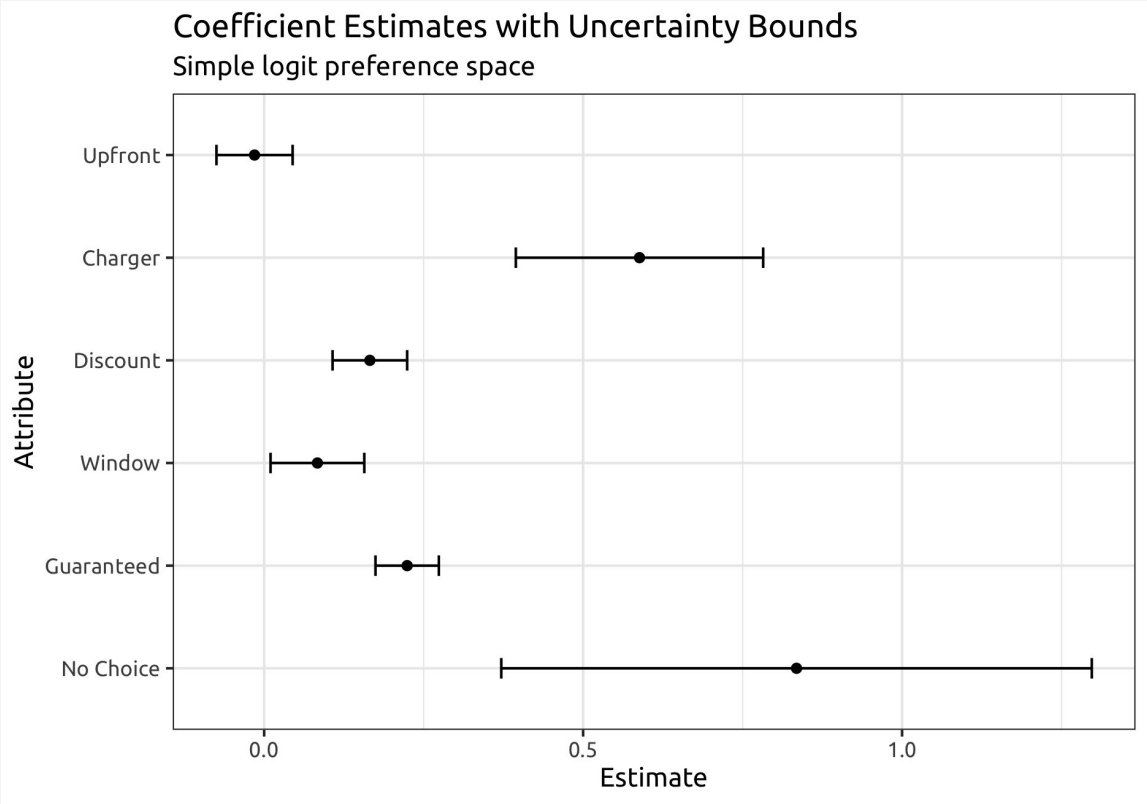
All Models…

- **Simple** Logit **Preference** Space
- **Mixed** Logit **Preference** Space
- **Simple** Logit **Preference** Space with **Groups**
- **Simple** Logit **WTP** Space
- **Mixed** Logit **WTP** Space

The **Simple** Logit **Preference** Space Model



Model **Coefficients** & **Equation**

Summary of Model Coefficients

	Coefficient	Meaning	Estimate	Std Error	Level	Unit
upfront	β_1	Upfront	-0.0151	0.0305	1, 3, 5	100 USD
lv_2_charger_yes	β_2	Lv 2 Charger	0.5884	0.0989	-	-
discount	β_3	Discount	0.1657	0.0298	1, 2.5, 5	10%
window	β_4	Window	0.0835	0.0375	0.5, 1, 2, 4	1 hr
guaranteed	β_5	Guaranteed	0.2242	0.0253	25, 50, 75	10%
no_choice	β_6	No Choice	0.8345	0.2361	-	-

$$u_j = -0.02x_j^{upfront} + 0.59\delta_j^{charger} + 0.17x_j^{discount} + 0.08x_j^{window} + 0.22x_j^{guaranteed} + 0.83x_j^{no} + \epsilon_j$$

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WTP Space Conversion

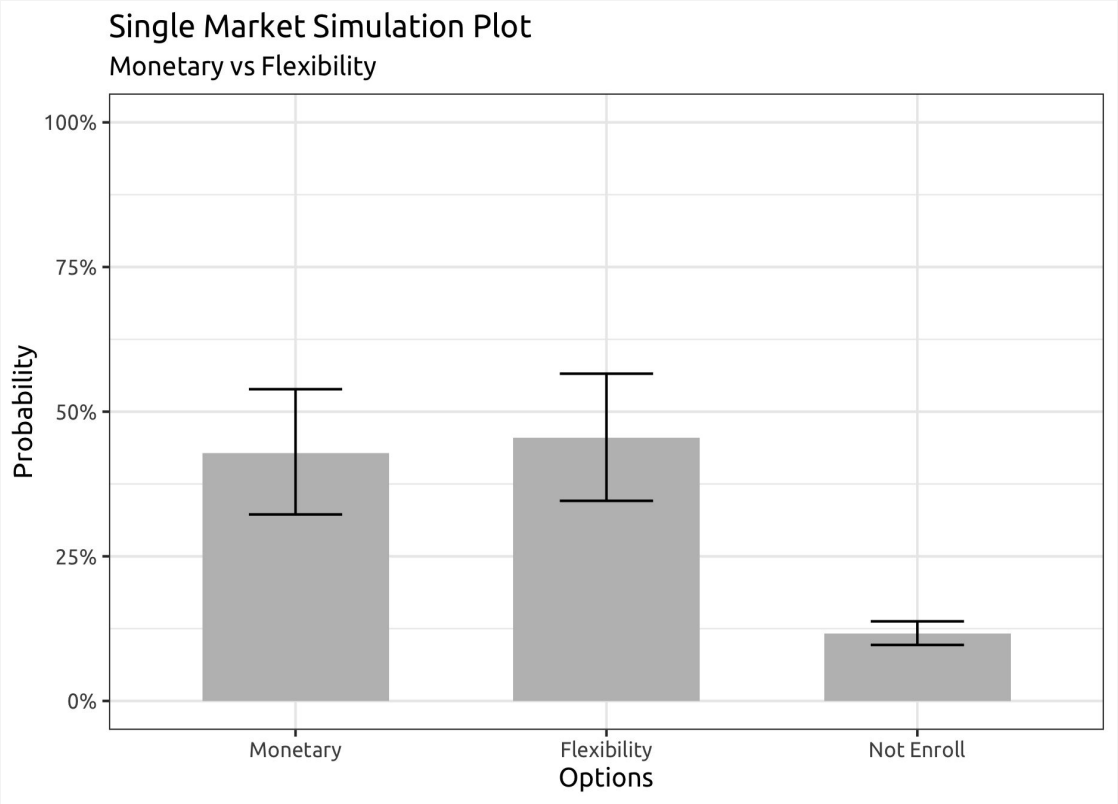
Computed WTP

Attribute	Coefficient
upfront	-1.000000
lv_2_charger_yes	39.027250
discount	10.989596
window	5.537059
guaranteed	14.868817
no_choice	55.354842

The **WTP** coefficients are generated from simple logit **preference** space.

They have units of **USD**, standing for users' willingness to pay to each feature.

Market Simulation

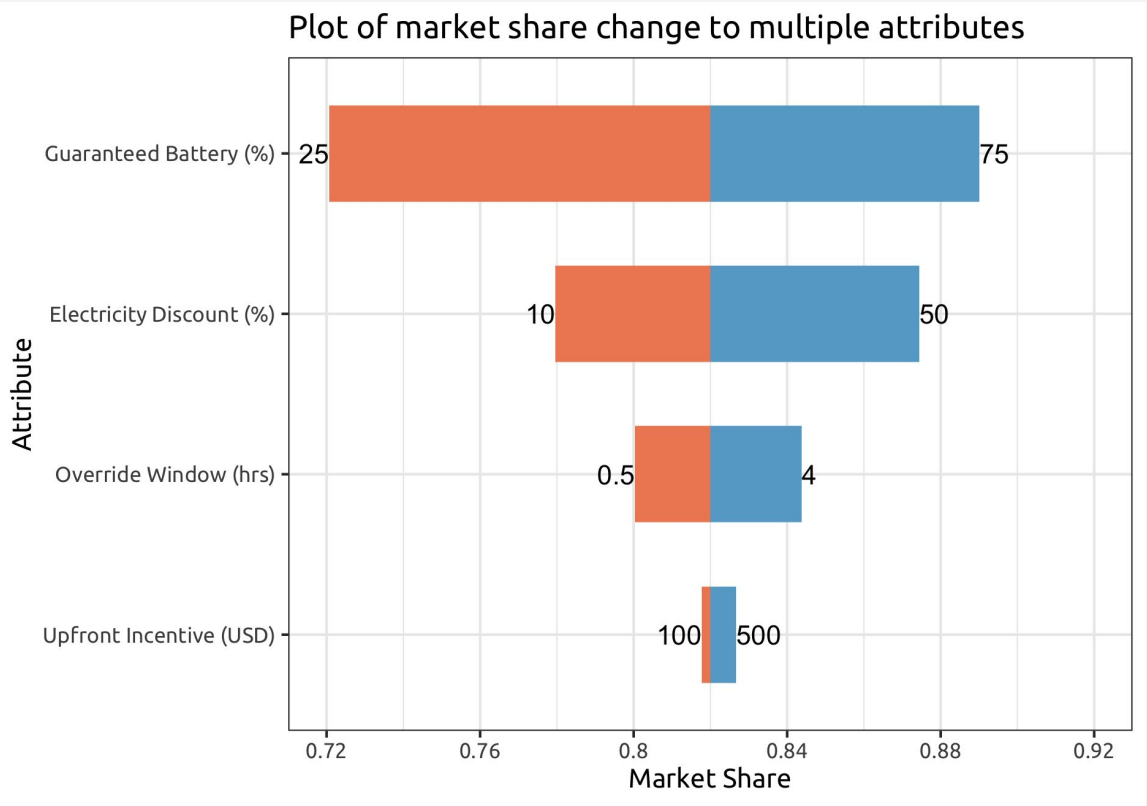


Monetary Incentives

ties with

Flexibility Compromises

Tornado Plot



Mid points set as moderate values.

Battery and **discount** cared most.

Window and **upfront** cared least.

Smart Charging for PEVs

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Recommendations

1. Since “no choice” has positive WTP, **incentives** are thus important to opt participants in.
2. Electricity discount is more important than upfront incentives, so **don’t waste money on upfront**.
3. Users worry about battery percentage, so it’s important to set a reasonable threshold for **guaranteed battery**.

Thank you!

Questions, comments, or concerns?