

Research Seminar:

**Designing Light Duty Vehicle Incentives for
Low- and Moderate-Income Households**

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March 21, 2019

UCLA Luskin School of Public Affairs

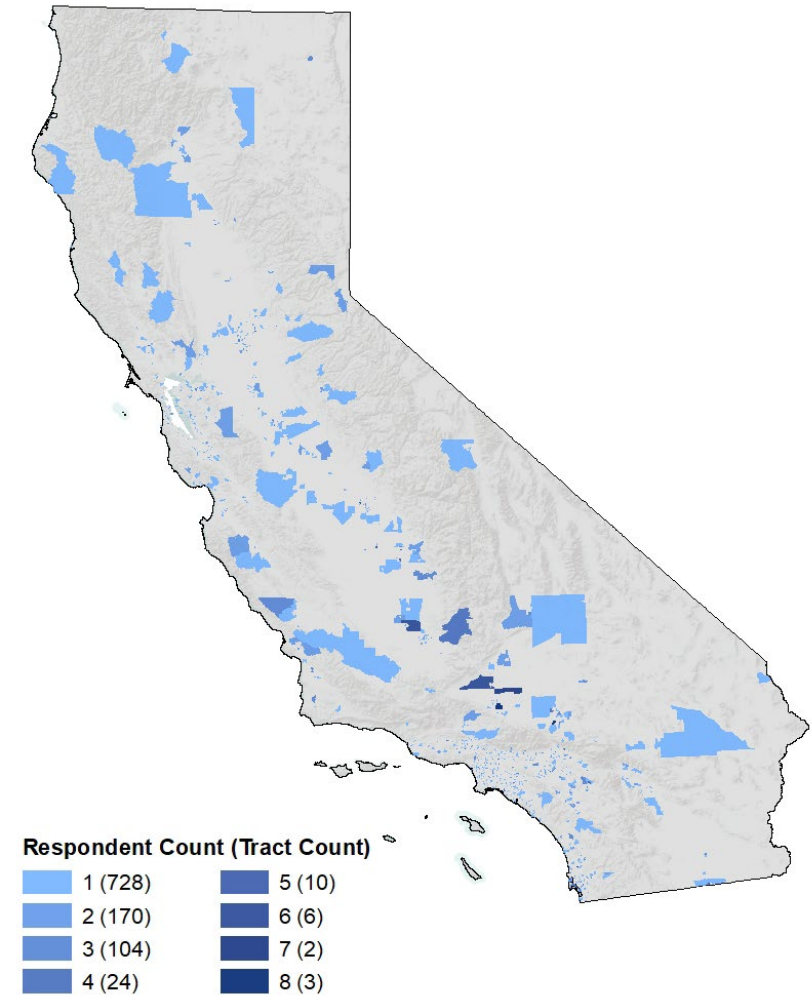
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Motivation for Study

- Overcoming barriers has become an increasingly important transport policy driver in California
- Surveying California low- and moderate-income households, this study examined:
 - vehicle holdings
 - purchase decision-making and financing
 - travel patterns
 - The impact of incentives to increase adoption of advanced clean vehicles

Survey Sample Characteristics

- 1,604 full survey responses recorded via online survey fielded in Summer 2018 by GfK
- All households had incomes < 300% of the Federal Poverty Level and were seeking to replace vehicle within next 3 years
- Survey design and weighting allowed sample to be representative of both the English and Spanish speaking low-moderate income population in CA



External Validity of Survey Sample: Race-Ethnicity

Characteristic	This Survey (2018)	Entire California Population (2016 ACS)	Population under 225% of FPL (2016 ACS)	Population under 300% of FPL (ACS)
Race/Ethnicity				
White, Non-Hispanic	27.1%	37.5%	25.1%	26.1%
Black, Non-Hispanic	9.2%	5.5%	6.9%	6.5%
Asian, Non-Hispanic	5.1%	14.3%	10.8%	11.2%
Other, Non-Hispanic	4.7%	3.7%	3.1%	3.1%
2+ Races, Non-Hispanic	2.2%	NA	NA	NA
Hispanic	51.6%	38.9%	54.1%	53.1%

- Survey weighting ensured proportional representation of the state’s low-moderate income population– especially among non-Hispanic White and Hispanic groups

Summary of Results: Vehicle Holdings and Preferences

Surveyed households:

- own as many vehicles (2.0) as higher-income households
- spend significant % of their annual reported income on their last vehicle purchase (>50%) and annual operation of their main vehicle (>10%)
- Are largely uninterested in transit or other alternative modes, despite high levels of expenditure on vehicles (Only ~6% rode transit daily)
- Over 40% are willing to accept \$1,500 or less to scrap current vehicle without a replacement vehicle incentive

Summary of Results: Clean Vehicle Incentives

- Offering rebates had a much larger impact on clean vehicle purchase propensity than offering guaranteed financing alternatives
- Rebates of \$2,500, \$5,000, and \$9,500 increased purchase rates from their baseline rates by about 20%, 40% and 60-80% respectively for hybrids, plug-in hybrids, and all-battery electric vehicles
- Further investment in clean vehicle purchase incentives for low- and moderate-income households would be cost-effective
- Less than 40% were aware of currently-offered PEV purchase incentives

Summary of Results: Barriers to Clean Vehicle Ownership

- Multiple remaining barriers to vehicle access must be overcome to ensure that lower income households can benefit from incentive and financing programs.
- Lower-income households had a greater dependence on used vehicles and a lower reliance on traditional financing mechanisms than those reported by higher-income households in other surveys.
- There appear to be remaining barriers to electric vehicle charging.

The Vehicle Purchase Process

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Results: Time of Search (Number of Months)

Income Category	N.	Mean
Less than \$25,000	440	6.9
\$25,000 to \$49,999	548	4.5
\$50,000 to \$74,999	353	4.4
More than \$75,000	139	10.2
Sample Total	1,480	5.7

- Households in the lowest and highest income brackets spent the most time searching for a vehicle, although likely for different reasons

Results: Where Households Bought Vehicles

Seller type	Past Main Vehicle		Expected Future Vehicle	
	N.	Pct.	N.	Pct.
1. Social network	310	19.8%	130	8.4%
2. Formal seller	945	60.3%	1,080	69.7%
3. Semi-formal seller	135	8.6%	126	8.1%
Local repair shop or garage	19	1.2%	47	3.0%
On-street advertiser	75	4.8%	41	2.6%
“Buy Here Pay Here” used dealer	41	2.9%	39	2.5%
4. Internet	155	9.9%	179	11.6%
5. Other	22	1.4%	35	2.2%
Sample Total	1,567	100%	1,549	100%

- Compared to where their current main vehicle was purchased, more households expected to buy their next vehicle through formal channels and the internet, and much less often through social networks (family, friends, etc.)

Results: Used v. New Purchases

	<\$25,000		\$25K-\$50K		\$50K-\$75K		>\$75,000		Sample Total	
	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.
New	144	31%	239	41%	171	47%	50	36%	603	39%
Used	318	69%	348	59%	193	53%	88	64%	947	61%
Sample Total	461	100%	587	100%	364	100%	138	100%	1,550	100%

- The majority of households, especially the poorest, purchased their current main vehicle used rather than new

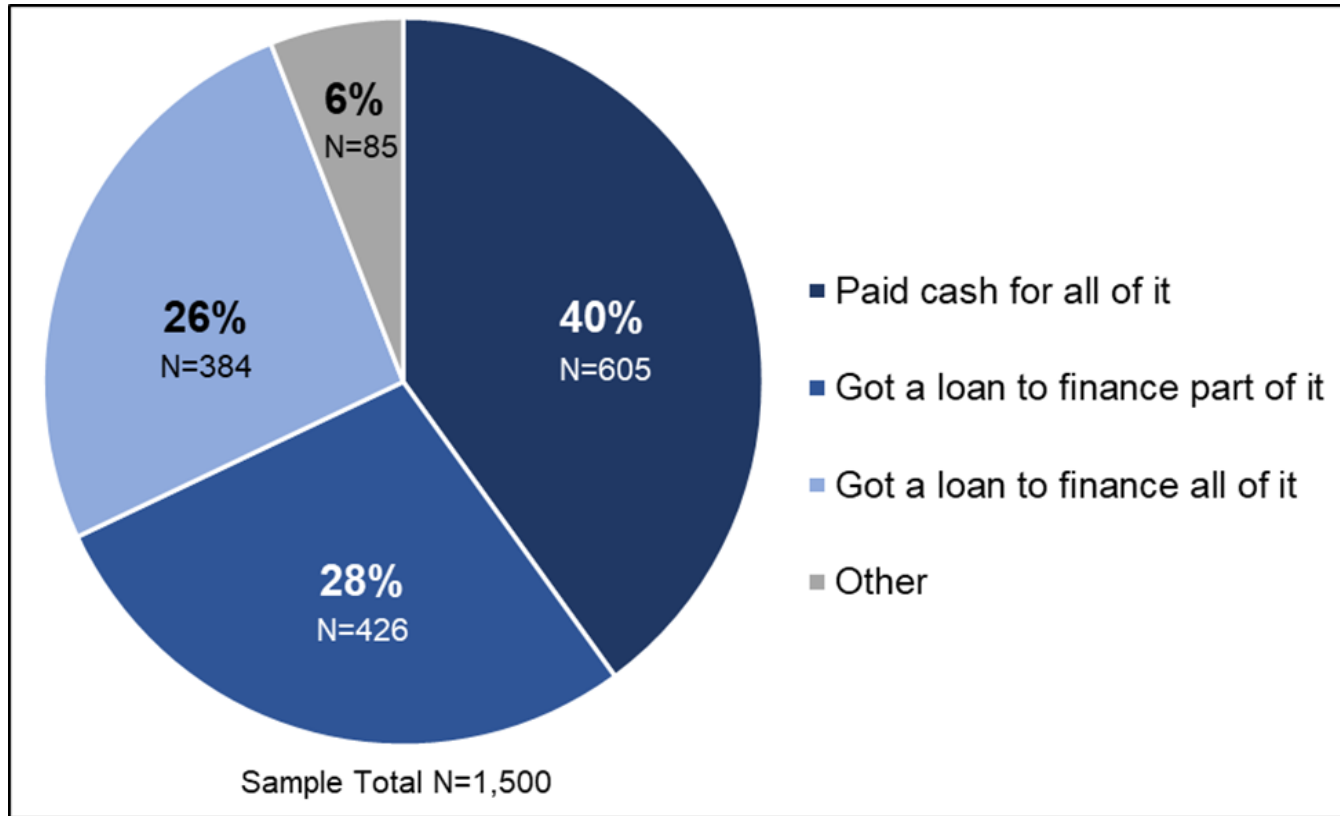
Results: Price of Purchase

	N.	Mean ¹	S.D.	Mean Pct. Inc.
Less than \$25,000	322	\$10,007	\$9,297	104.2%
\$25,000 to \$49,999	420	\$13,453	\$11,687	38.1%
\$50,000 to \$74,999	279	\$17,704	\$8,199	29.5%
More than \$75,000	103	\$18,236	\$8,053	22.4%
Sample Avg.	1,124	\$13,956	\$10,464	53.5%

1. The difference in mean amount between all combinations of income groups is statistically significant at $P < 0.05$, except between \$25-\$50K and >\$75K, and \$50-\$75K and >\$75K.

- Respondents in the highest income bracket paid 80% more for their main vehicle than those in the lowest income bracket, but expenditure burden decreased as income increased.

Results: Method of Payment for Last Vehicle



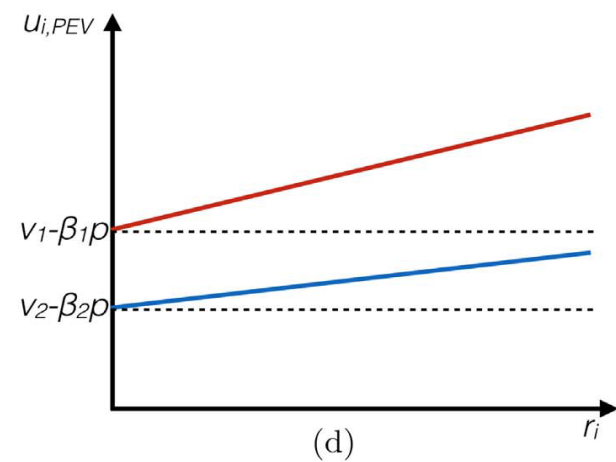
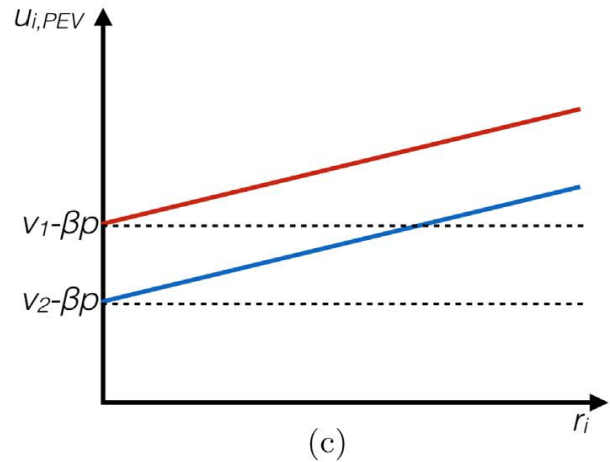
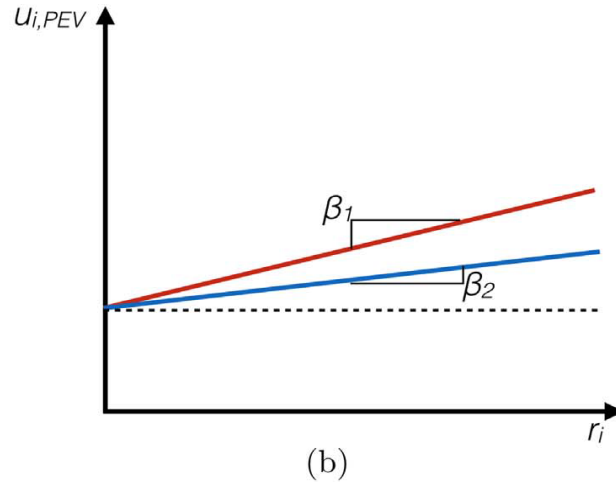
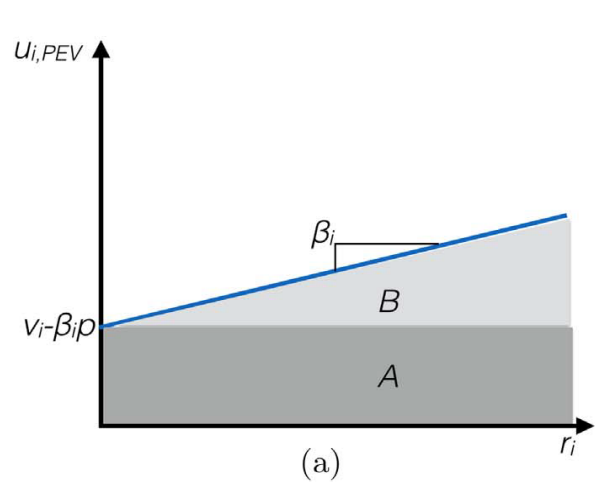
- Nearly 54% of respondents took out a loan to finance all or part of their previous vehicle purchase, while about 40% paid cash for the whole purchase in cash

Assessing the Effects of Rebates and Guaranteed Loans on Purchase Decisions

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Clean Vehicle Purchase Probability



- Area A represents a consumers' purchase probability in the absence of a rebate. Area B represents the marginal increase in the consumers' purchase probability in the presence of a rebate
- Rebates are more cost effective when they target consumers who otherwise would not purchase a clean vehicle

Results: Choice by Rebate and Income Level

By Income: % of Weighted Sample Choosing HEV/PHEV/BEV by Rebate				
	\$0	\$ 2,500	\$ 5,000	\$ 9,500
HEV				
Below 225	25.5%	30.5%	35.8%	43.9%
Above 225	25.9%	30.2%	34.8%	41.9%
PHEV				
Below 225	3.7%	4.5%	5.2%	6.8%
Above 225	5.4%	6.3%	7.3%	9.1%
BEV				
Below 225	5.4%	6.5%	7.6%	8.3%
Above 225	5.1%	5.9%	6.8%	7.6%

- Purchase propensity increased by ~20%, 40%, and 60-80% at subsidy levels of \$2,500, \$5,000, and \$9,500 respectively, with small differences in these rates across income groups.
- Results show a stronger preference by moderate-income consumers to purchase a PHEV, and a stronger preference by low-income consumers to purchase a BEV or HEV.

Results: Choice by Financing and Income Level

By Income: % of Weighted Sample Choosing HEV/PHEV/BEV by Financing/Interest Rate				
HEV	None	15.0%	7.5%	5.0%
Below 225	25.5%	26.3%	26.9%	27.0%
Above 225	25.9%	27.9%	28.7%	29.0%
PHEV	None	15.0%	7.5%	5.0%
Below 225	3.7%	4.1%	4.2%	4.3%
Above 225	5.4%	6.0%	6.3%	6.3%
BEV	None	15.0%	7.5%	5.0%
Below 225	5.4%	5.4%	5.4%	5.4%
Above 225	5.1%	5.3%	5.4%	5.4%

- Purchase propensity increased slightly at all guaranteed financing interest rates for HEVs and PHEVs regardless of income level
- Financing increases the probability of purchasing a BEV slightly – but only for the moderate-income population

Results: Choice by Financing at 15% with Rebate

By Income: % of Weighted Sample Choosing HEV/PHEV/BEV by Subsidy (Financing at 15%)				
HEV	\$0	\$ 2,500	\$ 5,000	\$ 9,500
Below 225	26.3%	30.5%	35.8%	43.9%
Above 225	27.9%	31.4%	35.2%	41.9%
PHEV	\$0	\$ 2,500	\$ 5,000	\$ 9,500
Below 225	4.1%	4.6%	5.2%	6.8%
Above 225	6.0%	6.7%	7.5%	9.1%
BEV	\$0	\$ 2,500	\$ 5,000	\$ 9,500
Below 225	5.4%	6.5%	7.6%	8.3%
Above 225	5.3%	6.0%	6.8%	7.6%

- Compared to a rebate-only scenario (slide 16), adding financing increases uptake marginally at the lowest subsidy level, but not at all at the highest subsidy level

Vehicle Holdings

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Results: Vehicle Holdings by Income Category

Income bracket	<\$25,000			\$25K-\$50K			\$50K-\$75K			>\$75,000			Sample Average		
Vehicle holdings	N.	Mean	S.D.	N.	Mean	S.D.	N.	Mean	S.D.	N.	Mean	S.D.	N.	Mean	S.D.
		500	1.4	0.9	598	1.9	1.0	366	2.6	1.3	140	3.1	1.2	1,604	2.0

- Households in the lowest income bracket held less than half as many vehicles (1.4) as households in the highest income bracket (3.1)

Results: Main Vehicle Characteristics

	Veh. Holdings			Fleet Age			Fleet Mileage			Main Veh. MPG		
	N.	Mean	S.D.	N.	Mean ¹	S.D.	N.	Mean ²	S.D.	N.	Mean	S.D.
Bay Area	170	2.0	1.4	166	2006.3	8.3	162	87,060	82,099	165	24.9	8.7
Sacramento	48	2.1	1.1	48	2008.3	8.8	48	68,744	90,285	48	25.1	9.8
San Diego	147	1.7	1.1	137	2008.8	6.9	134	92,015	99,424	137	24.0	8.0
SJV	186	2.0	1.2	176	2005.9	8.7	156	108,243	96,394	175	24.6	9.5
South Coast	732	2.0	1.1	715	2007.5	7.1	681	86,014	76,302	712	22.7	8.2
Other	298	2.1	1.2	296	2006.9	7.4	277	90,028	77,549	290	23.5	7.1
Sample Avg.	1,580	2.0	1.2	1,537	2007.2	7.6	1,458	89,280	82,387	1,527	23.5	8.3

1. The difference in mean fleet age is statistically significant at $P < 0.05$ between San Diego and SJV.

2. The difference in mean fleet mileage is statistically significant at $P < 0.05$ between SJV and South Coast, and at $P < 0.10$ between Sacramento and SJV.

- There is little variation across regions in average vehicle holdings, fleet age, and MPG, whereas there are more notable differences in average mileage

Barriers to Access and Alternative Travel Modes

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Results: Annual Fuel Expenditures and VMT

	N	Annual Fuel Expenditures		VMT Per Week		Fuel Economy	
		Mean ¹	S.D.	Mean ²	S.D.	Mean	S.D.
Urban	596	\$941	\$1,072	112	117	23.8	7.4
Suburban	627	\$1,224	\$1,256	156	156	24.2	8.2
Rural	212	\$1,164	\$1,070	144	129	23.8	7.7
Sample Avg.	1,435	\$1,097	\$1,169	136	139	24.0	7.9

1. The difference in mean annual fuel expenditures is statistically significant at $P < 0.05$ between Urban and Suburban.

2. The difference in mean VMT per week is statistically significant at $P < 0.05$ between Urban and Suburban.

- The price of a gallon of gas is consistent and MPG is fairly consistent across the state – differences in expenditures are driven by VMT.
- Respondents located in urban areas drive significantly fewer miles a week than those in suburban or rural areas, and thus have lower annual fuel expenditures

Results: Annual Insurance Expenditures

		N.	Mean ¹	S.D.	Mean Pct Inc.
Non-Hispanic	White	401	\$1,111	\$1,245	4.1%
	Black	130	\$1,525	\$1,151	22.8%
	Asian	66	\$1,221	\$780	5.3%
	Other	64	\$1,562	\$1,275	9.6%
	2+ Races	31	\$1,649	\$1,430	5.6%
Hispanic		729	\$1,367	\$946	6.8%
Sample Avg		1,420	\$1,317	\$1,123	7.5%
1. There are no statistically significant differences in mean annual insurance expenditures, except when White is compared to all other race/ethnicities combined (P<0.05).					

- Non-Hispanic White respondents paid 20% less than all other racial and ethnic minority groups combined. Non-Hispanic Black respondents had the highest expenditure burden.
- About 25% of all households surveyed were aware of the California Department of Insurance's Low Cost Automobile Insurance Program

Results: Annual Expenditure to Operate Vehicle

Annual Expenditure to Maintain and Retain Vehicle =
Annual Insurance Cost + Annual Fuel Cost + *Annual Repair Costs (where applicable)**

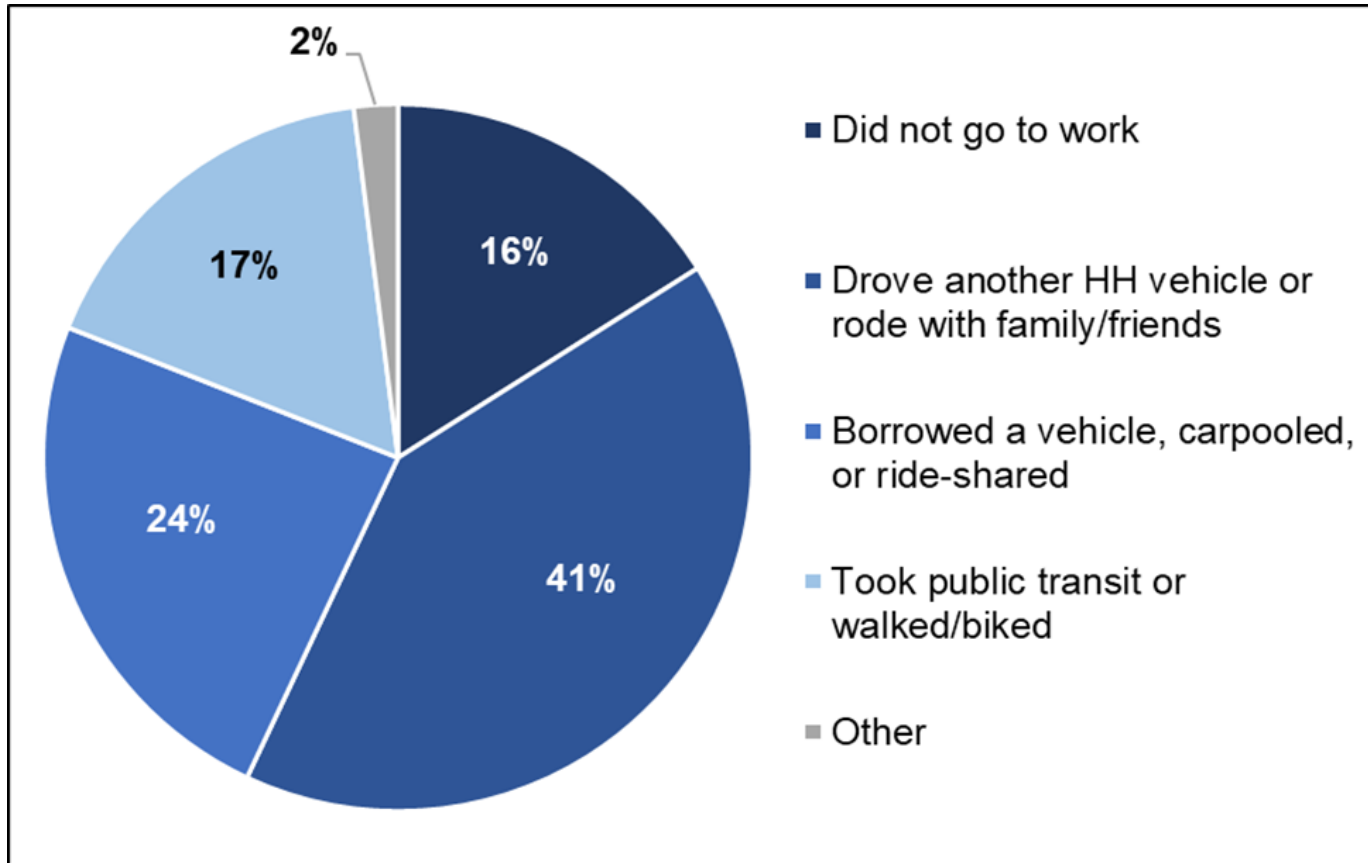
	N.	Mean ¹	S.D.	Mean Pct. Inc
<\$25,000	158	\$2,513	\$1,425	35.1%
\$25K-\$50K	198	\$3,408	\$2,397	9.5%
\$50K-\$75K	131	\$4,211	\$2,251	7.1%
>\$75,000	39	\$3,108	\$935	3.7%
Sample Avg.	526	\$3,317	\$2,151	16.2%

1. The difference in mean annual vehicle expenditure is statistically significant at P<0.05 between <\$25K and \$25-\$50K, and <\$25K and \$50-\$75K, and at P<0.10 between \$50-\$75K and >\$75K.

- Mean annual expenditures to maintain and retain a vehicle increased as income increased
- Households in the lowest income group had the highest expenditure burden. Expenditure burden decreased as income increased.

* Equation does not include vehicle purchase or payment expenditures, vehicle registration fees, or parking expenditures

Results: Mode of Getting to Work during Repair



- Two-thirds reported still using a personal vehicle to get to work, whereas nearly one-sixth of the sample reported not going to work while their vehicle was being repaired

Results: Credit and Interest

Mean Interest Rate by Credit Self-Assessment

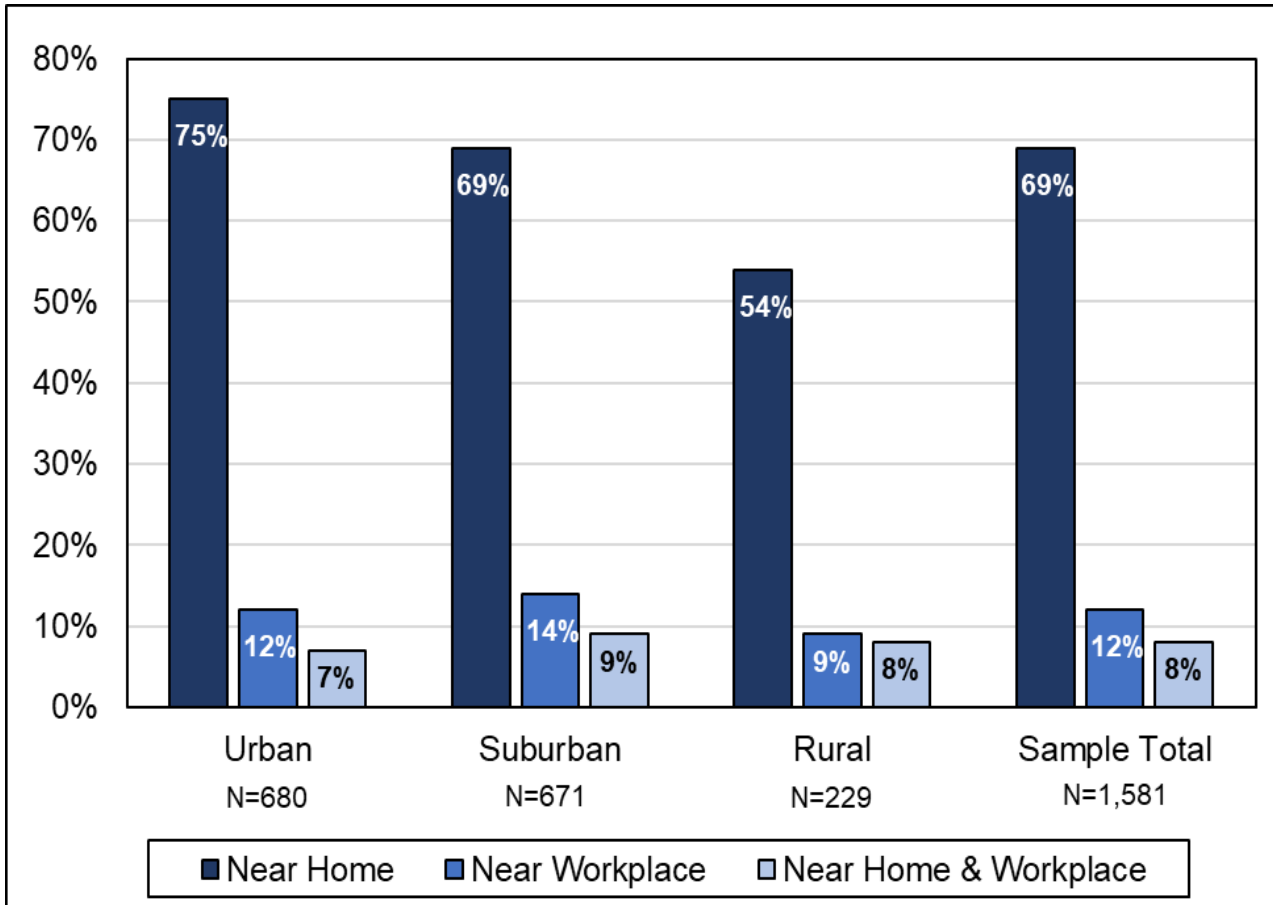
Credit Self-Rating	N.	Mean Interest Rate
Excellent	165	6.1%
Good	288	5.3%
Fair	203	8.9%
Poor	78	10.2%
Unknown	13	4.9%
No Credit History	22	3.3%
Total	769	6.8%

- Credit scores affect the favorability of loan terms. Respondents who assessed their credit score as fair or poor had higher interest rates.
- Interest rates were higher on loans taken out to cover the full purchase cost of the current main vehicle.

Mean Interest Rate by Method of Payment and Income

	<\$25,000		\$25K-\$50K		\$50K-\$75K		>\$75,000		Total	
	N.	Mean	N.	Mean	N.	Mean	N.	Mean	N.	Mean
Partial Loan	103	4.5%	153	7.6%	92	5.5%	55	6.0%	403	6.1%
Full Loan	72	5.2%	121	9.2%	138	7.3%	38	8.1%	369	7.6%
Total	174	4.8%	274	8.3%	229	6.6%	94	6.9%	772	6.8%

Results: Walkability to Transit Stop



- Walkable access to a transit stop (i.e., bus or rail) near the respondent's home is much higher in urban areas than suburban or rural areas.

Results: Alternative Travel Modes

Frequency of Alternative Travel Mode Usage

	Daily	Weekly	Yearly	Never
	Pct.	Pct.	Pct.	Pct.
Public transit	6%	5%	20%	58%
Vehicle in HH	70%	17%	1%	5%
Borrowed non-HH vehicle	1%	3%	16%	72%
Carpool	1%	6%	13%	67%
Ride-share	2%	3%	19%	64%
Car-share	1%	2%	3%	90%
Rental car	1%	1%	29%	63%
Govt-provided vanpool	1%	2%	1%	90%
Govt-sponsored dial-a-ride	1%	2%	1%	91%
Work-provided transportation	2%	2%	4%	85%
Bicycle	5%	5%	9%	66%
Walking	20%	16%	10%	29%
Other	3%	2%	3%	87%

- 70% of respondents report daily use of a household vehicle
- Only 6% of respondents use transit daily (and 58% have never used it)

Results: Preference to Keep Vehicle

Primary Reason Households Prefer to Own/Keep Vehicle Regardless of Alternative Travel Modes, by Income

	<\$25,000	\$25K-\$50K	\$50K-\$75K	>\$75,000	Total
	Pct.	Pct.	Pct.	Pct.	Pct.
Ownership is an investment	23%	14%	13%	13%	16%
Ownership provides a safety net	22%	18%	34%	21%	23%
Ownership is valued by family/friends	4%	7%	6%	7%	6%
Alternative modes are more expensive	6%	3%	0%	0%	3%
Alternative modes are not as useful for my travel needs	12%	23%	13%	4%	16%
I enjoy driving	31%	28%	22%	42%	28%

- About 40% would seriously consider selling their main vehicle if transit was made as convenient and inexpensive as operating their vehicle.
- 60% would keep their vehicle regardless. The main reason given by respondents was that they enjoy driving, followed by the economic safety net that vehicle ownership provides

Results: Preference to Keep Vehicle

Lowest Amount of Money Households Would Accept to Participate in a Vehicle Scrapping Program

Amount offered	N.	Pct.
\$250	49	4%
\$500	102	8%
\$750	68	5%
\$1,000	179	14%
\$1,500	145	11%
\$2,000	88	7%
\$2,500	64	5%
\$3,000	208	16%
None of the above	191	15%
I would not participate	175	14%
Sample Total	1267	100%

- Over 40% of respondents indicated a willingness to accept \$1,500 or less to scrap their vehicle

PEV Awareness, Travel Needs and Charging Potential

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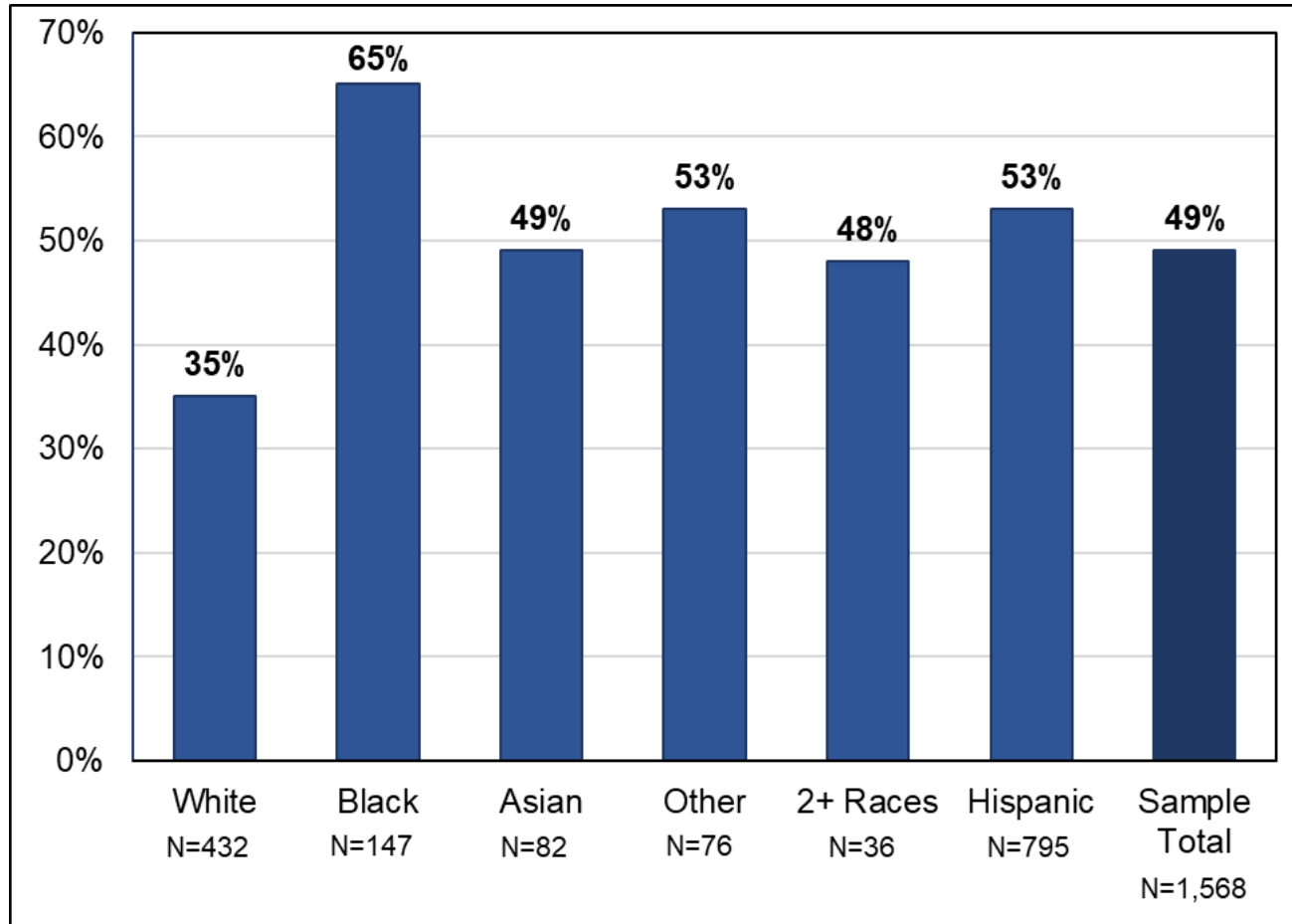
Results: Awareness of PEV Purchase Incentives

AQMD	Bay Area		Sacramento		San Diego		San Joaquin Valley		South Coast		Other		Sample Total	
Awareness Level	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.
	71	42%	24	51%	44	30%	59	32%	261	36%	112	38%	572	36%

- Awareness of PEV rebates varied across AQMDs and by come. 45% of respondents earning more than \$75,000 a year were aware of rebates, compared to 34% of those earning less than \$25,000 a year.

Results: Awareness of PEV Incentives

HOV Lane Access Awareness



- Non-Hispanic Black respondents report nearly double the level of HOV lane awareness than non-Hispanic Whites.

Results: Long-Distance Trips

Frequency of Trips Longer than 100 Miles by Urbanization Geography

	Urban		Suburban		Rural		Total	
	N.	Pct.	N.	Pct.	N.	Pct.	N.	Pct.
Weekly	48	7%	47	7%	9	4%	104	7%
Monthly	197	30%	173	26%	54	25%	425	28%
Yearly	227	34%	238	36%	102	47%	567	37%
Rarely/Never	191	29%	202	31%	54	25%	446	29%
Total	663	100%	660	100%	219	100%	1,541	100%

- The frequency of long trips is important for the feasibility of PEV ownership, as they may exceed or test the electric range of some PEVs. Only 7% of households take a trip exceeding 100 miles on a weekly basis.

Results: PEV Charging Potential at Home

Presence of Electrical Outlet within 25 Feet of Parked Car by Housing Type

	Yes		Total
	N.	Pct	N.
Single Family Detached	530	61%	872
Single Family Attached	87	43%	202
Multi-Unit Dwelling	93	24%	380
Mobile Home	73	76%	97
Boat, RV, Van, etc.	12	88%	13
Total	794	51%	1,564

- Residents of multi-unit dwellings appear to have the lowest charging potential

Review of Results

- Low- and moderate-income households have similar vehicle holdings and travel preferences to higher-income households
- Barriers to preferred transportation access for this population remain
- Incentives (especially rebates) can induce clean vehicle purchase and overcome some of these barriers

Future Research Topics

1. Perceived reliability and costs of operating aging PHEV and BEVs
2. Optimal adjustments to incentive levels overtime
3. Average fuel efficiency of vehicle fleets of household of differing incomes
4. Charging infrastructure needs of low- and moderate- income households
5. Factors explaining new versus used vehicle purchase among moderate and low-income households

Questions?

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