-Growing PEV markets?
-What if you held a transition to electric drive and now one knew?
-How do you think the future happens?
-So, you want 1.5 million ZEVs by 2025
-Stuck in the Slow Lane

STEPs Workshop
Davis, CA
11 December 2018

Ken Kurani
Plug-in Hybrid & Electric Vehicle Center
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University of California, Davis

Wall.

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Brief summary of data sources

2014

- Three surveys
  - All car-owning households, CA: June; November. n ~ 1,700 ea.
  - New-car buyers, CA (and twelve other states): December. CA n~1,700; total n ~5,500
- Regional interviews and workshop with PEV and non-PEV drivers

2017

- Two surveys
  - All car-owning households, California: February, June. n ~ 1,700 ea.

2019

- Two Surveys?
  - All car-owning households, California: January. n ~ 3,600 stratified by AQMDs and APCDs; English and Spanish
  - All car-owning households, ZEV states+: June. CA n ~3,600 stratified by AQMDs and APCDs; total n ~7,200

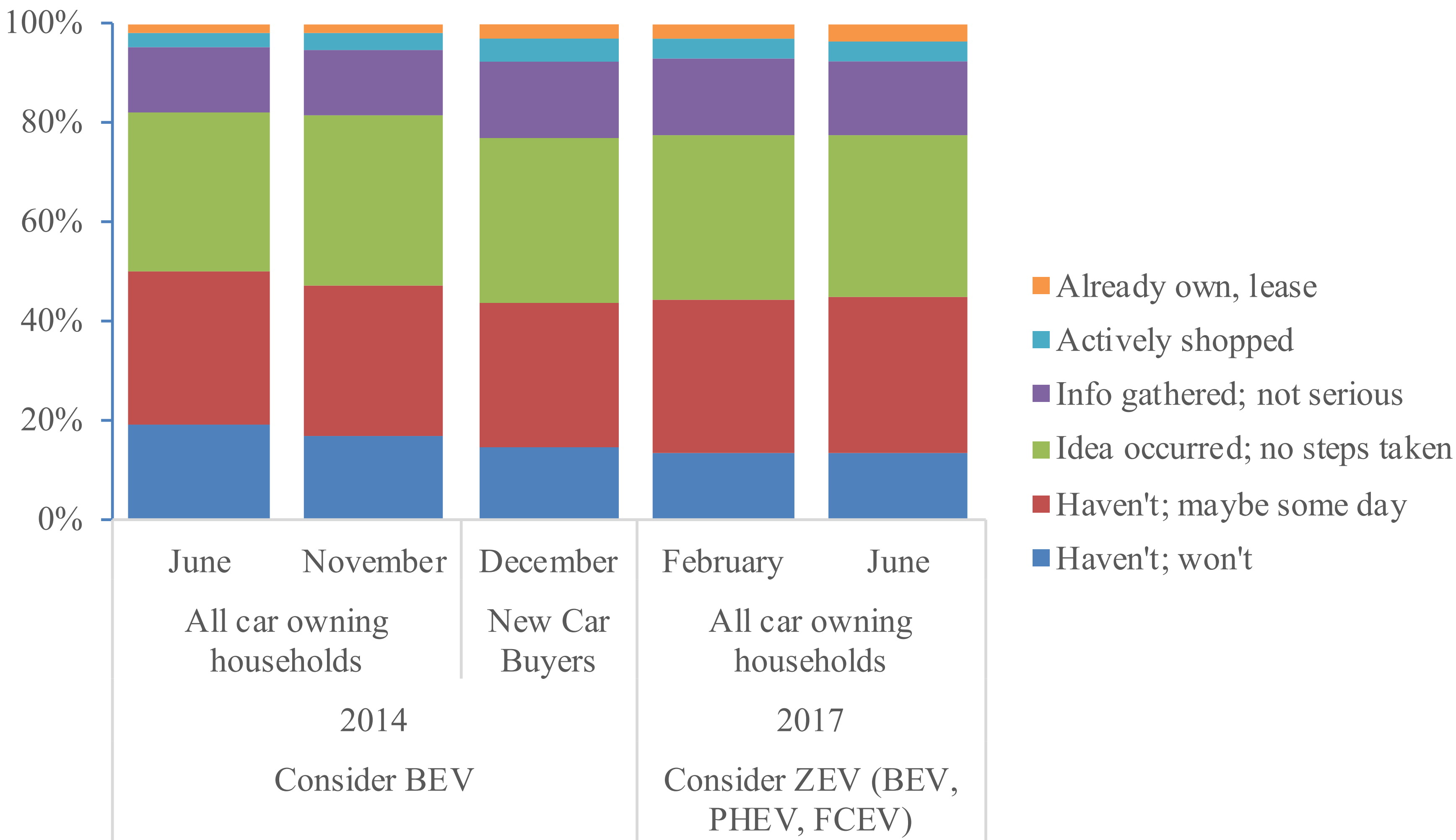
Have car-owning households in California considered ZEVs?

"Battery electric vehicles (BEVs) run only on electricity; they plug-in to charge their batteries. Have you considered buying a BEV for your household?

- ❑ I have not—and would not—consider buying a vehicle that runs on electricity
- ❑ I have not considered buying a vehicle that runs on electricity—but maybe some day will
- ❑ The idea has occurred, but no real steps have been taken to shop for one
- ❑ Started to gather some information, but haven't really gotten serious yet
- ❑ Shopped for an electric vehicle, including a visit to at least one dealership to test drive
- ❑ I already have, or have had, a vehicle powered by electricity"

(Question asked separately for PHEVs, BEVs, and FCEVs in 2017.)

Few; the percentage increases from June 2014 to June 2017 only by specifying PHEVs, BEVs, and FCEVs.



Increasing number of PEV makes and models for sale in consumer retail markets in California

2010 through 2014: **23**

- **10 PHEVs**
- **13 BEVs**

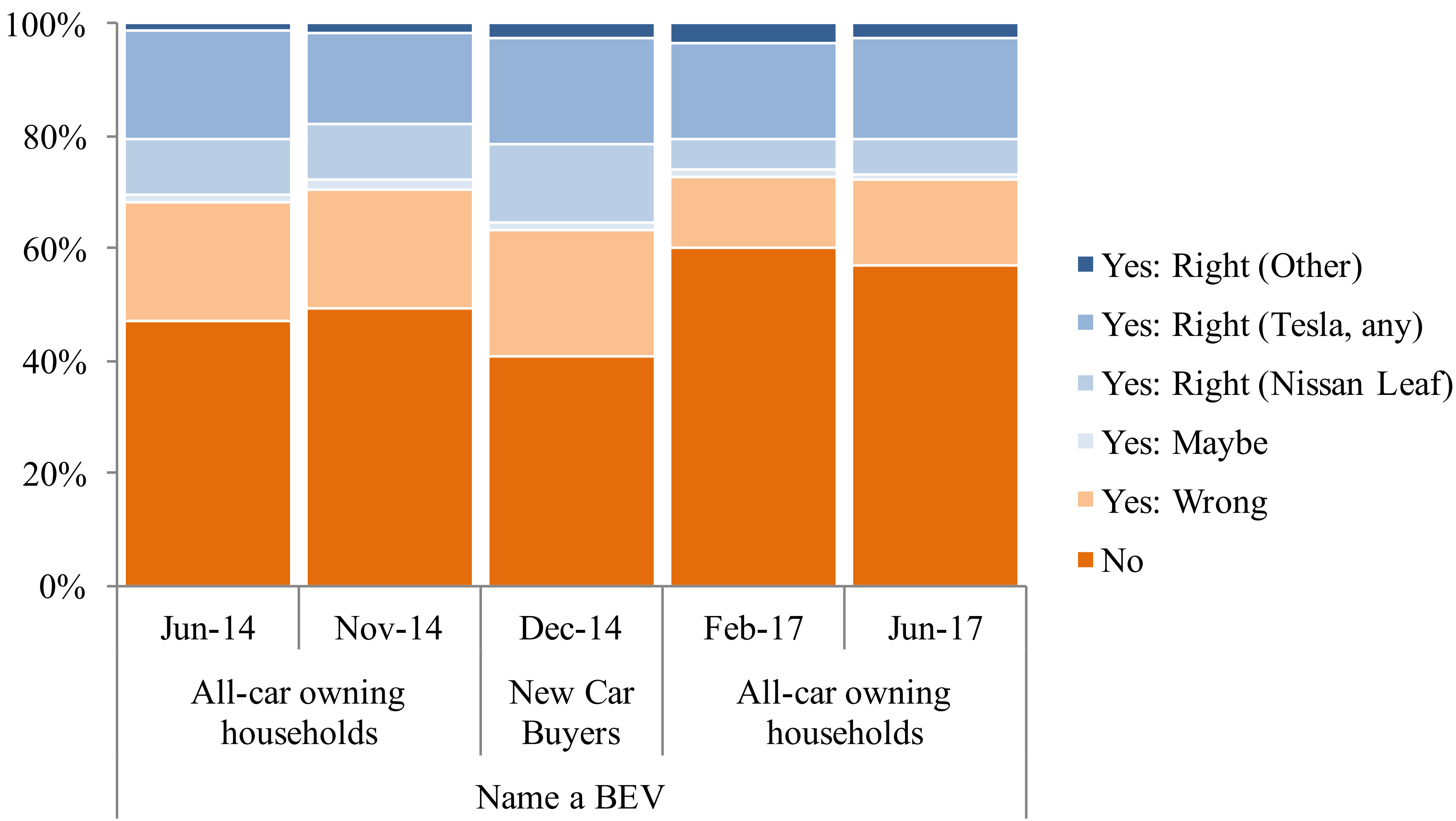
+ 2015 through 2017: **40**

12 PHEVs

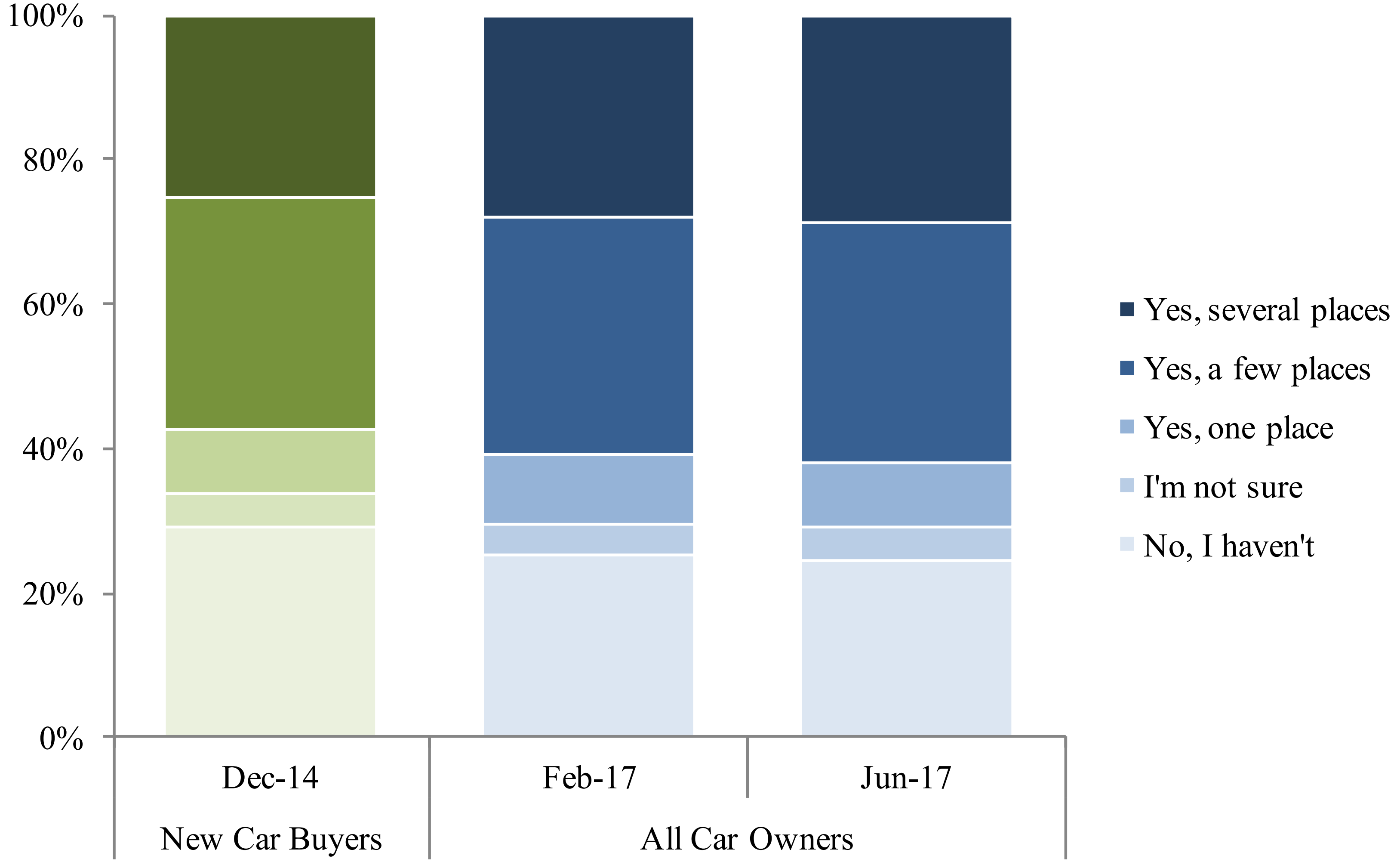
5 BEVs

https://www.driveclean.ca.gov/pev/Plug-in_Electric_Vehicles/Makes_and_Models.php

No increase in the percent of household that can name a BEV or in the variety of BEVs those who can, do name



"Have you seen any electric vehicle charging spots in the parking garages and lots you use?"

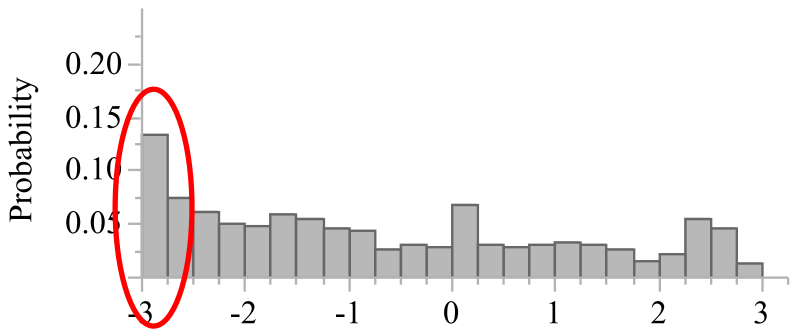


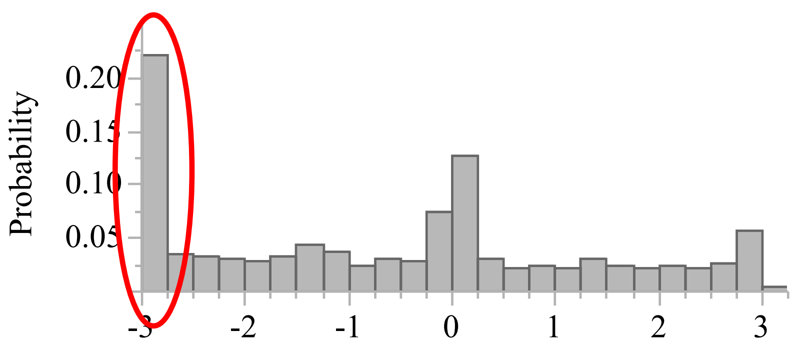
Three years of PEV charging infrastructure deployment: Percent of people who strongly disagree there is enough doubled.

June 2014 (top)
June 2017 (bottom)

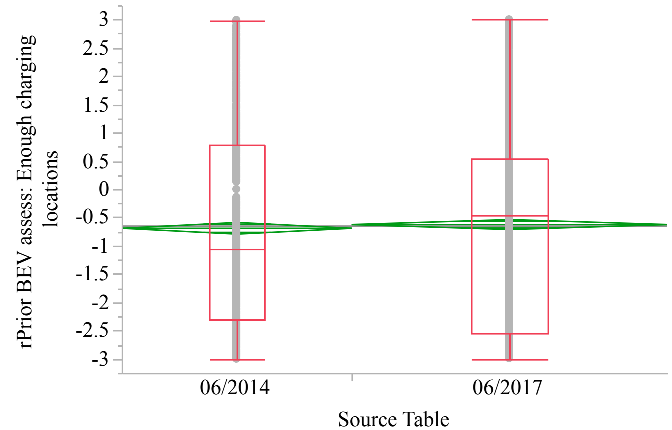
"There are enough places to charge battery electric vehicles."

Scale: -3 = strongly disagree; 3 = strongly agree





On average, slight disagreement there are enough; **No difference in means**

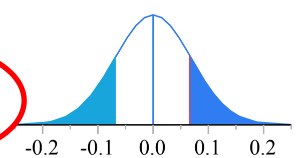


t Test

06/2017-06/2014

Assuming equal variances

Difference	0.06609	t Ratio	0.959362
Std Err Dif	0.06888	DF	2939
Upper CL Dif	0.20115	Prob > |t|	0.3375
Lower CL Dif	-0.06898	Prob > t	0.1687
Confidence	0.95	Prob < t	0.8313



Analysis of Variance

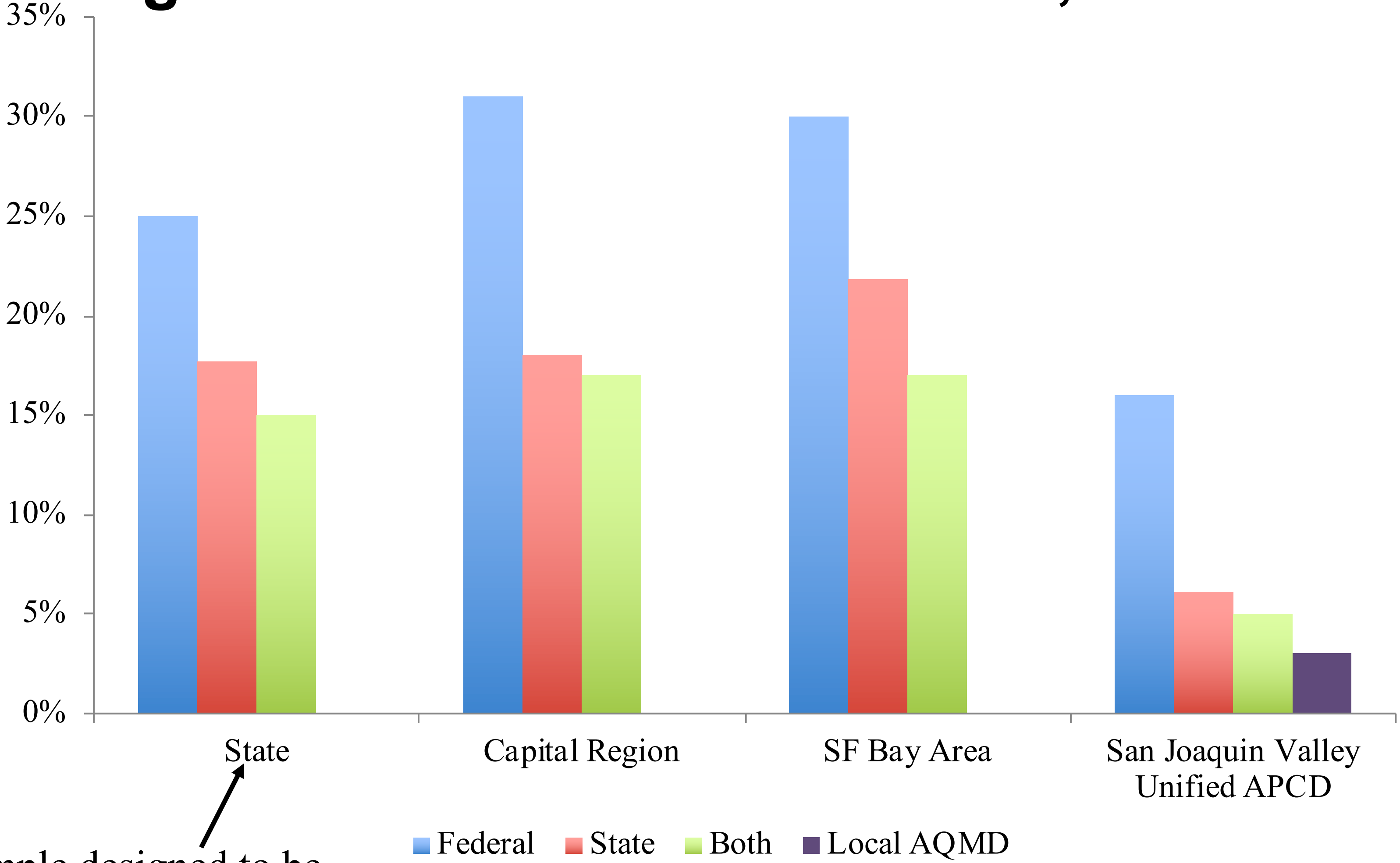
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Source Table	1	3.1294	3.12939	0.9204	0.3375
Error	2939	9992.9560	3.40012		
C. Total	2940	9996.0854			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
06/2014	1236	-0.68080	0.05245	-0.7836	-0.5780
06/2017	1705	-0.61472	0.04466	-0.7023	-0.5272

Std Error uses a pooled estimate of error variance

More and higher public incentives aren't linked to higher awareness of incentives, June 2014



Sample designed to be representative at state level.

Why Sample by AQMDs and APCDs in 2019?

Household Income	California	Bay Area AQMD	San Joaquin APCD	Balance of State
$0 to 49,999	34%	22%	46%	34%
$50,000 to 99,999	36%	32%	35%	36%
$100,000 to 149,999	18%	22%	12%	18%
$150,000 to 199,999	7%	12%	4%	7%
$200,000 to 249,999	3%	6%	1%	3%
$250,000 or more	2%	6%	1%	2%
		~1 out of 4	~1 out of 24	~1 out of 8

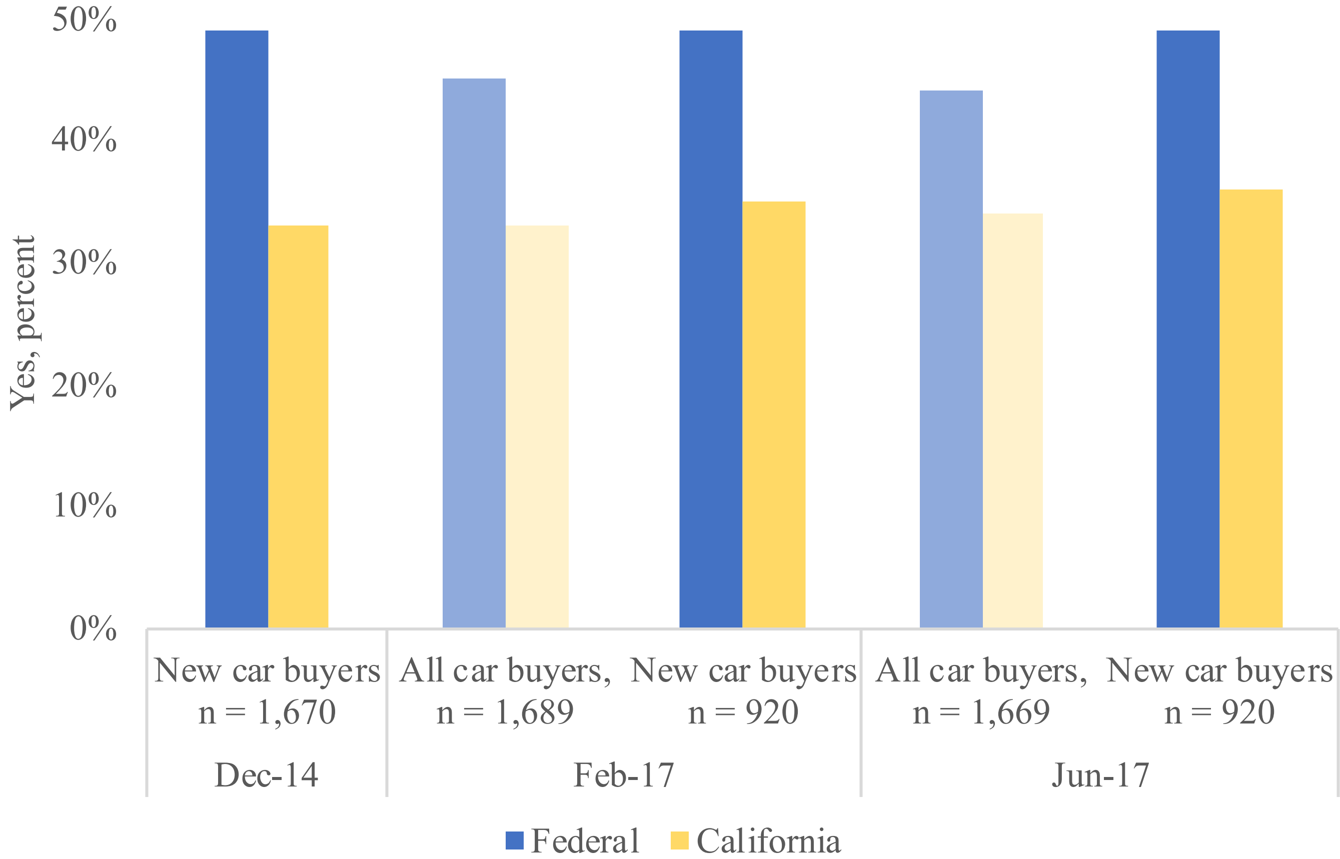
Why Sample by AQMDs and APCDs in 2019?
(circa early 2014)

	Fresno	Sacramento	Santa Clara	California
PEV/1000 people	**0.49**	**0.97**	**5.54**	**1.80**
Public Level 2 and Quick charge locations	Level 2: **5** Quick charge: **0**	Level 2: **74** Quick charge: **4**	Level 2: **142** Quick charge: **18**	Level 2: 1,703 Quick charge: 162
Median income, 2008-2012	**$45,741**	**$55,846**	**$90,747**	State: $61,400
Bachelor's degree or higher, % of persons age 25+, 2008-2012	**19.4** CVR recipients: 71	**27.9** CVR recipients: 81	**46.0** CVR recipients: 90	State: 30.5 CVR recipients: 83
Homeownership, 2008-2012, %	**54.2** CVR recipients: 92	**57.6** CVR recipients: 93	**58.1** CVR recipients: 89	State: 56.0 CVR recipients: 87
Female, %	**50.0** CVR recipients: 23	**51.1** CVR recipients: 24	49.7 CVR recipients: 24	State: 50.3 CVR recipients: 24

Convening conversations among PEV and ICEV owners

- Despite living in the same geographic region, PEV and ICEV drivers experience a different landscape
  - PEV drivers see signs of everywhere
  - ICEV drivers don't see these signs anywhere
- ICEV Drivers' questions included:
  - Purchase costs; benefits of driving a PEV
  - No questions about incentives because they don't know they exist; few questions about infrastructure,
- PEV Drivers respond
  - Accounts of saving money
    - Incentives and rebates; Free public charging; Electricity cheaper than gasoline
  - The finer points of recharging and BEVs vs. PHEVs
  - Social benefits
    - Air pollution; Dependence on foreign oil
    - Disavowal of environmental motivations by PEV owners in Fresno

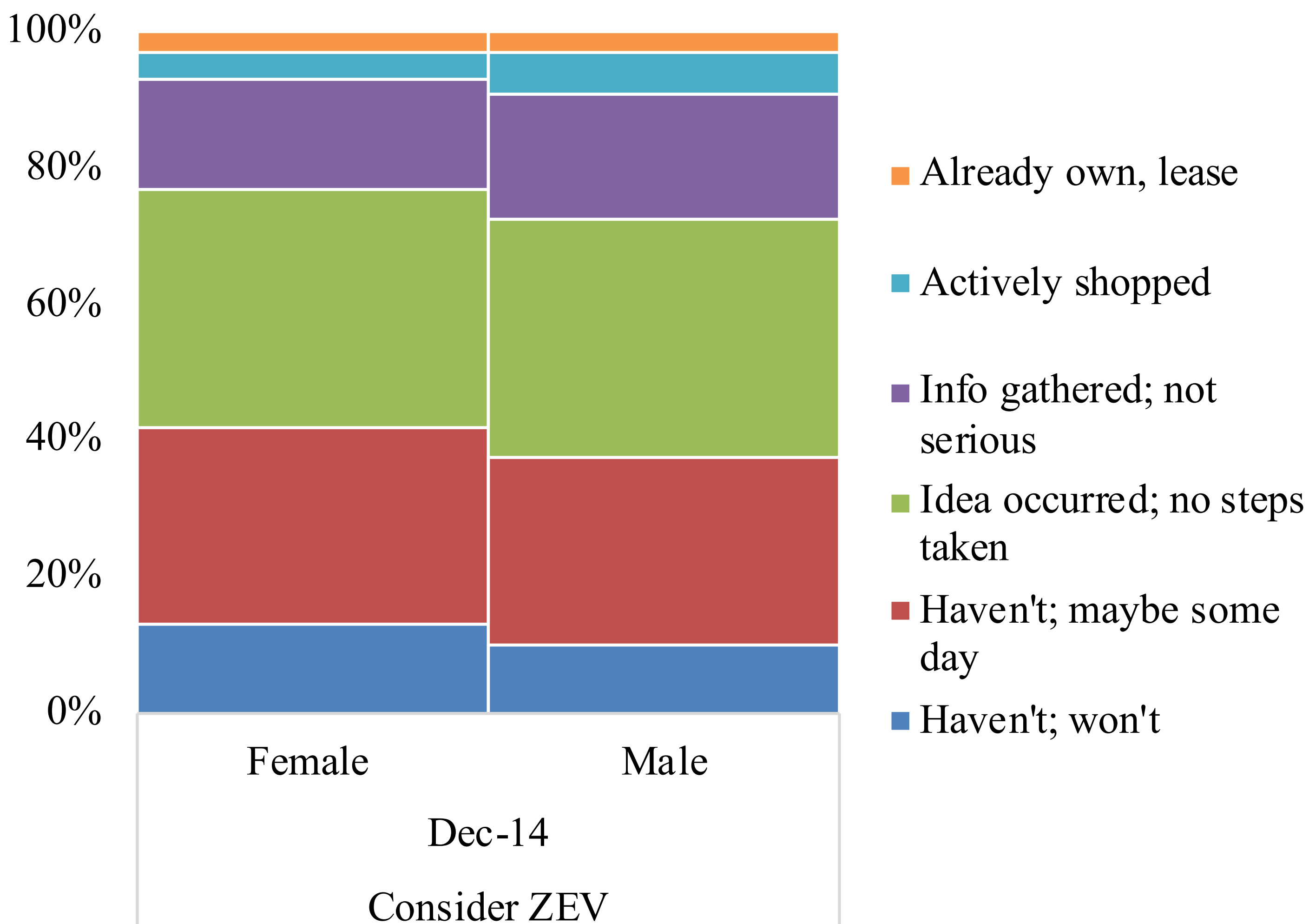
No increase in awareness of incentives from 2014 to 2017



"As far as you are aware, is each of the following offering incentives to consumers to buy and drive vehicles powered by alternatives to gasoline and diesel?"

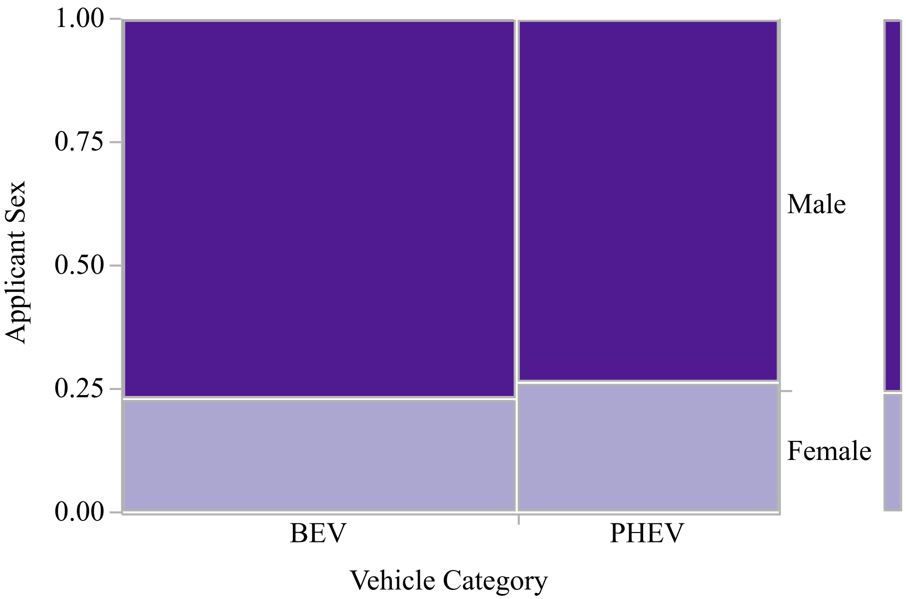
Differences between women and men extend to awareness of incentives

Among *CA new car buyers* (12/2014), females may have been more likely to be at lower levels of ZEV consideration than males ($\alpha < 0.10$)

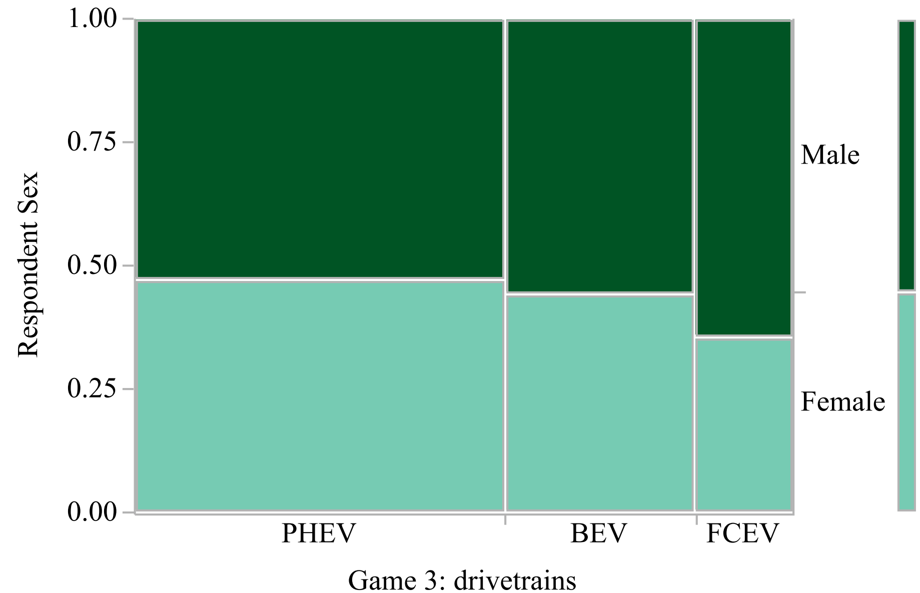


We're hardwiring gender differences in markets for ZEVs, but we don't have to

California Clean Vehicle Rebate Applicants, 9/1/12 to 5/31/2015



New-car buyers, CA; 12/2014; "ZEV designers"



Center for Sustainable Energy (2016). California Air Resources Board Clean Vehicle Rebate Project, EV Consumer Survey Dashboard. Retrieved 9/29/2017 from http://cleanvehiclerebate.org/survey-dashboard/ev.

Female and male respondents differ in how they talk about ZEVs and, for example, the environment (CA new car buyers 12/2014)

Females: Responsibility

"It's time to change how we harm our environment and the people on the planet. Simple remedies will help if each person takes the step necessary."

"I do hope the automobile companies head toward making better cars using safer fuels for the environment soon."

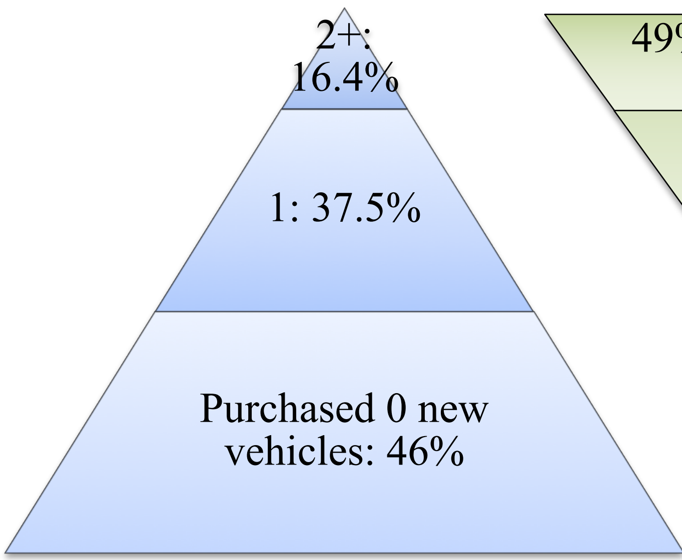
Males: Credibility

"My concerns about all-electric vehicles are that the pollution created by the generation of electricity may be far greater than the pollution generated by high-efficiency automobiles."

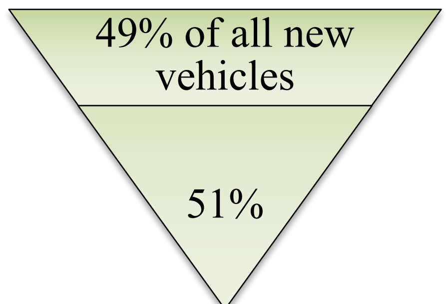
"You talk about 100% renewable zero pollutant generated. If we did ever go to an all-electric car we would obviously plug into our house where 98% of our electricity comes from solar panels."

Can we get to 5 million ZEV sales by 2030 if we don't get beyond ~8% of new car buyers already paying attention?

Households purchasing new vehicles, %



New Vehicles purchased, %



- Only if all these are true:
  - Every ZEV sold since 2010 stays on the road until 2030
  - The more than half of the 8% paying attention who shopped for a ZEV but did not buy one, start buying ZEVs today
  - Once any household starts buying ZEVs they buy nothing but ZEVs
  - All ZEV buyers are those who buy the most vehicles

Or, we engage the other 92 to 95 percent of households in the ZEV transition

- In the absence of *engagement*, more of the same may be necessary, but seems unlikely to be sufficient.
  - Financial incentives, infrastructure deployment, increasing variety of makes and models, and declining prices still leave ZEVs as **unknowns**.
- Californians are not deciding they don't want ZEVs;
  Californians are not asking whether they want one.
  1. **Unaware**: Simply don't know PEVs are a possibility
  2. **Unengaged**: Have no impetus to solve even their first (imagined) problem with PEVs; no initiative to ask what other barriers or benefits might be.
- Campaigns to create awareness *and* engagement with the transition.

  "Why are we even talking about electric cars? Cars and trucks are fine."

"It takes two good reasons to buy a PEV and one flimsy excuse not to."—Gil Tal

- PEV and ICEVs/HEV buyers are answering different questions
  - PEV buyers: **"How do I get a PEV?"**
  - ICEV/HEV buyers: **"Why would I buy a PEV?"**
    - Notably, many had not considered this question until the interview
- PEV buyers were engaged
  - They had the impetus to solve one problem and move on to solve the next until they owned a PEV
- ICEV/HEV buyers were either…
  1. **Unaware**: Simply don't know PEVs were a possibility, or
  2. **Unengaged**: Had no impetus to solve even their first (imagined) problem with PEVs; no impetus to explore any other problems.

With thanks to participants and funders…

- California Energy Commission and Sustainable Transportation Energy Pathways
  - 2014 Surveys of California Car-owning households
  - Regional PEV and non-PEV driver workshops
- California Energy Commission and National Center for Sustainable Transportation
  - 2017 Surveys of California Car-owning households
- California Air Resources Board
  - 2014-15 Survey and interviews of California New-car buying households
- National Center for Sustainable Transportation
  - Gender research: re-analysis of data