The Dynamics of Plug-in Electric Vehicles in the Secondary Market

Dr. Gil Tal gtal@ucdavis.edu

Dr. Tom Turrentine

Dr. Mike Nicholas

UCDAVIS

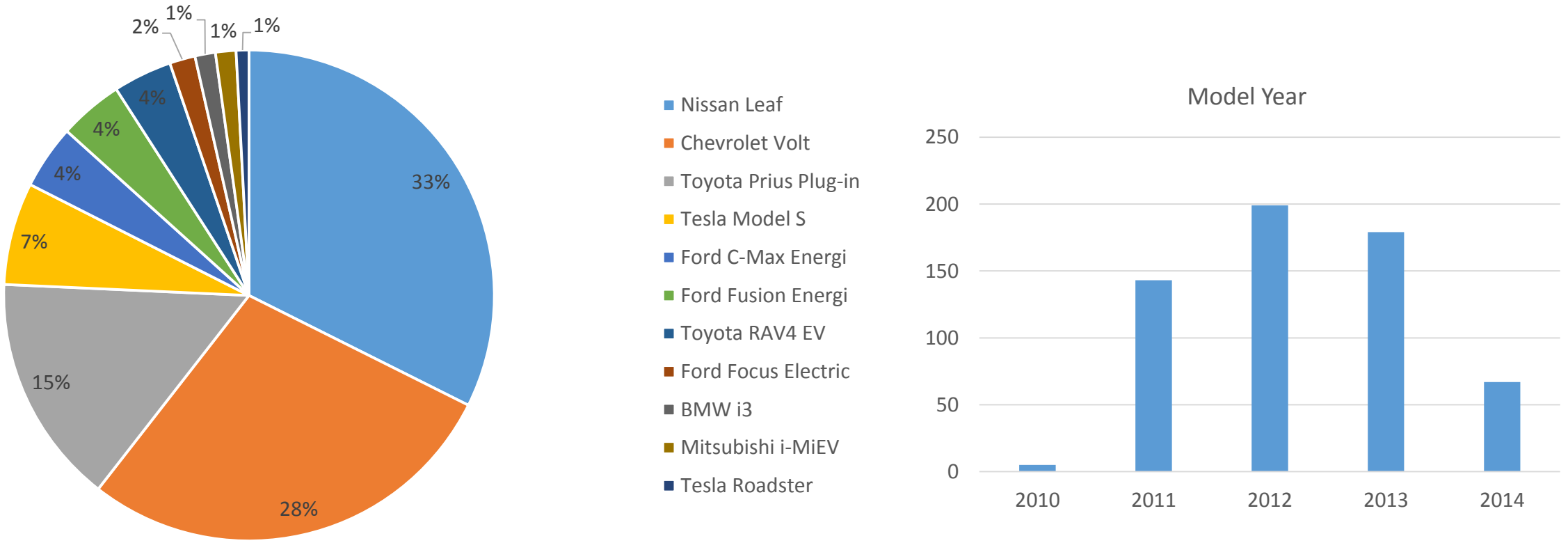
PLUG-IN HYBRID & ELECTRIC VEHICLE RESEARCH CENTER

of the Institute of Transportation Studies

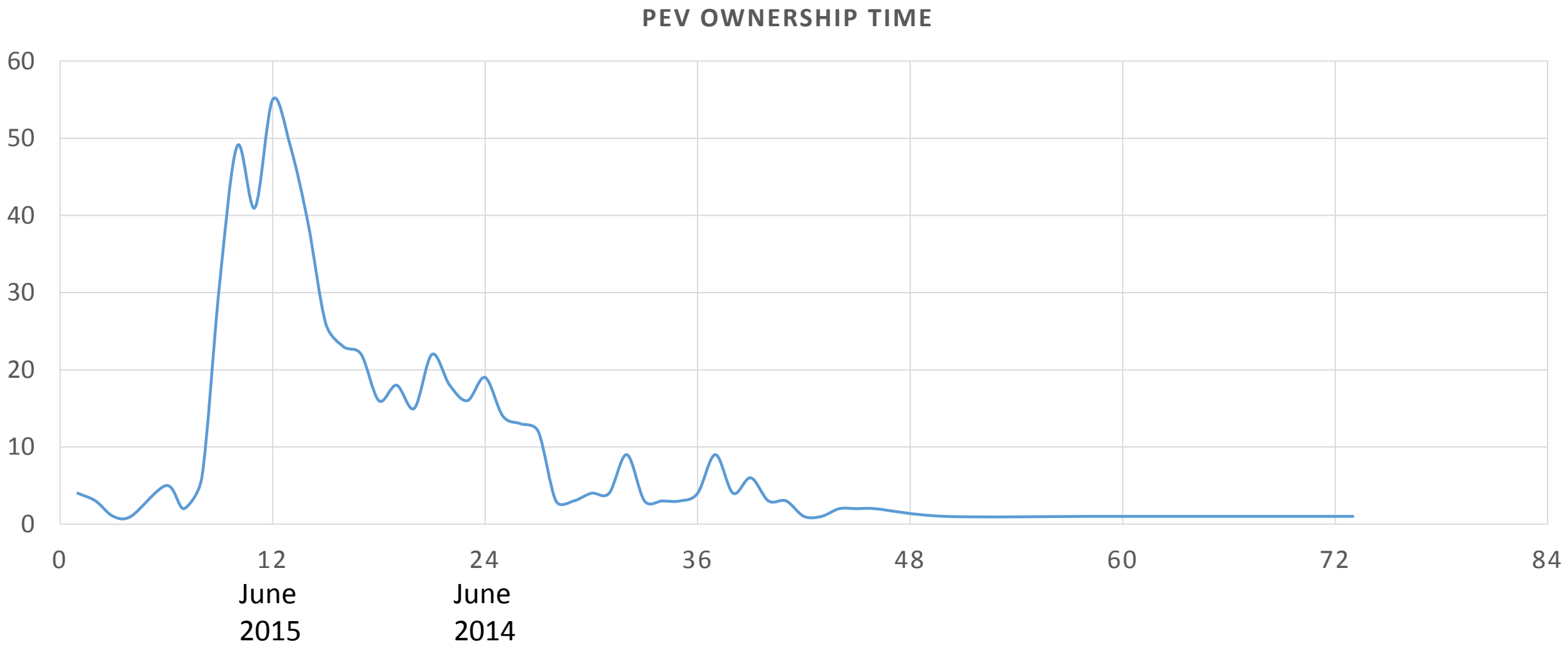
Sponsored by the
California Air Resources Board

Population and Sampling

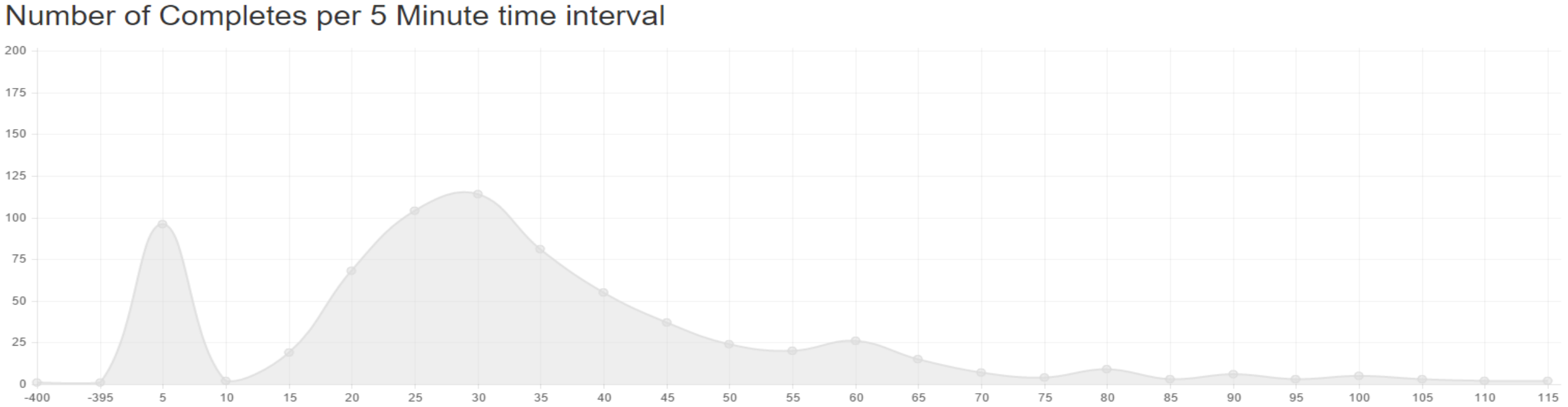
Used PEVs in DMV records	~14000		
Invitations letters	4700		
Address problem	183		
Started	913	Response rate	20%
Purchased used	732	Used owners response rate	17%
Purchased from lease	52		
Finished usable	602	Completion rate	82%
		of all invitations	**13%**

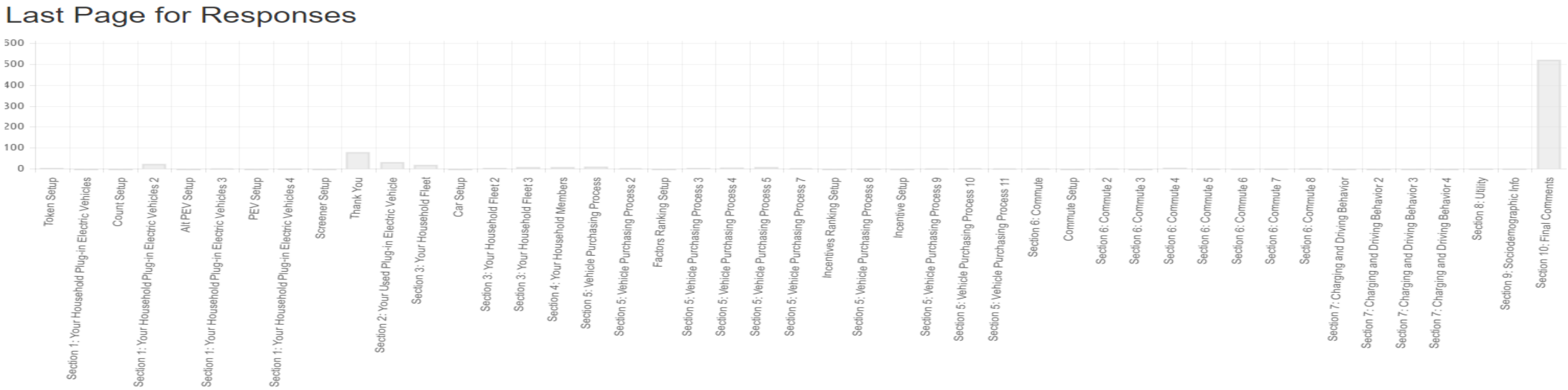


We only use households with some experience, our data is “old”



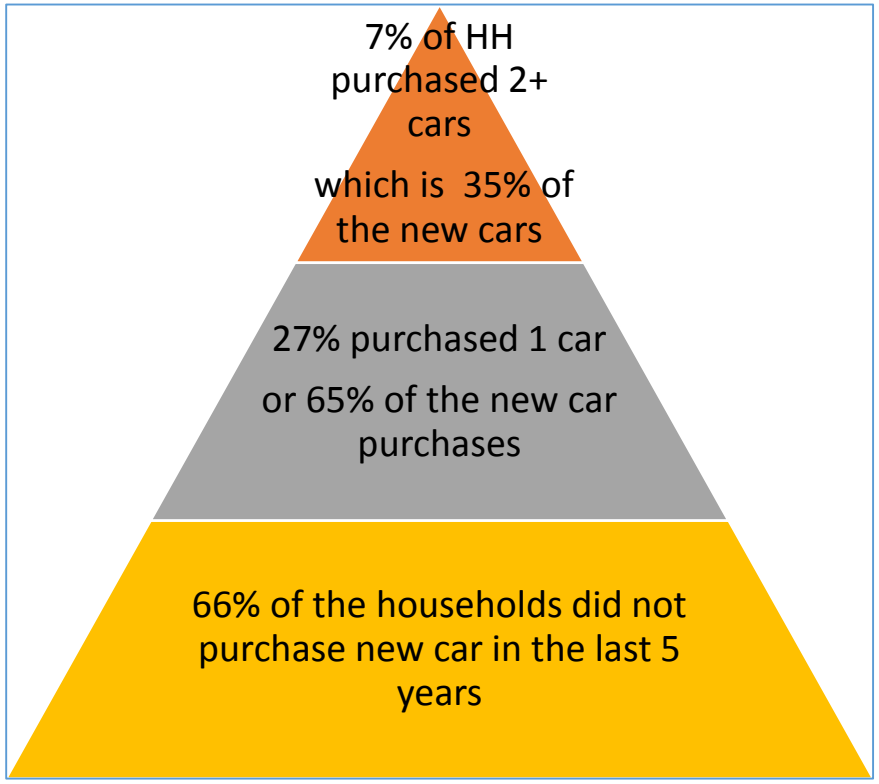
Completion Time and Drop Rates



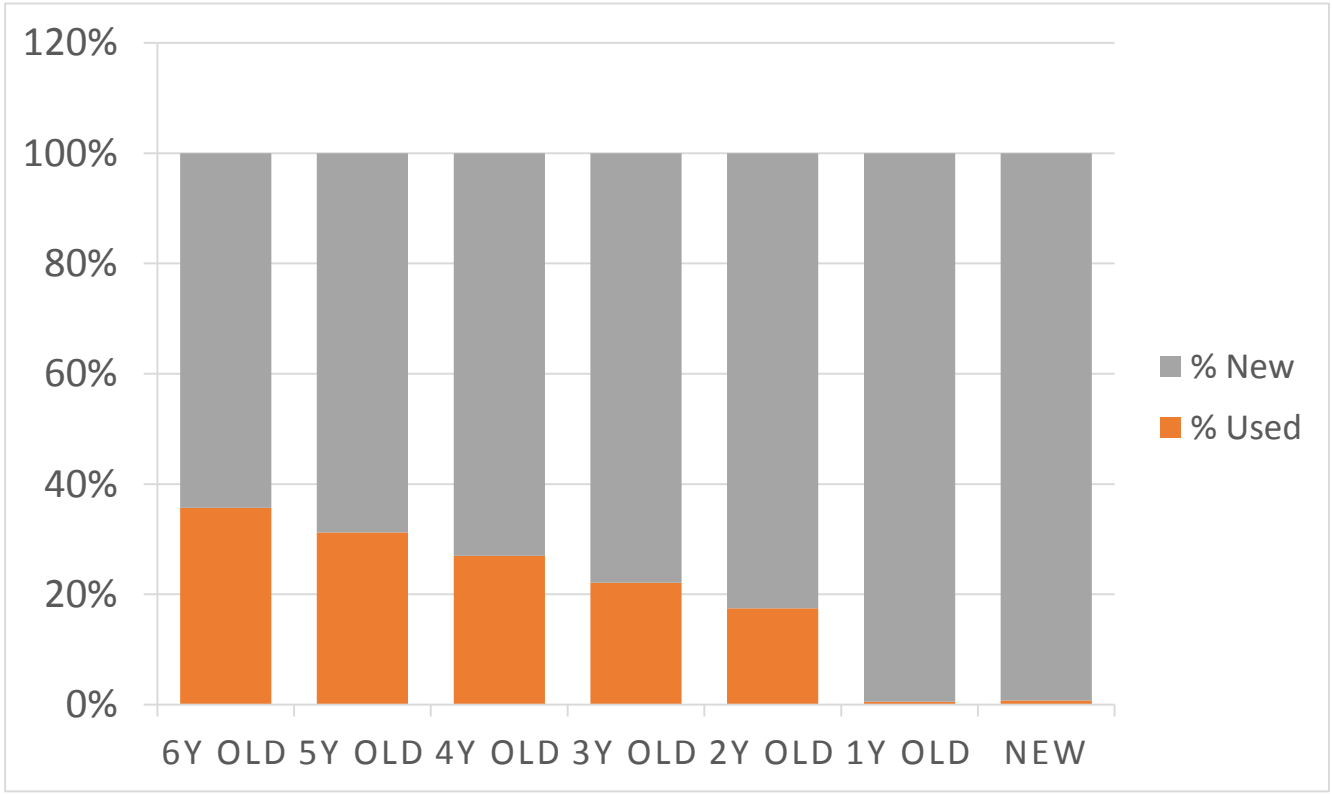


Who Sells Used PEVs?

New and Used Vehicles in California

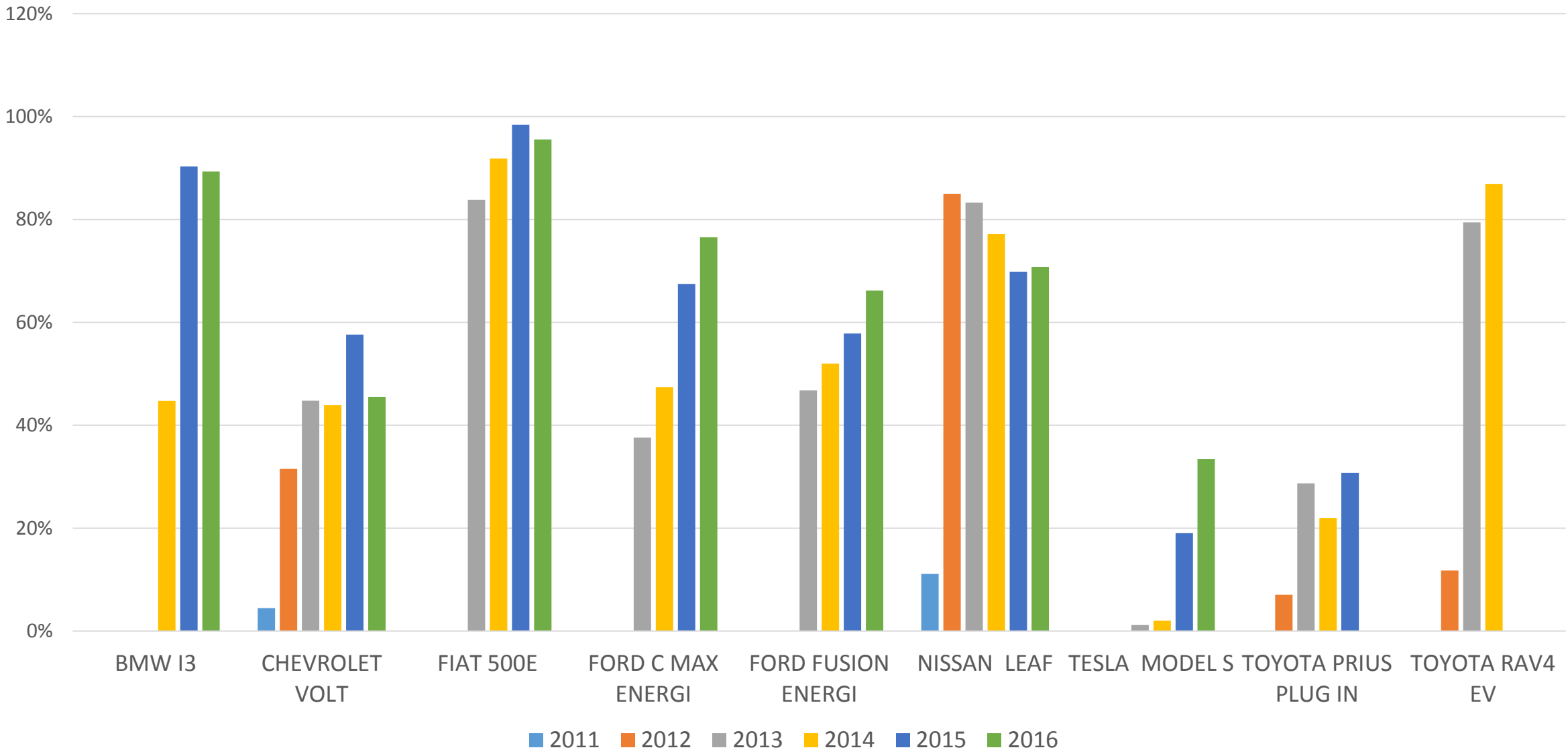


New Vehicle (ICE) Buyers in California



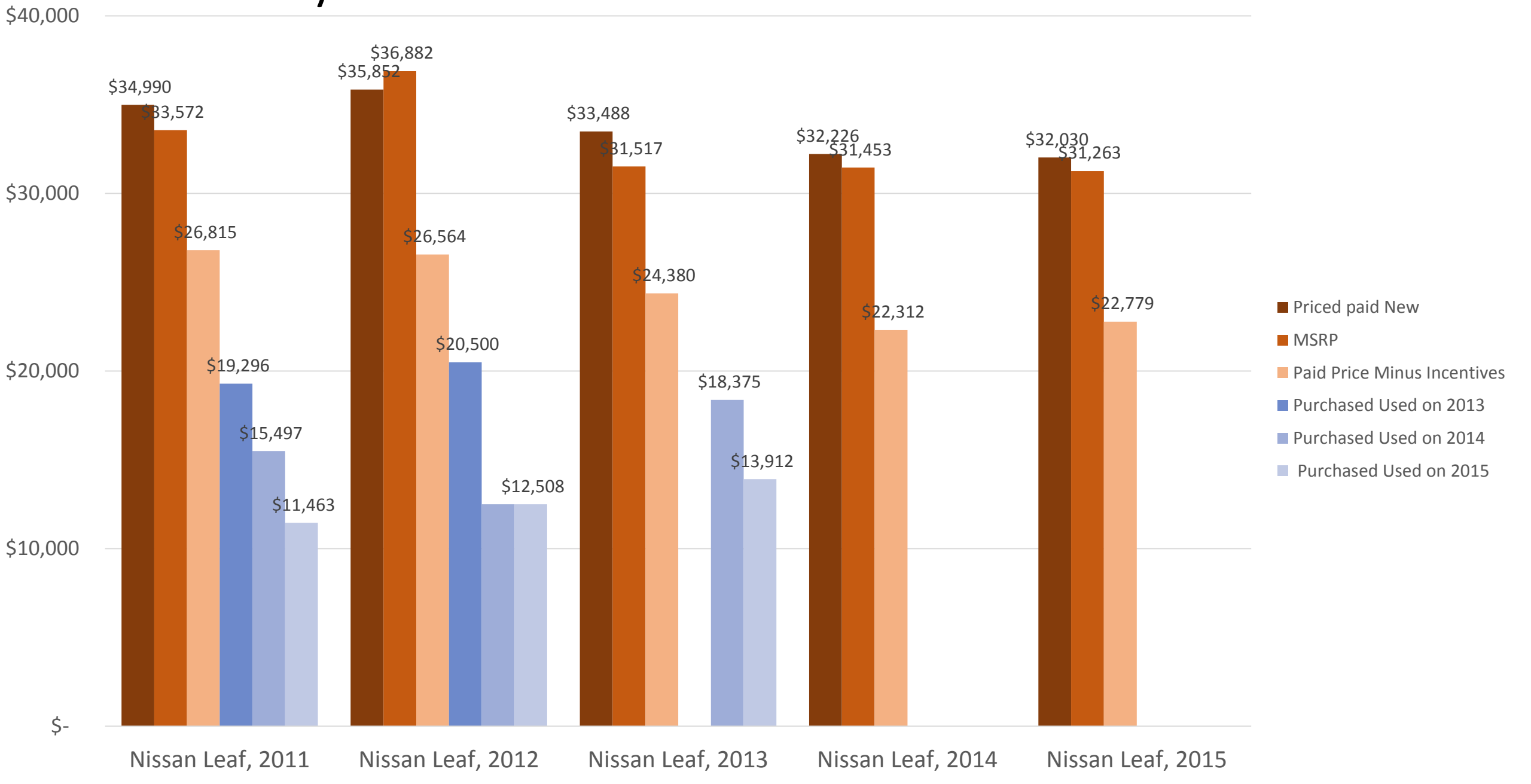
Ownership Status by Model Year

Share of Leased New PEVs



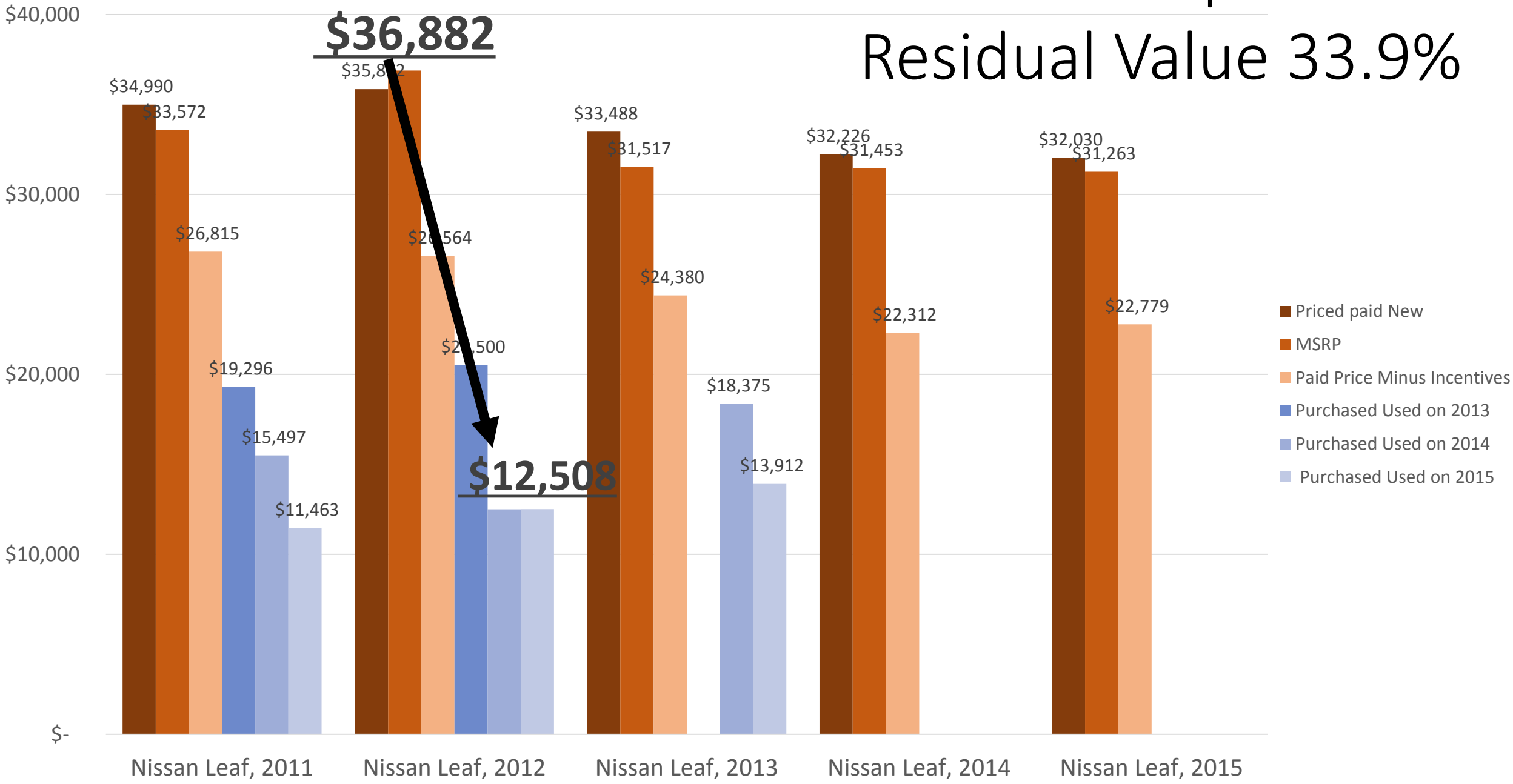
Used PEV Pricing

Price by Model Year and Purchase Year



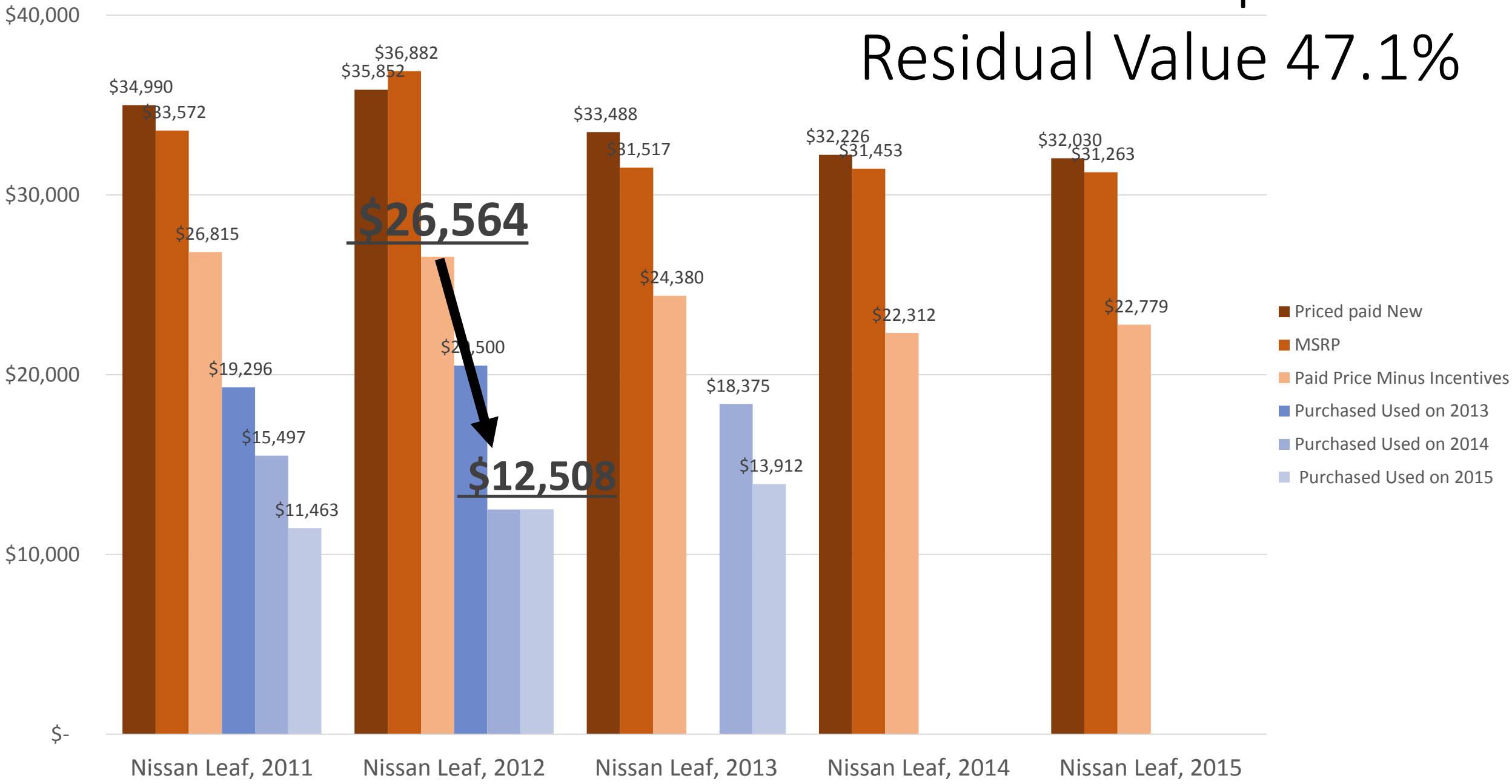
2012 LEAF Sold in 2015: The OEM Perspective

Residual Value 33.9%



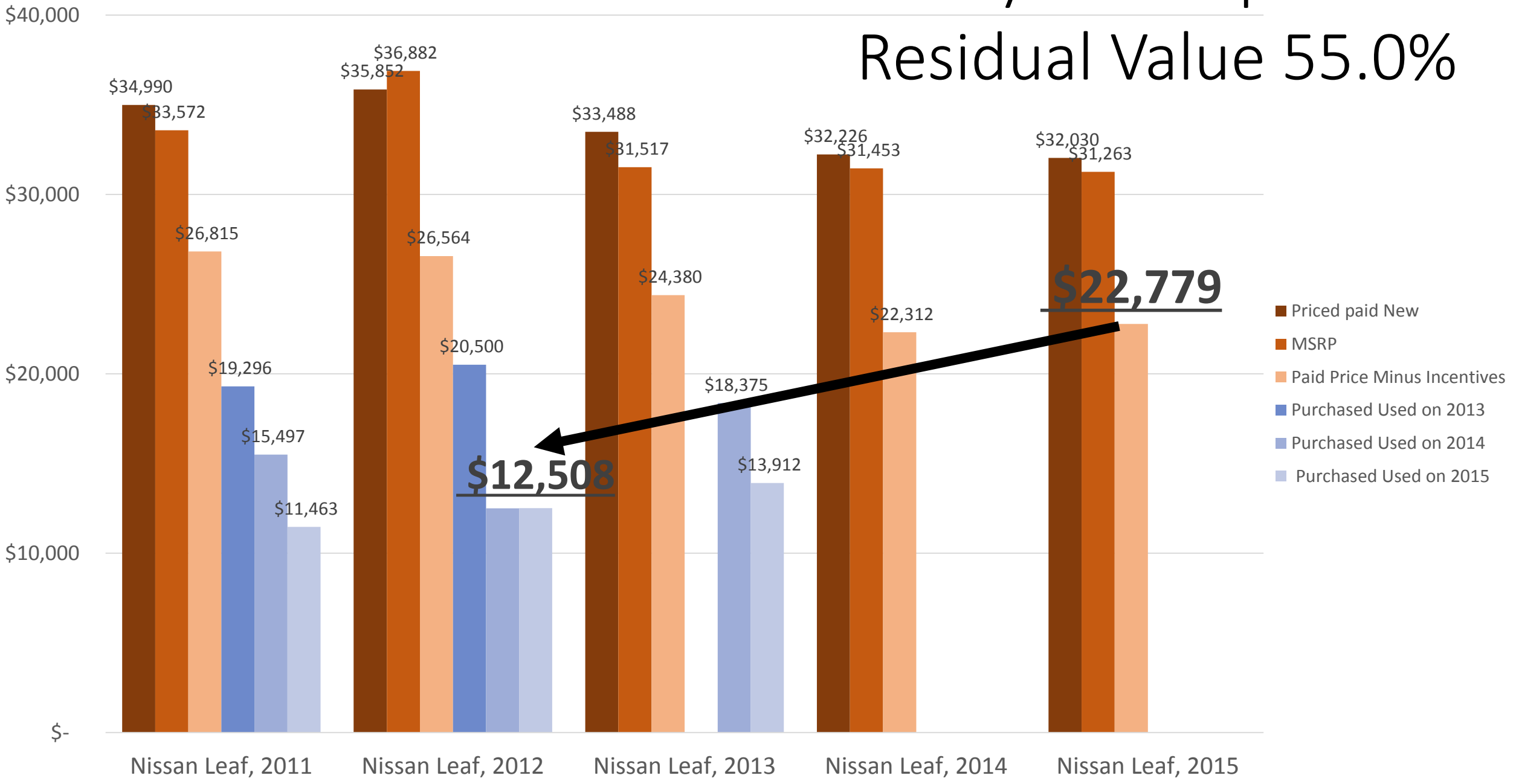
2012 LEAF Sold in 2015: The Seller Perspective

Residual Value 47.1%



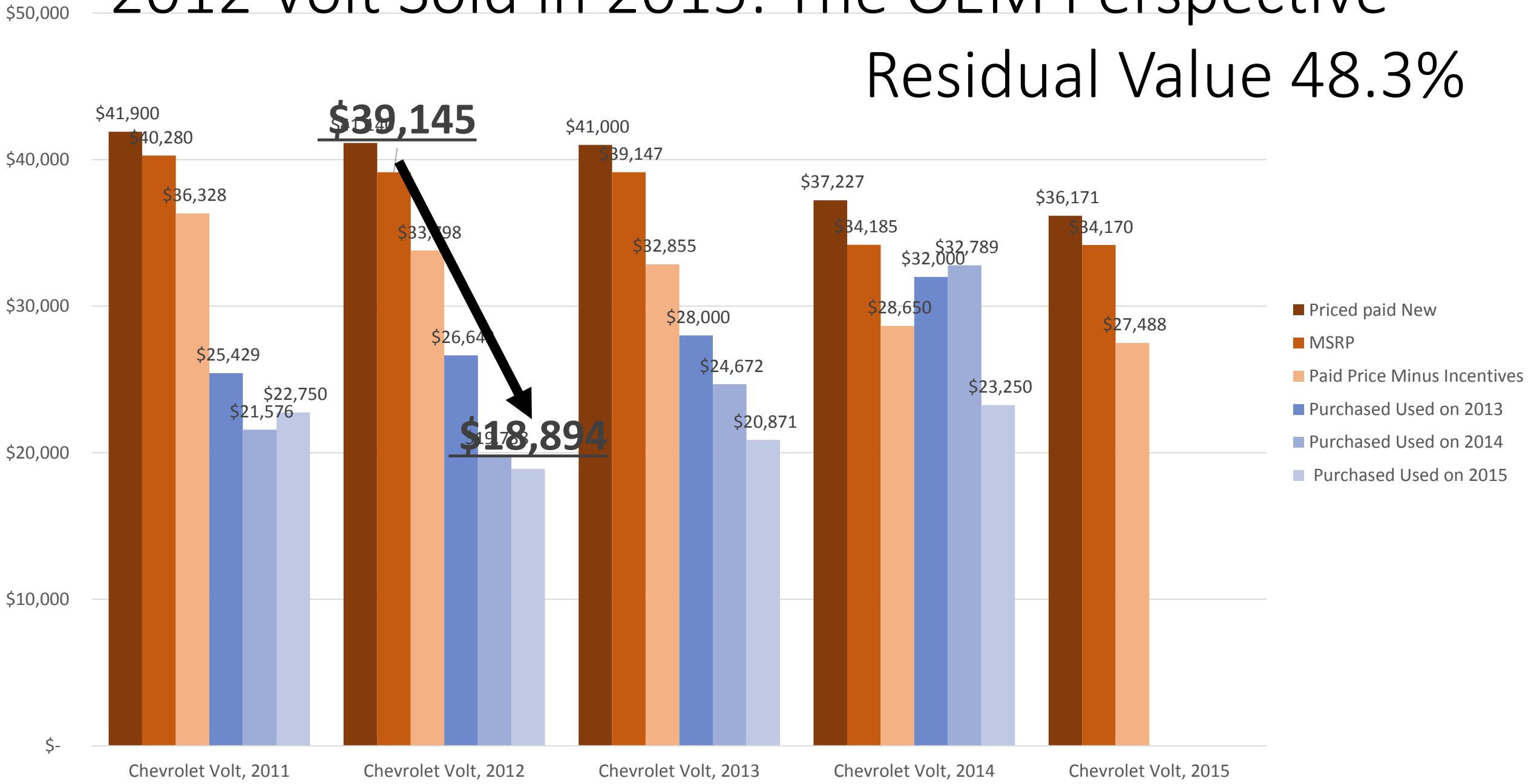
2012 LEAF Sold in 2015: The Buyer Perspective

Residual Value 55.0%



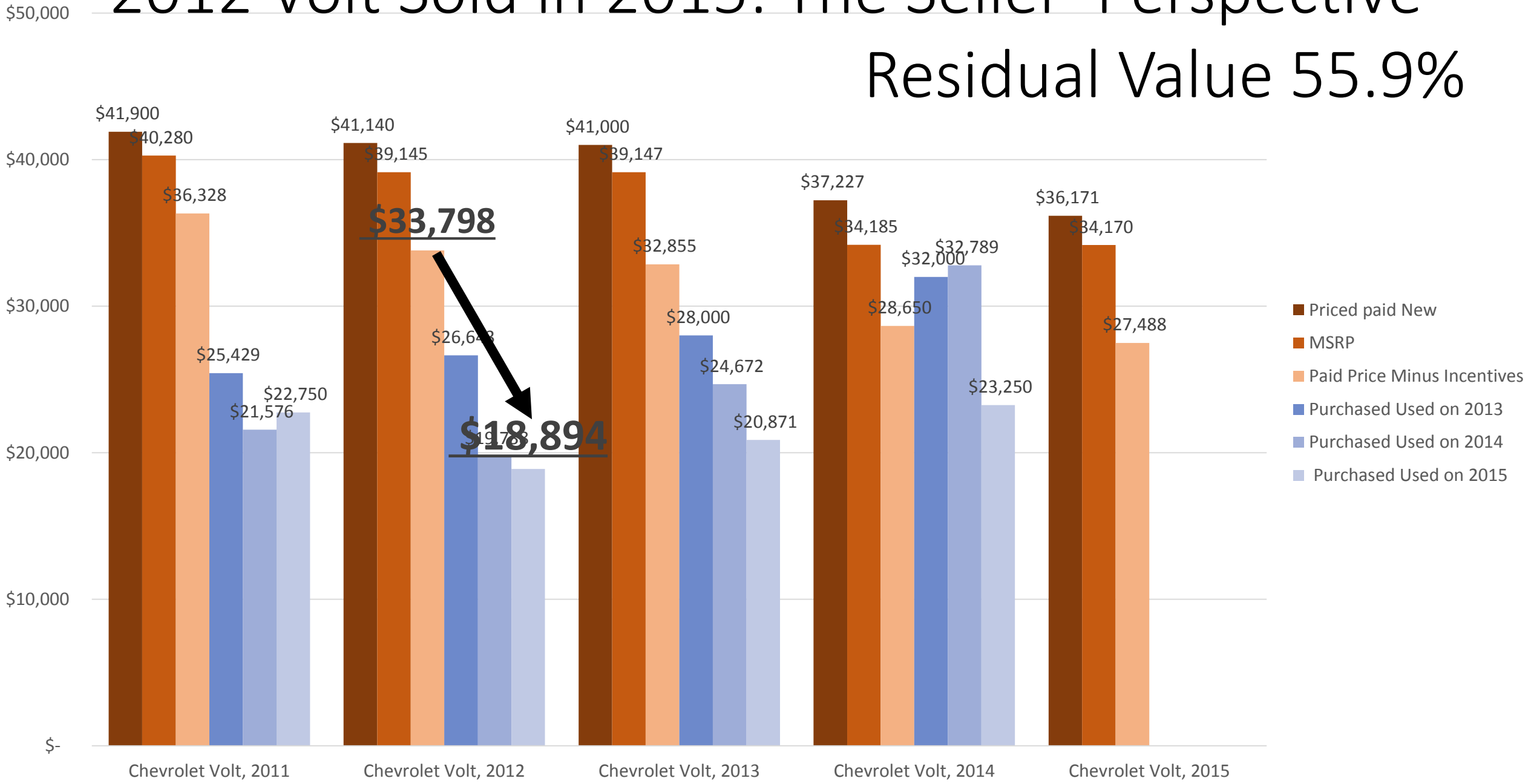
2012 Volt Sold in 2015: The OEM Perspective

Residual Value 48.3%



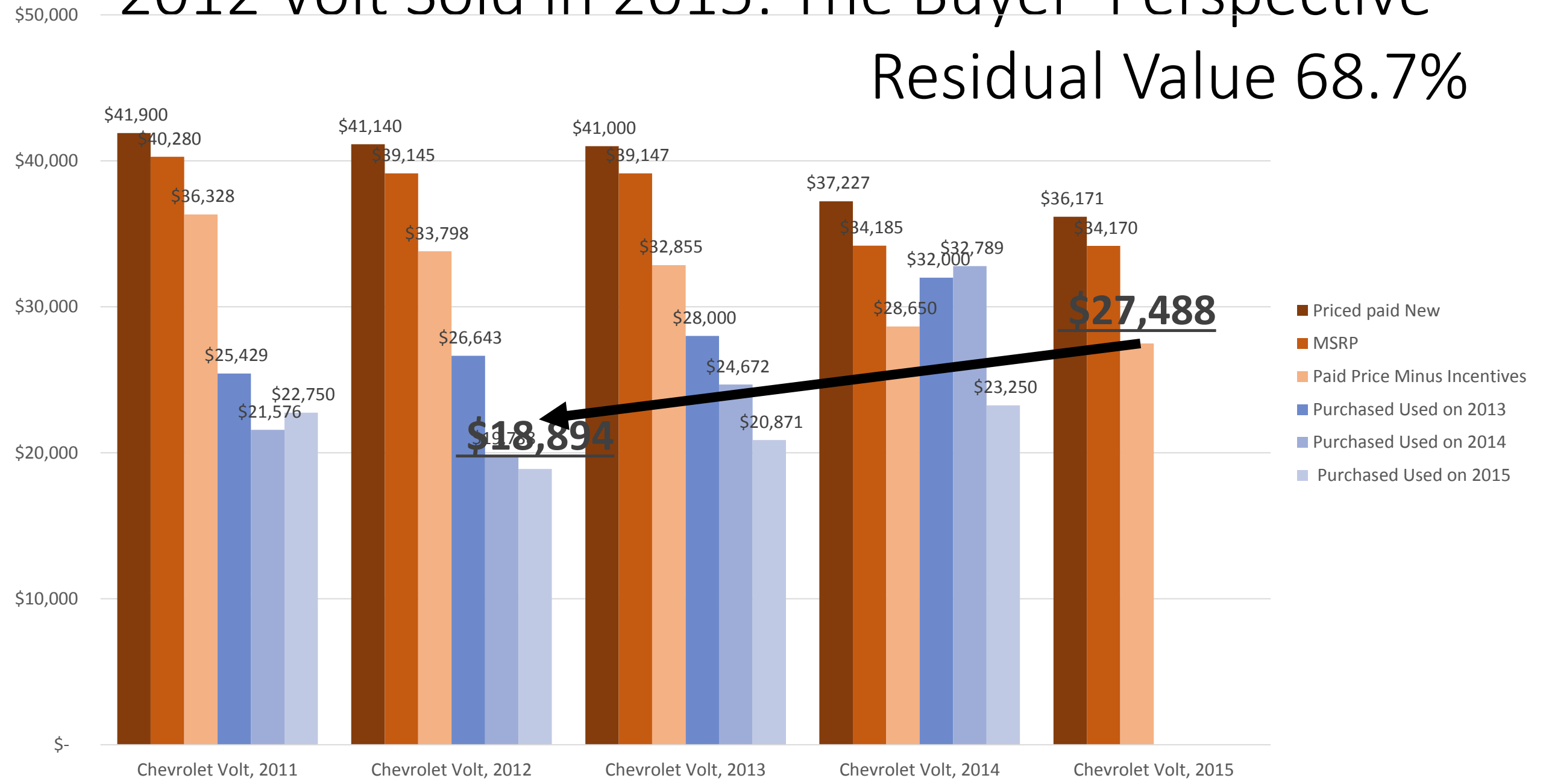
2012 Volt Sold in 2015: The Seller Perspective

Residual Value 55.9%

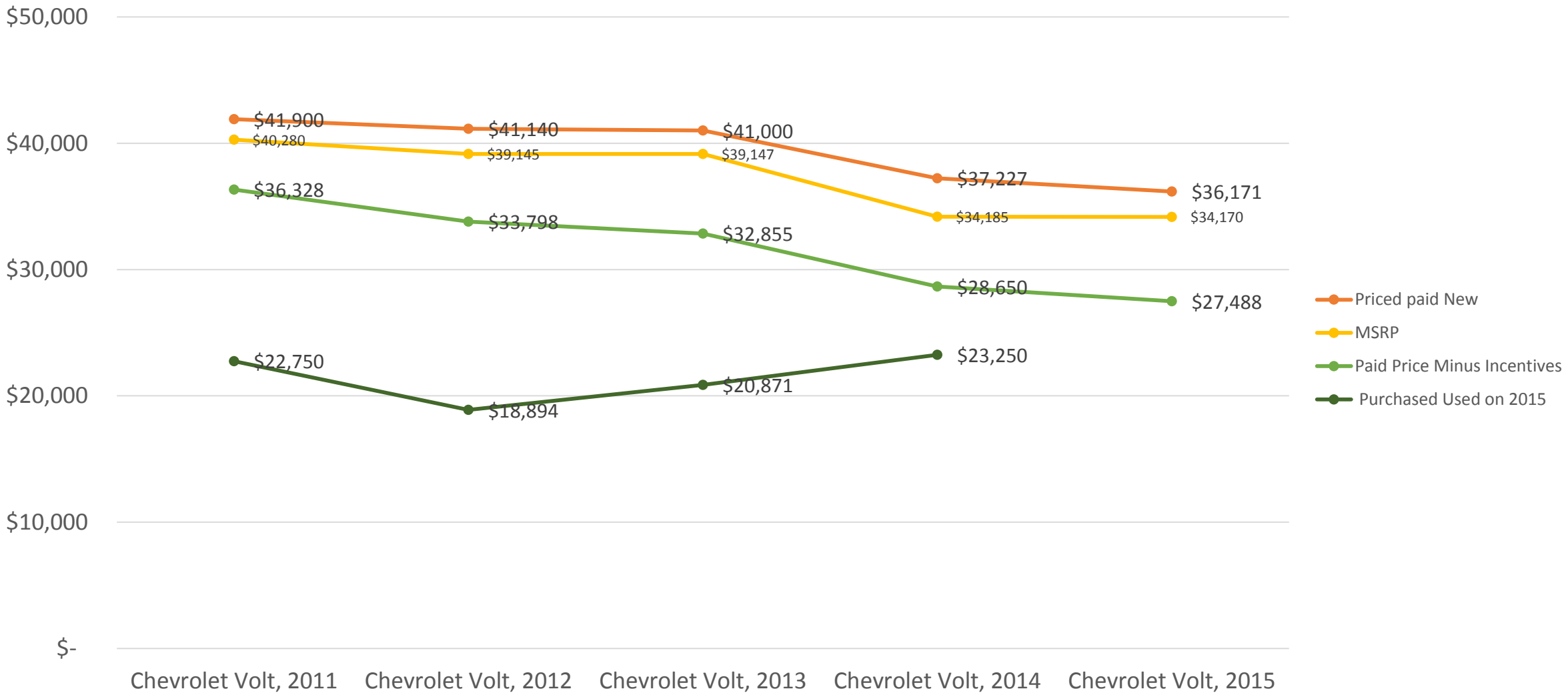


2012 Volt Sold in 2015: The Buyer Perspective

Residual Value 68.7%



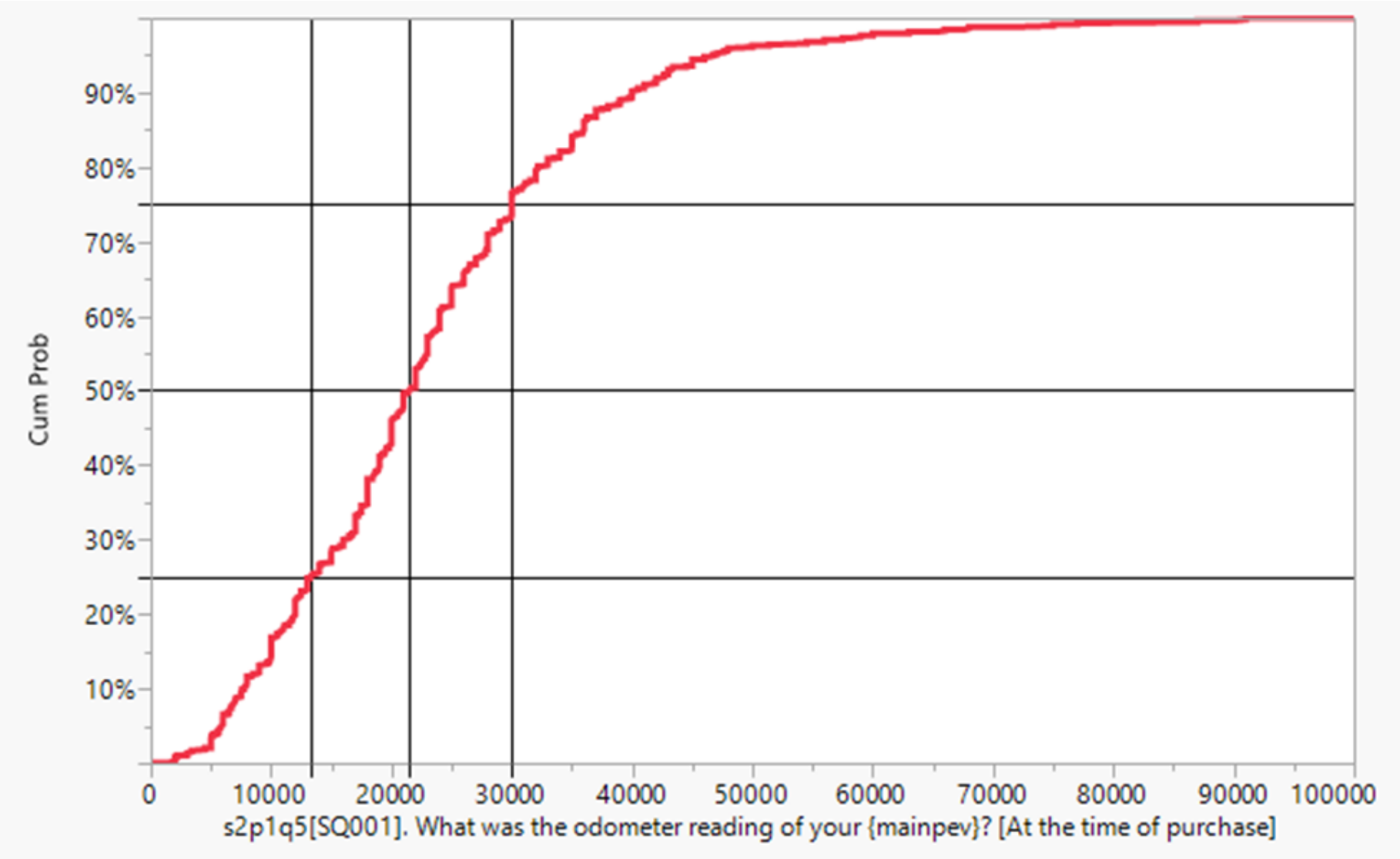
The Price of New Volt Dropped When the first Used Car came out of Lease



Residual Value is Between 34% and 99%

	MSRP	Full Price	Price Minus Incentives	Used Price in 2014	Used Price in 2015	price minus incentives of a 2015 model	2015 price over MSRP	2015 price over Paid as New	2015 price over new car price
Nissan Leaf, 2011	$33,572	$ 34,990	$ 26,815	$ 15,497	$11,463	$ 22,779	**34%**	**43%**	**50%**
Nissan Leaf, 2012	$36,882	$ 35,852	$ 26,564		$12,508	$ 22,779	**34%**	**47%**	**55%**
Nissan Leaf, 2013	$31,517	$ 33,488	$ 24,380		$13,912	$ 22,779	**44%**	**57%**	**61%**
Tesla Model S, 2013	$87,217	$ 96,732	$ 87,974		$67,338	$ 105,998	**77%**	**77%**	**64%**
Ford Fusion Energy, 2013	$39,235	$ 41,243	$ 35,936		$25,288	$ 36,214	**64%**	**70%**	**70%**
Chevrolet Volt, 2012	$39,145	$ 41,140	$ 33,798	$ 24,672	$20,871	$ 27,488	**53%**	**62%**	**76%**
Chevrolet Volt, 2013	$39,174	$ 41,000	$ 32,855	$ 24,672	$20,871	$ 27,488	**53%**	**64%**	**76%**
Ford C-Max Energy, 2013	$31,665	$ 35,014	$ 29,664		$22,875	$ 29,900	**72%**	**77%**	**77%**
Toyota Prius Plug-in, 2012	$38,195	$ 36,211	$ 32,273	$ 24,823	$22,973	$ 27,951	**60%**	**71%**	**82%**
Toyota Prius Plug-in, 2013	$38,704	$ 34,259	$ 30,394		$24,412	$ 27,951	**63%**	**80%**	**87%**
Toyota Prius Plug-in, 2014	$34,307	$ 31,726	$ 27,759		$27,525	$ 27,951	**80%**	**99%**	**98%**

Odometer Reading at Purchase



Used PEV price is, as in any car, correlated positively with the MSRP and negatively with time on the road and mileage

- PHEV remains on average a 10.3% higher value compared to the MSRP than BEVs

- PEVs with HOV access sticker receive $1,430 more than PEVs without an HOV sticker.

Table 3: Parameter Estimates for price paid when purchasing used PEV

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	6091.0037	2070.067	2.94	0.0034*
PEV Type [electric]	-1958.399	241.1654	-8.12	<.0001*
PEV age when purchased (years)	-2950.497	249.7977	-11.81	<.0001*
HOV Sticker [No]	-715.6517	252.7792	-2.83	0.0048*
Miles when purchased	-0.101106	0.016713	-6.05	<.0001*
Price paid when new	0.6887149	0.049827	13.82	<.0001*

Summary of Fit

RSquare	0.602079
RSquare Adj	0.598208
Root Mean Square Error	4642.141
Mean of Response	20814.7
Observations (or Sum Wgts)	520

Analysis of Variance

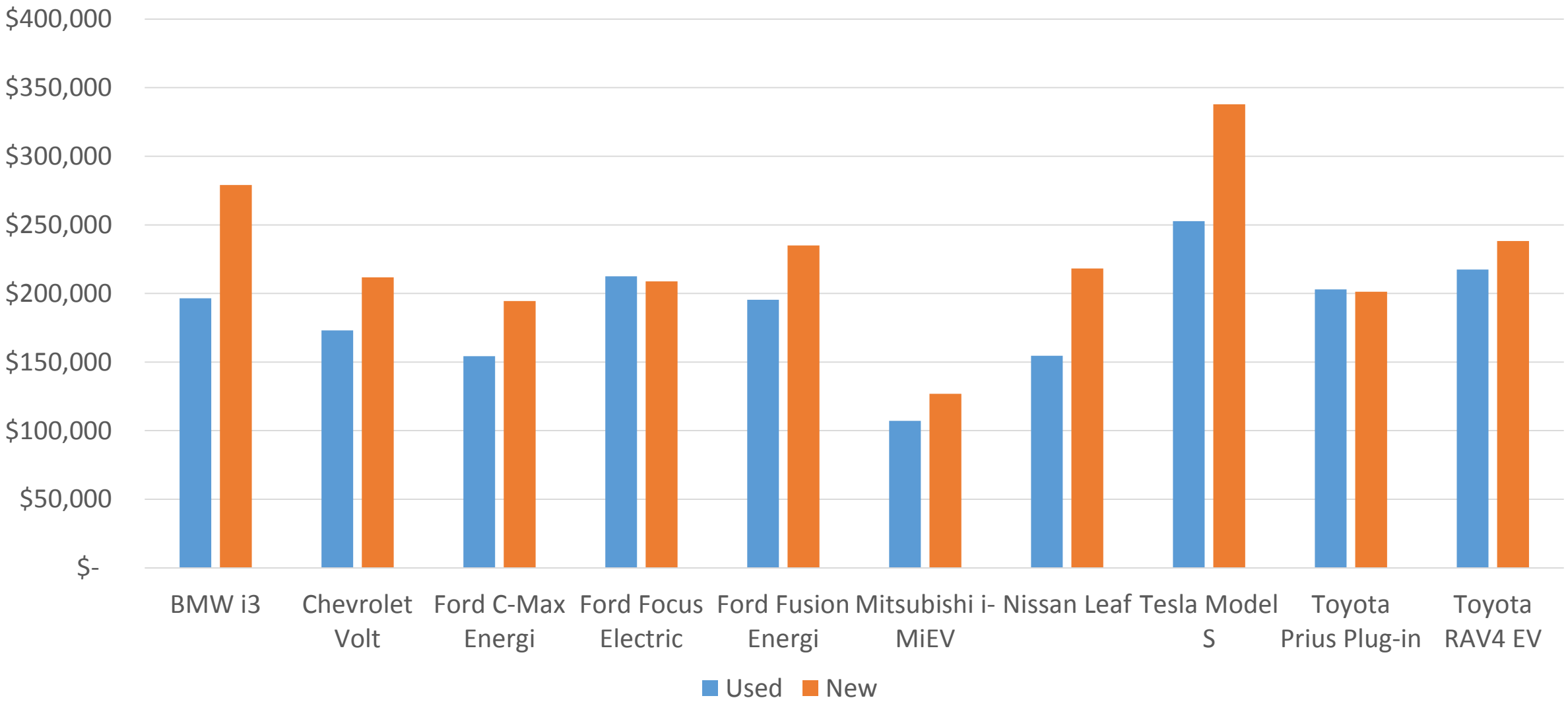
Source	DF	Sum of Squares	Mean Square	F Ratio
Model	5	1.6759e+10	3.3519e+9	155.5426
Error	514	1.1076e+10	21549476	**Prob > F**
C. Total	519	2.7836e+10		<.0001*

Lack of Fit

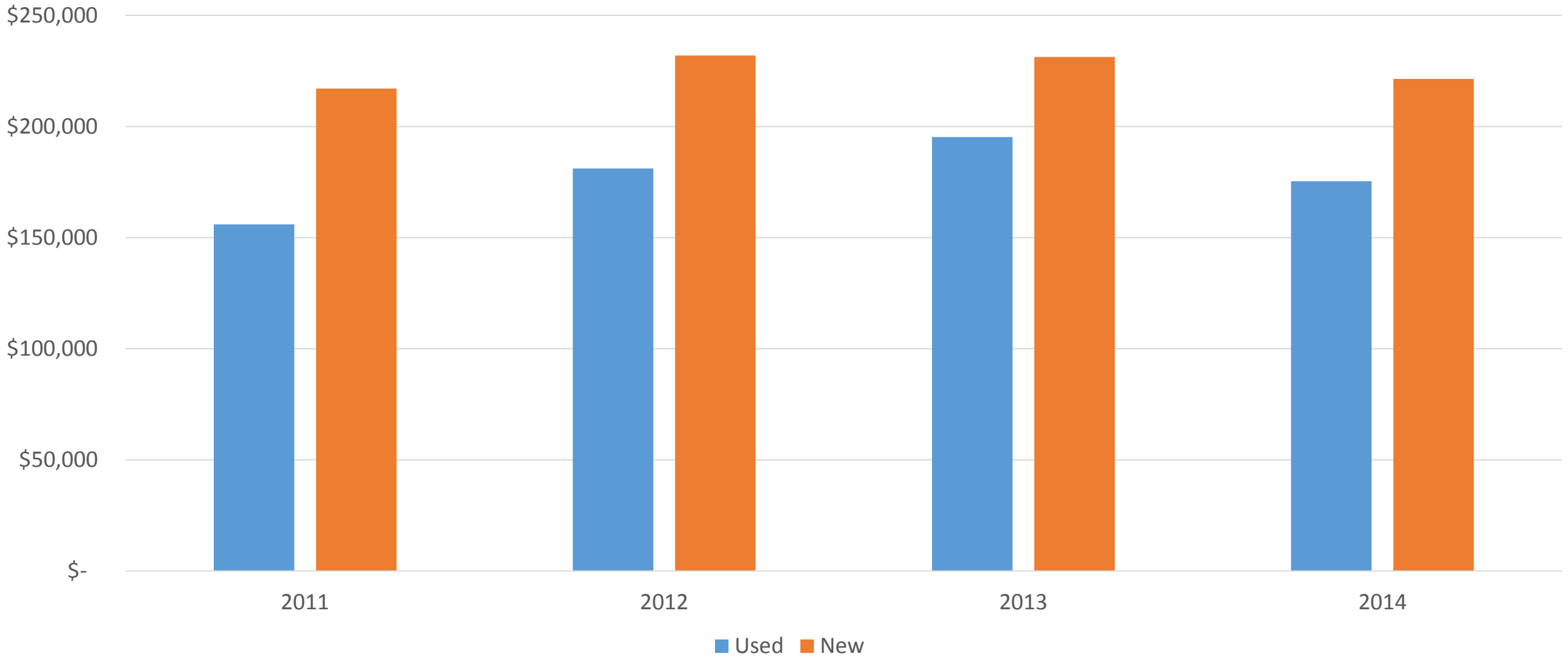
Source	DF	Sum of Squares	Mean Square	F Ratio
Lack Of Fit	472	1.0422e+10	22080574	1.4172
Pure Error	42	654400057	15580954	**Prob > F**
Total Error	514	1.1076e+10		0.0819
				Max RSq
				0.9765

Who Purchases Used PEVs?

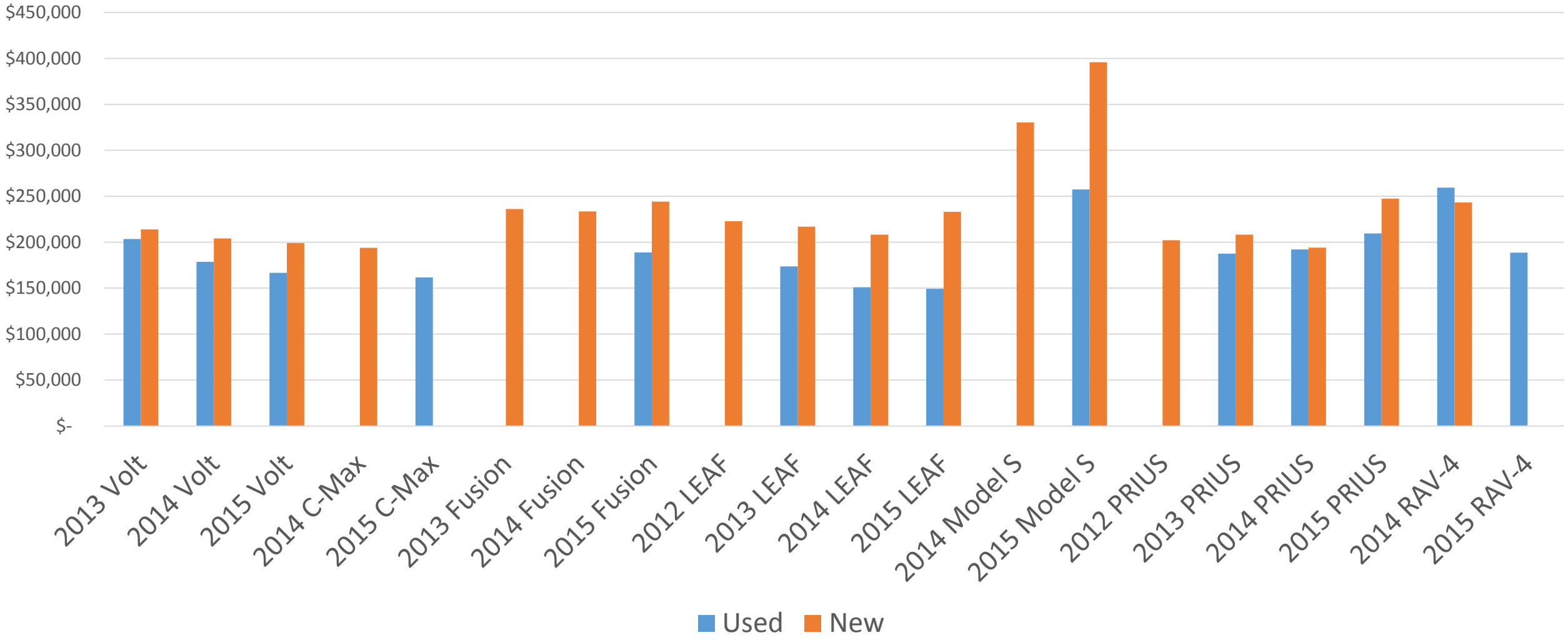
Household Income of New and Used Buyers



Household Income of New and Used Buyers: By Model Year

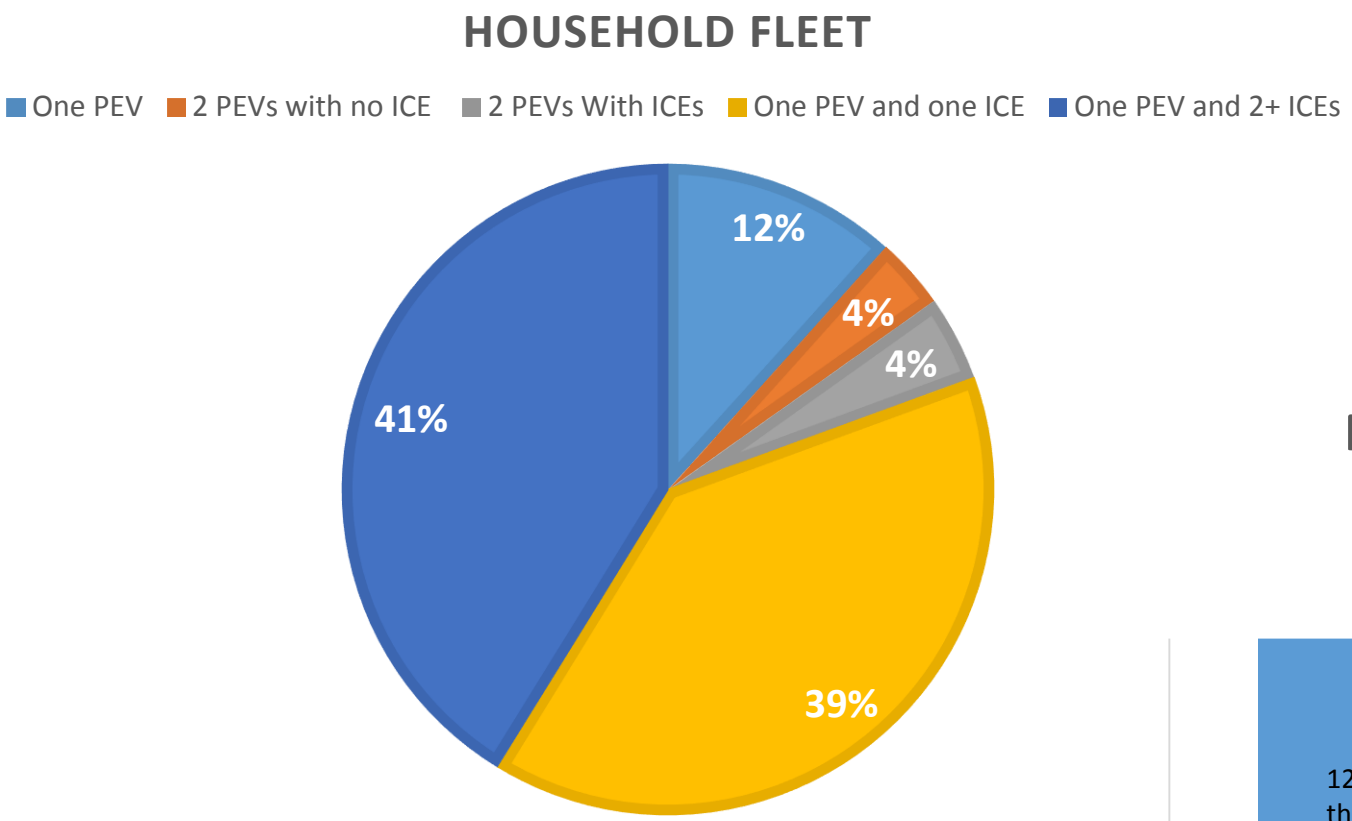


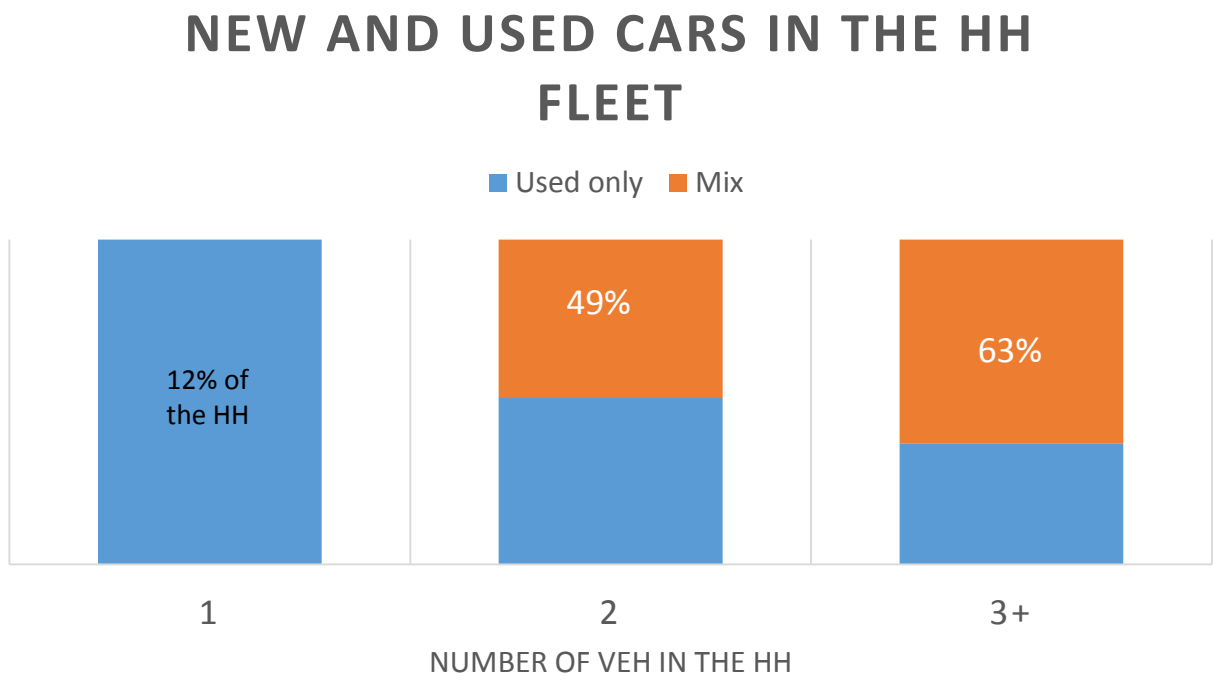
Household Income of New and Used Buyers: By Purchase Year



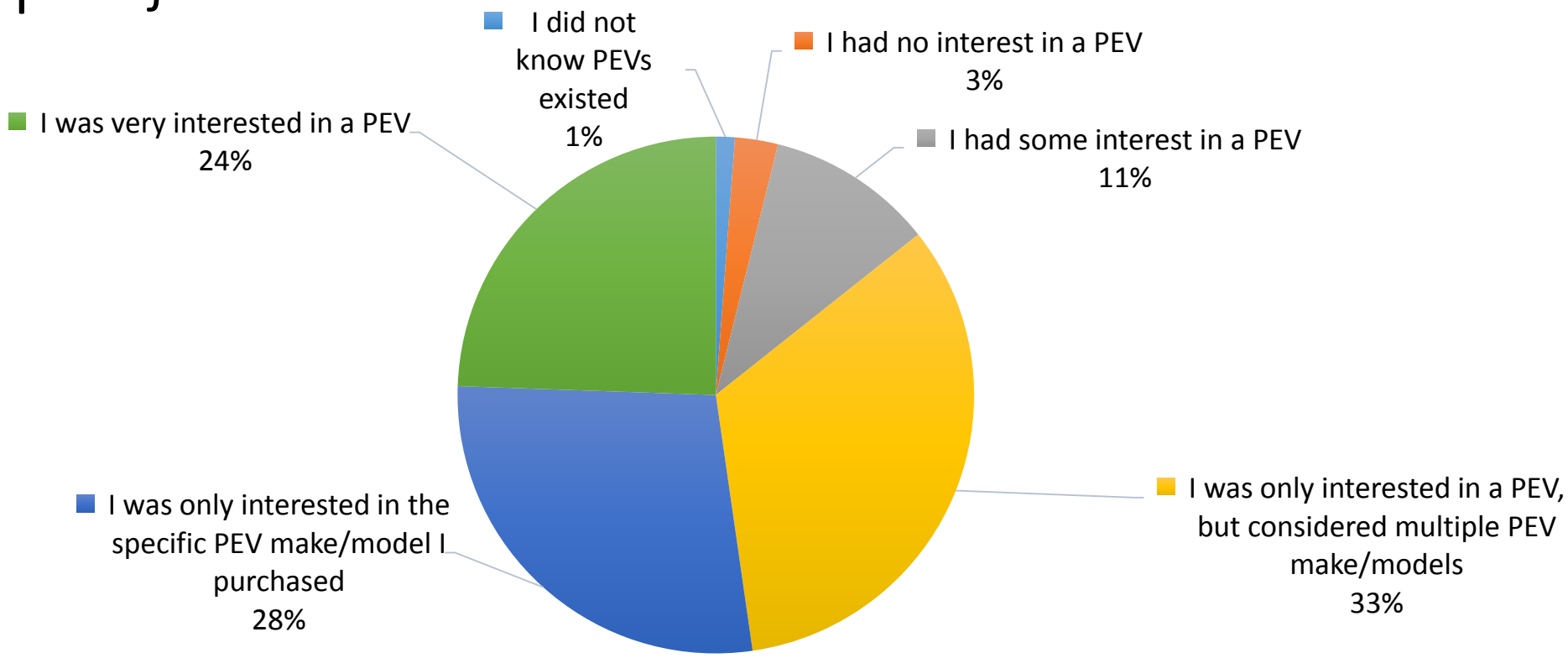
Knowledge and Motivations

Household Fleet



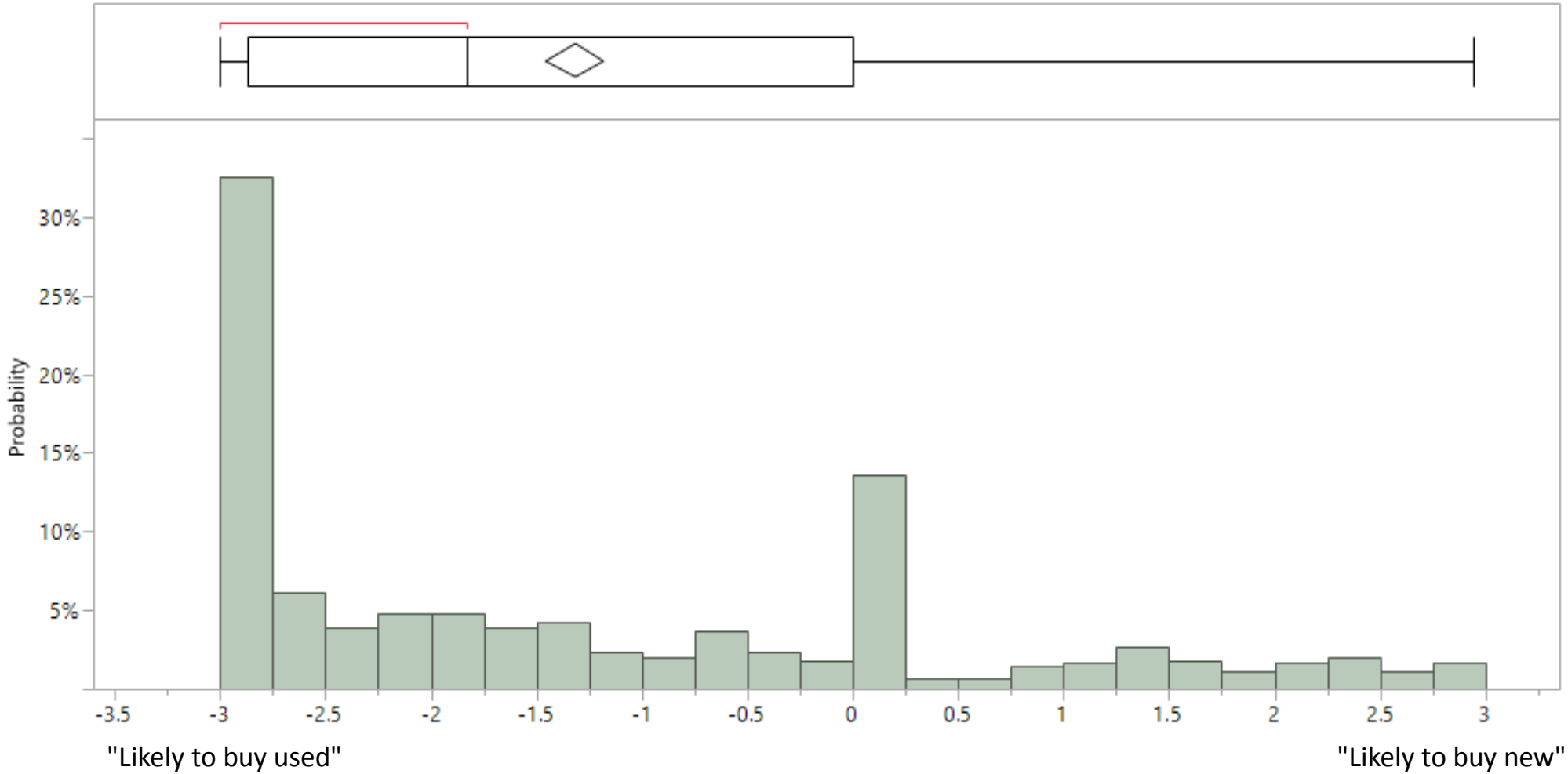


Which of the following statements best describes your interest in acquiring a Plug-in Electric Vehicle (PEV) when you started your search for your {mainpev}?



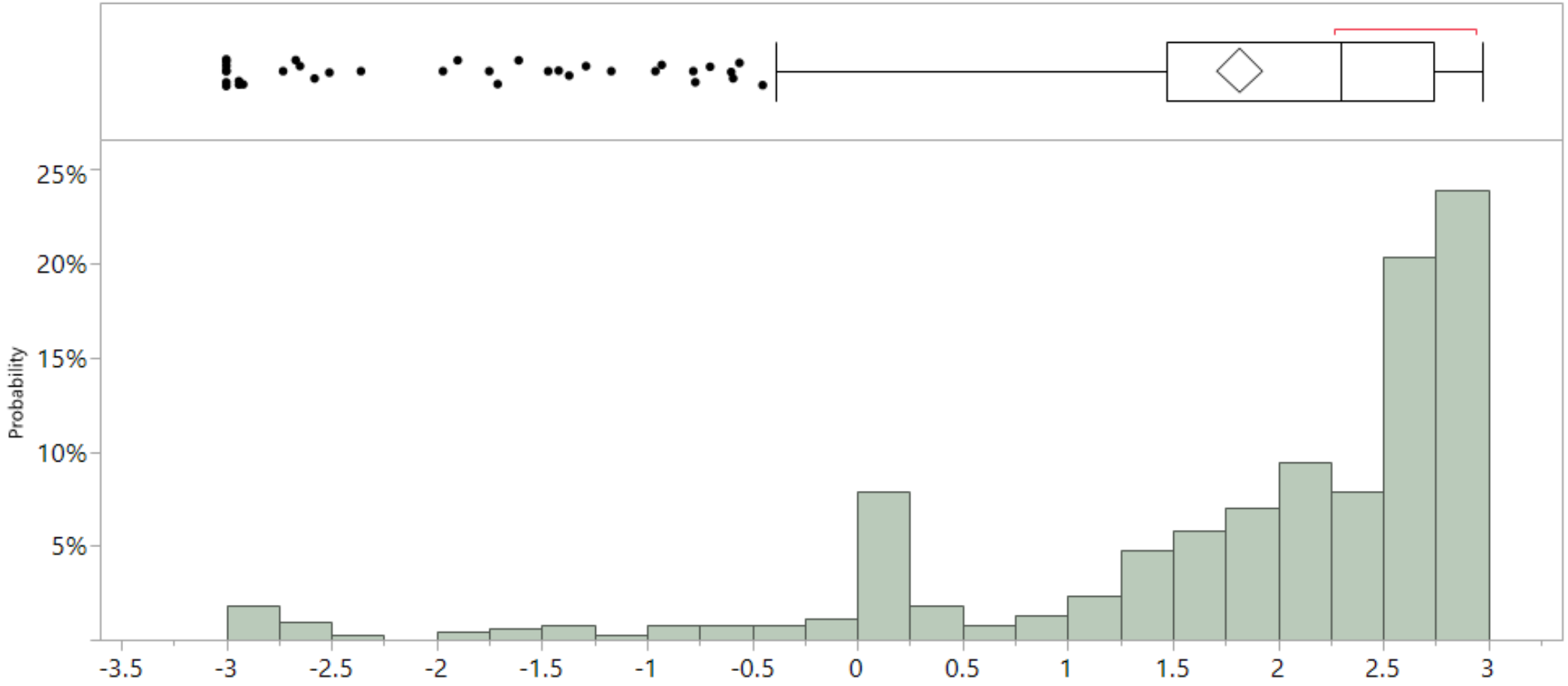
What did they look for?

- When comparing new cars to used cars, throughout your shopping experience for your {mainpev}, were you more likely to buy a new or used vehicle?



What did they look for?

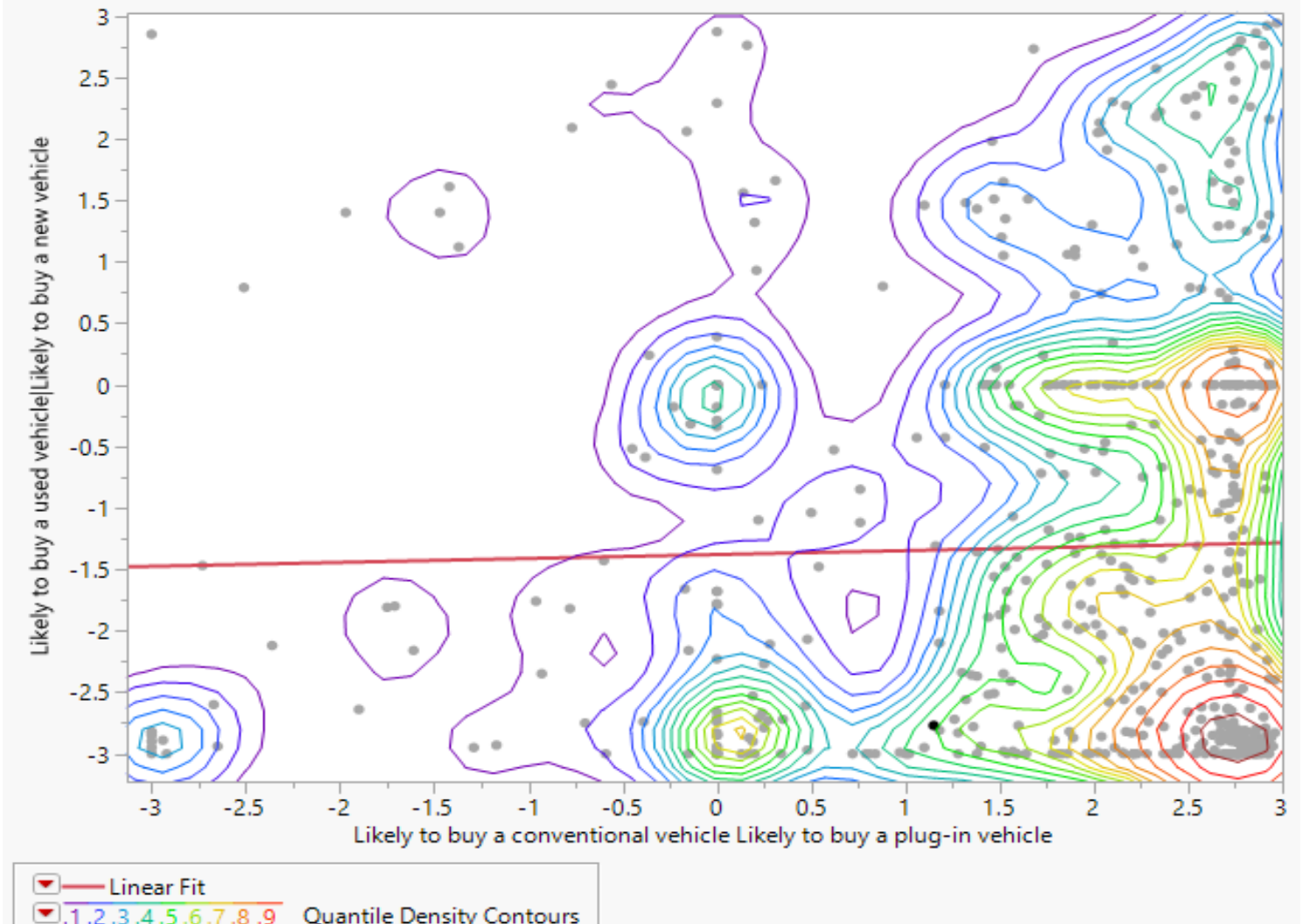
When comparing conventional vehicles to plug-in vehicles, throughout your shopping experience for your {mainpev}, were you more likely to buy a conventional or plug-in vehicle?



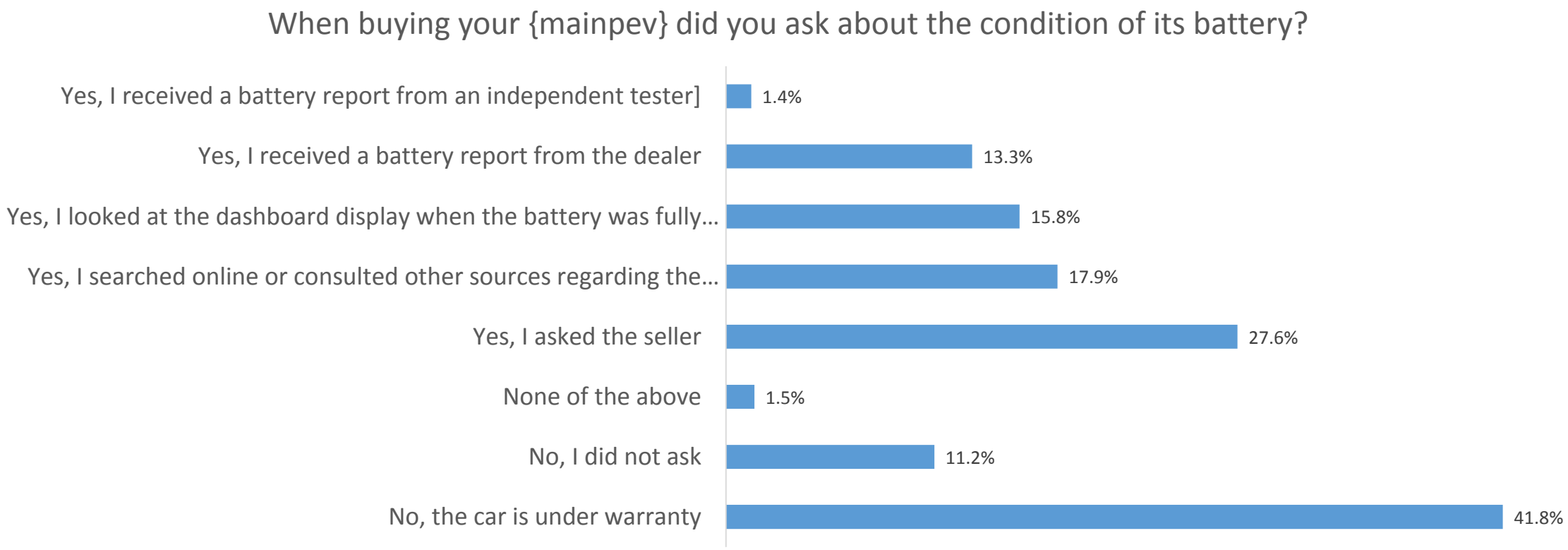
"Likely to a conventional vehicle"

"Likely to buy plug-in vehicle"

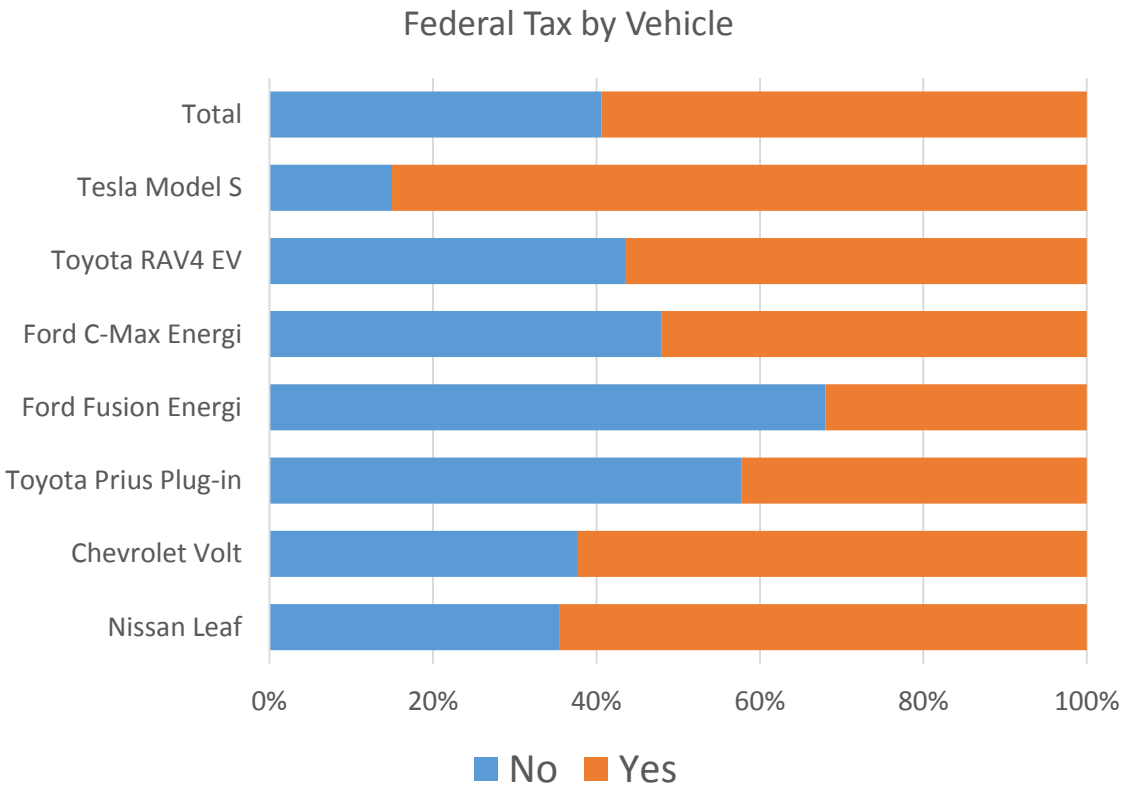
No Potential Buyers Of New ICEs Who Bought Used PEVs

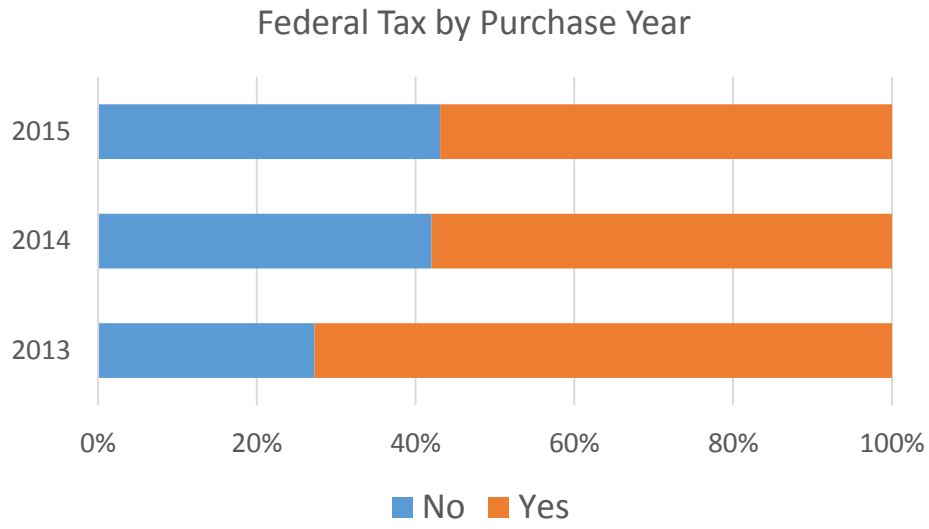


What about technical knowledge?

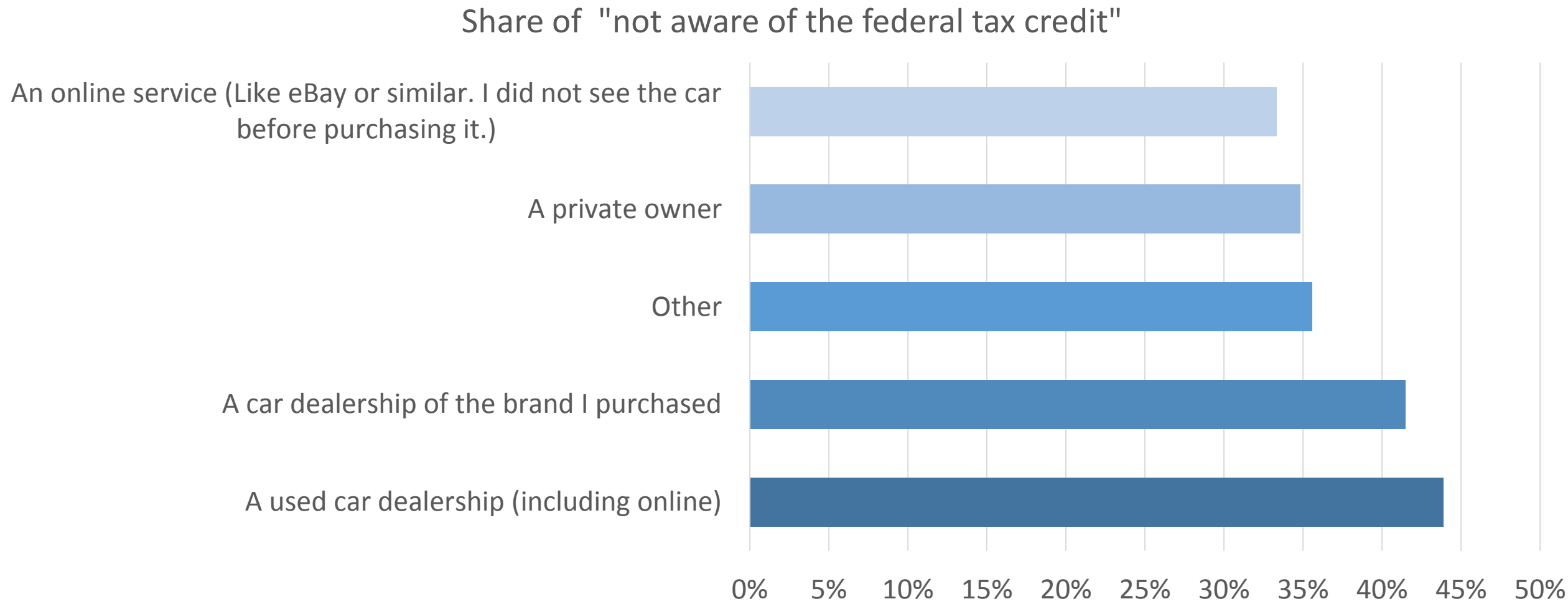


When buying or leasing a new {carmain}, or a similar new plug-in car you may (or may not) be eligible for different incentives that may reduce the price of the new vehicle in your area. When buying your vehicle were you aware of any of the "**Federal Tax Credit**"?



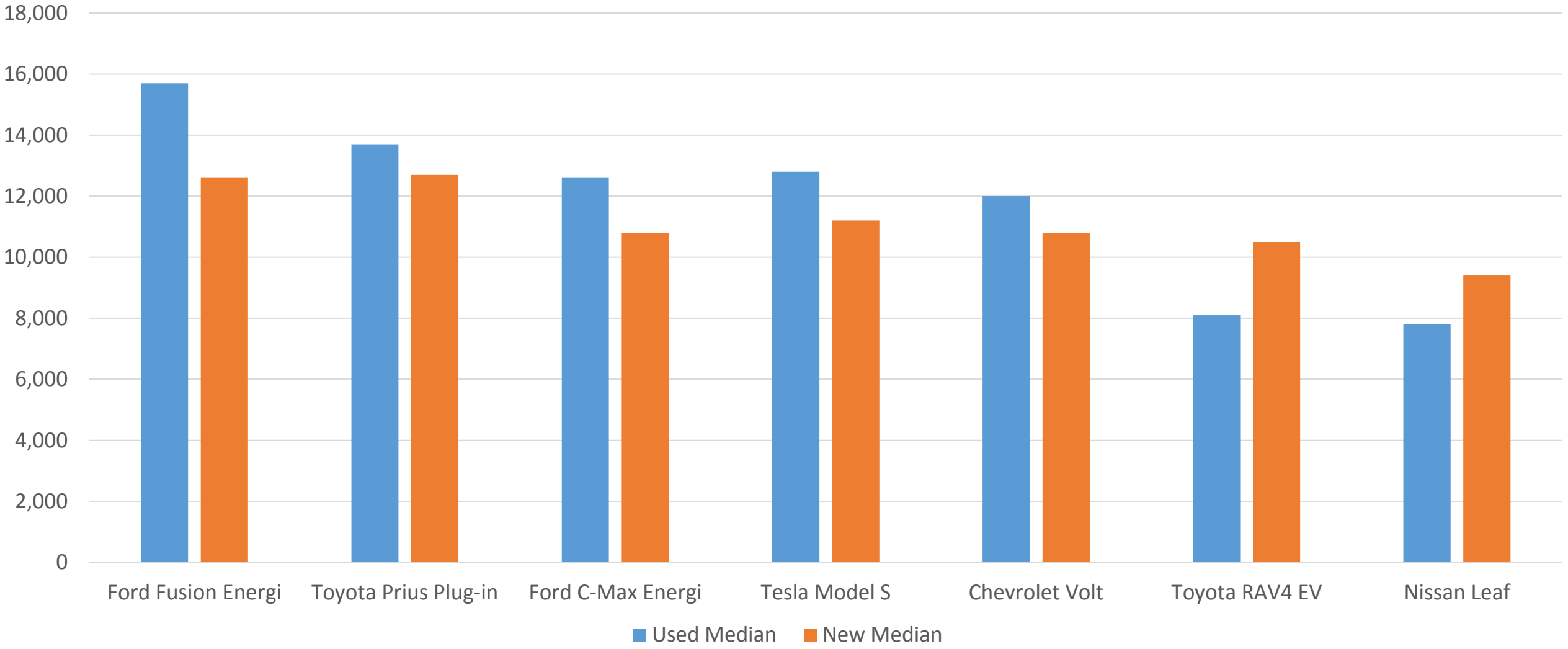


Dealers are Not Helping

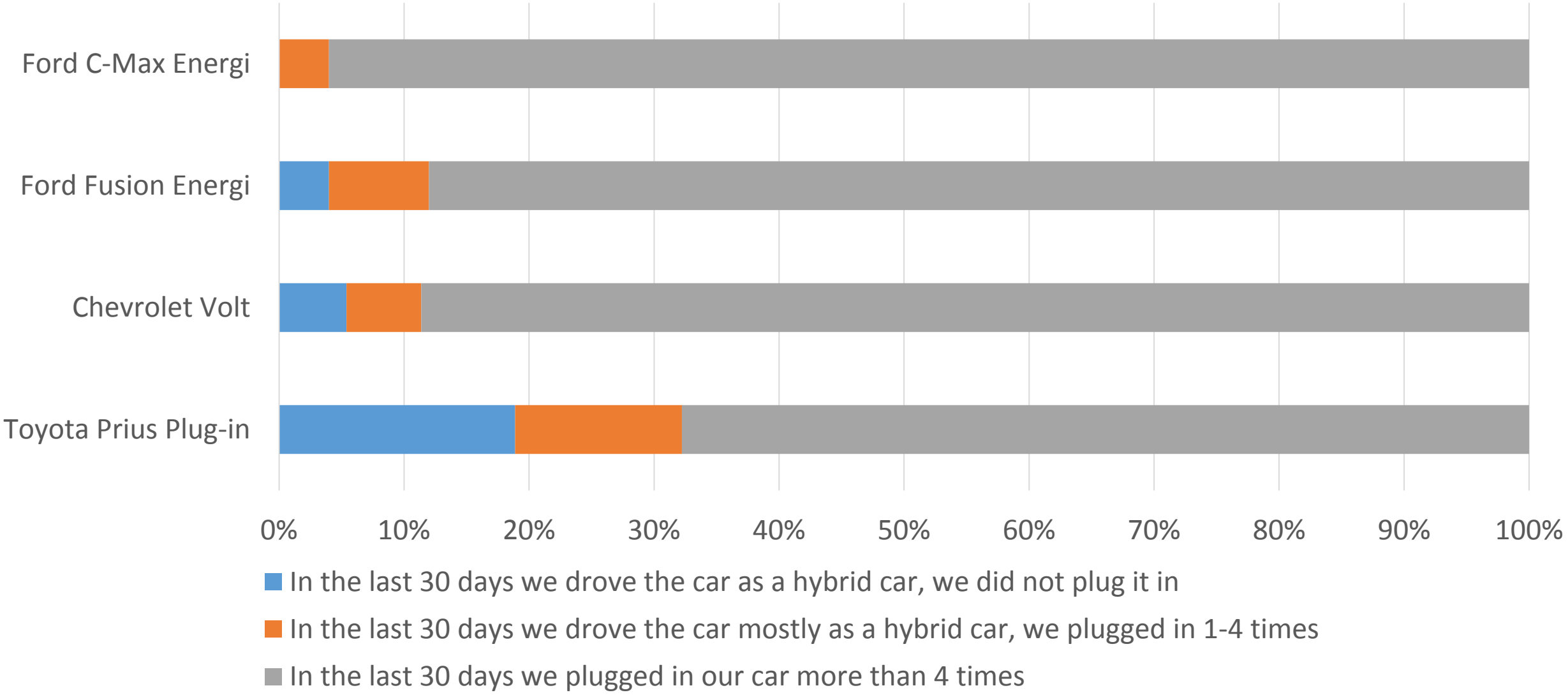


Used PEV Usage

Used PEVs are driven more than New PEVs except LEAFs and RAV4



But they plug in less



What do we know about the secondary market so far

- Residual value is in the eye of the beholder as
  - Price of new PEVs dropped over time
  - Some buyers had the right knowledge to calculate actual cost
  - BEVs price dropped more than PHEVs
  - HOV access may be part of the story
- Second owners have lower income than first owners, but not by much.
- Most of the buyers were looking for a used PEV, very few start with a different car in mind.
- Knowledge (awareness and education) is most likely the key for a strong secondary market
- Used PEV buyers are more utilitarian than new PEV buyers as reflected by their high driving need but they may be less committed to electric driving not always plugging in their vehicle

What do we know that we don’t know

- Overall buyers of used PEVs purchased a vehicle that
  - They plan to buy
  - They learn about it in advance
  - Is relatively new with low mileage and in most cases under warranty
  - Is at a relatively low price
- This may not be the case when the PEV market will contain more older vehicles with high mileage and over the battery and powertrain warranty limit.

Thank you

Questions?

Gil Tal
gtal@ucdavis.edu