



IHS Markit™

Re-Purchase Behavior of US Battery Electric Vehicle Households



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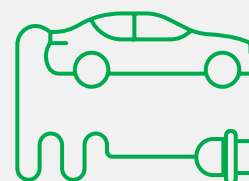
Parameters

“Battery Electric Vehicles” or “BEVs” are defined as those vehicles powered solely by electricity, with no extended range gas support system. Note that BEVs do not include any hybrids such as mild, full, or plug-in hybrids.

All loyalty data included in this paper have been obtained using the IHS Markit Household Loyalty Methodology, in which the newly-acquired vehicle may be an addition to the garage, unless specifically called out otherwise.

Key Findings

Battery electric vehicles’ **US market share** through eight months in 2017 is 0.5 %, up from 0 in 2010; California BEV share is five times as high, while in the other 49 states it is 0.3%; almost half of all BEVs on the road are in California



Currently the **BEV return-to-market (RTM) population** spans

29 different models;

the Leaf, Model S and 500 account for almost three quarters of all these

Gasoline



has the highest **fuel type loyalty** by a wide margin (91%), followed by BEV (38%), hybrid (32%), and diesel (30%)

BEV make loyalty



- generally is below make loyalty for the remaining models in the BEV’s brand
- generally is lower in California than in the other 49 states

BEVs in aggregate have had a **positive conquest/defection ratio** with all other fuel types throughout the five-plus year time period from 2012 to the present



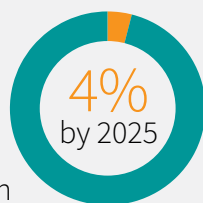
BEV inflow

from domestics is far less than **outflow** to domestics, and BEVs also have a high propensity to defect to another BEV

Despite extensive recent publicity about OEMs’ increased interest in battery electric vehicles,

IHS Markit forecasts

that BEV share of industry will only reach



22 BEV models will be introduced in the US market in **2018 through 2020**, including

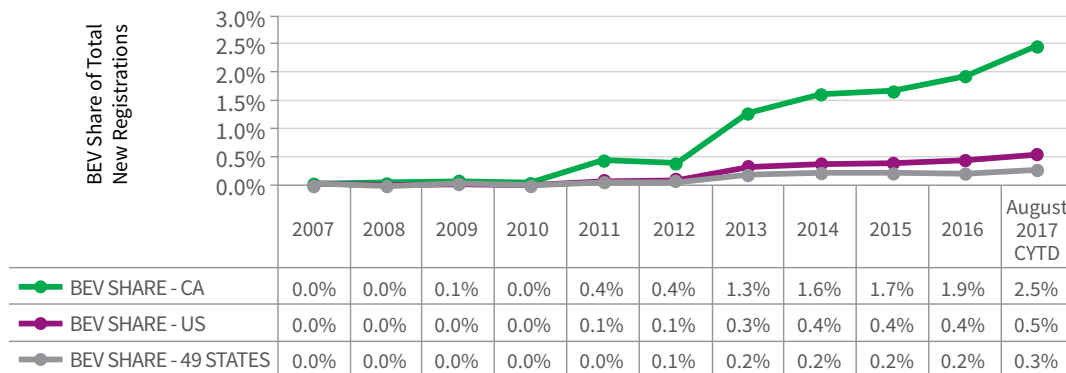
14 from European manufacturers, 7 from Asian companies, and one from a domestic automaker



The BEV Landscape

In the first eight months of 2017, battery electric vehicles accounted for 0.5% new light vehicles registered in the US. This share is not spread equally across all 50 states; rather, BEV share in California over the same time period is five times as high at 2.5%, while the remaining 49 states' share stands at 0.3%. While the national BEV share of 0.5% is small, it is noteworthy that this metric was 0.0% as recently as 2010.

BEV Market Share

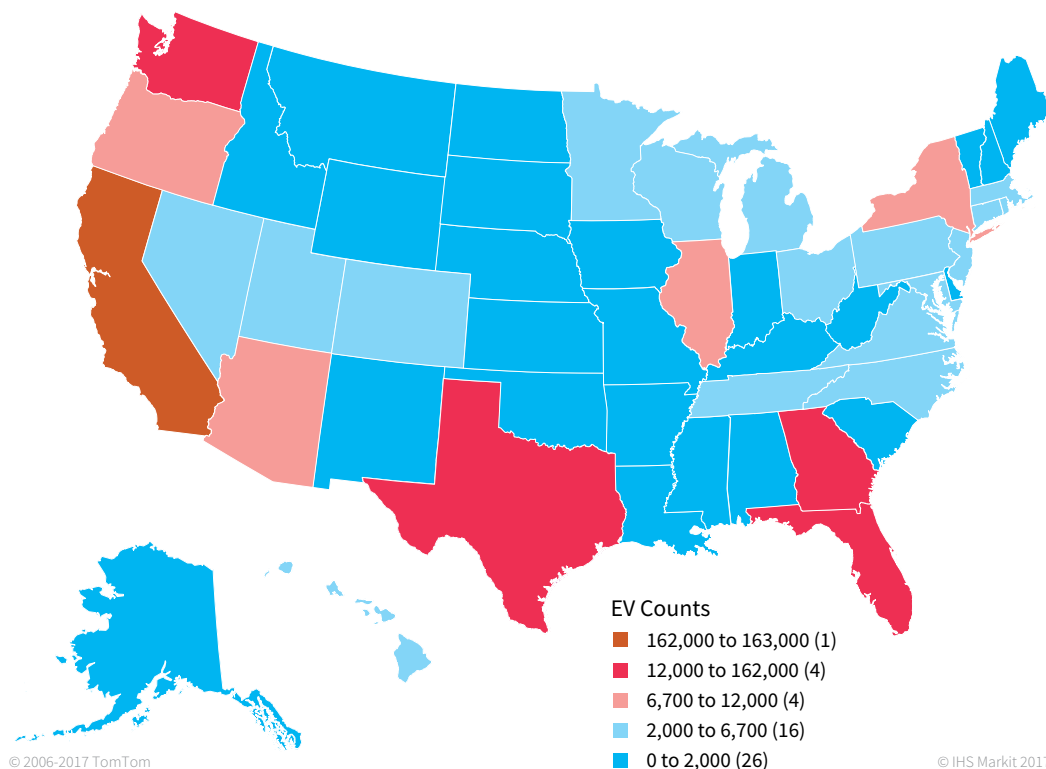


Registration Type: Total

Battery electric vehicles' US market share through 8 months in 2017 is 0.5%, up from 0 in 2010

As the above chart indicates, California's BEV market share has exceeded that of the nation since 2010, which has driven the California BEV vehicles in operation, or VIO (all light vehicles of any model year on the road at a given point in time), to a far higher level than that of any other state. As of July 2017, BEVs on the road in California comprised 50% of all BEVs nationally. Furthermore, BEVs in operation in just nine states, all of which are on the two coasts except Illinois and Texas, account for almost 80% of all BEVs.

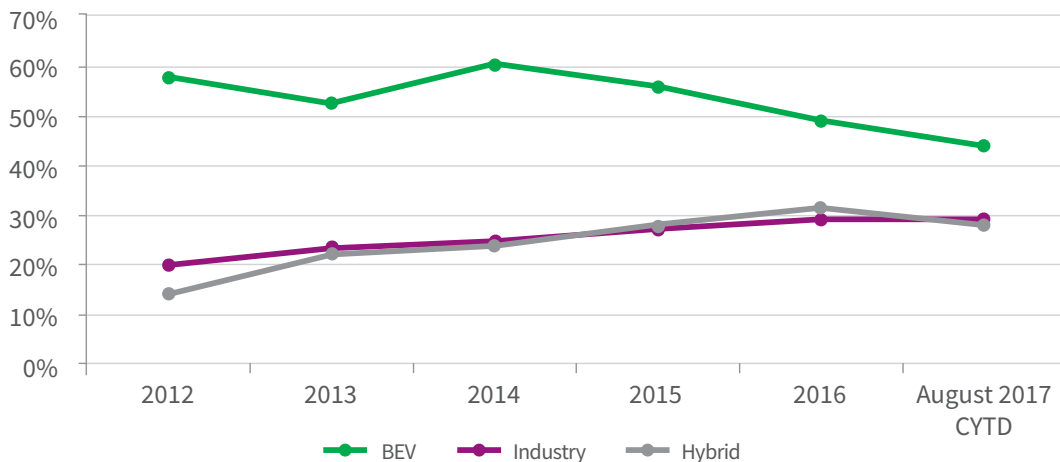
Total BEV Counts by State



California BEV share is five times as high; almost half of all BEVs on the road are in California

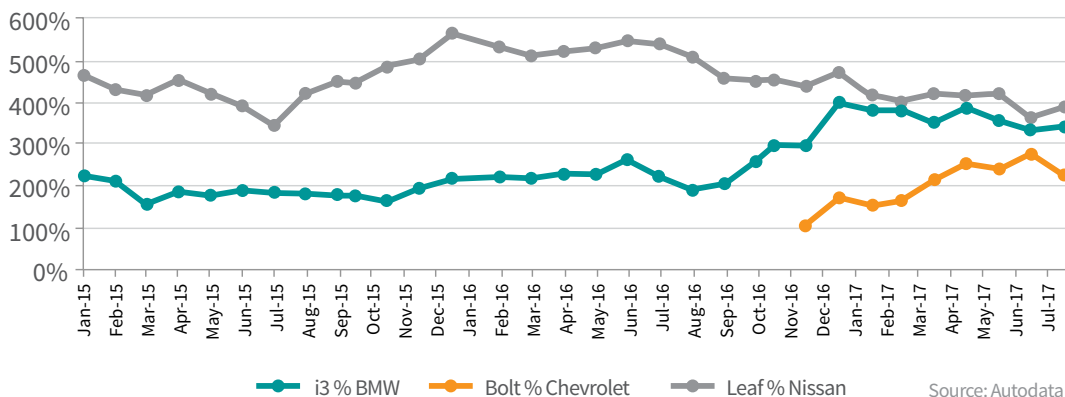
One of the inhibitors of BEV sales is their high price compared to conventionally powered vehicles, caused in part by the high cost of batteries and other components. Manufacturers have addressed this issue by offering attractive lease terms, driving up the BEV retail lease penetration rate (calculated as retail lease/retail). Currently more than four of every ten battery electric vehicles are leased, substantially above the lease penetration rate for both hybrids and all vehicles, as illustrated below.

Retail Lease Penetration



Another tactic used by manufacturers to lower BEV prices is to offer generous incentives. As shown below, BEV incentive spend per unit ranges from 200% to 400% of the corresponding brand’s incentive spend per unit.

(Incentive Spend Per Unit - BEV Model)/(Incentive Spend Per Unit - Brand)



Source: Autodata

An additional metric measuring BEV incentives compares incentive spend per unit to the price of the BEV; these data, as shown below, suggest incentives range from about 24% up to 46% of MSRP.

Model	Inc. Spend Per Unit	MSRP*	Inc % MSRP
i3 Series	\$17,697	\$48,195	36.7%
Leaf	\$16,271	\$35,475	45.9%
Bolt	\$10,562	\$44,620	23.7%

MSRP data are for “well-equipped” models on October 17, 2017 in zip code 48009

Sources: Incentive Data: Autodata; MSRP: Edmunds.com

BEV Loyalty and Conquest/Defection Trends

Return to Market (RTM):

Households owning or leasing twenty nine BEV models returned to market in the first seven months of 2017. The top ten, based on RTM volumes in 2017, are listed below.

RTM by Year for Top Ten BEV Models							
	2012	2013	2014	2015	2016	July 2017 CYTD	% of Total EV RTM - July 2017 CYTD
LEAF	1,070	3,412	6,768	9,345	11,383	6,049	37.2%
MODEL S	8	771	2,136	4,123	6,875	3,741	23.0%
500		68	572	1,165	2,240	1,867	11.5%
MODEL X					468	732	4.5%
I3			138	479	934	718	4.4%
GOLF			10	323	749	598	3.7%
FOCUS	33	227	417	681	757	541	3.3%
SPARK		21	136	350	678	498	3.1%
FORTWO	5	45	278	343	552	332	2.0%
BOLT					1	270	1.7%

Note: Top ten models based on July 2017 CYTD RTM

The return to market volume of these ten models by itself, 15,346, is equal to 94% of all BEV RTMs in the first seven months of 2017, and the first three models by themselves account for almost three quarters of all BEV RTMs. Obviously, return to market volumes for a recently introduced model such as the Bolt will not have reached “ongoing” levels since the vehicle has not been on the market for a normal ownership cycle.

As more BEVs are introduced to the US market, the RTM mix will evolve to a more even mix among all models.

Currently the BEV RTM population spans 29 different models.

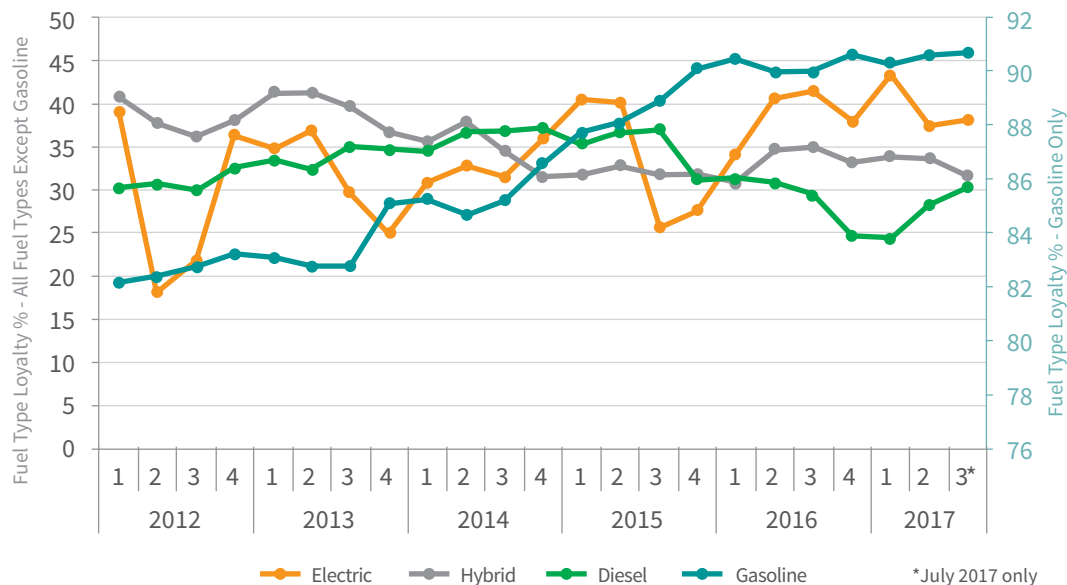
The Leaf, Model S and 500 account for almost three quarters of all these.

Fuel Type Loyalty

Among the four major fuel types, gasoline has the highest loyalty by a wide margin; reaching almost 91% in July 2017 (fuel type loyalty is defined as returning to market and acquiring another vehicle with the same fuel type as the original). Note that gasoline loyalty has been rising throughout the five-plus year window, in part due to lower retail gasoline prices.

As shown below, battery electric loyalty has been erratic; such fluctuations are to be expected when a small number of models dominate the entire data set, as in battery electric vehicles. Diesel loyalty began to decline immediately after the Volkswagen emissions issue announcement in September 2015, and while recently it has begun to recover, it remains below the 2014-15 levels.

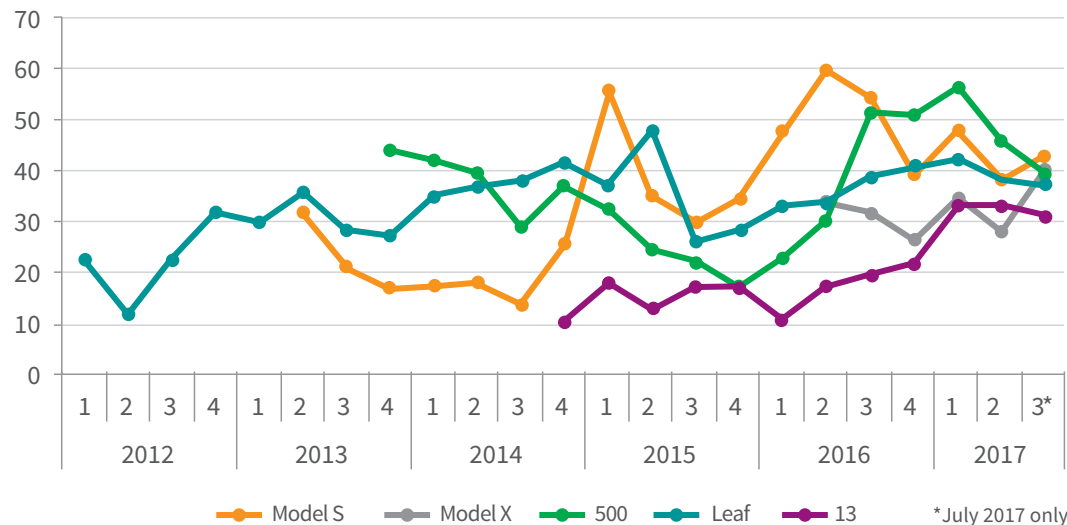
Fuel Type Loyalty by Fuel Type



Gasoline fuel type loyalty highest by a wide margin with BEV erratic and Diesel declining

BEV fuel type loyalty at the model level has been erratic, which is not unusual with low RTM counts. The five BEVs with the highest RTM counts now have fuel type loyalty ranging from a low of 31% for the i3 to 43% for the Model S (see below). Note that this range of 12 percentage points is down substantially from the 43 pp range a little over a year ago in Q2 2016.

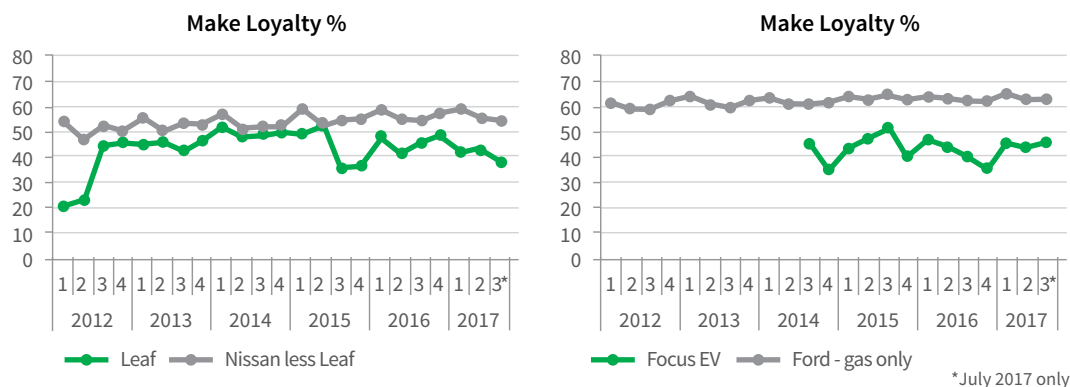
Fuel Type Loyalty for Five Highest RTM BEV Models



BEV Make Loyalty – BEV vs. Brand

BEV make loyalty (the percent of BEV households that return to market and acquire another vehicle from the same make) for the top five BEV models generally is lower than make loyalty for the remainder of the models from the same make. The BEV value proposition (benefit/cost) is difficult to make, as the direct cost (higher retail price) and indirect costs (range anxiety, lack of infrastructure, limited model availability, fear of new technology) are substantial, and the payback period (time period needed to recoup the price premium) has lengthened with the decline in fuel prices.

As illustrated below, Leaf and Focus BEV make loyalties consistently are lower than the metric for their respective brands.

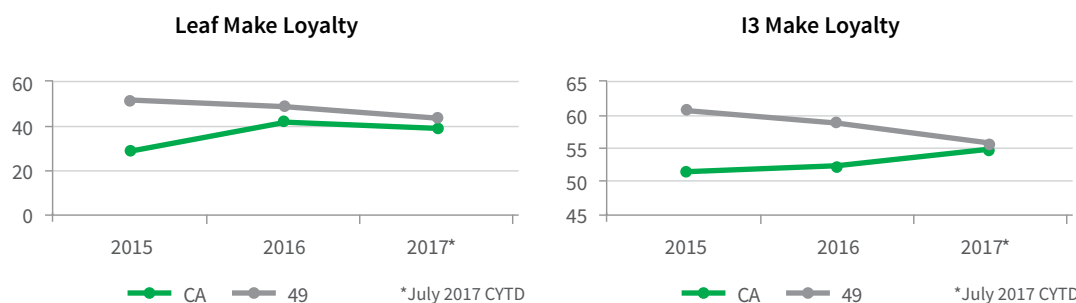


BEV make loyalty generally is below make loyalty for the remaining models in the BEV's brand.

Make loyalty for the 500 BEV relative to overall Fiat make loyalty has been inconsistent. 13 make loyalty, only available for the six most recent quarters, generally has been similar to BMW make loyalty.

BEV Make Loyalty – California vs. 49 States

Make loyalty for BEVs generally is lower in California than in the other 49 states; among four high-RTM models, this was the case in ten of the twelve years examined (four models in each of the three years 2015 through July 2017 CYTD). Data for two of these models are illustrated below.

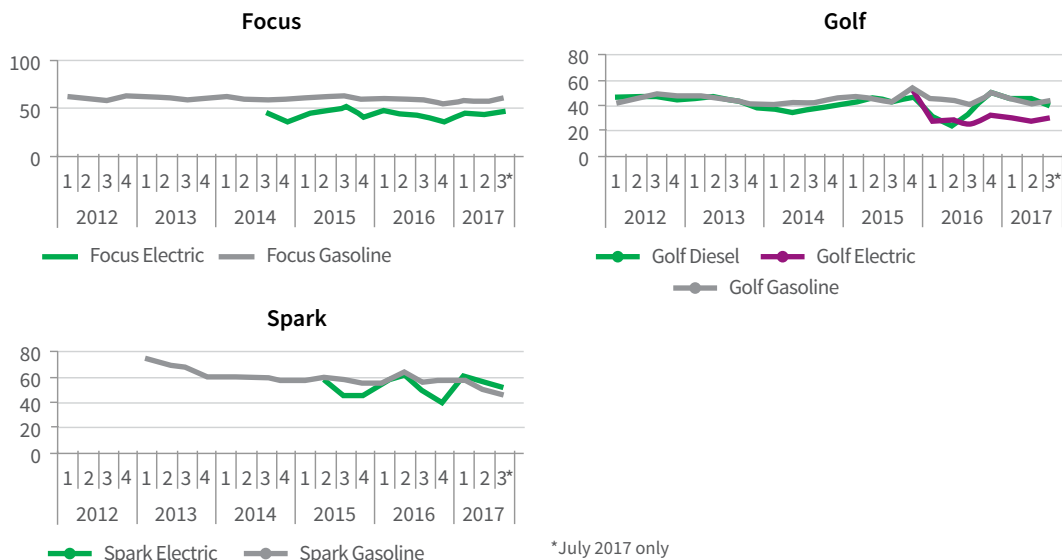


BEV make loyalty generally is lower in California than in the other 49 states

As mentioned, California's BEV share currently is five times the national share, a result in part of state regulations and incentives. This has led to greater awareness of BEVs and higher retailer inventory levels in California, all of which will provide the consumer with greater choice across brands and models; this in turn will drive greater movement across brands and models when the BEV household returns to market.

BEV Make Loyalty – BEV vs. Gas Versions

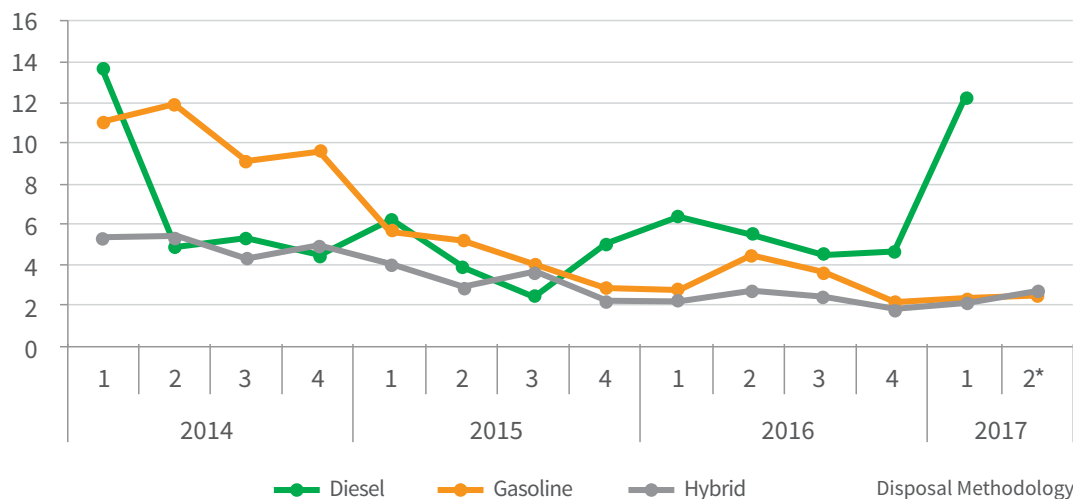
There are seven BEV models also available with another fuel type; among these models, the battery electric version generally has lower make loyalty than its gasoline counterparts; data for three of these are illustrated below.



BEV Conquest/Defection Ratio with Other Fuel Types

Battery electric vehicles as a group have been in a net inflow position with all other fuel types since (at least) 2012. BEVs’ ratios with gasoline and hybrid vehicles recently have stabilized in the 2.2 – 2.7 range (a ratio of 2.2 implies that for every 220 households that move from another fuel type to a battery electric vehicle, 100 defect from a battery electric vehicle to another fuel type); BEVs’ ratio with diesel vehicles, though, has been rising since the third quarter of 2015, when Volkswagen announced their diesel emissions issue.

BEV C/D Ratio with Other Fuel Types




BEVs in aggregate have had a **positive conquest/defection ratio** with all other fuel types throughout the five-plus year time period from 2012 to the present

Note that the data displayed above are derived from the IHS Markit Disposal loyalty methodology; with this methodology, the garaged vehicle has been disposed of and replaced by the newly-acquired vehicle.

Conquest/Defection Flow Charts for Five Highest RTM BEV Models

Conquest and defection charts for each of the five highest-RTM BEV models, with data at the model and fuel type levels, reveal noteworthy trends. Here is the chart for the Leaf:

Top Ten* Inflow and Outflow Models for Nissan Leaf								
Competitive Vehicle Model	Competitive Vehicle Fuel Type	Inflow Transaction Volume	% of Total Inflow		Competitive Vehicle Model	Competitive Vehicle Fuel Type	Outflow Transaction Volume	% of Total Outflow
LEAF	ELECTRIC	322	49.6%		LEAF	ELECTRIC	322	28.0%
ROGUE	GASOLINE	24	3.7%		BOLT	ELECTRIC	138	12.0%
PRIUS	HYBRID	18	2.8%		VOLT	HYBRID	59	5.1%
JETTA	DIESEL	12	1.8%		ROGUE	GASOLINE	52	4.5%
ALTIMA	GASOLINE	11	1.7%		SENTRA	GASOLINE	29	2.5%
MURANO	GASOLINE	9	1.4%		ALTIMA	GASOLINE	21	1.8%
VERSA	GASOLINE	8	1.2%		PRIUS PRIME	HYBRID	21	1.8%
PATHFINDER	GASOLINE	8	1.2%		PRIUS	HYBRID	19	1.7%
SENTRA	GASOLINE	8	1.2%		MODEL S	ELECTRIC	16	1.4%
ACCORD	GASOLINE	7	1.1%		CIVIC	GASOLINE	16	1.4%
VOLT	HYBRID	7	1.1%					
MAXIMA	GASOLINE	7	1.1%					
COROLLA	GASOLINE	7	1.1%					

Time Period: Q1 2017

Loyalty Methodology: Disposal

*More than ten included in the case of a tie

Two trends emerge from the inflow and outflow data among the five highest-RTM BEV models, including:

Outflow to domestic models exceeds inflow from domestics

- This pattern is being driven primarily by the Chevrolet Volt and Bolt.
- Leaf’s ten most frequent conquests include just one domestic, but the second and third most frequent Leaf defection models are both domestics.
- None of the ten models most frequently conquered by the 500 BEV are domestic models, but the second and third most frequent defections are domestics.
- Similarly for the i3, none of its top ten conquests are domestics but two of the six most frequent defection models are domestic.

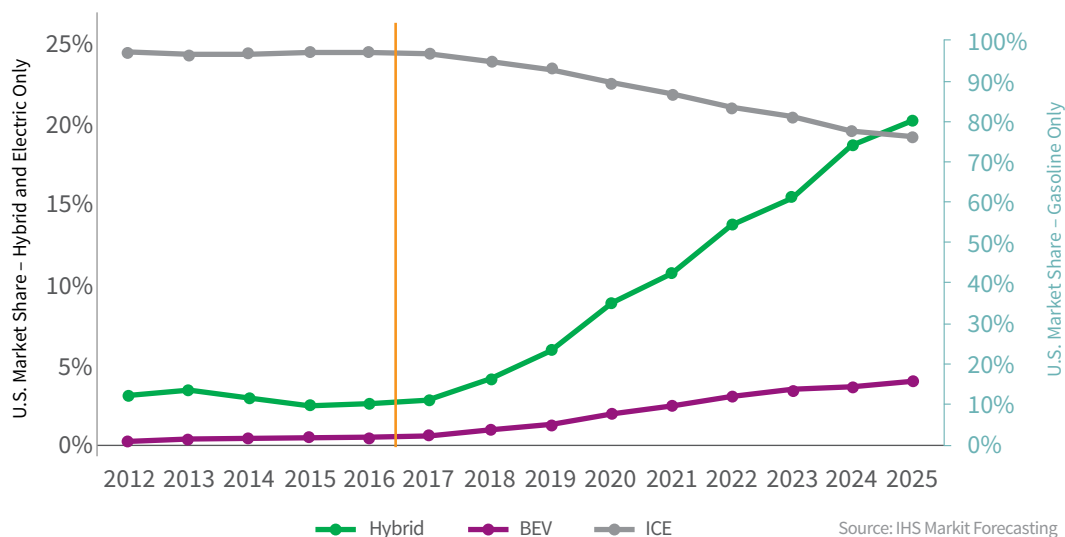
BEV inflow from domestics is far less than outflow to domestics, and BEVs also have a high propensity to defect to another BEV

BEVs have a high propensity to defect to another BEV.

- Three of the ten models to which Leaf households most frequently defect are BEVs.
- The two models the Tesla Model S defects to most often are both BEVs.
- Three of the top four 500 BEV defection models, and five of the top seven, are BEVs.
- The two models to which the Model X most frequently defects are both BEVs.
- Two of the top three i3 defection models are BEVs.

Looking Ahead

Despite manufacturers' recent shifts in spending in favor of electrification, IHS Markit forecasts battery electric vehicles' share of US new light vehicle registrations will only reach 4% by 2025, up from 1% (rounded up) in 2017. Traditional internal combustion engines (ICE) fueled by gasoline will remain the dominant powertrain throughout the next eight years, though its share will decline to 76% by 2025. Most of the ICE's decrease will be taken up by hybrid units, whose share will climb to 20% by 2025.



Despite extensive recent publicity about OEMs' increased interest in battery electric vehicles, IHS Markit forecasts that BEV share of industry will only reach 4% by 2025

Manufacturers will introduce 22 electric vehicles to the US market during the 2018-2020 time period; this number may increase due to the recent interest in the EV market and shift in resources towards development of this powertrain.

US Battery Electric Vehicle Launches		
2018	2019	2020
Audi e-tron	Hundai E-SUV	Audi A3
Hyundai C-SUV BEV	Kia Stonic	Audi A3 Sportback
Jaguar I-Pace	Lucid Air	Audi e-tron Sportback
Volkswagen Crafter	Mercedes-Benz EQC	Honda B-Hatch BEV
	Porsche Mission E	Jaguar I-Type
	Tesla Model Y	Mazda B-Hatch BEV
		Tesla Model 3 Roadster
		Volkswagen D-MPV
		Volkswagen ID C-Hatch
		Volkswagen ID D-CUV
		Volvo C-CUV BEV
		Volvo D-CUV BEV

Source: IHS Markit Forecasting

Of these 22 upcoming BEV launches, 14 are from European manufacturers, 7 from Asians, and one (Tesla Model Y) from a domestic OEM, though not a legacy domestic. Note the skew towards introductions later in the three year period, reflecting the recent focus on this fuel type and development time involved.

Twenty-two BEV models will be introduced in the US market in 2018 through 2020

- 14 European manufacturers
- 7 Asian companies
- Domestic automaker



Tom Libby

Loyalty Principal, IHS Markit

Mr. Libby serves as Loyalty Principal at IHS Markit, focusing on the US new and used vehicle industries. In this role he provides data and analysis to several automotive clients, and he also gives industry insight, data and commentary to the media. He has more than 25 years of experience in sales, marketing, and industry analysis in the US new and used vehicle markets, including more than a decade with Ford Motor Company and thirteen years with another automotive market research firm. Mr. Libby currently is President and a member of the Board of Directors of the Society of Automotive Analysts (he served as President of this organization in 2009 as well). He holds a Bachelor of Arts in history from Amherst College and an MBA in marketing from Columbia University. He has also served as an Adjunct Professor of Market Research at Pepperdine University.

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