

## 1. ZEV

### a. Beyond 2025

The Alliance recognizes that ARB seeks to increase the number of ZEVs in the fleet beyond 2025 to help meet California's environmental goals in 2030 and beyond. At the same time, we recognize that environmental goals alone cannot be used to determine future ZEV requirements. As ARB weighs various policy options, it must consider cost, technical feasibility, consumer acceptance, infrastructure, complementary policies, and other factors. Ultimately, as higher percentages of the fleet are required to be ZEVs, manufacturers must be able to make a profit on them to be sustainable. In determining and setting future requirements, ARB must strike a balance between waiting long enough to have more data on all of these factors versus providing manufacturers sufficient lead-time. We, therefore, offer the following recommendations on the process of setting 2026+ standards.

For ZEVs, the most significant changes (for better and for worse) to the market occur over the next five years.

- Next year begins the steepest ramp up in the ZEV requirements in their history, and not just in California but also in all the S177 states. This ramp continues from 2018 through 2025.
- Automakers plan an unprecedented number of ZEV models (over 70) by 2021 in almost every vehicle category (small cars, SUVs, minivans, AWD, 2WD, etc.).
- The 70+ ZEV models include over 24 BEVs with a 200+ mile range (4 standard size SUVs, 7+ small SUVs, 3 large cars, 7+ mid-sized cars), 6 FCEV including two with over 300-mile range, and over 36 PHEVs in all shapes and sizes.
- Some manufacturers have publicly announced mass-market 200+ mile BEVs at prices at or below those of average gasoline vehicles after Federal and state incentives.
- Some of these models will undoubtedly succeed, but as noted in the ACC MTR, others will fail.

- It is possible, if not likely, fuel prices (gasoline, electricity, and hydrogen) will change over the next five years. Fuel savings is a key driver for customers to choose ZEVs, so electricity and hydrogen prices need to be addressed.
- While in California we have funding through 2021 for the first 100 H2 stations using AB 8 funds, now is the time to plan for the 101+ stations needed to support the large volume of FCEVs expected in this time frame. The need for H2 infrastructure is just as great in the Northeast if they expect to have the same market as California.
- Even today, the number of public charge points in certain areas are not sufficient for the BEVs and PHEVs on the road and this will likely only get worse over time.
- The \$8,000 Federal tax credit for FCEVs has expired, and if left unchanged, the \$7,500 PEV Federal tax credit will be exhausted for some manufacturers over the next two years.
- Many other incentives that encourage customers to choose a ZEV (CVRP, HOV lane access, local incentives like parking, EVSE installation incentives, reduced registration fees) likely will be eliminated entirely or at least dramatically scaled back.

Some changes will help the ZEV market (more models, more vehicle categories, longer ranges, more hydrogen fuel stations), others will harm it (loss of the federal tax credit and other incentives), and still others (fuel prices, rate of infrastructure growth) are unknown.

How the ZEV market emerges from, or how consumers respond to, all the contradictory inputs cannot be fully known and understood until at least the 2021 timeframe. Ideally, ARB would begin developing 2026+ regulations in 2021 with a much clearer picture of the ZEV market when many of the variables mentioned above have settled. However, this may not provide sufficient lead time for 2026 regulations.

ARB must carefully balance developing 2026+ regulations with sufficient lead time, while at the same time waiting to get the best possible picture of the future ZEV market. Moreover, the regulatory development should be flexible enough to allow incorporation of a changing market environment. Developing 2026 regulations in 2018 is clearly premature since very little new knowledge will

have been gained and the more stringent 2018+ regulations will have just started.

Further, we believe that more collaboration between industry and ARB is needed to help determine the most appropriate valuation of credits for 2026+ regulations. As part of the ACC MTR, ARB has done a significant amount of work to evaluate several different credit alternatives, ultimately recommending that the current regulatory credit structure should be maintained. While we continue to believe that PHEVs should be awarded more credit on the basis of their significant electric mileage compared to shorter range BEVs, we also agree that more study would be beneficial. As PHEV electric ranges increase and emission controls continue to improve, we believe the case for these vehicles will become stronger. Therefore, we recommend that a new evaluation of credits be conducted as part of the 2026 rulemaking. We look forward to continuing to work closely with ARB to assist with that analysis.

***Taking all of this into consideration, we recommend ARB staff wait until 2019 to begin the process of developing 2026+ regulations. This should provide sufficient time to allow a board hearing in mid- to late-2020. As noted, this rulemaking should also include a review (if it hasn't happened already) of the S177 state ZEV market and appropriate adjustments to address differences between the Section 177 State markets and the California market.***

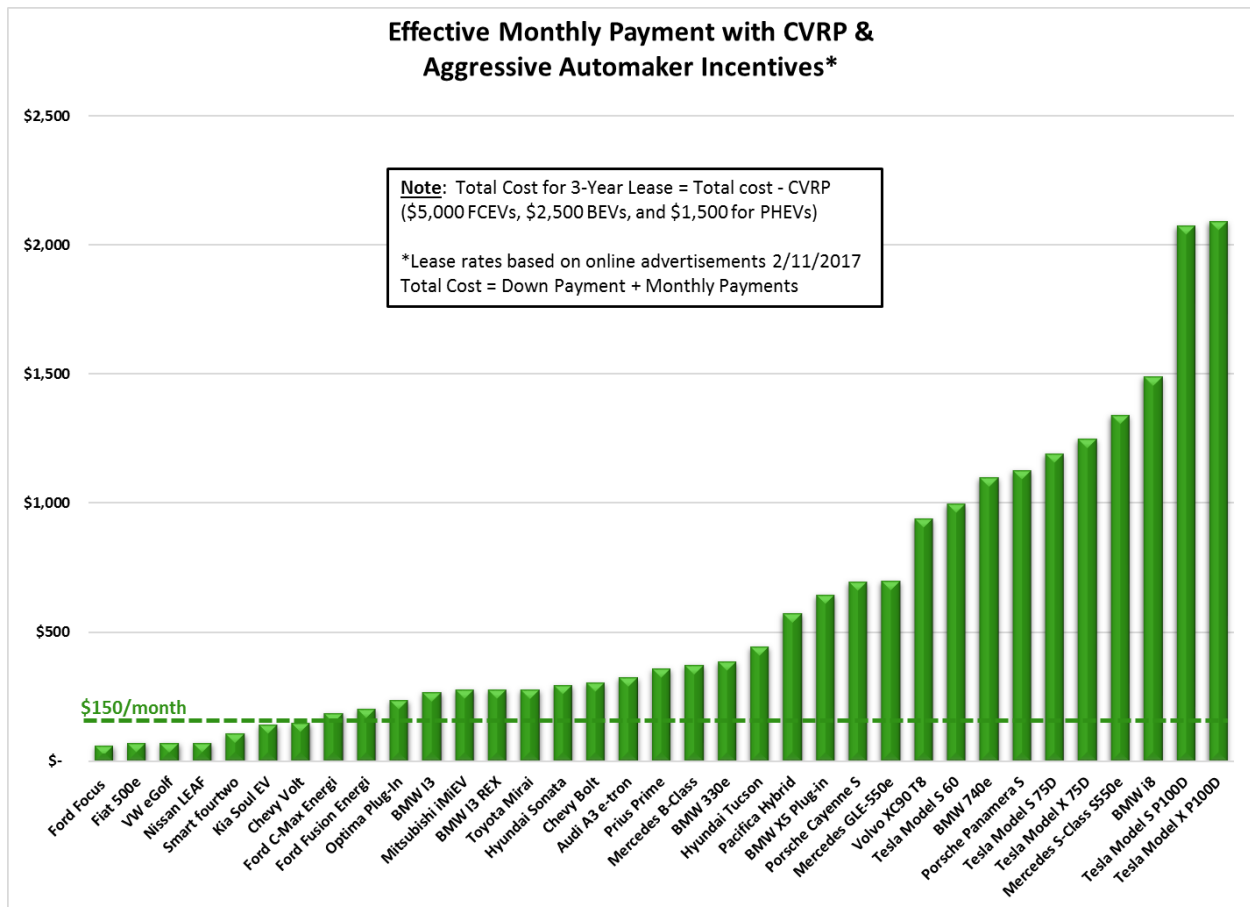
#### **b. Today's ZEV Offerings and Lease Rates**

Automakers have invested \$10s of billions over the last 10 years in every facet of ZEV technology – from batteries to fuel cells, from electric motors to battery cell controllers. They have invested billions of dollars in battery research (from manufacturing to cell materials) and fuel cell stack design and production. As a result of this massive industry-wide investment in technology development, batteries and components are smaller, more powerful, more durable, and more cost-effective than ARB or the auto industry imagined four years ago.

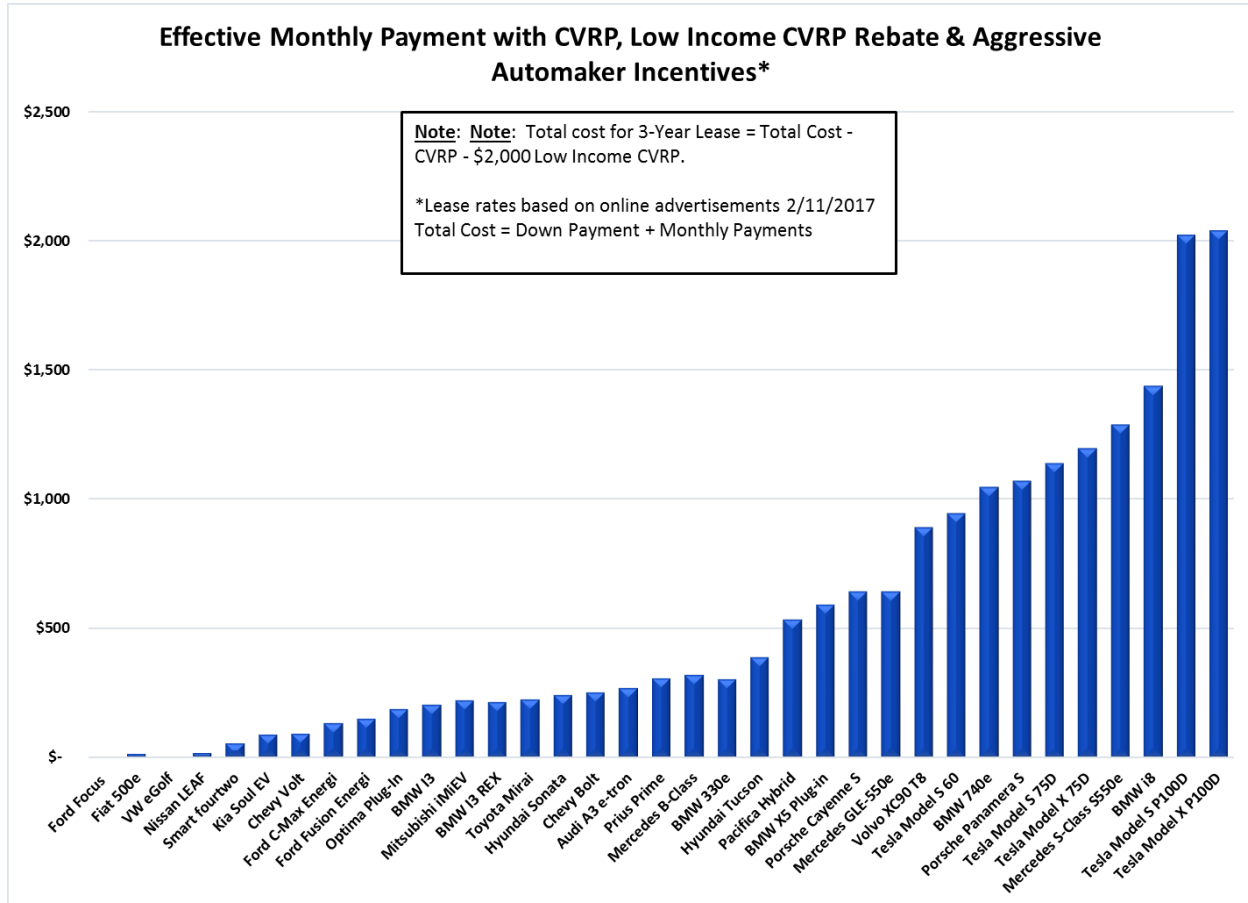
While making these important investments in core technology, automakers have invested billions of dollars in vehicle research and development, validation, production, and promotion. The result is over 30 different FCEVs, BEVs, and PHEVs

that have been praised by critics and customers alike. The ZEVs available today are safe, reliable, durable, loaded with technology, and fun to drive. Moreover, thanks to the generous incentives offered by automakers, dealers, and federal, state, and local governments, customers in California can lease numerous ZEVs for \$150 per month or less depending on location – see **Figure 1-1** and **Figure 1-2**.

**Figure 1-1: Lease rates for CA residents w/CVRP**



**Figure 1-2: Lease rates for San Joaquin Valley Residents w/CVRP and SJV Drive Clean**



The automakers' commitment to zero emission technology has only intensified. Over the past couple of years, most automakers have announced multi-billion dollar investments into zero emission technology and vehicle development and delivery. As a result, customers will see even more ZEV models, in more vehicle categories, with better performance and longer ranges over the next 5 years.

Today, there are plenty of ZEVs in all shapes and sizes, two-wheel drive (2WD) and all-wheel drive (AWD), at every price point, and in almost every vehicle category with more and better coming. However, even the market in California has been somewhat stagnant since 2014 – hovering between 3 and 4 percent. The problem is not a lack of ZEVs; the problem is a lack of interested customers. ARB staff noted in

the ACC MTR that having the technology and vehicles is not sufficient without strong and consistent complementary measures. We agree.

### c. Complementary Measures

#### i. Incentives:

Incentives are a critical enabler for ZEV customers. California's Clean Vehicle Rebate Project (CVRP) demonstrates a commitment by the state. When it is available, the CVRP generally covers the entire down payment of many low-cost leases. Of the residents receiving the CVRP, about 3 in 4 said that the rebate was extremely or very important.<sup>2</sup> Georgia is a good example of the importance of incentives. When Georgia eliminated its \$5,000 BEV rebate in July, 2015, BEV sales promptly dropped over 90 percent.<sup>3</sup>

In addition to financial incentives, HOV Lane access has proven to be a particularly important driver of ZEV sales in urban areas in California. According to surveys conducted by CSE, HOV lane access was the second most important motivation (behind fuel costs savings) for purchasing a PHEV between 2012 and 2015 across all census tracts including disadvantaged communities.<sup>2</sup> Likewise, a UCLA study showed that 40% of ZEV sales in major urban areas of California are tied to green and white HOV access stickers.<sup>4</sup>

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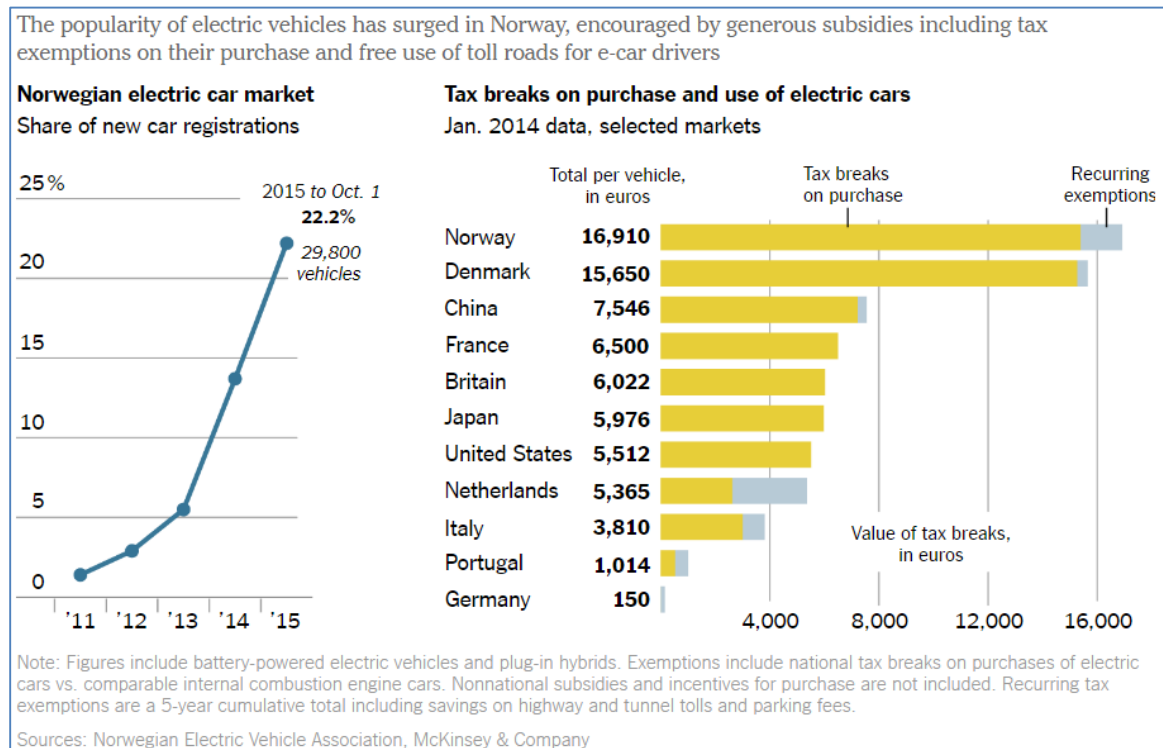
<sup>2</sup> Center for Sustainable Energy (2016). California Air Resources Board Clean Vehicle Rebate Project, EV Consumer Survey Dashboard. Retrieved 4-Feb-2017 from <http://cleanvehiclerebate.org/survey-dashboard/ev>.

<sup>3</sup> IHS Automotive new vehicle registration data.

<sup>4</sup> Weikel, Dan (2015, November 10). Law Expanding HOV Access to Plug-In Cars Drives Higher Sales, UCLA Study Says. *The Los Angeles Times*. Retrieved from <http://www.latimes.com>

Although rebates and HOV lane access are important, they may not suffice to reach California's market share targets. Norway presently has the largest market share of ZEVs and is a model for encouraging electric car sales (see **Figure 1-3**).<sup>5</sup>

**Figure 1-3: Fast Lane for Electric Cars<sup>6</sup>**



<sup>5</sup> Jolly, D. (2015, October 16th). *Norway Is a Model for Encouraging Electric Car Sales*. Retrieved from The New York Times: <https://www.nytimes.com/2015/10/17/business/international/norway-is-global-model-for-encouraging-sales-of-electric-cars.html>

<sup>6</sup> *ibid*

**Figure 1-4: Norway Vehicle Prices, Including Taxes and Fees<sup>7</sup>**



An example of the impact of Norway's taxes and fees can be seen in **Figure 1-4** comparing the cost of Tesla Model S to similar gasoline luxury vehicles. "The Tesla Model S is exempt from Norway's steep levies on purchases of fuel-burning vehicles that can double the base price of a car. This makes the Model S a relative bargain for the wealthy Norwegians that can afford a six-figure set of wheels."<sup>8</sup> Comparing Norway's incentives to California's is instructive.

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<sup>7</sup> <http://www.ibtimes.com/tesla-owners-norway-get-134000-tax-break-which-more-base-price-model-s-1507740>

<sup>8</sup> *ibid*

**Table 1-1: Norway vs California ZEV Incentives and Market Share<sup>9</sup>**

	Norway	CA
<b>Vehicle Cost Incentives</b>	\$8,000 to \$135,000 tax cost reduction	\$1,500 - \$5,000 rebates
<b>When 1st cost incentive started</b>	1990	2010
<b>Electric Cost Per kW-hr</b>	\$0.11	\$0.17
<b>Gas Cost Per Gallon</b>	\$7.20	\$2.50
<b>Other incentives</b>	Free parking and tollways	HOV Lane Access
<b>2016 Market Share</b>	29%	3%

As shown in **Table 1-1**, Norway makes the total cost of ownership of ZEVs significantly cheaper than their gasoline alternatives. BEVs are exempt from registration tax (averaging \$12,000), the 25% Vehicle Added Tax (VAT), and don't have to pay for using toll roads or municipal parking. Due to the tax structure in Norway, which includes factoring in emissions performance, an electric VW Golf is approximately \$9,000 cheaper than its diesel counterpart.<sup>10</sup> Once the large differential between electricity and gasoline prices is factored in it becomes clear why Norway has the highest electric vehicle market share in the world. **The vehicles are cheaper to buy due to the tax benefit, cheaper to use due to the energy price differential, and cheaper to travel in due to their exemption from toll roads and parking fees. This approach has yielded a market share in Norway that is ten times that of California.**

The constancy of Norway's incentives is important to note. Despite their importance to California ZEV market development, availability of both CVRP and HOV lane access has been sporadic over the last couple of years. PHEV HOV lane stickers were not available for the nine months from December 2015 to September 2016, and all HOV Stickers are currently scheduled to expire at the

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<sup>9</sup> See chart and footnotes in **Figure 1-19: Incentives, Energy Costs, & Market Share**

<sup>10</sup> Id. Jolly

end of 2018. CVRP funding was exhausted several times over the past few years, resulting in long delays for customers receiving rebates. Legislative requirements about CVRP eligibility change each year resulting in further confusion for both dealers and customers.

Existing ZEV owners are conditioned for incentives. With the anticipated reduction of Government incentives/motivators which align pricing with conventional gasoline products phasing out, returning second generation BEV buyers may defect at a higher than expected rate. The retention of early ZEV technology adopters is critical because of their social advocacy, which extends well beyond the environmental benefits and share a wider range of additional benefits (lower maintenance costs, fun to drive, avoiding the gas station, performance, HOV, parking incentives, etc.). However, their expectation for incentives will continue and if removed will provide a reason to defect. Their advocacy in favor of ZEVs could turn the other way.

Incentives are critically important for ZEV market development, and to be effective, the incentives must be consistently available and the eligibility criteria clearly defined and stable. Otherwise, the ability of these incentives to energize the ZEV market is greatly diminished. We recognize and appreciate ARB's continued and consistent support for these programs. The Alliance and our members have worked with ARB, the legislature, and the Governor's office to encourage and secure appropriate incentives, and will continue to do so.

## **ii. Infrastructure**

Mainstream customers will not buy a vehicle that is difficult to fuel. Public infrastructure for both, plug-in electric vehicles (PEVs, which includes both BEVs and PHEVs) and hydrogen FCEVs, not only relieves "range anxiety," but also raises consumer awareness of the technology and increases electric miles. Overall, we agree with the Governor's ZEV Action Plan that "A massive scale up of charging and fueling stations is needed" to meet state goals and that

“consumer confidence needed to adopt light-duty ZEVs relies in large part on adequate charging and fueling infrastructure.”<sup>11</sup>

Electric Charging Infrastructure: Governor Brown’s Executive Order B-16-2012 directed the state agencies to establish benchmarks to ensure the State’s zero-emission vehicle infrastructure can support up to one million PEVs by 2020.

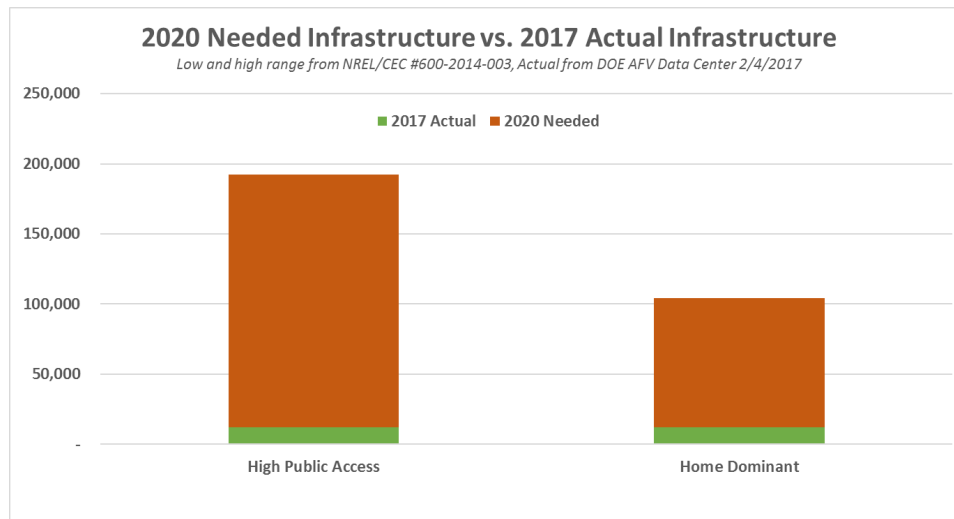
To implement the Executive Order, the California Energy Commission contracted a study to determine the minimum number of charging stations needed to support 1 million PEVs by 2020. The study, conducted by the National Renewable Energy Laboratory,<sup>12</sup> found that a minimum of 102,000 (if most PEV charging occurs at home) to 190,000 (if more charging occurs away from home) public and workplace Level 2 charging stations are needed. As shown in **Figure 1-5**, less than three years before the 2020 deadline, California is falling far behind with only 6 percent and 12 percent of the minimum needed charging. Recent action by the California Public Utilities Commission (CPUC) results in less than 25 percent of the goal.

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<sup>11</sup> [https://www.gov.ca.gov/docs/2016\\_ZEV\\_Action\\_Plan.pdf](https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf) (page 23)

<sup>12</sup> Melaina, Marc, Michael Helwig. (National Renewable Energy Laboratory). 2014. *California Statewide Plug-In Electric Vehicle Infrastructure Assessment*. California Energy Commission. Publication Number: CEC-600-2014-003

**Figure 1-5: Infrastructure Needed by 2020 Compared to Current**



The lack of infrastructure in California is far more than a simple conclusion from a research report. Most PEV drivers can attest to the current lack of public and workplace chargers. PEV drivers, once certain of an available workplace or public charger, are now equally certain that every charger will be taken. The New York Times reported, “In California, Electric Cars Outpace Plugs, and Sparks Fly” over a year ago.<sup>13</sup> Likewise, over three years ago and more recently last August, The Mercury News first reported, “‘Charge rage’: Too many electric cars, not enough workplace chargers.”<sup>14</sup>

The charging infrastructure is further behind outside of California. The chargers per vehicle referenced in the ACC MTR Appendix D is not the appropriate metric when planning for future success. This metric looks favorable due to historic low sales. However, if the S177 states plan to reach their goal of 1.8 million ZEVs by

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<sup>13</sup> Richtel, Matt (2015, October 10). In California, Electric Cars Outpace Plugs, and Sparks Fly. *The New York Times*. Retrieved from <http://www.nytimes.com>

<sup>14</sup> Hull, Dana (2014, Jan 10; updated 2016, Aug 12). ‘Charge rage’: Too many electric cars, not enough workplace chargers. *The Mercury News*. Retrieved from <http://www.mercurynews.com/>

2025, the NREL analysis suggests that between 180,000 and 342,000 Level 2 public and workplace chargers will be needed – a 29-fold increase from the 5,897 chargers in those markets today.<sup>15</sup>

While we agree with the ACC MTR point in Appendix D that “the introduction of BEVs with ranges of 200 to 250 miles...could significantly lessen the dependence upon public and private Level 1 and Level 2 chargers,” and we recognize that NREL is updating their report based on this, it does not change the fact that the current infrastructure is inadequate for the current PEVs on the road, and many more PEVs are required. Regardless of the impact of future long-range BEVs, the number of public and workplace chargers must increase soon if we truly intend to electrify transportation and expand the consumer base.

To understand the impact on the ZEV market, ARB should investigate the impact that inadequate workplace and public charging has on consumer demand for PEVs. This analysis would provide insight into both current and future rulemakings.

As noted in Appendix D, approximately 50% of California’s population resides in rental housing or multi-unit dwellings (MUDs). These people often lack access to charging at home, a situation which “presents unique challenges and may result in the need for more public charging infrastructure or dedicated resources to resolve these challenges.” (ACC MTR, Appendix D, page D-22) In the unlikely event that Level 1 charging is a viable option at MUDs, it may not meet the customers’ charging needs, especially if overnight charging is not possible. Moreover, MUDs frequently do not have dedicated parking.

Local permitting procedures and building codes can serve as significant barriers to the commercialization of PEVs. For example, existing building infrastructure may not have proper electrical service (i.e., service amp rating) to accommodate charging. MUDs and older homes are particularly problematic since they can require substantial retrofitting (e.g. tearing up of asphalt) to install charging

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<sup>15</sup> Air Resources Board, *Advanced Clean Cars Mid-Term Review, Appendix D, Zero Emission Vehicle Infrastructure Status in California and Section 177 ZEV States*, January 18, 2017; Needed infrastructure based on NREL Assessment (see footnote 5) scaled from 1 million PEVs to 1.8 million.

stations. In addition, if the transformers that feed the building are not sufficient to handle the electricity volume, this must be upgraded at considerable expense. Further, there may be disagreements where home owner associations or condo associations are unable to accommodate the expensive retrofits, or those who do not drive PEVs are unwilling to essentially subsidize those who do.

In addition, in high density areas like inner cities, land and parking is highly valued and the profit margins for turning space into publicly available charging stations are so low that there is no payback or it actually creates a decrease in value (e.g. if the charging station revenue doesn't cover property taxes). If governments depend on the infrastructure to be placed on private property, there must be sufficient value for this to be a sustainable business.

Hydrogen Infrastructure: AB 8 (Perea, 2013) authorized funding for up to 100 hydrogen fueling stations; however, despite the concerted efforts of state agencies, the Governor's office, automakers, station operators, and hydrogen fuel providers, stations have been slow to come on line. We believe there is some inaccurate information in the staff report regarding the status of the station rollout. In particular, Appendix D states " California's hydrogen fueling network currently contains 50 stations that are either operating or received a grant award for development and are currently in some phase of development" (ACC MTR Appendix D, page D-28) and "all remaining stations were expected to be completed by 2017" (page D-32). The actual number of public retail stations is 48, with currently only 25 now open. Based upon our evaluation of the current situation, we expect up to about 35 retail stations to open by the end of this year. We anticipate up to 6 stations should open in 2018, and the remaining 7 stations openings are indeterminate, and subject to cancellation.

In fact, some automakers have been forced to delay delivery of vehicles because of a lack of hydrogen refueling stations and due to an insufficient number of redundant stations in the local market.

The Alliance thinks this is an appropriate time to review the progress so far and make adjustments as necessary. For example,

1. The voice of the customer, by way of collaborative OEM market analysis, must play a primary role in selection of target station locations, and assessment of demand level.
2. Both coverage and capacity are important. West Sacramento is an example of an island station that has caused issues with customer satisfaction because of inadequate coverage in the form of station redundancy. Network analysis recommends a minimum of 3 stations for a local market area (e.g., Sacramento, Santa Monica) in order to approach conventional gasoline station availability.
3. New station projects should be awarded to well capitalized companies with a verified match of cost-share in excess of the simple cap-ex allocation, and with a proven track record. Station capacity must grow by 2-3x, with multiple independent H70 fueling positions, and verified capability to perform consecutive fills with High-SOC, and high-availability.
4. Station project applicants should demonstrate control of the project site (i.e., lease contract or ownership) as a prerequisite to consideration for solicitation awards.
5. Local communities and property owners/operators need to be incentivized to help drive this effort. They continue to be ignored, seriously impacting station timelines.
6. Project grant awardees must be incentivized to complete within 24 months of contract agreement, or be subject to termination and funding reassignment after a defined set of metrics not to exceed 36 months.

***Infrastructure is vital to the ZEV market now and in the future, and current infrastructure implementation is falling behind. The Alliance and our members will continue working with ARB, CPUC, CEC, the legislature, and the Governor's office to secure appropriate and sufficient infrastructure.***

### **iii. Fuel Pricing**

Fuel price is an important factor to encourage customers to purchase a ZEV.

Stakeholders (utilities, environmental organizations, and even some state agencies) frequently equate driving a PEV to paying the equivalent of \$1 per

gallon of gasoline. In the overwhelming majority of California residences, this is simply not true. If mass-market customers purchase a PEV with the expectation of ultra-low operating costs, only to realize they pay far more to operate on electricity than on gas, customers will be disappointed and reject the technology which could set the ZEV program back a decade.

Electricity: The Alliance commissioned Crossborder Energy (CE) to study residential utility prices last year and we have attached that study. As shown in **Table 1-2**, the CE study found that for the 90+ percent of Californians with flat-rate electricity rates, they would pay far more to fuel their PEVs compared to a similar 40-mile per gallon gasoline vehicle. For every case but one, driving electric cost significantly more than driving one of many high-mileage gasoline cars.

***Table 1-2: Residential Charging Rates for Flat-Rate Customers (over 90% of Californians)***

Utility Flat Rate	Nissan LEAF (price per gallon of gas equivalent)	Chevrolet Volt (price per gallon of gas equivalent)
PG&E	\$3.69	\$3.85
SCE	\$3.07	\$3.20
SDG&E	\$3.98	\$4.15
LADWP	\$2.47	\$2.57
SMUD	\$1.93	\$2.01

To be sure, utilities offer time-of-use (TOU) rate plans that dramatically reduce the cost of charging off-peak with several options where operating costs are in the \$1 per gallon of gas equivalent (see **Table 1-3**). However, these plans are a complex mess of options that confuse customers and dealer salespeople alike. To determine the true cost of shifting from a flat-rate plan to one of the many TOU rate plans offered by most utilities, customers would need to analyze their historical electric usage, hour-by-hour using both the summer and winter rate schedules.

*Table 1-3: Residential Charging Rates for TOU Customers*

Utility TOU Plan	Nissan LEAF (price per gallon of gas equivalent)	Chevrolet Volt (price per gallon of gas equivalent)
PG&E: E-6	\$3.37	\$3.52
PG&E: E-TOU A	\$2.93	\$3.05
PG&E: E-TOU B	\$2.21	\$2.30
PG&E: EV-A	\$1.18	\$1.23
PG&E: EV-B*	\$1.17	\$1.22
SCE: TOU-D	\$1.24	\$1.29
SCE: TOU-D-T	\$2.57	\$2.67
SCE: TOU-D-TEV	\$1.02	\$1.06
SCE: TOU-EV-1*	\$1.28	\$1.33
SDG&E: DR-TOU	\$3.76	\$3.92
SDG&E: EV-TOU*	\$1.84	\$1.92
SDG&E: EV-TOU-2	\$1.84	\$1.92
SDG&E: TOU-DR	\$3.77	\$3.92
LADWP: R-1B	\$2.06	\$2.15
LADWP: R-1B (EV)*	\$1.81	\$1.88
SMUD: R-TOU	\$0.74	\$0.77

\* These TOU rate plans require a separate meter for the EV charger.

One online EV blogger did just that – analyzed the different TOU rate plans offered by Southern California Edison (SCE).<sup>16</sup> The comprehensive and well-documented analysis demonstrates the complexity of just one utility’s TOU rate plans. (See, **Figure 1-6** on the following page.) For this blogger, based on his or her electricity usage, the SCE TOU-D-B offered the lowest overall rates (slightly higher than SCE TOU-D-A in winter, but significantly lower in summer).

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<sup>16</sup> vin (2015, February 14), *New SCE Time-of-Use Rate Structure*, Retrieved from <http://ev-vin.blogspot.com/2015/02/new-sce-time-of-use-rate-structure.html>

Figure 1-6: SCE TOU Rate Plan Analysis<sup>6</sup>

Plan	Targeted Users	Peak Period	Super-Off-Peak Period	Peak Rates	Off-peak Rates	Super Off-Peak Rates	Monthly Fee	Tiered?
TOU-D-TEV	Customers that charge EVs at home	10 hours 8am-6pm	6 hours 12am-6am	\$0.19 - \$0.49	\$0.13 - \$0.31	0.11	\$0.00	Yes
TOU-D	Self-generation customers High-usage customers	6 hours 12pm-6pm	0 hours	\$0.22 - \$0.47	\$0.13 - \$0.26	N/A	\$0.93	Yes
TOU-D-A	Customers that consume less than 700kWh/mo	6 hours 2pm-8pm	10 hours 10pm-8am	\$0.37 - \$0.47	\$0.26 - \$0.30	0.11	\$0.93	No
TOU-D-B	Customers that consume more than 700kWh/mo	6 hours 2pm-8pm	10pm-8am	\$0.25 - \$0.35	\$0.14 - \$0.18	0.11	\$16	No

WINTER RATE									TOU-D-TEV			TOU-D			TOU-D-A			TOU-D-B		
Hour	1/26/15	M	T	W	T	F	S	2/1/15	Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost
12:00 AM	3.04	2.6	4.52	4.75	4.5	4.31	4.08		\$ 0.11	\$ 0.11	\$ 3.06	\$ 0.19	\$ 0.19	\$ 5.28	\$ 0.11	\$ 0.11	\$ 3.06	\$ 0.11	\$ 0.11	\$ 3.06
1:00 AM	2.3	3.41	3.93	4.06	3.86	4.35	4.55		\$ 0.11	\$ 0.11	\$ 2.91	\$ 0.19	\$ 0.19	\$ 5.03	\$ 0.11	\$ 0.11	\$ 2.91	\$ 0.11	\$ 0.11	\$ 2.91
2:00 AM	3.07	3.66	3.71	3.71	3.72	3.9	3.74		\$ 0.11	\$ 0.11	\$ 2.81	\$ 0.19	\$ 0.19	\$ 4.85	\$ 0.11	\$ 0.11	\$ 2.81	\$ 0.11	\$ 0.11	\$ 2.81
3:00 AM	2.36	3.67	2.25	3.56	3.61	3.77	2.41		\$ 0.11	\$ 0.11	\$ 2.38	\$ 0.19	\$ 0.19	\$ 4.11	\$ 0.11	\$ 0.11	\$ 2.38	\$ 0.11	\$ 0.11	\$ 2.38
4:00 AM	2.97	4.08	2.91	4.36	4.29	4.41	3.11		\$ 0.11	\$ 0.11	\$ 2.87	\$ 0.19	\$ 0.19	\$ 4.96	\$ 0.11	\$ 0.11	\$ 2.87	\$ 0.11	\$ 0.11	\$ 2.87
5:00 AM	1.64	2.9	3.03	4.33	4.37	4.52	3.11		\$ 0.11	\$ 0.11	\$ 2.63	\$ 0.19	\$ 0.19	\$ 4.54	\$ 0.11	\$ 0.11	\$ 2.63	\$ 0.11	\$ 0.11	\$ 2.63
6:00 AM	0.67	0.59	2.23	3.45	3.42	1.99	1.94		\$ 0.24	\$ 0.24	\$ 3.38	\$ 0.19	\$ 0.19	\$ 2.72	\$ 0.11	\$ 0.11	\$ 1.57	\$ 0.11	\$ 0.11	\$ 1.57
7:00 AM	0.49	0.4	1.69	2.47	2.36	0.63	2.01		\$ 0.24	\$ 0.24	\$ 2.38	\$ 0.19	\$ 0.19	\$ 1.91	\$ 0.11	\$ 0.11	\$ 1.11	\$ 0.11	\$ 0.11	\$ 1.11
8:00 AM	0.35	0.43	0.53	0.49	0.41	0.5	1.93		\$ 0.24	\$ 0.24	\$ 1.10	\$ 0.19	\$ 0.19	\$ 0.88	\$ 0.26	\$ 0.26	\$ 1.21	\$ 0.14	\$ 0.14	\$ 0.65
9:00 AM	0.4	0.42	0.38	0.34	0.5	0.59	2.14		\$ 0.24	\$ 0.24	\$ 1.13	\$ 0.19	\$ 0.19	\$ 0.91	\$ 0.26	\$ 0.26	\$ 1.24	\$ 0.14	\$ 0.14	\$ 0.67
10:00 AM	0.26	0.34	0.36	0.32	0.31	0.55	1.91		\$ 0.30	\$ 0.24	\$ 1.05	\$ 0.19	\$ 0.19	\$ 0.77	\$ 0.26	\$ 0.26	\$ 1.05	\$ 0.14	\$ 0.14	\$ 0.57
11:00 AM	0.34	0.39	0.3	0.27	0.44	0.4	1.22		\$ 0.30	\$ 0.24	\$ 0.90	\$ 0.19	\$ 0.19	\$ 0.64	\$ 0.26	\$ 0.26	\$ 0.87	\$ 0.14	\$ 0.14	\$ 0.47
12:00 PM	0.29	0.33	0.35	0.4	0.37	0.61	1.02		\$ 0.30	\$ 0.24	\$ 0.90	\$ 0.29	\$ 0.19	\$ 0.81	\$ 0.26	\$ 0.26	\$ 0.88	\$ 0.14	\$ 0.14	\$ 0.47
1:00 PM	0.44	0.51	0.42	0.65	0.51	1	1.03		\$ 0.30	\$ 0.24	\$ 1.23	\$ 0.29	\$ 0.19	\$ 1.11	\$ 0.26	\$ 0.26	\$ 1.19	\$ 0.14	\$ 0.14	\$ 0.64
2:00 PM	0.33	0.34	0.27	0.43	0.33	0.36	1.01		\$ 0.30	\$ 0.24	\$ 0.83	\$ 0.29	\$ 0.19	\$ 0.74	\$ 0.37	\$ 0.26	\$ 0.99	\$ 0.25	\$ 0.14	\$ 0.62
3:00 PM	0.51	0.57	0.48	0.48	0.61	0.38	1.03		\$ 0.30	\$ 0.24	\$ 1.12	\$ 0.29	\$ 0.19	\$ 1.02	\$ 0.37	\$ 0.26	\$ 1.35	\$ 0.25	\$ 0.14	\$ 0.86
4:00 PM	0.61	0.37	0.68	0.46	0.62	0.27	1.19		\$ 0.30	\$ 0.24	\$ 1.16	\$ 0.29	\$ 0.19	\$ 1.06	\$ 0.37	\$ 0.26	\$ 1.39	\$ 0.25	\$ 0.14	\$ 0.89
5:00 PM	0.65	0.3	0.69	0.62	0.64	0.36	0.97		\$ 0.30	\$ 0.24	\$ 1.18	\$ 0.29	\$ 0.19	\$ 1.08	\$ 0.37	\$ 0.26	\$ 1.42	\$ 0.25	\$ 0.14	\$ 0.91
6:00 PM	0.75	0.51	0.54	0.9	0.81	0.75	1.26		\$ 0.24	\$ 0.24	\$ 1.31	\$ 0.19	\$ 0.19	\$ 1.05	\$ 0.37	\$ 0.26	\$ 1.82	\$ 0.25	\$ 0.14	\$ 1.16
7:00 PM	0.76	0.58	0.77	0.87	1.11	1.2	1.58		\$ 0.24	\$ 0.24	\$ 1.63	\$ 0.19	\$ 0.19	\$ 1.31	\$ 0.37	\$ 0.26	\$ 2.24	\$ 0.25	\$ 0.14	\$ 1.41
8:00 PM	1.17	2.98	1.34	1.19	2.42	3.88	3.17		\$ 0.24	\$ 0.24	\$ 3.82	\$ 0.19	\$ 0.19	\$ 3.07	\$ 0.26	\$ 0.26	\$ 4.20	\$ 0.14	\$ 0.14	\$ 2.26
9:00 PM	0.93	0.98	1.1	0.94	0.87	1.42	1.21		\$ 0.24	\$ 0.24	\$ 1.76	\$ 0.19	\$ 0.19	\$ 1.42	\$ 0.26	\$ 0.26	\$ 1.94	\$ 0.14	\$ 0.14	\$ 1.04
10:00 PM	0.9	0.82	1.19	1.09	0.85	0.94	1.18		\$ 0.24	\$ 0.24	\$ 1.65	\$ 0.19	\$ 0.19	\$ 1.32	\$ 0.11	\$ 0.11	\$ 0.77	\$ 0.11	\$ 0.11	\$ 0.77
11:00 PM	1.28	2.35	3.3	3.59	1.49	1.01	2.47		\$ 0.24	\$ 0.24	\$ 3.67	\$ 0.19	\$ 0.19	\$ 2.94	\$ 0.11	\$ 0.11	\$ 1.70	\$ 0.11	\$ 0.11	\$ 1.70
Total Consumption for week 274.53									Baseline Allocation Credit (Weekly) \$ -			\$ -			\$ (7.21)			\$ -		
Monthly Baseline Alloc 313.08									Rate Plan Fee (Weekly) \$ -			\$ 0.21			\$ 0.21			\$ 3.68		
									TOTAL TOU-D-TEV \$ 46.85			TOTAL TOU-D \$ 53.52			TOTAL TOU-D-A \$ 36.59			TOTAL TOU-D-B \$ 38.10		

SUMMER RATE								TOU-D-TEV			TOU-D			TOU-D-A			TOU-D-B		
Hour	8/18/14				8/24/14			Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost	Weekday Rate	Weekend Rate	Weekly Cost
12:00 AM	5	5.98	4.8	4.74	5.69	6.1	8.26	\$ 0.10	\$ 0.10	\$ 4.06	\$ 0.22	\$ 0.22	\$ 8.93	\$ 0.11	\$ 0.11	\$ 4.46	\$ 0.11	\$ 0.11	\$ 4.46
1:00 AM	2.96	5.22	4.24	4.18	4.9	4.92	7.31	\$ 0.10	\$ 0.10	\$ 3.37	\$ 0.22	\$ 0.22	\$ 7.42	\$ 0.11	\$ 0.11	\$ 3.71	\$ 0.11	\$ 0.11	\$ 3.71
2:00 AM	1.7	5.04	4.17	3.99	4.53	4.82	5.58	\$ 0.10	\$ 0.10	\$ 2.98	\$ 0.22	\$ 0.22	\$ 6.56	\$ 0.11	\$ 0.11	\$ 3.28	\$ 0.11	\$ 0.11	\$ 3.28
3:00 AM	1.09	4.55	4.21	4	4.53	4.56	4.78	\$ 0.10	\$ 0.10	\$ 2.77	\$ 0.22	\$ 0.22	\$ 6.10	\$ 0.11	\$ 0.11	\$ 3.05	\$ 0.11	\$ 0.11	\$ 3.05
4:00 AM	2.68	5.46	5	4.91	5.2	5.21	5.39	\$ 0.10	\$ 0.10	\$ 3.39	\$ 0.22	\$ 0.22	\$ 7.45	\$ 0.11	\$ 0.11	\$ 3.72	\$ 0.11	\$ 0.11	\$ 3.72
5:00 AM	2.99	5.47	4.99	4.94	5.05	5.08	4.55	\$ 0.10	\$ 0.10	\$ 3.31	\$ 0.22	\$ 0.22	\$ 7.28	\$ 0.11	\$ 0.11	\$ 3.64	\$ 0.11	\$ 0.11	\$ 3.64
6:00 AM	0.98	3.02	3.44	3.53	3.71	2.42	2.5	\$ 0.26	\$ 0.26	\$ 5.03	\$ 0.22	\$ 0.22	\$ 4.31	\$ 0.11	\$ 0.11	\$ 2.16	\$ 0.11	\$ 0.11	\$ 2.16
7:00 AM	0.71	1.6	0.73	2.11	2.46	2.29	2.6	\$ 0.26	\$ 0.26	\$ 3.21	\$ 0.22	\$ 0.22	\$ 2.75	\$ 0.11	\$ 0.11	\$ 1.38	\$ 0.11	\$ 0.11	\$ 1.38
8:00 AM	0.57	0.58	0.43	1.18	0.46	1.95	2.77	\$ 0.26	\$ 0.26	\$ 2.04	\$ 0.22	\$ 0.22	\$ 1.75	\$ 0.30	\$ 0.30	\$ 2.38	\$ 0.18	\$ 0.18	\$ 1.43
9:00 AM	0.31	0.64	0.28	0.25	0.36	0.54	2.92	\$ 0.26	\$ 0.26	\$ 1.36	\$ 0.22	\$ 0.22	\$ 1.17	\$ 0.30	\$ 0.30	\$ 1.59	\$ 0.18	\$ 0.18	\$ 0.95
10:00 AM	0.34	0.61	1.09	0.28	0.28	0.55	3.29	\$ 0.43	\$ 0.26	\$ 2.11	\$ 0.22	\$ 0.22	\$ 1.42	\$ 0.30	\$ 0.30	\$ 1.93	\$ 0.18	\$ 0.18	\$ 1.16
11:00 AM	0.34	1.17	2.33	0.33	0.28	0.82	3.37	\$ 0.43	\$ 0.26	\$ 3.00	\$ 0.22	\$ 0.22	\$ 1.90	\$ 0.30	\$ 0.30	\$ 2.59	\$ 0.18	\$ 0.18	\$ 1.56
12:00 PM	0.35	0.83	1.57	0.33	0.3	0.78	2.86	\$ 0.43	\$ 0.26	\$ 2.40	\$ 0.43	\$ 0.22	\$ 2.24	\$ 0.30	\$ 0.30	\$ 2.11	\$ 0.18	\$ 0.18	\$ 1.26
1:00 PM	0.58	1.46	0.54	0.58	0.45	0.94	1.92	\$ 0.43	\$ 0.26	\$ 2.30	\$ 0.43	\$ 0.22	\$ 2.17	\$ 0.30	\$ 0.30	\$ 1.94	\$ 0.18	\$ 0.18	\$ 1.16
2:00 PM	0.51	1.37	0.28	0.38	0.36	0.44	1.2	\$ 0.43	\$ 0.26	\$ 1.68	\$ 0.43	\$ 0.22	\$ 1.60	\$ 0.47	\$ 0.30	\$ 1.86	\$ 0.35	\$ 0.18	\$ 1.31
3:00 PM	0.81	2.33	0.37	0.61	0.63	0.41	0.88	\$ 0.43	\$ 0.26	\$ 2.39	\$ 0.43	\$ 0.22	\$ 2.31	\$ 0.47	\$ 0.30	\$ 2.62	\$ 0.35	\$ 0.18	\$ 1.89
4:00 PM	0.55	0.86	1.52	1.65	0.95	0.41	0.98	\$ 0.43	\$ 0.26	\$ 2.75	\$ 0.43	\$ 0.22	\$ 2.67	\$ 0.47	\$ 0.30	\$ 3.02	\$ 0.35	\$ 0.18	\$ 2.19
5:00 PM	0.77	0.32	1.58	2.3	0.79	0.74	0.53	\$ 0.43	\$ 0.26	\$ 2.82	\$ 0.43	\$ 0.22	\$ 2.74	\$ 0.47	\$ 0.30	\$ 3.09	\$ 0.35	\$ 0.18	\$ 2.24
6:00 PM	0.79	0.88	1.98	1.5	0.78	0.66	1.64	\$ 0.26	\$ 0.26	\$ 2.11	\$ 0.22	\$ 0.22	\$ 1.81	\$ 0.47	\$ 0.30	\$ 3.48	\$ 0.35	\$ 0.18	\$ 2.49
7:00 PM	0.86	1.19	1.16	0.64	1.01	0.96	2.34	\$ 0.26	\$ 0.26	\$ 2.09	\$ 0.22	\$ 0.22	\$ 1.80	\$ 0.47	\$ 0.30	\$ 3.27	\$ 0.35	\$ 0.18	\$ 2.30
8:00 PM	5.24	3.11	1.24	2.02	3.79	2.86	2.91	\$ 0.26	\$ 0.26	\$ 5.43	\$ 0.22	\$ 0.22	\$ 4.66	\$ 0.30	\$ 0.30	\$ 6.35	\$ 0.18	\$ 0.18	\$ 3.81
9:00 PM	3.66	2	1.34	2.68	2.69	1.43	3.36	\$ 0.26	\$ 0.26	\$ 4.40	\$ 0.22	\$ 0.22	\$ 3.78	\$ 0.30	\$ 0.30	\$ 5.15	\$ 0.18	\$ 0.18	\$ 3.09
10:00 PM	6.19	3.76	1.7	2.96	2.84	1.15	3.04	\$ 0.26	\$ 0.26	\$ 5.55	\$ 0.22	\$ 0.22	\$ 4.76	\$ 0.11	\$ 0.11	\$ 2.38	\$ 0.11	\$ 0.11	\$ 2.38
11:00 PM	7.4	5.26	4.72	6.38	5.29	2.56	6	\$ 0.26	\$ 0.26	\$ 9.65	\$ 0.22	\$ 0.22	\$ 8.27	\$ 0.11	\$ 0.11	\$ 4.14	\$ 0.11	\$ 0.11	\$ 4.14
Total Consumption for week			351.93		Baseline Allocation Credit (Weekly)			\$ -		\$ -		\$ -		\$ -		\$ -			
Monthly Baseline Alloc			399.00		Rate Plan Fee (Weekly)			\$ -		\$ 0.21		\$ 0.21		\$ 0.21		\$ 3.68			
					TOTAL TOU-D-TEV			\$ 80.22		TOTAL TOU-D		\$ 95.82		TOTAL TOU-D-A		\$ 73.50		TOTAL TOU-D-B \$ 62.44	

Now consider when a customer asks the salesperson, “How much will it cost me to fuel this?” Most people in California pay a flat rate for electricity; for them it will likely cost more to operate a PEV than a high-mileage gasoline vehicle. Of course, that answer does not encourage customers to buy a PEV. The customer could certainly lower the cost of fueling the PEV by switching their utility rate plan to a TOU, but that might raise their overall utility rate, which must be factored into the cost to purchase an electric vehicle. An accurate answer requires knowing and analyzing the electricity provider, the location of the residence (utility rates can vary even for the same utility company based on location), the rate plans offered, the amount of electricity used, and when the electricity is used each day both in the winter and in the summer.

Compare the complicated answer above with the simple and familiar one used by owners of gasoline vehicle – 40 miles per gallon at \$2.50 per gallon.

To be clear, this is not a criticism of the electric utilities. The CPUC approves every rate plan, and approval typically involves a very long process and a high degree of scrutiny. However, the complexity of the equation is a fact. Some utilities offer consumers assistance in determining the best plan based on previous utility history, but this is not consistent and consumers are likely not aware of it.

Beyond residential charging, for those public charging stations with fees (many are currently free), the costs are no less confounding. Some networks require a 1-year subscription and charge monthly and early termination fees, some charge by the minute, some charge by the minute after a specified period, others charge by the kW-hour, and still others charge by the minute AND by the kW-hour. Of course, time-based charging rates dramatically change based on the maximum charge rate of the vehicle (the vehicle receives fewer kW-hours per minute with lower maximum charging rate). In general, the rates range from about the same as gasoline to over four times the cost of gasoline and each network may have its own means of accessing or activating the stations.

### Hydrogen:

H2 infrastructure is in its infancy. While the cost of the hydrogen molecule is relatively inexpensive, the cost at the pump is very high at this time. In addition to addressing station rollout, how to address this high cost at the early phase of the market is no less important. Automakers currently offering FCEVs provide three years or \$15,000 of free hydrogen fuel. However, such subsidies cannot continue indefinitely. Moreover, the early FCEV adopters will face very high fuel prices in the next two to three years when their current 3-year agreements expire. For example, the Clean Cities Alternative Fuel Price Report received hydrogen pricing information from 9 stations (out of 25 total) with an average price of \$14.31 per gallon of gas equivalent.<sup>17</sup> This is consistent with ARB and CEC's January, 2017, AB 8 report showing the average cost of hydrogen was \$15.25 per kg for hydrogen delivered at 70 bar.<sup>18</sup>

For this early phase, we believe that an incentive mechanism to reduce the price to be competitive with gasoline will be important for market acceptance. While the ACC MTR Appendix D reports, "Hydrogen prices at the pump are forecast to decline over the next decade to approximately \$11/kilogram (kg). At this price, hydrogen may be cost-competitive with gasoline," we believe the reduction in cost must be much greater. As a point of reference, Japan is aiming at the economic self-sustainability with hydrogen fuel rates at about \$8.75/kg by around 2027.

Since the cost of natural gas and renewable energy in the U.S. is much cheaper than in Japan, a more aggressive target than \$11/kg should be possible. We believe that a target equivalent on a per mile basis to a future conventional or hybrid vehicle at around \$5.50-\$6.00/kg is more appropriate.

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<sup>17</sup> U.S. Department of Energy. (2016). *Clean Cities Alternative Fuel Price Report, Oct-2016*, retrieved from [http://www.afdc.energy.gov/uploads/publication/alternative\\_fuel\\_price\\_report\\_oct\\_2016.pdf](http://www.afdc.energy.gov/uploads/publication/alternative_fuel_price_report_oct_2016.pdf)

<sup>18</sup> California Energy Commission and Air Resources Board (2017). *Joint Agency Staff Report on Assembly Bill 8: 2016 Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California*, retrieved from <http://www.energy.ca.gov/2017publications/CEC-600-2017-002/CEC-600-2017-002.pdf>

As noted at the start, the hydrogen fueling market is in its infancy. The price of fuel will undoubtedly decline, but it is too early to determine how much or how fast. However, the price of hydrogen fuel and the infrastructure availability undoubtedly will be a key factor in determining the success or failure of FCEVs.

***Mass-market adoption of PEVs and FCEVs requires low cost fuel. For PEVs, this means simple and low cost electricity rates that a salesman can explain in one sentence. The Alliance is committed to working with ARB, CPUC, the legislature, and the Governor's office to address these issues.***

#### **iv. Consumer Awareness, Education, and Acceptance**

No one will buy a car they don't know exists.

A survey of 2,500 consumers by Altman Vilandrie & Company this past summer found that 60 percent of Americans are unaware of electric cars, and a full 80 percent have never ridden in one.<sup>19</sup> The survey goes on to find that a perceived lack of charging stations (85%) and uncertainty over the range (74%) were the top reasons for not wanting to purchase a PEV. This survey is in no way unique. Studies repeatedly show that customers have little knowledge or awareness of ZEVs. They certainly do not have a good understanding of the technology – benefits, limitations, range, options, etc. In truth, sales suggest that most customers never seriously consider buying a ZEV.

For their part, automakers promote ZEVs through national, regional, and local advertising, Super Bowl advertisements<sup>20</sup>, ride and drive events, dealer training, and through large customer incentives that dramatically reduce the cost of owning and driving a ZEV.

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<sup>19</sup> Hanley, Steve (2017, January 1), *60% of Americans Unaware Electric Cars Exist*, retrieved from <http://gas2.org/2017/01/01/60-americans-unaware-battery-cars-exist/>

<sup>20</sup> Over the last 5 years, automakers have purchased Super Bowl ads promoting the BMW i3, Chevrolet Volt, Fiat 500e, Smart Electric Drive Coup, Nissan LEAF, and this year the Toyota Mirai.

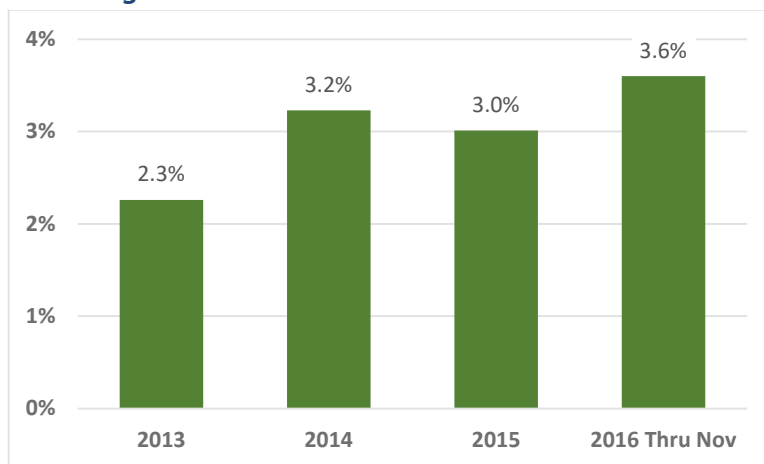
Collaboration with all stakeholders (government, automakers, utilities, charging station providers, NGOs, etc.) enhance consumer awareness and education outreach efforts. The state should launch a consumer education program like the Flex Your Power Campaign (Flex Your Power received \$50 million annually in 2001 and 2002, and over \$11 million in 2003) to increase customer awareness of vehicle options and educate customers on technologies that can be easily integrated within their current lifestyle.

#### d. Consumer Acceptance

Consumer acceptance is the most important factor in reaching the ZEV goals, so it is worth considering the record of consumer acceptance in the last 3 years and the obstacles we collectively face in the next few. During the next few years, we (ARB, automakers, NGOs, dealers, utilities, enthusiasts, etc.) must focus squarely on complementary policies that will grow the ZEV consumer market. While the ZEV regulations have pushed technology, they have yet to build a sustainable ZEV market.

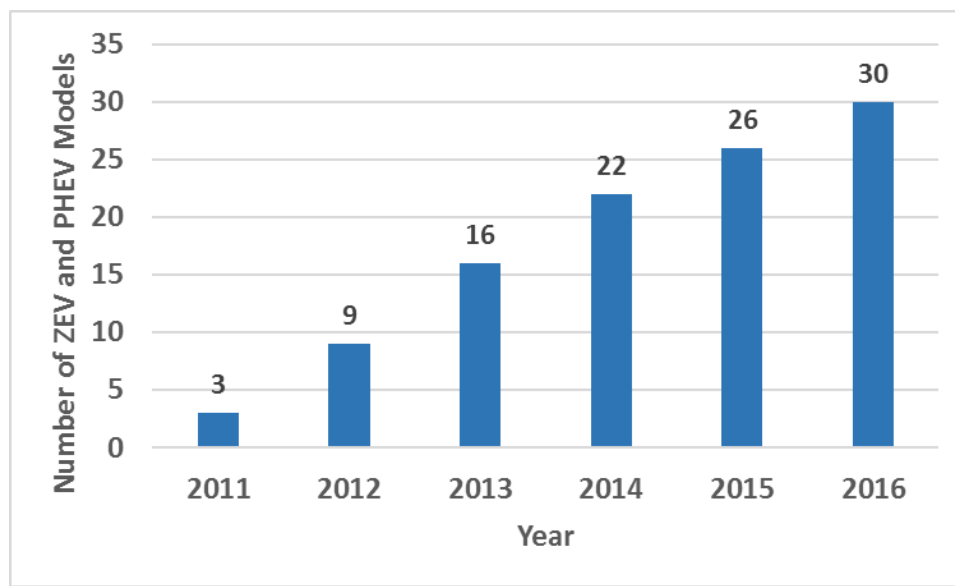
As shown in **Figure 1-7** despite a plethora of incentives – CVRP, HOV stickers, generous local incentives, federal tax credits, and lease deals that are half the cost of a typical cell phone contract – the market has remained relatively flat at 3 to 4 percent for the last three years.

**Figure 1-7: CA ZEV Market Share 2013-2016**



**More Models – Stagnant Sales:** As shown in **Figure 1-8**<sup>21</sup>, the number of FCEV, BEV, and PHEV models offered has doubled in the last three years while the sales rate has remained relatively flat. Moreover, the automakers now offer FCEVs, BEVs, and PHEVs in a range of vehicle categories, including 10 compact and subcompact models, 8 mid-size cars, 4 large cars, 5 all-wheel drive SUVs, 2 small station wagons, and a mini-van. Many expected and predicted that more models would increase sales, which has not yet happened to the degree expected.

*Figure 1-8: Number of ZEV and PHEV Models Available*



**Large Incentives, Exceptional Lease Rates – Stagnant Sales:** In addition to doubling the number of models, the past few years have seen unprecedented incentives from federal, state, and local governments in California. **Table 1-4** provides a sample of the incentives available in California over the last few years:

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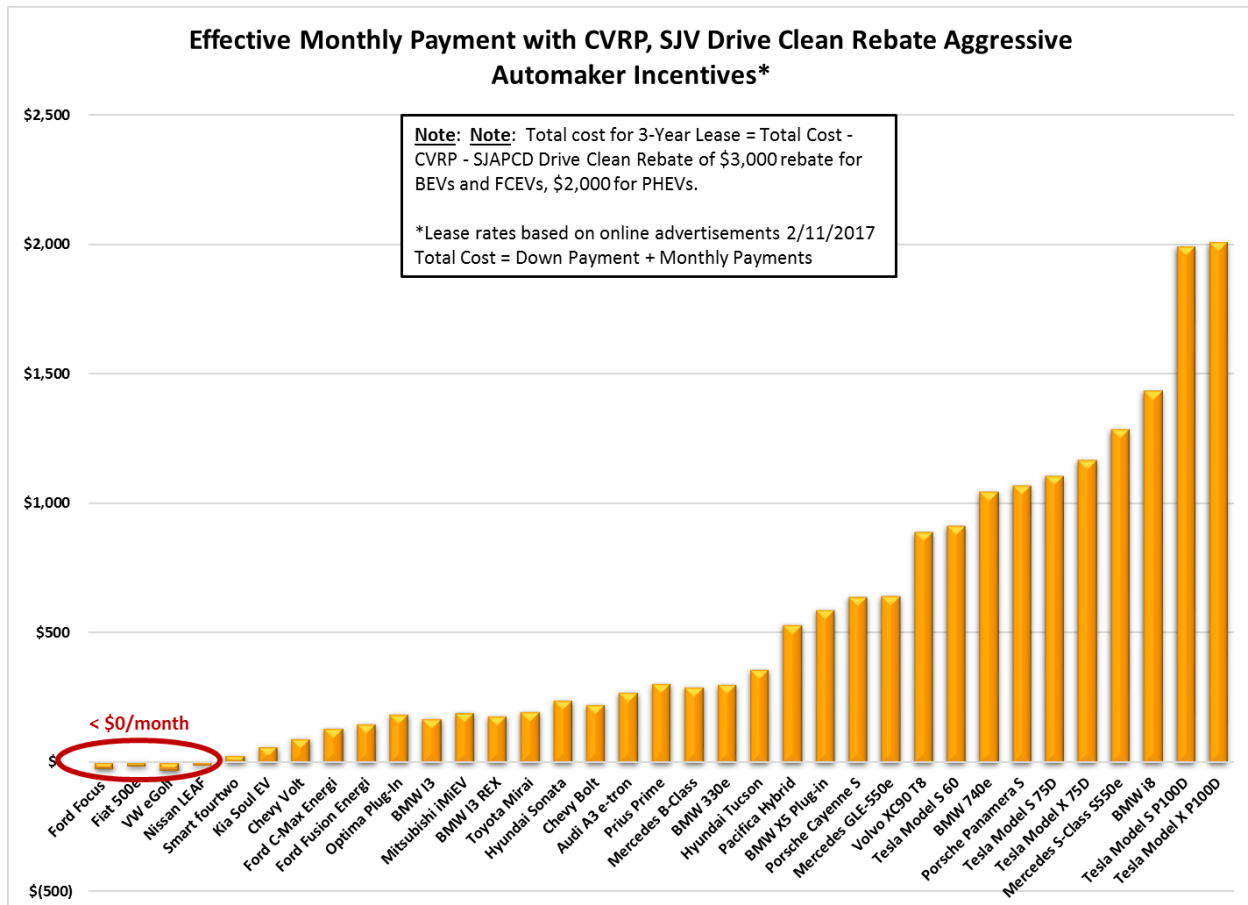
<sup>21</sup> InsideEVs.com. *Monthly Plug-In Sales Scorecard*. Based on models with sales in December of each year. Retrieved 4-Feb-2017 from <http://insideevs.com/monthly-plug-in-sales-scorecard/>

**Table 1-4: Some ZEV Incentives Offered in CA**

Incentive	FCV	BEV	PHEV
Federal Tax Credit	\$8,000	\$7,500	up to \$7,500
CA CVRP	\$5,000	\$2,500	\$1,500
CA CVRP Low Income Addition	\$1,500	\$1,500	\$1,500
San Joaquin Drive Clean	\$3,000	\$3,000	\$2,000
Low-Income EFMP Plus-Up Scrappage		\$9,500 + \$2,000 for Home Charger	\$9,500
Sacramento City Parking Discount	\$92.50/Month = \$3,300 in 3 years	\$92.50/Month = \$3,300 in 3 years	
High Occupancy Vehicle Access	Yes	Yes	Yes

As shown in **Figure 1-9** below, combined with very generous incentives by automakers, lease rates on some high-quality, well-reviewed ZEVs have dropped to well below \$100 per month and some customers can lease a ZEV for ZERO COST. Yet the ZEV market share has remained at the 3 to 3.5 percent level.

**Figure 1-9: Lease Rate for Eligible SJV Residents**



**Next Few Years – Fewer Incentives:** As difficult as it is to move past the four percent market share ceiling with a host of generous incentives, it will be far harder very soon as most of the incentives mentioned above are set to expire over the next few years.

The \$8,000 FCEV Federal Tax Credit has already expired. As discussed above in Section 2.b, CVRP funding and HOV lane access stickers for PHEV buyers have been sporadic. Local incentives are likely to flounder and fade under increasing ZEV volume. Finally, even if unchanged by the current Congress, the Federal Tax Credit for plug-in vehicles is limited to 200,000 rebates per automaker and several major automakers with the highest ZEV sales will hit that around 2019.

Incentives are one of the biggest drivers of ZEV sales. In Georgia, ZEV sales plummeted over 90% when that state's \$5,000 incentive expired. The potential loss of incentives over the next few years will have a negative impact on ZEV sales.

Automakers are committed to developing the market for ZEVs. In the coming years, new technologies, more models, longer ranges, better performance, lower battery prices, low gasoline prices, and drastically fewer incentives will all collide. How the ZEV market emerges from this collision is completely unknown. However, we know that automakers alone cannot change 100 years of American consumer behavior. Such change requires all stakeholders working together toward a common goal.

Automakers, auto dealers, ARB, other ZEV states, NGOs, utilities, hydrogen fuel providers and charging station manufacturers must work together to solidify incentives, deploy infrastructure, increase consumer awareness, and simplify and reduce the cost of electricity and hydrogen.

#### **e. The difference between early adopters and the mainstream market**

An evaluation of the existing PEV owners provides insights on two consumer groups that have differing expectations. Among the "Early Adopters" of PEV technology, there are the premium and non-premium category buyers. Price sensitive consumers value fuel economy and environmental considerations, whereas premium PEV buyers value high performance and luxury characteristics. The luxury EV segment (representing 19% share of EV registrations in 2015<sup>22</sup>) has seen recent growth. A study from King Abdullah Petroleum Studies and Research Center (KAPSARC) found that affluent BEV adopters value powertrain performance and availability of rear-wheel drive more than other BEV buyers.<sup>23</sup> As demonstrated by the KAPSARC results, luxury EV segment customers desire performance more than non-luxury EV buyers and are willing and able to spend on EV technology.

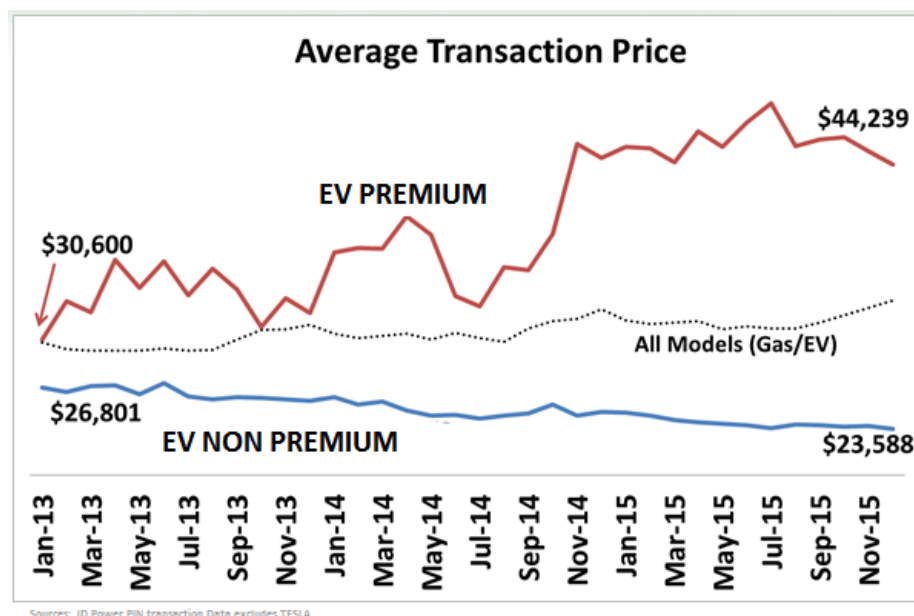
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<sup>22</sup> IHS Markit. Used with permission of IHS Markit

<sup>23</sup> Dua, et al. "Understanding Adoption of Energy-Efficient Technologies: A Case Study of BEV Adoption in the U.S." 2016. KAPSARC. 35.

Even with substantial financial subsidies from automakers, federal, state, and local governments to equalize the transaction price with gasoline vehicles, demand is not increasing. The non-premium consumers are not persuaded to adopt EVs as a function of price only (as shown in **Figure 1-10** the average transaction price on non-premium EV vehicles has significantly decreased).

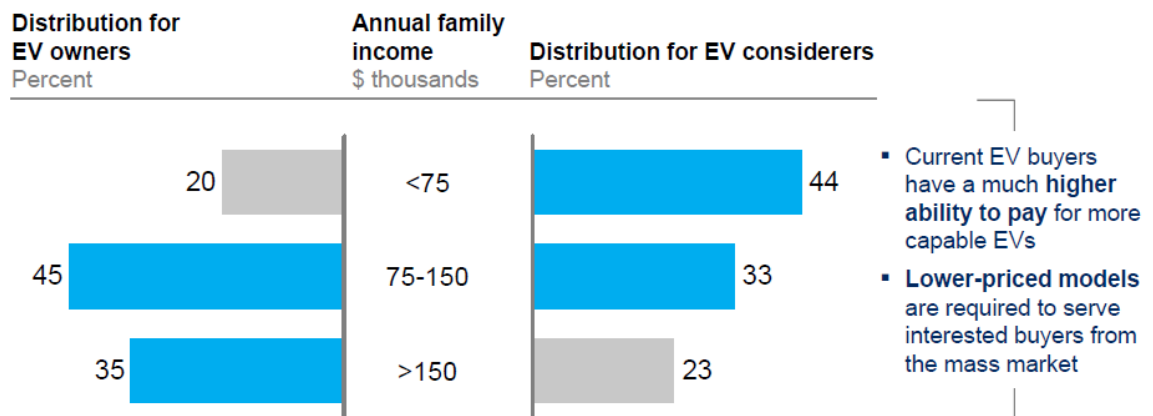
**Figure 1-10: Average Transaction Price<sup>24</sup>**



However, the future challenge is to appeal to a much broader group of consumers (both premium and non-premium) who are not progressive early adopters, but instead the non-compromising masses. The growth strategy must consider the price sensitive non-premium consumers - the mainstream market. Characteristics, which need to be appreciated include:

1. New EV considerers (those customers considering an EV) have lower average household income than the current EV buyer audience.

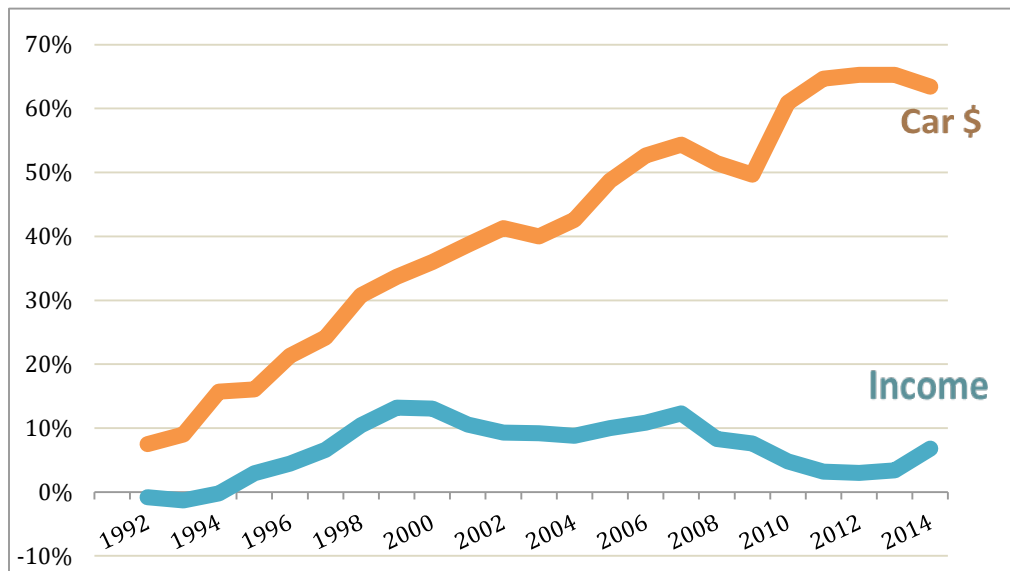
<sup>24</sup> JD Power Power Information Network (PIN) transaction data, excludes Tesla.



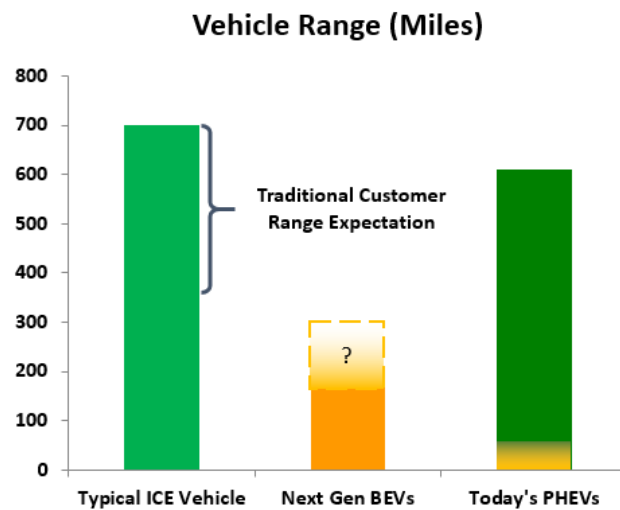
SOURCE: McKinsey Sustainable Mobility Initiative – 2016 Electrified Vehicle Consumer Surveys

The lower income of the mainstream market needs to address several issues. Vehicle prices have risen over time while income has remained flat (see **Figure 1-11**), and competing demands such as health care costs and other personal consumption expenditures have expanded. Customers are making various tradeoffs to maintain their transportation needs, but data suggest they are unwilling, or unable, to increase the share of their budgets allocated to transportation. Mainstream customers are seeking affordability.

**Figure 1-11: Percent Change of Median Household Income and New Car Prices (1991 Baseline)**

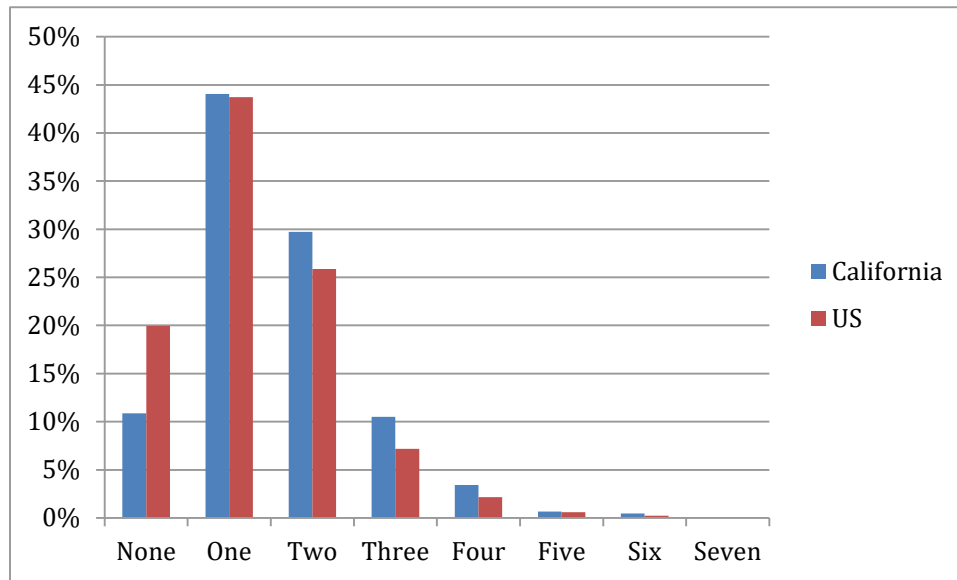


2. No-compromise. While early adopters were willing to accept risk and compromise, the mainstream customer will not. They want a PEV equal to or better than their existing vehicle in all attributes they consider important, all at the same price.
3. Range (both commute and longer journeys) is a critically important attribute that mainstream customers are not willing to sacrifice. Fortunately, PHEVs meet the range expectations of the mainstream customers, and next generation BEV range is improving.



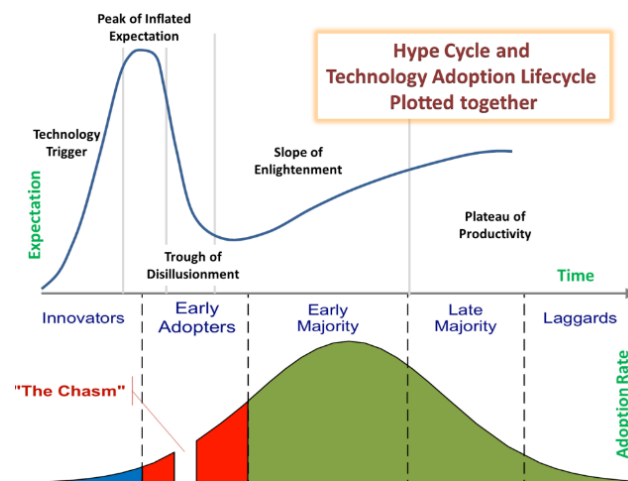
4. Mainstream consumers will expect the refueling experience for PEVs to be comparable to ICE vehicles. The wait times to reach a charging station need to be like those for a gasoline pump. Once at the charger, the charging time needs to be like fueling a gas vehicle. Although more direct current fast chargers (DCFCs) are available, recharging a BEV is still many times longer than refueling with gas. Access to charging is equally important.
5. A non-compromising solution is more relevant for one-vehicle households. Because more US households have one vehicle than multiple vehicles (see **Figure 1-12**), these households require that their vehicle address all their needs, not just their frequent needs. Even though they may not frequently take their vehicles on long trips for vacations or other purposes, they want their one vehicle to accommodate those trips.

*Figure 1-12: US Market Total Vehicles Per Household*



Studying today's early adopter purchasers of PEVs and applying conclusions of those studies to mainstream customers must be done with care. Looking at CVRP participants to determine the fraction of PEV buyers with one vehicle households is not forward looking (ACC MTR Appendix B, page B-56). What is needed is to look ahead to the mainstream customers and address their needs with ZEVs to grow the market.

Until the barriers for the non-premium masses are addressed, the next phase of 'Early Majority' will wane.



Referencing the Hype Cycle<sup>25</sup> (which represents maturity, adoption, and social application of specific technologies) and Technology Adoption lifecycle simultaneously it is apparent the ZEV industry needs to anticipate when “The Chasm” will occur. This is the profound point in which consumer acceptance and adoption become organic. In this phase, the early majority seeks the value of the product offering which is a no-compromise transportation solution equivalent to their current vehicle experience. Charging infrastructure compliments the units in operation. The projected time for early majority adoption ideally aligns with ARB’s target volume of ZEVs in operation. This supports our earlier recommendation for the consistent commitment to complementary measures to promote adoption for reaching an incremental ZEV audience.

#### f. S177 State ZEV market

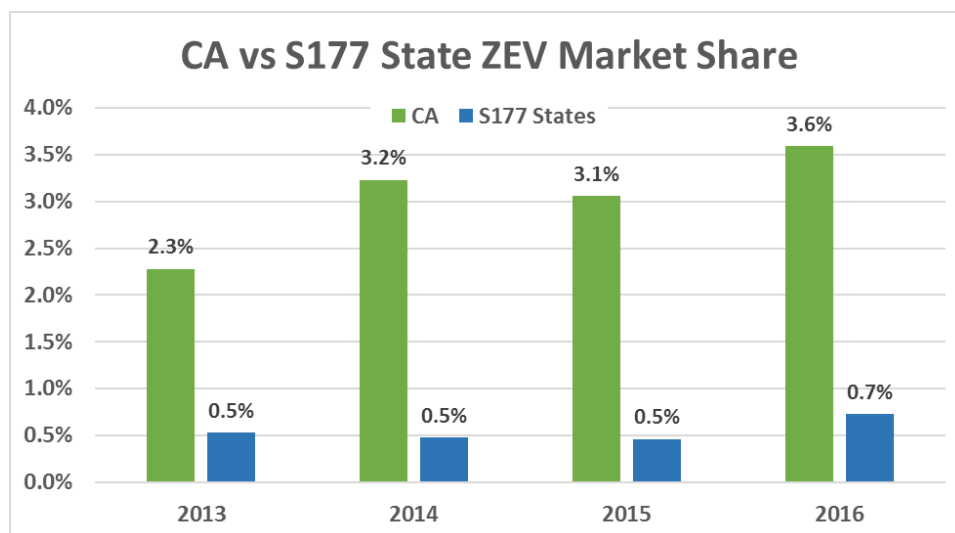
As shown in **Figure 1-13**, California’s ZEV market substantially outpaces those in the S177 states. However, other than a few flexibilities that expire in 2021, the ZEV regulations require identical ZEV sales in California and the S177 states. In

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<sup>25</sup> The Hype cycle is a research methodology developed by Gartner <http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp> along with the image source [https://www.researchgate.net/figure/263296438\\_fig1\\_Fig-1-The-technology-hype-cycle-and-adoption-life-cycle-plotted-together-Displays-the](https://www.researchgate.net/figure/263296438_fig1_Fig-1-The-technology-hype-cycle-and-adoption-life-cycle-plotted-together-Displays-the).

California, automakers face the substantial task of tripling ZEV sales over the next nine years. In the S177 states, rather than nine years to triple sales, automakers have two years, and must do so with complementary measures that are either far behind, lower, or in several cases non-existent. Automakers are appropriately concerned that the regulations, which are aggressive in California, are unachievable in the S177 states, at least on the timeline required by the regulations, with low consumer acceptance and relative lack of complementary measures in those states.

**Figure 1-13: California vs. Section 177 State Market Share 2013-2016<sup>26</sup>**



While no one disputes the market disparity between California and the S177 states, the cause is contested. Some stakeholders suggest S177 state market share would match California's if only automakers made the same ZEVs available, forced dealers to stock ZEVs at the same level in absolute terms, conducted the same dealer training, or advertised more. This section explores these in more detail, and concludes, much like California's vehicle market differs from that of Texas or Alaska, the S177 states simply reflect a different market than California.

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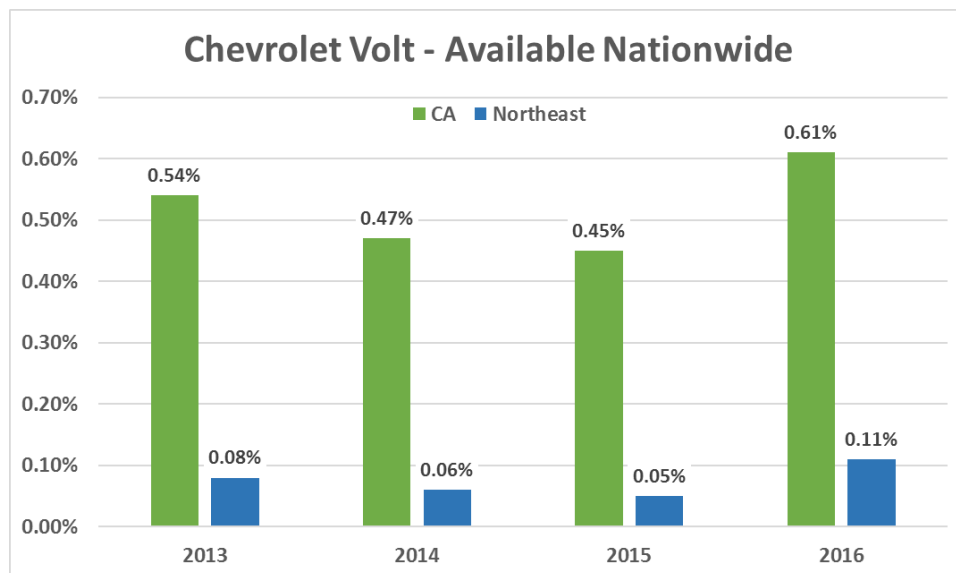
<sup>26</sup> IHS Automotive new vehicle registration data.

### i. ZEV Availability

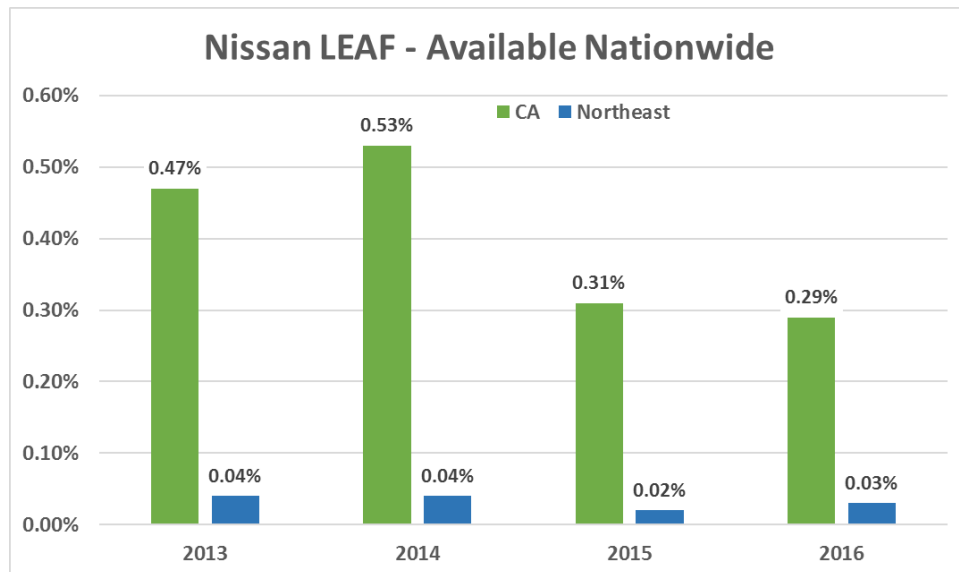
As noted above, several stakeholders suggest the difference in ZEV market share can be explained by limited availability of some ZEVs (e.g., the 2014 Chevrolet Spark and Fiat 500e were sold only in California and Oregon). However, ZEVs available in the S177 states and California alike accounted for the overwhelming majority (almost 90%) of total ZEV sales.

The best-selling ZEVs – Chevrolet Volt, Nissan LEAF, Tesla Model S, and BMW i3 – are all widely available in all states. However, as shown in **Figure 1-14, Figure 1-16, Figure 1-17, and Figure 1-17** Californians buy 5 to 10 times as many as residents in the Northeast ZEV states.

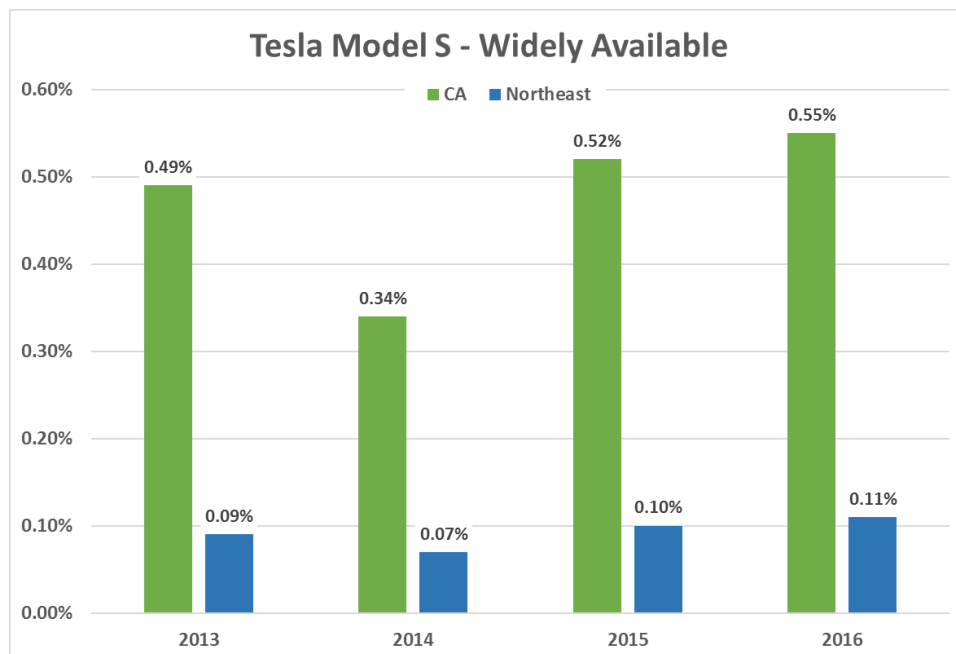
**Figure 1-14: Chevrolet Volt - Available Nationwide<sup>16</sup>**



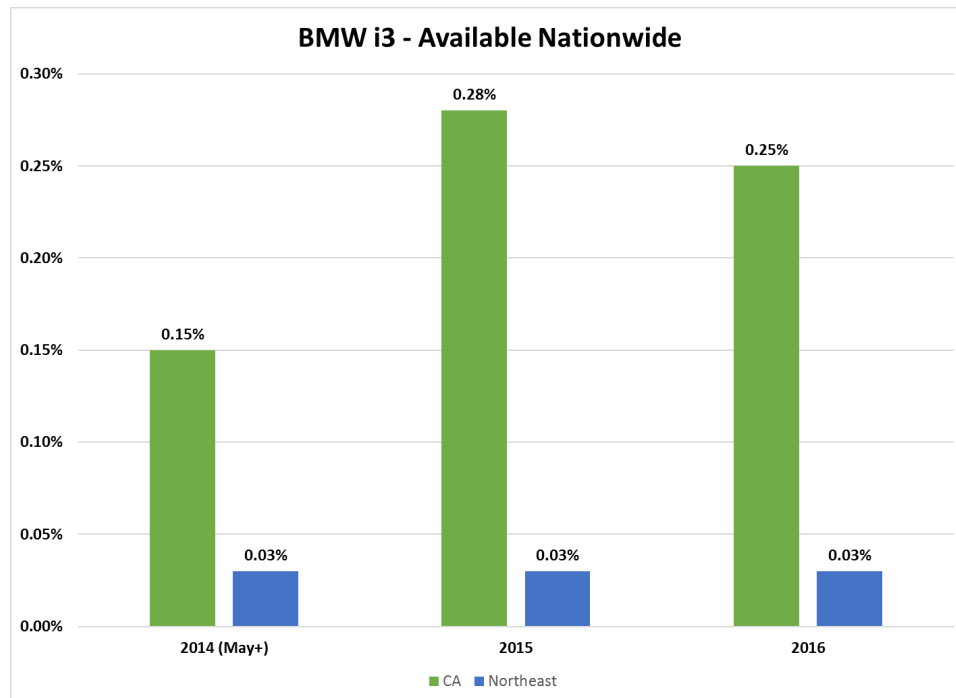
*Figure 1-15: Nissan LEAF - Available Nationwide<sup>16</sup>*



*Figure 1-16: Tesla Model S – Widely Available<sup>16</sup>*



**Figure 1-17: BMW i3 – Available Nationwide**



With such large differences in the sales rate for ZEVs that are available nationwide, ZEV availability does not explain the stark difference between California and the S177 states.

## ii. Dealer Stock of ZEVs

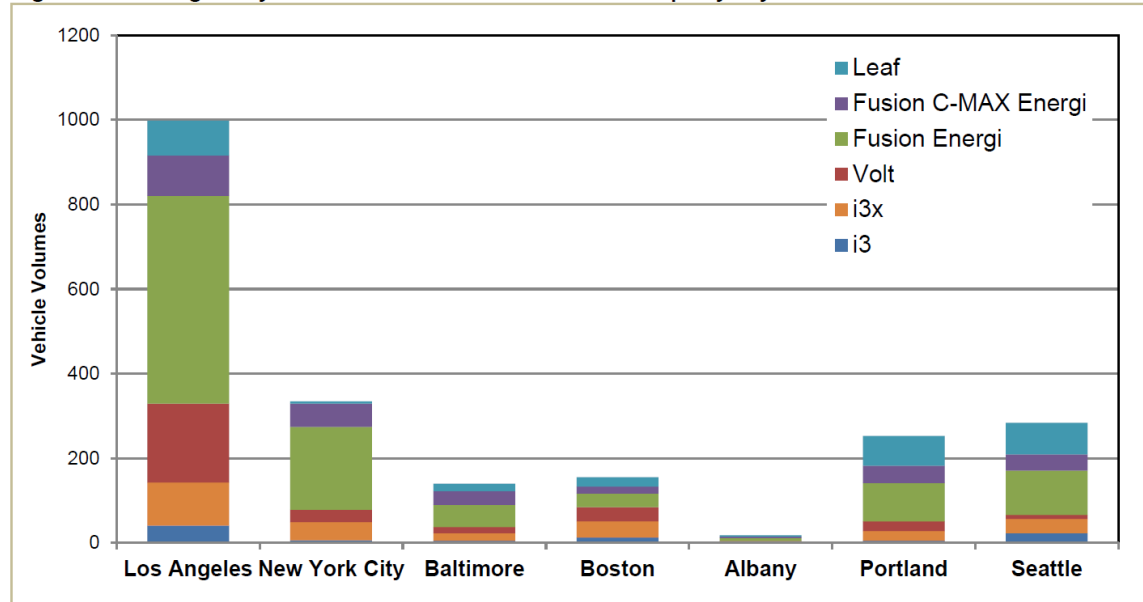
Some stakeholders have pointed out that dealers in the Northeast states stock fewer ZEVs than those in California. In fact, Appendix B of the ACC MTR, Section III.A.3, begins, “One question posed by stakeholders is whether low numbers of PEVs on dealer lots across the Section 177 ZEV states helps to explain their sales rates relative to California's” and goes on to detail the number of ZEVs and PHEVs stocked at all dealerships in Baltimore, New York City, Albany, Boston, Los Angeles, Portland, and Seattle. Figure 21, from Appendix B (copied below as **Figure 1-18**) summarizes the average daily number of PEVs available, and concludes:

*According to these data, it does appear that PEVs are less available in pure volume in Section 177 ZEV state cities than in Los Angeles, California.*

*However, vehicle volumes have not been normalized for new vehicle sales within each of the cities.*

**Figure 1-18: Figure 21 from ACC MTR, Appendix B, Section III.A.3**

**Figure 21 - Average daily number of PEVs available at dealerships by city**



The implication of this section is low dealer stock of PEVs contributes to low sales in the S177 States. However, this conclusion would be entirely incorrect. First, the ACC MTR recognizes that this is not normalized for new vehicle sales within each city. This is a glaring and unnecessary oversight that renders the chart all but meaningless. A chart comparing the number of health food stores in Los Angeles to the number in Albany would likely show ratios like those above. Second, this section of the ACC MTR provides no comparison of the complementary measures in each of these cities compared to those in Los Angeles. Finally, and possibly more importantly, a pure volume basis is simply not an appropriate measure of vehicle stock. No responsible retail business (whether car dealership or health food store) stocks products that do not sell. Rather than pure volume, the ACC MTR should have assessed the days of inventory for the different models. This is the standard industry metric for determining if a sufficient supply is available. The carrying costs associated with \$30,000+ vehicles are very high, and dealerships would be foolish to carry a high inventory of vehicles that do not sell.

In summary, the ACC MTR does not conclude if the low dealership availability of PEVs causes low PEV sales or if the low availability reflects the low market demand for PEVs in those local markets. Are dealers not ordering cars due to lack of demand, or are sales constrained by dealers not ordering cars? This is a critically important factor. The ACC MTR does not show that increased availability would actually increase sales significantly, and certainly not to the levels demanded by the regulation.

### iii. Dealer Training

Some suggest that differences in dealer training result in different market shares in the S177 states and California. It's certainly true that ZEVs require special consideration. Most customers have used gasoline vehicles their entire life. Customers, dealers, salespeople, and service technicians fully understand the operation, fueling, maintenance, and repair of gasoline vehicles. While easy to operate and maintain, ZEVs are largely unknown by salespeople, service technicians, and customers. For example, these questions can and do arise.

- For customers:
  - Where can I fuel?
  - When do I fuel?
  - How long will it operate on a full charge (or full tank of hydrogen)
  - How does performance or range change with weather
  - What incentives are available, to whom, and for how long?
  - For PEVs
    - Where can I charge it (home, work, public)?
    - What equipment do I need to charge at home?
    - How long does it take to charge?
    - How much will it cost to install?
    - How much does electricity cost to operate the car and how does that compare to a gasoline car?
- For dealers
  - How much will it cost to sell the ZEV?
  - What permitting is required to service and sell ZEVs (hydrogen, electricity)?
  - What technician training is required to service high-voltage systems?

- What salesperson training is required?
- What incentives are available, when, can I advertise those?
- What repair parts do we need to stock?
- Do we have chargers installed and operational?

Automakers have long recognized that additional training at every level is needed to address these and many other questions. Consequently, they require special training of dealer staff (salespeople, finance, and service technicians) prior to allowing any dealer (regardless of state) to offer ZEVs. The training is identical in every state recognizing that state laws vary and must be accommodated. There is simply no reason to have different training in different states. In fact, it would be far more work to do this. Therefore, there is no reason to believe that differences in dealer training have any impact on ZEV sales in the S177 states compared to California.

#### **iv. Advertisements**

Finally, some suggest that more advertising would spur sales of ZEVs and TZEVs. Interestingly, the #1 selling ZEV in the Northeast for the past 4 years, Tesla Model S, spends exactly \$0 advertising. Nonetheless, working with Northeast States for Coordinated Air Use Management (NESCAUM), the Sierra Club Compass reported “Auto Industry Failing to Advertise Electric Cars.”<sup>27</sup>

Advertising certainly can increase sales and automakers do advertise ZEVs and TZEVs as the report by the NESCAUM clearly shows.<sup>28</sup> However, the implication seems to be that advertising effectively drives demand for ZEVs and TZEVs, but a closer look at the data suggests that automakers already spend far more per vehicle sold on ZEV and TZEV advertisements compared to conventional gasoline counterparts. For example, looking at the article in Sierra Club’s Compass:

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<sup>27</sup> Coplon-Newfield, Gina, *New Data Shows Auto Industry Failing to Advertise Electric Cars*, December 19, 2016, retrieved from <http://www.sierraclub.org/compass/2016/12/new-data-shows-auto-industry-failing-advertise-electric-cars>

<sup>28</sup> NESCAUM, *Electric Vehicle Marketing Analysis*, December 19, 2016, retrieved from <http://www.zevstates.us/ev-marketing-analysis/>

➤ Ford Focus Gas vs. EV: The article notes,

*According to the data, Ford advertised its gasoline-powered Focus in about 4,750 instances on cable and broadcast TV to national audiences, whereas it only advertised its Focus Electric in about 200 instances to a national TV audience. That's nearly 24 times more non-EV ad instances!*

Ford sold 202,478 gasoline Ford Focus vehicles in 2015, compared to just 1,582 Ford Focus EVs in that same year. That's over 127 times more gasoline vehicles sold! To put it another way, Ford sold over 42 gasoline Ford Focus vehicles for every ad it ran, while it sold less than 8 EVs for every EV ad.

➤ Nissan LEAF vs Sentra: The article notes,

*What about the companies that are excelling in EV sales at higher rates than Ford and Mercedes? Nissan advertised the gasoline-powered Sentra sedan in about 3,500 instances to nationwide audiences (broadcast and cable TV only), while it only advertised the Nissan Leaf electric sedan in about 1,750 instances to a nationwide audience.*

Nissan sold 203,509 Sentras compared to only 17,269 LEAFs. Nissan ran twice as many commercials for the Sentra but sold 11 times more vehicles. Or Nissan sold 58 Sentras for every ad, but only 9.8 LEAFs per ad.

➤ Chevrolet Volt vs Cruze: Finally, the article notes

*General Motors advertised its conventional Chevy Cruze in just over 700 instances to a nationwide audience, while it only advertised its plug-in hybrid Volt in just over 200 instances. Notably, GM advertised the Volt in nearly 800 instances with California-focused audiences, whereas they only advertised the Volt to a Northeast-focused audience in about 10 instances.*

Again, GM sold 226,602 Cruzes compared to only 15,393 Volts Nationwide. Thus, GM sold 323 Cruzes per ad compared to only 77 Volts per ad. (This ignores the much higher ad counts in California.)

Finally, rather than comparing the number of ads for the highest volume vehicles, Sierra Club and NESCAUM might compare vehicles with similar sales

volume. For instance, how many national ads did General Motors run for the Chevrolet Corvette (2015 sales of 33,329) compared to Chevrolet Volt (2015 sales of 15,393)? As a point of reference, GM reports the 2015/2016 Chevrolet Volt media spend was 50% greater than for the Chevrolet Camaro. Note, both were new model-year vehicles and Camaro has nearly 4x the volume of the Volt.

In truth, advertising is a fraction of the cost of heavily subsidizing each vehicle sale (“money on the hood”). If selling ZEVs and TZEVs were as simple as a few more advertisements, automakers would certainly choose that path. However, automakers must both advertise and, according to public reports,<sup>29</sup> heavily subsidize each ZEV and TZEV sold.

#### **v. California and S177 States Represent Different Markets**

All the available data suggests that S177 state (particularly the Northeast) markets are different from California’s market. They differ in factors affecting the adoption of ZEV - such as climate, HOV lane availability, geography, incentives, energy prices, vehicle preferences, and timing of efforts to support electrification. Although some differences are being partially addressed, major efforts by all stakeholders are needed to improve the market.

However, some differences cannot be addressed. For example, as shown in **Table 1-5**, the different climates impact preference for AWD/4WD, vehicle range (cold temperatures reduce PEV range), and performance. The availability of HOV lanes and associated incentives for ZEVs in California has been a favorable influence on their adoption that is lacking in the Northeast. Additionally, the integrated cities of the Northeast are more suitable for longer vehicle trips (which exacerbates range anxiety for PEV owners and reinforces the need for a robust public charging infrastructure) as opposed to the isolated regions of California and the West Coast, which are more conducive to air travel.

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<sup>29</sup> See for example, Welch, David and Lippert, John, The Detroit News, *GM ready to lose \$9k a pop chasing electric car boom*, November 30, 2016, retrieved from [www.detroitnews.com](http://www.detroitnews.com)

***Table 1-5: CA vs. Northeast Characteristics Beyond State Control***

Issue	California	NE States
Winter Temp	Average Winter Temp <ul style="list-style-type: none"><li>• 46°F Nor-Cal</li><li>• 58°F So-Cal</li></ul>	Average Winter Temp: 26°F Winter temps impact vehicle range and performance.
HOV Lanes	1,400 miles	250 miles total in all 8 states
Different Geography	Isolated Regions NoCal & SoCal (Fly LA to Sac or SD to SF)	Integrated Cities (Drive Baltimore to Philadelphia to NY City to Boston)

Advancements in technology will help address some of these issues but until that time, they will remain a drag on ZEV sales in the Northeast.

Also important to note is the lack of sufficient incentives in some S177 states. Those that have implemented rebates did so 4 – 6 years later than California. Like California, the energy cost differential between electricity and gasoline does not favor ZEVs as it does in Norway.

**Figure 1-19: Incentives, Energy Costs, & Market Share**

	Norway	CA	MA	CT	ME	MD	NJ	NY	OR	RI	VT
<b>Present Max Rebate<sup>1</sup></b>									-		-
BEV	-	\$2,500	\$2,500	\$3,000	-	-	-	-	-	\$2,500	-
PHEV	-	\$1,500	\$2,500	\$3,000	-	-	-	-	-	\$2,500	-
FCEV	-	\$5,500	\$2,500	\$5,000	-	-	-	-	-	-	-
<b>When 1st rebate started</b>	1990 <sup>2</sup>	April 2010 <sup>3</sup>	June 2014 <sup>4</sup>	May 2015 <sup>5</sup>	-	July 2014 <sup>6</sup>	May 2004 <sup>7</sup>	-	-	Jan. 2016 <sup>8</sup>	-
<b>Tax cost reduction (max)</b>	Typically \$8,000 <sup>9</sup> to \$135,000 <sup>10</sup>	-	-	-	-	\$3,000* <sup>6</sup>	7% sales tax <sup>7</sup>	-	-	-	-
<b>HOV Lanes</b>	Yes <sup>2</sup>	Yes <sup>11</sup>	-	-	-	Yes <sup>12</sup>	Yes <sup>13</sup>	Yes <sup>14</sup>	-	-	-
<b>Electric Cost Per kWh<sup>15</sup></b>	\$0.11	\$0.17	\$0.14 - \$0.21								
<b>Gas Cost Per Gallon<sup>16</sup></b>	\$7.20	\$2.90	\$2.40 - \$2.56								
<b>Market Share<sup>17</sup> (most recent)</b>	29%	3%	0.4% - 0.6%						1.5%	0.4% - 0.8%	

1 CVRP Implementation Manual: <https://cleanvehiclerebate.org/sites/default/files/docs/nav/transportation/cvrp/documents/CVRP-Implementation-Manual.pdf>;

MOR-EV Implementation Manual: <https://mor-ev.org/sites/default/files/docs/Implementation%20Manual%20for%20MOR-EV.pdf>;

CHEAPR Implementation Manual: [http://www.ct.gov/deep/lib/deep/air/electric\\_vehicle/evct/CHEAPR\\_Implementation\\_Manual.pdf](http://www.ct.gov/deep/lib/deep/air/electric_vehicle/evct/CHEAPR_Implementation_Manual.pdf) ;

DRIVE: <http://www.drive.ri.gov/about-drive/>

2 <http://elbil.no/english/norwegian-ev-policy/>

3 CVRP Rebate Statistics Site: <https://cleanvehiclerebate.org/eng/rebate-statistics>

4 MOR-EV Program Statistics: <https://mor-ev.org/program-statistics>

5 CHEAPR Program Statistics: [http://www.ct.gov/deep/cwp/view.asp?a=2684&q=565018&deepNav\\_GID=2183](http://www.ct.gov/deep/cwp/view.asp?a=2684&q=565018&deepNav_GID=2183)

6 Maryland Motor Vehicle Administration: <http://www.mva.maryland.gov/about-mva/info/27300/27300-71T.htm>

7 New Jersey Division of Taxation: <http://www.state.nj.us/treasury/taxation/zevnotice.shtml>

8 DIVE Program Statistics: <http://www.drive.ri.gov/statistics/>

9 <http://www.npr.org/sections/parallels/2014/03/11/288611696/norway-takes-the-lead-in-electric-cars-with-generous-subsidies>

10 International Business Times: <http://www.ibtimes.com/tesla-owners-norway-get-134000-tax-break-which-more-base-price-model-s-1507740>

11 AFDC Incentives Website: <http://www.afdc.energy.gov/laws/5359>

12 Maryland Motor Vehicle Administration: <http://www.mva.maryland.gov/About-MVA/INFO/27300/27300-54T.htm>

13 New Jersey Turnpike Authority: <http://www.state.nj.us/turnpike/toll-rates.html#discounts>

14 New York State DOT: <https://www.dot.ny.gov/portal/page/portal/programs/clean-pass?nd=nysdot>

15 U.S. EIA Electricity Data Browser: <https://www.eia.gov/electricity/data/browser/>

Statistics Norway: <https://www.ssb.no/en/energi-og-industri/statistikker/elkraftpris/kvartal/2016-05-31>

16 U.S. EIA Petroleum Weekly Retail Gasoline Prices website: [https://www.eia.gov/dnav/pet/pet\\_pri\\_gnd\\_dcus\\_sca\\_w.htm](https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_sca_w.htm)

Norway Gasoline prices sourced from [http://www.globalpetrolprices.com/Norway/gasoline\\_prices/](http://www.globalpetrolprices.com/Norway/gasoline_prices/)

(1 Norwegian Krone is equivalent to 0.12 USD and there are 3.79 liters in a gallon)

17 Sourced from European Alternative Fuels Observatory - [www.eafo.eu/content/Norway](http://www.eafo.eu/content/Norway);

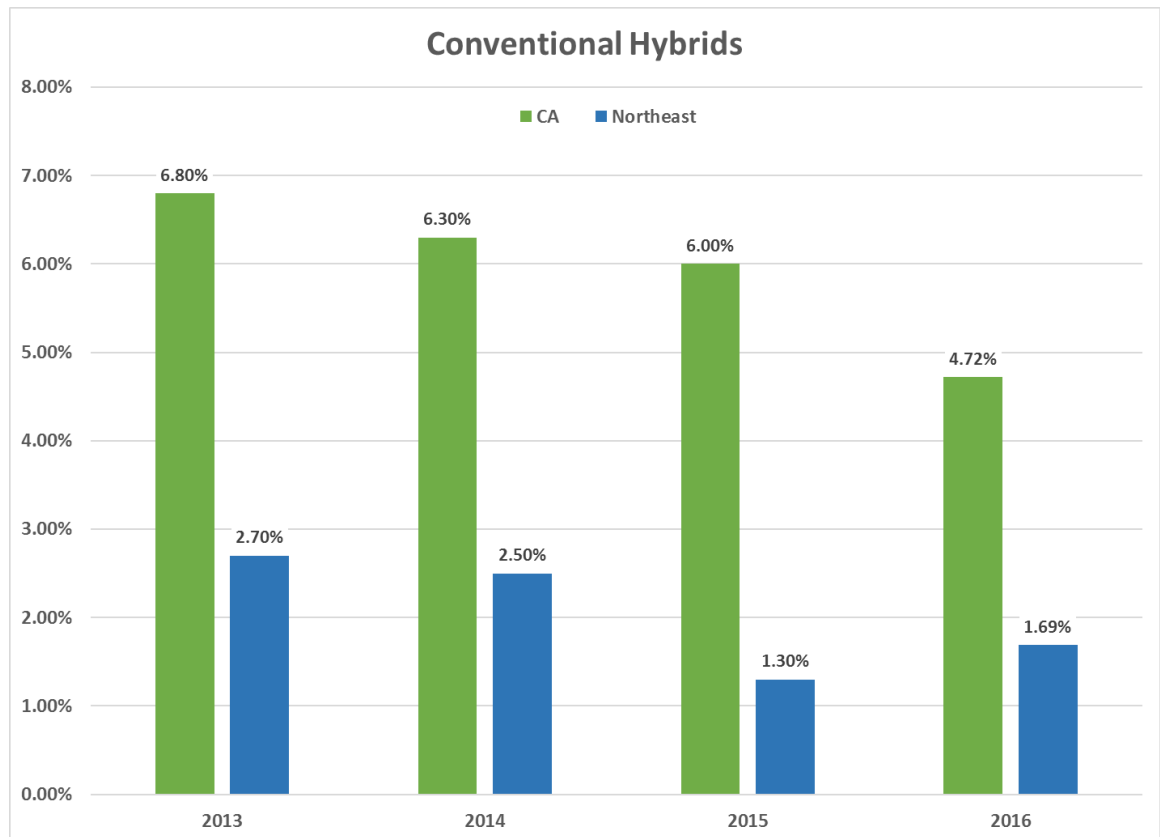
<https://public.tableau.com/profile/research.department#1/vizhome/AutoAllianceZEVSalesDashboard/ZEVSales>

It is particularly instructive to note the differences in customer acceptance of conventional hybrid electric vehicles between the regions shown in **Figure 1-20**. The market share of HEVs in the Northeast is less than 40 percent of the market share in California even though HEVs:

- Have been available for years in both regions at virtually every dealership
- Come in a variety of styles and include AWD options

- Suffer no deterioration in adverse weather (cold, snow)
- Have no infrastructure requirements and require no change in customer behavior to fuel

*Figure 1-20: Conventional Hybrid Vehicle Market Share CA vs. NE<sup>30</sup>*



Clearly, there is a different market penetration of electrified products between the regions that is unexplained by typical criticisms. The Alliance recommendation to adjust the S177 state ZEV requirements to be 40 percent of the California requirements allows for a practical path forward that will build the market rather than force sales of deeply discounted products. Deep discounts will not build the value of electrified products in the mind of the customer, rather the deep discounts will lead customers to see ZEVs as inferior products –

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<sup>30</sup> Data from IHS Automotive

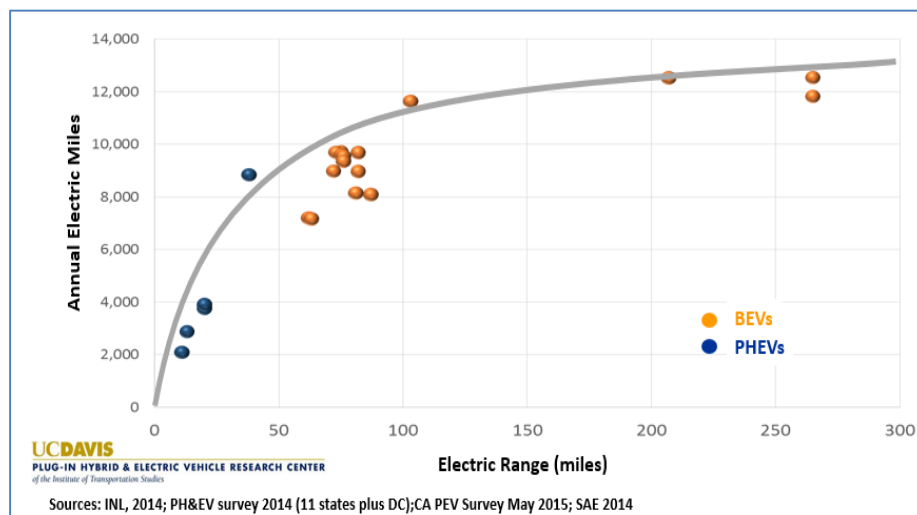
counter to the goals of the program, while also driving manufacturers further away from profitability which is essential to long-term sustainability.

**g. PHEVs**

**i. Electric Vehicle Miles Travelled (eVMT)**

PHEVs offer significant electric miles when compared to BEVs. As BEV ranges increase, the amount of annual electric miles travelled starts to flatten out. As PHEV ranges increase, their annual electric miles approach those of shorter range BEVs. (See **Figure 1-21**.)

**Figure 1-21: Annual Electric Miles Travelled Vs. Battery Range**



**ii. The Alliance Proposal – Raising PHEV Cap**

Currently, the regulations cap the use of ZEV credits generated from PHEVs starting at about 55 percent in 2018 and dropping to about 25 percent in 2025. We recommend allowing 80 percent of the ZEV credits to be generated from PHEVs for 2018 through 2025 because they provide more flexibility to consumers and therefore appeal to a larger mainstream market.

Attribute	Mainstream Consumer Demand	Comment
Range	✓	PHEV range is same as traditional vehicles
Refuel Time	✓	PHEV recharging time reasonable using common 110V household
Infrastructure Availability	✓	Charge on 110v household + traditional refueling stations
Electric Miles	✓	Longer range PHEVs meet electric mile needs of many consumers
ZEV Technology & Experience	✓	PHEVs use the same technology as BEVs and provide many consumers with a satisfying ZEV experience

The staff notes that “though PHEVs can be a significant share of the future fleet, there are limitations that make it necessary to still pursue substantial BEV and FCEV volumes” (page ES-40). We agree that PHEVs can be a significant share of the fleet through 2050. Staff notes that there could be significant variation in GHG emissions under a high PHEV Sales scenario particularly in the 2030+ timeframe. The analysis of variability staff uses to refute raising the PHEV cap in the 2018 to 2025 time period is an analysis of variability post 2025 (see the ACC MTR page ES-40, and ACC MTR Appendix F). It is important to note that the Alliance has not made a recommendation for the PHEV cap post 2025. When rules are developed for 2025 and beyond more information will be available for better modelling of a high PHEV scenario, and at that time, the Alliance will make a recommendation for 2025+ PHEV caps. However, with the information currently available, PHEV households have been shown to decrease GHG more than shorter-range BEV households<sup>31</sup>, so a higher PHEV cap in 2018 to 2025 is advisable.

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<sup>31</sup> Nicholas, 2016c. Michael Nicholas, Gil Tal. University of California Davis, Plug-in Hybrid and Electric vehicle research Center. Advanced Clean Car 2016 Symposium Presentation “Advanced Plug-in Electric Vehicle Driving and Charging Behavior” September 2016.  
[https://www.arb.ca.gov/msprog/consumer\\_info/advanced\\_clean\\_cars/pev\\_data\\_from\\_uc\\_davis\\_household\\_study\\_first\\_year\\_michael\\_nicholas.pdf](https://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/pev_data_from_uc_davis_household_study_first_year_michael_nicholas.pdf)

Additionally, blended PHEVs are a more viable ZEV alternative for larger more capable vehicles in the foreseeable future and we agree with staff that “as more manufacturers enter the PHEV market and PHEVs are introduced on larger and heavier vehicle platforms, blended PHEVs will likely continue to play a significant role” (ES-39). As PHEVs are likely a more viable solution for these larger vehicles, raising the PHEV cap also makes sense to encourage this transition.

Since PHEVs earn less credits than BEVs raising the PHEV cap will also result in more PEVs. Since many of the components in electrified vehicles require the same type of manufacturing and engineering knowledge the scale for manufacturing many electrified components (with battery capacity being a notable exception) would increase helping to drive down costs.

### **iii. Relative Impact of High Power Cold Starts**

Regarding ARB’s testing and analysis of PHEV cold start emissions, we disagree with aspects of the methodology that were used, and believe that emissions from blended PHEVs are substantially lower than estimated by ARB. For example, when comparing intermediate start rates from PHEVs to conventional gasoline SULEV vehicles, the following assumptions were stated:

*“For simplification, soak times were consolidated into three categories of hot starts (less than 60 minutes), intermediate starts (60 minutes to 720 minutes), and cold starts (greater than 720 minutes). Data from the 2013 California Household Travel Study was used to determine the distribution of the soak times and average starts per day for the conventional vehicle as described in Appendix G. For the conventional vehicle, the hot and cold start emissions were used to estimate an intermediate start emission rate of approximately half of the cold start rate.”*

*“For the PHEVs, emission rates were estimated for hot starts, intermediate starts, and cold starts in both normal and high power start conditions. For all normal starts, high power hot starts, and running emission rates, similar values to the conventional vehicle were used. For the high power cold and intermediate starts, the results from ARB’s testing were used for the cold starts and scaled down and used for the intermediate starts.” (ACC MTR Appendix H, page H-9)*

ARB's methodology for estimating the relative impact of start emissions between PHEVs and conventional vehicles should be revised. Rigorous accounting of the contribution from intermediate starts is particularly important since catalysts typically cool down rapidly and emissions for relatively short soak times can be significant. Although the ARB analysis properly recognizes that overnight soaks alone (>720 minutes) do not fully capture the impact of cold starts, the assumed "intermediate" start emission rate of 50% for conventional vehicles is too low and underestimates conventional vehicle start emissions relative to PHEVs. When the appropriate EMFAC2014 emissions fractions are individually applied to each intermediate bin in Figure 40 (ACC MTR Appendix G, page G-41) and then weighted by the respective start frequency of the bin, the weighted average cold start fraction for HC+NOx is greater than 80%. Improving the accuracy of the intermediate start emissions estimate in this way would result in conventional gasoline vehicles having a higher cold start emissions contribution relative to PHEVs than that estimated by ARB. ARB notes that it is working on updating the EMFAC2014 data, and we recommend that ARB revise its cold start soak analysis using the method described above as well as the new EMFAC data.

Ford analyzed high power cold starts for a late model Fusion Energi PHEV by using real-world driving data from the Atlanta Regional Commission (ARC) 2011 Regional Travel Survey and the results of dyno testing. The ARC data contains second by second speed vs. time profiles for 1,652 vehicles (~40,000 trips and ~370,000 total miles). Battery power was modeled using the speed vs. time profiles from the ARC data and vehicle road load/efficiencies assumptions. Ford's model then predicted when power demand exceeds EV capability threshold resulting in a high power cold start. When this frequency was combined with the results from dyno testing, Ford's calculations indicate that PHEV daily emissions are lower than conventional vehicles, even when taking high power cold starts into consideration, contrary to ARB's analysis indicating that they could be equal to or higher than conventional vehicles.

We agree with staff's recommendation that further analysis of PHEV emissions is necessary; especially as future PHEVs are introduced with stronger electric propulsion systems, longer electric range, and new and improved emission control strategies. We disagree with portions of staff's analysis and urge staff to consider the recommendations stated above, including the need for a more

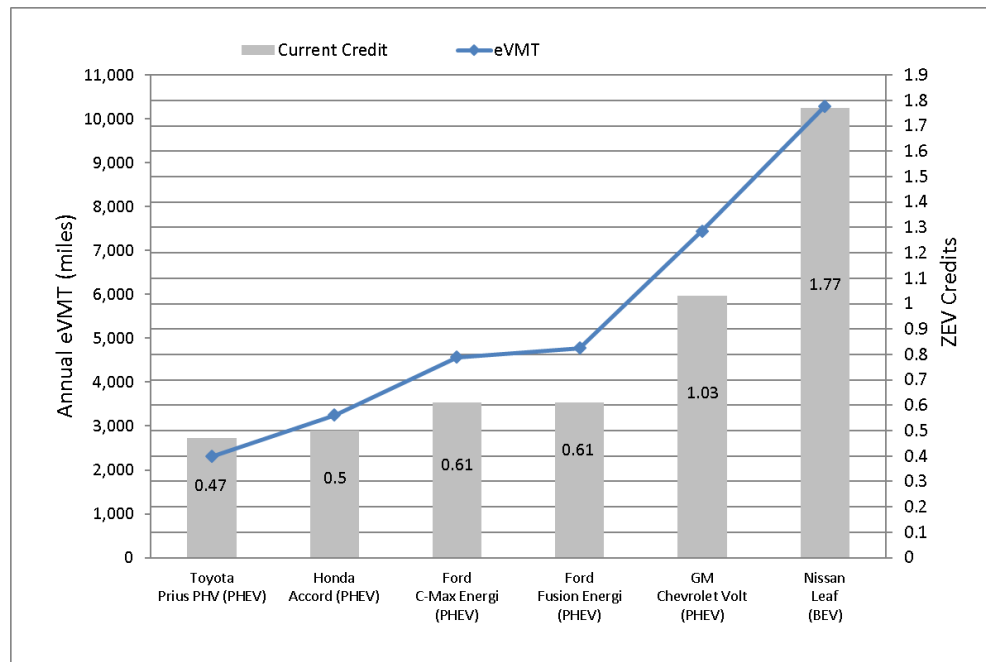
thorough review of the California Household Travel Study to ensure it delivers appropriate comparisons of cold soak data. Industry will continue to work with ARB to discuss and prove out the effectiveness of future PHEV emission control alternatives.

#### **iv. The Alliance Proposal – Adjusting PHEV Credits**

Industry appreciates the efforts of ARB staff to conduct an extensive analysis of plug-in electric vehicle data. As the number of PEVs on the road has grown, manufacturers have studied this data to understand trends in customer driving and charging behavior to improve our products. In particular, we have studied the in-use data of PHEVs compared to BEVs to get a better understanding of PHEV electric driving capabilities. The data shows that PHEVs deliver significant electric mileage (e.g. miles driven fueled by electricity from the grid) and we continue to believe the current ZEV credit structure undervalues PHEVs and should be adjusted as shown in. In fact, every alternative case analyzed for eVMT in Appendix I of the ACC MTR would increase the relative ZEV credit of PHEVs compared to BEVs.

**Figure 1-22** below compares the eVMT of PHEVs with the Nissan Leaf using the UDDS ranges in Appendix I of the staff report. Based upon this comparison, we believe that the longer-range PHEVs are under credited by 20-25 miles. Since these vehicles can use all the onboard battery, we believe the vehicles should get credit for the additional range made possible due to the PHEV architecture.

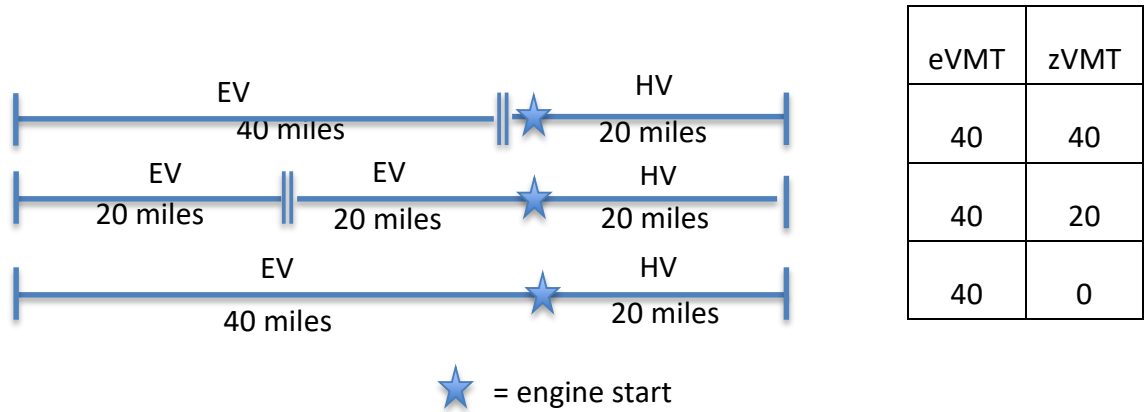
**Figure 1-22: Annual VMT versus ZEV Credit Value**



To be clear, the Alliance is not recommending a major overhaul of the ZEV credit structure, but simply an adjustment to PHEV credit levels. We recommend maintaining the current ZEV credit for operation on the US06 cycle in all electric mode since this credit incentivizes PHEVs to reduce the number of engine cold starts in-use. The credit levels provided to BEVs, BEVxs, and FCEVs based on range make sense and should be kept in place. The current credit system resulted in a variety of technologies being produced just as intended, including shorter range BEVs that are acceptable to many customers. It has also incentivized longer range BEVs that push the envelope on battery technology and provide greater battery production while expanding the market to customers that want a longer range. And it has incentivized the production of several fuel cell models to ensure continued progress on that promising technology. In addition, manufacturers have made multi-billion dollar investments based on the current credit structure and reducing credits would unfairly penalize manufacturers and take away their ability to plan for ZEV compliance in the future.

We agree with ARB that eVMT is a good metric for evaluating the GHG benefits associated with PHEVs. However, we do not agree that zVMT is an appropriate metric for evaluating the criteria benefits. We certainly do not agree that zVMT should be used to assign ZEV credits for PHEVs.

An example is shown below in which three different driving sequences can have the same eVMT and number of engine starts but a range of zVMT.



Both GHG and criteria emissions are important, but even without ZEVs, LDVs would account for less than 6% of total anthropogenic criteria emissions. Additionally, our estimates of the impact of high-powered cold starts are lower than staffs. We agree with staff that:

“It is also important to note that all of the vehicles tested are first generation PHEVs and most manufacturers are expected to introduce more capable second generation PHEVs in the near future. To the extent future blended PHEVs have stronger electric propulsion systems and longer electric range, those vehicles should be able to reduce the frequency of trips with an engine start including those with a high-power engine start.” ((ACC MTR, Executive Summary page ES-39)

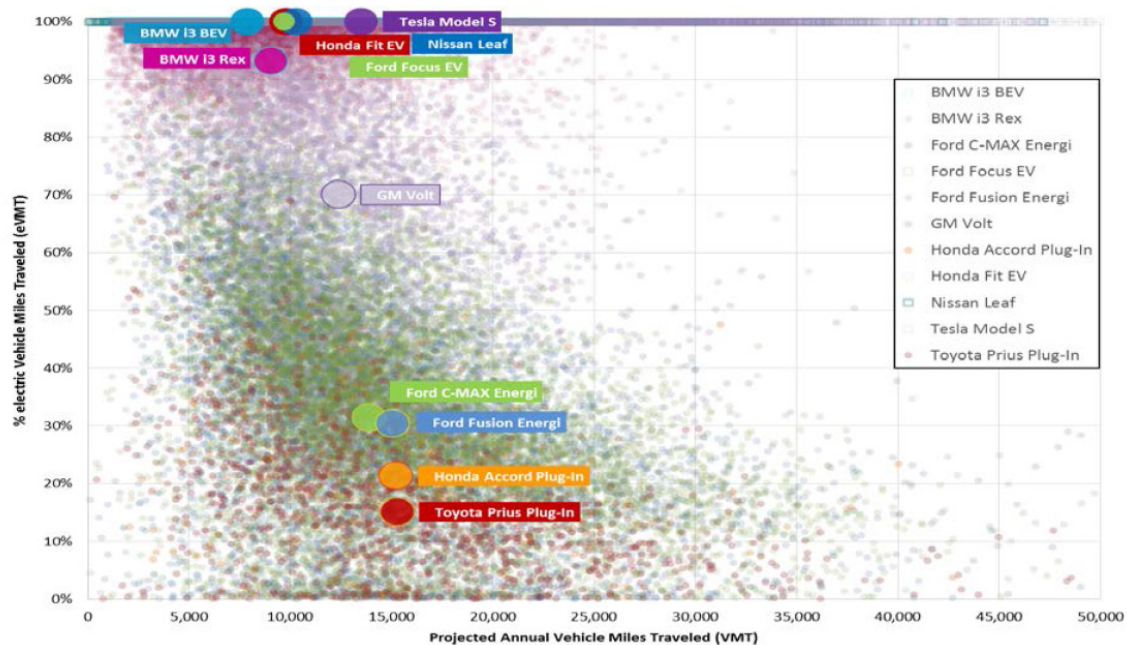
Manufacturers will introduce PHEVs that have stronger electric propulsion systems and longer electric range. Any need to address criteria emissions from future PHEVs can be handled via the LEV emissions regulations, outside the scope of the ZEV mandate.

It is too early to project technology winners by capping PHEVs and awarding them fewer credits than justified by eVMT. PHEVs meet the goals of the ZEV program – forcing technology, reducing GHG emissions, and reducing criteria emissions; while being the more attractive option to customers that need the same range as traditional vehicles.

#### v. PHEV Variability

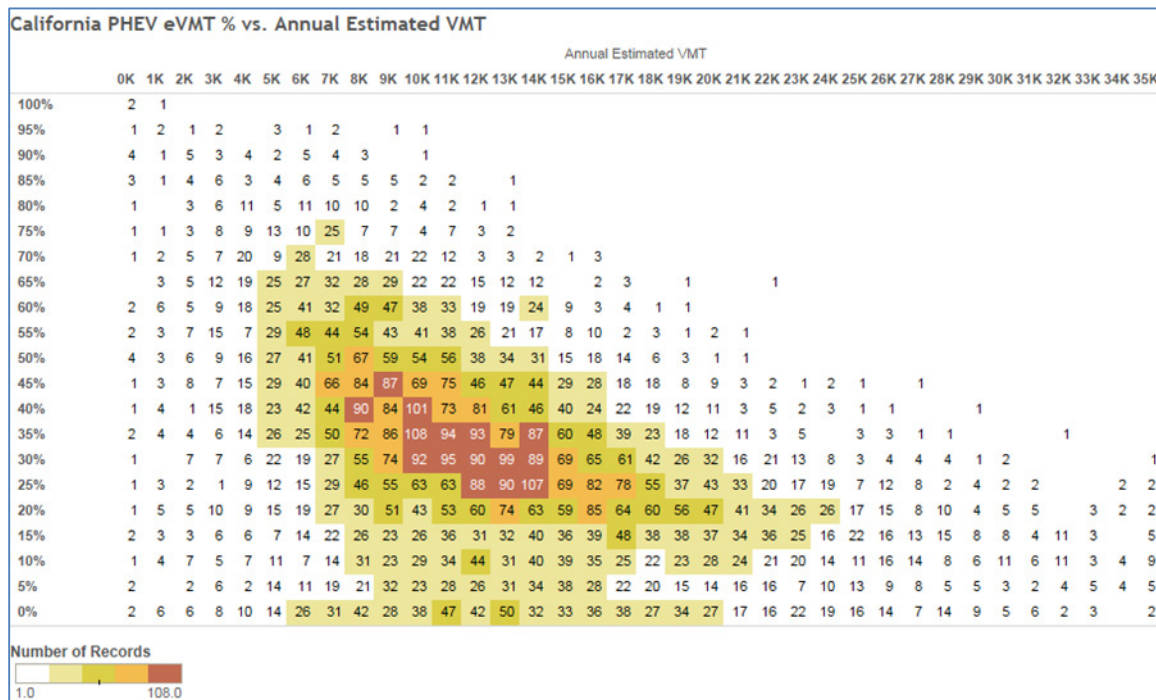
Staff notes PHEVs show significant variations in eVMT.

**eVMT Variation Across PHEVs**



Such a chart is not the best way to illustrate variation. A heat map better illustrates variation by showing the frequency of each data point (see **Figure 1-23**). A heat map for the Ford Energi PHEVs is shown below.

**Figure 1-23: Heat Map Ford Energi PHEV eVMT % vs Annual Estimated VMT**



Although there is variation, it is less than implied using a scatter plot as the high frequency events are shown on the heat map in the darker colors.

Although the Ford Energi heat map showed the percent eVMT to make it comparable to the graph in staff's report, the analysis should be done in relationship to the household fleet. This would show the true impact of the PEVs relative to one another. Moreover, there would be variation in the percentage of electric miles of even BEV drivers.

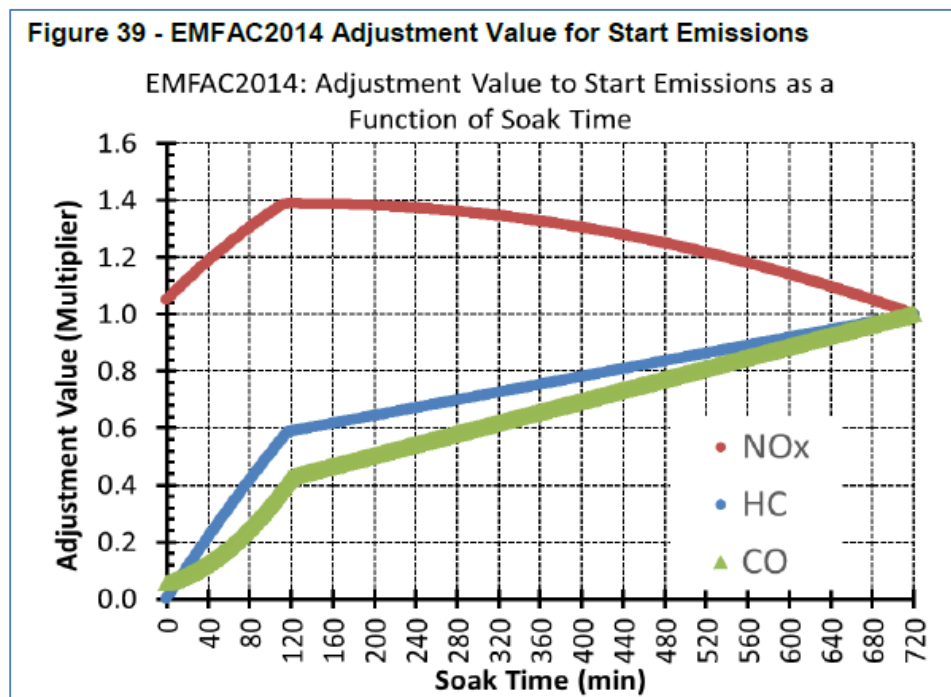
Additionally, ICE vehicles show no variation, as their eVMT is always 0. Increasing household eVMT is the goal of PEVs with or without variation. As more data is included average eVMT is more certain and represents the environmental benefit of the vehicle.

vi. PEV In-use and Charging Data Analysis (Appendix G)

**Comment on EMFAC NOx Adjustment Factor for Start Emissions**

Regarding appendix G “Figure 39 - EMFAC 2014 Adjustment Value for Start Emissions” (copied below as **Figure 1-24**), the Alliance requests ARB to update or reinvestigate the adjustment profile of NOx.

*Figure 1-24: EMFAC2014 Adjustment Value for Start Emissions*



The Alliance believes that NOx adjustment value when Soak time is 0 in figure 39 of the staff report is almost the same with hot start emission and it should be far less than 1.05. Since the catalyst is still warm when the soak time is 0, NOx emission should be less than cold start.

ARB also mentions that “bag3 emissions were assumed to be all hot start emissions” in H-9 of appendix H. This means that bag3 emissions are almost the same with the emission when Soak time is 0 in above figure 39, and Alliance believes that bag3 NOx emission is also far less than cold start NOx emission.

Therefore, figure 39, especially NO<sub>x</sub> profile, should be updated to improve future EMFAC accuracy.

The Alliance does not think the NO<sub>x</sub> emission factor is correct for short soak times. We believe it should be near zero like HC and CO. This can be a factor with over estimates the impact of cold starts.

#### **Improper use of Data from Prototype Vehicles**

In Appendix G, Section VII.B, “Empirical data from PEV loaners,” ARB refers to data from both after-market modified Prius and Prototype Prius to indicate that both petroleum and charging rates were very low. This data is old, and the vehicles were not representative in whole or in part of Toyota production PHEVs. ARB should have referred to the more recent data set of the production Prius PHEV in which the charging rate is on average greater than 1 times per day including approximately 16% of owners charging infrequently.

#### **h. ZEVs in California by 2025**

Much has been written and many spreadsheets developed to predict the number of ZEVs in California by 2025. Of course, the ZEV regulations do not specify a number of ZEVs, but rather a number of ZEV credits.

ARB first released the “ZEV Calculator” during the 2012 ACC rulemaking. The 2012 ZEV Calculator assumed that manufacturers would maximize the use of TZEVs (primarily 14-mile PHEVs that could not drive 10 miles of the US06 Drive Cycle on electricity only), BEVs with a 70-mile range, and an increasing number of FCEVs. The 2012 ZEV Calculator thus predicted about 1.4 million ZEVs would be necessary for minimum compliance by 2025.

Four years later, NRDC, realizing that automakers were producing ZEVs with longer ranges and better performance than anticipated in 2012, developed a spreadsheet

and issued a report,<sup>32</sup> using much longer range and better performing BEVs and PHEVs, predicting that only about 1 million ZEVs would be necessary for minimum compliance by 2025.

Upon reviewing the NRDC report, the Alliance identified several assumptions that seemed to be incorrect or out of date (e.g., total vehicle sales in California, range of BEVs, ZEV credit balances, etc.). We contracted with Sierra Research to replicate the NRDC spreadsheet (the NRDC spreadsheet was not made available) and then update the assumptions. Sierra Research predicted about 1.6 million ZEVs would be necessary for minimum compliance by 2025, using the NRDC analysis and updated assumptions. The Sierra Research report was transmitted to ARB on 13-Jan-2017, and is also attached.

With the ACC MTR, ARB issued the 2017 ZEV Calculator with updated vehicle range, performance, and assumptions regarding ZEV credit banks. The 2017 ZEV Calculator predicts about 1.2 million ZEVs will be necessary for minimum compliance by 2025.

In general, the 2017 ZEV Calculator seems to be the most comprehensive to date. However, we identified a couple of issues with the new calculator. First, the 2017 ZEV Calculator assumes substantially different ZEV credit bank compliance buffers between the three scenarios. For example, the Slow ZEV Technology case assumes manufacturers will maintain only three months of ZEV credit compliance buffer, while the Mid-Range ZEV Technology case assumes one year, and the High ZEV Technology case assumes two years.

The current ZEV credit bank compliance buffer exceeds two years, industry-wide, and we believe that is a reasonable assumption. The market is too variable, the complementary measures too erratic, and cost of non-compliance too high for automakers to have any security with less than a couple of years of ZEV credit bank compliance buffer.

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<sup>32</sup> Shulock, Chuck, *Manufacturer Sales Under the Zero Emission Vehicle Regulation, 2012 Expectations and Governors' Commitments Versus Today's Likely Outcomes*, July 21, 2016, retrieved from [https://www.nrdc.org/sites/default/files/media-uploads/nrdc\\_commissioned\\_zev\\_report\\_july\\_2016\\_0.pdf](https://www.nrdc.org/sites/default/files/media-uploads/nrdc_commissioned_zev_report_july_2016_0.pdf)

The second issue we identified is the treatment of NEV/AT-PZEV/PZEV (NAP) credits. NAP credits can be converted (with specified discounts) and used to meet up to 25 percent of the maximum TZEZ credits. Thus, the starting balance at the beginning of 2018 is important as is the likelihood of automakers trading the NAP credits.

The 2017 ZEV Calculator assumes that NAP credit balance will increase in MY 2016 and 2017, leading to more NAP credits at the beginning of 2018, than the end of 2015 MY. Since a large discount is applied to AT-PZEV credits (75 percent discount) and PZEV credits (94 percent discount) when converting for use in 2018 and beyond, we would not anticipate automakers banking more of these credits in the final two model years before the discount. Looking at the ZEV credit banks, NAP credits decreased from 2014 to 2015. This trend of decreasing NAP credits could very well continue in 2016 and 2017. However, a conservative estimate would keep the NAP credits at 2015 levels.

Another issue with the NAP credits is trading among automakers. The 2017 ZEV Calculator assumes that NAP credits are perfectly traded between automakers (i.e., if Automaker A has extra NAP credits, it sells them to an automaker in need). This might not be a reasonable assumption. Without perfect trading some automakers will arrive at 2025 with substantially larger NAP credit banks than assumed (maybe four years' worth of NAP credits rather than two years). It's impossible to predict how manufacturers will react, but a bracket of possibilities would be perfect trading and no trading. The 2017 ZEV Calculator already models perfect trading.

We asked Sierra Research to analyze the impact of:

1. Increasing the ZEV Credit bank buffer from one year to two years in the Mid-Range ZEV Technology case.
2. Assuming the ZEV bank balance of NAP credits does not change after 2015MY.
3. Assuming automakers do not trade NAP credits in 2018 to 2025.

We have attached the Sierra Research analysis, which predicts over 1.4 million ZEVs will be necessary for minimum compliance by 2025 using ARB's 2017 ZEV Calculator and the updated assumptions above.

Of course, this assumes that the requirements do not increase beyond 2025. To the extent the requirements increase after 2025, this will increase the necessary ZEV credit bank balance requirements prior to 2025.

#### **i. Transportation System Credits**

**Background.** Currently, the ZEV regulations support deployment of ZEV technologies into a variety of innovative shared-use applications (e.g. car-sharing or ride-sharing) through additional Transportation System Credits, which are set to expire after MY 2017. These regulatory incentives were initially designed to support the overall goals of the ZEV Mandate, including technology development and deployment as well as ZEV exposure.

Today, deployment of ZEVs in Transportation Systems offer the opportunity to overcome some of the disadvantages inherent in the deployment of ZEVs, such as infrastructure development and consumer acceptance. These deployments are also expected to occur in urban centers offering additional environmental and social benefits.

ZEV market shares are near one percent of new vehicle sales nationally and, in California, have stagnated well below four percent for three consecutive years. Many agree that continued market growth will be influenced by multiple factors ranging from current gas prices to customers' willingness to pay for these technologies to the growth of the infrastructure network. The ability of various stakeholders to influence these factors also ranges, yet nearly every stakeholder group believes significant work can be done to increase consumers' familiarity with ZEVs.<sup>33</sup> Multiple efforts are underway to address the topic of outreach and awareness, including traditional automaker marketing programs, electric utility education and outreach, independent stakeholder market assessments, Department of Energy EV Everywhere, as well as public private partnerships that consider

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<sup>33</sup> Most notable example is highlighted by K. Kurani's work at ITS UC Davis. "Studies of Consumer Awareness, Knowledge, Valuation, Experience & Consideration of ZEVs", 2015 California Governor Summit.

education campaigns such as the transition occurring at the PEV Collaborative and New Collaboration for ZEV Success.<sup>34</sup>

At a broader level, new transportation paradigms are emerging that develop an integrated and innovative approach to mobility. In June 2016, the US Department of Transportation (USDOT) announced Columbus, Ohio as the winner of the Smart City Challenge, highlighting a plan to integrate shared-mobility, autonomous and connected vehicle technologies, with special considerations to support underserved communities and goods movement corridors. In October 2016, additional Advanced Transportation Technology grants were announced by USDOT to support eight projects, which were contained in the 78 applications they received from the Smart City Challenge. At the same time, FTA announced Mobility-on-Demand Sandbox grants, seeking to support the development of multi-modal solutions. Together, new models and opportunities are emerging beyond traditional car- and ride-sharing while still leveraging these emerging shared-used transportation systems. The private sector, both traditional automotive manufacturers as well as non-traditional technology providers, have announced their intention to engage in these business models. Furthermore, these stakeholders remain active in the development of autonomous vehicles—announcing initial customer testing programs to full commercial deployment of these vehicles in less than 5 years.<sup>35</sup>

The opportunity to pair and integrate these smart mobility concepts has never been so apparent. The recent release of the Governor's updated ZEV Action Plan reemphasized the goal to incorporate ZEVs into shared-used applications, in part to promote direct consumer experiences with ZEVs, but also to maximize the

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<sup>34</sup> A variety of outreach programs include (Electric Utility) San Diego Gas & Electric's [Power Your Drive](#) and Southern California Edison's [Charge Ready](#). And third party assessments like Sierra Club's [Multi-State Study on Electric Vehicle Shopping Experience](#). Additional collaborative efforts include DOE's [EV Everywhere](#) Program, the California PEV Collaborative "Drive California" (see [Meeting Notes](#) from July 19, 2016) as well as the Phase 1 of 8-State Multi-State MOU parties and Automakers (New Collaborative for ZEV Success).

<sup>35</sup> Examples of announcements by traditional and non-traditional include GM and Lyft [Strategic Alliance Announcement](#) on Jan 4, 2016, Ford's [2021 Target](#) Announcement on Aug 16, 2016, Uber's [Pittsburgh announcement](#) on Sep 14, 2016.

opportunity to deploy ZEVs.<sup>36</sup> The “multiplier effects” of placing ZEVs into a variety of smart-mobility applications is obvious, and remains opportunistic, in a market where many consumers have yet to be exposed to transportation electrification.

For a variety of potential benefits which includes technology development to ZEV exposure, the Transportation System credit should continue beyond MY17. As discussed below, with the advent of new transportation business models, the Transportation System credit should expand to include a variety of new applications, such as Ride-Hailing and Autonomous Vehicles.

**Car-Sharing.** The environmental, exposure, and vehicle-ownership benefits are well-documented. UC Berkeley published a 2015 car-sharing study<sup>37</sup> of car share fleets with ZEVs, and concluded car-sharing with both BEVs and PHEVs play a role in promoting a greater appreciation of these technologies, facilitating long-term exposure and learning of these technologies while improving overall market penetration of ZEVs. Multiple, commercial programs are working to integrate ZEVs into fleets in innovative ways, such as Car2Go (Daimler), BMW’s ReachNow, and General Motors’ Maven and additional opportunities may lie in more traditional carpool, vanpool, and rental car programs.

**Ride-Sharing / Ride-Hailing.** With the recent advent and growth of ride-hailing services, stakeholders are focusing on the strong opportunity to deploy ZEVs into high-mileage, high-exposure applications for drivers and riders alike. For example, General Motors recently announced its intention to place Bolt EVs into a program where drivers can obtain a short-term rental/lease to provide ride-sharing

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<sup>36</sup> 2016 ZEV Action Plan. An updated roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025. Page references for shared used applications include pages 15, 16, 32. [https://www.gov.ca.gov/docs/2016\\_ZEV\\_Action\\_Plan.pdf](https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf)

<sup>37</sup> Zero- and Low-Emission Vehicles in U.S. Carsharing Fleets: Impacts of Exposure on Member Perceptions (Sep 22, 2015). <http://innovativemobility.org/?project=zero-and-low-emission-vehicles-in-u-s-carsharing-fleets-impacts-of-exposure-on-member-perceptions>

services.<sup>38</sup> Encouraging and incentivizing ZEVs to be placed into ride-hailing applications would provide a broad range of opportunities for multiple stakeholders—examples of benefits include vehicle miles travelled (VMT) is replaced with electric VMT, high-mileage applications (800-1,000 miles per week) drive technology development (e.g. larger batteries) to address operational efficiencies, and the benefits of lower-operating costs can be more easily realized by drivers. Moreover, these higher-mileage applications support infrastructure development, particularly around building the business model for public-facing charging infrastructure.

While the specific impact of deploying ZEVs into ride-hailing has yet to be fully understood, current evidence highlights the broader opportunity. Lyft's Economic Impact Report (2015) notes 60% of vehicle owners use their vehicle less, while 46% avoid ownership altogether. In addition, Lyft notes 25% of rides are used to connect to transit.<sup>39</sup> In parallel, The American Public Transportation Association highlighted the positive role that shared services can have on the transportation system, including reducing car-ownership from 1.5 to 1.05 vehicles per household while complementing public transit options, such as being available in early morning (10:00pm – 4:00am).<sup>40</sup> In addition, the growth of shared-pooling systems such as UberPool and Lyft Line highlight an additional opportunity to further reduce overall impacts—in early 2016, Uber noted a doubling of service in six months in New York City and Lyft highlighted a greater than 50% penetration in San Francisco.<sup>41</sup> The

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<sup>38</sup> Lyft and GM's Express Drive Expands to Colorado and California. Welcomes Chevrolet Bolt EV in California (July 11, 2016). <http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2016/jul/0711-lyft.html>

<sup>39</sup> Lyft [Economic Impact Report](#) (2015).

<sup>40</sup> American Public Transportation Association. Shared Mobility and the Transformation of Public Transit. (March 2016). <http://www.apta.com/resources/hottopics/Pages/Shared-Use-Mobility.aspx>

<sup>41</sup> The Verge. Andrew J Hawkins. [Uber joins forces with former New York City Council foe to promote carpooling](#) (April 18, 2016) and [You can now use pretax dollars to pay for UberPool, which is huge](#) (Aug 31, 2016).

CPUC's Summary Report noted a vast majority of trips are less than 10 miles. Each of these opportunities underline the potential benefits, and reinforces the opportunity for ZEVs to provide additional benefits while being ideally suited to meet the needs of a vast majority of these trips (e.g. lower operating costs).

**Autonomous.** To further establish environmental, energy, and safety benefits, strong considerations should be placed into incentivizing electrification of autonomous vehicles (particularly at Level 4 and Level 5).<sup>42</sup> In October 2016, the National Highway Traffic Safety Administration (NHTSA) established its first guidance on Federal Automated Vehicle Policy. Many acknowledge the opportunity to transform personal mobility, including the opportunity to support "vehicle electrification".<sup>43</sup> Independent research continues on the overall impact of autonomous vehicles, including a recent analysis completed by Rocky Mountain Institute (RMI).<sup>44</sup> Ranging from gasoline demand to impact on CO2 emissions, RMI concludes there is a strong potential of building a system "that is superior in terms of cost, convenience, safety and emissions."<sup>45</sup> With significant learning opportunities ahead for all stakeholders, including a variety of deployment scenarios from on-demand ride-hailing to complementary transit solutions, there appears to be a strong interest to incentivize electrification of autonomous vehicles.

#### j. ZEV Credit Program

Some stakeholders recommend effectively penalizing automakers by reducing credits, increasing requirements, or requiring specific vehicle volumes. The ZEV credit program, like virtually every credit program developed by ARB staff, provides

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<sup>42</sup> To learn more about SAE's Levels of Driving Automation, see [http://www.sae.org/misc/pdfs/automated\\_driving.pdf](http://www.sae.org/misc/pdfs/automated_driving.pdf).

<sup>43</sup> USDOT / National Highway Transportation Safety Administration. <http://www.nhtsa.gov/nhtsa/av/index.html>

<sup>44</sup> Rocky Mountain Institute. Charlie Johnson and Jonathan Walker. *Peak Car Ownership. The Market Opportunity of Electric Automated Mobility Services*. 2016. [http://www.rmi.org/peak\\_car\\_ownership](http://www.rmi.org/peak_car_ownership)

<sup>45</sup> Rocky Mount Institute. [Peak Car Ownership](#). See page 22.

flexibility in return for automakers providing earlier emission reductions, more rapid innovation, and economies of scale sooner rather than later.

**ZEV Credits Ensure Early Introduction of Technology:** The ZEV credit program resulted in over 170,000 ZEVs on the road today that might not have been on the road otherwise.<sup>46</sup> These early introduction ZEVs provide early emission reductions, improve manufacturing processes, result in more efficient electric powertrains, and reduce battery costs. Moreover, the early introduction of ZEVs provides invaluable consumer experience and insight. The current advances in ZEV technology, costs, and market demonstrate the success of the ZEV credit program. Automakers penalized for producing and delivering ZEVs early (at a cost of \$10s of billions) are unlikely to repeat this in the future.

Several stakeholders have spoken about a “ZEV credit glut.” However, these credits represent vehicles that provide California with real, quantifiable, and verifiable early emission reductions. For example, if an automaker sells a ZEV in 2014, but does not use the credits until 2019, California sees 5 years of emission reductions (GHG and criteria). These early emission reductions are real, and they are part of the design goal of the ZEV regulations since the 1990s – encourage the early introduction and thus the early emission reductions.

**Early ZEVs Seed the Consumer Market:** There are other benefits with the current regulatory credit structure. For example, if automakers strictly complied with the ZEV regulations, less than 100,000 ZEVs would be on the road in California instead of more than 260,000.<sup>11</sup> These additional ZEVs provide consumers invaluable experience with the technology. It allows automakers to gage consumer response to the technology, and adapt the vehicles and technologies to consumer demands. Moreover, this early consumer experience, to the extent that it is positive (and every research to date has demonstrated that it is), seeds the market with ZEV enthusiasts who talk to friends, family, neighbors, and co-workers. All of this helps build a market for ZEVs. Automakers that bring ZEVs to market early should be rewarded.

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<sup>46</sup> See ACC MTR, Appendix A, page A-7, finds the sales-weighted average credit of 3.29 for ZEVs and 1.98 for PHEVs. While ARB 2016b. California Air Resources Board. 2015 Zero-Emission Vehicle Credits. Website. <http://www.arb.ca.gov/msprog/zevprog/zevcredits/2015zevcredits.htm> shows 358,785 ZEV and BEVx credits and 118,785 PHEV credits.

**ZEV Credits provide Flexibility & “Insurance”:** Most of the vehicle regulatory programs since the 1990s included a credit provision allowing automakers to comply early and use the early credits in later years. The ZEV credit program is no exception – it allows manufacturers to produce vehicles early and bank the credits associated with those vehicles for later use. An automaker might use this flexibility to fill gaps in product or infrastructure availability. For example, the hydrogen infrastructure deployment has not progressed as rapidly as expected and automakers slowed vehicle deployment to keep pace with the infrastructure development.

Flexibility is important to automakers for more than just new technology introductions. The new vehicle market in general and ZEV market in particular, experience large swings based on a number of variables including the overall economy, fuel prices, perceptions of advanced technology vehicles, government support, and consumer awareness and acceptance (or lack thereof). Automakers and regulators cannot reliably predict these variables or how such changes will impact the ZEV market, particularly in the face of substantially increasing ZEV credit requirements in the 2018 through 2025 timeframe. Instead, the ZEV credit program allows automakers effectively to buy “insurance” against market downturns by building up ZEV credits to weather drastic changes in the ZEV market without falling out of compliance. Just as consumers are not comfortable driving a new car without insurance, automakers are not comfortable operating with no “ZEV credit insurance.” The consequence of non-compliance is simply too great. Typically, historically, and currently, automakers hold ZEV credit equivalent to about two years of compliance.

**ZEV Credits Result in a Variety of ZEVs:** The ZEV credit program encourages longer range ZEVs (BEVs, PHEVs, and FCVs) that receive more credits. As others have correctly pointed out, this means fewer ZEVs on the road in a minimum compliance scenario. However, as noted in the ACC MTR, long-range ZEVs require either much larger batteries or a fuel cell stack and are far more expensive to produce. However, the ultimate goal is to replace internal combustion engines. This will require a mix of technologies and vehicle ranges, across all vehicle categories from subcompacts to SUVs to pickups.

For example, plug-in hybrid technology could allow larger light-duty vehicles (LDVs) such as mini-vans to operate most of the time on grid electricity, but still provide

long range when needed. FCEVs operate exactly like an internal combustion engine – same range and same refueling time. Once the infrastructure is deployed, FCEVs can replace internal combustion engine vehicles on a much larger scale across a broader range of vehicles. The variety of models with different technologies and different ranges add to the lineup that expand the ZEV market to provide options that meet different customer lifestyles.

For some consumers, increased range may eliminate or reduce “range anxiety” and provide peace of mind needed to buy a BEV instead of a conventional gasoline vehicle. However, a constant march to higher-range vehicles is not the only path. It is important to have a variety of vehicle technologies and vehicle ranges to test the market. For example, current BEVs with an 85 to 105-mile range could meet 90 percent of the average daily driving needs for most vehicle owners. Some of these owners might not want to pay substantially more for a BEV that covers only five percent more of their driving. The market knowledge, gained by the early introduction of a wide variety of vehicles with different technologies and different ranges, is invaluable.

## 2. PM

We support the ACC MTR recommendation not to accelerate the 1 mg/mi standard from its current timeline. Accelerating the 1 mg/mi standard would take away from time needed to make improvements to the engine and fuel delivery system to achieve the standard and instead result in needing to use gasoline particulate filters which increase CO<sub>2</sub> emissions and have other adverse effects. Maintaining the current timing of 2025 model year provides also much-needed time to continue to improve PM measurement technology. While the ARB staff assessed PM measurement technology in 2015 we remain concerned about the magnitude of variation in measured PM emissions including lab-to-lab, vehicle-to-vehicle and driver-to-driver. Accelerating the 1 mg/mile PM standard would force automakers to redirect large amounts of resources at the same time they are attempting to dramatically lower criteria emissions, GHG emissions, and develop and deliver high-quality ZEVs.

We also propose working with ARB staff over the next few years to better understand the variability associated with PM emissions and PM emission measurement. As part of this collaboration, we recommend conducting round-robin PM testing at ARB, EPA, and the OEM labs like the round-robin testing conducted in 2010.

The 2012 ACC regulations established a very stringent two-step reduction in PM emission standards for LDVs. The first step is a 70% reduction in the PM Standard from today's 10 mg/mile to 3 mg/mile. This standard starts in the 2017 MY (this year) and is fully phased in with the 2021 model year. The next step is another almost 70% reduction in the standard to 1 mg/mile starting in 2025. For automakers, these standards represent two separate but equally difficult challenges – consistently and repeatedly measuring PM emissions at the levels proposed, and of course, controlling and reducing vehicle PM emissions.

#### **a. Advanced Clean Vehicles Contribution to PM Emissions in California**

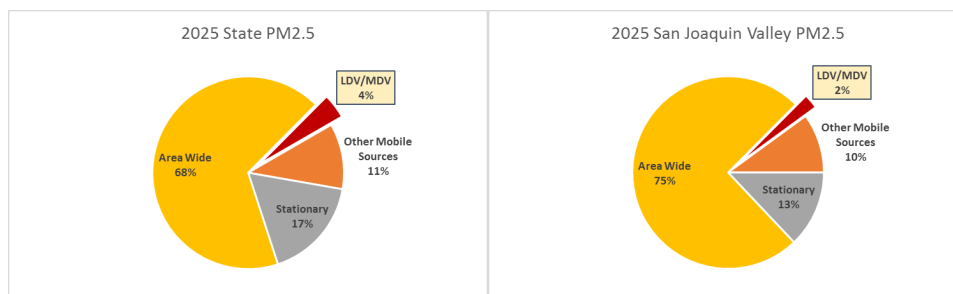
Automakers are ready and willing to do their share to reduce PM emissions from LDVs. However, before doing so, it is worthwhile to highlight ARB staff's findings in Appendix L of the ACC MTR. Appendix L reports the 1 mg/mile PM<sub>2.5</sub> standard will reduce PM<sub>2.5</sub> by 200 tons/year statewide and 25 tons/year in the San Joaquin Valley in 2050. The perspective provided in Appendix L is appropriate – total mobile source PM<sub>2.5</sub> emissions are 25,000 tons/year and 3,000 tons/year statewide and in San Joaquin Valley, respectively. Thus, the benefit of the 1 mg/mi standard is to reduce **mobile source PM<sub>2.5</sub> emissions by about 0.8 percent**. Of course, mobile source emissions are only a small part of the **total PM<sub>2.5</sub> emissions**. According to ARB's Emission Inventory Data<sup>47</sup>, mobile source emissions are about one-fifth of total PM<sub>2.5</sub> emissions so total PM<sub>2.5</sub> emissions will drop by about 0.2 percent - a reduction too small to show on a chart or graph.

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<sup>47</sup> Air Resources Board, *Emissions Inventory Data CEPAM: 2013 Almanac – Standard Emissions Tool*, Retrieved 22-Feb-2017 from <https://www.arb.ca.gov/app/emsinv/fcemssumcat2013.php>

This is not surprising since, as shown in **Figure 2-1**, LDV PM<sub>2.5</sub> emissions make up a small percentage of total PM<sub>2.5</sub> emissions. To put this in perspective in the South Coast, cooking produces about 50 percent more PM<sub>2.5</sub> emissions than all of the cars, minivans, pickup trucks, and SUVs combined. Again, automakers are ready and willing to do their part, but it is worthwhile to understand the overall impact of further LDV PM emission reductions.

**Figure 2-1 LDV Contribution to Total PM<sub>2.5</sub> Emissions**



## **b. Gasoline Particulate Filters (GPFs)**

We, like ARB, share the goal of achieving the PM standards on gasoline vehicles without the use of GPFs. The ACC MTR notes the costs of the GPFs; we agree these costs are substantial. However, we would also point out that costs go well beyond the cost of the GPF itself. Automakers do not simply bolt on a GPF. The GPF must be integrated into the vehicle's overall emissions control system. One of the most technologically challenging elements of installing any new emission control equipment is ensuring the on-board diagnostic (OBD II) system can monitor the equipment at the extremely low thresholds throughout the life of the vehicle.

Additionally, GPFs increase backpressure, add weight, and require regeneration, all of which increase GHG emissions. Regeneration also inconveniences customers that must drive for an extended period (~20 minutes) at highway speeds to complete the regeneration. Finally, adding a component both increases warranty costs for automakers and increases repair costs for customers. For these reasons and others, the ACC MTR is correct – automakers plan to reduce PM emissions through combustion chamber improvements. Combustion chamber improvements require years of lead time since virtually every modification potentially impacts emissions of every pollutant and possibly the durability of the engine itself.

**Table 2-1** provides a summary of the pros and cons associated with GPFs and engine mitigation measures. Of course, GPFs do effectively reduce PM emissions; however, that reduction comes at the price of:

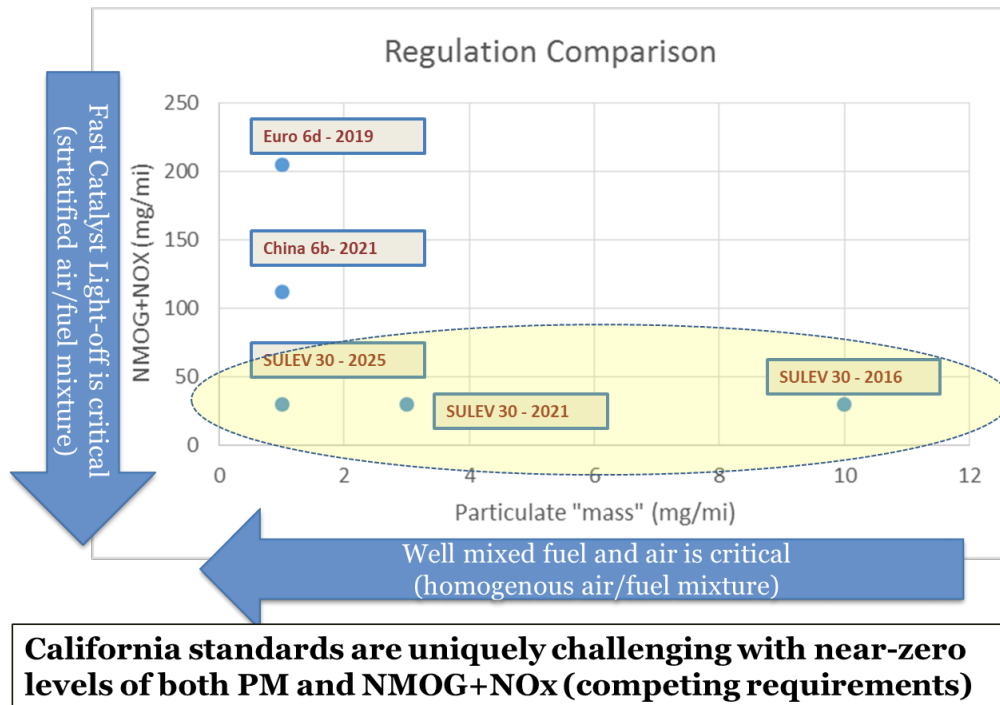
- Higher CO<sub>2</sub> emissions from increased weight, regeneration, and backpressure,
- Reliability problems and higher costs for these reliability problems for both the automaker under warranty or for the customer after warranty,
- Inconvenience and drive quality concerns associated with PM filter regeneration,
- Reduced peak power due to increased backpressure,
- Need for greater engine protection since increased backpressure causes higher exhaust temperatures, and
- Creating an incentive to tamper with the vehicle to improve performance

**Table 2-1: Pros and Cons of GPF vs. Engine Mitigation**

	GPF	Engine Mitigation
Particulate mitigation	+++	+
CO <sub>2</sub> emissions	--	+
Reliability/Warranty	--	+
Drive quality/ customer satisfaction	--	+
Peak power	---	+
Engine protection	--	+
Incentive for tampering	-	++
Cost	--	+

Some stakeholders have suggested that China and the European Union (EU) will achieve more stringent PM emission standards far earlier than California. However, as shown in **Figure 2-2**, China and the EU chose to trade off a slightly faster PM reduction for HC+NO<sub>x</sub> emissions that are four and seven times higher than ARB's.

**Figure 2-2: ARB, EU, China Criteria Emission Comparison<sup>48</sup>**



### c. PM Measurement

In an October, 2015, report to the Board, ARB staff assessed the feasibility of measuring PM emissions at the levels required to meet a 1 mg/mile standard. The data presented by the ARB Staff in their report was consistent with that of automakers. However, despite consistency of data, automakers could not then and cannot now conclude that measuring PM at levels necessary to meet a 1 mg/mi standard is feasible. We do not suggest that it will be infeasible to measure at this level in 2025. However, compared to decades of experience measuring hydroARBon (HC) and nitrous oxides (NOx) emissions, automakers have virtually no experience measuring PM emissions in a high-volume production environment. To wit, ARB approved new lab equipment, test procedures, and measurement techniques for PM

<sup>48</sup> Belton, David, General Motors, *Reducing PM Emissions: An Automobile Manufacturer Perspective*, Presented 28-Sep-2016, 2016 ARB ACC Technology Symposium. Retrieved on 23-Feb-2017 from <https://www.arb.ca.gov/msprog/acc/acc-symposium.htm>

emission measurement less than 18 months ago. Moreover, unlike ARB's relatively low-throughput test facility where vehicles are relatively clean, automakers operate production test facilities with high vehicle throughput not only for certification, but also for vehicle development. Some of the automaker development testing involves vehicles with very high PM emissions that might lead to lab contamination.

The primary concern automakers have is the high variability of PM test results. Variability occurs when the same vehicle with presumably the same emissions is repeatedly tested – with different drivers, in different labs, on different days - but measured emissions differ. An automaker must ensure that a vehicle certified at its lab will have similar emissions at another lab, or build in “headroom” to allow variability in measurement levels. In addition to variability lab-to-lab, driver-to-driver, day-to-day, actual vehicle emissions vary from vehicle to vehicle due to manufacturing tolerances. It is not sufficient that a single emissions test vehicle meets the standard – every vehicle produced must meet the standard, in every lab, with every driver, on every day.

Historically, the variability for PM emissions has been very high. For example, in 2010,<sup>49</sup> ARB, EPA, and automakers conducted a round-robin test program using a single vehicle – BMW 335i. **Figure 2-3** shows the results of the FTP testing without background PM correction. It's worth noting the test-to-test and lab-to-lab variability:

1. **Test-to-Test, same lab:** In ARB Cell 1, the first test measured PM emissions of about 0.6 mg/mile, the second test was almost twice that at 1.2 mg/mile. These two tests were run very shortly after one another. Likewise, ARB Cell 7 consistently measured around 0.5-0.6 mg/mile during the first set of three tests. After the vehicle had been tested at other industry and EPA labs, the vehicle was returned and tested again in ARB Cell 7, this time measured PM emissions were 1.3, 0.8, and 1.1 mg/mile. Again, these are highly variable results with the same vehicle in the same lab.

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<sup>49</sup> The 2010 round robin test program was conducted before the adoption of updated test procedures in Part 1066.

2. **Lab-to-Lab**: As shown, the variation in emission results between labs is very high. The ARB and BMW labs seems to measure lowest PM emissions, with emissions at other labs two to three times as high. This variation is critically important. If an automaker measures PM emissions at its lab at 0.6 mg/mile, but ARB measures at 1.2 mg/mile, the vehicle would be out of compliance and the automaker in compliance jeopardy.

More recently in early 2016, the Coordinated Research Council (CRC) published a study of PM measurement (study E99-1). This study was done under ideal conditions, one facility, one site, one driver, new Tier 3 equipment. The tests were conducted on 2 vehicles (the first vehicle had PM emissions <1mg/mi, and the second had PM emissions of about 2 mg/mi). This study, under ideal testing conditions, also showed significant PM measurement variability when one views all the data.

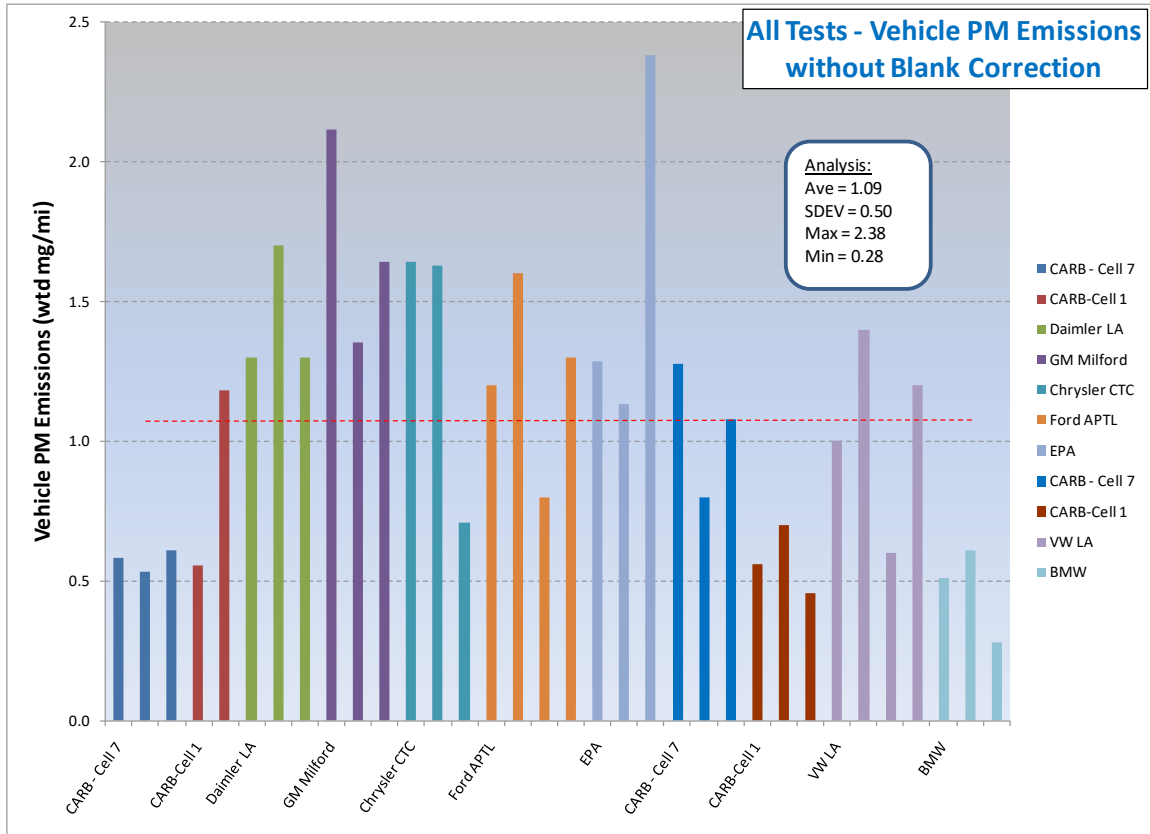
Additional studies are being conducted to understand, and ultimately reduce, variability associated with PM measurement.

Because of the variability automakers will likely certify vehicles with substantial headroom. However, there is a limit to headroom at very low PM emission levels proposed. During the round-robin testing, ARB, EPA, and manufacturers measured the background PM emissions (i.e., measured PM emissions not associated with the vehicle<sup>50</sup>). Background PM emissions varied from 0.0 to 1.8 mg/ mile.

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<sup>50</sup> Background PM emissions can result from airborne contamination such was wind-blown dust, smoke, or residual PM in the tunnel from prior tests.

**Figure 2-3: 2010 Round-Robin Test Results**



Over the next several years, automakers will gain experience with the new equipment and procedures and begin testing large numbers of vehicles to the 3 mg/mi standards. Automakers expect to improve and streamline the procedures and reduce variability. However, whether these improvements are sufficient to feasibly measure PM emissions at the levels needed to meet the 1 mg/mi standard is still unknown.

***For these reasons, we propose continuing to work cooperatively with ARB Staff to better understand PM measurement variability. We recommend another round-robin PM test program within the next two years. If variability is still a concern based on round-robin testing and lab experience, ARB should consider ways to reduce variability such as averaging in-use tests, or providing additional in-use compliance margin.***

#### d. US06:

The ACC MTR recommends developing more stringent US06 PM standards to match the more stringent 1 mg/mile federal test procedure (FTP) standards in 2025.<sup>51</sup> First, we note that ARB has already reduced the US06 PM standard from those initially set in 2012 ACC regulations. In 2012, ARB adopted US06 PM standards of 10 mg/mile for LDVs less than 6,000 pounds gross vehicle weight rating (GVWR) and 20 mg/mi for vehicles 6,501-8,500 pounds GVWR. ARB subsequently reduced the US06 PM standard to 6 mg/mi for all vehicles less than 8,500 pounds GVWR.

Second, as noted in section 2.a., the LDV PM emissions are a very small part of the total PM2.5 emissions (~ 3 percent). Further, US06 accounts for less than 13 percent of the LDV driving. In establishing the US06 drive cycle, U.S. EPA in cooperation with ARB and the auto industry found that “the 3-city analysis showed that nearly 13 percent of vehicle operation time occurs at combinations of speed and acceleration that fall outside the matrix of speeds and accelerations found on the LA4.”<sup>52</sup> Thus, the US06 PM Standards will only address about 0.4 percent of total PM2.5 emissions 13 percent of the 3 percent of total PM2.5 emissions. Said another way, even if all US06 PM emissions were eliminated, the change in total PM2.5 emissions would be less than 0.4 percent.

Finally, the variability mentioned in Section 3.b. above for FTP PM emissions is much more pronounced when measuring US06 PM emissions, particularly with the gasoline direct injection (GDI) vehicles expected to dominate in the 2025 timeframe. ARB recognized the greater variability for both US06 and GDI in the 2014 ISOR reducing the US06 PM standard.

Nonetheless, we are committed to working with ARB staff and investigating the appropriateness of the 6 mg/mi US06 PM Standard in 2025+. However, given the above, there is no justification for setting a US06 PM standard that would require

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<sup>51</sup> While the ACC regulations begin a phase in of the 1 mg/mile FTP PM standard in 2025, the US06 PM Standard remains at 6 mg/mile.

<sup>52</sup> U.S. EPA, *Final Technical Report on Aggressive Driving Behavior for the Revised Federal Test Procedure Notice of Proposed Rulemaking*, January 1995, EPA 420-R-95-102

automakers to make costly hardware changes. Changes to the US06 PM standards should be limited to those that can be accomplished through calibration changes.

### **3. Greenhouse Gas (GHG):**

The Alliance supports reducing GHG emissions associated with the operation of light-duty vehicles, but believes that reductions must be made in a manner that accounts for technology and market realities.

In October 2012, when EPA and the National Highway Traffic Safety Administration (“NHTSA”) initially set GHG standards for model year 2022-2025 vehicles in cooperation with the Air Resources Board, the endpoint was thirteen years in the future and the standards that EPA set were remarkably ambitious. No agency had ever set standards for GHG emissions or fuel economy so far into the future, or with such tremendous consequences across an entire critical industry. EPA, NHTSA, ARB and other stakeholders understood in 2012 that no one could accurately project the circumstances impacting the technological and economic practicability and feasibility of these standards all the way out through MY 2025. Accordingly, the agencies committed to a robust midterm evaluation process whereby the agencies would take a fresh look at whether to retain the MY 2022-2025 standards based on new technological developments, customer demand, market conditions and public input. Many manufacturers committed to standards so far in the future on the basis of a midterm evaluation of those standards.<sup>53</sup>

In regards to California’s midterm review of its MY 2022-2025 GHG standards, the Alliance has two key goals which we believe that the ARB can appreciate and support. First, maintaining a single coordinated and harmonized national program is of primary importance. In this, Air Resources Board staff appears to be aligned with our views in its recommendation to maintain the “deemed to comply” provision within California’s light-duty vehicle GHG regulation. Second, the results of the midterm review should be based on a technically robust record and due

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<sup>53</sup> See manufacturer 2011 commitment letters for the 2017-2025 national light-duty vehicle greenhouse gas program. Available at <https://www.epa.gov/regulations-emissions-vehicles-and-engines/2011-commitment-letters-2017-2025-light-duty-national>. Accessed March 3, 2017.

consideration of consumer acceptance and economic impacts. Although we agree that California (as well as U.S. EPA and NHTSA) have put forth significant effort in their analyses, to date, we believe the midterm evaluation process was brought to an abrupt and premature conclusion. We have significant concerns that all technical and consumer considerations have not yet been properly accounted for, leading to overly-optimistic assessments of the technologies required for compliance, their related costs, and consumer acceptance.

These concerns have led the Alliance to submit letters recently to U.S. EPA Administrator Pruitt and the Trump administration requesting that the EPA midterm evaluation Final Determination be withdrawn and that EPA reengage with all stakeholders. Similarly, we urge the Air Resources Board to also keep an open mind and to continue engagement in the midterm evaluation of the 2022-2025 GHG regulations and Corporate Average Fuel Economy (CAFE) rulemaking.

#### **a. Support for a Single National Program**

The Alliance strongly supports the concept of a single national program for light-duty vehicle fuel economy and GHG regulation which would allow manufacturers to build a fleet of vehicles compliant with all such regulations in the United States of America. Such an approach improves regulatory efficiency by minimizing unique actions required to comply with the three separate regulations (federal light-duty vehicle fuel economy, federal light-duty vehicle GHG, and California light-duty vehicle GHG) which all effectively require the same types of improvements to light-duty vehicles. The concept of a single coordinated and harmonized program is key tenet which led most manufacturers to support and commit to both the 2012-2016 and 2017-2025 rulemakings.

Therefore, the Alliance agrees with and supports the ARB staff recommendation to continue California's participation in the National Program by maintaining the

“deemed to comply” provision.<sup>54</sup> This provision is a model for the concept of a single national program, allowing manufacturers to show compliance with the federal light-duty vehicle GHG program in lieu of a separate compliance demonstration with the specific California light-duty vehicle GHG regulations.

#### **b. Midterm Evaluation of the 2022-2025 GHG Standards**

The Alliance submitted extensive technical comments to the Draft Technical Assessment Report (co-authored by California’s Air Resources Board) and to the EPA’s Proposed Determination.<sup>55</sup> The Alliance hereby incorporates those responses in these comments.

Although EPA provided an extensive response to comments in its Final Determination the process followed by the EPA calls into question how closely technical concerns were considered and how changes may have been made in response to those issues. For example, EPA issued its Final Determination only nine business days after the close of the comment period on its Proposed Determination. In addition, the curtailed comment periods for the Draft TAR (60 days) and subsequent Proposed Determination (30 days) provided little time for stakeholders to thoroughly understand and respond to the analysis provided. Therefore, many of the Alliance’s concerns remain and the Alliance believes that the EPA Final Determination was premature. The Alliance highlights the following issues which were and remain concerns of the Alliance regarding both the ARB and EPA analysis.

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<sup>54</sup> “California’s Advanced Clean Cars Midterm Review Summary Report for the Technical Analysis of the Light Duty Vehicle Standards.” California Environmental Protection Agency Air Resources Board. January, 2017. ES-3.

<sup>55</sup> The Alliance comments on the Draft Technical Assessment Report and Proposed Determination can be located at <https://www.regulations.gov> under docket ID numbers EPA-HQ-OAR-2015-0827-4089 and EPA-HQ-OAR-2015-0827-6156, respectively.

#### **i. Technology Benefit and Compliance Modeling**

- Not a single manufacturer or supplier has agreed with EPA's analysis of the likely technology requirements and costs to meet the 2025 standards.
- Much of EPA's modeling is based on theoretically combining assumed operation and benefits of future technologies in a manner that has not been demonstrated as meeting all regulatory and customer requirements. Therefore, the modeled benefits may not be achievable in practice.
- Further examination of EPA modeling outputs in the Proposed Determination appear to indicate a bias toward lower (better) CO<sub>2</sub> values as results are propagated from EPA's full vehicle simulation model (ALPHA) to its fleet compliance model (OMEGA). The Alliance expects to discuss this research with EPA (and ARB) once complete.
- EPA's compliance optimization model yields results unlikely to be executable by manufacturers. Therefore, more realistic assessments are likely to include a different mix of technologies at higher costs. The following issues are provided as examples of areas where the analysis appears to over-optimize the fleet:<sup>56</sup>
  - A number of vehicles are modeled as improving to meet standards at negative cost.
  - Some vehicles are modeled as receiving multiple different weight reductions on the same vehicle with the same features.
  - The model expands a fleet of ~2,600 unique vehicle / powertrain combinations out to ~7,200 without accounting for the increased

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<sup>56</sup> EPA OMEGA model inputs and outputs for the Proposed Determination MY 2025 control case central analysis. Available at <https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases>, OMEGA v1.4.56, "OMEGA pre-processors, Technology Benefit-Cost Analysis files and OMEGA runs used in the Proposed Determination analysis." Accessed March 3, 2017.

investment, design, manufacturing, and marketing costs or other such constraints.

## ii. Historical Data as an Indicator of Future Potential

- No non-electrified vehicle, including those with the technologies identified by EPA as enabling future compliance currently meet the 2025 standards. Even when assuming additional credits, only hybrid, plug-in electric and fuel cell vehicles meet the 2025 standards.<sup>57</sup>
- The market penetration of vehicles which do meet the 2025 standards remains less than five percent.<sup>58</sup>
- Average manufacturer compliance margins with the federal GHG regulations dropped sharply in 2015 to approximately half of its previous levels.<sup>59</sup> Early projections of 2016 compliance indicate that, for the first time ever, manufacturers on average will not meet the target.<sup>60</sup>

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<sup>57</sup> "Proposed Determination on the Appropriateness of the Model Year 2022-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards under the Midterm Evaluation: Technical Support Document." Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-16-021, November 2016. Appendix C.

<sup>58</sup> "Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2016." U.S. Environmental Protection Agency. EPA-420-R-16-010, November 2016. 119.

<sup>59</sup> "Greenhouse Gas Emission Standards for Light-Duty Vehicles, Manufacturer Performance Report for the 2015 Model Year." U.S. Environmental Protection Agency. EPA-420-R-16-014, November 2016. iii.

<sup>60</sup> "MY 2016 Baseline Study." Novation Analytics. December 2016. 31. Available at <https://www.regulations.gov>, Docket ID EPA-HQ-OAR-2015-0827-6156. Accessed March 3, 2017.

### iii. Consumer Acceptance

- Cost increases averaging almost \$1,400 per vehicle (before including the impacts of the California ZEV regulation) and up to \$14,500 for specific vehicles are projected by EPA, yet no impact to vehicle sales is projected.<sup>61</sup>
- Consumer survey data indicates that although consumers like higher fuel economy, fuel economy itself is a relatively low priority in the purchase decision relative to other considerations. In a recent survey by Strategic Vision, only 27% of new vehicle purchasers considered fuel economy to be a leading consideration in their purchase decision, and only 8% would pay significantly more for an environmentally friendly vehicle.<sup>62</sup>

Left unresolved, these and other concerns are likely to result in a misleading analysis of the practicability and feasibility of the 2022-2025 standards. The Alliance welcomes further discussion with ARB staff and Board members to discuss these concerns further. We recommend that ARB continue engagement in the analysis of the technology pathways and consumer acceptance of the 2022-2025 standards.

### c. Recent Alliance Requests to U.S. EPA to Withdraw its Final Determination

Based on our concerns with the process followed by U.S. EPA in conducting its midterm evaluation, as well as our significant concerns with the EPA's substantive technical evaluation, the Alliance submitted a letter to EPA Administrator Pruitt on

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<sup>61</sup> EPA OMEGA model inputs and outputs for the Proposed Determination MY 2025 control case central analysis. Available at <https://www.epa.gov/regulations-emissions-vehicles-and-engines/optimization-model-reducing-emissions-greenhouse-gases>, OMEGA v1.4.56, "OMEGA pre-processors, Technology Benefit-Cost Analysis files and OMEGA runs used in the Proposed Determination analysis." Accessed March 3, 2017. Costs calculated relative to MY 2015 baseline and do not include costs associated with other regulatory or customer-driven requirements.

<sup>62</sup> Strategic Vision 2016-2015 New Vehicle Experience Study (NVES).

February 21, 2017 requesting that EPA withdraw the Final Determination and return to the midterm evaluation process.

To be clear, the Alliance has been careful to not draw its own conclusion regarding the practicability and feasibility of the 2022-2025 standards, but has instead focused on responding to the technical evaluations provided by the agencies. We believe that it is premature to arrive at a Final Determination before significant technical concerns have been fully addressed. Nor is there a regulatory need to reach a Final Determination at this time, since EPA's rules do not require the midterm evaluation process to conclude until April 2018, over a year in the future. Our request is simple: to have EPA return to the midterm evaluation process in accordance with the timetable set forth in its own rules, and to consider additional stakeholder input before making a determination.

On March 15, 2017, EPA announced its intention to withdraw the Final Determination and to continue with the midterm evaluation. The Alliance looks forward to continuing engagement with ARB, EPA, and NHTSA on this critical evaluation of the 2022-2025 federal standards.

#### **d. Future GHG Standard Stringency Increases**

At several points in the staff report, California alludes to pursuing continued reductions in the national GHG standards. The Alliance looks forward to cooperating with all of the agencies involved in the development of such standards. Such future discussions should include consideration of the interactions between GHG regulations, California's ZEV regulations, and the federal fuel economy regulations. The role of fuels and the new vehicle market is similarly important.

Given the significant concerns the Alliance has with the data and analysis supporting the EPA Final Determination of January 2017 (and the Draft Technology Assessment Report upon which some of ARB's analysis is based) we believe that engaging in discussions of specific standards or increases in stringency are premature at this time.