



**Learning from the California
Experience:
Alternative Fuels, Vehicles, and
Infrastructure**

Workshop Summary Report

April 11, 2017

**Hosted By: Caltrans/ODOT/U.S. DOT-FHWA
Wednesday March 22, 2017
California Department of Transportation, Sacramento, CA**

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This workshop was held as part of the Deployment of Alternative Vehicle and Fuel Technologies initiative, a joint project of Oregon Department of Transportation and other state DOTs, along with the U.S. Department of Transportation's Federal Highway Administration. The initiative is being supported by The Cadmus Group, Atlas Public Policy, and Vermont Energy Investment Corporation.



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Background

In June 2014, the Oregon Department of Transportation (ODOT) and the U.S. Department of Transportation's Federal Highway Administration (FHWA) initiated a pooled fund to assist state and local transportation agencies interested in promoting the use of alternative vehicle and fuel technologies at a state, regional, or corridor scale and provide the tools, information, and knowledge to do so. The Deployment of Alternative Vehicle and Fuel Technologies initiative implements a series of workshops around the country and develops a "toolkit" for state and local transportation agencies that will facilitate their deployment of alternative fuel vehicle (AFV) and related technologies.

Learning from the California Experience: Alternative Fuels, Vehicles, and Infrastructure was the fifth workshop in the series. The first workshop, in Portland, OR, featured presentations and discussion of the latest research and data collection efforts related to deployment of charging infrastructure along EV corridors, including the West Coast Electric Highway, and lessons learned to develop potential new corridors in the Northeast and other regions. The second workshop was held in Washington, D.C., and focused on innovative finance approaches to accelerate alternative fuel infrastructure and vehicle deployment. Held in Austin, TX, the third workshop included presentations to provide context for alternative fuel use in state fleets and breakout sessions to focus on the challenges and opportunities state departments of transportation (DOTs) face when adopting alternative fuel vehicles within their fleets. The fourth workshop took place in Troy, NY, as part of the Clean Corridor Meeting. It sought to increase collaboration across government, industry, and other stakeholders in order to advance clean freight corridors.

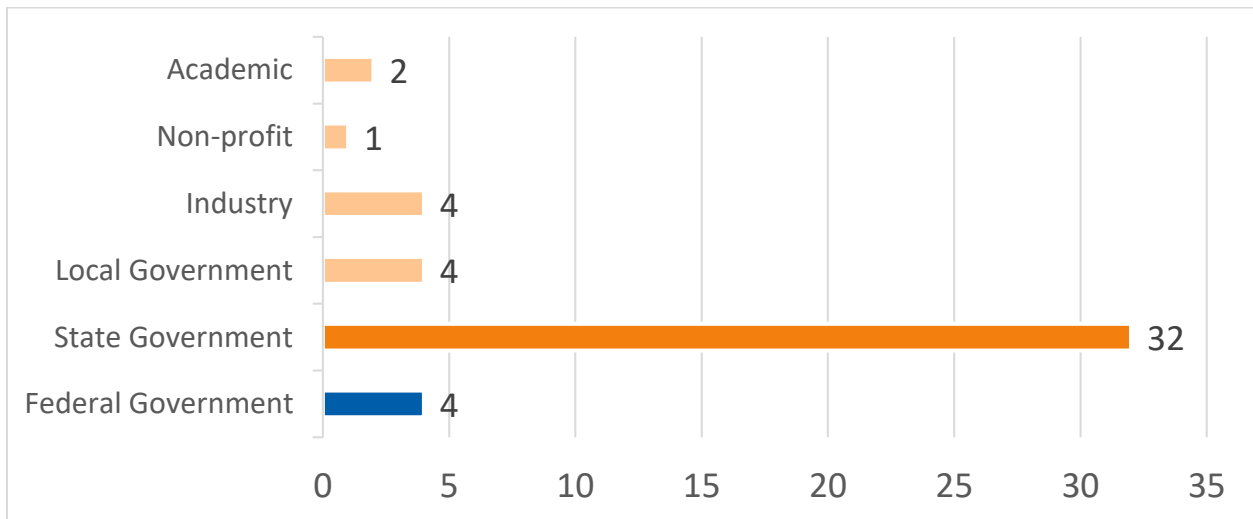


Workshop Summary

The California Department of Transportation (Caltrans) hosted the fifth workshop under the pooled fund initiative on March 22, 2017 in Sacramento, California. The workshop focused on the unique policy landscape in California and identified actions and practices from California that could be taken back to other jurisdictions. The agenda included several notable speakers, including [Kome Ajise](#) (Caltrans Chief Deputy Director), [Dan Sperling](#) (Director of the [Institute for Transportation Studies](#) at the University of California, Davis; Board member of the California Air Resources Board), [Larry Orcutt](#) (former Director of Equipment at Caltrans), [Gil Tal](#) (Professional Researcher at the Plug-in Hybrid and Electric Vehicle Center, University of California, Davis), and [Tyson Eckerle](#) (Deputy Director of Zero Emission Vehicle (ZEV) Infrastructure at California’s Governor’s Office of Business and Economic Development).

Attendees participated in two case study exercises designed to foster discussion and help them gain insights on alternative fuel vehicle deployment and public policy’s role in accelerating this deployment. The first case study focused on policies that encourage the greater use of low-carbon fuels. The second case study focused on the California ZEV program and compliance scenarios from the state’s recent program review. Finally, during the afternoon of the workshop, a panel of four staff members of California agencies answered questions and provided insights on the state’s newly released Sustainable Freight Action Plan. The workshop had a total of 47 participants. Workshop participants by industry category are shown in Figure 1.

Figure 1: Workshop Participants by Category



Key Outcomes

The key outcomes from the workshop arose from the speakers and the case study exercises. The speakers provided insights about California’s alternative fuel best practices and suggested how these could be replicated elsewhere. The case study exercises allowed attendees to discuss and debate how

best to craft policies that accelerate low carbon fuel and alternative fuel vehicle deployment. The following are some of the key outcomes from the day, as identified by workshop participants:

- The two main policy drivers for alternative fuels and vehicles in California are the Low-Carbon Fuel Standard (LCFS) and the ZEV program.
- The transportation industry is increasingly moving towards shared electric autonomous vehicles.
- Accessibility should be the ultimate goal of transportation planners, rather than mobility. Access stresses connecting origins and destinations whereas mobility focuses on movement.
- To achieve ambitious climate targets, electrification is the key strategy in the light-duty vehicle sector. A mix of low-carbon biofuels and hydrogen is the key strategy for medium and heavy-duty vehicles.
- California has placed a major emphasis on social equity in constructing alternative fuels programs and policies.
- Despite overwhelming approval of renewable diesel as a replacement for diesel fuel across city and state fleets, Caltrans reported having cold weather gelling problems in the winter of 2016-2017 for vehicles operating in the Sierra Nevada mountain ranges. The investigation is still ongoing.
- Battery-electric vehicle (BEV) deployment is growing faster in China and Europe than in the United States. Additionally, China has nearly twice as many BEVs as the United States.
- Consumers typically need two strong motivators to adopt BEVs, such as environmental-consciousness, HOV-lane stickers, lower operating costs, or performance. A single motivator tends not to be a strong enough rationale.
- California's recently released Sustainable Freight Action Plan provides a model for successful inter-agency collaboration and strong pursuit of legally-required emissions targets.

Action Plan

To help transportation planning agencies understand and implement some of California's best practices around alternative fuels, an online toolkit accompanying this workshop is available at

<http://www.altfueltoolkit.org>. This toolkit features a resource library of guides, websites, tools, and research reports meant as a "one-stop-shop" for AFV planning. The toolkit is accompanied by the AFV Planning Guide, an interactive guide showing a progression of actions state DOTs can take to advance through stages of engagement on AFVs, from no engagement ("Starting Points") to advanced engagement ("Leader").



Workshop Proceedings

Welcome and Introductions

Diane Turchetta, Transportation Specialist, Federal Highway Administration

See presentation for more information

- Diane kicked off the workshop by welcoming guests, describing the objective of the pooled fund, and outlining the goals and key outcomes of the workshop.
- She recognized the contributing states of the pooled fund and indicated that the topics of the workshops have been determined by these contributing states.
- Diane walked through the topic areas and timeline of the previous workshops. She indicated that the objective of the current workshop was to learn from California’s experience with alternative fuels and that an online toolkit will be developed as an outcome of the workshop. The components of the toolkit could take a variety of forms and Diane encouraged participants to provide suggestions throughout the workshop on useful additions to enhance the toolkit.

Patrick Tyner, Associate Transportation Planner, California Department of Transportation

- Patrick welcomed participants to Sacramento and expressed appreciation to everyone for attending, especially those that had traveled from out of state.
- He thanked everyone that made the workshop possible and emphasized that it would not have been possible without multiple partnerships.
- Patrick then introduced Kome Ajise, the Chief Deputy Director at the California Department of Transportation, responsible for overseeing the internal operations for approximately 19,000 employees and the annual budget that exceeds \$1.1 billion.

Kome Ajise, Chief Deputy Director, California Department of Transportation

- Kome indicated that while there is a lot to be proud of in California related to alternative fuels, there is still a lot more to do and there are always opportunities to learn from others.
- California’s current population is at about 39 million people and is expected to reach 60 million by 2050. This creates an imperative to accommodate higher travel demand in the future. In total, Caltrans oversees 50,000 lane-miles.
- Caltrans is charged with being the steward of the state highway system. The old mission of Caltrans was “Caltrans improves mobility across California” but today this mission is insufficient. Caltrans looks to embrace other objectives such as maintaining the highway system while also improving the economy, ensuring social mobility, and protecting the environment.
- As Caltrans was redoing their strategic plan, they thought about not just providing mobility, but what kind of mobility. The current mission of Caltrans is to “provide a safe, sustainable, integrated and efficient transportation system to enhance California’s economy and livability.”

- The California Transportation Plan (CTP) 2040 involved a remarkable quantity of stakeholders, including agriculture, water, air quality, public health, alternative transportation advocates, etc.
- The latest statewide household survey indicated that transit ridership has doubled and single occupancy drivers have decreased.
- Caltrans would like to triple cycling and double walking and transit trips statewide by 2020. Caltrans also has a requirement from the California Department of General Services and the Governor Brown's ZEV Action Plan to increase the number of ZEVs in the state vehicle fleet. Caltrans is also looking to build hydrogen stations and 30 DC fast charging stations in 30 months.

Roundtable introductions of all participants

- Participants were asked to introduce themselves by providing their name, title, and answering the question "What is the number one reason California should support alternative fuels?" using five words or less. Some of the responses provided included the following:
 - Climate change mitigation
 - If not California, then who?
 - All eyes are on you
 - So we can copy you
 - Greenhouse gas emissions reductions
 - To show the way
 - Future life will demand it
 - Because we have to
 - Because you can make money
 - Clean air. Security. Kids.
 - The cleanest air possible matters
 - To ensure our children's future
 - Because I live here
 - We all need clean air
 - National leadership needed



Figure 2: Word cloud of responses



Keynote on California Climate Policy

Dan Sperling, Director of UC Davis, Institute for Transportation Studies; Member of California Air Resources Board

- Today is an unprecedented period of change in the transportation sector, with technologies such as shared mobility, micro-transit, and connected and autonomous vehicles leading the way. This is the most rapid pace of innovation that we have seen since the early 1900s.
- Agencies are getting better at breaking down silos and working together with better collaboration among Caltrans, California Air Resources Board (CARB), California Energy Commission (CEC), metropolitan planning organizations (MPOs), air quality management districts, and the California Public Utilities Commission (PUC).
- Accessibility is a better word than mobility because it puts the focus on getting to destinations rather than on mobility itself.
- Since the 1970s, policymakers have embraced a series of alternative fuels and vehicle technologies – including methanol, ethanol, electricity, hydrogen, and others – but have subsequently shifted to focusing on other fuels and vehicles. This is nominally called the “Fuel du Jour” phenomenon.
- For light-duty vehicles, the primary path to lowering emissions is electrification. Automakers have made investments that will not be quickly undone. The diversity of models and vehicle ranges will increase substantially in the next five years, regardless of changes at the federal level.

- California is seeking to achieve a 40% market penetration in PEVs and 40% reduction in greenhouses gases (GHGs) by 2030.
- Utilizing biofuels is a primary strategy emissions reductions in medium- and heavy-duty vehicles.
- California’s primary motivators for reducing emissions from the transportation sector are clean air and climate change.
- Something that’s a little different in California is the emphasis on social equity – programs like the ZEV rebate offer higher incentives for low income households.
- Some of the landmark pieces of legislation encouraging alternative fuel use in California have been:
 - In 2002, AB 1493 was passed in California, which was slated to impose GHG standards on car manufacturers. The state was sued by car companies but these standards were eventually enacted nationwide as part of the light-duty Corporate Average Fuel Economy (CAFE) and GHG standards under the Obama administration.
 - In 2006, AB 32 passed, requiring California GHG emissions to be reduced back to 1990 levels by 2020.
 - Two years later, the Sustainable Communities and Climate Protection Act of 2008 set regional emission reduction targets from passenger vehicles in all metropolitan areas.
 - AB 118 (2007) and AB 8 (2013) provided funding for alternative fuels.
 - SB 350 (2015) required the electric utilities to decarbonize and provide 50% renewable energy sources by 2030. The bill also had provisions for electric vehicles.
 - The Los Angeles/San Joaquin regions of California have a goal of reducing nitrogen oxides (NO_x) emissions by 80% by 2032, which is playing a huge role in promoting alternative fuel vehicles.
 - The Clean Air Act at the national level also now categorizes carbon dioxide as a pollutant.
 - California’s LCFS requires the carbon intensity of fuels to be reduced by 10% by 2020. The LCFS only applies to gasoline and diesel for now.
- The two main policy drivers for alternative fuels in California are the LCFS and the ZEV program.
- One unexpected outcome from the first six years of the LCFS is which types of biofuels have developed. The designers of the policy thought that the LCFS would incent cellulosic biofuels. However, they have mainly encouraged lower carbon corn ethanol, biodiesel, and renewable diesel.
- For policymakers speaking outside of California, the competitiveness aspect of alternative fuels may make a better argument than the energy security aspect. Even if we don’t make progress on alternative fuels in the United States, other countries will. Air quality also continues to be a saleable argument.



- Policy must play a role to ensure that innovation in transportation technologies moves towards the public interest, for instance by having mobility services connect with transit.
- Traditional natural gas provides little or no benefits in terms of GHG reduction. But if the natural gas comes from a source like landfills or dairy farmers and is used in conjunction with a low NO_x engine, it can provide significant carbon benefits.

Caltrans Experience with Zero Emission Vehicles

Larry Orcutt, Former Division Chief, Equipment, Caltrans

See presentation for more information

- Caltrans is responsible for 12,000 pieces of equipment, from mowers to snow blowers.
- Three of the initiatives in California's 2016 ZEV Action Plan are:
 - Install 30 DC fast charging stations by end of 2018
 - Identify locations for three hydrogen stations on Caltrans properties
 - Support workplace charging
- DC fast charging stations promote intercity travel and reduce range anxiety, but not all cars can use them. A big challenge is figuring out who will pay for electricity and whether giving away electricity for free is considered a gift of public funds. Free employee workplace charging is allowed.
- Currently Caltrans has 82 ZEV credits and will add 57 ZEV credits next year with the planned purchase of 93 more ZEVs.
- Caltrans facilities currently have 179 built or planned Level 2 charging stations.
- The main concern heard from drivers whose cars may switch to ZEVs is limited range; drivers are concerned ZEVs will not meet their needs.
- Caltrans uses GPS on their entire fleet, and this allows Caltrans to determine the needs for each vehicle. Without data, you cannot determine vehicle needs.
- It is Caltrans policy that an EV charger will be provided with each vehicle; it is up to each customer to make arrangements to install the charger.
- Solar powered mobile EV chargers are in use in areas where connecting to the grid is difficult.
- One of the first places a charging station was installed was in Eureka, California. This was also where the first EV was deployed to a district. The vehicle ended up having the highest mileage because the district figured out how to best use the vehicle where it made sense.
- Caltrans has purchased 20 Toyota Mirai vehicles and is in the process of deploying those. The challenge is finding fueling infrastructure, though there are 25 retail locations available with 16 proposed. Toyota offers free fuel with the vehicles in the first three years, which equates to about 20,000 miles per year. So, these vehicles should be matched to replace high usage vehicles.

- Caltrans is looking at acquiring Hyundai Tucson vehicles, though the cost of leasing and Hyundai insuring requirements serve as challenges.
- Caltrans is also considering ZEV options for heavy-duty vehicles.
- Bob Myers, Acting Division Chief for Equipment, discussed Caltrans's experience with renewable diesel.
 - Caltrans initiated a pilot program with renewable diesel involving 33 vehicles and experienced no problems initially throughout the winter at high elevations.
 - After the pilot, renewable diesel bulk fuel tanks were installed in 250 locations statewide. There were no significant issues for about a year, but this past winter, there were issues with waxing and gelling at high elevations and in cold weather.
 - The situation is still being investigated to determine exactly what the problem was. It is known that some biodiesel was mixed in, though it is unclear if this occurred at the refinery or along the supply chain. Caltrans was also not using winterized renewable diesel, as both winterized and non-winterized blends exist.

Breakout Session 1: Fuels Policy Case Study

See case study for more information

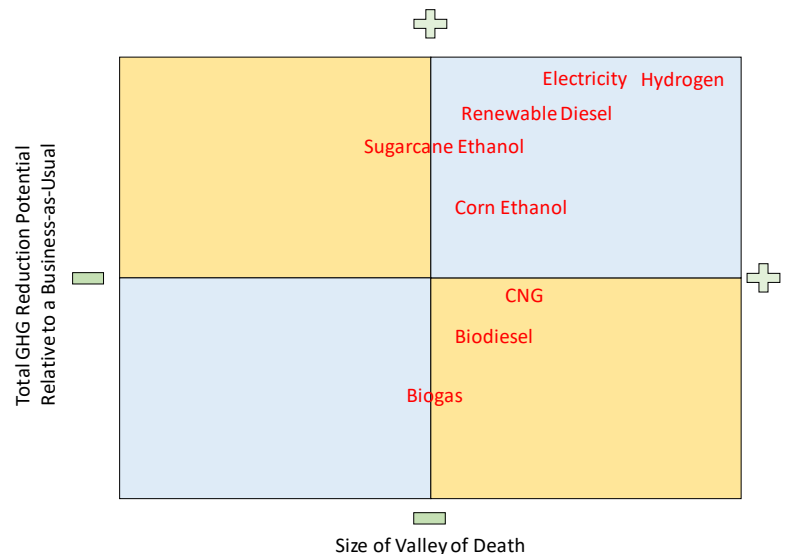
- Participants broke off into two groups and held discussions about three policies: the low carbon fuel standard, a tax credit, and a carbon tax.
- The following items emerged as key points during the breakout discussions:
 - When comparing the level of incentive created for biodiesel production from an LCFS credit value of \$100 per metric ton, versus a \$1 per gallon tax credit, or a \$20 per metric ton carbon tax, the group found that the \$1 per gallon tax credit is largest incentive of the three.
 - The levels of incentives for the LCFS credit and carbon tax depends on the fuel's carbon intensity value. In some cases, for fuels with extremely low carbon intensity (like electricity from renewable resources), LCFS credits may be more than the \$1 per gallon value of the tax credit.
 - There are many important differences between the three policies:
 - The LCFS is revenue neutral and makes higher-carbon fuels more expensive and other lower-carbon fuels less expensive.
 - Tax credits make a targeted fuel less expensive but are NOT revenue neutral.
 - A carbon tax generates revenue for the government, but makes all fuels that contain carbon more expensive. A carbon tax can encourage low-carbon supply, but it depends on uses of the tax revenue.
 - Each policy differs in the level of oversight that is required and the administrative burden it creates.



- Certain fuels like renewable natural gas need little to no public support to develop into mature markets, but also have limited volume potential and GHG reduction potential (i.e., limited number of landfills and digesters).
- Other fuels like hydrogen need a lot of public support to develop but also can offer large GHG benefits if made from renewable feedstocks.
- LCFS came online while the price of gasoline dropped. So, while the policy did not have as large of an impact as anticipated, it did have political viability.
- There is no one policy that will solve all the issues; a suite of policies is needed to address the environmental benefit, infrastructure needs, and demand from consumers.
- When policymakers craft a new policy, they need to be aware of the tradeoff between GHG reduction and innovation valley of death.

○ Figure 3 on the right was developed internally prior to the workshop and provides an example of one way to visualize the GHG reduction potential and size of valley of death for various fuels, in relation to each other. Within the breakout groups, there was much discussion and debate about how the different fuels could be placed among the quadrants and each group came up with a different version of the figure.

Figure 3: Different Fuels Mapped out with Their GHG Reduction Potential and Size of Valley of Death



- Fuels cannot be analyzed as an isolated component. Fuels and vehicles need to be seen as one system, as it's not as easy to electrify a tractor-trailer as it is for a passenger vehicle.
- There are a lot of feedstocks you can make alternative fuels out of, and some feedstocks go into making multiple fuels, making a comparison of their life cycle GHG emissions challenging.
- The Clean Fuels program in Oregon is similar to the LCFS but is a shorter program and only requires a 10 percent reduction in average carbon intensity from 2015 levels by 2025. Oregon is seeing if they can push the market further and further to incent fuels like hydrogen.
- Tax credits help bridge the valley of death. However, the tax credits need to be focused on the fuel producers not the blenders to really help push innovation (because the

producers are the ones taking the risk not the blenders). The main downside to tax credits are they are subsidized by the government and they tend to be on/off from year to year, destroying policy certainty.

- A carbon tax does nothing to bridge the “valley of death.” Rather it’s simply a disincentive for using carbon-intensive fuels. However, the upside is it generates revenue which can be used to bridge the valley.
- Policymakers must consider both the level of incentive and who the incentive is being offered to (i.e., the consumer, the fuel producer, the blender, etc.).

Table 1: Arguments For and Against How the Three Policies Help Overcome the Valley Of Death

Policy	Does policy push us over the valley of death?
LCFS	<p>Does help with valley of death:</p> <ul style="list-style-type: none"> • LCFS appears to be helping certain fuels that have relatively small valleys of death, like ethanol, RNG, renewable diesel, and biodiesel but not others. • There is policy certainty with the LCFS, which is good for risk-taking. • Credit prices have been high in the last couple years. • There is evidence that biofuel producers are incorporating LCFS credit values into their business plans. <p>Does NOT help with valley of death:</p> <ul style="list-style-type: none"> • Fuel producers tend to use “low hanging fruit” like renewable natural gas and biodiesel to meet the standard. These fuels are not the fuels that we need in the long run due to their relatively low total GHG reduction potential. • LCFS encourages “incrementalism” in carbon reductions rather than encouraging bold new leaps in innovation. This is because LCFS is on a continuous scale, so a fuel producer can decrease their carbon intensity by a small amount (e.g., 5 g CO₂e /MJ), and still create additional revenue.
Tax credit	<p>Does help with valley of death:</p> <ul style="list-style-type: none"> • Tax credits provide direct infusion of cash into the industry. • Tax credits allow government to target specific fuels rather than funding ALL fuels. <p>Does NOT help with valley of death:</p> <ul style="list-style-type: none"> • Blenders traditionally received biodiesel tax credits regardless of where they obtained fuel. This does little to overcome the valley of death in the U.S. because fuel is cheaper to produce overseas.



Carbon tax	<p>Does help with valley of death:</p> <ul style="list-style-type: none"> • The revenue generated through a carbon tax could potentially be reinvested back into high priority fuels. <p>Does NOT help with valley of death:</p> <ul style="list-style-type: none"> • Valley of death implies an infusion of money into emerging industry. However, carbon tax makes all fuel production more expensive. • A price signal of \$20 per metric ton is too small to shift the economics in favor of the fuels that are needed in the long-run (like electricity and hydrogen).
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Post-lunch speaker #1

Gil Tal, Professional Researcher, Plug-in Hybrid & Electric Vehicle Research Center, Institute of Transportation Studies, University of California, Davis

- The Plug-in Hybrid & Electric Vehicle Research Center conducts studies on:
 - Car buyers
 - Plug-in electric vehicle (PEV) buyers
 - PEV household use patterns
 - The world PEV market
- Data collection is done through surveys, data loggers on cars, and charging data.
- BEVs will move forward with or without the United States, as sales are growing faster in China and Europe.
- The diffusion of innovation framework shows the following segments of buyers:
 - Innovators – they buy the technology, but don’t quite know what to do with it
 - Early adopters – they understand the technology
 - Early majority
 - Late majority
 - Laggards
- Toyota lost money on the Prius for the first 12 years.
- Most Americans are not in the market for new cars. 75% of households did not purchase a new car in the last three years. 21% of households bought one new car, while 4% bought two or more cars in the last three years.
- Four percent of households were responsible for almost one-third of the PEV market over the years 2010-2012. Up to 15% of PEV buyers are on their second PEV, allowing for a used market.
- In a survey of car buyers from several states, most surveyed were not even considering electric cars. Those that did consider them were concerned about range and the expense of a charger at

home. Car buyers try to avoid unknowns. Thus, they avoid things that will require some homework.

- Incentives don't work for people who are unaware of the availability of electric cars.
- Electric car buyers needed at least *two* strong motivations to make their purchase. Those highly motivated by fuel cost savings also had another motivating factor.
- Monetary incentives create 25-50% of PEV sales. That is, without these incentives, sales would drop by that much. Non-monetary incentives (such as HOV access) account for 5-20% of sales and public infrastructure accounts for 2-8% of sales. Without incentives, two to five PEVs would be sold out of every ten PEVs currently sold.
 - We will lose about 50% of Nissan Leaf sales if we drop the \$7500 incentive.
 - We will lose about 14% of Tesla sales if we drop \$7500 incentive.
- If a price is added to public charging stations, a proportion of users will shift to charging at home.
- If public charging is free, we need about 60 charging stations per 100 PEVs.
- Average distance to a free DC fast charger is 5 miles and 10 miles for paid charger.
- The main reason original equipment manufacturer (OEMs) are not advertising EVs is because they don't make money on them.

Post-lunch speaker #2

Tyson Eckerle, Deputy Director of ZEV Infrastructure, California Governor's Office of Business and Economic Development

- California's ZEV strategy comes from the perspective of building the market; the only way to be successful is to have the ZEV market take off. Success cannot rely on internal agency champions alone.
- The Governor's Office of Business and Economic Development can make progress on streamlining permitting, building consensus among jurisdictions, and getting fleets to scale.
- When an approach related to alternative fuels works in one jurisdiction, the state would like it to be easily adopted in other jurisdictions. Similarly, if there is something that works in another area outside of California, California is interested in replicating it.
- California is currently the number one ZEV market in the country and has the most infrastructure. The state has met and exceeded ZEV purchasing targets.
- The key to success is building consensus and trust among the three pillars of industry, government, and consumers.
- Much of the progress has been accomplished due to leadership at the Governor's Office and within other agencies such as the Energy Commission.
- Sacramento Municipal Utility District (SMUD) made a purchase of electrified bucket trucks. At first those trucks sat at the back of the lot and were underutilized. Then, once workers realized



the safety benefits associated with being able to communicate back and forth without loud engine noise, they became much more in demand.

- AB 8 (2013), which committed the state to building hydrogen stations, kicked the hydrogen market into higher gear and now California has the only open retail network of stations.
- California is working on group buys – purchases across fleets to drive down cost.
- There is a goal to make all new car sales be ZEVs in California by 2050.
- California has clarified at the legislative level and through statewide policy that providing electric vehicle charging at public parking lots does not constitute a gift of public funds. There are challenges associated with navigating this issue at rest areas and office buildings.

Breakout Session 2: Achieving Zero Emission Success in California

See case study for more information

- Participants broke off into two groups and held discussions about the three compliance scenarios considered by the California Air Resources Board during its mid-term review of the California ZEV program. The following items emerged as key points during the breakout discussions:
- *Question 1. Which of the three scenarios CARB analyzed is California most likely going to experience?*
 - None of the scenarios include the cost of the fuel, though it makes sense to leave this as an unknown since it will fluctuate.
 - The lowest cost for the OEMs will win, which makes identifying who funds hydrogen infrastructure a critical dependency on fuel cell adoption.
 - The middle scenario seems likely, but BEV adoption might be too pessimistic in this case.
 - The three scenarios are based on OEM offerings, not likely projections of consumer behavior. Additionally, the three scenarios differ in the total number of vehicles in later years because each type of ZEV (BEVs and fuel cell electric vehicles) receives a different credit value.
 - PHEVs are not as popular as BEVs because the incentives have not been as big as they have been for BEVs.
 - Some may be hesitant to have the government picking alternative fuel winners and losers but in the light duty market, the time may have come to go ahead and do that.
 - Air Products recently announced they will begin selling hydrogen for \$8-\$10 per kilogram (down from \$13-\$15 per kilogram). This may have a beneficial impact on sales of hydrogen fuel cell electric vehicles.
- *Question 2. What are the tradeoffs of investing in hydrogen fueling infrastructure now versus five years from now? What about very high-powered charging? Which is less risky and why?*
 - Co-locating DC fast chargers with hydrogen stations could kill two birds with one stone by reducing station build out costs. High-powered DC fast charging (350 kilowatts)

- requires onsite energy storage and hydrogen could also be co-located for these purposes.
 - Knowing that hydrogen is an important emission reduction strategy for medium and heavy duty vehicles, getting infrastructure in place now puts California on an early path to meeting 2050 climate goals.
 - Expansion on the national scale is needed for both technologies and DC fast charging appears to have momentum to be distributed globally.
 - One participant suggested that hydrogen fuel prices likely can't fall below \$4 per gasoline-gallon equivalent.
 - Hydrogen can be lower risk since it's easier to accommodate urban and rural travelers.
- *Question 3. What is the criteria California policymakers should use to encourage private investment and avoid picking winners as it designs and deploys programs to support ZEV infrastructure in the near term?*
 - In terms of trying to avoid picking winners, there is a cost in not picking winners if the environmental goals aren't achieved.
 - Regarding criteria, investments should be tailored to the location (urban vs. rural), the OEM market generally, and the best long-term potential (e.g., leverage decarbonization of the electrical grid).
 - DOTs make a small amount of public dollars available to attract private investment. Yet there is an inherent disincentive for DOTs to make large investments in alternative fuel vehicles as long as their funds are coming from the gas tax.
- *Question 4. What is the most suitable role for Caltrans and metropolitan planning organizations to play in deploying ZEV infrastructure?*
 - MPOs are in touch with constituents and therefore can help influence stakeholders and business development groups. Additionally, MPOs can help identify optimal locations of stations, help build public-private partnerships, and may be more in tune with who will adopt the latest technology vehicles.
 - Planners need an awareness that Caltrans and MPOs are not in energy business – rather they are in the roads, mobility, and accessibility business.
 - Planning agencies can help the state overcome legal and code-related hurdles to infrastructure development.
 - MPOs can provide readiness planning.
 - Often, MPOs and Caltrans have the best or most up-to-date data on passenger and freight flows which directly inform where to site infrastructure.
 - DOTs can also work with utilities and/or community choice aggregators (an emerging opportunity).
 - For Tesla and Electrify America investments, DOTs should consider requiring extra stubs for future charging stations.



Panel on Sustainable Freight Action Plan

Chris Schmidt, Caltrans Division Chief, Division of Transportation Planning (Moderator)

Larry Rillera, Air Pollution Specialist, California Energy Commission

Heather Arias, Branch Chief, Freight Transport Branch, Air Resources Board

Frank Ramirez, Senior Permit Assistance Specialist, California Governor's Office of Business and Economic Development

- The California Sustainable Freight Action Plan is posted at www.casustainablefreight.org.
- California's Governor released Executive Order B-32-15 in July of 2015, directing multiple agencies to put together an action plan focused on efficiency and competitiveness in the freight sector.
- The agencies spent a year going through the public process or developing the plan. Key items in the plan include:
 - Vision for sustainable freight system (i.e., what the system needs to look like in 2050).
 - Guiding principles to achieve that vision.
 - Two quantitative and one qualitative target:
 - System efficiency target: Improve freight system efficiency 25 percent by 2030.
 - Transition to zero emission technology target: Deploy over 100,000 ZEV freight vehicles and equipment by 2030.
 - Increased competitiveness and economic growth targets: Establish a target or targets for increased State competitiveness and future economic growth within the freight and goods movement industry.
 - Nine state actions.
 - Funding opportunities.
 - Three pilot projects:
 - Dairy biomethane for freight vehicles.
 - Advanced technology for truck corridors.
 - Advanced technology corridors at border ports of entry.
- There is no dedicated funding tied to the plan, including the pilot projects, so the agencies are leveraging funds they already have.
- The agencies are currently working on the plan's implementation. Workshops will be conducted in May 2017 and work plans for the pilot projects are due to come out in the summer of 2017.
- Initially, there was pushback from private industry on the Sustainable Freight Action Plan. This was the first time the state said they wanted to increase competitiveness of the freight industry

while maintaining its environmental sustainability. Industry was skeptical because they thought ARB was pushing for major changes which would reduce their competitiveness.

- Key questions associated with developing the plan and targets were:
 - How is the freight industry defined?
 - How is competitiveness defined and quantified?
 - How do state actions impact competitiveness of industries?
- The agencies involved are working to break down silos and move forward together. Agencies no longer have the ability to pursue single-minded goals (e.g., air quality), since each individual action may have a ripple effect on other goals (e.g., social equity).
- California already had a state freight plan, but it is mostly focused on mobility projects. The Sustainable Freight Action Plan created conversations that otherwise would not have happened.
- While the target for competitiveness is still being worked out, deployment of zero emission and near zero technologies is being tracked using simple counts. Emissions inventories are being done through existing standard operating procedures.
- In conversations with the freight industry, competitiveness was measured differently depending on the context. For example, in ports it may be measured by the amount of time a ship is at port, and how quickly it can be turned around. Truckers define it differently, so the Governor's Office is looking at collapsing these varied definitions into one overarching objective. Workforce development must be a critical piece of competitiveness.
- Electric utilities must also be brought into the conversation.
- There is a balance to strike between competitiveness (and wanting to make California the most attractive state for freight) and cooperation with other states along the west coast. Cooperation among multiple entities is helpful to scale infrastructure and do bulk purchases to drive down cost.

Wrap-up

During the final session of the day, Nick and Geoff solicited ideas from the attendees regarding the types of tools and resources that it would be useful to have in the toolkit that is produced after this workshop. The suggested ideas included:

- Research studies from UC Davis
 - The UC Davis ITS website has a search engine and the resource library in the toolkit will include relevant studies.
- A compendium or timeline of California policies related to alternative fuels that have worked and haven't worked.
- A case study on the collaboration model that made the California Sustainable Freight Action Plan possible.
- Guidelines and models related to alternative fuel infrastructure.

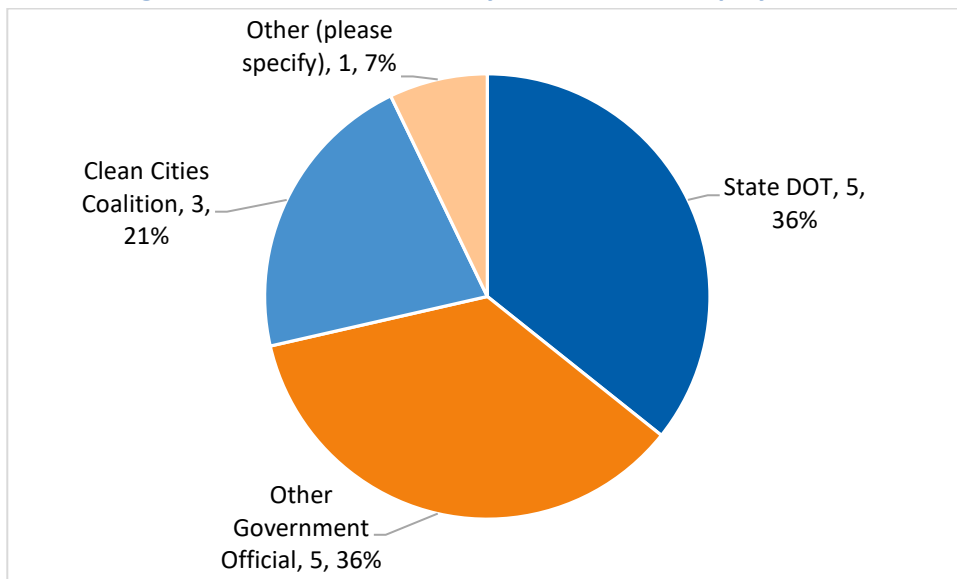


- Drive Clean website - <https://www.driveclean.ca.gov/>
- CalEnviroScreen tool - <https://oehha.ca.gov/calenviroscreen>
- A map overlaying alternative fueling stations with the alternative fuel corridor designations.
 - FHWA is working with the National Renewable Energy Laboratory to develop this.
- A map of truck parking locations to help identify opportunities for electrification.
- Map of the right-of-way across the country that is under the prohibition barring commercialization of the rest areas.
- Fact sheet on how to have a corridor designated as an alternative fuel corridor by FHWA
 - FHWA is developing this.

Summary of Workshop Evaluations

An online survey was distributed to meeting attendees on March 23, 2017. The survey was intended to assess the effectiveness of the workshop, help build the workshop toolkit, as well as inform the development of future workshops. A total of 14 attendees responded to the survey. Their answers are summarized below.

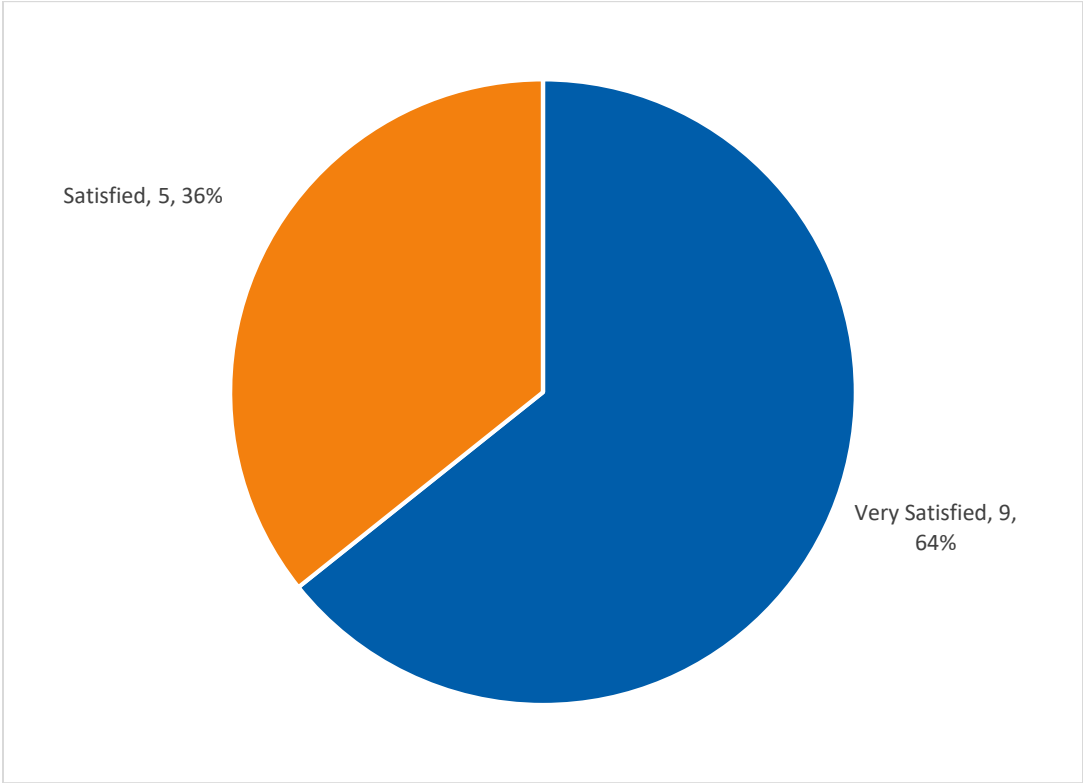
Figure 4: What best describes your role in AFV deployment?



Out of those that responded to the survey, most were state DOT representatives and other governmental officials, with a few from Clean Cities Coalitions. The respondent who selected “Other” said they were from a technology investor.

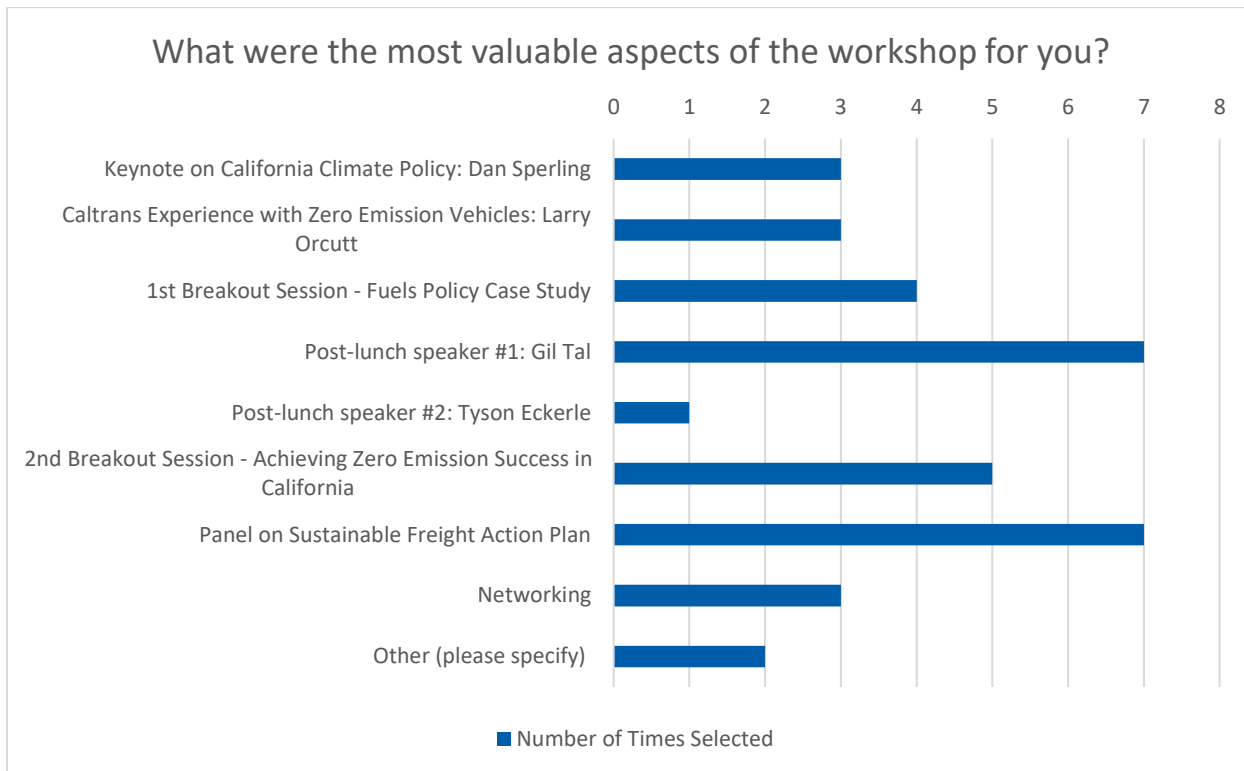


Figure 5: How satisfied were you with the overall content and organization of the workshop?



All respondents (100%) were either satisfied or very satisfied with the overall content and organization of the workshop. No respondents indicated that they were “somewhat satisfied” or “not satisfied,” which would have required further explanation.

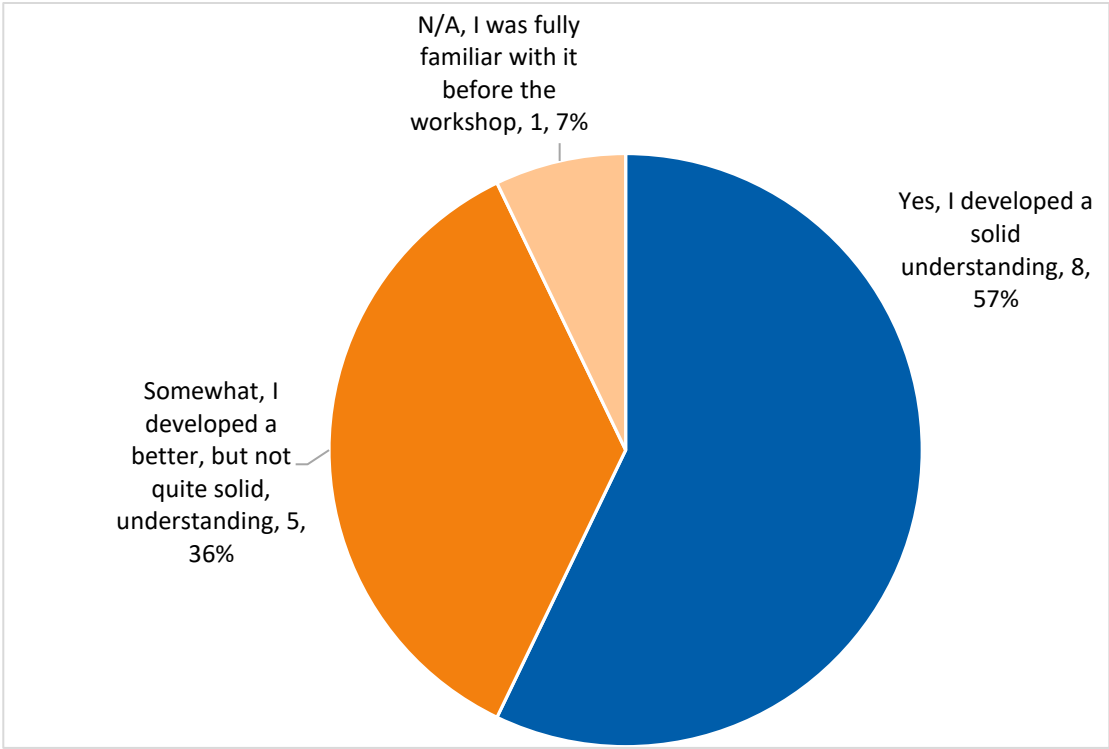
Figure 6: What were the most valuable aspects of the workshop for you?



Survey respondents found that Gil Tal’s presentation and the panel on the Sustainable Freight Action Plan were equally the most valuable portions of the workshop, with the second breakout session on achieving zero emission success in California being a close second choice. Two respondents selected “other,” with one writing “I liked the breakouts as well - it made us think and discuss at a practical level” and the other writing “[t]hey were all really good.” Respondents were allowed to select more than one answer to this question.

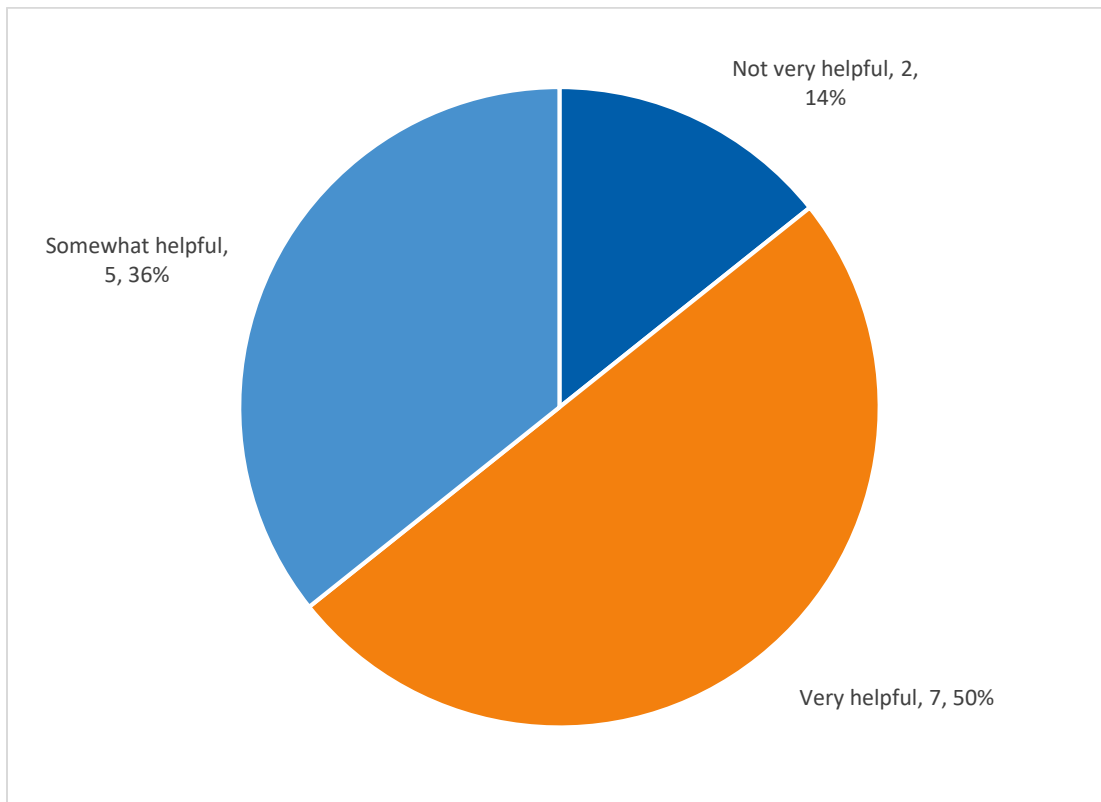


Figure 7: As a result of the workshop, do you feel you developed a solid understanding of the alternative fuel policy landscape in California?



Most respondents (57%) felt they developed a solid understanding of the alternative fuel policy landscape in California, as a result of the workshop. One respondent was already familiar with the landscape before the workshop. Some of the respondents (36%) said they developed a better, but not quite solid, understanding. One of those that responded “somewhat” said that they made this selection because they consider themselves relatively new to the field and that they learned a lot at the workshop.

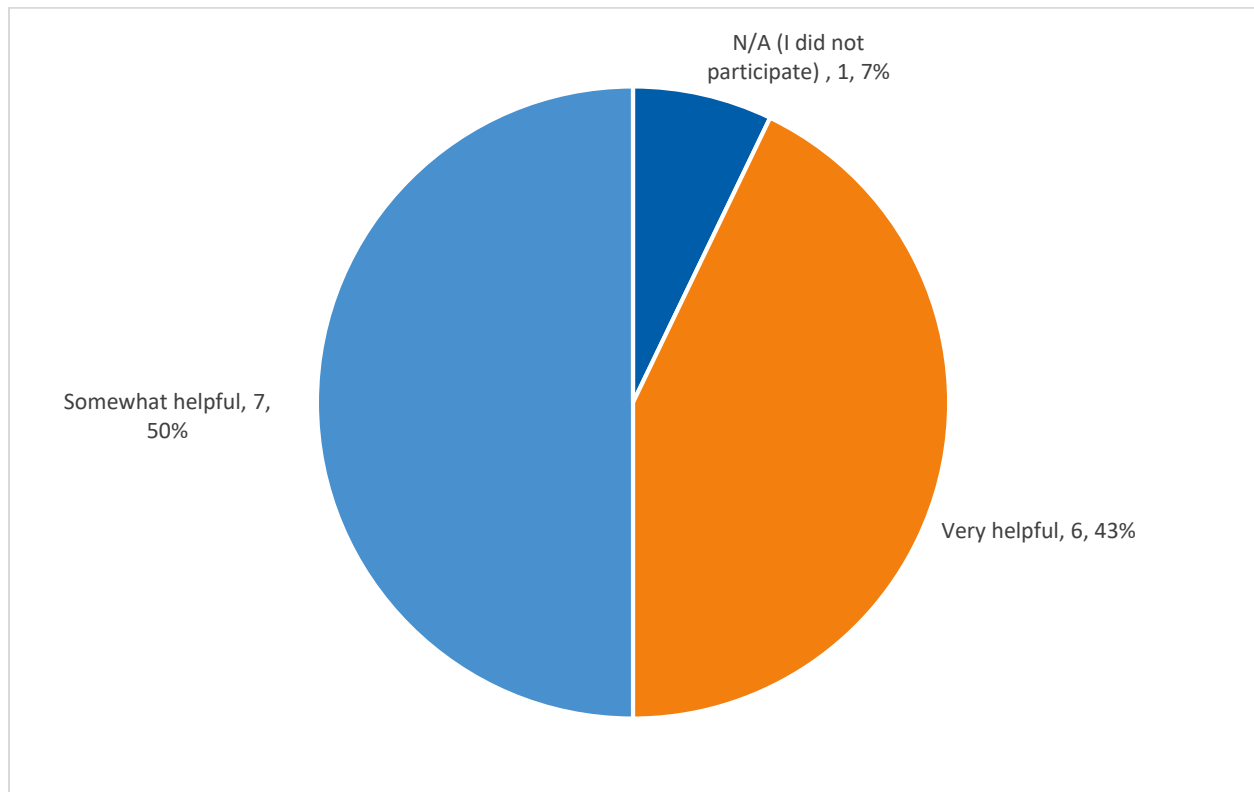
Figure 8: Regarding the Fuels Policy case study in the morning, to what extent did the case study help you compare and contrast the effectiveness of policies at encouraging the production and use of low-carbon fuels?



Most respondents (86%) found the Fuels Policy case study exercise to be “very helpful” or “somewhat helpful.” Two respondents said that it was “not very helpful,” with one explaining that there was “no alignment with Texas programs/priorities” and another found it “confusing and ambiguous.”



Figure 9: Regarding the Achieving Zero Emission Success in California case study in the afternoon, to what extent did the cases study help you better understand the tradeoffs California faces in the near term on investments in ZEV infrastructure?



The vast majority of survey respondents (93%) found the Achieving Zero Emission Success in California case study to be “very helpful” or “somewhat helpful.” One respondent did not participate in this part of the workshop.

The last three questions in the survey were open-ended. The first of these asked “What was your key takeaway from the panel on California's Sustainable Freight Action Plan at the end of the day?” Several responses (8) referenced inter-agency collaboration as their biggest takeaway. The other responses were unique and are captured below:

- It will be very difficult to reduce criteria pollutants in the mandated timeframes.
- That creating a vision for an industry requires involving a wide range of stakeholders.
- There are many moving pieces and possible domino effects, but the most important thing is to START NOW.
- Value of the LCFS credits.
- No alignment with Texas programs/priorities.
- California is leading by example.

The second open-ended question solicited ideas for the resource library portion of the workshop toolkit. Respondents replied with the following suggestions:

- <https://www.driveclean.ca.gov> (recommended by two respondents)
- <https://www.californiahvip.org>
- <http://www.energy.ca.gov/drive>
- A handout on the existing valley of death, or an analysis of such, for each fuel type. Ideally this would be tied to multi-state regions with similar supply and demand.
- Handout overview/summaries of LCSF, maybe FAQs.
- Recommend an exercise that quantifies the return on investment and GHG reduction potential of renewable fuels (diesel and natural gas) for medium and heavy duty trucks vs. ZEVs that aren't ready for prime time.
- Best practices including non-traditional relationships between agencies as well as industry (including utilities).
- I stated this in the workshop, however to reiterate the point, the partnership model used in developing the freight plan was great.
- <https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30>
- <http://www.energy.ca.gov/altfuels>

The final question allowed respondents to provide additional open-ended feedback on the workshop or future workshops. Respondents replied with the following comments:

- Thanks for coordinating a worthwhile event. It was great to see how many transportation agencies from around the nation were willing to come to California to learn more about the state's alternative fuel efforts.
- Well done!
- Have some topics that apply to other geographic areas as well as that of the host.
- Carbon reduction benefits and return on investment for implementing renewable fuels in fleets.
- Better involvement with public utilities - what are the keys to success in that relationship?
- As local government staff, it was invaluable to meet state agency practitioners. We don't necessarily cross paths!
- Consultant team did a great job in facilitating this workshop. Thanks.



Appendix I: Workshop Agenda

Learning from the California Experience Alternative Fuels, Vehicles, and Infrastructure

March 22, 2017, 8:30 am – 4:30 pm PST
Caltrans Lassen Meeting Room
1500 5th Street
Sacramento, CA 95814

Meeting Objective: The objective of this meeting is to highlight best practices and emerging technologies in California related to alternative fuels and infrastructure. Key topics addressed at the workshop will include:

- Policy drivers in California for alternative fuels
- Roles of each transportation and energy planning agency (DOTs, CARB, CEC, AQMD, MPOs)
- Procurement process of alternative fuels for fleets
- Alternative fuel infrastructure planning
- Electric vehicle consumer research
- Sustainable Freight Action Plan

8:30 am	Arrival and Registration
9:00 am	Welcome and Introductions <i>Kome Ajise, Caltrans Chief Deputy Director</i> <i>Diane Turchetta, Transportation Specialist, FHWA</i> Roundtable introductions of all participants
9:30 am	Keynote on California Climate Policy <i>Dan Sperling, Director at UC Davis Institute for Transportation Studies, Member of California Air Resources Board</i>
10:00 am	Caltrans Experience with Zero Emission Vehicles <i>Larry Orcutt, Division Chief, Equipment, Caltrans</i>
10:30 am	Break

10:45 am	<p>Breakout Session 1: Fuels Policy Case Study</p> <ul style="list-style-type: none"> • Format: Participants will be divided into two groups. Each group will play the role of the Alternative Fuels Task Force advising Governor Brown on how best to decarbonize California’s fuel supply. Each group will have a facilitator and work through a series of tasks and discussion questions (described on a handout). • Scenario (fictitious): Governor Brown has directed the Task Force to determine a policy that will ensure carbon intensity reductions in the state’s fuel supply and ensure the policies can garner broad support. • Intended Outcome: With the help of the facilitator, the group will compare the advantages and disadvantages of these fuel policies: LCFS, tax credits, and carbon tax. They will estimate the incentives offered under these policies, discuss the public investment necessary to support various alternative fuels, and discuss the ways in which each policy supports innovation. They will report out to the larger group at the end of the session.
11:45 am	Breakout Groups Report
12:00 pm	Lunch
1:00 pm	Post-lunch speaker # 1: <i>Gil Tal, Professional Researcher, Plug-in Hybrid & Electric Vehicle Research Center, Institute of Transportation Studies, University of California, Davis</i>
1:30 pm	Post-lunch speaker # 2: <i>Tyson Eckerle, Deputy Director of ZEV Infrastructure, California Governor's Office of Business and Economic Development</i>
2:00 pm	<p>Breakout Session 2: Achieving Zero Emission Success in California</p> <ul style="list-style-type: none"> • Format: Participants will be divided into two groups. Each group will have a facilitator and will work through a scenario and a set of discussion questions (described on a handout). • Scenario (true): The mid-term review of the California ZEV program was completed by the California Air Resources Board in January and the program structure is now set through 2025. The agency considered three scenarios in its analysis that could achieve compliance with the ZEV program: low, mid-range, and high technology. The groups will discuss the policy and program decisions California policymakers must now make to achieve compliance with the program in a cost-effective manner. • Intended Outcome: With the help of the facilitator, the group will work through discussion questions based on the three scenarios CARB analyzed. They will report out to the larger group at the end of the session.
3:00 pm	Afternoon Break
3:15 pm	Breakout Groups Report



3:30 pm	Panel on Sustainable Freight Action Plan <i>Chris Schmidt, Caltrans Division Chief, Division of Transportation Planning (Moderator)</i> <i>Larry Rillera, Air Pollution Specialist, California Energy Commission</i> <i>Heather Arias, Branch Chief, Freight Transport Branch, Air Resources Board</i> <i>Frank Ramirez, Senior Permit Assistance Specialist, California Governor's Office of Business and Economic Development</i>
4:00 pm	Wrap-up
4:30 pm	Adjourn

Appendix II: Workshop Participant List

*Did not attend.

First Name	Last Name	Affiliation	Title
Adeel	Ahmad*	California Energy Commission	Air Resources Engineer
Kome	Ajise	California Department of Transportation	Chief Deputy Director
Heather	Arias	California Air Resources Board	Freight Transport Branch Chief
Leslie	Baroody	California Air Resources Board	Zero-Emission Vehicle Implementation
Richard	Battersby*	City of Oakland	Equipment Services Manager
Nico	Bouwkamp	California Fuel Cell Partnership	Technical Program Director
Tonia	Buell	Washington State Department of Transportation	Project Development Manager
Lakiesha	Christopher	Connecticut Department of Energy and Environmental Protection	Air Pollution Control Engineer 3
Catharine	Crayne	California Department of Transportation	Associate Transportation Planner
Noel	Crisostomo	California Energy Commission	Transportation Electrification Specialist
Sofi	Cullen	Governor's Office of Business and Economic Development	Executive Fellow
Samuel	Diaz	Governor's Office of Planning and Research	Senior Intergovernmental Program Analyst
Tyson	Eckerle	California Governor's Office of Business and Economic Development	Deputy Director of ZEV Infrastructure
John	Fairman	Governor's Office of Energy - Nevada	Management Analyst
Ingrid	Fish	City of Portland Bureau of Planning & Sustainability	Policy and Research Analyst
Tracey	Frost	California Department of Transportation	Chief, Office of Smart Mobility and Climate Change
Tom	Fulks	Mightycomm	Principal
Ellen	Greenberg*	California Department of Transportation	Deputy Director for Sustainability
Elisabeth	Hahn	Stanislaus Council of Governments	Principal Planner
Kevin	Hamilton*	Central California Asthma Collaborative	Chief Executive Officer
Brent	Jamison*	California Department of General Services	Deputy Director
Shrayas	Jatkar*	Coalition for Clean Air	Policy Associate
Taylor	Jones*	Governor's Office of Business and Economic Development	ZEV Policy Manager
Anand	Kapoor	California Department of Transportation, District 6	Project Manager



First Name	Last Name	Affiliation	Title
Elias	Kurani	California Department of Transportation	Sustainability Program
Oana	Leahu-Aluas	Cadmus	Senior Analyst
Keith	Leech	Sacramento County	Fleet Services Division Chief
Aileen	Loe	California Department of Transportation	Deputy District Director
Suzanne	Loosen	City and County of San Francisco	Clean Cities Coordinator
Bob	Madewell	Nevada Department of Transportation	Assistant Chief-Roadway Systems
Erica	Martinez*	Earthjustice	Policy Advocate
Andrew	Martinez	California Air Resources Board	Air Resources Engineer
Jeremy	Matsuo	California Department of Transportation	ZEV Infrastructure
Devin	Middlebrook*	Tahoe Regional Planning Agency	Sustainability Program Coordinator
John	Mikulin	US Environmental Protection Agency, Region 9	Specialist, Technology & Partnerships
Dillon	Miner	California Department of Transportation	Transportation Planner
Geoff	Morrison	Cadmus	Associate
Bob	Myers	California Department of Transportation Division of Equipment	Supervising Superintendent
Nick	Nigro	Atlas Public Policy	Founder
Larry	Orcutt	California Department of Transportation Division of Equipment	Division Chief
Sarah	Pittiglio	California Air Resources Board	Staff Air Pollution Specialist
Frank	Ramirez	Governor's Office of Business and Economic Development	Senior Specialist
Larry	Rillera	California Energy Commission	Air Pollution Specialist
Sondra	Rosenberg	Nevada Department of Transportation	Assistant Director, Planning
Satvinder	Sandhu	Federal Highway Administration	Local Programs Manager
Michael	Scarpino	US Department of Transportation - Volpe Center	Transportation Project Engineer
Chris	Schmidt	California Department of Transportation	Division Chief, Transportation Planning
Ryan	Schuchard*	CALSTART	Policy Director
Suzanne	Seivright*	Clean Cities Coachella Valley Region	Chair, C3VR
Evan	Speer	CA DGS, Office of Fleet and Asset Management	Chief
Dan	Sperling	University of California, Davis	Professor
Rahul	Srivastava	California Department of Transportation	Chief, Office of Freight Planning

First Name	Last Name	Affiliation	Title
Gil	Tal	Plug-in Hybrid & Electric Vehicle Research Center	Professional Researcher
Lindsee	Tanimoto*	California Energy Commission	EV Specialist
Diane	Turchetta	Federal Highway Administration	Transportation Specialist
Patrick	Tyner	California Department of Transportation	Associate Transportation Planner, DRISI
Barby	Valentine	California Department of Transportation	Associate Transportation Planner
Rick	Wallace	Oregon Department of Energy	Senior Policy Analyst
Nicklaus	Watson*	Texas Comptroller of Public Accounts	Office of Vehicle Fleet Management
Robert	White	Texas Department of Transportation	Fleet Services Manager
Anthony	Zepeda*	Merced County Association of Governments	Transportation Planning Manager