Electrifying Clean Vehicle Incentives

energy independence now

energy independence now

Mission

Energy Independence Now (EIN) is the only environmental nonprofit organization dedicated to advancing fuel cell electric vehicles (FCEVs) and renewable hydrogen infrastructure for transportation, renewable energy storage and deep decarbonization. Our organization engages in comprehensive research, policy advocacy and public outreach to promote the widespread adoption of a diverse zero-emission portfolio. Committed to fighting climate change and improving air quality, EIN believes that FCEVs and battery electric vehicles (BEVs) are critical to catalyze a rapid transition to a clean energy economy.

Philosophy

EIN believes that the urgency and massive scale of climate change, petroleum dependence and air-quality challenges warrant solutions that are immediate, diverse and far-reaching. EIN believes that any and all vehicle technologies and alternative fuels that hold the promise of addressing these challenges should be actively pursued. Our organization advocates for both the deployment of immediate, near-term solutions as well as longer-term solutions that will help us achieve California's climate and air quality goals.

Leadership

EXECUTIVE DIRECTOR - BRIAN GOLDSTEIN
DEPUTY DIRECTOR - JUSTO ROBLES

A SPECIAL THANKS TO THE

Leonardo DiCaprio Foundation

The Leonardo DiCaprio Foundation (LDF) is dedicated to the long-term health and wellbeing of all Earth's inhabitants. LDF supports projects around the world that build climate resiliency, protect vulnerable wildlife, and restore balance to threatened ecosystems and communities.

Through grant-making, public campaigns and media initiatives, LDF brings attention and needed funding to six program areas – Wildlands Conservation, Oceans Conservation, Climate Change, Indigenous Rights, Transforming California and Innovative Solutions.

EIN is grateful for the support of LDF, which has provided grant funding in support of EIN's ongoing research, advocacy and outreach to promote the widespread adoption of fuel cell electric vehicles and renewable hydrogen.

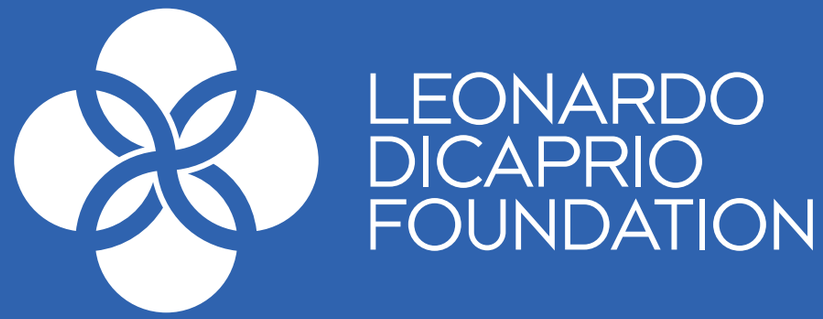
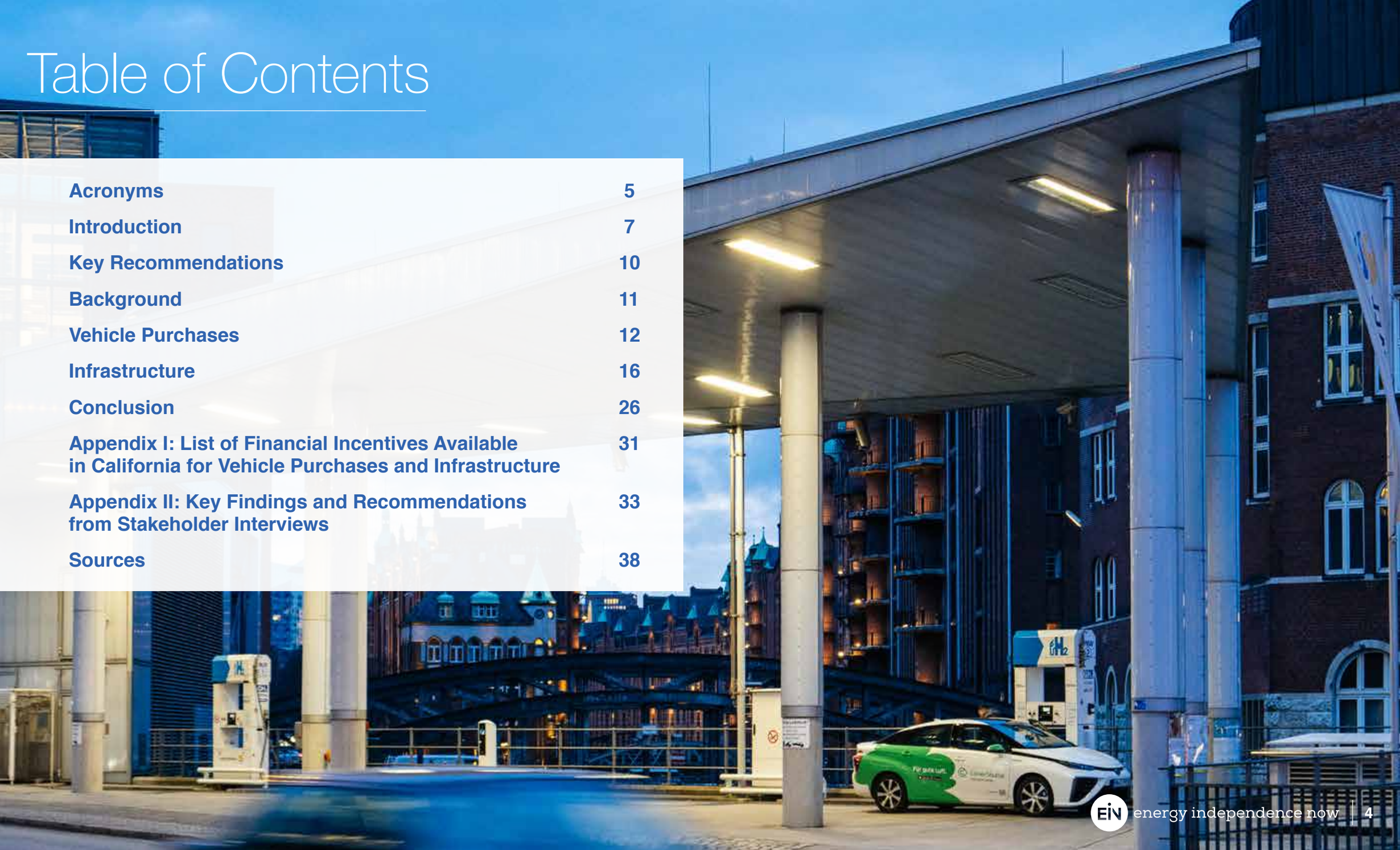


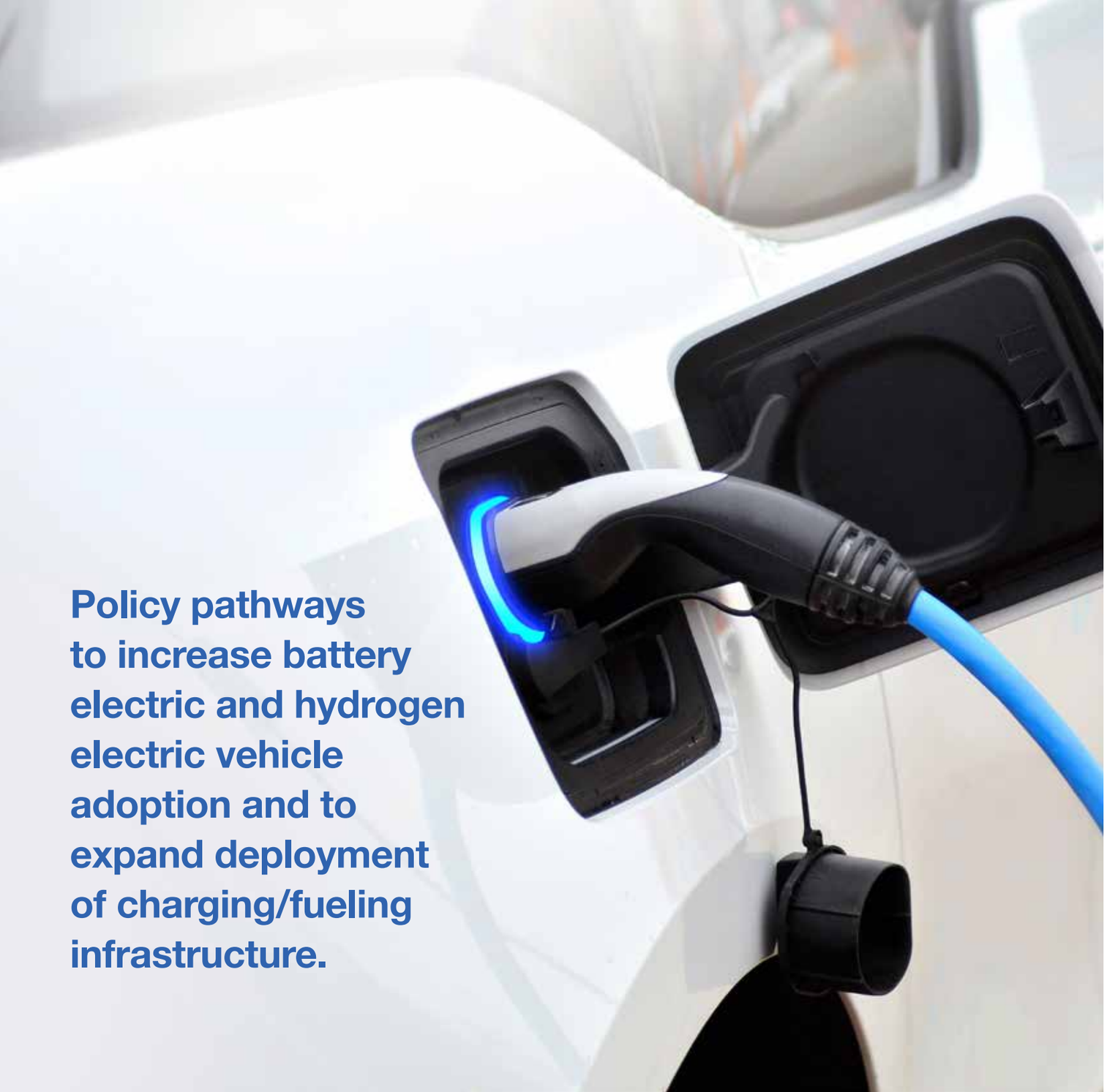
Table of Contents

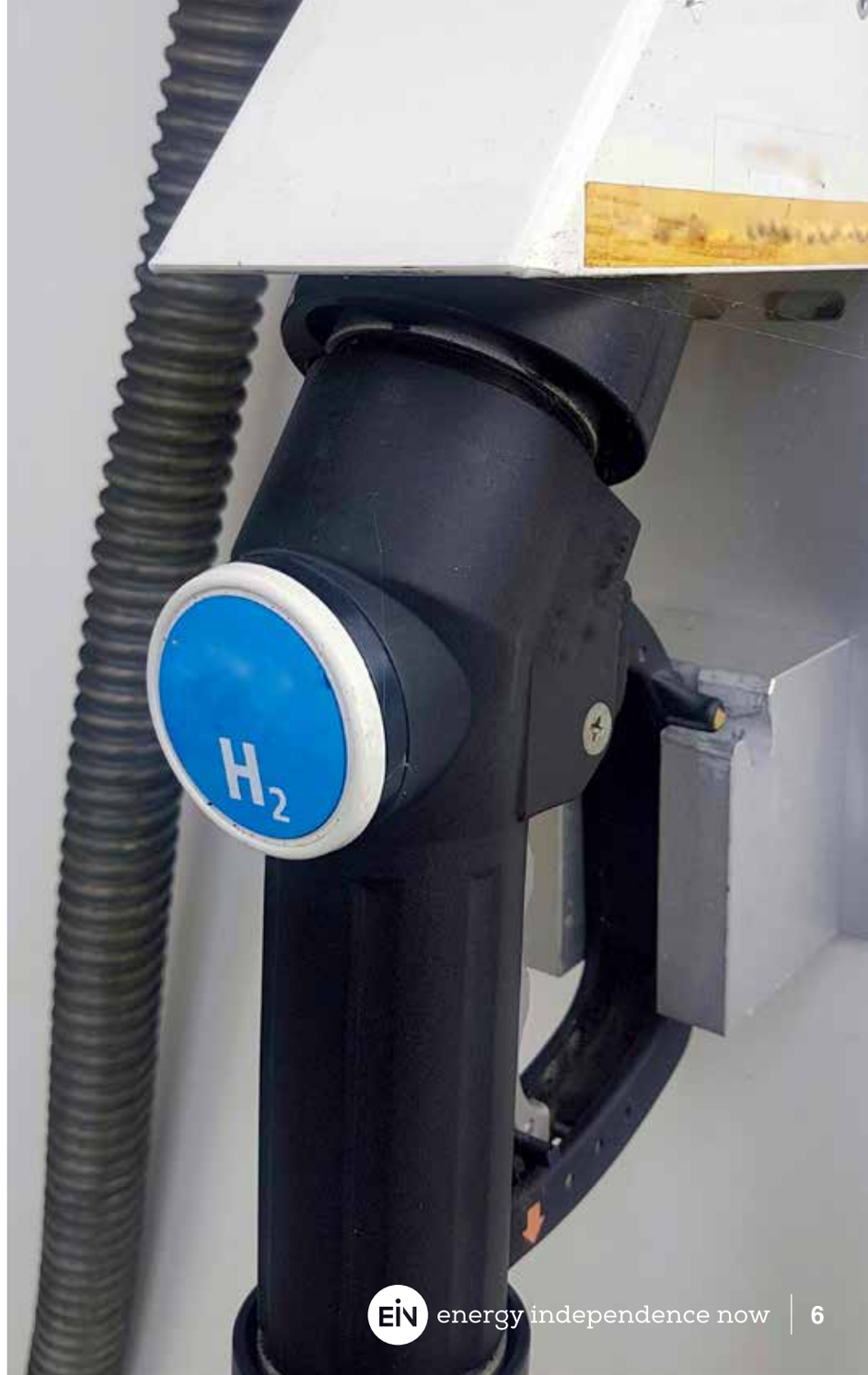


Acronyms

AB 8	Assembly Bill 8: Alternative Fuel and Vehicle Technologies (Perea, Chapter 401, Statutes of 2013)
AB 2127	Assembly Bill 2127: Electric Vehicle Charging Infrastructure (Ting, Chapter 365, Statutes of 2018)
ARFVTP	Alternative and Renewable Fuel Vehicle Technology Program
BEV	Battery Electric Vehicle
CalEPA	California Environmental Protection Agency
CalETC	California Electric Transportation Coalition
CARB	California Air Resources Board
CPUC	California Public Utilities Commission
CVRP	Clean Vehicle Rebate Project
DCFC	Direct Current Fast Charger
EFMP	Enhanced Fleet Modernization Program
EIN	Energy Independence Now
EV	Electric Vehicle
EVSE	EV Supply Equipment
FCEV	Fuel Cell Electric Vehicle
GHG	Greenhouse Gas
GFO	Grant Funding Opportunity
HOA	Homeowner Association
HOV	High-Occupancy Vehicle
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
IOU	Investor-Owned Utility
kWh	Kilowatt Hour
LCFS	Low Carbon Fuel Standard
MDU	Multi-Dwelling Unit
NOx	Nitrogen Oxide
PEV	Plug-In Electric Vehicle
PG&E	Pacific Gas and Electric
PHEV	Plug-In Hybrid Electric Vehicle
SB 350	Senate Bill 350: Clean Energy and Pollution Reduction Act (de León, Chapter 547, Statutes of 2015)
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SMUD	Sacramento Municipal Utility District
TOU	Time-of-Use
UC Davis	University of California, Davis
VW	Volkswagen
ZEV	Zero-Emission Vehicle

Policy pathways to increase battery electric and hydrogen electric vehicle adoption and to expand deployment of charging/fueling infrastructure.

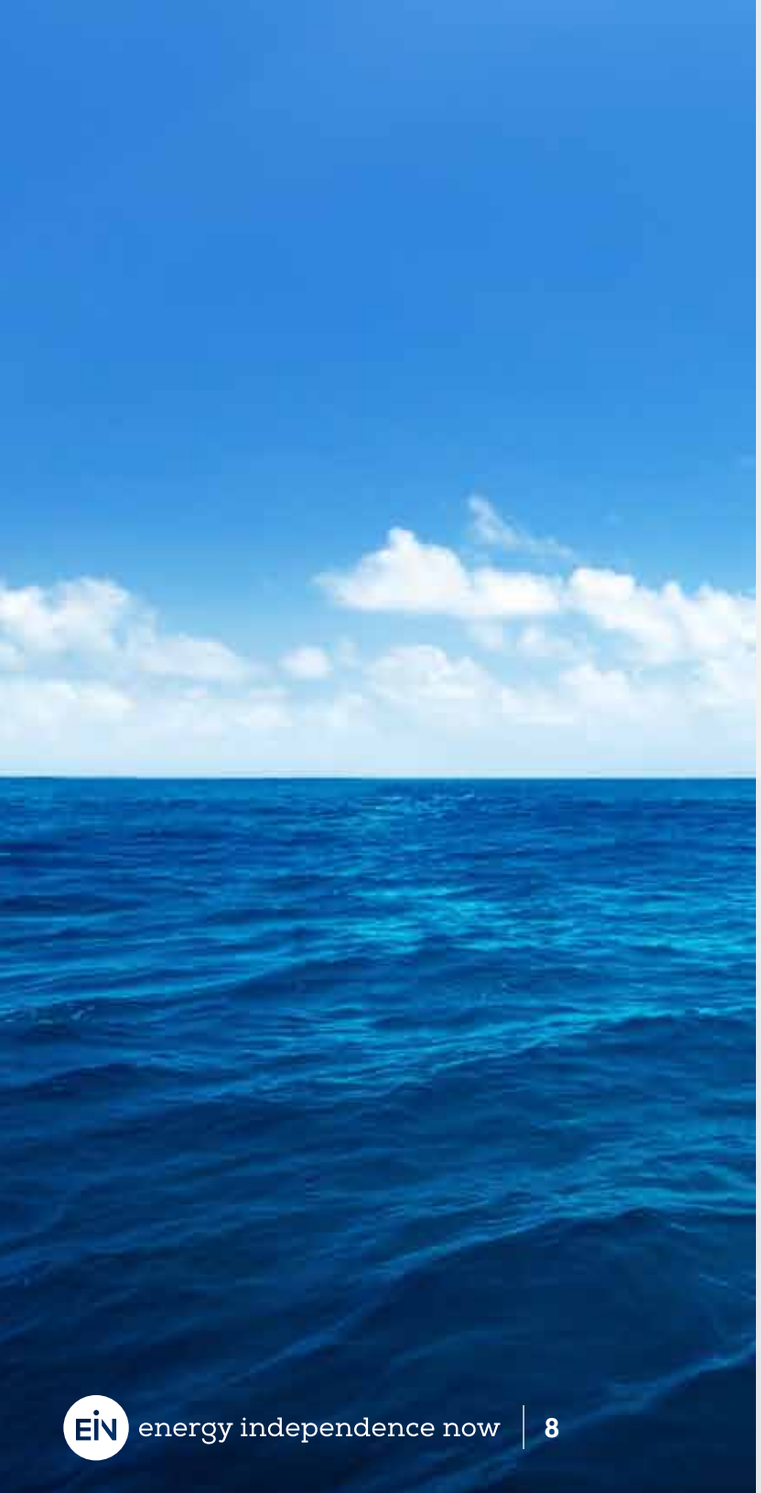




Introduction

California suffers from some of the worst pollution in the US and consistently sets ambitious goals to combat this growing issue. By transitioning to zero-emission vehicles (ZEVs), the state will significantly reduce its pollution levels while working to achieve many of its climate goals. In January 2018, California Governor Jerry Brown issued Executive Order B-48-18, designed to expand upon the state's existing target of one million ZEVs by 2020 and to cut carbon emissions to 40% below 1990 levels by 2030. Along with these objectives, the Executive Order aims to put 5 million ZEVs on the road by 2030 and calls on the state to work with the private sector to install 200 hydrogen fueling stations and 250,000 ZEV chargers, including 10,000 direct current fast chargers (DCFC), by 2025.[1] To achieve these ambitious goals, the state will be required to leverage its limited incentive dollars effectively to maximize the sales of new ZEVs, of which a growing subset will be fuel cell electric vehicles (FCEVs).

At the 2018 Global Climate Action Summit, California's environmental stewards were joined by governors, mayors and business leaders, who pledged to invest in the advancement of the ZEV marketplace. Accelerating the deployment of ZEVs is critical to California's environmental health, given the state's increasing gasoline consumption and associated greenhouse gas (GHG) emissions. Reducing, and ultimately eliminating, transportation emissions is one of the most impactful measures that state leaders can take to meet Executive Order B-48-18 and become carbon neutral by 2045.



In order to achieve its emissions goals, the California legislature passed a 2018 budget that included $200 million of cap-and-trade funding for the California Air Resources Board (CARB) to continue to provide rebates to California residents for the purchase of new light-duty zero-emission vehicles and plug-in hybrids, including $25 million in incentives specifically for low-income consumers. This annual funding will continue through 2025, reflecting the state's commitment to achieve its zero-emission vehicle target.

Beyond these measures, California is also directing non-state funding toward additional infrastructure investments. In May 2018, the California Public Utilities Commission (CPUC) approved historic proposals from Southern California Edison (SCE), Pacific Gas and Electric (PG&E) and San Diego Gas and Electric (SDG&E). These accumulated into a massive investment of $738 million to be spent solely on charging infrastructure for electric vehicles submitted under provisions of SB 350 (de León).[2] CARB also approved the expansion of the Low Carbon Fuel Standard (LCFS) through 2030, endorsing a plan developed by the utility companies to offer ratepayer credits as point-of-purchase incentives to reduce consumers' clean vehicle purchase costs. Additionally, in response to its emissions scandal, Volkswagen (VW) agreed to invest $800 million in California-based ZEV projects over a 10-year period. As a part of the agreement, CARB will review and approve eligible projects every two years. This is supposed to include the installation of ZEV fueling infrastructure for both battery electric vehicles (BEVs) and FCEVs, the funding of campaigns to raise consumer awareness of the ZEV marketplace as well as increased access to ZEVs in lower-income and disadvantaged communities.[3]

Despite this progress, during the 2018 legislative session, California policymakers did not authorize Governor Jerry Brown's requested funding increase, which would have accelerated development of hydrogen fueling infrastructure. Energy Independence Now (EIN) conducted its analysis prior to the legislature's finalization of the 2018 state budget and under the expectation that the legislature would continue to invest in clean vehicle infrastructure. Thus, this report does not include an extensive analysis of infrastructure development, which we consider critical to advancing the ZEV marketplace as a whole. This is specifically relevant to California's expansion of hydrogen fueling stations, which provide broad access to clean vehicle fueling in a state where more than half of residents live in multifamily housing, often lacking access to BEV chargers.

The legislature's support of charging and fueling infrastructure development would catalyze ZEV market expansion by signaling the state's long-term commitment to the clean vehicle marketplace. Automakers limit production of BEVs and FCEVs because there is not adequate infrastructure to support them. Developers are also cautious of investing in ZEV infrastructure given relatively low consumer demand for hydrogen fueling and battery charging stations. Public access to fueling and charging sites for BEVs and FCEVs is essential to help reduce risk for automakers, developers and consumers. State-driven incentives that support infrastructure development would address both sides of this chicken and egg conundrum and are therefore, one of EIN's top recommendations.

Governor Gavin Newsom and the legislature now have the opportunity to craft policies to expand the ZEV marketplace in support of the state's environmental agenda. California's unique economic position allows its clean vehicle programs to set an example for automakers, other state legislatures and federal policymakers, demonstrating how the ZEV marketplace can deliver lasting economic, health and environmental benefits.

While EIN acknowledges that federal incentives—soon to be phased out unless restructured and subsequently renewed by Congress—play a significant role in encouraging ZEV purchases, the focus of this paper is on evaluating California's programs and policies, specifically drawing on comparable incentive programs in other states and countries for the purpose of providing additional data and potential recommendations for policy consideration.

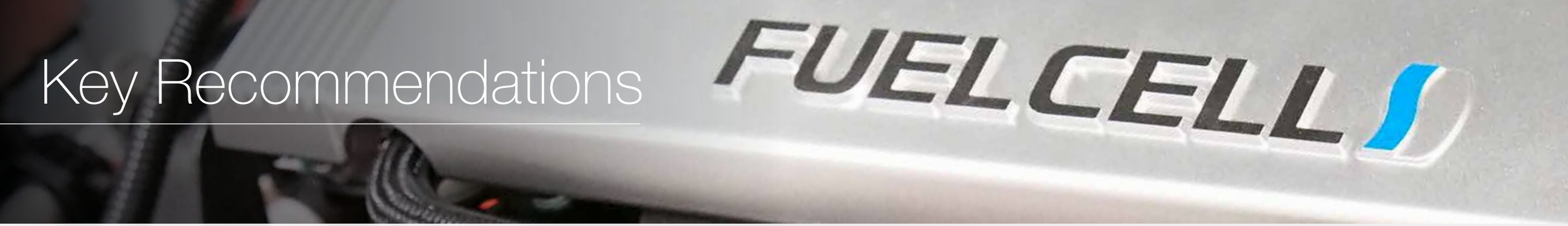
EIN's recommendations are based on a review of more than two dozen academic, government and industry reports, issued over the past few years and supplemented by expert interviews across the automotive, government and nonprofit sectors. While there are distinctions in each sourced report, the studies are nearly unanimous in concluding that incentives accelerate consumer uptake of ZEVs and enable greater deployment of ZEV charging and fueling infrastructure. The distinctions that do exist among the studies primarily center on the suggested approaches to the geographic distribution of incentive programs. For example, certain academics recommend focusing charging infrastructure deployment in urban areas that enjoy higher utilization rates and, therefore, offer policymakers a greater return on investment; others argue for a general increase in infrastructure deployment, thereby encouraging greater uptake of ZEVs in both urban and rural areas.

Before continuing further, it is important to clarify the terms of this discussion:

ZEVs can take two primary forms: BEVs, which recharge by plugging into electric outlets or chargers, and FCEVs that refuel at hydrogen stations. Plug-in hybrid electric vehicles (PHEVs) can also operate as BEVs via an electric motor, but have internal combustion engines typically used for longer-distance travel. Like BEVs, their batteries are charged by plugging into an outlet or charger. BEVs and FCEVs both feature electric motors, but the former consumes energy stored in batteries and the latter generates electricity on-demand from energy stored in the form of hydrogen.[4]

This report analyzes existing research about the impact and effectiveness of vehicle and infrastructure incentives and it explores expert practitioner interviews to provide recommendations for policies that could further increase ZEV purchases and infrastructure deployment. Based on its evaluation, EIN has developed the following recommendations:

Key Recommendations



1) Create policies that promote sustained public sector, corporate and utility-scale investment in electric charging and hydrogen fueling infrastructure. Such policies should support both light- and heavy-duty vehicles in order to leverage economies of scale and support uptake of all ZEVs while minimizing development costs.

2) Bolster alternative, non-monetary incentives such as High-Occupancy Vehicle (HOV) stickers and free/preferred parking. These are especially appealing to consumers in urban and congested areas.

3) Prioritize the development of incentive programs targeting the ride-hailing and ride-sharing marketplaces in order to:
    a) Increase the number of ZEVs on the road.
    b) Improve the services' impact on air pollution.
    c) Grow consumer familiarity with clean vehicles while subtly informing future purchase decisions.

4) Increase California's clean vehicle incentive packages to counter deteriorating US environmental policies/incentives, like the $7,500 federal clean vehicle tax credit that was not renewed in 2018.

5) Streamline the redemption process to deliver consumer ZEV incentives as close to the point-of-sale as possible.

6) Implement incentive programs aimed at motivating auto dealers to offer, promote and sell ZEVs, similar to Connecticut's model, which grants state-supported cash bonuses to both dealers and individual sellers.

7) Establish second-hand market incentives to increase ZEV access among low-income communities, thereby expediting the replacement of older, less efficient vehicles with ZEVs and ultimately expanding the clean vehicle marketplace.

8) Safeguard California's commitment to provide sustained funding for clean vehicle incentives such as fuel credit and vehicle rebate programs. These drive uptake and generate long-term confidence among consumers, automakers and infrastructure developers.

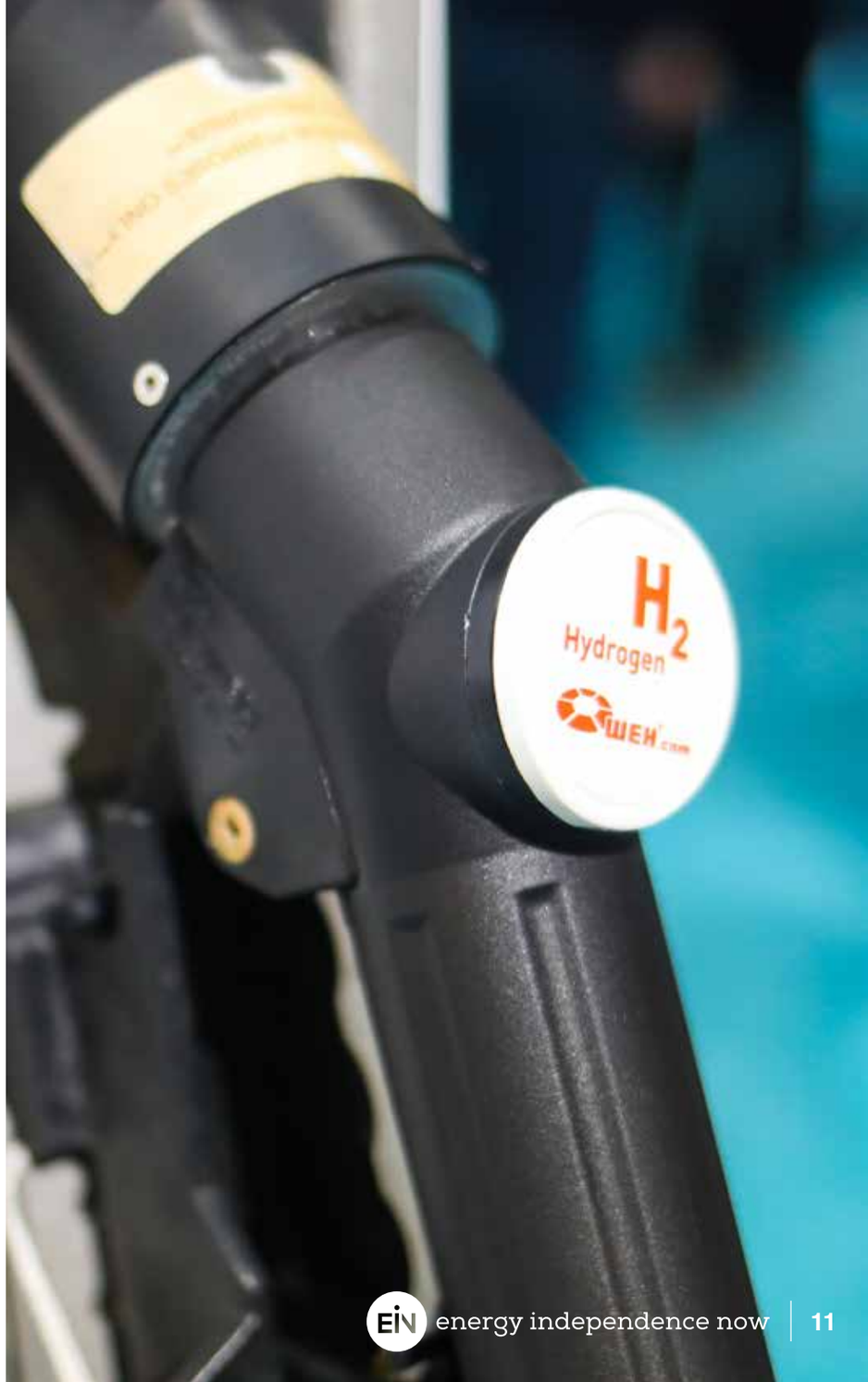
9) Present straightforward incentive guidelines for consumers, service providers, automotive manufacturers and dealers through an online portal that communicates the full-scale of incentives and benefits.

10) Reduce high costs of installing and operating hydrogen fueling and electric charging infrastructure by:
    a) Reducing electricity costs for EV charging stations and hydrogen production.
    b) Expediting incentives allocated toward infrastructure deployment.

Background

Vehicle incentives can vary by vehicle type. For example, California's Clean Vehicle Rebate Project (CVRP) typically offers $2,500 for the purchase or lease of a BEV and $1,500 for the purchase or lease of a PHEV.[5] Additionally, California offers a $5,000 rebate for the purchase or lease of an FCEV.[6] The CVRP also offers increased rebates for lower-income consumers, whose applications it prioritizes with dedicated funding. This paper does not analyze the merits of tailoring incentive programs based on vehicle type; rather, it focuses on the merits of incentives more broadly and evaluates their effect in accelerating general market adoption of clean vehicles across the spectrum of available models.

Market share for ZEVs in California increased from 3.6% in 2016 to 4.5% in 2017.[7] California's policies to meet its ambitious ZEV and climate goals have resulted in the state leading the nation in ZEV sales as well as the development of electric charging and hydrogen fueling infrastructure. As a result, California earned the Electrification Coalition's first-place ranking in the inaugural ZEV State Policy Scorecard.[8] Although California is on the right path, policymakers must implement additional programs to increase BEV and FCEV adoption in order for the state to achieve its ambitious climate goals.



Vehicle Purchases

As of April 2019, ZEV sales in California totaled 570,079 or 49% of nationwide sales in the US.[9] As ZEVs gain acceptance and a greater number of manufacturers such as General Motors, Volvo and Jaguar Land Rover work toward electrifying their fleets, ZEV sales will likely increase.[10] Toyota, Honda and Hyundai have already begun to produce FCEVs, which are seeing brisk demand—more than 6,111 FCEVs are on California's roads as of March 12, 2019 —and those numbers are growing.[11] The data clearly demonstrates that incentives for EV purchases have a pronounced impact on sales. According to the California Electric Transportation Coalition (CalETC), states with above-average total incentives saw electric vehicle (EV) adoption at rates seven-times higher than those of states with below-average total incentives. In the case of ZEVs specifically, purchases appear to increase as the number of incentives rises, regardless of the type of incentive.[12]

In a September 2017 story, The Washington Post noted that sales in New York rose by 74% in the three months after the state's $2,000 rebate took effect relative to the same period the year before.[13] While adding incentives appears to have a positive impact on sales, the inverse is also true: removing incentives has an adverse impact. In the same September 2017 story, The Washington Post wrote that the state of Georgia's fleet of private EVs was among the largest in the nation after the state decided to offer up to a $5,000 state income tax credit. After the income tax credit was pulled back, however, sales cratered.[14] In January 2017, The Atlanta Journal Constitution reported that Georgia registered 1,426 vehicles in July 2015, when the tax credit expired, and only 242 the following month.[15]

Nevertheless, simply creating vehicle incentives does not guarantee success. As the International Council on Clean Transportation (ICCT) notes, “markets like Colorado, Illinois, France, Japan and South Korea have had substantial incentives that have not been associated with a comparatively high electric vehicle uptake.”[16] The data suggests that many factors contribute to EV uptake, including consumer awareness, easily understandable incentive structures and eligibility criteria, fewer limitations on incentives (i.e. caps on incentives) and availability of charging infrastructure.[17] In fact, a UC Davis report from 2016 finds that 77% of Californians (responding to their survey) “have yet to seriously consider a PHEV or BEV for their household,” and two-thirds cannot name a BEV currently on the market, despite there being a number of ZEVs available for purchase in California at the time of the survey.[18]

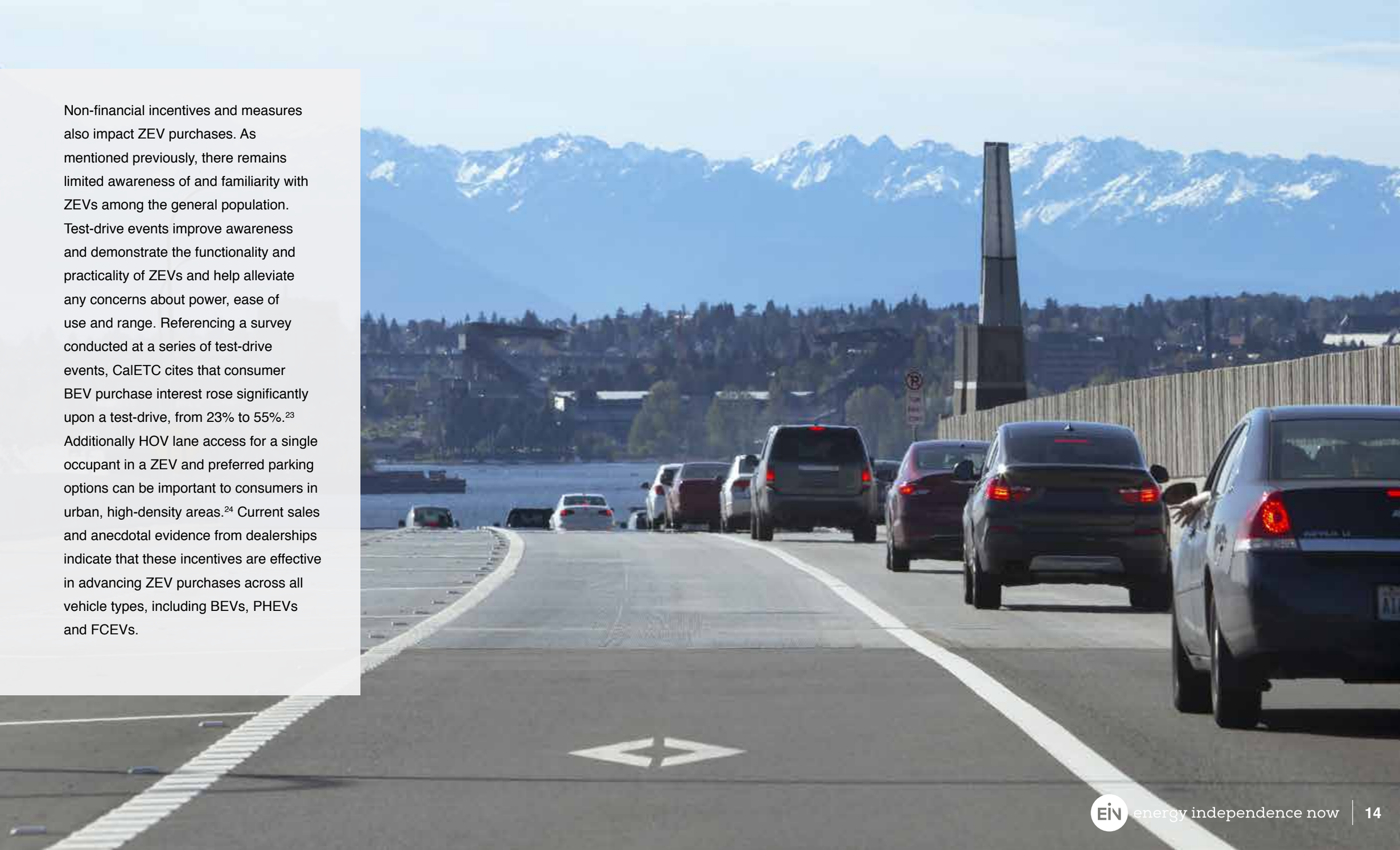
If consumers are not aware of the ZEV options available to them, it is unlikely they will consider a ZEV for their next vehicle purchase. Moreover, lack of awareness or understanding regarding available incentives may lead consumers to shy away from ZEVs due to the vehicles’ relatively higher upfront cost. In fact, some surveys have found the greatest barrier to ZEV adoption is high upfront cost.[19]

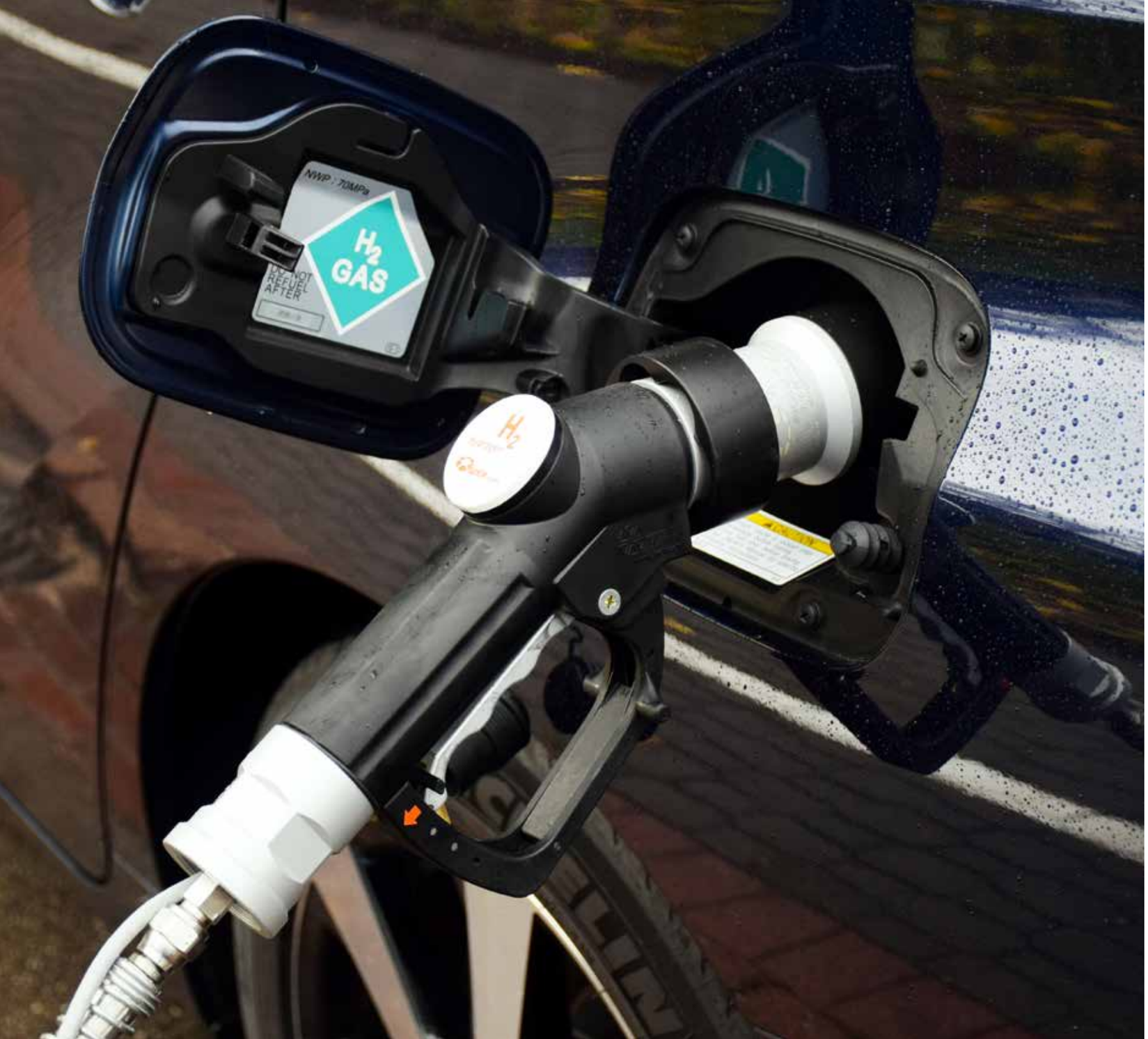
Beyond purchase incentives, consumers' decisions to invest in ZEVs is also dependent on available vehicle choice. The ICCT’s July 2017 study indicates that greater ZEV model availability is a prerequisite for market growth. According to the study, the five leading markets in the United States for EVs each had at least 24 available models in 2016, while about half the population of the fifty major U.S. markets only had access to 10 or fewer models.[20] According to a January 2018 Next10 report, auto dealers in California’s top cities offer up to 30 different models.[21]

In order to promote ZEV adoption, policies must be carefully crafted and enacted with ample opportunity to succeed. The ICCT’s key principles for designing effective incentive programs are worth noting: (1) move incentives to the time of purchase and make them visible; (2) make the value of the incentives clear; (3) provide incentives to the full marketplace, including vehicle owners and lessees as well as ride-hailing and ride-sharing services and providers; and (4) commit to durable, long-term incentives that will provide certainty to the industry and consumers.[22]

Principles (1) and (2) seek to address the obstacles posed by the high upfront cost of many ZEVs as well as the lack of clarity regarding incentives. Principle (3) aims to ensure that certain market segments and potential buyers will not be left out. Principle (4) is geared toward enabling the automotive industry to plan long-term business strategies that account for the certainty of available incentives, in turn, encouraging automakers to further invest in ZEV development. Increased sales achieved as a result of adhering to these key principles will encourage greater investment in ZEV technologies and help fuel the development of additional vehicle models, thus spurring additional sales in the sector.

Non-financial incentives and measures also impact ZEV purchases. As mentioned previously, there remains limited awareness of and familiarity with ZEVs among the general population. Test-drive events improve awareness and demonstrate the functionality and practicality of ZEVs and help alleviate any concerns about power, ease of use and range. Referencing a survey conducted at a series of test-drive events, CalETC cites that consumer BEV purchase interest rose significantly upon a test-drive, from 23% to 55%.[23] Additionally HOV lane access for a single occupant in a ZEV and preferred parking options can be important to consumers in urban, high-density areas.[24] Current sales and anecdotal evidence from dealerships indicate that these incentives are effective in advancing ZEV purchases across all vehicle types, including BEVs, PHEVs and FCEVs.





Fuel Cell Electric Vehicles (FCEVs)

As of March 12, 2019, more than 6,000 FCEVs were on California's roads, supported by 39 hydrogen fueling stations throughout the state.[25] Automobile marketplace experts predict that the FCEV market, like that of BEVs and PHEVs, will continue to grow not only in absolute numbers, but also in terms of vehicle diversity.[26] In fact, CARB projects there will be 13,400 FCEVs in California by 2020 and 37,400 by 2023.[27] Developing policy solutions to sustain the growing momentum in the FCEV marketplace is critical because the state will not be able to meet its transportation objectives with BEVs alone. FCEVs offer consumers longer range, larger vehicle options and considerably faster refueling relative to BEVs. Additionally, FCEVs present a vital alternative for drivers that lack consistent access to charging infrastructure. This is especially crucial for drivers that don't have dedicated parking, which is common for those living in multifamily housing.

California already offers a $5,000 rebate for buying or leasing a new FCEV. There are also several local FCEV incentives as well as automaker incentives that offer free fuel to FCEV buyers and lessees.[28] According to CARB, this combination of incentives is "generating a shift in the FCEV first adopter market away from the traditional socio-economic definition" and broadening "the portion of the population that could be first adopters."[29] To achieve California's ZEV and carbon emission reduction goals, policymakers must continue to invest in incentives that encourage the adoption of all types of ZEVs because the market relies on choices that offer consumer flexibility.

Infrastructure

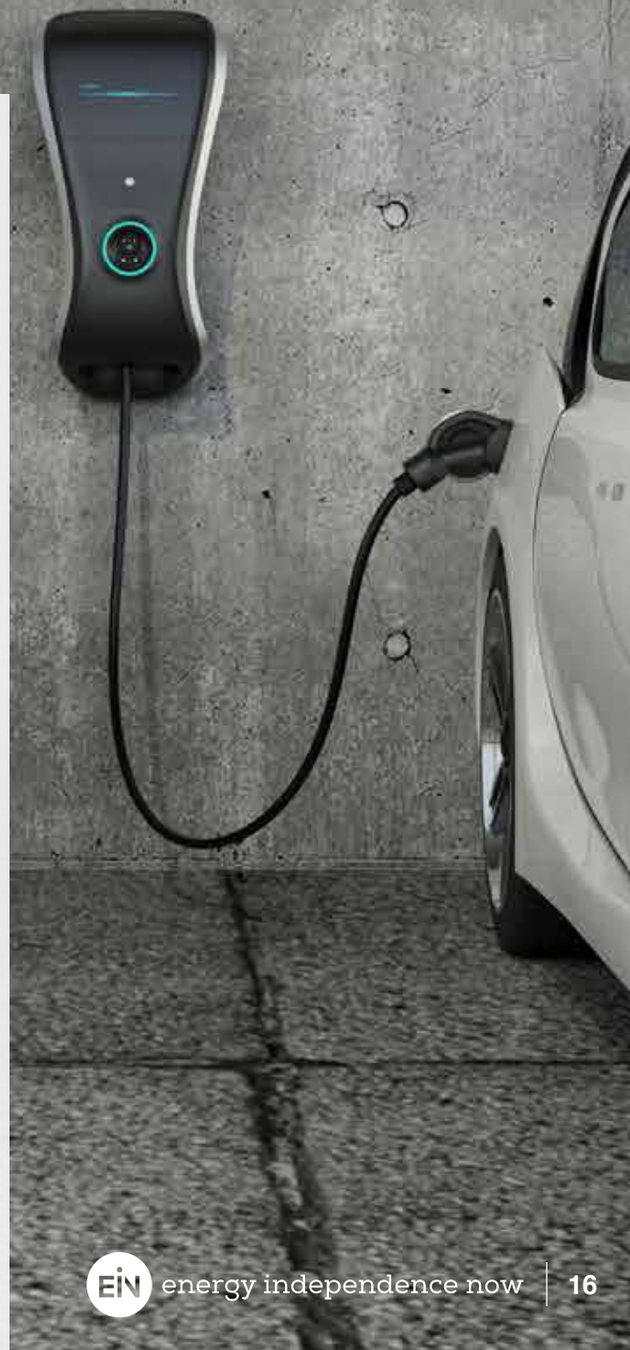
Overview

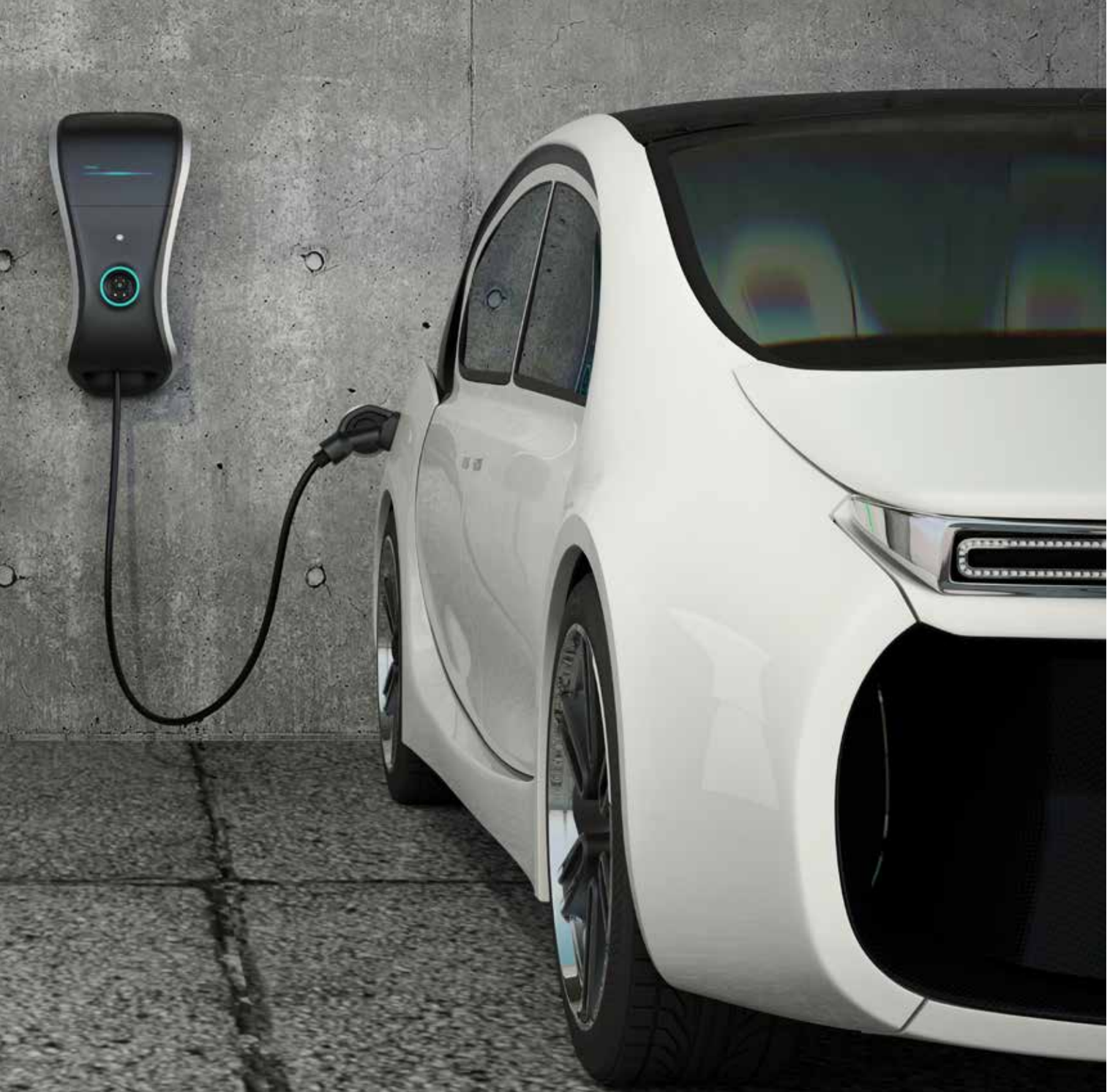
Developing ZEV infrastructure and designing incentive structures to enable such development remains complex and challenging. Evolving technology, building codes, construction and design challenges and practical considerations (e.g. vehicle charge time) all play a role. Moreover, there is a challenge of economics: installing charging stations remains expensive, while the product itself (electricity) is not. As a result, it can take years for developers to reach a breakeven point.[30]

EVgo's letter to the CPUC shows that a $50.5 million investment funds at least 200 DCFC sites, most of which include two 50 kW fast chargers, for a total cost nearing $252,500 per DCFC site. While electricity costs are generally much lower than gasoline costs—especially when factoring in the preferred rates consumers receive when charging vehicles at home—fast charging costs, in particular, can be higher than gasoline costs. The EVgo letter reports that, in a single year across EVgo's 90 public EV fast charging stations in California investor-owned utility (IOU) territories, the average all-in unit cost of electricity was $0.36 per kWh, with costs ranging from $0.23 per kWh to as high as $0.65 per kWh. This figure is based on station-weighted averages of annual demand, monthly utility bills and monthly electricity delivered.[31] EVgo cites the most significant contributor to the stations' high electricity costs as "the demand charge component of the commercial electricity rates available to public EV charging stations," explaining, "The wholesale cost of electricity to EVgo exceeds the retail cost for the equivalent gasoline."

Many consumers prefer charging their BEVs and PHEVs at home due to the convenience, while others who might prefer to charge their vehicles at public stations are unable to do so given the limited public charging options, as well as the cost and time to charge.[32] Together, these factors form an additional challenge to the development of public charging stations: limited consumer use. In fact, the U.S. Department of Energy finds that "drivers do more than 80% of their charging at home."[33] Survey data also indicates that the ability to charge at home is positively correlated with BEV and PHEV sales. Therefore, residents of single-family homes, which have access to electrical outlets for charging, are more likely to own a BEV or PHEV than are residents of multifamily developments, where not all parking spaces may be electrified and charging installations can be expensive for developers to include on site.[34]

Nevertheless, as more and more ZEVs adorn American roads, additional charging infrastructure will be needed. By 2020, Bloomberg New Energy Finance expects to see 39 models of PHEVs in North America.[35] Additionally, Bloomberg New Energy Finance's 2017 Electric Vehicle Outlook states that 54% of new car sales and 33% of the global car fleet will be electric by 2040.[36] Without EV charging infrastructure, consumers may struggle to charge their cars conveniently. "As of January 2018, California had a total of 16,549 public and non-residential private sector charging outlets, or about six times as many outlets as the next state." Yet, that is only one public charging outlet per 20 ZEVs in the state.[37] With the expected growth in BEV and PHEV purchases, and given infrastructure deployment turnaround times, the Rocky Mountain Institute argues that key investments in EV charging infrastructure and installation should begin immediately.[38] While Governor Jerry Brown's 2018 proposal of $2.5 billion for ZEV infrastructure development was not fully funded as originally proposed, the state legislature did approve $200 million, annually, in consumer rebates through its CVRP program.[39]





Determining the Appropriate Level of Installation

Before continuing further, it is important to understand the types of chargers on the market. There are three types of chargers: Level 1, Level 2 and DCFCs. Level 1 chargers use a standard wall outlet; Level 2 chargers are typically 3-20 kW in power output and "suitable for charging vehicles of any capacity overnight"; and DCFCs are typically 50-400 kW in power output and "useful where vehicles need a substantial charge in a fairly short period of time."[40] DCFCs are extremely expensive but can charge vehicles in minutes as opposed to hours.[41] These will be necessary to allow BEVs to travel longer distances with shorter charging time relative to slower Level 1 and 2 chargers, both of which require multiple hours for charging.

The Rocky Mountain Institute finds, given the power levels of the various chargers and expected time to charge, Level 2 chargers are best in locations where drivers have the preference and opportunity to charge over a longer period of time (e.g. overnight) and DCFCs should be installed where utilization is high (e.g. key connector routes between big cities, high-traffic areas, locations where charging needs are more immediate and short-term).[42]

Assemblymember Phil Ting authored AB 2127, which passed the state legislature and was signed by Governor Brown in 2018. The bill directed the California Energy Commission, CPUC and CARB to provide a biennial assessment of EV charging to support the levels of vehicle adoption required for the state to meet its goal of putting at least 5 million ZEVs on the road by 2030.

State and Municipal Incentives

There are dozens of incentive programs for charging installation across the California—many put in place by city governments. Among the largest is the EV Charging Station Financing Program, which offers loans up to $500,000 "for the design, development, purchase, and installation of EV charging stations at small business locations" throughout California.[43] To be eligible for the loan, the charging station must be a Level 2 alternating current charger or a DCFC.[44] Here is a sampling of incentives (for a more comprehensive list of municipal and utility incentives, please see Appendix I):

- Los Angeles Department of Water and Power's Charge Up LA! Program offers a $500 rebate for the installation of an EV charger. It also offers an additional $250 rebate and a $0.025 per kWh rate discount with the installation of a second meter, purchased before June 30, 2018, enrolled in a time-of-use (TOU) rate plan.
- The City of Anaheim provides a $400 rebate and city permit fee waiver for a Level 2 charger installation.
- The City of Burbank offers a $500 rebate for residential customers and $1,000 for commercial customers for installation of a Level 2 charger.
- City of Colton offers $500 for a Level 2 charger installation for residential or commercial use.
- Pasadena offers $200 in LED light bulbs for a PEV purchase with an existing 120/240 volt AC charger or $200 in LED lights and a $400 rebate for a PEV purchase and PEV charger installation.
- Glendale offers a $500 rebate for Level 2 charger installations.[45]
- Redding Electric Utility offers a $3,000 account credit per EV charging station installation (up to 10) that is Level 2 or greater.[46]
- The Sacramento Municipal Utility District Commercial Electric Charger Incentive Program provides $1,500 per Level 2 EV charging port at both workplace and multifamily locations with a maximum of 20 incentives per property. It also offers up to $100,000 for each DCFC project, consisting of at least two DCFCs and one Level 2 station.[47]
- The Bay Area Air Quality Management District Charge! program enables projects to request up to $4,000 per Level 2 charging station and up to $25,000 per DCFC station.[48]
- The Northern Sonoma County Air Pollution Control District offers rebates to businesses, public agencies and other organizations within district boundaries that wish to install publicly available EV chargers (up to $5,000 per charger for a DCFC, $2,000 per charger for a Level 2 charger and $3,000 per charger for installation).[49]

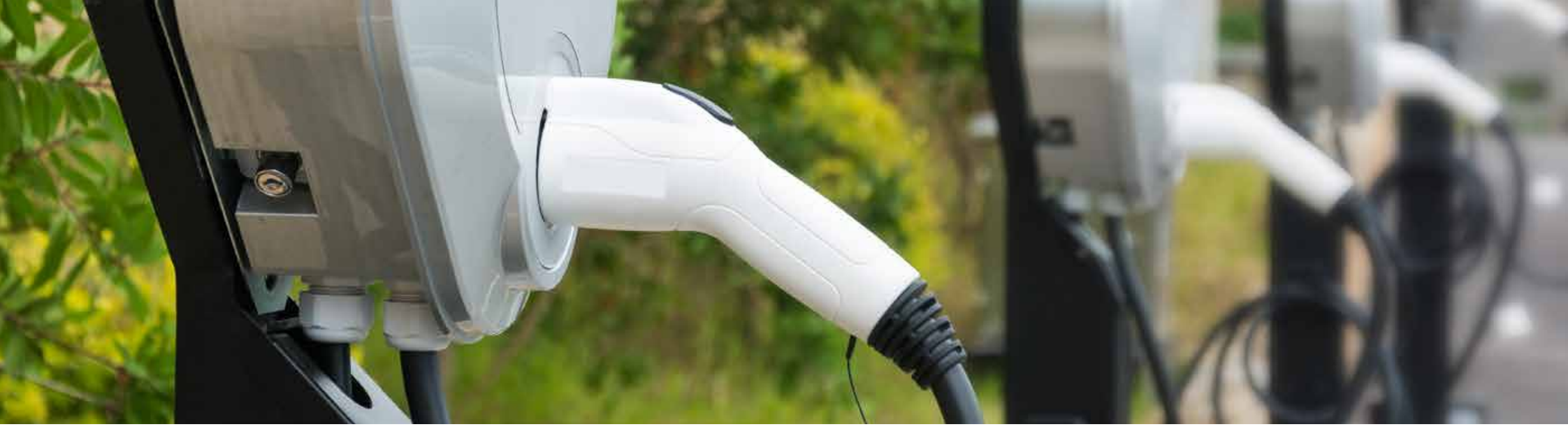
While the number of available incentives across California is encouraging, additional research and analysis must be undertaken to assess the effectiveness of the aforementioned programs in driving deployment and installation of ZEV fueling and charging infrastructure. Future studies must include a cross-segment analysis of infrastructure and station type (e.g. DCFC, hydrogen fueling, etc.) by location type and area demographics (e.g. workplace, public space, low-income community, multifamily residential, etc.) in order to form a full assessment of deployment effectiveness.

Multi-Unit Housing

There are barriers to charging EVs in multifamily housing, where large numbers of California residents live. More than 50% of Los Angeles residents, for example, live in multifamily developments.[50]

With home charging as one of the most reliable and convenient options for EV owners, this barrier is particularly problematic for rapidly scaling EV adoption. Many residents of multifamily complexes don't have dedicated parking and parking structures in multifamily complexes are often inadequately electrified. Moreover, charging installations "generally have high deployment costs, including trenching, new poles or transformers, and often involve more stakeholders than at single family residences, like Homeowner Associations (HOAs) and property managers."[51] Additionally, housing complexes are often charged commercial rates and are required to pay commercial rate demand charges, which can make overall electricity bills more expensive.[52]

The complexities of installing and managing charging infrastructure as well as the potential for increased energy bills may force property managers to shy away from installing charging infrastructure. As a result, individuals living in multifamily housing are "severely constrained in their ability to participate"[53] in the EV market.



Public / Workplace Charging

The availability of public charging infrastructure is a key concern for prospective EV purchasers. A recent Ceres report notes that "the availability of public and workplace charging is directly linked with electric vehicle market development,"[54] and, accordingly, many countries have rolled out charging installations in order to "reduce range anxiety."[55] Questions remain, however, as to whether or not consumers will use the installations given existing studies that show many primarily charge at home.[56] Nevertheless, charging stations should be installed where they will be most frequently used.

As the Rocky Mountain Institute explains, "a high utilization rate is important not only so that chargers can serve a large number of vehicles, but also so that they can earn enough revenue to support a profitable business case and justify the investment made in them."[57] The 2017 Ceres report argues that "chargers will be most useful at locations where PEV owners already park for 15+ minutes on a regular basis as part of their normal routine."[58] Such locations include areas of high traffic, shopping centers and malls, grocery stores, taxi and ride-sharing depots and places of work where cars may be parked for extended periods. When siting such stations, in addition to identifying appropriate high-traffic areas, it is important to consider the distance between charging stations, expected vehicle dwell time at each location (to help determine what level of charger is required) and convenience of access to the station.[59] An especially important location where vehicle owners will often park for extended periods is the workplace.

According to a U.S. Department of Energy report, "an employee with access to workplace charging is six times more likely than the average worker to drive electric."[60] A 2015 paper by the Idaho National Laboratory finds that the workplace is second only to the home in terms of EV owners' preferred charging location.[61] Additionally, the July 2017 ICCT report notes that "workplace charging has been reported as the most effective nonresidential charging investment for increasing electric vehicle adoption."[62] Therefore, charging stations at places of work will not only be utilized at a high rate, but they can also encourage prospective buyers to make an EV purchase because they know that they will be able to charge their vehicle at the workplace.

Role of Utilities

Utilities play a key role in driving the transition to broad adoption of EVs and development of charging infrastructure. In fact, the California Transportation Electrification Assessment states, "California utilities have a history of forwarding services to society that are not typically cost-effective, such as early renewable energy installations and energy efficiency measures."[63] In other words, utilities have stepped in to provide key services at a stage when it is not yet economically viable for private sector entities to do so.

Several California utilities are already undertaking steps to do the same for EV charging infrastructure. These investments in infrastructure may lessen the state's need to directly pay for infrastructure.

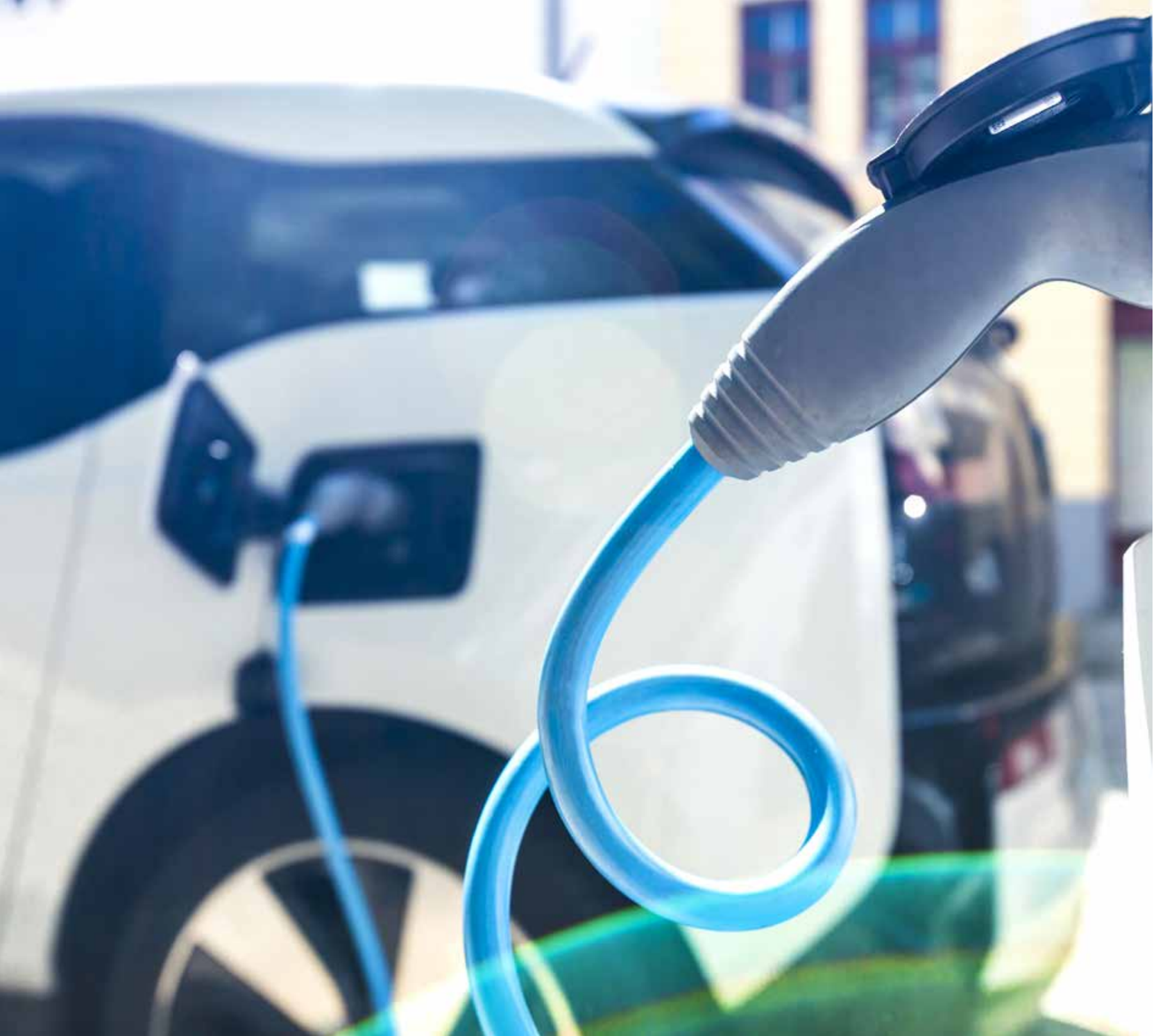
- SCE authorized $343 million for "make-ready" infrastructure at a minimum of 870 sites for medium- or heavy-duty vehicles. The utility is required to offer rebates for up to 50% of the cost of EV service equipment for locations in disadvantaged communities and in areas that support transit and school buses.[64] Furthermore, SCE has requested $760.1 million to support increased adoption of EVs by installing "make-ready" infrastructure for an additional 32,000 charge ports, creating new solutions for charging needs in multi-unit developments. This will support an additional 16,000 charge ports with at least 30% of new charging infrastructure in disadvantaged communities.[65]

- SDG&E, after previously gaining approval for $45 million from ratepayers to deploy 3,500 chargers, has now authorized $137 million to install up to 60,000 Level 2 chargers at single-family or small multi-unit residences. At least 25% of that funding must be spent in disadvantaged communities.[66]

- PG&E previously gained approval for a $130 million rollout at apartments and workplaces, and is now authorized for $236 million for "make-ready" electric infrastructure for medium- to heavy-duty and off-road fleets at a minimum of 700 sites. It also authorized $22.4 million for "make-ready" infrastructure supporting approximately 234 fast charging stations at about 52 sites. At least 25% of that funding must be spent in disadvantaged communities.[67]

Overall, the three IOUs are authorized to spend approximately $738 million on new infrastructure.[68] There are many benefits to utility involvement in infrastructure development. MJ Bradley & Associates and the Georgetown Climate Center argue that such benefits include:

- Increasing the pace and scale of infrastructure development by opening the market to utility capital, expertise and other resources;
- Maintaining reliability, minimizing grid impacts and streamlining required distribution and transmission system upgrades through coordination with existing utility systems and planning processes;
- Streamlining and improving customer communications by tapping into existing communications channels;
- Developing comprehensive customer pricing models that include TOU-based EV charging incentives that provide grid benefits; and
- Providing more equitable access to charging infrastructure for all ratepayers and communities, and increasing mobility for all through utility partnerships with transportation programs focused on serving disadvantaged communities.[69]

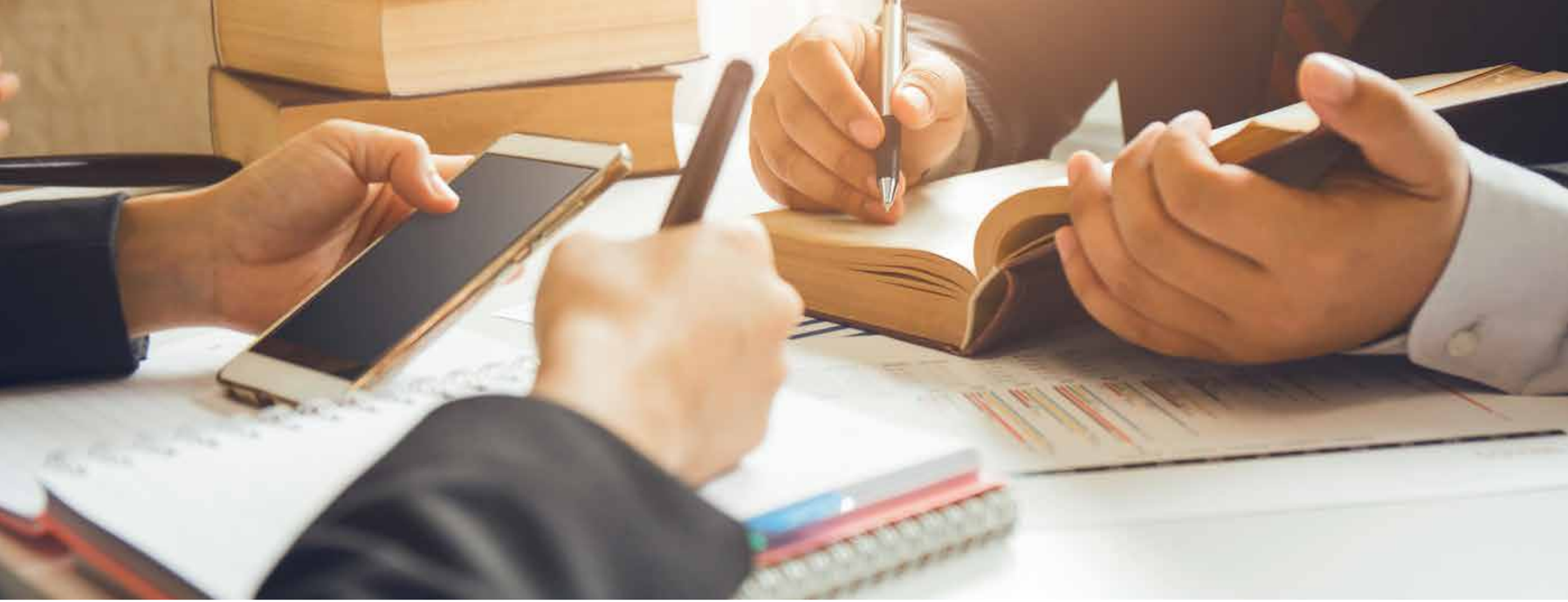


EV charging is one of the few growth opportunities for utilities.

In an era when loads are generally flat or declining, EVs will add load as more come online. “If all light-duty vehicles in the US were replaced with EVs, they would require about 1,000 TWh of additional electricity per year, or an increase of about 25% over our current electricity demand.”[70]

As described in EIN’s most recent Renewable Hydrogen Roadmap, utilities will also play a key role in the growth of hydrogen fueling infrastructure. Because hydrogen is an energy carrier, renewable hydrogen production relies on energy sources such as electricity and biogas. Therefore, utilities are essential to ensuring access to renewable electricity at consistent and affordable rates.[71]

In addition to rolling out much needed infrastructure, utilities can also play a key role in increasing awareness about EVs. They can explain the available options and organize programs that demonstrate the benefits of various charging solutions for the grid and for ratepayers.[72] As the California Transportation Electrification Assessment states, “Utilities can engage workplaces and multifamily unit developments in meaningful discussions to help identify optimal solutions for consumers/drivers, HOAs, employers and other parties interested in providing MDU (multi-dwelling units) or workplace charging.”[73]



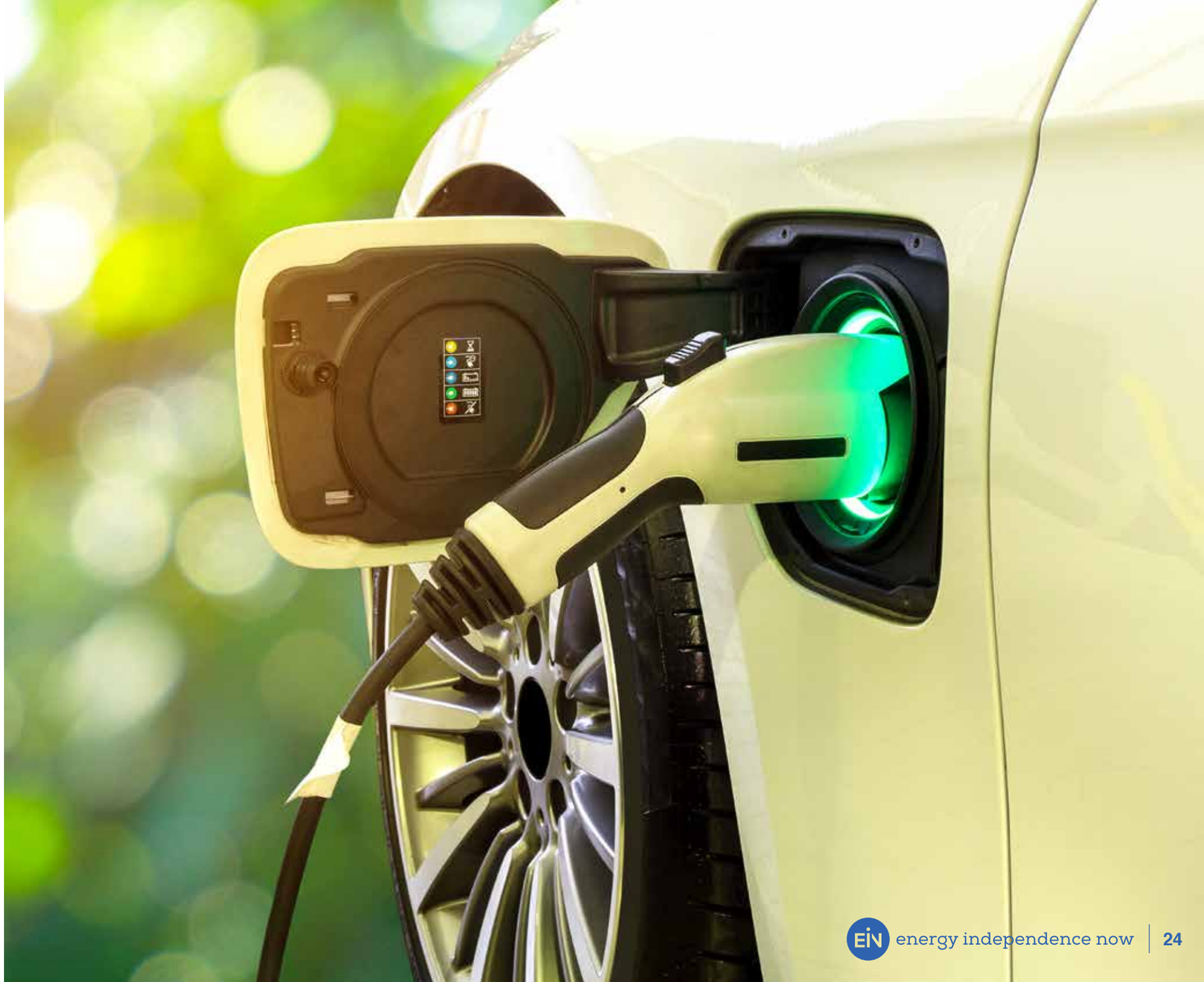
Legal Settlements Contributing to Infrastructure Development

Funds from settlements can also be leveraged to support EV charging and hydrogen fueling infrastructure. Following revelations of emissions test cheating, VW was court-ordered to invest $800 million over 10 years in zero-emission infrastructure and access in California. The funding can be used for fueling infrastructure, public education and marketing programs, efforts to increase access and the creation of “Green City Programs.” The car company will also invest $1.2 billion in additional funds outside of California to facilitate the transition to zero-emission vehicles and it will invest a further $381 million to reduce nitrogen oxide (NOx) emissions.[74] Years prior to the VW settlement, NRG Energy also agreed to a settlement with the State of California (stemming from the 2001 energy crisis) that allocated $100 million for EV charging infrastructure.[75] Also included in the settlement is $50.5 million to fund 200 Freedom Stations sites, each of which must include at least one DCFC location and a Level 2 charger unit; $40 million to fund 10,000 “make-ready” electrical installations; and a $9 million investment to advance charging technology and all-electric car-sharing programs.[76]

The Chicken and Egg Problem

Presently, much of consumers' hesitance to purchase ZEVs is due to "range anxiety" that is, in part, due to limited EV charging infrastructure. However, many utilities and other providers are apprehensive to invest in EV charging stations due to a perceived lack of demand for EVs. This perception is highlighted in a recent UC Davis study shows that consumer ZEV awareness is severely lacking. Even after many years of marketing, 66% of California's new car buyers participating in the study could not name a BEV currently on sale.[77]

The Rocky Mountain Institute points to Kansas City, Missouri to explain why infrastructure is a critical component of EV adoption. In 2015, Kansas City Power and Light installed more than 1,000 EV charging stations, the majority of which were Level 2 chargers. This became the largest network in the nation and Kansas City was quickly able to boast "the largest number of chargers on a per-capita basis of any city in the United States."[78] The results are staggering: "Kansas City now leads the nation in EV growth, with EV adoption nearly doubling" since the network was installed.[79]



FCEV Infrastructure

Perhaps even to a greater degree than other EVs, FCEV uptake is closely tied to infrastructure deployment because there are currently no home refueling options. As such, development of public hydrogen fueling stations directly impacts FCEV deployment. FCEVs offer consumers a fast/familiar fueling experience and vehicle range that is comparable to typical combustion vehicles. Centralized hydrogen fueling stations help serve dense communities and are especially important for consumers that don't have easy access to charging (i.e. residents of multi-family housing complexes that don't have parking garages or dedicated EV chargers).

Currently, state-supported funding mechanisms such as Assembly Bill 8 (AB 8) drive FCEV uptake and hydrogen fueling station development. AB 8, which passed in 2013, "directs the Energy Commission to annually allocate up to $20 million from the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) for the development of hydrogen refueling stations until at least 100 stations operate publicly."[80] The program, which grew out of EIN's pioneering research and policy work to establish California's "Hydrogen Highway," is the major driver for California's existing hydrogen fueling network and projected additions.

Growing station deployment will lead to greater FCEV adoption as consumers buy FCEVs knowing that refueling infrastructure is accessible, leading manufacturers to develop new FCEVs because consumer demand is increasing. Still, more must be done to help this nascent market thrive. Despite AB 8, which continues through 2024, a 2017 report from CARB projects hydrogen fueling capacity will be "a cause for concern around 2021 under business-as-usual station network growth assumptions."[82] Tools like Grant Funding Opportunity (GFO) 15-605, which includes incentive and reimbursement eligibility mechanisms that enable the construction of 16 new high-capacity fueling stations across California, can address the expected shortage, but that effort is not sufficient alone.[83] CARB "recommends that the State agencies currently working toward this goal work closely with station developers to identify an appropriate resolution."[84]

There are reasons to be optimistic that hydrogen fueling capacity will increase to meet projected demand. For example, the cost of station development is steadily decreasing. In the previous two years, the cost per kilogram of station capacity decreased from $8,689 to $6,409.[85] Additionally, there are a large number of applications for funding under GFO-15-605, indicating that the "market for developing and operating hydrogen stations is strong enough for the Energy Commission to incrementally lower the maximum available funding amount per station in future solicitations in order to fund more stations per fiscal year."[86]

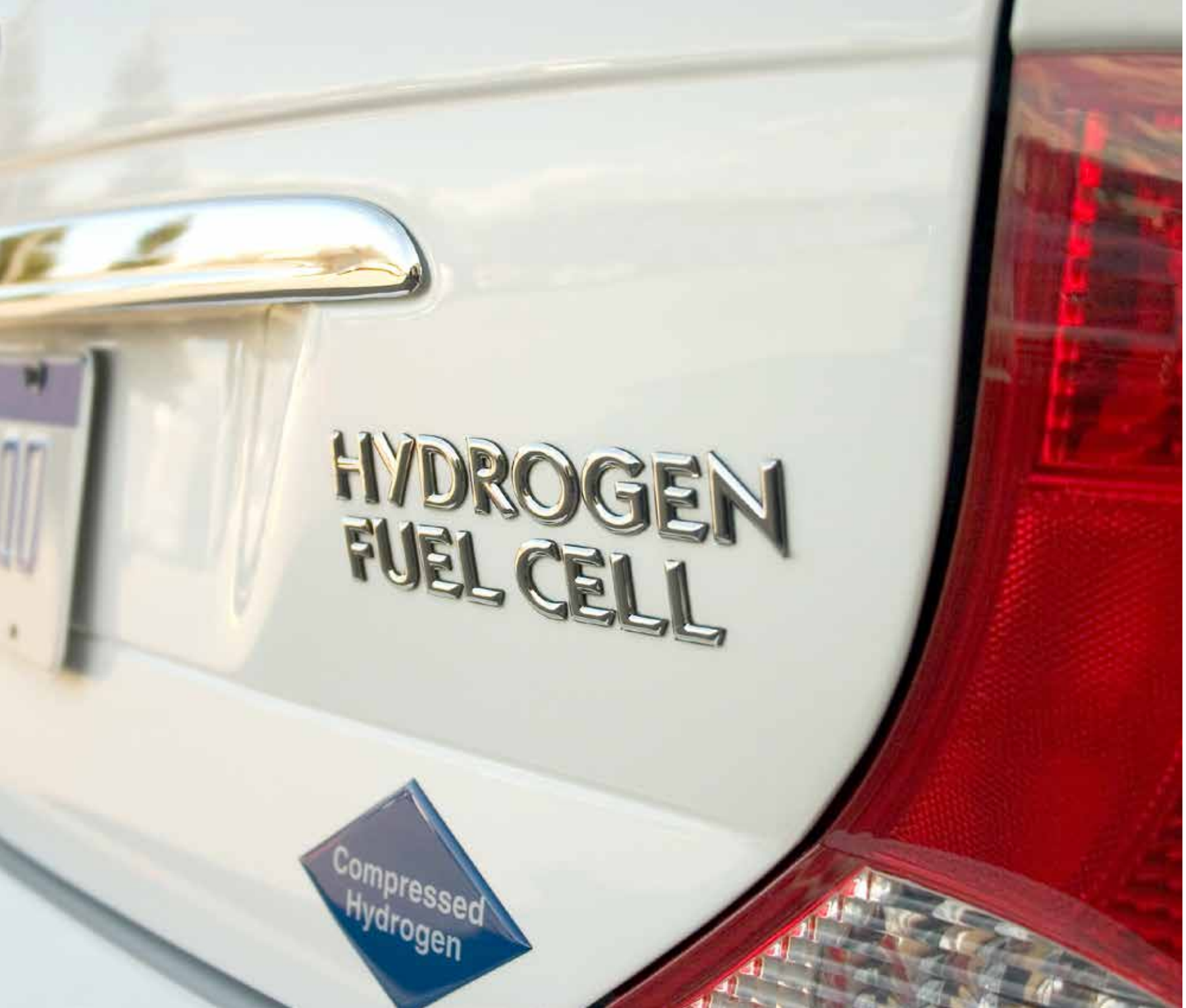
The California Energy Commission is considering alternative funding mechanisms from the public and private sectors in order to decrease its reliance on GFO-15-605. The Joint Agency Staff Report on AB 8 suggests alternative funding could include short-term and long-term strategies. Examples of long-term strategies include "new financing programs to augment or replace the grant funding process…[and] would attempt to leverage additional outside investment to increase the number of stations funded per year."[87] Potential short-term strategies cited in the report would work within the existing grant funding structure to allow "greater flexibility on how grant funds are used (toward capital expenditures or operation and maintenance [O&M] expenses) to enable station developers to choose the type of assistance that best fits their business model and resources."[88] The Joint Staff Report also suggests structuring grants in ways that encourage developers to build more stations and achieve economies of scale by awarding grants to build networks of stations rather than standalone locations.[89]

Conclusion

What should state policy look like?

California has the opportunity to set a positive example for the U.S. and the rest of the world by transitioning to a zero-emission vehicle future, which will in turn dramatically reduce air pollution and GHG emissions. Not surprisingly, cost (both upfront and operating) is a significant factor in ZEV adoption and infrastructure development. Therefore, state policies must ensure that the economics and convenience of charging/fueling ZEVs, including FCEVs, must be on par or superior to those of fueling traditional gas-powered vehicles.

Regulators, electricity providers and hydrogen fuel suppliers should act to ensure access to infrastructure, particularly for those who do not have the ability to charge at home or must travel long distances to charge or refuel. Vehicle and infrastructure incentives should be designed with such goals in mind.



Vehicle Incentives

A comprehensive package of financial and non-financial incentives is necessary to encourage a sufficient level of consumer uptake toward the achievement of California's ZEV goals. Point-of-purchase rebates, HOV access, test-drive programs and advertising campaigns create a robust combination of incentives and measures which would effectively grow the ZEV market.

Rising ZEV sales will lead the auto industry to invest further in the development of ZEV technologies. As previously mentioned, it is especially important that policymakers institute sustainable and long-term incentive programs, the certainty of which enables consumers and manufacturers alike to plan their long-term participation in the ZEV marketplace.

Policymakers should continually evaluate state programs and wind down incentives gradually as ZEV costs decline. State leaders should also consider refining incentives strategically based on marketplace circumstances (e.g. tailor incentives to make lower-priced and long-range ZEVs more favorable).

Infrastructure Incentives

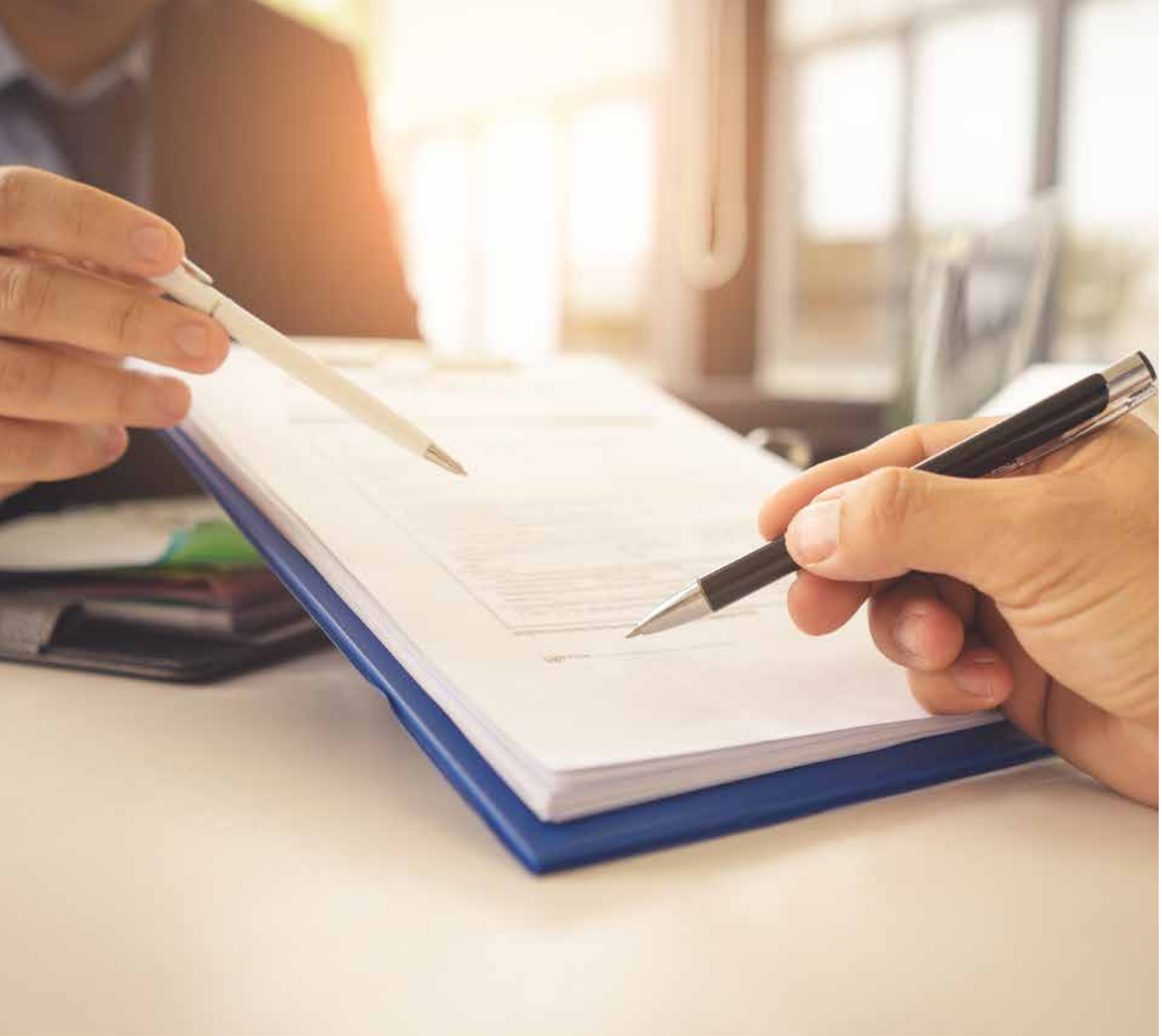
Infrastructure incentives will become increasingly important as more ZEVs hit the road. California should take a comprehensive approach to promoting the development of BEV charging and FCEV hydrogen fueling infrastructure. To that end, the state should (1) enable utilities to engage with consumers, business/property owners and charging station providers; (2) encourage partnerships with the private sector to identify opportunities for developing charging and hydrogen stations; and (3) look at regulatory policies, electricity pricing, incentives, opportunities and barriers that specifically impact multifamily housing and workplaces. In particular, policymakers should examine building codes to promote construction of multifamily housing complexes with EV charging stations or components to enable future installation of such stations.

As more consumers move to cities, the demand for multifamily units will likely increase. In order to prevent residents of apartment and condominium buildings from being shut out of the ZEV marketplace, the state should focus on providing access to charging for multifamily dwellings, publicly accessible hydrogen fueling stations and electric charging stations. Enabling multifamily residents to access charging infrastructure more easily will encourage consideration of ZEV purchases.

California has already taken steps in this direction: the California Building Standards Commission adopted changes to the California Green Building Standards Code that require "newly constructed parking lots and housing to put electrical capacity in place to easily install PEV chargers."[90] The City of Atlanta also offers an example to consider: In November 2017, Atlanta passed a new ordinance requiring all new residential homes, including multifamily complexes and public parking facilities, to be EV-ready.[91] In addition to code changes, California policymakers should identify ways to lower the installation costs for charging equipment in multifamily housing complexes through a variety of measures, including incentives, installation streamlining and strategic utility investment.[92]

There are also measures to consider that go beyond multifamily complexes. Though tax credits and rebates are well-known incentives, other incentives such as changing local air quality management rules that encourage workplace charging and expediting development permits for charging equipment installations are also viable options.[93]

Policymakers should not overlook hydrogen fueling infrastructure. Identifying policy solutions and measures that can build on and complement existing programs will be essential to increasing infrastructure deployment and addressing the threat of a potential slowdown in the activation of new hydrogen fueling stations mentioned previously in this paper. It is encouraging that the cost of hydrogen fueling station development is decreasing and the volume of applications for funding under GFO 15-605 is high. Policymakers should take advantage of the demand for funding and provide alternative funding mechanisms that leverage this interest and provide greater certainty for developers to find economies of scale.



Policies to Encourage Cost-Effective Development

The state must implement policies to encourage cost-effective technological development while remaining cautious about unwittingly incentivizing developers down a specific pathway[94] (e.g. focusing infrastructure deployment funding on charging station incentives rather than hydrogen fueling station incentives would disproportionately favor the growth of BEVs and PHEVs over that of FCEVs). To avoid this, state policies should focus on encouraging lower-cost and lower-risk avenues for electrification in the near- to mid-term.

As technology costs decrease, state policy can be revisited and revised. A 2017 Bloomberg New Energy Finance report suggests that BEVs will achieve cost parity with internal combustion engines (ICE) in the mid-2020s, and may be up to "15% cheaper than equivalent ICEs by 2030."[95] Therefore, today's policies can act as a bridge to cost parity over the next decade. Incentivizing long all-electric range PHEVs today will not impede the development of longer range BEVs tomorrow because long all-electric range PHEVs have "most powertrain components in common with BEVs."[96] Incentives for PHEVs can then be unwound and redirected to BEVs as the cost of batteries decreases.

Low and Middle-Income Households and Disadvantaged Communities

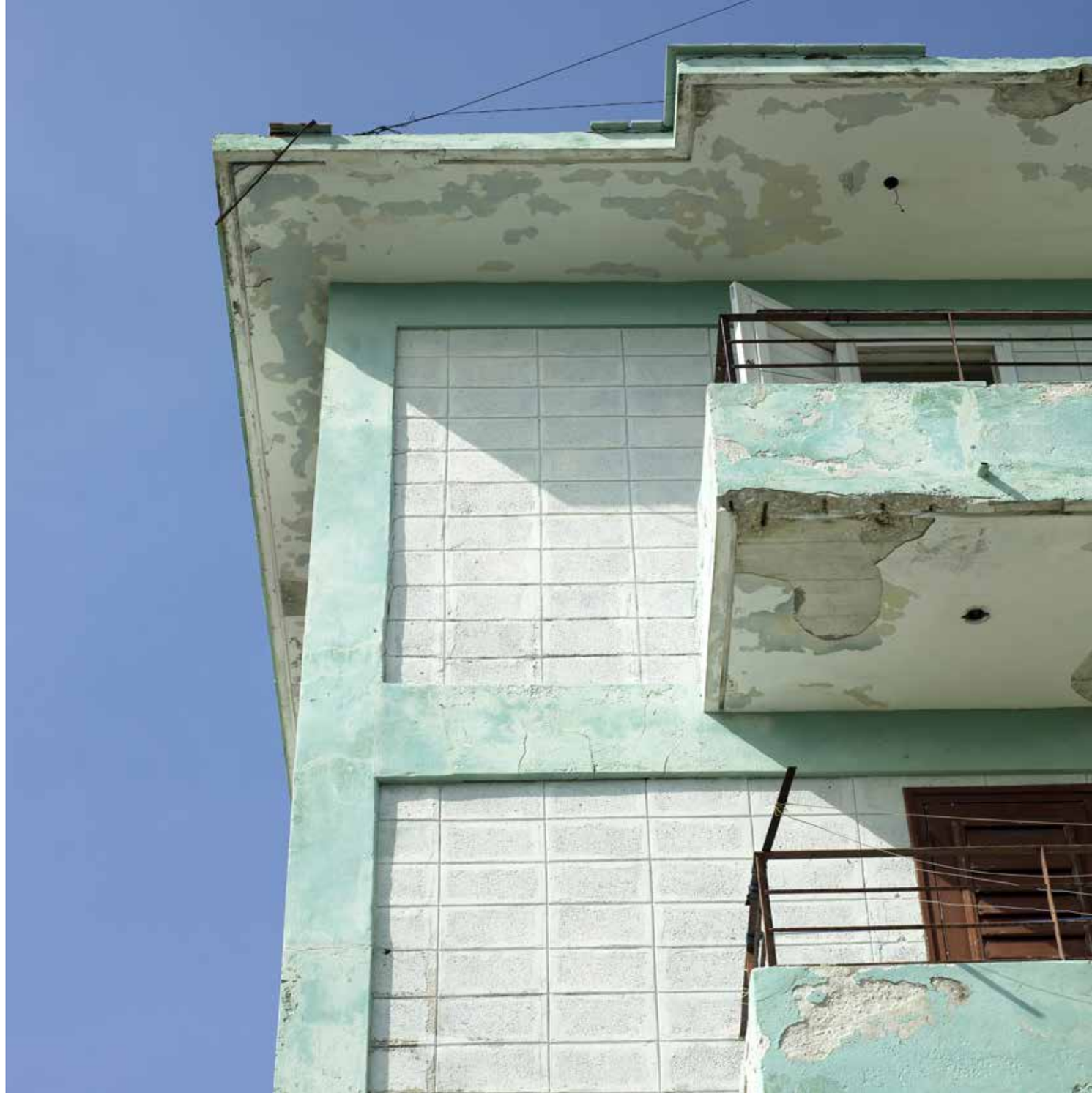
In order for California to meet its ambitious ZEV deployment and greenhouse gas reduction goals, low- and middle-income households, particularly in disadvantaged communities, must also receive support and encouragement to purchase ZEVs and/or to participate in ZEV car-sharing programs. Such communities, however, often face increased barriers to ZEV adoption due to factors that include cost and charging availability (many residents live in multi-unit housing developments, which are less likely to have charging infrastructure.)[97] Policies to encourage adoption in lower- and middle-income families in disadvantaged communities can and should be crafted to include:

- A tiered rebate program
- Targeted incentives

Such programs already exist in California and should be considered for expansion. Under CARB's Low Carbon Transportation Program, the Enhanced Fleet Modernization Program (EFMP) Plus-Up program offers low-income households up to $12,000 toward the purchase or lease of a BEV; furthermore, those who purchase a BEV are eligible for up to $2,000 toward a charging unit. In order to qualify, they must "reside in a zip code that includes a disadvantaged community census tract."[98]

- Targeted deployment of infrastructure

Like targeted incentive programs, programs that target deployment of infrastructure already exist in the state and should be expanded. SCE's Charge Ready program will target at least 10% of its deployment of up to 1,500 charging stations in disadvantaged communities.[99]



APPENDIX I: LIST OF FINANCIAL INCENTIVES AVAILABLE IN CALIFORNIA FOR VEHICLE PURCHASES AND INFRASTRUCTURE

- Clean Vehicle Rebate Project
  - Offers up to $2,500 for the purchase or lease of BEVs, $1,500 for the purchase or lease of PHEVs and $900 for electric motorcycles and neighborhood EVs.
  - Qualifying low-income households may also receive an additional $2,000 for vehicles purchased or leased after November 1, 2016.

- Consumers living within zip codes deemed "disadvantaged community" by the state as determined by the California Environmental Protection Agency (CalEPA) using CalEnviroScreen, receive an additional $3,000–$5,000 for the vehicle and $2,000 for EVSE. The City of Riverside provides a $500 rebate for PEV purchases and SCE offers a $450 rebate for PHEV and BEV purchases. The rebate applies to second and third owners of the eligible vehicle.

- In addition to the CVRP program, CARB is currently undergoing a public process for guidelines to its Clean Cars 4 All statewide program. Residents living within Southern California Air Quality Management District and San Joaquin jurisdictions are eligible for incentives to retire and replace an old vehicle with a low-emission vehicle, depending on income level and vehicle model, under the Replace Your Ride and Tune In, Tune Up programs.

- Various utilities throughout the state offer discounted rates for residential vehicle charging during off-peak hours.
  - PG&E offers two residential EV rates: one that combines the EV electricity costs with those of the residence, and one that keeps the EV electricity costs separate. The lowest rates are offered between 11pm and 7am.
  - SCE offers an EV rate plan with off-peak pricing between 9pm and 12pm that is charged separately from the residential electricity, and a TOU rate plan with off-peak pricing between 10pm and 8am.
  - SDG&E offers an EV rate plan with off-peak hours from 6pm to midnight and super off-peak hours from midnight to 5am.
  - Several other city utilities offer EV rate programs, including Los Angeles, Rancho Cucamonga, Burbank, Colton, Azusa and Riverside.
  - The City of Sacramento offers free charging in public parking garages for EVs that apply and are certified by the City's Emerging Small Business Development Program.
  - Pasadena Water and Power offers up to $600 of free electricity for EV charging for one year.

- Many hotels and commercial buildings offer free or reduced parking for EV drivers.
  - The City of Sacramento offers free parking to those BEVs that apply and are certified by the city's EV Parking Program.
  - The City of San Jose, the City of Santa Monica and the City of Hermosa Beach offer free parking.

- Residential property owners may have access to Property-Assessed Clean Energy (PACE) financing to install EV supply equipment (EVSE), depending on if the local government has a PACE program in place.
  - PACE financing allows property owners to borrow funds to pay for the EVSE, and repays the funds through a special assessment on the property over a defined time.
  - The City of Sacramento offers free charging in public parking garages for EVs that apply and are certified by the City's Emerging Small Business Development Program.

APPENDIX I: LIST OF FINANCIAL INCENTIVES AVAILABLE IN CALIFORNIA FOR VEHICLE PURCHASES AND INFRASTRUCTURE

- The EV Charging Station Financing Program offers loans up to $500,000 for the design, development, purchase and installation of EV charging stations at small business locations throughout CA.
    - The program may provide up to 100% coverage to lenders on certain loan defaults, and borrowers may be eligible to receive a rebate of 10–15% of the enrolled loan amount.

- Sacramento Municipal Utility District (SMUD) is offering residential customers either a $599 rebate or a free Level 2 charger for SMUD customers who purchase or lease a PEV.
    - Los Angeles Department of Water and Power's Charge Up LA! Program offers a $500 rebate for the installation of an EV charger. It also offers an additional $250 rebate and a $0.025 per kWh rate discount with the installation of a second meter, purchased before June 30, 2018, enrolled in a TOU rate plan.

- The City of Anaheim provides a $400 rebate and a city permit fee waiver for a Level 2 charger installation.

- The City of Burbank offers a $500 rebate for residential customers and $1,000 for commercial customers for installation of a Level 2 charger.

- City of Colton also offers $500 for a Level 2 charger installation for either residential or commercial use.

- Pasadena offers $200 worth of LED lights for PEV purchase with an existing 120/240 volt AC charger, or $200 worth of LED lights and $400 rebate for PEV purchase and PEV charger installation.

- Glendale offers a $500 rebate for installation of a Level 2 charger.

- CA Auto Insurance companies may offer discounts on PEVs. Vehicles that do not pass emissions tests may be eligible for a retirement rebate of up to $1,500 if the vehicle is removed from the road.

- PG&E is offering a $500 clean fuel rebate for PG&E customers who own or lease a PEV. SCE is offering a $450 clean fuel rebate for SCE customers who own or lease a PEV under the Clean Fuel Rewards Program.[100]

APPENDIX II: KEY FINDINGS & RECOMMENDATIONS FROM STAKEHOLDER INTERVIEWS

The EV marketplace is still in the very early stages of development. Because even the most recent analyses of incentive regimes and programs are now 2 to 3-years-old, we have supplemented the research presented in this paper with interviews from leading experts in order to formulate a comprehensive set of recommendations.

It is important to note that, although many of the expert recommendations align with and reinforce the findings of the broader research community, not all of the recommendations were unanimously proposed or endorsed by our interview participants.

EIN would like to thank the following individuals for providing their thoughts and perspectives. Titles and organizations are listed for informational purposes only.

Robert Bienenfeld
Assistant Vice President, Environment & Energy Strategy
American Honda Motor Co., Inc.

Elán Bond
Project Manager
NEL Hydrogen Inc.

Gilbert Castillo
Sr. Group Manager, Alt. Vehicle & Adv. Vehicle Strategy
Hyundai Motor America

John O'Dell, Editor
The Green Car Guy
(Former LA Times and Edmunds.com green car reporter and automotive expert)

Tyson Eckerle
Deputy Director of Zero-Emission Vehicle Infrastructure
Governor's Office of Business and Economic Development

Jamie Hall
Manager, Public Policy
General Motors

Michael Lord
Executive Engineer
Toyota Motor Engineering & Manufacturing NA

Ryan McCarthy
Science and Technology Policy Advisor to the Chair
California Air Resources Board

Mary Nichols
Chair
California Air Resources Board

Jeff Serfass
Executive Director
California Hydrogen Business Council

Mike Sullivan
Founder
LAcarGUY

Michael Samulon
Senior Policy Analyst, Sustainability
Budget & Innovation Team
Office of Los Angeles Mayor Eric Garcetti

Key Findings & Recommendations from Stakeholder Interviews

Key Findings & Recommendations: Vehicle Incentives

- Large rebates that are long-term and non-disruptive are key to making the most of the state's investments.
  - Multi-year funding is critical to ensure confidence in rebate programs and to provide certainty for carmakers, dealers, government agencies and other stakeholders. Carmakers specifically need substantial lead time to produce and distribute clean vehicles. Short-term incentive programs do little to help them bring new vehicles to market.
  - It is important to keep the incentive program as simple as possible to attract consumers.
  - Given the future uncertainty of the federal tax credit program, California can give a consistent market signal that car companies, government agencies and other stakeholders can easily promote without caveats about waitlists or availability of rebates.
- According to a study conducted by the Center for Sustainable Energy[i], typically 90% of rebate users find incentives to be "Very Important" or "Extremely Important."
  - Approximately 60% of users indicate they would not have completed their purchase without a rebate.
  - Roughly 80% of recipients use rebates to replace gasoline-only vehicles, 90% of which become primary-use vehicles.[ii]
  - 10% of EV owners do not charge their vehicles at home—a figure that is likely to grow as infrastructure develops and clean cars become cheap enough for consumers that don't have access to home charging.
  - 25–33% of EV owners charge their vehicles on Level 2 or DCFC.
- HOV lane access is critical in dense urban corridors.
- Ideal manufacturer incentives would offer a large amount of money in a limited timeframe to make carmakers compete for a diminishing pot of money.
- While an incentive cliff should be avoided, the elimination of specific incentive programs is preferable to a gradual across-the-board funding decline, which could present a less clear signal to market participants and, in turn, depress marketplace momentum.
- Consumers consider point-of-purchase rebates, and those provided very close to time of purchase, significantly more valuable. This applies especially to low-income residents who can least afford to invest in the upfront cost of purchasing a vehicle. CVRP launched a pilot Rebate Now program in San Diego County allowing consumers to secure pre-approvals for rebates toward an EV purchase. More information about this innovative program can be found at: https://cleanvehiclerebate.org/eng/rebatenow and additional background can be found here: http://energycenter.org/blog/ensuring-electricvehicles-are-accessible-all

Key Findings & Recommendations: New Incentives to Consider

- Since the majority of car buyers do not purchase new cars, incentives for used cars would create an opportunity to reach many more Californians — especially low-income families. This would also help signal that clean vehicles are financially accessible for all drivers rather than just those who can afford to purchase new vehicles.

- Incentives for using zero-emission ride-hailing services could be a tremendous opportunity to reach new audiences and address a lack of consumer awareness.

- Consumer incentives alone are simply not enough to grow the ZEV marketplace. Sufficient charging and fueling infrastructure is critical to ensure that rebates are effective and that consumers can feel confident that the support network for their new ZEVs is sufficient to support their driving habits. Electric charging and hydrogen fueling should be affordable, accessible and easy to use.

- Incentives for dealers are also very important. This can be critical because dealers are often the sole point of contact that consumers engage to learn about vehicle choices. If dealers lack awareness of clean vehicle options or the motivation to advocate for ZEVs, rebates and infrastructure incentives can quickly become irrelevant.

- Some stakeholders advocate for a single statewide rebate to reduce incentive complexity while others favor performance-based incentives that reward electric miles in order to support investments in longer-range (and more expensive) vehicles. Still, other respondents recommend a focus on PHEVs, which they believe hold greater appeal to low-income Californians given the vehicles' more cost-effective charging requirements.

- While some incentives are subject to an income cap, perhaps a vehicle price cap would be an appropriate way to avoid dissuading ZEV purchasers who think they will not qualify.

Key Findings & Recommendations: Infrastructure

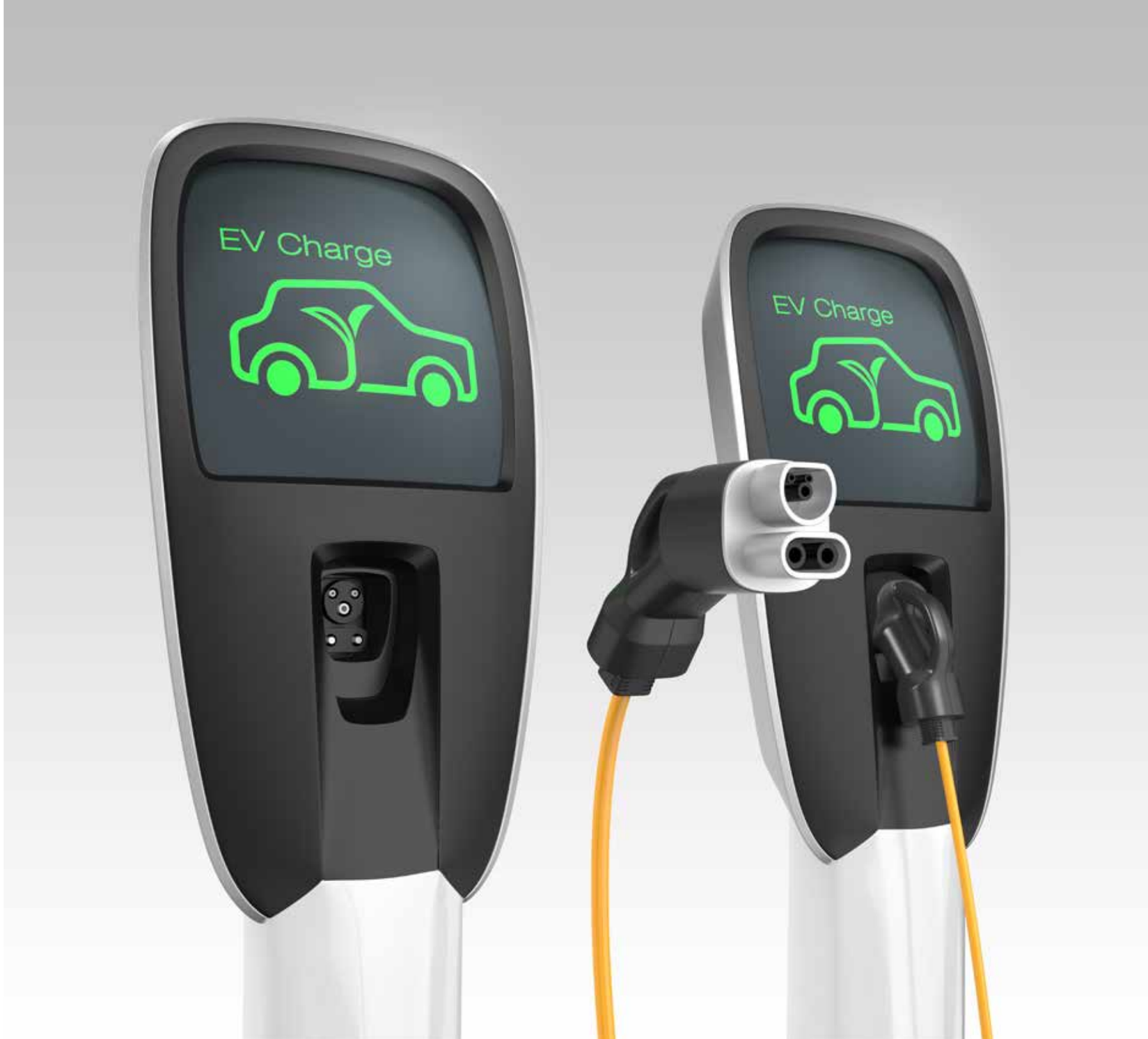
- While California has implemented substantial growth in charging infrastructure, there remains insufficient public charging to support the fast- growing BEV market. In fact, ICCT published a report in January 2019 that shows California currently on track to build only 40% of the 68,000 workplace and public charge points that the state will need to build by 2025, leaving "a substantial gap to be filled through public and private efforts".[iii]

- Given there are so many different incentive programs for infrastructure designed for consumers, businesses, municipalities, etc., a clearinghouse should be designated to disseminate information on state, local and utility incentive programs.

- Stakeholders should create highly visible and clear signage, on par with traditional gas station signage, to highlight ZEV charging and refueling infrastructure.

- Consumers need a simple, consistent and unified payment method for ZEV fueling.

- State leaders should promote multifamily infrastructure pilots and encourage cities to install more curbside charging options.



Key Findings & Recommendations: Hydrogen

FCEVs are a critical part of California's zero-emission future, yet are still at an early adoption stage relative to BEVs. Therefore, we want to highlight the following findings and recommendations to ensure effective development of this important market:

- An increase in designated permitting and development speed for hydrogen stations is vital. A two year delay for an individual station can be a major setback for network development and the consumer market.
- Incentive programs should be designed to not only scale hydrogen station development, but to also focus on renewable hydrogen production with the goal of achieving hydrogen price parity with gasoline.
- Conversion from measuring hydrogen in metric units to Imperial units to align with current U.S. consumer usage and rates. Stakeholders should explore ways to show the cost of hydrogen per pound. Consumers simply do not purchase many things in kilograms in the United States and that becomes a barrier.
- Hydrogen should not be excluded from the VW settlement.
- Until FCEVs are sold beyond California, the technology will be dismissed. Incentives should be designed to create regional corridors with neighboring states.
- Consider incentives to co-locate heavy-duty and light-duty fueling stations together or in close proximity.
- Electricity rates for hydrogen production should be at least as inexpensive as they are for oil producers.
- Consider a multi-year funding program with location-based goals and a sliding scale of incentives (e.g., With an aim to have 1,000 stations in California by 2030, create a 10-year funding program with a declining public match offer that decreases from 75% to 30% and, ultimately, discontinues upon the achievement of the 1,000-station goal).

Notably, hydrogen stations can soon be as or more cost effective than BEV charging stations on a per-vehicle basis, due to the significantly shorter 5–6-minute refuel window for FCEVs (compared to 30–60-minutes for fast charging and much longer for Level 2 charging). Hydrogen fueling stations are essentially a 3,000 kW fast charger, compared to a DCFC or Level 2 charger at 50–350 kW or 6 kW respectively.

Sources*

1. “Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments,” Office of Governor Edmund G. Brown Jr. January 26, 2018.
2. “Transportation Electrification Activities Pursuant to Senate Bill 350,” California Public Utilities Commission. Accessed: June 26, 2018. http://www.cpuc.ca.gov/sb350te/
3. “Volkswagen Settlement - California ZEV Investments,” California Air Resources Board. May 22, 2018.
4. Josh Goldman. “Comparing Electric Vehicles: Hybrid vs. BEV vs. PHEV vs. FCEV,” Union of Concerned Scientists Blog. February 12, 2014.
5. “State Incentives,” Plug In America. https://pluginamerica.org/why-go-plug-in/state-federal-incentives/?location=ca
6. Rob Nikolewski, “Hydrogen fuel stations are clustered in L.A. and O.C., but that may be changing soon,” The San Diego Union-Tribune. November 25, 2017.
7. Bohlsen, M. (2017). “EV Company News for the Month of October 2017.” Seeking Alpha. November 1, 2017. Available at: https://seekingalpha.com/article/4118944-ev-company-news-month-october-2017 in “The Road Ahead for Zero-Emission Vehicles in California,” Next10. January 2018. Pg 4
8. “ZEV State Policy Rankings,” Electrification Coalition. June 2018. Pg 1
9. “Sales Dashboard,” Veloz. June 2018.
10. “The Clean Power and Electrification Pathway,” Southern California Edison. November 2017, pg 7 and Brett Williams, “Here’s how every major automaker plans to go electric,” Mashable. October 3, 2017. https://mashable.com/2017/10/03/electric-car-development-plans-ford-gm/#bIfgIsW_siqb
11. “FCEV Sales,” California Fuel Cell Partnership. https://cafcp.org/sites/default/files/FCEV-Sales-Tracking.pdf
12. “Evaluating Methods to Encourage Plug-in Electric Vehicle Adoption,” California Electric Transportation Coalition. October 2016, pg 9
13. Fredrick Kunkle, “New York sees big jump in electric vehicle sales after rebate goes into effect,” The Washington Post, September 30, 2017 https://www.washingtonpost.com/news/tripping/wp/2017/09/30/new-york-sees-big-jump-in-electric-vehicle-sales-after-rebate-goes-into-effect/?utm_term=.3414dbdd3d43
14. Fredrick Kunkle, “New York sees big jump in electric vehicle sales after rebate goes into effect,” The Washington Post, September 30, 2017 https://www.washingtonpost.com/news/tripping/wp/2017/09/30/new-york-sees-big-jump-in-electric-vehicle-sales-after-rebate-goes-into-effect/?utm_term=.3414dbdd3d43
15. Chris Joyner, “Here’s why electric car sales are plummeting in Georgia,” The Atlanta Journal-Constitution, January 12, 2017 http://www.myajc.com/news/state--regional-govt--politics/here-why-electric-car-sales-are-plummeting-georgia/lNGjfnDMALGkv2iUzwwXIO/
16. Zifei Yang, Peter Slowik, Nic Lutsey, Stephanie Searle, “Principles for Effective Electric Vehicle Incentive Design,” The International Council on Clean Transportation, pg 2
17. Zifei Yang, Peter Slowik, Nic Lutsey, Stephanie Searle, “Principles for Effective Electric Vehicle Incentive Design,” The International Council on Clean Transportation, pg 2
18. Kenneth S. Kurani, Nicolette Caperello, Jennifer TyreeHageman. “New Car Buyers’ Valuation of Zero-Emission Vehicles: California,” UC Davis Institute of Transportation Studies. 2016. pg 3
19. “Evaluating Methods to Encourage Plug-in Electric Vehicle Adoption,” California Electric Transportation Coalition. October 2016, pg 12
20. Peter Slowik, Nic Lutsey. “Expanding the Electric Vehicle Market in U.S. Cities,” The International Council on Clean Transportation. July 2017, pg iv.
21. “Update: California’s electric vehicle market.” The International Council on Clean Transportation. May 2017. Available at: https://www.theicct.org/sites/default/files/publications/CA-cities-EV-update_ICCT_Briefing_30052017_vF.pdf in “The Road Ahead for Zero-Emission Vehicles in California,” Next10. January 2018. Pg 3
22. Zifei Yang, Peter Slowik, Nic Lutsey, Stephanie Searle, “Principles for Effective Electric Vehicle Incentive Design,” The International Council on Clean Transportation, pg 29-30
23. “Evaluating Methods to Encourage Plug-in Electric Vehicle Adoption,” California Electric Transportation Coalition. October 2016, pg 11
24. “Evaluating Methods to Encourage Plug-in Electric Vehicle Adoption,” California Electric Transportation Coalition. October 2016, pg 18
25. “FCEV Sales, FCEB, and Hydrogen Station Data,” California Fuel Cell Partnership. June 6, 2018. https://cafcp.org/by_the_numbers
26. “2017 Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. August 2017. Pg 2
27. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 3.
28. “2017 Evaluation of the Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. August 2017. Pg 61
29. “2017 Evaluation of the Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. August 2017. Pg 61
30. “California Transportation Electrification Assessment, Phase 1: Final Report,” ICF International. August 2014; updated September 2014. Pg 52
31. Terry O’Day. “Electric Vehicle Stakeholder letter to the CPUC,” EVgo www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442452815 March 5, 2017. Pg. 16
32. “California Transportation Electrification Assessment, Phase 1: Final Report,” ICF International. August 2014; updated September 2014. Pg 47 and “Factors Affecting PHEV sales in California,” UCLA Luskin School of Public Affairs. Pg 12
33. “Charging at Home,” U.S. Department of Energy. https://energy.gov/eere/electricvehicles/charging-home
34. “Factors Affecting PHEV sales in California,” Luskin Center, pg 12
35. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 15
36. “Electric Vehicle Outlook 2017,” Bloomberg New Energy Finance. July 2017. Pg 2
37. Alternative Fuel Station Counts by State. Alternative Fuels Data Center, U.S. Department of Energy. Data last updated on November 6, 2017 in “The Road Ahead for Zero-Emission Vehicles in California,” Next10. January 2018. Pg 6.
38. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 13, 18
39. “Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments,” Office of Governor Edmund G. Brown, Jr. January 26, 2018.
40. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 33-34
41. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 34-35
42. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 37
43. Electric Vehicle Charging Station Financing Program, http://www.treasurer.ca.gov/cpcfa/calcap/evcs/summary.asp
44. Electric Vehicle Charging Station Financing Program, http://www.treasurer.ca.gov/cpcfa/calcap/evcs/summary.asp
45. https://pluginamerica.org/why-go-plug-in/state-federal-incentives/?location=ca
46. “Taking Credit for Going Green,” Chargepoint. https://www.chargepoint.com/products/station-incentives/
47. “Taking Credit for Going Green,” Chargepoint. https://www.chargepoint.com/products/station-incentives/
48. “Taking Credit for Going Green,” Chargepoint. https://www.chargepoint.com/products/station-incentives/
49. “Taking Credit for Going Green,” Chargepoint. https://www.chargepoint.com/products/station-incentives/
50. “Profile of the City of Los Angeles,” Southern California Association of Governments. May 2017
51. “California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 46
52. California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 46
53. “California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 46
54. ICCT, P. Slowick, N. Lutsey, Expanding the Electric Vehicle Market in U.S. Cities, July 2017 cited in “Accelerating Investment in Electric Vehicle Charging Infrastructure,” Ceres. November 2017, pg 14
55. “Marcello Contestabile, Mohammed Alajaji, Bader Almubarak , “Will current electric vehicle policy lead to cost-effective electrification of passenger car transport?”
56. “Factors Affecting PHEV sales in California,” Luskin Center, pg 132 and “Plugged In: How Americans Charge Their Electric Vehicles,” Idaho National Laboratory (INL). 2015. <https://avt.inl.gov/sites/default/files/pdf/arra/SummaryReport.pdf> in Peter Slowik, Nic Lutsey. “Expanding the Electric Vehicle Market in U.S. Cities,” The International Council on Clean Transportation. July 2017, pg 6.
57. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 37
58. “Accelerating Investment in Electric Vehicle Charging Infrastructure,” Ceres. November 2017, pg 4
59. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 37
60. Workplace Charging Challenge Progress Update 2016: A New Sustainable Commute https://www.energy.gov/sites/prod/files/2017/01/f34/WPCC_2016%20Annual%20Progress%20Report.pdf
61. “Plugged In: How Americans Charge Their Electric Vehicles,” Idaho National Laboratory (INL). 2015. <https://avt.inl.gov/sites/default/files/pdf/arra/SummaryReport.pdf> in Peter Slowik, Nic Lutsey. “Expanding the Electric Vehicle Market in U.S. Cities,” The International Council on Clean Transportation. July 2017, pg 6.
62. Peter Slowik, Nic Lutsey. “Expanding the Electric Vehicle Market in U.S. Cities,” The International Council on Clean Transportation. July 2017, pg 6.
63. “California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 63
64. “Summary of Decision on Transportation Electrification Program Proposals from the Investor-Owned Utilities,” California Public Utilities Commission. May 31, 2018. Pg 2
65. “Application of Southern California Edison Company For Approval of its Charge Ready 2 Infrastructure and Market Education Programs,” Southern California Edison. June 26, 2018. Pg 3-5.
66. “Summary of Decision on Transportation Electrification Program Proposals from the Investor-Owned Utilities,” California Public Utilities Commission. May 31, 2018. Pg 1
67. “Summary of Decision on Transportation Electrification Program Proposals from the Investor-Owned Utilities,” California Public Utilities Commission. May 31, 2018. Pg 1 and Jeff St. John, “California Utilities Seek $1B to Build Out Electric Vehicle Infrastructure,” Greentech Media. January 24, 2017. https://www.greentechmedia.com/articles/read/california-utilities-seek-1b-to-build-out-electric-vehicle-infrastructure?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+GreentechMedia+%28Greentech+Media%29#gs.hhCJtpg
68. Jeff St. John, “California Utilities Seek $1B to Build Out Electric Vehicle Infrastructure,” Greentech Media. January 24, 2017. https://www.greentechmedia.com/articles/read/california-utilities-seek-1b-to-build-out-electric-vehicle-infrastructure?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+GreentechMedia+%28Greentech+Media%29#gs.hhCJtpg

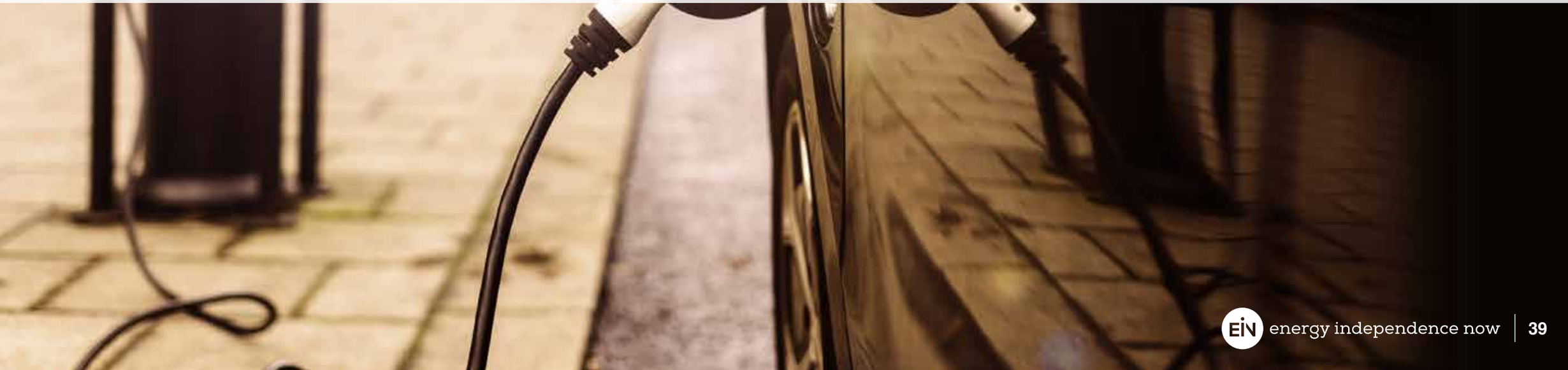
Sources Continued*

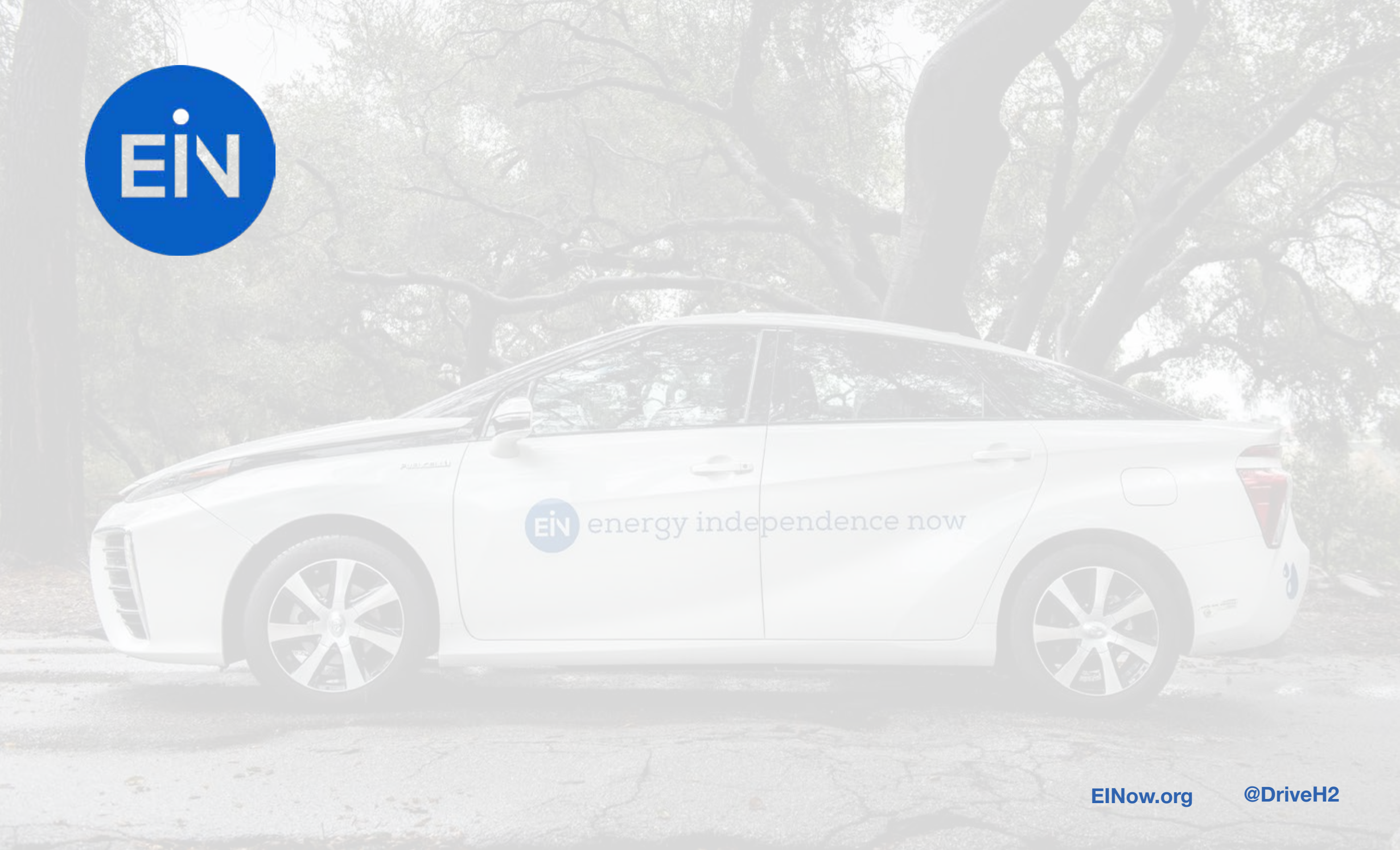
69. “Utility Investment in Electric Vehicle Charging Infrastructure: Key Regulatory Considerations,” MJ Bradley & Associates and Georgetown Climate Center. November 2017
70. Found in “From Gas to Grid,” Rocky Mountain Institute, pg 30; also cites IEEE webinar with Mike Jacobs and Peter O’Connor of Union of Concerned Scientists, “Questions and Answers on Storage and Vehicle Charging as Renewables Arrive,” February 4, 2016, <http://smartgrid. ieee.org/resources/webinars/past-webinars?eid=61&m =d7ad069d3940ebcaaf9ce65812521293>
71. “Renewable Hydrogen Roadmap,” Energy Independence Now. May 2018. Pg 20, 34
72. “California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 55
73. “California Transportation Electrification Assessment: Phase 1: Final Report,” ICF International and Energy+Environmental Economics. September 2014. Pg 55
74. “2016 ZEV Action Plan,” Governor’s Interagency Working Group on Zero-Emission Vehicles. October 2016, pg 13.
75. “Zero Emission Vehicles,” CPUC. <http://www.cpuc.ca.gov/General.aspx?id=5597>
76. Jon LeSage. “EVgo Becomes Independent Charging Network as NRG Settles with California,” hybridCars, June 23, 2016.
77. Kenneth S. Kurani, Nicolette Caperello, and Jennifer TyreeHageman, “New Car Buyers’ Valuation of Zero-Emission Vehicles: California,” UC Davis Institute of Transportation Studies. July 2016. Pg 3.
78. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 31
79. Garrett Fitzgerald and Chris Nelder “From Gas to Grid,” Rocky Mountain Institute and Mobility Transformation. September 2017, pg 31
80. “Joint Agency Staff Report on Assembly Bill 8: 2016 Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. Pg 1
81. “Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. April 2017. Pg 4
82. “Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. April 2017. Pg 4
83. “Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. April 2017. Pg 3
84. “Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” California Environmental Protection Agency Air Resources Board. April 2017. Pg 4
85. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 4
86. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 5
87. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 5
88. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 5
89. “Joint Agency Staff Report on Assembly Bill 8: 2017 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California,” California Energy Commission and California Air Resources Board. December 2017. Pg 5
90. “News Release: City of Atlanta Passes EV Ready Ordinance Into Law,” City of Atlanta, GA. November 21, 2017. https://www.atlantaga.gov/Home/Components/News/News/10258/1338?backlist=%2fhome 92. “2016 ZEV Action Plan,” Governor’s Interagency Working Group on Zero-Emission Vehicles. October 2016, pg 9
91. Ethan N. Elkind. “Plugging Away: How to Boost Electric Vehicle Charging Infrastructure,” UC Berkeley School of Law and UCLA School of Law. June 2017. Pg 3.
92. Ethan N. Elkind. “Plugging Away: How to Boost Electric Vehicle Charging Infrastructure,” UC Berkeley School of Law and UCLA School of Law. June 2017. Pg 2.
93. Marcello Contestabile, Mohammed Alajaji, Bader Almubarak , “Will current electric vehicle policy lead to cost-effective electrification of passenger car transport?” Energy Policy Vol. 110. Pp 20 - 30. November 2017. ttp://ac.els-cdn.com/S0301421517304937/1-s2.0-S0301421517304937-main.pdf?_tid=dc0777cc-9428-11e7-9600-00000aacb362&acdnat=1504829067_29f4ff59a765c355ae14949f55a07378
94. Ethan N. Elkind. “Plugging Away: How to Boost Electric Vehicle Charging Infrastructure,” UC Berkeley School of Law and UCLA School of Law. June 2017. Pg 2.
95. Marcello Contestabile, Mohammed Alajaji, Bader Almubarak , “Will current electric vehicle policy lead to cost-effective electrification of passenger car transport?” Energy Policy Vol. 110. Pp 20 - 30. November 2017. <http://ac.els-cdn.com/S0301421517304937/1-s2.0-S0301421517304937-main.pdf?_tid=dc0777cc-9428-11e7-9600-00000aacb362&acdnat=1504829067_29f4ff59a765c355ae14949f55a07378>
96. Nikolas Soulopoulos. “When Will Electric Vehicles be Cheaper than Conventional Vehicles?” Bloomberg New Energy Finance. (April 12, 2017) pg 4, 8.
97. Marcello Contestabile, Mohammed Alajaji, Bader Almubarak , “Will current electric vehicle policy lead to cost-effective electrification of passenger car transport?”
98. J.R. DeShazo, Norman Wong, Jason Karpman. “Overcoming Barriers to Electric Charging in Multi-unit Dwellings: A Westside Cities Case Study,” UCLA Luskin School of Public Affairs. November 2017. Pg 46.
99. J.R. DeShazo, Norman Wong, Jason Karpman. “Overcoming Barriers to Electric Charging in Multi-unit Dwellings: A Westside Cities Case Study,” UCLA Luskin School of Public Affairs. November 2017. Pg 46
100. J.R. DeShazo, Norman Wong, Jason Karpman. “Overcoming Barriers to Electric Charging in Multi-unit Dwellings: A Westside Cities Case Study,” UCLA Luskin School of Public Affairs. November 2017. Pg 46

---

i. “Electric Vehicle Rebates: Exploring Indicators of Impact in Four States,” June 2018, Center for Sustainable Energy https://cleanvehiclerebate.org/sites/default/files/attachments/2018-06-20-4State-EV-Rebate-Impact_EVRM11.pdf
ii. “California’s Electric Vehicle Rebates: Exploring Impact BECC, 17 October 2017, Sacramento,” Center for Sustainable Energy https://cleanvehiclerebate.org/sites/default/files/attachments/2017-10-19-CSE-EV-Rebate-Impacts.pdf
iii. Michael Nicholas, Dale Hall, Nic Lutsey, "Quantifying The Electric Vehicle Charging Infrastructure Gap Across U.S. Markets," The International Council on Clean Transportation. January 2019. Pg 22

***Wed Addresses Last Verified 4/30/2019**





EINow.org @DriveH2