Charging Ahead with Vehicle Electrification: Understanding Developments in International and U.S. Markets—and Implications for Wider U.S. Adoption

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American Association of Blacks in Energy—An Essential Voice in Vehicle Electrification

Electric vehicle (EV) adoption will soon amend the automotive landscape as it is currently known—changing how consumers purchase, how dealerships sell, how manufacturers assemble, and how consumers drive. According to a recent AAA survey, 20% of Americans say their next vehicle purchase will be an EV.[1] When reviewing actual sales over time, credible support exists showing that EV adoption is growing—and in the near future will become a preferred ownership option. In December 2017, plug-in vehicle sales registered 27 months of consecutive increases, representing a 25% year over year growth from 2016 to 2017.[2]

It remains to be seen whether the current trend means 50 million Americans will buy a plug-in vehicle the next time they purchase an automobile. However, sales data suggests more Americans are making that choice as technology improves and manufacturing costs decrease. As accessibility grows, we can expect ownership of plug-in vehicles to expand exponentially. This expansion will significantly impact the allocation of benefits and burdens related to electricity generation, transmission, and distribution—directly affecting electricity end-users, notwithstanding actual EV ownership.

The growth of EVs will create the need to develop charging station infrastructure across cities, towns and the interstate highway system. This will also include infrastructure from which charging stations will draw. As a result of increased vehicle electrification, we can anticipate an increased reliance on the existing grid, requiring additional generation, robust transmission, and resilient distribution. This will demand significant additional outputs of natural gas, solar, wind, hydro power, nuclear, and other electricity resources.

Generally, utilities make forward investments in generation, transmission, and distribution infrastructure to ensure electricity reliability. These investments and related costs are regularly reviewed by various state regulators to identify allowable rates charged to consumers. Public policies impacting rate-burden allocation, resulting from investments related to EV infrastructure, should be considered early in EV adoption maturation. This will ensure consumers are not unfairly burdened as rates resulting from EV investments are determined.

Policy of the American Association of Blacks in Energy (Association) dictates that energy regulations and laws should be equitable and not burden (*or benefit*) one class of consumers over another.[3] Consistent with these principles, the Association supports and advocates for the use of renewable and clean energy resources, in addition to the growth and use of EVs.

Policymakers, must consider how best to allocate future regulatory rate structures, including an examination of the incentives necessary to ensure investment costs are not unnecessarily passed to consumers least likely to adopt electric vehicles in the initial phases of maturation. Additional questions must also be considered. Are there appropriate available incentives for utilities to avoid overall rate increases related to EV infrastructure, including grid resiliency? Are there non-utility private sector models that support or repay utility infrastructure investments? Where will vehicle infrastructure be built? And finally, are there other economic considerations for examination, such as linkages to workforce development?

International and National Developments in Vehicle Electrification

Issues concerning EV infrastructure development, while complex, are not particularly new. From an international perspective, a significant record exists on which U.S. policy makers can rely to identify best practices, particularly those related to back-bone and last mile infrastructure.

International EV market growth is primarily driven by policy frameworks designed to eliminate or significantly reduce carbon emissions resulting from automobiles. Within these frameworks are various policy incentives directed at participants representing nearly every point of EV deployment, including research and development, manufacturing, the end user, and those who might support appreciable consumer use. Predominantly led by national governments, incentives include grants and awards to develop battery storage capacity solutions, awards to build last mile infrastructure such as charging stations, reduced or eliminated toll costs for drivers, and rebates or tariff relief related to EV purchase. Incentive layering has been so successful for some countries, that automobile markets now reflect EV costs which are similar to, or better than the purchase of gasoline or diesel powered vehicles. While these constructed markets are not sustainable over long periods of time, policy makers aim to establish a self sustaining market consistent with their environmental goals.

An area of constant discussion among international governments and proponents of EV markets is how best to determine what amount of infrastructure is required to establish equilibrium. Equilibrium, at least theoretically, represents the point in time when consumer concerns regarding charging anxiety are eliminated sufficiently to induce EV purchase, and non-incentivized markets encourage infrastructure deployment. All agree that absent the infrastructure, the EV market would not thrive.

Norway has been recognized as a major leader in EV deployment.[4] Although China was the leader in EV sales in 2017, at 605,500, this number represents only 2.6% of all vehicle sales in the country.[5] However, Norway's sales for 2017 equaled 35% of all vehicle purchases—and for the month of December 2017, EVs represented 52% of vehicles sold.[6]

EV incentives in Norway were initially implemented to assist the country's incumbent EV industry, and later shifted as part of an overall climate protection strategy. The table below identifies Norway's EV incentive history.[7]

Year	Norway EV Incentives
1990	No purchase taxes (Approximately 11,611 U.S. Dollars on average of gasoline and diesel automobiles)
1996	Low annual road tax
1997	Exemption from road toll
1999	Free municipal parking (revised in 2017 and now determined by local ordinance)
2000	50% reduced company car tax
2001/2015	Exemptions from 25% VAT on purchase/leasing
2003	Access to bus lanes
2009	Free access to state ferries

Table 1: Historical EV Incentives in Norway

Norway's government incentives to support charging infrastructure began as early as 2009, and provided 100% funding for charging point installations, resulting in approximately 1,800 residential sockets throughout the country.[8] The incentive investment equaled just over 610 million U.S. dollars (current Norwegian Krone exchange). More recently, from 2010-2014, Norway also authorized incentives for fast charging infrastructure, supporting 100% of installation (though not operation), again investing the equivalent of about 610 million U.S. dollars (current Norwegian Krone exchange).[9]

Similar investments are being made in other countries as well, including the U.K., France, and the Netherlands. In July of 2017, U.K. authorities announced a $25.8 million investment[10] to support EV infrastructure, and currently make available various EV owner incentives as well, including road tax exemptions on some vehicles, grants to cover purchase cost, and grants to offset the cost of residential charging stations, up to 75%.[11]

In France, the government incentivizes exchanging diesel fueled vehicles for EVs, including hybrid plug-ins, and provides license plate tax exemptions or discounts for these vehicles as well. The company car tax is also available.[12]

The Netherlands, also considered one of the most developed EV infrastructures, has consumer incentives rivaling Norway, with public charging infrastructure primarily powered by wind generated energy. Incentives include purchase and ownership tax exemptions, and reductions on the company car tax.[13]

International Approach to Infrastructure Development

Charging station infrastructure has evolved within three key areas of consumer use, including home charging, work charging, and public charging, the latter of which would include charging accessibility at restaurants, public parking lots and garages, movie theatres, etc. Also important to the equation is fast charging infrastructure. As noted by Dale Hall and Nic Lutsey in Emerging Best Practices for Electric Vehicle Charging Infrastructure, "charging infrastructure is broadly broken into three categories based on speed: Level 1, Level 2, and Direct Current (DC) fast charging…"[14]

Charging Level	Voltage (V)	Typical Power (kW)	Location
Level 1	120 V AC	1.2-1.8 kW	Primarily residential in North America
Level 2	200-240 V AC	3.6-22kW	Home, workplace, public
Fast Charge (DC)	400 V DC	50kW or more	Public- metropolitan areas

Table 2: Types of Charging Stations

According to available data, China leads the world in the actual number of charging stations, with Norway leading in charging station availability per capita.[15] The vast majority of available stations are Level 2, and this is consistent throughout all international markets, including the U.S. While there is significant investment in fast charging infrastructure, particularly in densely populated metropolitan areas, DC infrastructure makes up a smaller percentage of charging overall, although this is expected to change as EV adoption widens. As in other infrastructure, Norway also leads in DC charging deployment.[16]

Charging Infrastructure Backbone

The deployment of charging infrastructure involves much more than simply attaching a charging station to the grid. As many countries have learned, charging installations have an unavoidable impact on existing grid infrastructure, and if not carefully planned, reduce grid reliability. In Norway, authorities discovered significant issues during peak charging hours and when charging stations were installed closely together. Issues of demand spikes became more concerning as more fast charging infrastructure was installed. According to reports, at one time, an energy provider proposed to implement higher fast charging costs during designated peak hours, as a mechanism to discourage fast charging and avoid grid load.[17]

In the UK, researchers studied potential impacts of EV infrastructure on the country's distribution network. According to the study, at 33% penetration, "voltage imbalances, coupled with overloaded distribution transformers could severely impair power lines."[18] The Committee on Climate Changes estimates a 37% U.K. EV penetration by 2030, including plug-in hybrids.[19]

U.S. Electric Vehicles and Charging Infrastructure

When determining how best to develop the U.S. EV market, and considering necessary impacts on the grid, challenges experienced by other countries will exist here as well. To some degree, issues could be even greater, considering current and planned advances in battery and fast charge technologies. By some estimates, when reviewing actual energy usage, today's DC chargers can draw electricity in the amount of a commercial complex. [20]

Notwithstanding EV adoption rates in international markets, the U.S. is still considered an industry leader, both in EV sales and charging deployment. Though the U.S. lags in per capita ownership, the market is experiencing significant growth, and along with China, is considered one of the two largest EV markets.[21] The U.S. noted a 27% increase in 2017, with 199,826 EV sales.[22]

California leads in the U.S. in both EV sales and public charging infrastructure deployment, which accounts for nearly half of all U.S. sales. Approximately 96,000 EVs were purchased in the state in 2017, led by San Jose, San Francisco, and Los Angeles, which represented 13%, 7%, and 5%, respectively, of actual national share and sales volume.[23] According to reports, Los Angeles led in 2017 in terms of actual number of sales within the state, with 12,000 sales, followed by San Jose, San Diego, San Francisco, and Irvine. If any doubt exists about the level of EV adoption in California, a review of EVs as total share of the automobile market provides guidance. In a recent California market update, the International Council on Clean Transportation (ICCT) concluded that in 2017, nine cities in California reported EV market share exceeding 15%. Palo Alto reported 29%; Saratoga, 24%; and Los Altos 22%.

When looking at the proportion of California sales as part of all U.S. sales of EV manufacturers, ICCT demonstrated a few trends. For Tesla, a 100% EV manufacturer, 43% of all of its U.S. EV sales occurred in CA in 2017. This number equaled 94% for Mercedes; 69% for Volkswagen; 56% for GM, and 46% for Toyota.[24]

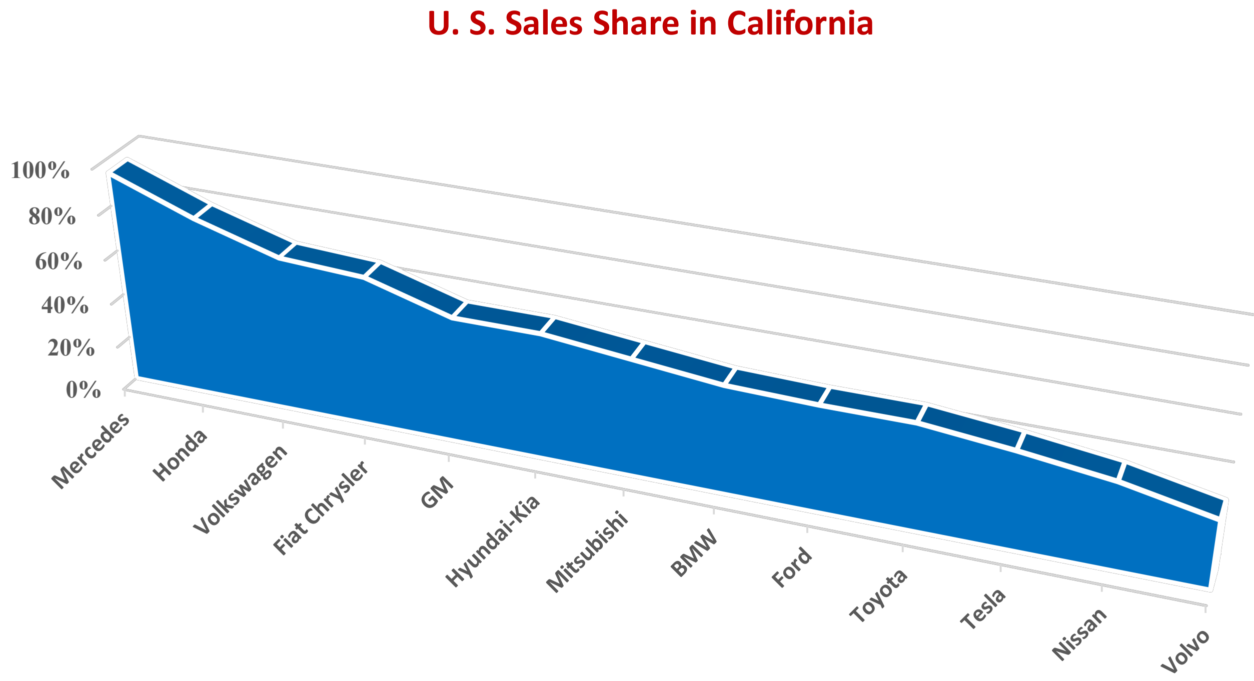

Table 3: Share of U.S. Automakers' EV Sales in California[25]

Much like Norway, California's EV growth can be attributed to a layered mix of government and private sector incentives to encourage EV adoption, including rebates, tax exemptions, HOV access exemptions, insurance discounts, etc.[26] Also similar, California's charging infrastructure has experienced extensive growth, but with greater experimentation.

As a general rule, the highest number of California charging stations exists where the greatest number of EV units are identified. Overall, the state has 344 charging stations per million residents, whereas the ratio is 107 to a million in the whole country (2017).[27] San Jose, San Francisco, and Los Angeles lead in share of charging infrastructure, capturing 13%, 7%, and 5%, respectively,[28] and as recently as June 2018, the state's Public Utility Commission approved up to $738 million for charging infrastructure projects over the next five years.[29] Though much of this will be for charging heavier vehicles, PG&E, one of California's utility companies, will invest $22 million in fast charging infrastructure.[30] Additionally, San Diego Gas and Electric will invest up to $137 million in residential charging infrastructure, with rebates for 60,000 homeowners who wish to install Level 2 chargers.[31]

The participation or leadership of utilities in charging infrastructure is not new, internationally or throughout the U.S. However, economic concerns are primarily guiding U.S. utilities, and will determine the pace and robustness of their infrastructure investments. In a 2017 Deloitte Utility Electric Vehicle Survey, Deloitte sought to identify the level of existing utility infrastructure investments, and whether the nation's utilities planned additional steps in the future.[32] The survey consisted of some 34 utilities, representing 31 states, divided by investor owned (44%), cooperatives (41%) and municipal entities (15%).

When seeking to determine why utilities have not been more involved in charging installations, 66% revealed that it was too expensive and that there was not a sufficient business case to economically justify the investment. Only 23.5% of those surveyed said they have installed charging infrastructure.[33] Notwithstanding the promising growth in parts of California and internationally, it is axiomatic that additional charging infrastructure, including Level 2 and DC, will be required to achieve desired EV adoption levels. That said, many would argue utilities are best equipped to make the necessary large scale investments. Paul Allen, et. al., seemed to agree, when they stated "utility ownership and operation of charging stations may reduce the risk of stranded assets compared to other investment models because utilities may have greater capacity and expertise to maintain charging infrastructure across the service territory to ensure the ongoing reliability of the charging stations."[34]

Models for Electric Vehicle Infrastructure

From its earliest stages of development, America's (and the world's) automobile fuel source infrastructure has been driven by private industry. Pharmacies were among the first "filling stations," and often sold fuel to customers driving from point to point, and represented the infrastructure used for what has been recorded as the "first road trip" when Bertha Benz, the wife of Karl Benz, traveled nearly 60 miles, stopping at pharmacies to refuel with benzene.[35] Historically, private innovation and investment have underpinned automobile development, and the fuel infrastructure that supports it. As the cost of car ownership decreased, more consumers purchased cars; fuel pumping mechanisms were developed; and the driving experience was enhanced.[36]

However, EV evolution is occurring somewhat differently, motivated by environmental urgency and accompanied by substantial government investments and incentives. Consequently, real questions exist whether government and taxpayers alone can successfully motivate EV purchases, and support the high cost of charging infrastructure deployment. Although tax incentives and rebates have been useful, mass EV adoption will likely occur when vehicles become more affordable, much as the Model T was when Henry Ford made the automobile available to middle America. Additionally, as purchase price declines, fueling infrastructure will be necessary—allowing consumers to overcome range anxiety.

The questions for policymakers (and consumers) are: How quickly can the infrastructure be built, and at what cost? The nation's utility companies, including rural co-ops, public utilities, and investor owned utilities (IOU), are likely best positioned to lead in charging infrastructure investments and development. Each is already part of a regulatory framework at the federal, state or local level, wherein regulators and utilities manage and appropriately identify stress on the grid; analyze impacts on generation markets; build-out reliability to facilitate Level 2 and fast charging; monitor cyber risks; and balance customer rates.

Utility Ownership Models

According to a Georgetown Climate Center analysis, *supra*, a fully utility-owned EV charging infrastructure serves numerous advantages, including access to capital to make the necessary investments for research and development, ability to conduct build-out throughout a designated service territory, and experience with managing usage data and grid reliability.[37] A "utility owner-operator model" would consist of the regulated utility owning and operating all aspects of charging infrastructure, including the charging station equipment and the electricity utility infrastructure that supports it. Other potential models considered by the Climate Center include the "make ready," "business as usual," and "utility incentive" models, where the utility's role is limited at the meter or shortly thereafter. Proponents of these latter approaches caution the all utility model prevents competition, and excludes private innovation as the EV charging market develops.

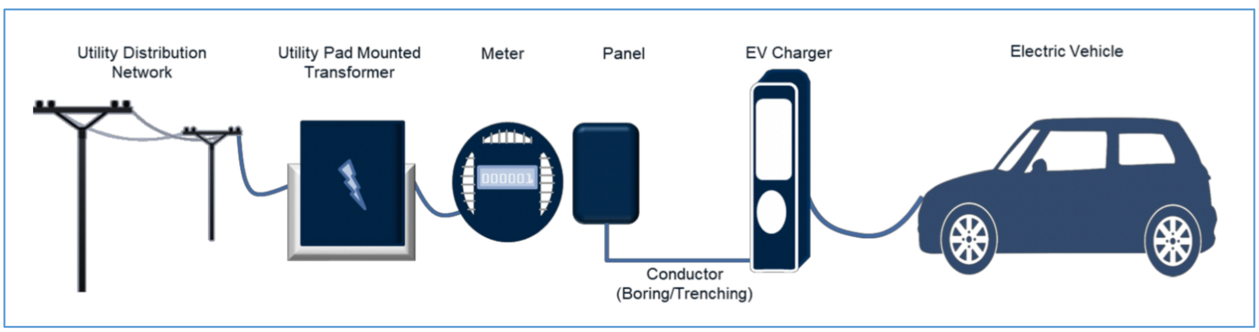

Figure 1. Charging Station Infrastructure Models (Georgetown Climate Center, *M.J. Bradley and Associates*)

Until 2015, California limited IOU ownership and operation of charging station infrastructure, concerned that competitive markets would be disadvantaged.[38] The state was also concerned that cost incurred by utilities would be passed to consumers least likely to adopt EVs in the early or intermediate stages of market growth. A number of states have also imposed restrictions, although some have begun to experiment with various infrastructure models, allowing greater utility ownership and participation.

Policy Developments and Diverse Communities

Early decisions by utility commissions limiting ownership of charging infrastructure have some merit, particularly when based on customer ratemaking concerns. Initial EV adoption unquestionably has been dominated by higher income consumers. Data from California, where EV purchases are highest in the nation, show the vast majority of ownership is in the highest income areas of the state. Those cities in California where EV market share equals 15% or more are among the wealthiest cities in the state.[39]

As EV markets have developed, adoption rates are increasing in middle and low-income areas—and manufacturers are beginning to target these consumers. For example, Tesla has put forward considerable effort to launch its Model 3, base-priced at about $35,000 (longer range models over $50,000), and the Chevy Bolt, at about $40,000. That said, less expensive EV models will likely have shorter charge ranges, which could reduce attractiveness for targeted income buyers. This result could be mitigated, making the case for building extensive fast charge infrastructure in moderate and low-income communities.

Appropriately, many state utility commissions are now rethinking previous infrastructure ownership prohibitions, recognizing the need to motivate wider EV acceptance, and to meet established clean energy objectives. This is a step in the right direction, according to Max Baumhefner of the Natural Resource Development Council, who believes utilities are good at developing the infrastructure that "EV drivers want and [is] sorely lacking at this point."[40]

As one approach, related to concerns about equity-based infrastructure development, California's Public Utility Commission recently approved investor-owned utility projects totaling over $760 million.[41] The decision is recognized for its focus on fast charge development in disadvantaged communities. Additionally, California is home to an important "hybrid" approach to utility infrastructure ownership, agreeing to allow IOUs to own infrastructure, including charging stations, when located in underserved markets, while limiting ownership in those areas not considered under-resourced.[42]

Eventually, technology and increased charging deployment will make wide EV adoption attractive. To ensure charging infrastructure is available in under-resourced communities as in other parts of a utility's service territory, IOU participation and ownership will likely be required. Such a structure permits diverse communities to achieve the benefit of potential rate increases associated with charging infrastructure investments. A robust regulatory framework will also be necessary to ensure equitable and fair rate structures.

Personal Electric Vehicles and Under-Resourced Communities

By one of the more optimistic estimates, U.S. EV adoption share will reach over 50% by 2030.[43] If current adoption trends continue to match those states and cities with heavy EV and infrastructure incentives, then from a national perspective, EV growth will likely expand from California and cover a number of states with significant African American populations. In a recent survey by the Electrification Coalition, researchers ranked the top 10 U.S. states by their incentives, and cross matched each by percentage of EV market share sales. California, Maryland, Connecticut, Massachusetts, and New York rounded out the top 5.

Top U.S. States by Incentives[44]

Significant State Incentives (By Rank)	Total EV Sales (2011- 2017)	Market Share Sales Within State (2017)	African American Demographics/ Population Rank[45]
California	356,241	5.02%	3,792,045 (8%)/29
Maryland	11,604	1.05%	1,945,309 (32%)/5
Connecticut	7,502	1.39%	471,282 (13%)/22
Massachusetts	13,834	1.35%	676,366 (10%)/25
New York	30,645	1.03%	3,792,045 (19%)/11
New Jersey	16,716	0.91%	1,540,133 (16%)/16
Vermont	2,483	2.13%	12,089 (2%)/48
Rhode Island	1,347	0.92%	103,558 (9%)/28
Oregon	15,457	2.36%	125,542 (3%)/42
Maine	1,657	0.80%	27,569 (2%)/46

Table 4: State Incentive Rankings

However, incentives alone may not tell the full story, as evidenced by Washington, Hawaii, the District of Columbia, and Colorado. These areas were not identified as heavily incentivized, but rank high in market share of sales, some of which have notable African American populations as well.

Top U.S. States by EV Market Share Sales

State by Rank	Total EV Sales (2017)	Market Share Sales Within State (2017)	African American Demographics/ Population Rank[46]
California	94,873	5.02%	3,792,045 (8%)/29
Washington	7,068	2.51%	409,981 (6%)/34
Oregon	3,988	2.36%	125,542 (3%)/42
Hawaii	1,934	2.33%	50,825 (4%)/40
Vermont	871	2.13%	12,089 (2%)/48
District of Columbia	398	1.87%	336,753 (49%)/1
Colorado	4,156	1.57%	310,304 (6%)/35
Connecticut	2,304	1.39%	471,282 (13%)/22
Massachusetts	4,632	1.35%	676,366 (10%)/25
Maryland	3,244	1.05%	1,945,309 (32%)/5

Table 5: U.S. EV Sales and African American Population Rankings

Full U.S. EV adoption means incentives will continue—and likely consist of specific targets to reach those markets not yet part of EV evolution. This is an area in which California has demonstrated significant leadership for vehicle purchase and charging infrastructure.[47] Notably, California has begun to curtail incentives for wealthier buyers, eliminating rebates when incomes exceed $150,000 for individuals, $204,000 if head of household, and $300,000 for joint filers.[48] At the same time, those with incomes of $36,420 or less (individuals) or earning under $75,300 (family of four) receive rebates that are $2,000 more than the standard amount.[49]

Although African American and other minority auto buyers have not been a large part of EV purchases in the past, some have signaled a desire to join the market for the same reasons as early entrants. According to a recent study by Think Now Research, African Americans scored similar to other ethnic and racial groups, including Caucasian, Hispanics and Asians, when citing a preference for gas alternative engines for environmental and sustainability reasons.[50] While the study revealed all buyers still prefer gas engines, African Americans ranked higher than or as high as their counterparts in terms of electric vehicle preference, at 8% African American; 8% Hispanic; 6% white, and 7% Asian.[51]

If EV adoption is to take hold in the country's urban areas, where a majority of ethnic and racial groups reside, then accessibility for EV use will have to increase. As noted in a recent article in the San Diego Tribune, "EV adoption has largely been a suburban phenomenon… but for people who live in apartments and condominiums, simply finding a place to charge their EVs can be so difficult that it sometimes keeps them from considering buying a car that requires plug-in."[52]

Based on existing demographic trends, African Americans, Hispanics, Asians, and others account for 56% of urban county populations, 32% of suburban county demographics, and 21% or rural county populations.[53]

If solely left to unregulated markets, urban EV acceptance could be slowed considerably, since private capital is more likely to gravitate to where EV cars are, versus where they need to be. Municipal, state and federal incentives will continue to play a significant role in determining where urban infrastructure build-out occurs, how quickly, and by whom. Government participation is critical to ensure charging infrastructure development occurs in urban communities, with specific involvement of state utility commissions.

Hedging EV's Future

According to recent announcements from BMW, the German automaker expects to have an excellent shot at capturing EV market share from Tesla. Among the major manufacturers identified in Table 3, Tesla is the only company whose total sales are 100% electric vehicles. For everyone else the focus is divided, meeting the needs of today's gas powered consumers, while anticipating EV's future—and responding to zero emission regulatory requirements. BMW believes it has solved the issue of fractured manufacturing (one for gas and another for electric), by moving to a modular platform that will adapt to market trends and consumer needs. These platforms will accommodate electric, hybrid, or internal combustion powertrains, with EVs ranging from 134 to 800 horsepower, and have a maximum distance of about 600 kilometers (372 miles) per charge.[54] BMW has also planned a concept platform with a distance range up to 700 kilometers (435 miles), with a 10 minutes DC fast charge providing an additional 100 kilometers.

BMW is not alone in its sense of EV market uncertainty—and decidedly flexible to adapt to changing economics. The oil and gas industry has planned a similar strategy. Unconcerned about increases in EV market share, the industry predicts that if the anticipated 41 million EVs come online by 2040, this would equal approximately 8% of today's grid capacity, much of which is powered by natural gas. Moreover, oil is a flexible resource, and should consumer use for cars change, oil products and byproducts will necessarily shift to other fuel uses, including but not limited to jet fuel and plastics.[55] Some are predicting gas and electric vehicles will co-exist for long periods of time—and under a worst case scenario (a ban on internal combustion passenger vehicles), the industry would experience no more than a 10% loss.[56] The rationale is the "demand growth for oil in sectors like petrochemicals, [and] heavy transport keeps expanding significantly, [keeping] these segments largely insulated from future switching."[57]

As a related matter, should a real reduction in consumer gasoline use occur, governments should also expect a reduction in revenue from gasoline taxes. State and local governments

collected nearly $44 billion in fuel taxes in 2015, according to the Tax Policy Center.[58] At the federal level, based on a March 2018 updated report, U.S. fuel taxes equal 18.40 cents for every gallon of gas, and 24.04 cents on each diesel gallon.[59] Absent an appropriate replacement, should gasoline and diesel use significantly decrease, policymakers will need to identify substitute transportation dollars to fund state and U.S. projects.

Some have also raised environmental concerns, but related to the battery technology on which electric vehicles will rely, both as to mining and disposal. If not planned out now, in 15-20 years, we might encounter an environmental footprint that adversely impacts the green energy future so many have imagined.[60]

Conclusion and Recommendations

The automotive market shifting to plug-in electric vehicles is directly connected to environmental public policy, primarily powered by capital, tax, and other incentives needed to spur consumer adoption. Although electric vehicles are not new to the automobile landscape, advances in technology, and capital investments made by companies like BMW, Tesla, GM and others, are likely to establish EVs as the alternative fuel vehicle of the future. That said, U.S. markets have yet to reach a point where sales operate fully absent incentives. Additionally, sufficient charging infrastructure, including fast charging, has yet to be deployed to eliminate consumer charging anxiety.

Moreover, EV pricing may still be perceived as too high (particularly when coupled with charging anxiety) for consumers to purchase an EV as their main or secondary automobile. Additionally, to expand EV adoption from the suburbs to urban counties and cities, significant infrastructure development will be required to meet the needs of apartment and condominium residents.

As EV incentives continue to develop, the Association supports policies that encourage market entry in urban communities, particularly targeting moderate and low-income consumers. The Association also supports infrastructure development policies requiring Level 2 and fast charging deployment in places where people of color and moderate incomes reside, including in urban counties and cities. In that these investments often require large and intensive capital investments, including grid infrastructure improvements, regulators and others should identify best models to incentivize grid investments to pave the way for urban EV adoption. Utility regulators will play the necessary and essential role of establishing equitable market growth across diverse incomes and communities.

End Notes

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