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INVESTMENT IN PUBLIC EV CHARGING IN THE UNITED STATES

An overview of current and historical funding from the public and private sector

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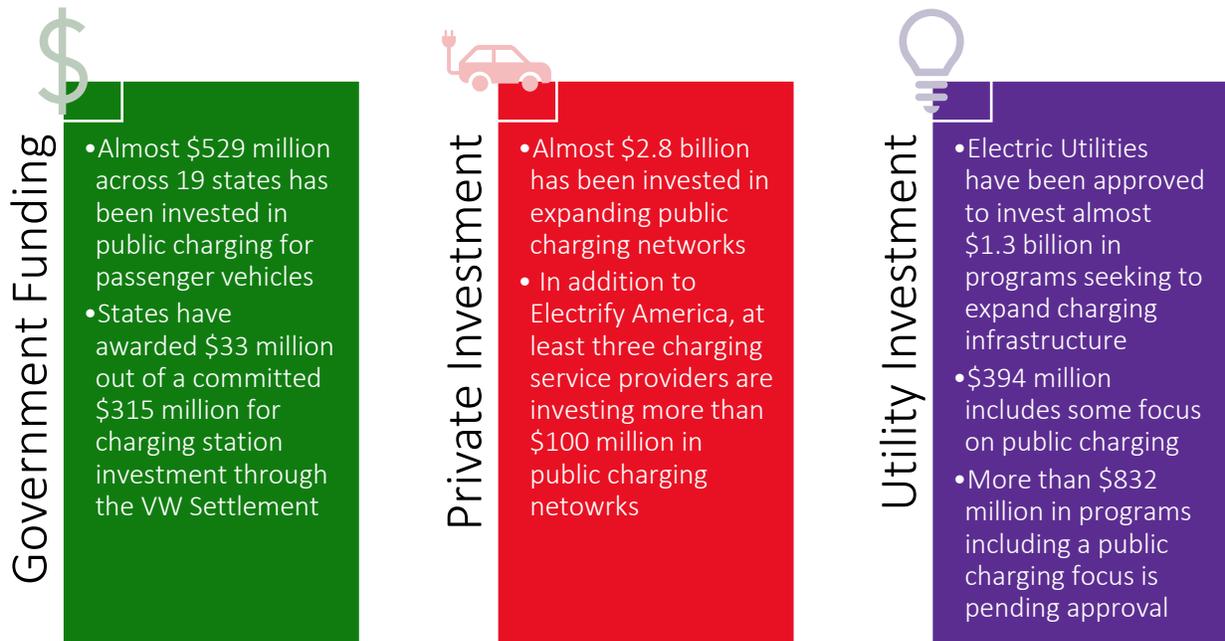


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This brief provides an overview of the historical and current state of government, private sector, and electric utility investment in publicly available charging infrastructure in the United States. This market is in the early stages of development. Multiple business models are being tested, and several sources of funding are being used. Several reports estimate the “infrastructure gap,” or the need for publicly available infrastructure, to be very large over the next decade or two. The public charging network must grow by between four and 16 times from 2017 levels by 2025 in order to meet the needs of the anticipated EV market. The business case for investing in and hosting public charging stations remains challenging. As more EVs hit the roads, electric utility investment and government funding can enhance the value proposition of these services and lower the barriers associated with deploying infrastructure. With increasing funding available from both the electric utility and government sectors, charging service providers and related stakeholders have a significant, near-term opportunity to grow the public EV charging network in the United States and reduce the dependency on government subsidization over time.

OVERVIEW



This figure includes data through December 2019.

BACKGROUND OF PUBLICLY ACCESSIBLE EV CHARGING

Accessible public charging is essential to grow the electric vehicle (EV) market in the United States. Overall, public charging networks benefit from three primary funding types: government funding, private investment, and electric utility investment. Investment in publicly accessible charging infrastructure is critical to encouraging further EV adoption and meeting climate goals [1, 2]. Publicly accessible EV charging infrastructure in the United States has grown from almost no available stations in 2010 to more than 56,000 ports at 19,000 locations through the end of 2019, not including Tesla's 15,500 proprietary ports at more than 4,500 locations [3]. Much of this growth has occurred since 2017 and the business case for investing in EV charging has improved somewhat as the EV market has grown. In the early days, challenges including high upfront costs, uncertain demand, and consumer willingness to pay for charging services was prohibitive to the development of a robust private market. Many of these challenges still remain. In order to reduce these uncertainties and act as a catalyst for market transformation, government funding continues to be essential to encourage private investment and demonstrate the various charging business models that would capture the direct and indirect benefits of EVs [4].

Box 1. What Makes a Charging Station “Public”?

While there are some disputes over what constitutes a “publicly accessible” station, the Alternative Fuel Data Center (AFDC) classifies a station as “public” as long as it is not located at a private residence, multi-unit dwelling (MUD), workplace, private fleet depot, or any other location that restricts parking access. The California Air Resources Board defines a charging station as publicly accessible as long as the “[charging station] and associated parking space or spaces designated by a property owner or lessee [is] available to, and accessible by, the public for any period of time” [5]. The Public Service Commission of New York employs a similar definition which includes any charging stations “without site-specific physical access restrictions” [6]. Public charging locations can typically support both Level 2 and DC fast charging stations.

Public charging stations are considered essential for those without access to residential charging and DC fast charging in particular can facilitate longer range travel while improving the convenience of charging to reduce range anxiety [7]. The AFDC notes that public charging stations are typically found in locations where drivers are concentrated and spend significant periods of time parked. Some of these locations include:

- Shopping Centers
- Airports
- Hotels
- Government Offices
- Public Parks
- Public Parking Lots
- Other Businesses
- Truck stops, gas stations, and along transportation corridors
- City curbsides and right-of-way locations

A majority of the early funding for EV charging came through the American Recovery and Reinvestment Act (ARRA) of 2009, which included investment worth more than \$700 million in competitive, cost-share grants specifically directed towards clean transportation projects, including EV and charging deployment.

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Roughly \$300 million of this was administered by Clean Cities Coalitions for innovative clean transportation efforts for alternative fuels at the regional level and the remaining \$400 million was split between five core transportation electrification projects overseen by the Idaho National Laboratory (INL) [8, 9]. Between 2011 and 2013, the five projects overseen by INL deployed more than 17,000 Level 2 charging stations at both private residences and public locations and more than 100 DC fast charging stations across 22 regions of the United States [10].

ARRA also contributed critical early funding to local governments through the Clean Cities projects that jumpstarted ambitious transportation electrification plans. Following initial funding for projects through ARRA, Columbus, Ohio in particular went on to secure a \$50 million grant through the Department of Transportation's Smart Cities Challenge in 2016, which includes funding for publicly accessible EV charging [11].

Federal funding laid the foundation for regional and state EV charging networks, especially in California, New York, and the rest of the Northeast. As of November 2019, programs in at least 19 states offer public funding through grants, rebates, and tax credits to reduce upfront costs and lower the payback time for charging stations. California and New York are the leaders in government funding for charging infrastructure, accounting for almost 90 percent of the total \$527 million invested in publicly available charging at the state level [12]. States have only spent 11 percent of more than \$315 million committed to light-duty charging infrastructure through the Volkswagen Settlement as of December 2019.

Some government-funded projects provided seed funding for charging service providers that are now a critical source of private investment for publicly accessible EV charging. ChargePoint, which has deployed the most charging ports in the United States, completed their ARRA project in 2013 and was able to deploy more than 4,600 public and residential Level 2 charging stations with the help of a \$15 million grant [13, 14]. However, not all early efforts to expand the EV charging network were successful; some companies could not turn early public investments into viable businesses. For example, after receiving almost \$100 million in federal grants through the ARRA to build a nationwide charging network, ECOtality went bankrupt in 2013 and sold their assets to Car Charging Group [15, 16]. Car Charging Group faced many challenges bringing the network up to par and many of their stations sat idle, leading some stakeholders in the EV charging industry to express concerns around overstating charging station availability in some areas [17].

Overall, increasing public sector investment in publicly accessible EV charging has helped improve the private case for hosting charging stations. A recent study by Atlas assessed the business case for hosting charging stations in New York and revealed several potential pathways to profitability for station hosts. The report also concluded that public funding could enhance the chance of profitability of hosting a charging station [4].

Over a similar time period that ARRA projects were being implemented, electric utilities also increased their engagement with the EV market. Early efforts from California utilities to promote transportation electrification were put on hold by the California Public Utilities Commission (CPUC) in 2011. The Commission expressed concern that utility involvement could hinder the development of a private market and that recovering investment costs through the entire customer base could disproportionately benefit a small segment of wealthy EV owners, an outcome known as "cost shifting." [18]. In subsequent years, as an uneven market developed across the state and high-profile bankruptcies, including the aforementioned ECOtality, took place, an unfavorable business case for charging emerged. In response to the unfilled charging infrastructure gaps and the need to accelerate the market to reach EV deployment goals, the CPUC reversed this decision in 2014 and allowed utility involvement in EV charging infrastructure on a case-by-case basis.

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Following the CPUC's reversal and the adoption of other state policy, California is now the leader in both EV adoption and EV infrastructure deployment. In 2015, the state enacted SB 350 to further encourage utility engagement in the EV market, citing this effort as a core component of California's ambitious emissions reduction efforts [19]. California's utility and state investment has supported the growth of a robust private market for EV charging and is now host to the most vibrant EV charging market in the country.

California utilities lead in electric utility investment in programs including a focus on publicly accessible EV charging, accounting from more than 48 percent of the total \$394 million invested by electric utilities in 22 states through December 2019 [20]. The surge in utility engagement in the EV market since 2017 has helped to improve the business case for owning and deploying publicly available charging infrastructure, while helping capture the benefits of EVs to all ratepayers through increased utilization of existing electrical grid assets [21]. The state has been able to implement programs encouraging off-peak charging where increasing EV adoption has resulted in lower electricity rates for all utility customers, including those who do not own an EV [21].

Despite considerable progress since the early days of the EV charging market, publicly accessible charging infrastructure in the nation's leading EV markets will need to increase by between four to 16 times by 2025 to meet the expected EV market growth and deployment goals [22, 23, 24]. The following sections go into greater detail on how government, private sector, and electric utility programs are working to address this infrastructure gap.

GOVERNMENT INVESTMENTS FROM GRANTS, REBATES, AND TAX INCENTIVES

A range of both national and state-led initiatives are seeking to accelerate charging infrastructure deployment across the country. In addition to the ARRA investments discussed above, the intermittently available Alternative Fuel Vehicle Refueling Property Credit has awarded \$537 million in tax credits for charging infrastructure through the end of 2017 when it expired [25]. Although the U.S. Congress renewed the federal tax credit for charging infrastructure for one year in late 2019 [26], action by Congress on legislation for new funding programs is highly uncertain today; indeed, it is likely that state and local governments will continue to lead the way on funding for publicly accessible charging networks.

On the state level, almost \$529 million in rebates, grants, and tax credits has been awarded for public charging infrastructure across 19 states through December 2019. Programs like the New York Power Authority's EVolve NY and the California Energy Commission's Clean Transportation Program far outpace others in terms of total investment and four out of the five largest state programs are managed by these two states. All of the top five states for utility investment are also among the states investing public funds in charging network expansion [12]. Table 1 provides an overview of the largest public programs seeking to expand the public charging network.

Currently ranked 32nd and 18th among all states in terms of DC fast charging stations and Level 2 stations per person, respectively, New York is looking to close the charging gap [27]. The state has made significant progress with almost \$290 million in public investment dedicated to charging stations. A majority of this comes from the \$250 million committed by the New York Power Authority (NYPA) through the EVolve NY plan [28]. Supplemented by the New York State Energy and Resource Development Authority (NYSERDA)'s

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Charge Ready NY program and Governor Cuomo’s Green New Deal, New York is set to rapidly expand the publicly accessible charging market [29]. New York also administers one of the largest consumer tax credit programs for charging stations with a cost of more than \$3 million in 2019 alone [30]. New York’s market acceleration is complemented by efforts to gather data on station use and operational lessons from recipients of NYSERDA’s Charge Ready NY grants; data collection and analysis by NYSERDA equips the state with actionable information on the business case for hosting charging stations and effective ways to encourage private investment.

TABLE 1: LEADING STATE PROGRAMS FOR INVESTMENT IN PUBLIC CHARGING INFRASTRUCTURE

State	Program	Investment	Timeline	Status
New York	EVolve NY	\$250 million	2019-2025	Funding Available
California	ARFVTP	\$158 million	2015-2024	Funding Available
California	CALeVIP	\$51 million	2016-2020	Funding Available
New York	Green New Deal	\$31.6 million	2019-2025	Funding Available
Virginia	VW Settlement	\$14 million	2018-2019	Funding Awarded

This table shows the top five state programs in terms of total investment in charging infrastructure through December 2019. All of these programs include funding for public charging. New York and California lead other states by a wide margin, accounting for almost 90 percent of the total funding recorded on the Atlas EV Hub.

Source: [12]

Though it is not possible to estimate the amount of funding specifically for charging infrastructure at the state level in California since several state programs do not disaggregate charging station investment from vehicle investment, it is clear California leads in state investment in charging infrastructure. Overall, the California Energy Commission (CEC) leads the state’s investment with almost \$200 million committed to charging infrastructure deployment [12]. This includes a recent announcement of \$62.7 million in investment for EV charging through the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) [31]. California also leads the way in investment for medium- and heavy-duty charging with at least \$30 million from the Clean Transportation Program going to electric bus and truck charging [32]. The CEC also oversees the California Electric Vehicle Infrastructure Project (CALeVIP), which is currently funded at \$51 million with the potential to increase to \$200 million [33].

Other states are also allocating significant grant funding to expand the charging network albeit at lower levels than California and New York. In Maryland, the state’s Electric Vehicle Supply Equipment (EVSE) Rebate Program has gone through two rounds of awards already and is oversubscribed for the \$3.6 million in available funding through the first half of 2020 [34]. Colorado is targeting publicly accessible fast charging along highway corridors through their Charge Ahead Colorado rebate program and has awarded more than \$10 million to the charging service provider ChargePoint to build the network [35]. In December 2018, ChargePoint was also announced as the winner of a \$3.15 million grant from Maine to deploy fast charging stations along highway corridors using funds from the VW Settlement [36]. Earlier that year in August, Virginia awarded \$14 million to EVgo through the Volkswagen Settlement. As

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mentioned earlier, the VW Settlement is expected to yield more than \$315 million specifically for publicly accessible EV charging across all states [37].

Two states have also employed market-based credit systems to encourage transportation electrification. California's Low Carbon Fuel Standard (LCFS), a fuel-neutral, market-based program offering credits to entities that reduce the carbon intensity of transportation fuels, helps to advance both EV and charging infrastructure deployment in the state. Overall, the LCFS supports transportation electrification across a variety of sectors and uses and has generated more than \$100 million in credits for utilities, drivers, charging station hosts, and other entities each year since 2017 [38]. As of December 2019, Oregon is the only other state to adopt a similar program with their Clean Fuels Program. While the program is still in its early stages, primary stakeholders including the utilities Portland General Electric and Pacific Power have generated an estimated \$7 million from the credit system and expect to secure another \$5.5 million in 2020 to go towards transportation electrification initiatives [39].

For California's LCFS, regulations from the California Air Resources Board require utilities in the state to use the credits they generate through the LCFS program to benefit current and future EV customers [40]. A 2018 amendment to the program introduced capacity-based credits for DC fast charging that would reward the investor based on the projected capacity of the station rather than the usage alone. Capacity-based credits are limited to five percent of all credits and while data reporting does not yet suggest the impact of this addition, industry stakeholders expect this to boost EV and charging deployment [38]. Publicly-owned utilities in California including the Los Angeles Department of Water and Power and Sacramento Municipal Utilities District also benefit from the LCFS program and use funds generated through the credit system to finance publicly accessible EV charging [41, 42].

Early success from credit programs in California and Oregon could encourage states to implement similar programs. Washington enacted HB 2042 in mid-2019 to extend its infrastructure funding program and reinstate its vehicle incentive [43]. The Washington Legislature also passed HB 1512 in 2019 that directed municipal utilities to invest directly in charging infrastructure and required all utilities to develop and file comprehensive transportation electrification plans recognizing their critical role in market transformation [44]. Moreover, LCFS bills have been introduced in both the Washington and New York State Legislatures as a possible mechanism to spur EV charging market development [45, 46]. Market-based credit programs like these can provide valuable near-term funding to expand charging networks in which stakeholders like electric utilities can participate and convey benefits to all customers, ratepayers, and charging station site hosts.

PRIVATE INVESTMENT SUMMARY

Private investment in the public charging network is increasing as well and charging service providers often work directly with state agencies to support public programs. Charging service providers continue to tap into a variety of investment sources such as private equity and venture capital, including the unregulated venture arms of electric utilities, as well as government grants. This section summarizes direct investments in private companies and investments in charging deployment in an attempt to quantify the amount of private investment in the charging market.

The Volkswagen Settlement resulted in the single largest private investment in charging infrastructure with the creation of Electrify America. Through the settlement, Volkswagen was required to contribute \$2 billion in funding and establish Electrify America as a subsidiary responsible for investing in a nationwide

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network of publicly accessible charging stations through 2026 [47]. Though Electrify America is a private company allowed to earn a profit, plans for the \$2 billion investment, including \$800 million in California alone, must be approved by the U.S. Environmental Protection Agency and the California Air Resources Board for the company's national and California-specific plans, respectively [48].

In addition to Electrify America, other leading charging service providers including ChargePoint, Volta, and EVgo have made significant investments in publicly accessible EV charging [14]. Public information is difficult to obtain for many of the charging service providers in the United States. Investment totals in Table 2 are estimated from announcements that also include general fundraising and operational support.

TABLE 2: INVESTMENTS IN PUBLIC CHARGING INFRASTRUCTURE AND CHARGING SERVICE PROVIDERS IN THE UNITED STATES

Company	Investment
Electrify America	\$2 billion
ChargePoint	\$290 million
Tesla ¹	\$183 million
Volta	\$126 million
EVgo	\$100 million
EV Connect	\$28 million
Greenlots	\$25 million
Total	\$2.75 billion

This table outlines both privately raised funds and direct private investment by charging service providers supporting the public charging network and associated infrastructure. Electrify America, which was created because of the Volkswagen Settlement, leads with a significant portion of this total. These investments were assembled from press releases, press reports, and other publicly available sources such as Crunchbase. Tesla's investments are estimated based on per-station cost estimates and deployment of its Supercharger network and do not include Level 2 destination charger investment.

Source: [14]

Overall, more than \$2.7 billion in private investment for publicly accessible EV charging has been announced through December 2019. This does not include cost-share investment from the site hosts themselves, which can match the amount of investment from the charging service provider or government entity in some cases. For state rebate programs like the California Electric Vehicle Infrastructure Project (CALeVIP), site hosts are required to provide at least 25 percent of the total investment in public DC fast charging stations [49]. Private investment figures are based on the best available information and some companies that are not publicly traded have limited investment

¹ Tesla has not directly reported investment in their proprietary charging network since 2016. Total investment numbers are estimated using the company's most recent SEC filings, external estimates of the per-station cost for a Tesla Supercharger, and the number of Superchargers deployed around the country through December 2019. This estimate does not include Level 2 destination charger investment as that information has never been reported by Tesla.

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information. For example, these investment estimates also do not include major industry developments including the acquisition of Greenlots by Royal Dutch Shell in January 2019 [50].

Electrify America accounts for more than 73 percent of the total private investment in charging infrastructure [51]. The company is quickly expanding its fast charging network, becoming the largest non-proprietary fast charging network in the country in November 2019. Electrify America is also working to improve access to charging through roaming agreements with ChargePoint and EVgo that allow drivers to plug-in at stations on those networks for no additional fee [52, 53].

As more of these charging service providers move towards peer-to-peer roaming agreements, operational issues such as plug standardization and hardware and software communication protocol standardization will need to be addressed. Regulators in some states are pushing for a move to dynamic systems such as the Open Charge Point Interface (OCPI) to facilitate payment interoperability, which has enabled increased mobility for EV owners in the European market, and Open Charge Point Interface for charger hardware and software interoperability [54].

As the largest overall charging service provider on a charging port basis, ChargePoint has received at least \$415 million from investors, \$290 million of which is designated exclusively for the U.S. charging market [14]. While most of these stations are Level 2 and owned by the site hosts, ChargePoint also deploys DC fast charging stations. In addition to this private funding, the company has been successful at winning government funding awards through the VW Settlement as discussed above.

As is the case with Electrify America, EVgo's network was greatly expanded in California as a result of a government settlement. In 2012, the CPUC reached an agreement with the energy generation company NRG Energy to recover losses caused by the utility's predecessor, Dynegy, in the California energy crisis of 2001 [55]. The terms of the settlement directed NRG to invest more than \$100 million in publicly accessible fast charging throughout the state through its EVgo network [56]. EVgo has since been acquired twice, first by Vision Ridge Partners in 2016 and most recently by LS Power at the end of 2019 [57]. These acquisitions have opened up deeper pools of resources for the company, helping them leverage both government and private investment to expand their reach beyond California to serve EVs across the country. In August 2019, the company announced a six-year partnership with Nissan that will lead to the installation of 200 new DC fast charging stations in cities around the country. While the investment details concerning this project are unspecified, EVgo estimates that Nissan has already invested at least \$60 million to support more than 2,000 charging stations around the country [58].

Tesla, the nation's leading EV manufacturer, has invested more than other automakers in charging deployment in the United States and continues to expand their Supercharger network to boost sales and reduce range anxiety. While the company has not reported direct investment in the network since 2016, investments from the company likely total more than \$180 million based on corporate filings and the total stations deployed [14]. General Motors is also making moves to advance the EV charging market with the announcement of a partnership with engineering giant Bechtel in 2019. Neither company has released information on the size of this venture, although early reports estimated that "thousands" of charging stations could be deployed [59].

Investment from charging service providers alone is unlikely to meet charging infrastructure needs and partnerships or joint ventures with automakers, fleet operators, and other private companies will likely continue to play a valuable role in the development of the market [24]. Other forms of these partnerships could materialize as more long-range EVs are introduced in the market and the importance of publicly available charging increases.

ELECTRIC UTILITY INVESTMENTS IN EV CHARGING

Since 2012, electric utilities across 23 states have been approved to invest more than \$1.3 billion in programs supporting the expanding charging network. In some states like California (SB 350), Colorado (SB 19-077), Oregon (SB547), and Washington (HB 1512), the legislature has directed the utilities to file comprehensive transportation electrification programs with the state commissions, and for the commissions to review, modify, and approve them in a timely manner. In other states, such as Michigan, Minnesota, Maryland, Georgia, and Missouri, the commissions have acted under their general ratemaking authority in accepting, reviewing, and approving pilot programs for transportation electrification deployments that serve “the public interest.” Electric utility customers (or ratepayers) serve as the main source of funding for these projects and electric utilities benefit from access to capital that can be allocated over long time horizons. Regulated utilities, bound by numerous statutes and detailed rules, are typically required to ensure universal access for all customers, like EV owners, who request service under line extension and other Commission policies. Utilities are also required to submit programs that meet the “just and reasonable” standard for ratemaking. The emphasis on fairness for utilities when investing in new technologies makes them a key player in jump-starting public charging networks in their service territories. Utility investment in transportation electrification conveys benefits beyond EV owner benefits and EV programs that generate more revenue than their costs, such as through off-peak charging, have been shown to deliver grid benefits that result in lower rates for all customers [21].

While there has been significant utility engagement in EV charging, direct utility ownership of charging stations is less common than investments in make-ready infrastructure, rebates, and line-extensions. Overall, only \$165 of the total approved utility investment supporting charging infrastructure is going towards utility-owned charging stations. Almost all of the 339 utility-owned DC fast charging stations and roughly half of the 6,860 Level 2 stations are publicly accessible. These stations account for 60 percent of the total approved investment in utility-owned stations [20].

TABLE 3: LEADING STATES FOR APPROVED ELECTRIC UTILITY INVESTMENT IN PROGRAMS SEEKING TO EXPAND PUBLIC CHARGING INFRASTRUCTURE

State	Investment	DC Fast Charging Stations	Level 2 Stations
California	\$190 million	342	10,109
Massachusetts	\$47.1 million	72	3,955
New York	\$36 million	1,074	0
Maryland	\$21.5 million	85	874
Missouri	\$14.5 million	108	1,138

This table shows the top five states with the highest approved electric utility investment in public charging infrastructure through December 2019. Not all of the investment totals included above will go directly towards public charging. There is a heavy concentration of investment in California and the Northeast.

Source: [20]

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Including programs beyond utility ownership, approved investment in programs including a public charging focus is worth \$394 million. This accounts for more than 30 percent of all approved utility funding for charging infrastructure and supports 2,375 DC fast charging stations and 19,625 Level 2 stations. Many utility programs including a public charging focus do not specify the amount of investment going towards different use cases and location types. For many of these programs, stations will be deployed at a range of location types including residences, workplaces, multi-unit dwellings, medium- and heavy-duty fleet facilities, and public locations. Pending filings for charging programs including a focus on public charging in 14 states could bring in another \$832 million for 1,072 DC fast charging and 38,528 Level 2 charging stations if approved [20]. Table 3 shows the top states for utility investment in programs that include a focus on public charging expansion through December 2019.

Electric utilities play a vital role in accelerating transportation electrification and filling public charging infrastructure gaps that the private sector has not yet been able to address, according to the Edison Electric Institute [60]. Public charging infrastructure gaps prevail even in the states with the largest utility investments. Most of the states listed in the table above are not in the top 10 states for charging stations per person and leaders in terms of total deployment, like New York, are far behind on a per capita basis. Table 4 shows the relative rank of states with the highest utility investment in public charging programs in terms of charging stations per person.

TABLE 4: CHARGING STATION DEPLOYMENT RANK FOR TOP FIVE STATES WITH HIGHEST APPROVED UTILITY INVESTMENT IN PUBLIC CHARGING

State	DC Fast Charging Ports Per Person	Nationwide Rank	Level 2 Ports Per Person	Nationwide Rank
California	0.10	2	0.6	3
Massachusetts	0.04	18	0.31	8
New York	0.03	32	0.2	18
Maryland	0.06	9	0.29	9
Missouri	0.03	29	0.28	11

This table shows the ranking in terms of charging stations per person of the top five states with the highest approved electric utility investment in public charging infrastructure. This counts all charging station networks including Tesla's proprietary network. Some of these states, like New York, rank relatively low compared to the amount of utility investment.

Source: [27]

The approved and pending investments by electric utilities are unlikely to result in a public charging network sufficient for a robust EV market in the United States. In California, which accounts for more than 48 percent of all approved utility investment in programs with a public charging focus, 342 DC fast charging and 10,109 Level 2 stations would be deployed if all of the approved utility investment went directly to public charging stations.

California also leads in terms of pending utility investment in programs with a focus on publicly accessible charging. More than 70 percent of the pending investment in public charging comes from one filing by Southern California Edison. Originally proposed in 2018, the utility's Charge Ready 2 program includes make-ready investments worth more than \$600 million with the potential to support more than 32,000

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public, workplace, multi-unit dwelling, and fleet charging stations. Outside of California, utilities in New York, New Jersey, and North Carolina account for most of the remaining pending investment in public charging. These programs could support more than 880 public DC fast charging stations across the three states.

Utility investment in charging infrastructure, both direct ownership and support for investment from other stakeholders, has been shown to catalyze the EV charging market and improve overall market growth over time. Utility engagement can also lessen the need for government subsidization of EV charging in the long run as the overall business case for hosting charging stations improves. However, even the states benefiting from the highest levels of utility investment require a dynamic mix of funding sources to address the charging gap.

DEFINING THE CHARGING GAP

Over the next decade, a considerable gap exists between the expected amount of public charging deployment and the amount that would be needed to reach expected EV market growth across the country. Approved utility investment in California, for example, falls well short of expected charging needs in the Golden State. For DC fast charging, which is assumed to be fully accessible to the public, approved utility programs would lead to a 70 percent increase in stations compared to 2017 deployment levels [3]. At the end of 2018, the California Energy Commission estimated that the state was a quarter of the way towards their public infrastructure deployment goals for 2025. While utility investment is critical for meeting deployment targets, California will need to draw on other sources of funding to secure this projected four-fold increase in charging stations to meet EV adoption targets [61].

Other states also have considerable ground to cover to meet infrastructure deployment needs from anticipated EV market growth. Reports from MJ Bradley & Associates estimated the publicly accessible infrastructure needs across the twelve largest electric utility service territories in the country including California, Georgia, Maryland, Massachusetts, New York, Ohio, and Pennsylvania. The firm found that at least 121,000 publicly accessible EV charging stations will be needed in these states, assuming that EV market share of all new passenger vehicle sales reaches eight percent by 2025. This would require a six-fold increase from the approximately 20,000 publicly accessible charging stations already installed in these seven states at the end of 2019 [24].

The International Council on Clean Transportation (ICCT) concluded that major metropolitan regions in the state had less than 20 percent of the public infrastructure installed in 2017 that will be needed to satisfy charging demand by 2025 [22]. This estimate of a required five-fold increase in public charging infrastructure contributes to the uncertainty around the future deployment needs in a scenario where EV adoption accelerates significantly through the rest of the decade. Nationwide, 900,000 public charging ports will be needed by 2030 to meet the EV market growth predicted by the Edison Electric Institute and the Institute for Electric Innovation [23]. This represents a 16-fold increase over the 56,000 public charging ports recorded at the end of 2019.

These charging gap analyses indicate that even in a market-leading state like California, significant investment in publicly available infrastructure is necessary now in order to prepare for more EVs. Moreover, these studies indicate that each of these sectors – electric utility, private sector, and government – have an important and complementary role to play in helping to transform this market [22].

ROOM TO GROW

There is significant potential for an increase in investment for charging stations from the government, private, and utility sectors in the near term. As of mid-2019, most states have yet to award millions in VW Settlement funds to the expansion of the charging network (see Box 2). Electric utilities are also positioned to support the leveraging of VW Settlement funds. In Indiana, for example, the Indiana Energy Association includes several electric utilities who are encouraging utility-administered investment of settlement funds in fast charging networks along highway corridors to boost EV adoption in the region [62].

Box 2. VW Settlement Promises More Charging Investment

More than \$315 million has been directly allocated to charging station investment through the VW Settlement [37].

- Only \$34 million of this has been awarded across 11 states
- Virginia accounts for the largest investment so far at \$14 million
- 35 states have allocated the maximum 15 percent of total settlement funds to charging expansion

Looking beyond VW Settlement funds, electric utility programs pending approval could more than double the amount of investment already seen in programs supporting public charging. Notable investments in states like North Carolina and New Jersey alone could bring in more than \$275 million for public charging, if approved by electric utility regulators [20]. In addition, network roaming partnerships between charging service providers like ChargePoint and Electrify America can improve the customer experience and capitalize on increasing EV charging demand. Public investment in charging infrastructure can also help private companies and individual investors achieve shorter payback periods and improve the business case for hosting public charging stations. The pool of public funding resources could accelerate significantly in the near term as VW Settlement programs and large state programs like California's CALeVIP spend their funds.

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