Electric Vehicles: A Look at Opportunities, Challenges, and Trends for Cooperatives

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# Introduction

The adoption of electric vehicles (EVs) is continuing at varying rates across the country. EVs present a major opportunity to electric cooperatives to grow their load after a decade or more of stagnant or declining load, and to establish or expand their roles as their members’ trusted energy advisors by engaging them about and preparing them for EVs. The load associated with EVs can be beneficial to co-ops since it is highly flexible; it can be shifted away from peak hours or other periods when grid supply is low and/or expensive, and to periods of excess or low-cost electricity. However, EVs have the potential to negatively impact co-ops if they are not prepared to accept and manage the charging load. Unmitigated charging load may increase peak demand, electricity costs, and exceed the limits of co-op infrastructure. In order to realize the benefits and avoid negative impacts related to EV adoption, co-ops will likely need to take a proactive approach, including:

1. Monitoring rapidly evolving EV market and technology trends to understand the uptake of EVs in their service territories,
2. Developing business structures that increase EV adoption and manage EV load to ensure that the associated load growth is beneficial rather than harmful,
3. Monitoring and upgrading infrastructure so that the co-op can support the additional load, and
4. Monitoring and engaging in policy activities.

This paper is intended to provide a comprehensive picture of the current state of EV adoption, policy, and related impacts. It is a resource to guide generation and transmission (G&T) and distribution co-ops as they develop strategies, infrastructure investments, business plans, and policy activities as they prepare for and address EV adoption.[[1]](#footnote-1) The paper contains a review of current technology, business structures, rate structures, policies, and regulations; case studies that illustrate the range of EV strategies so far utilized by co-ops and other utilities; and identification and analysis of key risk indicators (KRIs) that outlines key questions co-ops may address as they decide how and when to act on EVs.

## EV Background

Virtually every type of transportation now has an electric or alternative fuel option in production or at least in development, including those that will use the roads in co-ops’ territories, like passenger, freight, and fleet vehicles. For the purposes of this report, we focus on vehicles that draw electricity from the grid and store it in batteries that power electric motors to propel and operate the vehicle. The batteries may be the only fuel source for the vehicle - a battery electric vehicle (BEV) - or the vehicle may also have a gasoline engine - a plug-in hybrid electric vehicle (PHEV). Other electric vehicles, such as fuel cell EVs, which use hydrogen to fuel an electric motor, are also gaining traction as a clean energy transportation option; however, in this report we focus on the technologies that draw electricity from the grid and therefore have the most potential to impact or benefit electric co-ops.

An EV driver has several options for charging the vehicle depending on the type and use of the EV. Passenger vehicles are most often charged at home, but also can be charged while drivers are at work, shopping or dining, or on trips. Fleet vehicles like delivery trucks and buses may charge at depots if they have enough range for their daily routes, or may need on-the-go charging options. Long-haul freight vehicles will rely on truck stop-like charging stations on the road. To charge any of these vehicles, they are connected to electric vehicle supply equipment (EVSE) which regulates and safely supplies power to the vehicle. Co-ops and other utilities use communicating EVSE to control charging, reducing charging during peaks and shifting the load to more preferable times of day.

## Potential Opportunities and Impacts

Co-ops work to provide their members safe, reliable, and affordable electricity. Increasingly, some co-ops’ members are also demanding clean energy from renewable sources. EVs can play a role in meeting these and other co-op goals. In particular, EVs offer the opportunity for co-ops to:

* Engage members as their trusted energy advisor. Most consumers are unfamiliar with EVs and EV charging, and may need help finding accurate information. Co-ops that establish themselves as the go-to source for information on EVs can place themselves in a position of expertise and trust with their members.
* Increase electricity sales through EV charging;
* Provide grid stability by shaping and managing EV load (e.g., charge when renewable generation is plentiful; curtail during system or demand charge peaks);[[2]](#footnote-2)
* Manage load and supply around system needs and capacity; and
* Reduce transportation-related emissions to the atmosphere.[[3]](#footnote-3)

By not acting on EVs, co-ops may still experience load growth, but that growth could impact co-ops by increasing peak demand or occurring during other high-cost periods of the day. Unmanaged EV charging could overwhelm distribution infrastructure, resulting in the need to invest in and install increased capacity equipment like distribution transformers. Finally, co-ops who wait to engage on EVs may find their members going to other sources for EV and DER information, eroding the co-op’s standing as the trusted energy advisor, and missing the opportunity to develop engaging relationships with members that could be increasingly valuable in a future of DERs and load control programs.

EV adoption will have implications for every organization within the electricity generation and supply chain. Distribution co-ops will likely be the main point of contact for consumer-members as their trusted energy advisors. Distribution co-op infrastructure - particularly distribution transformers - will likely be the first infrastructure to be impacted. If EV adoption grows as projected, distribution and G&T co-ops may need to start taking steps to ensure that EV charging does not negatively impact peak demand. G&Ts and RTOs will also need to understand the growing load due to EVs and be able to supply that demand. This will be particularly important in the new paradigm of variable renewable electricity generation to leverage the flexibility of EV charging to match generation.

## The Policy Section

This section provides an overview of the current public policy landscape in the United States, as well as trends, describes Key Risk Indicators (KRIs) associated with policies which co-ops may want to consider when evaluating future EV plans, identifies potential elements of an EV advocacy platform, and explores case studies in co-op EV programs from a policy perspective. From an advocacy perspective, understanding extant policies and regulations offers two value streams: it supports the co-ops’ ability to identify policies that may/may not work in their own backyards and to prepare their advocacy strategies accordingly; and, it provides NRECA with the same opportunity (coupled with valuable input from members), *albeit* at the federal and national level, since policies on EVs, like other DERs, begin at the state and local level and bubble up.

This paper is organized around the key questions that co-ops should ask in order to assess relevant EV issues, the risks associated with acting or not acting on those issues, and metrics and information co-ops should track and gather to keep their decision making up to date. These KRIs are introduced and analyzed throughout the paper.

# EV Technology Trends and Markets

EV development and adoption is increasing in all vehicle segments, but at varying rates. For the purposes of this discussion, we divide the EV landscape into categories based on vehicle usage type: Light-duty or passenger vehicles, buses, and other medium- and heavy-duty vehicles.

## Passenger Vehicles

###### Sales and Models

Passenger EV sales have been increasing steadily over the past years, and accounted for 2% of new vehicle sales in 2019 in the U.S.[[4]](#footnote-4) Despite a slowdown in manufacturing and sales in 2020 due to the Covid-19 pandemic, market research firms predict continuing growth; EVs are expected to comprise half of new vehicle sales by 2035.[[5]](#footnote-5) About 16 BEV and 25 PHEV models are currently available, including sedan, hatchback, crossover, and SUV styles. The models cover a wide range of initial cost: BEVs with ranges less than about 150 miles can start in the low $30,000s, while high performance, luxury models can cost over $100,000. PHEV models cost as little as $25,000 and as much as $100,000.[[6]](#footnote-6) After early focus on smaller sedan and hatchback models, manufacturers have shifted focus to EV model types that better match U.S. demand by recently introducing crossovers and SUVs. Several pickup models are slated to begin production in the near future, filling a significant gap in EV offerings. Rivian and Tesla expect to start delivering their R1T and Cybertruck pickups, respectively, next year, and Bollanger, Ford, GMC, Lordstown, and Nikola have announced their intent to produce pickups in the near future.

Several free resources are available to help co-ops track passenger EV sales and models, and are included in the Appendix. In addition, NRECA periodically publishes Tech Advisories on new vehicles, sales forecasts, and other market trends. [Link to NRECA website?]

###### Range and Features

A major obstacle to EV adoption is vehicle range and the anxiety associated with running out of energy. Battery packs comprise a significant portion of EV costs, (as well as add additional weight to the vehicle), limiting the range that can be offered for a reasonable price. However, decreasing battery costs have led to increasing battery size and increased range in recent models beyond 200 miles. Of the models on the market at the beginning of 2020, the median range is 236 for BEVs and 20.5 for PHEVs.[[7]](#footnote-7)

Consumer driving habits and perceptions ultimately determine how much range is enough. Co-op members who live in rural areas may need a longer range to be comfortable with owning an EV, whereas suburban or urban dwelling members may feel that a shorter range is adequate. Although some may argue that even short range EVs are sufficient for most trips,[[8]](#footnote-8) consumer purchasing indicates that when buying a vehicle, people want to be able to cover all possible trip types. Co-ops can help address range anxiety by installing or encouraging public charging in strategic locations.

###### Demographics of Purchasers

Because EV adoption is still relatively nascent, demographics of EV owners are similar to those of other new technologies. They tend to be younger, have higher incomes and more education, be environmentally conscious and energy savvy, and own their homes (Table 1). Consumers most interested in buying EVs tend live in towns, suburbs, or cities.[[9]](#footnote-9) Consumers with prior experience with EVs, whether owning one or just riding in one, are also more likely to purchase an EV for their next car, as are consumers that are in the market for body styles that are offered in EV models, rather than pickup trucks or large SUVs.

Table : Demographic characteristics of EV owners.

|  |  |
| --- | --- |
| **Characteristic** | **Explanation** |
| Age | EV buyers are generally younger. A Touchstone Energy Cooperatives survey of co-op members found that members aged 35 to 44 are most likely to consider an EV, while members who are 65 and older have the least interest. |
| Education Level | EV buyers tend to be well educated. A survey of California EV owners found that 83 percent of respondents had at least a bachelor’s degree and 49 percent had a post-graduate degree. |
| Environmentally Conscious | EV buyers tend to be more concerned about the environment than the average citizen. |
| Family Size | EV buyers tend to live in households with more than one person. A survey of California EV owners found that 94 percent reside in households of two people or more.[1] However, larger families may be less likely to purchase an EV, as currently available EVs have limited cargo and passenger space due to their battery packs. |
| Number of Vehicles per Household | Members with multiple vehicles are more likely to purchase an EV; owning a gas-powered vehicle compensates for EV range limitations. A study of California EV owners found that 94 percent of respondents also owned a gas-powered vehicle.[1] |
| Home Ownership | Members who own, rather than rent, their homes are slightly more likely to purchase an EV.[2] |
| Household Income | According to Touchstone Energy average household income of those interested in EVs was over $100,000. |
| Uses Other Energy-Saving Technologies | Members who participate in coops’ “green power” programs or who use other energy-saving technologies (especially solar panel systems, which can be used to fuel an EV) may be more likely to purchase an EV. One survey found that 15 percent of EV owners have photovoltaic systems installed on their homes.[3] |
| Sources  1. California Center for Sustainable Energy. California Plug-in Electric Vehicle Driver Survey Results. May 2013. <http://energycenter.org/sites/default/files/docs/nav/policy/research-and-reports/California%20Plug-in%20Electric%20Vehicle%20Owner%20Survey%20Report-May%202013.pdf>  2. Swanson, Jeff, et al.  3. California Center for Sustainable Energy. California Air Resources Board Clean Vehicle Rebate Project: EV Consumer Survey Dashboard | |

###### Benefits to Consumers

EVs present many benefits over internal combustion engine (ICE) vehicles, which some consumers might not be aware of. These include:

* Lower total cost of ownership and fuel costs[[10]](#footnote-10)
* Not having to fuel up at a gas station
* A quiet ride with instant torque for quick acceleration
* Driver assist tools and future self-driving capability
* The ability to be continuously improved via software updates

Because much outdated or incorrect information may be shaping consumer perception of EVs, co-ops are finding a role to play in relaying the benefits of EVs to their members. This is discussed in more detail below.

###### Accelerating Adoption: A Role for the Co-ops

Major barriers still exist to widespread adoption of EVs, including high initial cost, lack of charging infrastructure and related range concerns, lack of familiarity with EVs, and the types of EVs available. A recent J.D. Power survey found that the top three barriers U.S. consumers give for EV adoption are charging station availability, driving range, and purchase.[[11]](#footnote-11) In addition, Americans have limited experience with EVs; the same survey found that 70% of Americans have never been in an EV, and 30% do not know anything about them. Co-ops and other electric utilities can lower many of these barriers through member engagement, education, and programs. Initial cost barriers may be addressed with incentive programs (discussed below in the Business Structures section). Co-ops can play a key role in educating members about EVs and the many benefits they present, including lower fuel costs and cost of ownership than ICE cars.

Co-ops have taken steps to help members experience EVs through a variety of creative activities. Many co-ops hold “ride and drive” events, where members can experience EVs. Corn Belt Energy, a distribution co-op in Illinois, takes a family-friendly approach with its EV Drive-In event. Members, non-members, and dealers display and discuss their EVs, and food trucks and entertainment round out the evening.[[12]](#footnote-12) Gunnison County Electric Association, a distribution co-op in Colorado, allows its members to borrow its Chevy Bolt for up to a week to fully appreciate the EV experience.[[13]](#footnote-13) They also have a EV website, which facts about and benefits of EVs, fuel cost and CO2 savings calculators, EV models, a map with EV charging locations, and programs and incentives so that their members can get much of the information they might need to make EV decisions.[[14]](#footnote-14)

## Buses

As of last year, about 1,800 electric buses had been deployed in the U.S. (Atlas Policy 2019).[[15]](#footnote-15) Most of these were transit buses, with about 150 being school buses. The demand for electric buses is growing. The American Public Transportation Association (APTA) estimates that 0.8% of public transit buses on the road in 2019 were electric, but 4.7% of models built in 2018 and 7.6% of models on order were electric.[[16]](#footnote-16) This increasing adoption is being accelerated in part by state and transit agencies that are committing to electrified fleets and dedicating funding to that effort (see Policy section below for more details). School buses have so far experienced lower adoption rates, but Vermont Energy Investment Corporations (VEIC) and others have recognized the opportunity to leverage funds from the Volkswagen emissions settlement to purchase electric school buses and begin to understand their viability.[[17]](#footnote-17) Washington state, for example, bought 40 electric school buses in 2020, which will go to 22 different school districts, with VW settlement funds.[[18]](#footnote-18)

Battery electric transit buses available today offer about 100 to over 300 miles of range on 200 to more than 600 kWh battery packs (Table 2). Designed to use DC fast charging (DCFC, discussed in the Infrastructure section below), they can draw a maximum of about 70 to 300 kW when charging. School buses typically travel fewer miles during a day than a transit bus, and electric models have a range of about 65 to 150 miles on 90 to 220 kWh battery packs. They typically charge using Level 2 charging at a maximum of about 19 kW, but some have the option to be capable of DCFC. Because they have predictable schedules and spend much of the day parked, school buses are actively being examined as a vehicle-to-grid (V2G) or vehicle-to-building (V2B) resources, particularly during emergencies (see infrastructure section below).

Table : A sampling of transit and school bus models available, with battery capacity, estimated range, and maximum charging load.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Type** | **Brand** | **Model** | **Battery capacity (kWh)** | **Estimated range (mi)** | **Maximum charging load (kW)** | **Source** |
| **Transit** | Proterra | XR | 220 | 120 | 73 | [1] |
| E2 | 440 | 230 | 132 |
| E2 Max | 660 | 300 | 132 |
| New Flyer | xcelsior CHARGE | 100-600 | up to 260 | up to 300 | [2] |
| BYD | K9 | 350 | 145 | 80 | [3] |
| **School** | eLion | LionC | 90-220 | 65-155 | 19.2 | [4] |
| Blue Bird | Vision | 155 | 120 | 19.2 | [5] |
| Thomas Built | Jouley | 220 | 134 | 19.2 | [6] |
| Sources [1] Proterra. https://www.proterra.com/vehicles/catalyst-electric-bus/range/ ; https://www.proterra.com/wp-content/uploads/2020/06/Proterra-Catalyst-35-ft-Spec-Sheet-June-2020.pdf [2] Newflyer. https://www.newflyer.com/site-content/uploads/2017/10/Xcelsior-CHARGE\_USA-web.pdf [3] BYD. https://en.byd.com/wp-content/uploads/2019/07/4504-byd-transit-cut-sheets\_k9s-35\_lr.pdf [4] Lion Electric. https://thelionelectric.com/en/products/electric [5] Blue Bird. https://www.blue-bird.com/buses/electric-school-buses [6] Thomas Built. https://thomasbuiltbuses.com/school-buses/saf-t-liner-c2-jouley/ | | | | | | |

Major barriers to widespread adoption of electric buses include high initial cost and the need for charging infrastructure. Battery electric transit buses cost $750,000 to $1,000,000, or about twice as much or more than a compressed natural gas- or diesel-powered bus. Hybrid electric buses have less of an initial cost premium, costing around $650,000.[[19]](#footnote-19) Electric school buses cost about $350,000, or about 3 times as much as a fossil fuel burning one. Charging infrastructure may be installed at bus depots in many cases, but transit buses with long routes may need satellite charging locations to charge on route without having to return to the depot.

Co-ops are getting involved and generating interest in electric buses. NRECA, in collaboration with the Edison Electric Institute (EEI), the American Public Power Association (APPA), and APTA, has developed a guide for public transit agencies and electric utilities to prepare for electric bus adoption.[[20]](#footnote-20) Distribution and G&T co-ops are also testing electric school buses. In Minnesota, Dakota Electric Association and its G&T Great River Energy have been testing an electric school bus for two years, saving $12,000 per year in fuel and maintenance costs, and testing it in cold conditions with positive.[[21]](#footnote-21) Other co-ops are partnering with state agencies to use VW settlement funds to test electric school buses and understand their benefits, including fuel and maintenance cost savings, reduced noise and fumes, and the potential to supply power during peaks or other emergencies with the energy stored in the bus battery.[[22]](#footnote-22)

## Medium- and Heavy-Duty Vehicles

NRECA has been tracking the technology and market evolution of commercial EVs for several years. Although commercial EVs that are typically used in manufacturing or commercial facilities, such as forklifts, burden carriers, and side-by-sides, have already seen considerable uptake of electric models, over-the-road medium- and heavy-duty EVs are just now becoming available and will likely soon be seen charging and operating in co-op service territories. Adoption of these vehicles is being driven by sustainability commitments by companies such as Amazon,[[23]](#footnote-23) UPS,[[24]](#footnote-24) and Ikea.[[25]](#footnote-25) Additional push toward adoption may come from states with goals for significant reductions in air pollution. In July 2020, for example, 15 states and the District of Columbia signed a memorandum of understanding calling for 30 percent of new medium- and heavy-duty trucks and buses to be zero-emissions by 2030, and 100 percent of these vehicles to be zero-emissions by 2050.[[26]](#footnote-26)

In 2019, about 12,000 electrified medium- and heavy-duty vehicles other than buses were in use in the U.S.[[27]](#footnote-27) An estimated 39 medium-duty EV models, which include minibuses, walk-in delivery trucks, and box trucks, and 55 heavy-duty vehicles, including garbage trucks and truck tractors, are available or in development (Table 3). Models with lower battery capacity and therefore range are appropriate for in-city or town use, and can likely return to a staging yard or depot for charging at the end of a shift. These vehicles may charge via Level 2 or DCFC, depending on the size of the battery and the time between shifts. Long-haul vehicles, particularly semi tractors, will have larger battery packs, longer range, and need to charge on the go at truck stops or public charging stations via DCFC. Charging is discussed in the Infrastructure section below.

Table : Summary of medium- and heavy-duty EVs (that are not buses) available or in the development pipeline by weight class.

|  |  |  |  |
| --- | --- | --- | --- |
| **Weight class** | **Models available or planned** | **Battery capacity (kWh)** | **Range (miles)** |
| 3 | 7 | 49-99 | 60-220 |
| 4 | 10 | 61-136 | 50-200 |
| 5 | 12 | 62-135 | 50-150 |
| 6 | 10 | 99-200 | 60-220 |
| 7 | 10 | 120-352 | 60-230 |
| 8 | 45 | 88-1000 | 30-500 |
| Source: ORNL (2019) | | | |

As a member of the North American Council for Freight Efficiency (NACFE), NRECA and its member co-ops have access to a variety of reports that examine the benefits, challenges, and economics of alternative fuel freight vehicles, including EVs. These resources, along with Business & Technology Advisories summarizing report findings, are available on NRECA’s Commercial Electric Trucking website[[28]](#footnote-28) and are briefly summarized below.

Compared to comparable diesel-fueled models, medium- and heavy-duty freight EVs already have some advantages, and many disadvantages of EVs are likely to turn into advantages in the coming years. Medium-duty EVs in particular, now perform as well as or better than their diesel counterparts in typical freight weight capacity, net cost, operating cost, most maintenance issues except the availability of service centers, vehicle life, typical daily range, off-shift fueling, safety and emissions (Figure 1). By 2030, medium-duty EVs are expected to pull even with diesel models in terms of initial cost, residual value of used models, and maximum daily range, and outperform diesel models in every other category except for refueling speed and product maturity.[[29]](#footnote-29)

A screenshot of a cell phone

Description automatically generated

Figure : Comparison of the benefits of medium-duty commercial BEV models to their diesel counterparts. Source: NACFE (2018a).

Heavy-duty freight EVs are slightly behind medium-duty in terms of benefits over their diesel counterparts, but by 2030 EV models should perform as well as or better than diesel models in all areas except new cost, maximum life, refueling time, and product maturity (Figure 2). NACFE therefore expects that the adoption of freight EVs will occur over several decades, with medium-duty vehicles that have stable routes no more than 100 miles per day and return to a base charging location to transition to electric models in the near term.

A screenshot of a cell phone

Description automatically generated

Figure : Comparison of the benefits of heavy-duty commercial BEV models to their diesel counterparts. Source: NACFE (2018a).

The decision to electrify medium-duty fleets will depend largely on the total cost of ownership, which in term depends on several factors, such as having the charging infrastructure in place with adequate power supplies, managing batteries and their charging so that they can provide the longest useful life, and sometimes hard-to-predict market and regulatory issues.[[30]](#footnote-30) Long range and heavy-duty EVs will be possible in many applications, but face challenges particularly related to charging infrastructure and payload capacity.[[31]](#footnote-31)

Co-ops who engage early with freight operators can help them understand alternative fuel choices and the benefits of EVs.[[32]](#footnote-32) Through this engagement, co-ops can learn where charging infrastructure might be needed to encourage further growth in EVs and determine what infrastructure investments may be necessary to make it a reality. EEI, in collaboration with APPA and NRECA, has prepared a guide for fleet operators to prepare for EVs,[[33]](#footnote-33) which may be a useful place for co-ops to start the conversation.

## Charging Infrastructure

With EV adoption comes the need to develop infrastructure and grid supply that supports EV charging. Here we focus on the charging equipment that delivers electricity to EVs and its related distribution infrastructure.

Electric vehicles can charge at different rates based on the input current allowed by the vehicle’s batteries or its on-board battery charger, and the voltage available at the point of charge. Three types of charging can be utilized to charge EVs, and the type of charging utilized depends on battery size and how quickly the vehicle needs to be charged. (Table 4). In all cases, charging is orchestrated by EVSE. Level 1 and 2 EVSE regulate and safely supply AC power to the on-board charger of the EV, which converts AC to DC power and charges the battery. DCFC, or Level 3, EVSE supply DC power to the EV. For the purposes of this discussion, we separate charging by sector. In the residential sector, charging is presumed to be of passenger vehicles, and is carried out at residential voltages (120 or 240Vac). All EV types utilize public or workplace sector charging, which is typically Level 2 and DCFC (although some public Level 1 chargers do exist).

Table : Summary of EV charging methods by sector and type.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sector** | **Charging Type** | **Voltage** | **Current (A)** | **Typical power (kW)** | **Best Applications** | **EVSE Cost** |
| **Residential** | Level 1 | 120 Vac | 12 | 1.2 - 1.4 | Passenger vehicles: Short range (less than 100-mile) BEVs and PHEVs | Typically included with passenger EV |
| Level 2 | 240 Vac | 16-80 | 3.8 – 19.2 | Passenger vehicles: Long range BEVs | $500-1,000 plus service upgrades (if needed) and dedicated circuit |
| **Public and workplace** | Level 2 | 240 Vac | 16-80 | 3.8 - 19.2 | School buses: Normal routes Medium-duty vehicles: Short range that return to base location after shift | Hardware: $900 - 1200 (not network connected), $2800 - 3200 (network connected); Installation: $2300-3000 |
| DCFC (Level 3) | 480 Vdc | 100+ | 50 - 350 | Passenger vehicles: long trips Transit buses Medium-duty vehicles: Long range or do not return to base location after shift Heavy-duty vehicles | Hardware: $28,000-140,000 (depends on power output); Installation: $18,000 - 65,000 (depends on power and chargers per site) |
| Sources: US EPA (2013): https://www.energystar.gov/sites/default/files/asset/document/Electric\_Vehicle\_Scoping\_Report.pdf; ICCT (2019) https://theicct.org/sites/default/files/publications/ICCT\_EV\_Charging\_Cost\_20190813.pdf | | | | | | |

###### Passenger Vehicles

About 80% of passenger vehicle charging occurs at home, on either Level 1 or Level 2 EVSE.[[34]](#footnote-34) The simpler, lower cost option is Level 1 charging, in which the EV is plugged into a 120 V outlet with the cord provided with the vehicle. With Level 1 charging, the EV can draw 8 to 12 amps of AC current, providing anywhere from 2 to 5 miles of charge per hour. The member controls and schedules charging through the vehicle or the vehicle’s app, but the co-op has no insight into the charge behavior. The second, more expensive, but more controllable type of charging uses Level 2 EVSE, which deliver up to 40 amps, provides about 10 to 30 miles of charge per hour, and, if connected to the Internet, can communicate with both the member and the co-op. Level 2 EVSE cost about $500 to $1,000, and depending on any necessary service and wiring upgrades, can cost a few hundred to one or two thousand dollars for installation by an electrician.[[35]](#footnote-35) The advantage of Level 2 EVSE is two-way communication that allows the co-op (or a third party) to control charging and collect charging data. Without network-connected Level 2 EVSE, the co-op cannot directly control charging, will not receive information about charge behavior, and must rely on members to charge during beneficial times. Co-ops can encourage adoption of network connected EVSE through a wide variety of residential EVSE programs, which are discussed in the Business Structures section below.

The remaining 20% of passenger vehicle charging and essentially all charging of other EV types occurs in the commercial sector. Passenger vehicles may be charged at the workplace, in downtown or commercial areas, typically via Level 2 charging, or on long trips where Level 2 or DCFC may be employed. As discussed above, charging networks that consumers can use when they are away from home, or if they do not have residential charging available, are key to removing range anxiety barriers.

Many co-ops have worked to install EV charging networks to help alleviate range anxiety. A few examples include:

* Great River Energy (GRE), a G&T in Minnesota, partnered with distribution co-ops to install a charge corridor from Minneapolis-Saint Paul to Tettegouche State Park in northeast Minnesota. Rather than using the corridor as merely a connection between two end points, the co-ops installed chargers in towns and at attractions along the way to allow EV drivers to experience interesting sites along the way.[[36]](#footnote-36)
* North Carolina co-ops have been building out a charging network across co-op-served areas of North Carolina. They have installed 30 chargers and are investing $1 million on 21 more chargers to build a network that EV drivers can use to visit scenic and tourist attractions across the state.[[37]](#footnote-37) They also have an informative website that includes information about the benefits of EVs.[[38]](#footnote-38) The site also directs drivers to other sites for information on where to find public chargers, such as Plugshare and the Alternative Fuels Data Center.[[39]](#footnote-39)
* Western Farmers Electric Cooperative, a G&T in Oklahoma, and its distribution co-ops have partnered with investor-owned utilities, Frances Renewable Energy, and other organizations to develop a charging network whose goal is to provide charging within a one-hour drive from anywhere in the state. They site chargers in locations where drivers may be stopping anyway, like grocery stores and shopping centers, hotels, casinos, travel centers and gas stations.[[40]](#footnote-40)

###### Buses, Medium-, and Heavy-Duty Vehicles

Buses and freight vehicles have larger batteries than passenger vehicles and, depending on daily miles driven, may be charged using Level 2 or DCFC. Level 2 charging may be sufficient for vehicles that travel shorter distances during the day, return to a base location like bus depots or parking lots, and spend several hours of the day not in use. EVs that travel farther and operate for more of the day must use faster DCFC to recharge. This is especially true for long-haul freight vehicles, whose drivers simply cannot afford to wait long periods for charging several times a day. Trends toward higher voltage (350V +) DCFC stations will help address the need for fast recharging similar to a gas station experience. Barriers to adoption include siting charging in the right place, and charge time. To enable long-distance EV driving, networks of DCFC stations are necessary on popular routes. The West Coast Electric Highway is one such network in California, Oregon, Washington, and British Columbia. DCFC are located approximately every 30 miles on the two major north-south highways on the west coast, Interstate 5 and Highway 101.[[41]](#footnote-41)

###### Wireless Charging

All of the charging methods discussed above require the EV to be stationary and physically connected to an EVSE in order to charge. Wireless charging is also being developed and piloted for both stationary and moving EVs. For example, the transit authority in St. Petersburg, Florida is piloting wireless charging pads for their electric buses so they can charge at bus stops on their routes rather than having to return to the bus depot.[[42]](#footnote-42) Many researchers envision an future in which highways are equipped with wireless charging to charge EVs while they are driving.[[43]](#footnote-43) Inductive wireless charging through air, however, is potentially less efficient than charging via copper wires, so co-ops should keep an eye on the development of wireless charging and understand impacts related to reduced efficiency if they observe uptake of the technology in their areas.

###### Opportunities to Manage Charging

Different charging types and technologies meet different user expectations and therefore present different opportunities and impacts. When an EV driver connects to a Level 2 charger, chances are the driver does not need the EV charged quickly, but rather intends to park the car for a significant amount of time, like overnight or for the workday. In this situation, the driver or the co-op can determine the best time to charge the car, avoiding peaks and shifting charging to advantageous times of day. When connecting to a DCFC, however, the driver usually expects charging to commence immediately and finish as quickly as possible. Little opportunity is available to shift the demand of DCFC loads. DCFC is likely needed to encourage adoption of all types of vehicles, and is necessary for certain types like long-haul freight, but co-ops will need to understand the impacts of DCFC on their systems.

## Questions and Associated KRIs

###### How quickly will consumers, companies, municipalities, and school districts adopt EVs?

Understanding the answer to this question is key to EV decision making. If underprepared, co-ops could experience undesirable load growth, overloaded infrastructure, and frustrated customers. Overpreparing may lead to overinvestment in infrastructure or programs. Key metrics to track to keep tabs on EV adoption in your co-op’s service area include:

* National or regional adoption rate trends. Although may not be specifically applicable to your co-op, changes in national adoption trends may give early insight into adoption in your co-op.
* State or county specific EV adoption information, e.g. EV Hub, information from dealerships, DMV registrations. Localized information will help co-ops estimate how many EVs they are serving, of what type
* Variety of models available. Great demand exists for electric SUVs and pickups. When these models hit the market, co-ops may expect an uptick of adoption in their territories
* Cost, especially relative to a comparable ICE vehicle. Although total cost of ownership of EVs is already less than comparable ICE vehicles,[[44]](#footnote-44) initial cost can also impact consumer buying habits. If EVs are within range of ICE vehicles, expect greater adoption
* Availability of used EVs. Many consumers cannot afford or simply do not want a new vehicle. A growing market of EVs will likely increase the used EV market, allowing further expansion of adoption by otherwise unlikely adopters.

###### How do co-ops evaluate or build consumer confidence in EVs and charging infrastructure?

Adoption of EVs depends on consumers’ understanding on how to operate the vehicle, particularly how and where to charge it. Co-ops can provide information to potential buyers or fleet managers on how to charge at their homes or home facilities, and where to charge when they are away from those locations. Co-ops should also work to understand the charging needs of their members and build or encourage charging infrastructure where it is needed. In particular, the following data could be useful:

* Member surveys may give insight into member knowledge of EVs and the barriers to EV ownership, as well as driving behaviors to identify where additional charging infrastructure may be needed.
* Charge visits for public chargers in their territory to understand utilization and identify areas where more charging may be needed.

###### Where should co-ops install changing stations to build consumer confidence?

Co-ops may choose to install charging stations themselves, or partner with building managers, businesses, tourism boards, or municipalities to do so. Co-ops may consider visibility, ease of access, and traffic in deciding where to site stations. They should also consider the needs of EV drivers. Are drivers passing through the area on long trips and in need of DCFC? Do drivers tend to park for several hours in one location, like a restaurant, shopping center or hotel, and therefore can use Level 2 charging? These considerations depend on the co-op’s geography and may differ for distribution co-ops versus their G&Ts. Collaboration between distribution and G&T co-ops, however, can help develop a regional strategy of charging corridors and destination charging that covers the needs of EV drivers

###### How much does infrastructure cost, what are the trends, and when is the best time to invest in installation or upgrades?

Co-ops may pay more for early installation of EVSE, and as they become more widely adopted, costs may fall. Waiting too long to act on infrastructure upgrades may mean losing the opportunity to install well planned and highly functional infrastructure that gets well used. Co-ops should plan ahead, and monitor EVSE cost and technology trends (charging speed, equipment type, etc.). Co-ops should begin conversations with EVSE providers to understand costs and trends related to their EV charging plan.

# EV Business Structures: Topics and Trends

Co-ops have two main reasons for creating business structures: increasing EV adoption and managing EV charging. Because these two issues are related, co-ops may find that they need to create EV business structures around both EV adoption and charging. On the other hand, some co-ops may find that their members are adopting EVs without additional incentive or education from the co-op, and may instead focus on managing the charging load. Co-ops have a wide variety of options for encouraging EV adoption and managing EV charging load, which are discussed in this section

## Member Education and Outreach[[45]](#footnote-45)

One of the largest obstacles to EV adoption is a lack of broad consumer understanding of EV technology. Before implementing any EV or EVSE programs, your co-op may want to design an EV communications and education strategy. This strategy may, at a high level, include identifying the co-op’s goals related to EVs in the near- and long-term, and defining the scope of your initiatives. This discussion may involve defining target audiences, choosing the key information you want to share with your members, using best practices learned from other utility EV communications and behavior-change efforts, and outlining the specific actions that need to happen to implement your initiatives. Co-ops can use the information in this section as a resource for starting or building on an EV communications strategy.

###### Identify Key Audiences

Defining key audiences will help your co-op target your EV outreach initiatives. Your co-op may want to reach out to the following parties:

* **Individual Members.** As most EV owners will likely be individuals, your members are the most important audience of your EV education and outreach initiatives. You may want to consider tailoring messages to both prospective and current EV owners in your service territory.
* **Commercial Fleet Managers.** Increasing the number of EVs in commercial fleets is an important component of increasing EV adoption. Co-ops may want to offer test-drives of EV vehicles to fleet managers of commercial and industrial (C&I) members and work with them to determine whether or not EVs make sense for their fleet operations.
* **Dealerships.** As car dealerships play an important role in influencing customer-purchasing decisions and controlling what information your members will receive about their new vehicles, dealerships can be important partners in your co-op’s EV education and outreach efforts. Co-ops may even want to make EV dealerships part of their trade ally umbrella and add them to their list of contractors.
* **Government/Public Officials.** Engaging with public officials at the city, county, and state level is an important part of facilitating charging infrastructure deployment. Co-ops may want to work with these officials to streamline coding, zoning, and permitting processes around charging station installation.
* **Charging Equipment Installers.** Members looking to install residential EVSE will generally rely on the help of electrical contractors. Co-ops may want to collaborate with electrical contractors to (1) assess the need for new equipment (i.e., a meter socket box) or grid upgrades to support EV charging, and/or (2) install additional metering infrastructure to help members take advantage of any special EV rate plans, if applicable. Some utilities have created installation guides and are offering training courses to EVSE installers.
* **Local Businesses.** Although most charging will take place at home, increased availability of workplace charging infrastructure may reduce range anxiety among prospective EV buyers. Co-ops may want to reach out to local businesses about the possibility of becoming workplace charging site hosts.
* **Schools.** Some utilities are incorporating schools into their EV outreach initiatives. School programs can be excellent tools in educating parents and future co-op members.

###### Consider Communication Channels

Utilities are using a variety of communication channels to provide EV-related information to end-users. Using more than one communication channel increases your co-op’s chances of reaching your members. Co-ops may want to consider using one or more of the following channels:

* **Member Services.** Members with questions about EVs are likely to pick up the phone or write an email, if they are not able to find the answer to their questions elsewhere. A number of utilities have trained specific staff as EV “experts” who respond to EV-specific questions and issues. Co-ops concerned about liability issues — or that do not have the resources to respond to EV inquires — may want to direct member inquiries to a specific contact at a local EV industry association.
* **Bill Inserts.** Bill inserts are a method to reach many end-users and may be a good way to broadcast any information on any special EV rates.
* **Blogs.** Online blog posts can be an easy, free method of sharing information on your co-op’s EV-related research or programs with your members.
* **Brochures/Handouts.** Easy-to-read fact sheets (printed or online) can be a good format for educating a range of audiences on key EV basics. Brochures can be distributed to EV dealerships or at EV-awareness events. Fact sheets are particularly useful for disseminating information on your co-op’s EV incentives. For example, Dakota Electric created downloadable fact sheets with information on its two special EV charging programs.
* **Annual Meeting or Cooperative-Moderated EV Forum.** Co-ops may consider setting up an online forum or Facebook page for members who own EVs — or are considering buying EVs — to publicly share information and ask questions.
* **Newsletters.** Printed or online newsletters can be a good opportunity to profile a member with an EV or encourage participation in your EV program. Some utilities are using commercial and industrial (C&I) newsletters to provide EV-related information specific to commercial customers, such as information on workplace charging stations.[[46]](#footnote-46)
* **Annual Reports.** Annual reports may be a good place to highlight any work your co-op is doing to study EVs for your members. Wisconsin generation and transmission (G&T) Dairyland Power Cooperative discussed the co-op’s plan to purchase more low-emissions vehicles for the co-op’s fleet in its annual report, along with a picture of the co-op branded Ford C-Max PHEV.
* **Online Videos.** Videos are a great way to bring your co-op’s EV work to life.
* **Public Presentations/Seminars.** Some utilities are presenting information on EVs at conferences and meetings of local groups, such as homeowners’ associations, business leadership councils, and Chambers of Commerce. In March 2013, Wisconsin co-op Polk-Burnett Electric Cooperative offered members a free seminar on EVs, which covered a range of EV topics, such as EV types, different models, charging, range capabilities, and batteries.
* **Social Media.** A number of utilities are using Facebook, Twitter, and other social media channels to disseminate information on EVs and publicize their EV-related efforts. For example, Austin Energy created a separate EV Facebook page with EV news, updates, and events.[[47]](#footnote-47)
* **Websites.** As today’s consumers do much of their research online when considering a new vehicle purchase, engaging and sophisticated EV-related web content is a critical component of EV education. A number of utilities have created EV web “portals,” which provide a wide range of useful EV-related information.

###### What EV-Related Information Should Co-ops Provide Their Members?

Co-ops may take different approaches to deciding what role they want to play in educating their members on EVs. Your co-op can draw on what you have learned about EVs and member attitudes towards EVs in your service territory to identify EV-related topics your members want to know more about. Most potential EV buyers need information about the availability of EVs in their area, the environmental and other benefits of EVs, their charging options, and the experiences of fellow members who have already adopted EVs.

NRECA and Touchstone Energy provide several ready-made resources for marketing and communicate various aspects of electric vehicles. Those resources can be accessed on Coopeartive.com.[[48]](#footnote-48)

## Increasing EV Adoption

As discussed above, EV adoption faces several barriers due to potential consumer concerns. These may be related to the range and range anxiety of EVs, high initial cost, questions about EV performance, total cost of ownership, charging, and environmental impact. Co-ops and other utilities can and are playing a role in addressing and mitigating to some degree these concerns. Some co-ops find that partnering with car dealers is an effective way to increase EV sales, while others have success with dealer alternatives or direct interactions with their members. Some of the approaches that co-ops may consider are outlined in this section.

###### Dealer Programs

If electric vehicles, either new or pre-owned, are not available in a specific area, the likelihood of a large number of EVs on the road will be remote. Low EV sales at auto dealerships may result for a variety of reasons, including sales staff that lack knowledge or experience with EVs, uncertainty in consumer interest in EVs, and a lack EV service technicians.

Co-ops can partner with dealers to increase EV inventory and sales. To do so, co-ops should first identify where their members purchase vehicles. In some cases, members may purchase vehicles outside their co-op’s service territory, so the co-op may find it needs to work with dealers both inside and outside its territory. Co-ops should also understand the availability of EVs in their area, and which dealerships are selling them. Car shopping websites such as Cars.com and Autotrader.com provide information on the number and type of EVs sold in a given area within and near a service territory.

A co-op can begin the relationship by meeting with the dealership owner and manager and explain in detail the co-op’s EV strategy and commitment to growing or even creating a market. If the dealer does not see a commitment to growing the market, they will most likely be hesitant to invest in resources to sell EVs. Next, the co-op and dealer should decide on a strategy that will encourage EV purchases by co-op members. Possible strategies include:

* **Dealer incentives**. Many dealers operate on thin margins, so co-ops may explore financial incentives to the dealer and sales staff for EVs sold to co-op members. Such incentives can provide a necessary inducement to encourage sales staff to become informed on EVs and be able to discuss their benefits and how to charge them with potential adopters.
* **Marketing material**. Many potential EV adopters may not know about the benefits of EV ownership, such as government or co-op incentives, special charging rates, and the value of EV ownership. Co-ops may work with dealers to place signage and information inside the dealership, detailing pertinent information that co-op incentives, rates, and the value of EV ownership.
* **Notification of sales**. Co-ops should develop relationships with dealers to be able to have advance notice of EV sales so that co-ops can relay that information to their members. Advance notification of sales should be a requirement if the co-op offers incentives to the dealer, and may otherwise be a good first step in establishing a working relationship between the co-op and dealers.
* **Secret Shopper**. The co-op may consider sending “secret shoppers” to dealers in order to check on how they discuss EVs and co-op EV or EV charging programs with potential buyers. This method might be used before approaching a dealership or even once a relationship with the dealer has been established to understand how the buyer experiences EV shopping, and to identify opportunities to improve it.

###### Alternative to the Dealer

In some cases, the co-op may find limited opportunity to partner with dealers, or limited available of EV brands. In these situations, co-ops may consider group purchase programs or other sales mechanisms through online or otherwise remote services. For example, Today’s Power, which is fully owned subsidiary of Arkansas Electric Cooperatives, Inc., has launched an EV ordering program to bring EVs to co-op markets. In partnership with McLarty Auto Group, which owns six dealerships in Arkansas and Missouri, Today’s Power offers group purchase programs for co-ops. The program, which is available to all electric co-ops, allows co-ops to order EVs from brands like BMW, Honda, Volvo, Toyota, and Nissan for their vehicle fleets. and designed for co-op fleets at discounted prices. In the future, Today’s Power plans to make the program available to co-op members.[[49]](#footnote-49)

Co-ops should also develop strategies to help members purchase used EVs, especially low- and moderate-income members who may most benefit from fuel and maintenance cost savings, or any member who may not necessarily want a new car. In these situations, that co-op may need to partner with a car buying service that finds cars in other regions and delivers them to the purchasers. Such companies offering online shopping for preowned vehicles include Carvana.[[50]](#footnote-50) Their delivery fees are typically in the $300 to $600 range, and they offer a 7-day guarantee. As part of an EV program, the co-op could rebate the delivery fee.

###### Member Education and Hands-on Events

The vast majority of drivers have never been inside or driven an EV. “Track days” and “ride and drive” events effective ways to create excitement and hands on experience with the cars. These events can be open to the general public or invitation only events targeting key community leaders that can be technology and co-op ambassadors. Such public events are prime opportunities to partner with local dealers, fish and wildlife conservation groups, environmental advocates, and health advocates.

###### Leveraging Early Adopters

Current EV owners typically embrace the role of an early adopter. Many EV owners love educating others about the benefits of EVs and alleviating potential concerns of prospective owners, like lack of power and range anxiety. If early adopters are present within the service territory, it would be beneficial for the co-op to engage them as ambassadors of the technology. They could be active participants in the co-op’s EV rate and control programs. To be effective, these ambassadors need to also be well-educated in the rationale for and the benefits of the co-op’s programs, and be given enough information to educate non-EV owners on the value of the co-op’s programs and the co-op’s leadership on EVs.

The remaining business structure strategies discussed below focus on aspects related to the EV charging load: deploying the equipment – specifically EVSE – required to be able to control EV charging load; streamlining the permitting process for commercial and public EVSE installations; developing managed charging programs; and setting electricity rates for EV charging.

## EVSE Program Concepts

Key to mitigating any negative impacts of EV charging load is the ability to control the load so that most of it occurs during off-peak hours, when electricity is less expensive and abundant. This opportunity is available in situations where the EV is parked for long periods of time - at homes, bus depots, fleet parking lots, or workplaces – and the driver is not expecting to charge the vehicle quickly and continue driving once it has sufficient charge. Co-ops control charging through network-connected Level 2 EVSE, which is often not the cheapest option for consumers when they choose how they will charge their EVs. Consequently, co-ops may find that they must encourage adoption of particular EVSE that allow them to control charging.

NRECA has explored how co-ops may encourage adoption of network-connected, controllable EVSE in the residential sector specifically.[[51]](#footnote-51) Some of these program concepts translate into workplace or commercial settings as well.

Eight program concepts that can be tailored to a specific co-op’s needs are presented below in three groups: Education and Partnerships, Traditional Program Strategies, and EVSE as a Service (Figure 3).

A screenshot of a cell phone

Description automatically generated

Figure : Summary of program concepts in terms of level of effort and EV maturity.

###### Education and Partnerships

As a first step, co-ops can leverage education opportunities and partnerships to offer programs that require relatively few co-op resources.

**1. Member EVSE advising:** In this education-based concept, the co-op’s knowledgeable staff provides members with information on existing incentives, such as federal and state tax credits for EVs, and installation assistance. The co-op does not offer additional financial incentives of their own, but instead leverages the significant incentives that already exist through various government jurisdictions around the country.

**2. Auto dealer EV + EVSE partnership:** The co-op leverages a strong relationship with area dealerships to promote EVSE. The dealer may, for example, provide customers educational literature on co-op EVSE programs, or sell and finance an EV + EVSE package. For some, co-ops partnerships with dealers are either not feasible because the dealers in the area were not focusing on EV sales or not desirable because the co-op prefers to interact directly with its members. Co-ops likely need to be vendor agnostic in their partnership efforts, which could mean partnering with many dealerships.

**3. EV-ready new homes:** The co-op develops a strong partnership with developer(s) to build homes with EVSE installed, or ones that are at least EVSE-ready (that is, with a dedicated 240V circuit to the likely charge location). Developers who build energy efficient and/or solar homes may be a good fit for these partnerships. Co-ops in high-growth areas see potential value in guaranteeing that residential EVSE infrastructure is put in place during development, limiting retrofit costs. Co-ops with low growth and low EV penetration noted that this approach may be premature for their purposes.

###### Traditional Program Strategies

These program concepts use approaches that have been applied to other products and, therefore, are already familiar to co-ops.

**4. Rebates:** Similar to many current co-op programs, members would purchase and install a co-op approved EVSE and receive a rebate from the co-op for the EVSE and/or the installation. Rebate programs are by far the most common residential EVSE programs among co-ops. Rebates generally range from $200 to $500. Some co-ops require enrollment in load management programs, EV rates, or data sharing programs to qualify for the rebate. Among utilities, Green Mountain Power takes perhaps the most novel approach, offering a free EVSE with the purchase of an EV, and unlimited off-peak charging for $30 a month[[52]](#footnote-52).

**5. On-bill financing:** Similar to co-op programs for large investments like geothermal heat pump ground loops or HVAC equipment, co-ops would provide financing for the EVSE and possibly the installation. Monthly payments would be included on member electric bills. Co-ops who have had good results with on-bill financing programs in the past can leverage those experiences. A significant challenge, however, may be having a way to recoup costs for non-payment of an account.[[53]](#footnote-53)

**6. No-hassle installation:** Once a member has purchased an EVSE from the co-op’s approved list, the co-op manages the installation process by coordinating co-op technicians and electricians. The co-op covers all installation costs (perhaps with a cap). This approach is appealing to co-ops with service-oriented business models, providing their expertise to guide the member through the installation. Some co-ops, however, noted potential risk in recommending a contractor and taking the lead on the installation process. Members may attribute any problems associated with the installation to the co-op, which may create an undesirable liability.

###### EVSE as a Service

Finally, with enough experience and EV penetration, co-ops may want to explore EVSE programs that offer value-added energy services. In these concepts, very little is required of co-op members beyond telling the co-op they want an EVSE. The co-op, perhaps in partnership with a vendor, then facilitates the installation of the EVSE.

**7. EVSE lease program:** The co-op owns and installs the EVSE, charging the member a monthly fee for the service. Energy costs may also be included in the flat fee, or may be charged separately on a consumption basis. Installation and sales could be handled by a co-op subsidiary that specializes in HVAC equipment and building efficiency solutions. To co-ops who are focused on providing energy services to members (without the help of third parties), this may be an appealing approach. However, many co-ops may not want to own EVSE, due to the additional liability for the equipment and the need for staff resources for installation and repairs. In addition, the EVSE could become a stranded asset, if the member moves and the new resident does not purchase the EVSE service.

**8. End-to-end vendor solution:** The co-op partners with a vendor to provide program elements from procurement through operation, tailored to co-op needs. A complete end-to-end solution provided by vendors, such as eMotorWerks or Greenlots, may include, for example, (1) an online marketplace for members to select, purchase, and receive a rebate for their EVSE, (2) installation coordination with local, EVSE-trained electricians, and (3) a charge control platform for coordinating DR events or smart charging. This approach has the potential to reduce the staff time needed to run the program. Because the vendor is representing the co-op, a good relationship with a reputable vendor is essential. Cost, however, could be a challenge as co-ops are often too small to justify the start-up costs associated with customizing the vendor platform. Economies of scale may be gained, if such a program is offered by the generation and transmission (G&T) co-op rather than individual distribution co-ops. Table 5 summarizes the opportunities and risks of various program concepts.

Table : Opportunities and risks associated with various program concepts.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | **Program Concept** | **Opportunities** | **Risks** |
| **Education & Partnerships** | 1. Member EVSE advising | | * Low cost for co-op. * Educate both members and co-op staff. | * May not provide adequate financial assistance to members. |
| 2. Auto dealer financing | | * Low cost for co-op. * Simple financing for members. | * May miss opportunity to be trusted advisor on EV charging. * New, potentially unknown partner. * Covering all EV brands in territory may require significant outreach. |
| 3. EV-ready new homes | | * Low cost for co-op. * Reduces installation cost * Installation cost minor compared to home price. * Ready infrastructure may encourage EV purchase. | * Must develop relationship with builder that values EV-ready home as selling point. |
| **Traditional Program Strategies** | 4. Rebates | | * Familiar approach. * Reduces cost to member. | * If member dislikes product, dissatisfaction may be aimed at co-op. |
| 5. On-bill financing | | * Familiar approach for some. * Reduces up-front cost member. * Provides easy process for re-payment. | * May not have process to recoup costs for non-payment. * Requires more co-op effort than rebate program. |
| 6. No-hassle installation | | * Provides additional service to member. * Reduces member effort. | * Co-op must select contractor and takes on liability for contractor’s work. |
| **EVSE as a Service** | 8. EVSE lease program | | * Low effort for member. * Promotes co-op as EVSE expert and provider. | * Asset may be stranded if member moves. * Potential co-op liability for equipment, contractor installation. |
| 9. End-to-end vendor solution | | * Low effort for member. * Promotes co-op as EVSE expert and provider. | * Potential co-op liability for equipment, contractor installation, and vendor. * May require partnering with other co-ops to make vendor solution cost-effective. |

###### Workplace and Public Charging

In some cases, EVSE installation at workplaces or in public settings can be a more complex, lengthy process than residential charging, involving general contracting, electrical, landscaping, paving, concrete, masonry, and communications systems. The permitting process may also be more complex and may require the involvement of several permitting offices and detailed installation drawings from an engineering company.

It is particularly important to plan carefully when installing workplace/public EVSE, as it often can be costlier to expand later. The planning process may involve considering factors such as:

* Anticipated interest in EVSE,
* Anticipated charging hours,
* Management and control of charging-station use, and
* Employee policies on EVSE use (e.g., amount of charging time allowed per vehicle).

The U.S. Department of Energy has created a useful handbook for public charging station hosts.[[54]](#footnote-54)

Co-ops interested in facilitating the expansion of charging infrastructure in their service territories may want to advise commercial members on installing workplace EVSE for the use of employees and/or customers. More and more employers are providing new charging stations as part of corporate sustainability initiatives and in order to attract employees. Some employers pay for the cost of infrastructure through a daily charge; others offer charging as a free employee benefit. Workplace EVSE has the added benefit of increasing consumer exposure and access to EV charging. Co-ops may also consider conducting or supporting the build out of public charging infrastructure. This includes stations at workplaces, retail locations, public parking lots, etc. A handful of states have established regulations on utility EVSE ownership (see Policy section). Since EVs are often away from home during the day workplace charging also offers the opportunity to use excess solar generation to charge EVs.

## Streamlining the EVSE Permitting Processes[[55]](#footnote-55)

In non-residential charging settings, particularly public and workplace, the permitting process for EVSE installation can be inhibitive. Co-ops can support and enable the deployment of charging infrastructure by working to streamline the cost, complexity, and duration of EVSE installation, permitting, and inspecting. In some cases, these multiparty dealings can last up to month, slowing EV deployment. Shortening the duration of the permitting procedure simplifies the process of acquiring an EV, and lowers costs and uncertainty for developers and business owners looking to invest in EVSE.

Co-ops interested in working to streamline permitting processes can start by learning more about the procedures in their service territories and identifying any inefficiencies or areas for improvement, such as:

* Permitting fees,
* Vague or unnecessarily complex zoning rules about charging station siting,
* Inconsistent processes across local jurisdictions,
* Insufficient or non-uniform EVSE signage,
* Lack of enforcement for charging-only use of public charging spaces, and
* Lack of coordination between stakeholders.

Your co-op can use this initial review to identify the most high-impact actions your co-op can take to improve local processes.

Electrical contractors and inspectors are critical partners in the EVSE installation process. Electrical contractors will likely be the first point of contact for certain member questions about EVSE installation, such as whether an electrical panel upgrade is necessary, where to site a charging station, where additional metering infrastructure should be installed, etc. It is important that they understand EVSE specifications and technical information and their effect on power delivery systems. There are a number of useful resources designed to support EVSE installation training, including:

* **National Electrical Contractors Association.** NECA’s Electric Vehicle Infrastructure Training Program (EVITP) provides training and certification for electricians throughout the U.S. through a network of electrical industry training centers and community colleges. The curriculum consists of two 24-hour courses, covering residential, commercial, public, and fleet installation best practices.[[56]](#footnote-56)
* **U.S. Department of Energy.** DOE’s *Plug-In Electric Vehicle Handbook for Electrical Contractors* was designed to answer basic questions about EVs and charging infrastructure and to point to additional information.[[57]](#footnote-57)

## EV Charging Control Strategies

Once network-connected, controllable EVSE are deployed, the co-op can begin to control and shape charging load to avoid peaks and better match the electricity supply. Controlling EV charging can take many forms, and how a co-op decides to control charging depends on its goals. In the near term, these goals may include increasing EV sales and adoption, growing managed load, and establishing the co-op as the members’ trusted source for EV information and EV charging services. As the aggregate load of EVs increases, however, co-ops will need to address impacts in two areas:

1. **Distribution grid infrastructure.** EV drivers on flat electricity rates tend to plug in to charge their cars upon returning home. If a large number of drivers in a neighborhood return home and commence charging at the same time, demand may exceed the capacity of the distribution transformer or other local infrastructure. Rather than increasing the hosting capacity of the distribution grid, shifting load to times of day when the grid is underutilized is an effective means of providing additional electricity without investing in grid upgrades.
2. **Power procurement.** One of the benefits of EVs is increased electricity sales,[[58]](#footnote-58) but co-ops will want to strategically procure cheaper off-peak power over expensive peak power, and shift demand to times of day when electricity rates are lower. In addition, as variable renewables increase their share of the power supply, co-ops may need to match flexible loads like EVs to the available supply.

Co-ops will need control solutions to address these impacts, increase load factor to avoid the need for expanded infrastructure, and align EV charging load with supply.

Where to address and control charging is a key consideration. More than 70 percent of EV charging occurs at home. EVs are generally at home overnight and for long periods of time, allowing flexibility in when the vehicle is charged. Consequently, a co-op should focus on residential charge control opportunities.

Figure 4 emphasizes the effectiveness of using indirectly controlled charging through TOU rates with off-peak hours from midnight to 6 am as compared to load profiles for uncontrolled EV charging.

A close up of a map

Description automatically generated

Figure : Examples of load profiles for uncontrolled EV charging (left) and indirectly controlled charging through TOU rates with off-peak hours from midnight to 6 am (right). Figure modified from The EV Project (2013).

NRECA has examined control strategies for residential charging, which are summarized below.[[59]](#footnote-59) These strategies may be transferrable to other sectors where charge control is possible, specifically in cases where the vehicle is parked for long periods of time without expectation of an immediate charge.

The charge control strategies fall into two main approaches: indirect and direct control. Indirect control provides nudges via financial or other incentives that influence member charge behavior. Under these strategies, members can use either Level 1 or Level 2 EVSE to charge their vehicles. Direct control is managed by the co-op or a third party through a Level 2 EVSE, and includes auto demand response (DR) and flexible charging services.

###### Indirect Control Strategies

**Rate Structures:** Price signaling through time-dependent rates gives members financial incentive to charge their EVs during low-cost periods. Price signal strategies include time-of-use (TOU) rates, off-peak charging for a reduced rate or monthly fee, and peak demand charges.

**Required equipment:** If the price signal applies to the EV separately from the rest of the home, a second meter and/or a Level 2 EVSE capable of revenue grade metering is necessary. If the rate applies to the whole home, no additional equipment is required.

**Benefits:** Proven to be effective at shifting load, provided that the financial incentive is appreciable and there is flexibility to charge during on-peak hours, if necessary. If rates are set so they reflect the cost of power, the co-op does not gain or lose financially; the costs and savings are passed to the member.

**Challenges:** If the price signal applies to the EV, installing a separate meter and/or Level 2 EVSE capable of revenue grade metering adds significant cost to the implementation of this strategy. When the rate applies to the whole home, the member may have little to no incentive to install a Level 2 EVSE, and the co-op misses out on an opportunity to install the equipment necessary for future direct control. EV owners who are worried about higher bills due to on-peak usage of other products in their homes may be discouraged from signing-up for a whole-home rate. Finally, at high EV penetration, the co-op may experience a rebound peak if members schedule charging to begin at the start of off-peak periods.

**Rewards Programs:** Rather than changing or adding rate structures, the co-op can reward off-peak charging and voluntary charging load reduction (sometimes called voluntary demand response (DR)) through bill credits or other rewards programs. This strategy requires the co-op to announce curtailment requests via email, text, or phone. EV charging must be monitored so that the co-op can reward appropriately.

**Required equipment:** Device to monitor load reduction. May be gathered directly from the EV using products like FleetCarma,[[60]](#footnote-60) which collects data from the EV through a small piece of equipment that connects to the vehicle’s onboard computer and transmits it to the co-op, or through Level 2 EVSE and/or a separate meter.

**Benefits:** Potentially easier to implement and more flexible than special EV rates, greater flexibility in monitoring equipment.

**Challenges:** Determining appropriate levels for bill credits or rewards, factoring in costs related to monitoring equipment. Similar to using price signals, rebound peaks are possible at high reward program participation rates.

**Green Power Mix Options:** The co-op can encourage a behavior change through non-financial incentives, especially for the generally less cost sensitive early EV adopters. One example is providing green power (i.e., retiring renewable energy certificates on a member’s behalf) to EV owners to enhance the green attributes of EV ownership and encourage charging during periods of excess renewable generation. These incentives are combined with TOU rates that incentivize off-peak charging on renewable energy.

**Required equipment.** None.

**Benefits.** Provides additional, non-financial incentive to encourage members to charge off-peak that plays to first adopters’ environmental motivations for getting an EV. Supports decarbonization and boosts demand for renewable energy.

**Challenges.** Unless combined with an EV TOU rate, this strategy does not provide incentive for the member to install Level 2 EVSE.

###### Direct Control Strategies

Direct control strategies are those in which a system administrator, either the utility or a third party, controls when and how EVs charge, rather than relying on the member to respond to behavior nudges. These strategies include the familiar, such as auto (nonvoluntary) DR, and newer techniques that are tailored to management of EVs and other flexible loads.

**Automated Demand Response:** The co-op cuts power to the EV during DR events to curtail load and reduce expensive system demand peaks. Unless the member contacts the co-op and is allowed to opt-out, charging is not allowed during the event. Co-ops can use a similar approach to limit charging to off-peak hours. Instead of curtailing load during system peaks, it is curtailed on a daily basis, limiting charging to nighttime hours. The EV charging circuit is controlled separately from the rest of the house, using a load control switch or a Level 2 EVSE. Co-ops can offer the charging for reduced rates or a fixed monthly fee. Many co-ops offer such a program, frequently called an “EV Storage” program.

**Required equipment.** Load control switch or Level 2 EVSE.

**Benefits.** Co-op familiarity and experience with DR programs reduces the learning curve, and auto DR yields more curtailment than voluntary DR. An auto DR program presents the opportunity to incentivize installation of Level 2 EVSE for managed charging. Level 2 EVSE provides two-way communication to confirm curtailment and collect charging data.

**Challenges.** If used as an alternative to EVSE, load control switches do not facilitate managed charging control strategies.

**Managed Charging:** Managed charging leverages the long, often overnight, periods that EVs are parked at home to coordinate charging at the system level. When an EV driver returns home and plugs in the vehicle, it does not matter when and how the EV is charged, as long as it is ready with the required amount of charge when the driver needs it. Managed charging allows the co-op to match load with supply, minimize electricity costs, and avoid rebound peaks. As supply becomes more variable due to a growing share of renewable generation, the ability to manage flexible loads in real-time will become an essential tool for electricity providers.

Managed charging relies on member inputs to determine how to charge the vehicle in a way that works for them as well as the utility. These inputs, gathered through Level 2 EVSE, include the vehicle’s state of charge (SOC) before charging,[[61]](#footnote-61) the amount of charge needed, and the time the EV needs to be available with that charge (for example, “I need 75 percent charge by 7:30am”). With this information, the charge control platform – be it the EVSE control platform, a Distributed Energy Resource Management System (DERMS) platform such as Virtual Peaker, or a smart home platform, such as Google Home – automatically decides when and how to charge each EV based on aggregate demand. This creates a seamless charging service for the member. Using a DERM or smart home platform further expands the co-op’s load control capabilities by adding the capacity to control other flexible loads. Managed control platforms could also eventually enable co-ops to provide vehicle-to-grid (V2G) services by aggregating their EV resource for use when the grid calls for additional supply.

**Required equipment.** Level 2 EVSE

**Benefits.** Allows co-op to match demand to supply in real-time, avoid rebound peaks associated with tiered rate structures, and provide charging-as-a-service to members. Opens potential to aggregate EV resources for V2G services.

**Challenges.** By providing charging-as-a-service, the co-op takes on the responsibility of providing EV charge to member expectations. Until a solution is developed, the member must input SOC information in addition to charge preferences.

###### Examples: Auto DR

Delaware Electric Cooperative (DEC) conducted an auto DR pilot in 2018, and expanded it to a program in January 2019. Members who participated in the pilot received a ChargePoint Level 2 EVSE from DEC, then paid for its installation and agreed to share their data with DEC. DEC integrated with the ChargePoint platform to send interrupt signals during peak reduction periods. DEC noted that two pilot participants used the EVSE to schedule all charging to be overnight, effectively taking their load out of the peak time, and shifting to off-peak. For the 2019 program, DEC offers a one-time credit of $100 for installing the approved EVSE and $5 per month bill credit for participating in the program.

Green Mountain Power (GMP) is an investor-owned utility in Vermont. GMP offers unlimited charging outside of peak events for a fixed monthly fee of $29.99. Power to the EV charging circuit is cut during peak events with a load control switch, but customers can contact GMP to opt-out of the event and charge for $0.60 per kWh. For an average EV driver, the monthly fee is equivalent to an electricity rate of $0.10/kWh, assuming the EV is driven 1,000 miles a month and uses on average 300 Wh per mile[[62]](#footnote-62). Although fixed fee structures can lead to increased usage, such as increased cell phone data usage when data is unlimited, this risk for EV charging seems low, since EV consumption is tied to the distance driven and drivers are not likely to drive extra miles simply because they are free.[[63]](#footnote-63) GMP’s program has been very popular and successful, with 300 customers enrolled and very few complaints, according to Graham Turk, Innovation Strategist.

###### Example: Managed Charging Rewards Program

The IOU American Electric Power (AEP) is working with eMotorWerks to provide charge control options to their customers. The program uses Level 2 EVSE to automatically shift charging to off-peak hours for a $5/month bill credit with five opt-outs per month. Customers can also allow AEP to reduce charge current from 4pm to 7pm for a $3 credit per month with 2 opt-outs per month, or participate in day ahead peak demand events for $5 credit per event.[[64]](#footnote-64)

###### Developing an EV Charge Control Strategy

The EV and power supply markets are rapidly and simultaneously transforming, and the well-prepared co-op will be able to respond to and capitalize on this changing landscape. Many co-ops already control EV charging to some extent by offering rate structures and other incentives that encourage members to charge when most beneficial. At low EV penetration, these indirect strategies have proven to be effective. In the longer term, however, direct and especially real-time control of EV charging may be necessary to better match EV load with a more variable supply and increase distribution grid load factor.

Although some direct control strategies can be carried out using a load control switch, Level 2 EVSE offers a broader range of control strategies, including managed control that allows the co-op to respond to real-time pricing, supply fluctuations, and grid conditions. Because it will take time to deploy Level 2 EVSE into the field in significant numbers, co-ops should begin planning for direct control strategies in the near term, deciding which Level 2 EVSE (and perhaps the associated charge control platform) best suits their needs and deploying that equipment.

In the near term, a co-op can develop strategies for identifying EVs in their service area, as well as begin indirect control strategies, such as price signaling and rewards. Steps for preparing for future direct control include establishing the co-op as the members’ trusted source for EV charging information, including how and when to charge, to prepare members for the charging-as-a-service future of direct control. The co-op can also decide how it will control EV charging and use indirect charge control programs as an opportunity to deploy the Level 2 EVSE that will make direct control possible. These activities will address current EV charging, while building a solid foundation for future direct control.

## Designing and Implementing an EV Rate Program

By far the most common residential charge control program used by co-ops and utilities is TOU rates, either whole-home or EV-specific. Key to implementing a successful EV rate program is setting the right rate: one that will send proper price signals to allow members to determine whether they want to modify their behavior to charge at off-peak times and ultimately reduce costs to the co-op and in turn the co-op’s membership as a whole.

The difference between on and off-peak rates must be large enough for the member to see value in altering their behavior to off-peak charging. If on and off-peak rates are similar, then the member may not see value in altering behavior to charge during off-peak hours. A study by San Diego Gas & Electric (SDG&E) found that customers on EV rates with higher ratios between on and off-peak hours[[65]](#footnote-65) shifted more of their charging to off-peak. On-peak rates of about 2, 4, and 6 times greater than off-peak rates resulted in 78 percent, 83 percent and 85 percent of total charging during off-peak hours, respectively. Researchers estimate that on-peak rates greater than 6 times off-peak yield minimal additional shifting.

More recently, Salt River Project (SRP) studied load shifting with TOU and EV rates. They found that customers on a basic flat rate plan tend to begin charging their vehicles when they arrive at home, often in the late afternoon. Customers on whole home (on- to off-peak ratio ~ 3) and EV TOU (on- to off-peak ratio ~ 3.5) rates shifted most of their charging to off-peak hours.

Many utilities are using EV rate plans to incentivize off-peak charging. Price signaling through time-dependent rates gives members financial incentive to charge their EVs during low-cost periods. Price signal strategies include TOU rates, off- peak charging for a reduced rate or monthly fee, and peak demand charges.

TOU rates include at least on-peak and off- peak rates, but can include more granularity. Typically, off-peak rates occur overnight and on-peak rates in the morning and evening hours. Co-ops that have photovoltaic (PV) or other distributed generation may set off-peak hours to include the hours of distributed generation, such as the afternoon PV generation, as well. The rates and peak hours may vary with season, and may apply to the whole home or only to the EV. If the rate applies to only the EV, the EV must be metered separately from the house. Often co-ops and utilities install a second AMI meter on the EV circuit, but many EVSE manufacturers are now developing Level 2 EVSE models that include this metering capability. TOU rates are by far the most prominent EV charging control strategy employed by utilities and co-ops.

Although co-ops and utilities most often use peak demand charges for commercial and industrial customers, they may also be used in residential rate structures. Peak demand charges are calculated on the highest demand interval (often 15 minutes or 1 hour) during  
a billing period. Peak demand charges can encourage members to charge EVs at lower current, reducing the magnitude of the load but increasing charge time. Alternatively, peak demand charges can be used to reduce system peaks if demand charges apply to a peak window. Mid-Carolina Electric Cooperative, for example, has this rate in place for all accounts. Like TOU rates, peak demand charges can apply to the whole home or, if it is metered separately, only the EV.

###### Publicize Your EV Rate Plan

If your co-op decides to offer a special EV rate, it is important that new EV buyers learn about these incentives upon purchase, if not sooner, when they are still exploring their options. Research shows that even consumers in high adoption areas may not know of special EV rates. A 2013 survey of EV owners in California found that about a third of respondents did not know about their utility’s EV rates. These findings illustrate the importance of clearly communicating your co-op’s EV rates to members through multiple channels, such as local EV dealerships and municipal authorities.

As cost is the primary motivator influencing charging behavior, your co-op may want to focus on cost savings when communicating your EV rate plan to members. You could explain that charging on peak can increase costs for your co-op and all member-owners, and highlight the nonmonetary benefits of your EV rate plan, such as grid-efficiency benefits.

More information on EV rate options can be found in NRECA’s Tech Surveillance article on the subject.[[66]](#footnote-66)

## Where should we start?

With all the business structures approaches above, where should a co-op start in developing its strategy around EVs and EVSE? Every co-op is unique in its geography, demographics, and level of EV readiness. As a result, no one-size-fits-all EV or EVSE program exists. Instead, each co-op that is considering EV or EVSE programs should determine its goals for leveraging the benefits and mitigating the impacts of EV charging load. A co-op that wants to start laying the groundwork on EVs by engaging its members and establishing itself as their trusted EV advisor, for example, may start with an EV adoption program related to education, EV incentives, or installing public charging. As EV adoption grows, co-ops may need to mitigate negative impacts to both the co-op and member-owners, such as increased peak demand, increased electricity costs, the need to upgrade distribution infrastructure.

Although avoiding distribution infrastructure upgrades may be a goal primarily for distribution co-ops, the both distribution and G&T co-ops are impacted by increased peak demand and electricity costs. G&Ts and their distribution co-ops can work together on common EV goals to increase their resources and effectiveness. For example, charging networks or EVSE and charge control programs can have lower cost per charger when deployed at larger scales. G&T and distribution co-ops that have different goals related to EVs and their charging load, however, may find that different programs suit their needs.

## Questions and Associated KRIs

###### How much do programs cost, and what is the value they can deliver?

Before launching a program, co-ops need to make sure program costs don’t outweigh the benefits delivered. They should also make sure that the benefits are realized by the entire membership rather than just a select few. The benefits may differ by member, however. An EV rate program, for example, might benefit EV drivers by reducing their charging costs if they take advantage of off-peak charging, but it also benefits the entire membership by reducing (or avoiding increases in) peak demand charges. Co-ops should plan to evaluate and continually monitor program costs and benefits to understand their efficacy, and to give insight into when changes to a program are necessary.

###### When is the right time to implement a program, and what type of program should be used?

Co-ops should develop goals and objectives around EVs. These goals will help co-ops decide whether they want to develop programs that encourage EV adoption and charging at times of greatest benefit to the vehicle’s owner. Do they want to proactively encourage adoption to grow load? Do they want to avoid peak growth and/ or infrastructure upgrades? Co-ops should continue to track the EV market to gage adoption rates in their area, and monitor trends in charging technology to understand when things change in a way that will impact their systems. Finally, co-ops can track pilot and program results from co-ops and other electric utilities.

###### How can the co-op adapt its program to change as EV adoption and charging technologies evolve?

EVs are relatively nascent compared to other end uses that tend to be the focus of co-ops programs, so it is important to be flexible to adapt to changes as more consumers adopt EVs and as charging technologies evolve. Because the EV space is developing and changing rapidly, static EV programs run the risk of becoming outdated, costly, or cause negative impacts to the distribution system. For example, EV rates may cause a rebound peak that exceeds capacity of a distribution transformer. Identifying this issue before it happens and adapting the program to a managed charging one, for example, will help the co-op continue to realize benefits of EVs and avoid potential impacts. In developing even an early program, co-ops should think about changes that will be necessary as EV adoption grows and make sure they are able to change and update programs. They should continuously monitor load on transformers to understand where growth is occurring. Finally, co-ops can look to areas that have high EV adoption rates to understand what strategies tend to work well in situations similar to those the co-op faces.

# EV Impact on Co-op Systems: Topics and Trends

The magnitude of the impact of EVs on a co-op’s system depends on the number of EVs present, the type of EVs and their charging load, and how many EVs are charging at any given time. Co-ops will need to analyze potential EV impact both on particular sensitive infrastructure like distribution transformers, and in aggregate at the distribution and G&T co-op level, to ensure that they understand what impacts they face at a given level of EV adoption, and plan strategies to mitigate those impacts. A distribution co-op that serves mostly residential meters, for example, may decide it must monitor passenger EV sales figures and engage with members to understand where those EVs are charged to estimate charging load and the impacts on distribution infrastructure. Distribution and G&T co-ops who serve residential, commercial, and industrial sectors will have more to track, but ultimately must understand the charging load of the EVs in their territory, where that load occurs and at what time of day, and what infrastructure is involved in delivering that load. This evaluation will help co-ops decide when to implement load control programs and infrastructure upgrades to ensure charging load continues to be served affordably and reliably. For a detailed discussion of the factors and impacts co-ops should consider, see Volume 2 of CRN’s examination of plug-in EVs and co-ops.[[67]](#footnote-67)

New developments may complicate this calculus. With the current and future adoption of distributed energy resources (DERs), including future EVs with bi-directional charging, co-ops must understand flow of energy onto the grid from distributed sources. EVs capable of bi-directional charging will allow consumers and co-ops to leverage the batteries in vehicles not only to store excess energy but also to call on as a resource when grid supply is low or expensive. This so-called vehicle-to-grid (V2G) or vehicle-to-building (V2B) technology – collectively called vehicle-grid integration (VGI) - is in the piloting phase now, and widespread deployment of bidirectional vehicles depends on battery technology, consumer acceptance, and policy (below).

This section discusses methods to proactively analyze the grid and financial impacts of EVs on your co-op’s specific distribution system, and the current state of VGI.

## Analyzing Impacts

Certain charging scenarios — such as daytime on-peak charging above Level 1 — can be highly demanding on the grid and may result in higher peaking wholesale power costs. The clustering of EVs on loaded feeders may also result in costly distribution system upgrades. It is important that your co-op proactively evaluate the grid and financial impacts of EVs, so that the impacts can be managed appropriately.

This section outlines two paths for evaluating the grid and financial impacts of EVs. The first path is a low-cost, qualitative approach that can be implemented with an internal team. The second path is a higher-cost, data-driven approach involving consultants or use of software programs that can perform a deeper quantitative analysis. More detail may be found in Volume 3 of CRN’s guide to plug-in EVs.[[68]](#footnote-68)

###### Path 1: Form an Internal Team to Monitor Grid Impacts

Co-ops can assemble a team from current employees to evaluate the potential grid and financial impacts resulting from EVs. This mostly qualitative, low-cost approach will involve forming a multidisciplinary team of staff members that most likely do not normally work together. Here are the internal experts that would need to be at the table:

* **Marketing or Member Services Manager.** This person should be familiar with current member-facing programs and should offer expertise and insights about how the co-op connects with, educates, and encourages behavior changes among members. This person may have experience running energy efficiency (EE) programs. EV programs and EE programs have similarities in the sense that both programs seek to educate members and encourage certain behaviors and/or investments.
* **Power Supply Planner.** Power supply planners are in charge of estimating the amount of wholesale electricity a co-op needs and executing power purchase agreements. This staff member should be able to answer the following questions: How does your co-op buy wholesale power? What are the terms of your power purchase agreement? How is peak defined in your power purchase agreement? How much does the co-op pay for wholesale electricity at different times?
* **Distribution Engineer.** This person should be able to provide information about the current capacity of the distribution grid, including answering the following questions: How many transformers or feeders are near capacity? How are transformers and other parts of the distribution grid monitored and how are grid upgrades decided? What are the general costs to expanding or increasing the capacity of the grid? What is the general cost range for a transformer upgrade? Co-ops may want to designate a point person to track how EV adoption is impacting your grid.

#### Getting the Team Started

Once the group is generally in agreement on the need for an EV program a good way to get the discussion going is by thinking about hypothetical scenarios. For example, here are three scenarios to get the team thinking about the **costs of different grid impacts**:

* What could the potential grid impacts be if 50, 100, or 500 EVs began connecting to the grid at peak over the next year? What about non-peak?
  + Would new investments need to be made to mitigate those grid impacts and what would the cost be to increase the capacity of the distribution system?
* What could the potential grid impacts be if two, three, or four EVs connected to the same transformer using Level 2 EVSE during a peak period? What about non-peak?
  + Should certain transformers at capacity be monitored?
  + Should EV clusters be monitored? How will you know when transformers need to be upgraded as a result of EV clusters?
* How would different EV load profiles affect peak day load on your distribution system? If your co-op already has some method of distribution modeling, you may want to enter in EV load scenarios.
  + To what extent do these load profiles coincide with the load profile of your co-op’s distribution system, i.e., peak day loads? What percentage of EVs in your service area are charging at Level 1 versus Level 2 during peak day loads?

Here are two scenarios to think about **wholesale power costs and benefits** presented by EVs:

* How might wholesale power costs change if 50, 100, or 500 EVs began connecting to the grid at peak over the next year?
  + Per the terms of the power purchase agreement, what time of day is ideal for EV charging to minimize wholesale power costs?
* How much increased revenue could the co-op expect if 50, 100, or 500 EVs began connecting to the grid during those off-peak periods when wholesale power is low?
  + What are the key actions the co-op should take to maximize the potential financial benefits of EV charging?

These discussions will likely require several meetings. The team might find that, until EV adoption reaches a certain threshold, the financial impacts are too minor to warrant any action. Or, the team might use the outcomes of the meetings to build support for the need to launch a charge management program. The team may also decide that outside help is needed to do a more in-depth analysis (see the following section).

###### Path 2: Conduct a Deeper Quantitative Analysis

Organizing an internal discussion to approximate how EVs might impact your utility will likely meet the needs of most co-ops, especially those currently seeing low EV adoption. However, some co-ops may want to conduct a deeper, more quantitative analysis to obtain more accurate numbers on EV grid and financial impacts.

This more complex analysis may involve using demographic and/or hybrid adoption data to forecast EV usage, advanced metering infrastructure (AMI) to monitor and manage EV grid impacts, or analytical or grid visualization software.

#### Forecasting EV Adoption

Even if overall adoption rates in your service territory are low, forecasting can help co-ops identify where EV clusters may form. Localized forecasting of EV adoption will help your co-op to both target your EV initiatives and proactively ensure the reliability of your distribution system. Co-ops can use a number of both quantitative and qualitative methods to estimate EV adoption, utilizing a range of simple to complex forecasting techniques. The following section provides descriptions of these forecasting methods.

##### Analyze Demographic Data

Co-ops can use demographic data to determine the extent to which their members fit the profile of the prototypical, early-adopter EV owner.

Co-ops know their member base and can use public demographic data on top of this preexisting knowledge of their members to predict adoption rates. Public demographic data can be obtained through free online resources, such as the United States Census Bureau.[[69]](#footnote-69)

Co-ops can use Table 1 as a starting point for this analysis. The table contains a number of key demographic indicators of EV buyers. The degree to which these variables are accurate predictors of EV adoption in a service area will vary from co-op to co-op.

##### Consider Using Your AMI to Manage EV Grid Impacts

Utilities in high EV adoption areas are carefully monitoring power demand via automated metering infrastructure (AMI) — i.e., smart meters — in order to identify neighborhoods that need an upgrade. Your co-op likely already has some sense of whether your distribution system is at capacity or has excess capacity. Your co-op may be monitoring substation transformers, but might not have a good sense of what is happening on your system’s secondary distribution transformers or feeders; co-ops can use AMI to monitor grid infrastructure at a more granular level. Co-ops are using AMI to more easily gather capacity rating, utilization, and peak load data on circuits, feeders, and substations to get real-time visibility on the current and spare capacity of the distribution system.

###### Use Pilot Projects to Learn What Works

Sometimes the best plans in theory do not succeed when put into practice. Piloting EVSE technologies and business structures on a small scale before deploying a co-op-wide program can provide valuable field experience. Pilots can be an effective way for a co-op to learn which EVSE will suit its (and its members’) needs, which strategies are most effective at shifting EV charging load to low-cost hours, and the related financial benefits of doing so. This information can help the co-op understand the current and future impacts of EV charging and decide when and how to best manage it. For examples of recent co-op pilots on residential EV charge control strategies, see NRECA’s recent paper discussing methods and outcomes of two such studies.[[70]](#footnote-70)

Each co-op will have different goals for managing EV charging, and it is important to consider those goals when selecting EVSE hardware as well as designing control strategies and rate structures. To design a program to meet its goals, the co-op will need to gather key information about the utility of potential EVSE options, and financial impacts of load management strategies. Table 6 lists many of these considerations, but is not likely to be exhaustive.

Table : Key information to gather in EVSE pilots.

|  |
| --- |
| page20image4981520**EVSE Selection** |
| * Equipment and installation cost * Ease of installation * Ease of use: connecting to the EV, scheduling and managing charging * Features that are important to members, e.g.,app features, cord length * Ability to maintain network connectivity, including best location for EVSE and network equipment within the home * Ability to respond to load control signals * Utility of control platform, including event scheduling and dashboard views * Accuracy of on-board meter, if present * Data reporting at individual station and aggregate level as appropriate, with proper flags for missing or corrupt data * EVSE vendor customer service and willingness to respond to specific needs of the co-op |
| **Program Design** |
| ▪Member charge behavior ▪EVSE electricity use and load shape ▪Potential of charge control to shift peak load ▪Potential of TOU pricing to shift load ▪Economic benefits of increased sales and load shifting |

Cooperatives interested in assistance in starting or expanding an existing EV pilot program are encouraged to contact NRECA’s Business & Technology Strategies Department. Our Management Services and Consulting team is available to work with you to clearly define your unique needs and provide a proposal on how we can help you achieve your goals.

## VGI: Future Opportunities

With managed charging programs, utilities today can control energy flow from the grid to EVs, and can potentially charge EVs when excess supply exists. VGI will enable EVs to provide grid services through bi-directional energy flow to and from their batteries, much like stationary batteries, so that utilities or buildings can also draw power from EVs when grid supply is low or expensive. This integration will also allow EVs to provide voltage support to the grid. VGI is being piloted at several investor-owned utilities, and in other research settings such as Pecan Street in Austin, Texas. Several barriers still exist to VGI, including the high cost of bi-directional chargers, potential decreased battery life and voided warranties related to increased charge-discharge cycles, and communication to orchestrate VGI.[[71]](#footnote-71)

If VGI can overcome its challenges, integrated EVs as grid resources will help co-ops better manage variable supply from both utility-scale distributed variable generation, decreasing energy costs for all co-op members. If co-ops remain on the sidelines, consumers, especially those with on-site generation, may look to other energy service providers to help them integrate their generation and storage resources at their building or campus level, resulting in a missed opportunity to realize benefits on the co-op-side of the meter. Thus, despite the early stage of VGI, co-ops and other utilities are exploring and testing opportunities to leverage EV batteries as a grid resource once VGI becomes a reality. The New York State investor-owned utility ConEdison, for example, is using five school buses to provide about 75 kW power during summer peaks, recharging the buses during off-peak.[[72]](#footnote-72) Holy Cross Energy, a distribution co-op in Colorado, is also exploring V2G and school buses, specifically as energy resources during emergencies like wildfires.[[73]](#footnote-73) Small, focused projects like these will help co-ops build experience with VGI and start to understand where the greatest benefits and challenges exist.

## Questions and Associated KRIs

###### How will EV changing impact distribution infrastructure and future investments?

Unmanaged EV charging can cause negative impacts on peak demand, and can exceed the capacity of infrastructure, particularly distribution transformers. Impacts may be at the G&T level, or more localized issues that the distribution co-op addresses. Co-ops should develop a plan for evaluating infrastructure impacts. G&T and distribution co-ops may wish to collaborate where impacts and solutions overlap.

Co-ops could continue to estimate and monitor the rate of EV adoption, the cost of unmanaged charging versus the benefits of managed charging, and how charging strategies might impact infrastructure.

Finally, co-ops should consider conducting pilots or monitor pilots from other co-ops to test strategies and better understand impacts before enacting mitigation efforts like programs or infrastructure upgrades.

###### How will new DER technologies like VGI impact the grid and co-op business models?

If co-ops remain uninvolved, the combination of self-generation and storage technologies could impact co-op electricity sales. Consumers are increasingly looking to market disruptors like solar and storage providers to purchase and manage their electricity usage. The same could happen with VGI EVs if co-ops do not play an active role. Co-ops should monitor DER technologies and ways they can leverage them for the benefit of their members, while maintaining their role as the members’ trusted advisor for all electricity needs. Co-ops should monitor VGI-capable vehicles as they enter the market and their service territory, stay current on other co-op and utility VGI pilots, and potentially develop a small VGI pilot themselves on a use case that may solve a particular challenge, similar to Holy Cross Energy’s approach.

# Resources

## Market Trends

###### Broad EV market trends

Bloomberg New Energy Finance (BNEF) publishes their global Electric Vehicle Outlook on an annual basis: <https://about.bnef.com/electric-vehicle-outlook/>

U.S. DOE’s Alternative Fuels Data Center (AFDC) publishes data and trends related to all alternatively fueled vehicles. Data on EVs can be found here: <https://afdc.energy.gov/data/search?q=electricity>

###### Passenger Vehicles

CNET tracks and periodically updates a list of available passenger EV models, key features, and reviews (if available): <https://www.cnet.com/roadshow/news/every-electric-car-ev-range-audi-chevy-tesla/>.

The Electric Power Research Institute (EPRI) publishes an annual Consumer Guide to EVs available in the U.S. The 2020 guide is available here: <https://www.epri.com/research/products/000000003002018113>

EVAdoption.com: Lists models of passenger BEVs and PHEVs available in the U.S., including range, MSRP, battery pack size, and efficiency. BEV list: <https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/>; PHEV list: <https://evadoption.com/ev-models/available-phevs/>.

###### Buses

Current Trends

Atlas Policy, 2019. Electric Trucks and Buses Overview: The State of Electrification in the Medium- and Heavy-Duty Vehicle Industry. <https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/>

APTA, 2019. Public Transportation Vehicle Database. <https://www.apta.com/research-technical-resources/transit-statistics/vehicle-database/>

#### NRECA Resources

TechSurveillance: How a Problem with Vehicle Emissions Affects the Electricity Industry. Volkswagen, Electric School Buses, and New Energy Storage Resources. K. Glitman, F. Huessy, S. Morse, and B. Whitaker. Vermont Energy Investment Corporations (VEIC). February 2017. <https://www.cooperative.com/programs-services/bts/Pages/TechSurveillance/vehicle-emissions-affects-electricity-industry.aspx>

Business & Technology Advisory: Electric Transit Buses. 10 Things to Consider When Preparing to Plug In Your Municipal Transit Bus Fleet. May 2020. <https://www.cooperative.com/topics/distributed-energy-resources/Pages/Preparing-to-Plug-In-Your-Electric-Transit-Bus-Fleet---10-Things-To-Consider.aspx>

Preparing to Plug in Your Bus Fleet: 10 Things to Consider. A Guide to Working with Your Electric Company. Prepared by the Edison Electric Institute in collaboration with the American Public Power Association, the National Rural Electric Cooperative Association, and the American Public Transportation Association. December 2019. <https://www.eei.org/issuesandpolicy/electrictransportation/Documents/PreparingToPlugInYourBusFleet_FINAL_2019.pdf>

###### Other Medium- and Heavy-Duty Vehicles

#### Current Trends

Atlas Policy, 2019. Electric Trucks and Buses Overview: The State of Electrification in the Medium- and Heavy-Duty Vehicle Industry. <https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/>

ORNL, 2019. Medium- and Heavy-Duty Vehicle Electrification. <https://info.ornl.gov/sites/publications/Files/Pub136575.pdf>

NREL maintains a database of medium- and heavy-duty EV models: <https://app.box.com/s/04h4jqs50w88f5ziwvmf4o2sxbxpzhzg>

#### NRECA Resources

Preparing to Plug in Your Fleet: 10 Things to Consider. A Guide to Working with Your Electric Company. Prepared by the Edison Electric Institute in collaboration with the American Public Power Association and the National Rural Electric Cooperative Association. October 2019. <https://www.eei.org/issuesandpolicy/electrictransportation/Documents/PreparingToPlugInYourFleet_FINAL_2019.pdf>

NACFE, 2018a. Electric Trucks Where They Make Sense. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/NACFE-Electric-Trucks-Where-They-Make-Sense-2018.pdf>

NAFCE, 2018b. Medium-Duty Electric Trucks Cost of Ownership. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/NACFE-Medium-Duty-Electric-Trucks-Cost-of-Ownership-2018.pdf>

###### Charging Infrastructure

#### Background Information on Charging

U.S. DOE, 2020. <https://www.energy.gov/eere/electricvehicles/charging-home>

## Business Structures

NRECA’s series Plug-In Electric Vehicles and Electric Cooperatives, Volume 3: Keys to Developing a PEV Program for Your Electric Cooperative. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/keys_to_developing_a_pev_program_for_your_electric_cooperative.pdf>

Gearing Up for Electric Vehicles: Residential EVSE Program Design for Co-ops. <https://www.cooperative.com/programs-services/bts/Documents/Secure/TS/TS-Residential-EV-Service-Equipment-June-2018.pdf>

Electric Vehicle Charging Control Strategies. <https://www.cooperative.com/programs-services/bts/Documents/TechSurveillance/Surveillance-Article-EVSE-Load-Control-Strategies-Jan-2019.pdf>

Tate, 2018. Rate Options That Support Electric Vehicle Adoption. <https://www.cooperative.com/programs-services/bts/Documents/TechSurveillance/TS-EV-Rate-Options-June-2018.pdf>

## Impacts

Dayem and Mercier, 2020. Electric Vehicle Service Equipment Load Control Case Studies. <https://www.cooperative.com/programs-services/bts/Documents/Reports/Report-EVSE-Load-Control-Case-Studies-April-2020.pdf>

Grant et al., 2015b. Managing the Financial and Grid Impacts of Plug-In Electric Vehicles. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/managing_the_financial_and_grid_impacts_of_plugin_electric_vehicles.pdf>

# Why Policy Is Important to Co-op EV Decision-Making

Electric vehicles (EVs) could make up 60 percent of light-duty vehicles sales in the United States by 2040, according to Bloomberg New Energy Finance’s 2020 EV Outlook.[[74]](#footnote-74) This creates a significant opportunity and, in some instances, a challenge for electric utilities across the country. As discussed earlier in the Business and Technologies Sections, EVs can bring value to cooperatives. In order to assess the overall value proposition of EVs, it is important for co-ops to be aware of the policies that address EV adoption and how those policies may impact them individually-from co-ops that are in the vanguard of EV development to those co-ops for which a more gradual approach makes the most sense. Like other forms of Distributed Energy Resources (DER), the success of EVs from the co-op’s perspective can be dependent on applicable policies and regulations and financial incentives at the federal and state levels. However, unlike other DER policies such as Renewable Portfolio Standards (RPS) or Clean Energy Standards, effectuating state EV plans (such as transportation electrification plans) does not fall exclusively to the public utility commissions and non-regulated utilities. Rather, a coordinated effort among transportation, environment and commerce/tourism agencies, PUCs and non-regulated utilities is essential to implement an EV plan. Therefore, it is important for co-ops, regardless of their specific goals for EVs, to understand the relationship among individual policies and the impact they may have on co-op systems, operations, business structures, rates and consumer-owners. As discussed subsequently, this is also the reason why co-ops may want to factor in policies such as Zero Emission Vehicles (ZEV) programs (which don’t directly apply to utilities) into their advocacy strategies on EVs.

This section provides an overview of the current public policy landscape in the United States, as well as trends, describes Key Risk Indicators (KRIs) associated with policies which co-ops may want to consider when evaluating future EV goals and plans, identifies potential elements of an EV advocacy platform, and explores case studies in co-op EV programs from a policy point of view. From an advocacy perspective, understanding extant policies and regulations offers two value streams: it supports the co-ops’ ability to identify policies that may/may not work in their own backyards and to prepare their advocacy strategies accordingly; and, it provides NRECA with the same opportunity (coupled with valuable input from members), *albeit* at the federal and national level, since policies on EVs, like other DERs, begin at the state and local level and bubble up.

## Overview of Key EV Policies and Trends

There are several types of policies that affect transportation electrification: rate design, financial and market incentives, regulation of charging infrastructure, retail sales of power, GHG emissions, EV fees, and EV data. To date, state governments and electric utilities have taken the initiative to implement policies and programs to support transportation electrification.[[75]](#footnote-75) These, in turn, have prompted interest at the federal and regional levels: Congressional efforts to address EV incentives and charging infrastructure, FERC orders on aggregating technologies like EVs into wholesale market[[76]](#footnote-76), DOE’s new initiative- An EV Future: Navigating the Transition, and regional coordination efforts, such as REV WEST. This is not a new phenomenon. Many policies over the past 15 years have started at the local or state level before gaining broader traction: RPS, Energy Efficiency Program Standards, net metering, data access/privacy and integrated distribution and resource planning procedures (IDRP). While EV policies impact co-ops differently, all co-ops have a common goal-to have the flexibility to adopt and implement policies in ways that work for each of them and their member-owners.[[77]](#footnote-77) In this vein, co-ops may want to consider advocacy strategies that stress the importance of local decision-making and control-irrespective of where the co-op currently sees itself on the spectrum of EV deployment.

Certainly, policy Key Risk Indicators (KRIs) that may impact whether and how co-ops engage in EV markets focus on local decision-making. Do the policies:

* Enable co-ops to develop business structures that are best suited for how they wish to pursue EVs;
* Impact the ability of co-ops or third parties to own, operate, and manage charging infrastructure;
* Provide incentives, rebates or other funding for which, G&Ts, their co-op members and consumer-members are eligible;
* Establish requirements for what entities may own and sell the underlying power supply necessary to charge EVs;
* Allow co-ops to implement charging rate structures that appropriately allocate the costs and benefits of EV charging;
* Enable co-ops to access consumer charging data that is needed to cost-effectively meet consumer demand and to continue to operate the co-op’s system reliably and efficiently;
* Coalesce in order to achieve a unified objective as opposed to a set of contradictory principles; as discussed subsequently, the impact of a ZEV program can only be fully understood if it is assessed in conjunction with incentive policies; and
* Enable co-ops to re-assess and revise EV programs in order to maximize the opportunities and minimize challenges?

# State and Regional Policies and Trends

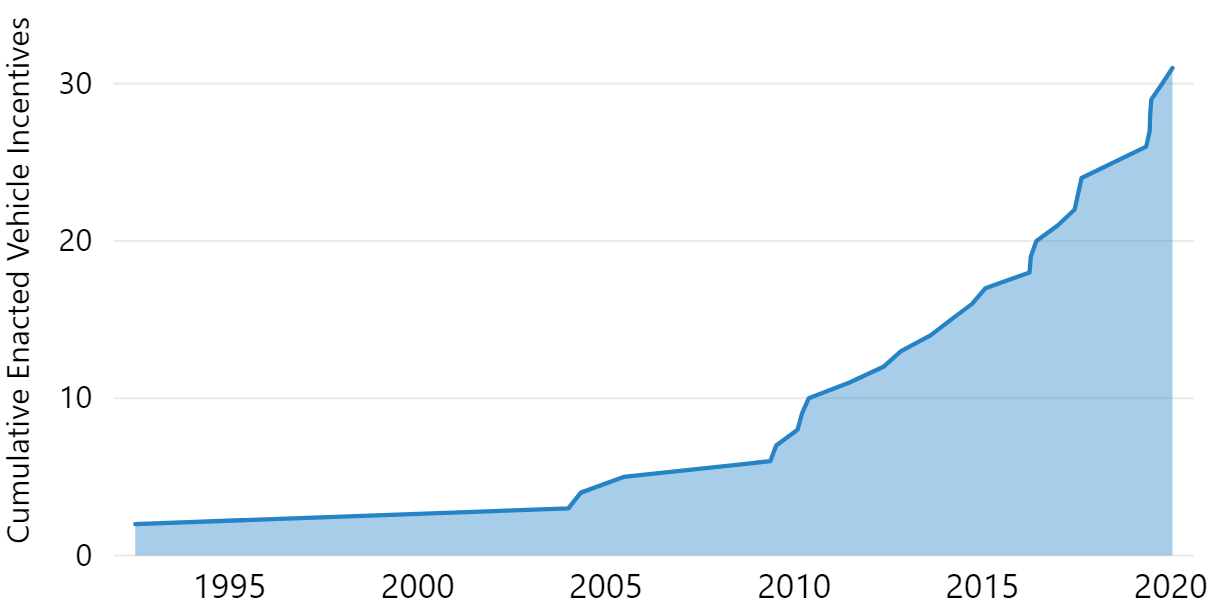
**EV or EV Charging Infrastructure Incentives (Rebates, Grants, Tax Credits)**

Almost 30 states offer financial incentives to help cover the costs of EVs or EV charging infrastructure for any vehicle type (*i.e*., light-, medium-, and heavy-duty).[[78]](#footnote-78),[[79]](#footnote-79) Financial incentives could be rebates, grants, or tax credits and may cover a percentage of the total cost of EVs or EV infrastructure.[[80]](#footnote-80) Incentives are always important in building new markets, and EVs are no exception, particularly in markets, such as California, where there are EV mandates (discussed subsequently).

###### Public Funding

Public funding awards are led by states with strong EV commitments and policy frameworks designed to accelerate transportation electrification. Despite challenges stemming from the COVID-19 pandemic, public agencies continue to award funding to support EV and EV charging deployment across all vehicle classes with total awards worth almost $2 billion.[[81]](#footnote-81) Most states that have EV fees also offer incentives that are greater than the fee. This includes $292 million in funds for transportation electrification issued through the Volkswagen Settlement. Of the 15 states that have active incentives for consumer EVs, 10 also have Zero Emission Vehicle policies in effect, as discussed subsequently. These incentives typically take the form of either a rebate or tax credit and, in the case of Colorado, can apply to medium- and heavy-duty vehicles as well.[[82]](#footnote-82) In California (which is at the forefront of policy implementation), all-electric vehicles are eligible for rebates worth $2,000 and plug-in hybrids can claim $1,000. These values increase by $2,500 for qualifying low-income households.[[83]](#footnote-83) Incentive programs, coupled with ZEVs, have helped to build thriving EV markets in seven of the top states for EV sales between January and May 2020. Collectively, the 12 ZEV states claimed 64 percent of the total U.S. EV sales through May.[[84]](#footnote-84) Figure 2 shows the trend in EV incentive implementation over time.

Figure : Cumulative Enacted EV Incentives



This figure shows the newly enacted EV incentives over time. Since the launch of mass market EVs in 2010, a clear increase occurred with an acceleration of newly enacted policies since 2015.

Source: Atlas EV Hub[[85]](#footnote-85)

Until recently, few states have implemented incentive programs for medium- and heavy-duty vehicles and only four have regular programs designated specifically to support electric bus and truck adoption. Nevertheless, there is a trend towards increased public funding for procuring electric tricks and buses for both public and private fleets.[[86]](#footnote-86) California and New York are the forerunners in this policy category, both opting to implement voucher incentive programs for electric trucks and buses. Through June 2020, the California Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) has issued $320 million to applicants to reduce the upfront cost of electric buses and trucks of all classes. New York is drawing on funds from the Volkswagen Settlement to support their New York Truck Voucher Incentive Program (NYTVIP) which has provided $35 million in funding.[[87]](#footnote-87)

###### Co-op Incentive Funding Programs

At least 22 electric cooperatives are also supporting EV adoption by their members and implementing EV programs such as rebates for EVs or EV charging infrastructure as well as creating EV charging rates to encourage charging during off-peak times. See Appendix B. The U.S. Department of Energy’s Alternative Fuels Data Center (AFDC) tracks co-ops having EV-related programs in 11 states.[[88]](#footnote-88) Rebate programs, like the one offered by United Cooperative Services in Texas, provide up to $500 for customers to install Level 2 charging stations. Others, like the Vermont Electric Co-op, provide up to $500 for the purchase of an all-electric vehicle and $250 for a plug-in hybrid.[[89]](#footnote-89), [[90]](#footnote-90)

States are beginning to acknowledge and take steps to mitigate the urban-rural divide for EVs, which is very important to co-ops. Colorado enacted legislation that prioritizes funding from its Charge Ahead Colorado program for charging stations in areas with lower revenues, such as rural areas.[[91]](#footnote-91) To date, at least 2 co-ops have received Charge Ahead funding, White River Electric Association and Yampa Valley Electric Association.[[92]](#footnote-92) Benefits of such programs are twofold: they support the growth of local businesses through EV charging and they ameliorate range anxiety.

Incentives for EVs or EV charging infrastructure may be particularly important for co-ops in rural areas that want to encourage EV adoption due to range anxiety from longer driving distances and less access to public charging compared to urban areas. Are the policies for partnering and incentives flexible enough for co-ops to set up successful joint ventures? Western Farmers Electric Cooperative (WFEC) in Oklahoma worked with partners, including Francis Energy, to build out a statewide charging network. Obtaining two different state funding sources made the project feasible: the Charge Ok grant program which distributed VW settlement funds; and a state tax credit for investment of alternative vehicle infrastructure that Francis Energy utilized.[[93]](#footnote-93) In addition to WFEC, co-ops across several states, including North Dakota, North Carolina, Minnesota and Colorado, have either received or are working together to advocate at the statehouse and state agencies for VW settlement funds for electric school buses or EV charging stations.[[94]](#footnote-94)

In North Carolina, electric co-ops have invested more than $1 million to install DC fast charging stations along highway corridors in their service territories. These stations complement other Level 2 chargers already installed by co-ops including the Cape Hatteras Electric Cooperative and at least 10 DC fast chargers and 11 new Level 2 chargers in co-op territory throughout the state.[[95]](#footnote-95), [[96]](#footnote-96)

Other co-ops, such as Dakota Electric Association and its G&T, Great River Energy, in Minnesota, are partnering with state agencies to use VW settlement funds to test electric school buses and understand their benefits, including fuel and maintenance cost savings, reduced noise and fumes, and the potential to supply power during peaks or other emergencies with the energy stored in the bus battery.[[97]](#footnote-97)

###### Low-to-Moderate Income (LMI) Funding

As awareness of transportation electrification grows, more and more state policy makers and utilities are looking at the availability and impact these programs may have on LMI communities and whether or not benefits are reaching them.[[98]](#footnote-98), [[99]](#footnote-99) As addressed subsequently, this has been a focus of NRECA’s advocacy efforts in discussions of various EV bills considered by Congress. States also have pinpointed LMI and rural areas for EV funding and support.

Many states and utilities are making efforts to expand electric vehicle access to lower income individuals by offering special electric vehicle or charging station incentives to income-qualified residents. On Jan. 1, 2020, Roanoke Electric Cooperative-NC (REC) launched a new Electric Vehicle pilot project. Approximately 50% of REC’s service territory is in persistent poverty counties. Under this new program, participating EV owners will pay a modest monthly subscription rate to charge their cars for nearly 1,500 miles. REC will also install chargers in their homes, a value of $1,700, at no upfront cost to the member-owner. Investor-owned utilities Black Hills Electric and Xcel Energy in Colorado are implementing rebate programs targeting low-income customers and communities. The Public Utilities Commission of Nevada approved a new incentive program for NV Energy’s low-income multi-family housing customers. In California, Pacific Gas and Electric has been approved to invest $4 million in a program dedicated to underserved communities, which could help 2,000 low- and moderate-income families install residential Level 2 EV charging stations. The program is also designed to increase EV awareness and provide educational resources to these families.[[100]](#footnote-100), [[101]](#footnote-101)

In Virginia, state lawmakers recently enacted a bill requiring a working group to determine the feasibility of an electric vehicle rebate program, including potential special provisions for low-income individuals. Low-income customer rebate programs are also being considered or implemented in a number of other states, including New York, Oregon, and Vermont.[[102]](#footnote-102)

For co-ops, there are common themes which can resonate for many NRECA members and which can form the basis for an advocacy platform for maximizing opportunities for incentives and funding. Given the pace of EV actions at the state and utility level (and increasing Congressional interest), co-ops may do well to have a framework of advocacy principles in their back pockets. Co-ops and rural communities (including LMI communities) should not be disadvantaged regarding development of EV infrastructure, including resources for EV infrastructure development (*e.g.* location and ownership of charging stations).

Co-ops need access to EV and EV infrastructure resources and incentives such as grants, preferential financing (e.g. RUS), tax incentives (e.g. vehicle purchase). Supporting emerging industries such as EV markets in ways that benefit these segments requires input and leadership from the local utilities, such as co-ops.

## Owning/Operating (Managing) Charging Stations

A fundamental question is who may own and/or manage charging stations and to what extent are they regulated by state utility commissions? Co-ops are especially necessary to any discussion of charging infrastructure, without which an EV market is impossible.

###### Third-Party EV Service Providers

Third-party EV service providers manage public and private charging infrastructure. Electrify America manufactures, installs and manages chargers at public sites throughout the country, and sells charging stations to private entities. Electrify America also sets the rates for its public charging stations, based on the time of the charge or under a monthly subscription fee.[[103]](#footnote-103) Charge Point sells chargers to entities and these buyers then manage them. Both Charge Point and Electrify America offer customers networks of charging locations. [[104]](#footnote-104)

Delaware Electric Cooperative (DEC), a self-regulated co-op in Delaware, worked with vendors and members on a two-phased EV charging plan. DEC conducted an EV pilot in 2018 and expanded it in January 2019. Members who participated in the pilot received a ChargePoint Level 2 EVSE from DEC, then paid for its installation and agreed to share their data with DEC. DEC integrated with the ChargePoint platform to send interrupt signals during peak reduction periods. DEC noted that two pilot participants used the EVSE to schedule all charging to be overnight, effectively taking their load out of the peak time, and shifting to off-peak. For the 2020 program, DEC offers a one-time credit of $200 for installing the approved EVSE and $5 per month bill credit for participating in the program.[[105]](#footnote-105)

For co-ops that want to encourage private sector EV charging investment, removing regulatory roadblocks to private sector investment in EV infrastructure can be an important way help build out EV infrastructure.[[106]](#footnote-106) This applies equally to state regulated and self-regulated co-ops. Self-regulated co-ops that want to encourage private sector EV charging investment should provide certainty to third-parties that they will be permitted to operate in their service territories and whether they will be permitted to administer energy-based charging fees.

Twenty-eight states have explicitly clarified that non-utility EV charging operators, such as Electrify America, may sell electricity without being considered electric utilities and therefore being subject to state regulation as an electric utility.[[107]](#footnote-107) The prevalent rationale for this is that since 3rd parties aren’t attempting to recover costs associated with charging, they aren’t “public utilities.” While this rationale may address state regulatory authority, it raises ambiguities concerning FERC regulation of co-ops.

FERC has jurisdiction over transmission and wholesale sales of electricity in interstate commerce. Retail sales are left to the states. Even if state authorities determine that 3rd party owners/managers of charging stations that are reselling the power aren’t public utilities, that doesn’t mean that the co-op selling power to the charging station isn’t engaged in a wholesale sale under the Federal Power Act (FPA).[[108]](#footnote-108) To date, FERC has not addressed this issue. However, in the event that FERC concludes that co-ops are engaged in a wholesale sale, there are two outcomes. First, any distribution co-op that does not qualify for the exemption under Section 201(f) of the FPA because they bought out of RUS lending and exceed 4 million MWH sales becomes a public utility under the FPA.[[109]](#footnote-109) Second, distribution co-ops that do qualify for the exemption under Section 201(f) would still be transmitting utilities, subject to interconnection and wheeling requirements under Sections 210-210 of the FPA.[[110]](#footnote-110)Although FERC currently has active proceedings that would include this issue, it does need to be resolved.

Just because a state commissions does not regulate 3rd party charging stations as public utilities does not mean that it lacks authority over ancillary issues, such as integrating EV load in system planning and ratemaking for associated impacts on utilities. Similarly, non-regulated co-ops are encouraged to adopt policies that address 3rd party charging w/in the context of these same issues in order to maintain system reliability and appropriate cost recovery.

###### Utility Ownership/Management of Charging Stations

The other issue is whether utilities may be in the charging business. Most state commissions that have considered this will regulate rate-basing by utilities of costs associated with their own charging stations; whereas a few commissions, like the Alabama PUC, have concluded that charging stations are completely outside their statutory purview. [[111]](#footnote-111) Still others in retail restructured states, such as the Maryland Public Service Commission (MDPSC), determined that 3rd party service providers are electricity service providers and as such not subject to commission regulation, whereas public utility ownership/operation is a permissible regulated service. [[112]](#footnote-112)

A number of states have undertaken broad investigations to determine the appropriate roles for utilities and private entities in transportation electrification, including the ownership and management of charging stations. In New Jersey, the Board of Public Utilities released a straw proposal regarding the roles of utilities and private entities in electric vehicle infrastructure deployment. Connecticut’s Electric Vehicle Roadmap, released in April 2020, discusses ownership and investment models for public charging infrastructure, among other topics. As noted earlier, the Virginia Corporation Commission currently has an open proceeding examining several transportation electrification issues, including the role of utilities in deployment of charging infrastructure. Regulators in Missouri and Wisconsin are also considering this issue as part of ongoing electric vehicle investigatory proceedings.[[113]](#footnote-113)

For co-ops that are state regulated, advocating for the ability to participate in EV charging is essential. Regardless of a co-op’s timeframe for if and/or when it decides to get involved in EV charging, engaging with policy makers to ensure that it is able to do so is a critical first step. Subsequent to the MDPSC determination on jurisdiction, Southern Maryland Electric Cooperative (SMECO) received approval from the MDPSC to develop a pilot program for installing and operating public charging stations within SMECO’s service territory. [[114]](#footnote-114)

There are several arguments that have resonated with policymakers that support providing utilities the opportunity to engage in decision-making about EV charging, including:

* Utilities are in the best position to expedite a build out of a charging infrastructure, thereby speeding up deployment.
* Utilities are in the best position to minimize installation costs through scales of economy, access to existing capital lines, and available O&M expertise.
* Utilities are in the best position to site charging stations in order to maintain reliability and minimize impacts to the grid and the need for grid upgrades.[[115]](#footnote-115)

Irrespective of their regulatory status, co-ops are encouraged to consider advancing principles if they want to participate in the charging station markets. The principles address issues that are important to consumer-members as well: range anxiety and costs (both for EV charging and to support grid reliability). Moreover, they align with the broad advocacy platform that co-ops need to retain local decision-making authority regarding whether and how to supply power to and invest in and manage public and private EV infrastructure.

## Rates

Rate structures are covered in detail elsewhere in this paper. Here, the focus is discussing the rate policies in conjunction with the co-op’s overall goal for EVs. Each rate offers opportunities and challenges, which a co-op can evaluate within the context of EV future planning, coupled with assessing benefits to member-owners. For example, by sending the proper pricing signals to member-owners, a co-op can help member-owners make informed decisions on when to charge EVs using lower-priced power. This, in turn, can result in lower overall load factors from EVs, benefitting the co-op’s ability to manage the grid impacts that EVs may have on the system.

###### Public Charging Rates

Currently, there are 3 methods for public EV charging: a minute-based rate multiplied by the number of minutes the car has charged, such as $0.30/per minute; the kWh method, which is based on the amount of electric energy consumed; and the monthly subscription, which can offer unlimited or segments of free amounts of charging time and/or lower rates based on time of charging. [[116]](#footnote-116) To date, the vast majority of states have adopted the kWh method.[[117]](#footnote-117) The impact of a utility’s demand charge is discussed below.

###### Private Charging Rates

#### Time-of-Use (TOU)

TOU rates encourage electric customers to shift their energy use to off-peak hours when electricity demand is low by charging less for electricity use during those periods.

Increasing peak electricity demand may create a need for utilities to invest in upgrades to the electrical grid and may therefore increase the cost of electric service. Increasing load during off-peak times and aligning it with grid system needs allows utilities to increase revenue without upgrading the electrical grid, putting downward pressure on the cost of electric service. TOU rates can encourage EV drivers to charge during off-peak times, minimizing the costs and needs for upgrades to the grid and maximizing the benefits of EV charging load. This is especially important in states with higher variable renewable energy generation. It is important to note that third-party charging providers can only pass on TOU rates through to drivers if they are permitted to administer energy-based fees without being subject to regulation as a utility.

Cobb EMC in Georgia has a program called NiteFlex, which provides up to 400 kWh of free electricity each month to charge an electric vehicle or run smart appliances during super off-peak periods, thereby shifting load.[[118]](#footnote-118)

TOU pricing also encourages consumers to change their charging behavior in ways that can benefit resource planning. and give enhance the co-op’s ability to curb power supply costs during high-peak periods. Being able to influence charging times can permit utilities to postpone expensive investments in generation capacity that may only be needed at peak. As is the case with supporting the grid, controlling power supply costs during peak periods is especially important in states that have higher renewable generation within supply portfolios. Also, with changed behavior, TOU rates can result in cost savings to customers. Co-ops that favor TOU pricing may want to highlight these benefits. Conversely, benefits from TOU pricing are dependent on uncertain customer behavior. Since customers only save if they shift peaks, education for all, especially LMI, is essential. Otherwise, customers will pay more. Additionally, over time, TOU pricing can create new peaks. Any consideration of TOU pricing should include all potential outcomes.

#### Real-Time Pricing (RTP)

RTP rates vary based on the actual energy costs at wholesale. While RTP is the most efficient in terms of managing the grid, consumer participation is very low, so the benefits can be minimal. Customers are especially hesitant to engage when they don’t know what the price is beforehand. To mitigate this, pre-program education is key, especially within certain communities such as LMI. Co-ops are encouraged to factor in these challenges in their EV policy deliberations.

#### Subscription Rates

Some utilities offer a monthly subscription rate for charging, sometimes along with a modest monthly fee. As noted earlier, Roanoke Electric Cooperative, which serves one of the poorest congressional districts in the country, implemented a subscription based EV charging rate that could save EV drivers $135 in monthly refueling cost on standard rates. REC’s new rate is a flat fee of $50 per month for up to 450 kWh.[[119]](#footnote-119)

#### Managed Charging Rate

Managed charging is a form of TOU rate, where the utility controls the charging (a version of a utility-controlled DR program).

From the consumer’s perspective, the biggest draw of managed charging is that it doesn’t require the consumer to do anything in order to get the benefits of TOU rates. Managed charging is valuable to co-ops, in part, because from the co-op’s perspective, the ability to stage charger starts enables the co-op to prevent a huge surge on the system at exactly the time when the TOU rate shifts over to lower costs. In addition to shifting peaks, co-ops would be able to manage EVs to provide ancillary services that support the distribution grid.

However, there are privacy concerns associated with managed charging rates. Also, the utility must be ensured of a sufficiently sized network of chargers participating in managed charging, or else the ability to shape load isn’t achieved.[[120]](#footnote-120)

Impact of Demand Charges on Public and Private EV Rates

As discussed earlier, co-ops and utilities most often use demand charges for commercial and industrial customers; however, they may also be used in residential rate structures. Peak demand charges can encourage members to charge EVs at lower current, reducing the magnitude of the load but increasing charge time. Peak demand charges also can be used to reduce system peaks if demand charges apply to a peak window.[[121]](#footnote-121) Despite these benefits to utility systems and their customers, demand charges are controversial within EV stakeholders, especially when applied to public chargers. As noted above, the vast majority of public charging rates are based on kWh-energy consumed. Charging companies and some EV proponents are advocating for policymakers to curtail utility inclusion of demand charges in their tariffs for EV charging stations.

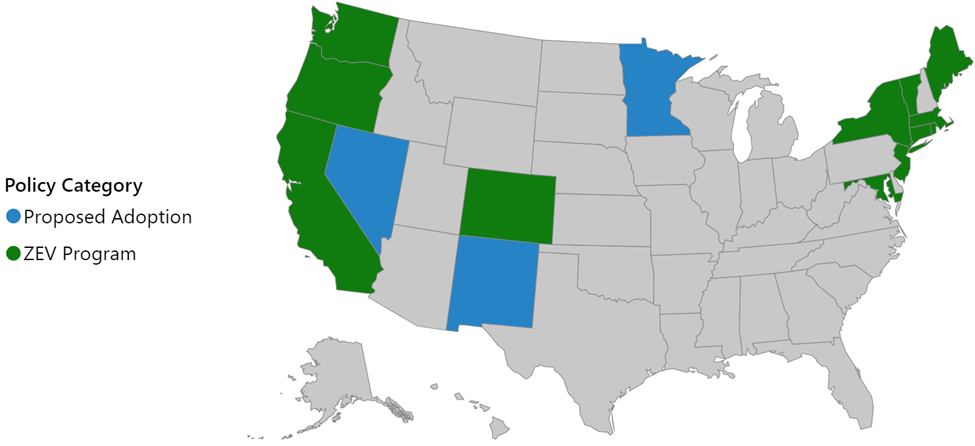
###### Generic Considerations About Rates

A key question for any rate structure or incentive is: what is the tipping point at which the co-op’s payment to the EV consumer to use the EV as a battery is more expensive that the value of the DR to the co-op’s system?

Additionally, co-op boards and state commissions are the decisionmakers for determining whether EVs should play a role in load management and, if so, which rate designs might optimize that impact. Co-ops are encouraged to engage in these sorts of discussions and to identify how rates may fit within their overall EV advocacy strategy. At the end of the day, co-ops need to retain the local authority to adopt those EV rate structures that their boards or state commissions conclude permit them to appropriately allocate the costs and benefits of EV programs among their consumer-members.

## Zero Emission Vehicles (ZEV) Program

California and 11 other states have implemented regulations requiring automakers to sell an increasing proportion of passenger EVs relative to their overall vehicle sales in their respective states, thereby reducing GHG emissions.[[122]](#footnote-122) Zero Emission Vehicles Programs (ZEVs) generally have a target for customer market penetration by certain dates. ZEVs vary in terms of what types of vehicles are eligible to meet the emission targets.[[123]](#footnote-123)

Figure 1: States that have either adopted or proposed to adopt the ZEV Program, as of July 2020.

Source: Atlas EV Hub[[124]](#footnote-124)

As a stand-alone policy, a ZEV program’s benefit to co-ops is dependent on a number of factors. While a ZEV program puts the onus on another industry-transportation-to reduce emissions, implementing a program impacts the local utility as well: developing the charging infrastructure and generation sources, and recovering costs therefor are all important considerations to co-ops. Other supportive policies are necessary for the ZEV Program to succeed. Most importantly, are there incentives and rebates that flow to the EV owner as well as the operator of the charging infrastructure? From the co-op’s perspective, is it eligible to own and operate charging infrastructure? Do co-ops have the flexibility to develop rates that appropriately compensate EV owners for benefits to the system and equitably allocate associated costs? If co-ops are in a state that is considering a ZEV program, it may be important to advocate for opportunities within these policies in order to maximize any system benefits flowing from the ZEV. Conversely, lack of incentives, when coupled with EV fees, can run counter to co-op efforts to build out EV markets and/or adopt a formal ZEV program.[[125]](#footnote-125)

## Transportation Electrification Targets

Transportation electrification targets are goals or commitments regarding EV deployment, usually at the city- or state-level. Many policymakers perceive such targets as a way to achieve more specific objectives: lower GHG emissions; save consumers money over time; support utility grid reliability; and lessen reliance on foreign oil. Depending on these local or regional objectives, targets can be coupled with other policies, such as ZEVs (a key objective for emission levels). Targets can be set in a variety of ways, including through state or utility EV planning processes (Transportation Electrification Plans (TEP)), executive orders by state governors, or legislative action.[[126]](#footnote-126) Targets may indicate specific numbers of EVs, charging stations to be deployed, or growth of EVs within a market measured in percentages. In September 2020, California Gov. Newsom signed an executive order requiring all new automobiles (including trucks) sold in California to be electric/emissions-free by 2035.[[127]](#footnote-127)

Establishing targets at the state-level can provide guidance to help coordinate across the various state agencies that will need to be involved in successful transportation electrification.[[128]](#footnote-128) TEPs generally include plans for investments in charging infrastructure, EV fleets, rate designs and customer education.[[129]](#footnote-129) Through targets, states and utilities can assess progress and adjust policies to ensure appropriate action is being taken to reach the targets.[[130]](#footnote-130) Targets and TEPs can also help provide some certainty that can attract the private sector investment.[[131]](#footnote-131)

Because co-ops may face issues such as consumer range anxiety about EVs, limited staffing and constrained internal funding as a non-profit, financing and implementing TEPs may be challenging. Unlike other forms of DER such as renewables, EVs are not stationary, so their actual impact on any given service area can be difficult to quantify. If the majority of EVs are going through co-op territories on highways, the impact on load shaping and load planning is difficult to measure. Likewise, recovery of sunk costs for EV infrastructure cannot be guaranteed via traditional rate structures. Co-ops in this position may find socializing costs to be uneconomic and infeasible. Additionally, factors such as the size and segments of retail load and the future ability to reliably integrate EVs into the grid should be taken into account in developing targets. For these reasons, co-ops in states that are considering electrification targets or which are developing their own individual TEPs may want to assess the likelihood of implementing them in ways that are fair to all consumer-members and support the business and financial health of the co-op. Policy makers cannot assume that all affected utilities will be able to implement the same targets or TEPs in the same manner, within the same timeframe and with the same degree of success. Co-ops may decide to advance the position that a one-size-fits-all target will be counterintuitive to meeting the TEP underlying goals.

## EV Data

EV data increasingly is becoming an important issue: who has access to it and what can it be used for. For the co-ops, EV data provides two significant value streams: (1) it is essential for co-ops to understand charging behavior and develop effective strategies for integrating charging load; and (2) data is necessary simply for system planning (both grid design and resource plans). As discussed earlier, co-op direct control of EV charging focuses on demand response programs. Maximizing the opportunities of those programs requires charging data. Additionally, co-ops can use data to plan for future charging stations, for upgrades to the grid to support EVs, and for managing the co-ops’ overall load. Some EV manufactures maintain that the data collected from their EVs is proprietary. However, multi-state coordination EV initiatives, which are discussed subsequently, are focusing on uniform data collection and sharing standards. Data is essential to maximizing the benefits of EV charging for co-op members, enhancing the efficiency of the grid and for grid planning.

Connectivity and data collection are also essential to perform remote operations and maintenance of charging stations to ensure maximum station uptime. For these reasons, co-ops are encouraged to consider advocating for increased co-op access to consumer charging data in order to cost-effectively meet consumer demand and to operate the co-op’s system effectively and efficiently. In recognition of the importance of data collection to maximize the public benefits of EV charging, many electric utility EV charging programs require charging equipment to be capable of data collection and sharing. More than 80 percent of state commission-approved investor-owned utility filings require equipment to be capable of “smart charging,” which means the equipment has data collection and communication capabilities that facilitate efficient integration of charging load into the electrical grid.[[132]](#footnote-132)

Many state funded EV charging programs also recognize the importance of data collection, requiring the data to be collected and shared with the state. Colorado’s Volkswagen Settlement-funded Alt Fuels DCFC Corridors Grant Program requires charging stations to connect to a charging network via Wi-Fi or cellular connection and requires remote maintenance and control capabilities and periodic reporting to the state of charging use data.[[133]](#footnote-133) These kinds of network connection and data sharing requirements are common among Volkswagen Settlement-funded programs in Florida, Virginia, North Carolina, and New Jersey, among others.[[134]](#footnote-134), [[135]](#footnote-135)

Keep in mind that for utilities, including co-ops, EV charging data presents familiar challenges that arise with other types of consumer data. This is particularly true in an era of evolving transparency. First and foremost, maintaining and protecting customer data privacy is a core of the utility business. Similarly, clear procedures for customer approval for sharing data are critical. Ensuring the physical and digital security of the data is also foundational. Concerns that the data will not be handled properly and securely once released to third parties should not be dismissed. Likewise, questions of liability and customer redress if the data was mishandled or breached must be answered. For these reasons a broad mandate that utilities are required to share customer EV data with 3rd parties, arguably, is inconsistent with the utility’s obligations to its consumers.

## Annual EV Fees

As EV adoption increases throughout the county, 28 states have implemented annual registration fees for EV drivers. This is often done to cover lost revenue that would have been collected through a motor fuel tax. An analysis by Consumer Reports reveals that many of these fees are higher than what drivers of conventional vehicles pay in fuel taxes, which can discourage EV adoption.[[136]](#footnote-136), [[137]](#footnote-137) In addition, data shows that gaps in road network funding shortages arise primarily from inflation and the increasing average fuel economy of passenger vehicles in the United States as opposed to lost fuel tax revenue due to EV adoption.[[138]](#footnote-138)

Annual registration fees for EV drivers may be particularly discouraging of EV adoption in rural co-op service territories where range anxiety is likely already high due to the long distances drivers often need to travel and less access to public charging compared to more urban locations. States like Wyoming, Ohio, Georgia, Alabama, and Arkansas with EV fees equal to or exceeding $200 per year are also states where co-ops operate in many counties.[[139]](#footnote-139) A co-op’s perspective on EV fees may depend on the co-op’s assessment of the costs and benefits of EV adoption within its system and or state. Based on that perspective, the co-op can determine whether to advocate for or against proposed EV fees. Does the co-op believe that a robust EV program would benefit its system and consumer-members, or would a more phased implementation, based on the pace of value of each phase, be a better fit with the co-op’s future planning?

## Truck Regulations

On June 25, 2020, California adopted the first-of-its kind Advanced Clean Trucks Rule requiring all truck sales in the state to be zero emission by 2045.[[140]](#footnote-140) The program is modelled after the ZEV program.

This regulation is intended to drive investment in the electrification of trucks. If successful, it will set an example for other states to follow. It also sends a strong signal to manufacturers, fleet owners, and utilities in the state to prepare for fleet electrification.[[141]](#footnote-141) As with the ZEV program, the impact on co-ops of clean truck requirements would depend on a number of variables and the cost/benefit analysis of each: whether or not co-ops would be required to purchase these trucks for their own fleets; will there be competition from third parties, such as truck stops, to own and operate the charging infrastructure (Level 2 or Level 3 DCFC); Levels 2 and 3 chargers can require significantly more power supply-will there be competition from 3rd parties to provide it; and if the co-op is in a state that is participating in a multi-state compact to incentivize interstate charging buildouts (discussed subsequently), the co-op may want to consider what the combined impact of an in-state clean truck requirement and a multi-state coordination program would be on the co-op’s load, power supply, and plans for deploying charging infrastructure.

## Multi-State Coordination

Multi-state coordination in transportation electrification is when multiple states commit to the same set of targets, goals or actions. Examples of multi-state coordination include:

* The Multi-State ZEV Task Force has been in place since 2013 to facilitate policy coordination related to implementing the ZEV program.[[142]](#footnote-142)
* Regional Electric Vehicle (REV) West Plan: A memorandum of understanding (MOU) signed by Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming to deploy interstate corridor EV charging stations making it possible to drive an EV across the signatory states.[[143]](#footnote-143)
* Transportation Climate Initiative (TCI): A collaboration of 12 states working to decrease transportation carbon emissions. TCI is currently developing a “cap and invest” program to set caps on transportation emissions and invest in programs that support clean transportation.[[144]](#footnote-144)
* Following California’s recent rule adoption on trucks, California and 14 other states as well as Washington D.C., in July 2020, signed a MOU committing to 100 percent zero emission truck and bus sales by 2050.[[145]](#footnote-145), [[146]](#footnote-146)

While these compacts can apply to cars or trucks and buses, the role of the utility participants is the same. Utilities are viewed as essential partners. The July 2020 truck MOU highlights “[U]tility actions to promote zero emission MHDVs, such as electric distribution system planning, beneficial rate design and investment in ’make-ready’ charging infrastructure.”[[147]](#footnote-147) The diffuse range of multi-state efforts likely will draw significant interest from many stakeholders- EV manufacturers, truck fleets, 3rd party providers of generation and/or charging infrastructure, environmental advocates and local and state agencies. In addition to the environmental benefits touted in compacts, co-ops need to be ready to advocate for their share of the pie and for flexibility to use it in ways that benefit their systems and consumers-members.

Co-ops that are considering developing or expanding existing EV programs may find multi-state coordination programs to be beneficial because they set an example for other states and help coordinate efforts and establish common interests and goals. Nonetheless, it is important to recognize that the goals of one state may not work as a cookie-cutter in another state. For example, both Colorado and Montana are partners in the REV West initiative. Colorado also has implemented a transportation electrification target and a ZEV program, both of which are integrated with Colorado’s efforts under REV West. Moreover, Colorado has allocated the rest of its VW allotment to state transportation agencies for projects such as charging infrastructures.[[148]](#footnote-148) Hypothetically, would Colorado’s additional steps work in Montana or for the co-ops in the other state participants in REV West?

## Building Codes

Building codes can require new buildings to be prepared for EV charging infrastructure and may be set at the city level or state level. For example, New York City requires newly constructed garages and open lots to have EV ready hardware at least 20 percent of parking spots and the state of Colorado established buildings codes allowing residents of leased property to install charging infrastructure (also referred to as “EVSE”) at their own expense and subject to certain requirements.[[149]](#footnote-149), [[150]](#footnote-150) Five states have implemented EV-related building codes.[[151]](#footnote-151)

Building codes can be a valuable way to increase access to charging, especially at multi-family dwellings and commercial properties. EV charging infrastructure buildings codes focused on new construction are particularly valuable for decreasing costs of charging since it is substantially less expensive to install EV-ready infrastructure during construction than afterwards. A report prepared for the City and County of San Francisco found that installing electrical circuits for EV infrastructure at multi-family and nonresidential properties is several times more expensive after construction than during construction.[[152]](#footnote-152) Here again, policies do not directly attach to the utility business. Nevertheless, the possibility of integrating and supplying additional load at specific locations across the co-op’s system is something that co-ops should be aware of and plan for accordingly, including whether or not to influence state legislative or regulatory initiatives.

## Direct Sales of Passenger Vehicles

Direct sales laws improve access to purchase EVs from manufacturers that do not have automotive dealers (e.g., Tesla). Colorado is the most recent state to enact a law that allows EV manufacturers that do not have franchised dealers to sell directly to consumers rather than through dealerships.[[153]](#footnote-153), [[154]](#footnote-154)

## Preparing for Vehicle to Grid (V2G)

While many of the policies discussed earlier focus on how co-ops can benefit based on their ability to manage and provide services to EVs (appropriate rate structures, ability to own and manage chargers), integrating EVs as resources that can provide services back to the grid is not yet part of the commercial mainstream. As discussed in [Sections 1 and 2], technical and business hurdles remain in place: software needs to be developed; more manufactures (including Tesla) need to buy into V2G; and one-way residential chargers will need to be switched out for 2-way chargers. From a policy perspective, co-ops are encouraged to consider if current or upcoming policies would enable the co-ops to participate in V2G markets in ways that work for them. Would current policies allow co-ops to manage charging as a means to use EVs to (1) support the grid by shaving peaks, (2) offset expensive power purchases during peak hours; and (3) ensure that interconnections of charging infrastructure do not jeopardize the safety and reliability of the system. Also, where do policies that directly address V2G reside? Are they within the purview of co-ops and state regulators (as in the NARUC/NASEO initiative discussed below), is there a FERC role (also discussed below)? Until these issues are resolved, co-ops may need to be prepared to advocate for states and FERC to be more deliberate in implementing V2G markets in order to provide the flexibility and opportunities necessary for successful co-op participation.

# Policy Trends at the Federal and National Level

As noted at the beginning of this section, EV policy by and large begins at the state and local levels, with national efforts arising in response. Here are the “trends” that are gaining traction.

## Congress

The House Infrastructure bill, the Moving Forward Act H.R.2, which passed the House in July, included the EV provisions below:

* EV Charging Rebates: Establishes a $500 million rebate program for expenses associated with publicly accessible electric vehicle supply equipment. Co-ops are directly eligible and rebates will also pay for necessary grid upgrades/modifications required for the installation of such equipment.
* EV Charging Grants: Establishes a $1.4 billion grant program for electric vehicle charging, hydrogen, natural gas and propane fueling infrastructure. Grants are awarded to states/localities who then partner with private entities, including electric utilities, to acquire and install the infrastructure.
* Electric School Buses: Provides a series of incentives for electric school buses, including prioritizing grants to retrofit school buses, allowing EPA to award grants, rebates or low-cost loans up to 60% for replacing with clean buses (costs include charging and fueling infrastructure), and reauthorizing the clean school bus program at $65 million.
* EV credit - § 30D: Replaces the phaseout of the credit (currently after manufacturer sales exceed 200,000 vehicles) with a transitional phase for sales between 200,000 and 600,000 vehicles, but reduces the amount by $500. Then phases out the credit by 50% for one quarter, before expiring. Extends the credit for 2-wheeled and 3-wheeled plug-in vehicles through 2025.
* New Used EV Credit - § 25E: Creates a new credit for buyers of used plug-in electric cars through 2025. The credit is $1,250, with additional incentives for battery capacity and it is capped at the lesser of $2,500 credit or 30% of the sale price.
* Exempt Facility Bonds for Zero-Emission Vehicle Infrastructure: Expands the definition of exempt facility bond eligible for tax-exempt private activity bond financing to include any bond issued if 95 percent or more of the net proceeds are to be used to provide zero-emission vehicle infrastructure.

The need for economic development in LMI and rural areas cannot be overemphasized (especially during the COVID pandemic). This has been a focus of NRECA’s advocacy efforts in discussions of various EV bills considered by Congress. All of these provisions either directly or indirectly support co-op participation in EV business models, should they choose to do so. H.R.2 did not move in the Senate. The upcoming election on November 3, 2020 will influence if and to what extent Congress revisits EVs in 2021.

## Agency

###### FERC

FERC’s Order 841 (Storage Order) will impact EV markets because it requires RTOs to establish procedures for bidding energy storage, such as EVs, into their wholesale markets.[[155]](#footnote-155) Unlike FERC’s Order 719 (bidding demand response into RTOs)[[156]](#footnote-156), Order 841 does not provide for a “relevant electric retail regulatory authority” RERRA opt-in or -out that allows state commissions and non-regulated utilities such as co-ops to determine whether or not storage resources within their systems can participate in markets. The essence of the Storage Order is that EVs will be able to bid into wholesale markets without taking into account the impact these transactions and services would have on the local utility systems, adverse consequences for utility and/or state programs or goals, or the need for state and local regulators to have a say about this expanded participation in wholesale markets.

On September 17,2020, FERC issued Order 2222 which requires RTOs to establish procedures for aggregators to bid DER (including EVs) into their markets. [[157]](#footnote-157) Unlike the Storage Order, Order 2222 requires RERRAs for small utilities (under 4 million MWh of retail sales in the preceding year) to affirmatively opt-in to allow aggregators w/in their regulated systems to participate in the RTO markets. This was an important win for the co-ops’ and NRECA advocacy efforts, because virtually all co-ops fall under the small utilities size threshold. With respect to EVs, it means that while individual EV storage sources may participate in RTOs (a highly unlikely scenario), they cannot be aggregated and bid, absent RERRA approval. At this juncture, the full impact of Order 2222 on DER (including EV) participation in markets is unknown. Potentially countervailing policies at the state and local levels raise significant questions for how Order 2222 will be implemented.

###### DOE

The Department of Energy recently kicked off “An EV Future: Navigating the Transition.” [[158]](#footnote-158) The initiative is not a policy forum; however, it is convening stakeholders to highlight ongoing efforts, uncover potential shortcomings, encourage collaborative, multi-stakeholder approaches, and identify areas for new research or federal collaboration.

## National

NARUC/NASEO (N/N) Initiative: The NARUC/NASEO Task Force on Comprehensive Electricity Planning is a national initiative by state utility commissioners and state energy office administrators to develop voluntary regulatory pathways for integrating distribution and resource planning-from behind-the meter DER (including EVs) up to RTOs.[[159]](#footnote-159) The pathways are aimed at the state and local levels and focus on many of the same objectives found in the EV polices discussed earlier: improve grid reliability and resilience; optimize use of distributed and existing energy resources; cost-effectively allocate costs and benefits; and support related state policy priorities, such as limiting GHG emissions. Once completed (2021-22), N/N Initiative pathways will offer regulators guidance on creating planning frameworks that assess resources such as EVs in meeting grid needs. NRECA and several co-ops are participating in the N/N Initiative in order to ensure that the pathways include options that work for co-ops.

# Going Forward: KRIs and Advocacy Principles

Whether co-ops are self-regulating or state-regulated, many of the KRIs discussed here may be relevant to co-op strategies going forward on EVs. Co-op boards as well as state commissions are responsible for evaluating EV policies to assess whether or not they advance applicable EV objectives. Considering these KRIs can help in that evaluation and in developing advocacy strategies in forums such as the statehouse. Some co-ops may want to develop or take advantage of EV policies just to get out ahead of the curve. While all of these KRIs and advocacy principles are woven into the earlier text on EV policies, co-ops may find it helpful to view them here as standalone bullets.

## KRIs

* Overall, do the policies give co-ops the flexibility and opportunities to develop EV programs based on the costs they want to assume, time frame, rate structure, business structure, and the ability to revise programs as the needs of the co-op and its consumer-members evolve?
* Do the policies work in an integrated fashion to support opportunities for co-op EV programs? As discussed earlier, the impact of one policy, such as the ZEV program, can only be fully understood if it is assessed in conjunction with incentive policies.
* Do the policies afford co-ops the opportunity to own and operate charging infrastructure and the flexibility to develop business models which can work for them?
* Do the policies provide co-ops the flexibility/ability to directly control or manage charging, either through DR programs or matching load with supply?
* Are rate policies inclusive and flexible enough to work for co-op businesses and services?
* Who has a right to provide the power supply, including battery storage, to the charger, can the generation be used for other things or the excess sold elsewhere?
* Are there incentive programs that are available to co-ops?
* If the co-op is eligible under a state transportation electrification target, is it in a position to comply? If not, what has to happen in order to meet the target in ways that support all consumers and the grid?
* Do the policies allow for co-op access to charging data, which is essential for DR programs and maintaining reliability of the grid?

## Advocacy Principles

* Overall, at the most basic level, co-ops need the ability and flexibility to make decisions about if and how to develop an EV program, and support from federal and state incentive opportunities to implement it.
* Co-ops should be fairly compensated for all costs associated with both developing EV infrastructure and providing power to EV infrastructure.
* Co-ops need access to consumer charging data needed to cost-effectively meet consumer demand and to plan and operate the co-op’s system and resources effectively and efficiently.
* Co-ops need the ability to own and/or manage EV charging and vehicle-to-grid operations in order to ensure safe, reliable, and cost-effective integration into the grid, optimization of system operations, and service to members with EVs.
* Co-ops need access to EV and EV infrastructure resources and incentives such as grants, preferential financing and tax incentives for co-op members.
* Co-ops and rural communities (including LMI communities) should not be disadvantaged regarding development of EV infrastructure or access to incentives.
* Co-ops need to retain local decision-making authority regarding whether and how to supply power to and invest in and manage public and private EV infrastructure.
* Co-ops need to retain the local authority to adopt those EV rate structures, compensation structures, and program designs that their boards conclude permit them to appropriately allocate the costs and benefits of EV programs among their consumer-members and to provide efficient incentives for charging that maximize EV value to the system.

# Useful Resources for Co-ops Working on EV Programs

This section describes resources co-ops can use to help them understand the potential benefits and risks associated with EVs and implement programs that maximize benefits and minimize risks.

NRECA has several resources provide helpful data on policies and regulations, all of which are available at https://www.cooperative.com/topics/distributed-energy-resources/Pages/default.aspx:

Distributed Energy Resources: Trends and Impacts on G&Ts and Their Member Cooperatives[[160]](#footnote-160)

State Summaries of DER and Other Retail Policies[[161]](#footnote-161)

DER Policies Interactive Tracker[[162]](#footnote-162)

Distribution and Energy Resources Compensation and Cost Recovery Guide[[163]](#footnote-163)

The U.S. Department of Energy’s Clean Cities Coalition network is a group of nearly 100 coalitions working to advance alternative fuels, fuel-saving technologies and practices, and new mobility choices.[[164]](#footnote-164) Each coalition is led by a Clean Cities coordinator who works on projects within their state or community, and many are locally focused. Clean Cities coordinators can be a valuable source of local knowledge on transportation electrification topics for electric co-ops.

While co-ops are different from IOUs in many important ways including how they are regulated, how they earn revenue, and what their customers need, co-ops may find value in using IOU EV programs as resources in designing their own programs. IOU programs can serve as case studies in utility EV programs as well as references for program design details such as how to prioritize underserved communities, how to create time-of-use rate schedules to encourage off-peak charging, and how high to set EV or EV charging incentives. The Atlas EV Hub tracks and collects key information on all IOU EV programs in its Utility Filings Dashboard. This is just one of several data dashboards covering a range of topics available on the EV Hub, a comprehensive resource on transportation electrification activities in the United States.[[165]](#footnote-165)

1. : EV Programs at Co-Ops

This table lists all EV programs at co-ops tracked in AFDC. These programs include rebates for EVs, incentives for EV charging infrastructure, and EV electricity rates.

| Co-Op | State | Program | Source |
| --- | --- | --- | --- |
| Holy Cross Electric Assn, Inc | Colorado | EVSE Rebate | http://www.afdc.energy.gov/laws/12186 |
| Gunnison County Elec Assn. | Colorado | Residential Whole House Meter Only | http://www.afdc.energy.gov/laws/12008 |
| Delaware Electric Cooperative | Delaware | EVSE Incentive | http://www.afdc.energy.gov/laws/12042 |
| Illinois Rural Electric Coop | Illinois | Residential Separate Meter Only | http://www.afdc.energy.gov/laws/11670 |
| Central Iowa Power Cooperative | Iowa | EV Incentive | http://www.afdc.energy.gov/laws/12338 |
| Central Iowa Power Cooperative | Iowa | EVSE Incentive | http://www.afdc.energy.gov/laws/12339 |
| Consumers Energy | Michigan | EVSE Rebate | http://www.afdc.energy.gov/laws/12272 |
| Connexus Energy | Minnesota | EVSE Rebate | http://www.afdc.energy.gov/laws/11718 |
| Dakota Electric Association | Minnesota | EVSE Rebate | http://www.afdc.energy.gov/laws/11700 |
| Lake Region Electric Cooperative - (MN) | Minnesota | EVSE Rebate | http://www.afdc.energy.gov/laws/12147 |
| Dakota Electric Association | Minnesota | Residential Separate Meter Only | http://www.afdc.energy.gov/laws/10414 |
| Connexus Energy | Minnesota | Residential Separate or Whole House Meter | http://www.afdc.energy.gov/laws/11522 |
| New Hampshire Elec Coop Inc | New Hampshire | Residential Separate Meter Only | http://www.afdc.energy.gov/laws/11997 |
| Cape Hatteras Elec Member Corp | North Carolina | EVSE Rebate | http://www.afdc.energy.gov/laws/12169 |
| Randolph Electric Member Corp | North Carolina | Residential Whole House Meter Only | http://www.afdc.energy.gov/laws/12027 |
| United Electric Coop Service Inc - (TX) | Texas | EVSE Incentive | http://www.afdc.energy.gov/laws/12355 |
| Vermont Electric Cooperative, Inc | Vermont | EVSE Incentive | http://www.afdc.energy.gov/laws/12018 |
| Vermont Electric Cooperative, Inc | Vermont | Vehicle Rebate | http://www.afdc.energy.gov/laws/11808 |
| Barron Electric Coop | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12327 |
| Chippewa Valley Electric Coop | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12328 |
| Clark Electric Coop - (WI) | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12329 |
| East Central Energy | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12330 |
| Pierce-Pepin Coop Services | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12333 |
| Price Electric Coop Inc | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12331 |
| Riverland Energy Cooperative | Wisconsin | EVSE Incentive | http://www.afdc.energy.gov/laws/12332 |

1. : Key EV Policies by State

This table provides, for each state, a count of key EV-related state policies in areas where co-ops are the predominant utility.

| State | Annual Fee | Building Codes | Charging Incentive | Charging Service Provider | EV Charging Rate | State BEV Incentive | State PHEV Incentive | Transportation Electrification Plan | Utility Incentive | ZEV Program | Per State Total |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Alabama | 1 |  | 1 | 1 | 1 |  |  |  | 1 |  | 5 |
| Arizona |  |  | 1 |  | 2 |  |  | 1 | 3 |  | 7 |
| Arkansas | 1 |  | 1 | 1 |  |  |  |  | 1 |  | 4 |
| California | 1 | 2 | 3 | 1 | 7 | 2 | 1 | 2 | 23 | 2 | 44 |
| Colorado | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 12 |
| Delaware |  |  | 2 | 1 |  | 1 | 1 |  | 1 |  | 6 |
| Florida |  |  |  | 1 |  |  |  | 1 | 4 |  | 6 |
| Georgia | 1 |  | 1 |  | 1 | 1 |  |  | 2 |  | 6 |
| Hawaii | 1 |  | 1 | 1 | 1 |  |  | 1 |  |  | 5 |
| Idaho | 1 |  | 1 | 1 |  |  |  | 1 | 1 |  | 5 |
| Illinois | 1 |  | 1 | 1 | 1 | 1 | 1 |  |  |  | 6 |
| Indiana | 1 |  |  |  | 2 |  |  |  | 1 |  | 4 |
| Iowa | 1 |  |  | 1 |  |  |  | 1 | 6 |  | 9 |
| Kansas | 1 |  |  |  |  |  |  |  |  |  | 1 |
| Kentucky |  |  |  | 1 |  |  |  |  |  |  | 1 |
| Louisiana |  |  | 1 |  |  | 1 | 1 |  | 2 |  | 5 |
| Maine |  |  |  | 1 |  | 1 |  |  |  | 1 | 3 |
| Maryland |  |  | 1 | 1 | 4 | 1 | 1 | 2 | 7 | 2 | 19 |
| Michigan | 1 |  |  |  | 4 |  |  |  | 4 |  | 9 |
| Minnesota | 1 |  |  | 1 | 3 |  |  |  | 5 | 1 | 11 |
| Mississippi | 1 |  |  |  |  |  |  |  | 1 |  | 2 |
| Missouri | 1 |  | 1 |  |  |  |  |  | 1 |  | 3 |
| Montana |  |  |  |  |  |  |  | 1 |  |  | 1 |
| Nebraska | 1 |  | 1 |  |  |  |  |  | 3 |  | 5 |
| Nevada |  |  |  |  | 1 |  |  | 1 | 1 | 1 | 4 |
| New Hampshire |  |  |  | 1 | 1 |  |  | 1 |  |  | 3 |
| New Jersey |  |  | 3 | 1 |  | 2 | 1 | 2 | 1 | 2 | 12 |
| New Mexico |  |  |  | 1 |  |  |  | 1 |  | 1 | 3 |
| New York |  |  | 1 | 1 | 2 | 1 | 1 | 1 | 3 | 2 | 12 |
| North Carolina | 1 |  |  | 1 | 2 |  |  | 1 | 1 |  | 6 |
| North Dakota | 1 |  |  |  |  |  |  |  |  |  | 1 |
| Ohio | 1 |  | 1 |  |  |  |  |  | 2 |  | 4 |
| Oklahoma |  |  | 1 | 1 |  |  |  |  | 1 |  | 3 |
| Oregon | 1 |  | 2 | 1 | 1 | 2 | 2 | 1 | 5 | 2 | 17 |
| Pennsylvania |  |  |  |  |  | 1 | 1 |  | 4 |  | 6 |
| South Carolina | 1 |  |  |  |  |  | 1 |  |  |  | 2 |
| Tennessee | 1 |  |  |  |  | 1 | 1 |  | 1 |  | 4 |
| Texas |  |  | 2 | 1 | 1 | 1 | 1 |  | 6 |  | 12 |
| Utah | 2 |  | 4 | 1 | 2 | 2 | 2 | 2 | 1 |  | 16 |
| Vermont |  |  | 1 | 1 |  | 1 | 1 | 2 | 7 | 2 | 15 |
| Virginia | 1 | 1 | 1 | 1 | 2 |  |  | 2 |  |  | 8 |
| Washington | 1 |  | 2 | 1 |  | 1 | 1 | 2 | 2 | 1 | 11 |
| West Virginia | 1 |  |  | 1 |  |  |  |  | 1 |  | 3 |
| Wisconsin | 1 |  |  |  |  |  |  |  | 11 |  | 12 |
| Wyoming | 1 |  | 1 |  |  |  |  | 1 |  |  | 3 |
| Per State Total | 29 | 4 | 37 | 27 | 39 | 21 | 18 | 29 | 114 | 18 | 336 |

1. Electric cooperatives are: (1) independent entities; (2) governed by independent boards of directors; and (3) affected by different member, financial, legal, political, policy, operational, and other considerations. For these reasons, each electric cooperative should make its own business decisions on whether and how to use this information and on what rate designs and policies are appropriate for that cooperative’s own circumstances. Where specific rates and prices are provided, they are provided as examples only. [↑](#footnote-ref-1)
2. International Council on Clean Transportation, 2017. Literature Review on Power Utility Best Practices Regarding Electric Vehicles. <https://theicct.org/publications/literature-review-power-utility-best-practices-regarding-EVs> [↑](#footnote-ref-2)
3. Union of Concerned Scientists (UCS), 2018. New Data Show Electric Vehicles Continue to Get Cleaner. <https://blog.ucsusa.org/dave-reichmuth/new-data-show-electric-vehicles-continue-to-get-cleaner> [↑](#footnote-ref-3)
4. Bloomberg New Energy Finance (BNEF), 2020. Electric Vehicle Outlook 2020. <https://about.bnef.com/electric-vehicle-outlook/> [↑](#footnote-ref-4)
5. BNEF, 2020. [↑](#footnote-ref-5)
6. EVAdoption, 2020. <https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/> and <https://evadoption.com/ev-models/available-phevs/> [↑](#footnote-ref-6)
7. EVAdoption, 2020. <https://evadoption.com/ev-models/bev-models-currently-available-in-the-us/> and <https://evadoption.com/ev-models/available-phevs/> [↑](#footnote-ref-7)
8. See for example <https://www.greencarreports.com/news/1128626_why-you-really-don-t-need-your-ev-to-go-500-miles> [↑](#footnote-ref-8)
9. EPRI, 2020. Consumer’s Guide to Electric Vehicles. <https://www.epri.com/research/products/000000003002018113> [↑](#footnote-ref-9)
10. National Renewable Energy Laboratory (NREL), 2020. Levelized Cost of Charging Electric Vehicles in the United States. <https://www.cell.com/joule/fulltext/S2542-4351(20)30231-2> [↑](#footnote-ref-10)
11. J.D. Power, 2020. <https://www.jdpower.com/business/press-releases/2020-q1-mobility-confidence-index-study-fueled-surveymonkey-audience> [↑](#footnote-ref-11)
12. <https://www.cornbeltenergy.com/ev-3/corn-belt-energy-celebrates-a-successful-ev-drive-in-event.html> [↑](#footnote-ref-12)
13. <https://www.gcea.coop/ev-rentapp> [↑](#footnote-ref-13)
14. <https://www.gcea.coop/Electric-Vehicle> [↑](#footnote-ref-14)
15. Atlas Policy, 2019. Electric Trucks and Buses Overview: The State of Electrification in the Medium- and Heavy-Duty Vehicle Industry. <https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/> [↑](#footnote-ref-15)
16. APTA, 2019. Public Transportation Vehicle Database. <https://www.apta.com/research-technical-resources/transit-statistics/vehicle-database/> [↑](#footnote-ref-16)
17. Glitman et al., 2017. How a Problem with Vehicle Emissions Affects the Electricity Industry. Volkswagen, Electric School Buses, and New Energy Storage Resources. <https://www.cooperative.com/programs-services/bts/Pages/TechSurveillance/vehicle-emissions-affects-electricity-industry.aspx> [↑](#footnote-ref-17)
18. <https://ecology.wa.gov/About-us/Get-to-know-us/News/2020/April-29-electric-school-buses-headed-to-WA> [↑](#footnote-ref-18)
19. Atlas Policy, 2019. Electric Trucks and Buses Overview: The State of Electrification in the Medium- and Heavy-Duty Vehicle Industry. <https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/> [↑](#footnote-ref-19)
20. EEI, 2019a. Preparing to Plug in Your Bus Fleet: 10 Things to Consider. <https://www.eei.org/issuesandpolicy/electrictransportation/Documents/PreparingToPlugInYourBusFleet_FINAL_2019.pdf> [↑](#footnote-ref-20)
21. https://www.cooperative.com/remagazine/articles/Pages/co-ops-see-electric-school-bus-builds-interest-electric-vehicles.aspx [↑](#footnote-ref-21)
22. <https://www.cooperative.com/remagazine/articles/Pages/co-ops-see-electric-school-bus-builds-interest-electric-vehicles.aspx> (same as previous footnote) [↑](#footnote-ref-22)
23. https://www.businessinsider.com/amazon-creating-fleet-of-electric-delivery-vehicles-rivian-2020-2 [↑](#footnote-ref-23)
24. https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1580304360144-453 [↑](#footnote-ref-24)
25. https://electrek.co/2020/01/23/att-amazon-ikea-corporate-electric-vehicle-alliance-ceres/ [↑](#footnote-ref-25)
26. Natural Resources Defense Council (NRDC), 2020. <https://www.nrdc.org/experts/patricio-portillo/15-states-take-historic-action-transportation-pollution> [↑](#footnote-ref-26)
27. Oak Ridge National Laboratory (ORNL), 2019. Medium- and Heavy-Duty Vehicle Electrification. <https://info.ornl.gov/sites/publications/Files/Pub136575.pdf> [↑](#footnote-ref-27)
28. <https://www.cooperative.com/topics/distributed-energy-resources/Pages/Market-Potential-for-Commercial-Electric-Trucking.aspx> [↑](#footnote-ref-28)
29. NACFE, 2018a. Electric Trucks Where They Make Sense. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/NACFE-Electric-Trucks-Where-They-Make-Sense-2018.pdf> [↑](#footnote-ref-29)
30. NAFCE, 2018b. Medium-Duty Electric Trucks Cost of Ownership. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/NACFE-Medium-Duty-Electric-Trucks-Cost-of-Ownership-2018.pdf> [↑](#footnote-ref-30)
31. NAFCE, 2019. Viable Class 7/8 Electric, Hybrid and Alternative Fuel Tractors. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/Viable-Class-7-8-Alternative-Vehicles-Final-12-10-.pdf> [↑](#footnote-ref-31)
32. NRECA, 2020. <https://www.cooperative.com/programs-services/bts/Documents/Advisories/Advisory-Alternative-Fuels-Freight-Trucks-April-2020.pdf> [↑](#footnote-ref-32)
33. EEI 2019b. Preparing to Plug in Your Fleet: 10 Things to Consider. <https://www.eei.org/issuesandpolicy/electrictransportation/Documents/PreparingToPlugInYourFleet_FINAL_2019.pdf> [↑](#footnote-ref-33)
34. U.S. DOE, 2020. <https://www.energy.gov/eere/electricvehicles/charging-home> [↑](#footnote-ref-34)
35. For more details see background information in NRECA’s TechSurveillance article, Gearing Up for Electric Vehicles: Residential EVSE Program Design for Co-ops. <https://www.cooperative.com/programs-services/bts/Documents/Secure/TS/TS-Residential-EV-Service-Equipment-June-2018.pdf> [↑](#footnote-ref-35)
36. <https://greatriverenergy.com/great-minnesota-road-trip-electrified/>; <http://greatriverener.wpengine.com/smart-energy-use/beneficial-electrification/electric-vehicles/> [↑](#footnote-ref-36)
37. <https://www.electric.coop/north-carolina-co-ops-invest-one-million-electric-vehicles-charging-stations/> [↑](#footnote-ref-37)
38. <https://www.ncdriveelectric.com/> [↑](#footnote-ref-38)
39. <https://www.plugshare.com>; <https://afdc.energy.gov/stations/#/find/nearest> [↑](#footnote-ref-39)
40. <https://www.electric.coop/oklahoma-co-ops-commit-to-electric-vehicle-charging-network/> [↑](#footnote-ref-40)
41. <http://www.westcoastgreenhighway.com/electrichighway.htm> [↑](#footnote-ref-41)
42. <https://chargedevs.com/newswire/st-petersburg-florida-transit-authority-deploys-wave-inductive-charging-station-for-e-buses/> [↑](#footnote-ref-42)
43. <https://chargedevs.com/newswire/stanford-researchers-demonstrate-major-advance-in-dynamic-charging/> [↑](#footnote-ref-43)
44. Union of Concerned Scientists (UCS), 2018. New Data Show Electric Vehicles Continue to Get Cleaner. <https://blog.ucsusa.org/dave-reichmuth/new-data-show-electric-vehicles-continue-to-get-cleaner> [↑](#footnote-ref-44)
45. For more details on member education and outreach, see NRECA’s series Plug-In Electric Vehicles and Electric Cooperatives, Volume 3: Keys to Developing a PEV Program for Your Electric Cooperative. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/keys_to_developing_a_pev_program_for_your_electric_cooperative.pdf> [↑](#footnote-ref-45)
46. EEI, 2011. *The Utility Guide to Plug-In Electric Vehicle Readiness*.

    [www.eei.org/issuesandpolicy/electrictransportation/Documents/EVReadinessGuide\_web\_final.pdf](http://www.eei.org/issuesandpolicy/electrictransportation/Documents/EVReadinessGuide_web_final.pdf). [↑](#footnote-ref-46)
47. [www.facebook.com/AustinEnergyElectricVehicles](https://www.facebook.com/AustinEnergyElectricVehicles) [↑](#footnote-ref-47)
48. <https://www.cooperative.com/programs-services/touchstone/advertising-and-campaigns/electric-vehicles/Pages/Secure/default.aspx> and <https://www.cooperative.com/programs-services/communications/straight-talk/Pages/default.aspx> [↑](#footnote-ref-48)
49. <http://www.todayspower.com/pev/> [↑](#footnote-ref-49)
50. [www.carvana.com](http://www.carvana.com) [↑](#footnote-ref-50)
51. Dayem et al., 2018. Gearing Up for Electric Vehicles: Residential EVSE Program Design for Co-ops. <https://www.cooperative.com/programs-services/bts/Documents/Secure/TS/TS-Residential-EV-Service-Equipment-June-2018.pdf> [↑](#footnote-ref-51)
52. https://greenmountainpower.com/rebates-programs/electric-vehicles/ev-rebate/ [↑](#footnote-ref-52)
53. [↑](#footnote-ref-53)
54. [www.afdc.energy.gov/pdfs/51227.pdf](http://www.afdc.energy.gov/pdfs/51227.pdf) [↑](#footnote-ref-54)
55. ç series Plug-In Electric Vehicles and Electric Cooperatives, Volume 3: Keys to Developing a PEV Program for Your Electric Cooperative. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/keys_to_developing_a_pev_program_for_your_electric_cooperative.pdf> [↑](#footnote-ref-55)
56. [www.evitp.org](http://www.evitp.org/) [↑](#footnote-ref-56)
57. [www.afdc.energy.gov/pdfs/51228.pdf](http://www.afdc.energy.gov/pdfs/51228.pdf) [↑](#footnote-ref-57)
58. A cooperative with one thousand EVs in its territory may see a load increase of 9 MWh per day, assuming the average EV drives 30 miles per day and consumes 300 Wh per mile. [↑](#footnote-ref-58)
59. For more details, see NRECA’s Tech Surveillance article, Electric Vehicle Charging Control Strategies. <https://www.cooperative.com/programs-services/bts/Documents/TechSurveillance/Surveillance-Article-EVSE-Load-Control-Strategies-Jan-2019.pdf> [↑](#footnote-ref-59)
60. https://www.fleetcarma.com/smartcharge-rewards/ [↑](#footnote-ref-60)
61. At least one EVSE manufacturer (eMotorWerks) is coordinating with EV manufacturers to develop the ability for the EV to communicate SOC information to the EVSE. This functionality would eliminate the need for the user to provide SOC information. [↑](#footnote-ref-61)
62. https://cdn2.hubspot.net/hubfs/5496199/VP\_gmp\_case\_study\_2019.pdf?\_\_hssc=55780276.1.1574692338206&\_\_hstc=55780276.c55500bc617d34c1a6b6290bb8317de4.1574692338204.1574692338204.1574692338204.1&\_\_hsfp=2724414874&hsCtaTracking=336ab0b0-9a22-4016-84ae-165057b03ad3%7Cd20d5238-47d4-43cf-8f63-0d7ca6e3d21c [↑](#footnote-ref-62)
63. In some situations, however, unlimited charging could increase usage. Unlimited charging could, for example, lead to additional trips by the EV that had previously been made in an internal combustion engine vehicle, or more aggressive driving behavior that decreases the EV’s efficiency. [↑](#footnote-ref-63)
64. <http://aepinnovation.com/ev/> [↑](#footnote-ref-64)
65. Note that the study had three rates: on-peak (most expensive), off-peak (intermediate rate), and super off-peak (least expensive) hours. Findings showed that customers charged during super off-peak hours a large majority of the time. For simplicity in this discussion, we compare the most expensive rates to the least expensive rates and ignore the intermediate rate, which is optional. We refer to the most expensive rate as the “on-peak” rate, and the least expensive as “off-peak.” [↑](#footnote-ref-65)
66. Tate, 2018. Rate Options That Support Electric Vehicle Adoption. <https://www.cooperative.com/programs-services/bts/Documents/TechSurveillance/TS-EV-Rate-Options-June-2018.pdf> [↑](#footnote-ref-66)
67. Grant et al., 2015b. Managing the Financial and Grid Impacts of Plug-In Electric Vehicles. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/managing_the_financial_and_grid_impacts_of_plugin_electric_vehicles.pdf> [↑](#footnote-ref-67)
68. Grant et al., 2015c. Keys to Developing a PEV Program for Your Electric Cooperative. <https://www.cooperative.com/programs-services/bts/Documents/Secure/Reports/keys_to_developing_a_pev_program_for_your_electric_cooperative.pdf> [↑](#footnote-ref-68)
69. <https://data.census.gov/cedsci/> [↑](#footnote-ref-69)
70. Dayem and Mercier, 2020. Electric Vehicle Service Equipment Load Control Case Studies. <https://www.cooperative.com/programs-services/bts/Documents/Reports/Report-EVSE-Load-Control-Case-Studies-April-2020.pdf> [↑](#footnote-ref-70)
71. Pecan Street, 2020. Vehicle to Grid Technology and Energy Storage. <https://www.pecanstreet.org/v2gcasestudy/> [↑](#footnote-ref-71)
72. <https://www.coned.com/en/about-us/media-center/news/20180619/electricity-from-school-bus-batteries-will-support-con-edison-grid-reliability> [↑](#footnote-ref-72)
73. Rocky Mountain Institute (RMI), 2020. Working Together Toward a More Resilient Future: A community-based approach to energy resilience in the Roaring Fork Valley. <https://rmi.org/insight/working-together-toward-a-more-resilient-future/> [↑](#footnote-ref-73)
74. Bloomberg New Energy Finance, "Electric Vehicle Outlook 2020," May 2020. [Online]. Available: https://bnef.turtl.co/story/evo-2020/page/3/1?teaser=yes. [Accessed July 2020]. [↑](#footnote-ref-74)
75. See Appendix A for a list of states with EV programs where co-ops have a presence. [↑](#footnote-ref-75)
76. See FERC Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators Order No. 2222, 172 FERC ¶ 61,247 (2020); see, also Electric Storage Participation in Markets Operated by Regional Transmission Organizations & Independent System Operators, Order No. 841, 162 FERC ¶ 61,127 (2018), order on reh’g, Order No. 841-A, 84 FR 23902, 167 FERC ¶ 61,154 (2019), aff’d sub nom. Nat’l Ass’n of Regulatory Util. Comm’rs v. FERC, 964 F.3d 1177 (D.C. Cir. 2020). Congressional and federal administrative activities are addressed subsequently. [↑](#footnote-ref-76)
77. See Appendix B for DOE EERE AFDC’s table of co-op EV programs. Additionally, NRECA has the following resources that track regularly state EV activities.

    https://www.cooperative.com/topics/distributed-energy-resources/Pages/Secure/State-Retail-Policy-Summaries.aspx

    https://www.cooperative.com/programs-services/government-relations/Pages/Secure/GR-Policy-Issues-Tracker.aspx [↑](#footnote-ref-77)
78. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-78)
79. Atlas EV Hub, "Electric Utility Filings Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/electric-utility-filings/. [Accessed July 2020]. [↑](#footnote-ref-79)
80. Non-financial incentives such as HOV incentives or parking incentives can also be used to encourage EV adoption. [↑](#footnote-ref-80)
81. Atlas EV Hub, "Public Funding Awards Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/. [Accessed July 2020]. [↑](#footnote-ref-81)
82. Alternative Fuels Data Center, "Plug-In Electric Vehicle (PEV) Tax Credit," July 2020. [Online]. Available: https://afdc.energy.gov/laws/11702. [Accessed July 2020]. [↑](#footnote-ref-82)
83. Alternative Fuels Data Center, "Plug-In Hybrid and Zero Emission Light-Duty Vehicle Rebates," July 2020. [Online]. Available: https://afdc.energy.gov/laws/8161. [Accessed July 2020]. [↑](#footnote-ref-83)
84. Atlas EV Hub, "State EV Sales and Model Availability Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/state-ev-sales-and-model-availability/. [Accessed July 2020]. [↑](#footnote-ref-84)
85. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-85)
86. Atlas EV Hub, "Medium- and Heavy-Duty Vehicle Electrification," June 2020. [Online]. Available: https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/. [Accessed July 20202]. [↑](#footnote-ref-86)
87. Atlas EV Hub, "Medium- and Heavy-Duty Vehicle Electrification," June 2020. [Online]. Available: https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/. [Accessed July 20202]. [↑](#footnote-ref-87)
88. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-88)
89. United Cooperative Services, "Rebate Programs," July 2020. [Online]. Available: https://ucs.net/rebate-programs. [Accessed July 2020]. [↑](#footnote-ref-89)
90. Vermont Electric Coop, "Energy Transformation Programs," July 2020. [Online]. Available: https://vermontelectric.coop/energy-transformation-programs. [Accessed July 2020]. [↑](#footnote-ref-90)
91. <https://www.utilitydive.com/news/colorado-passes-bill-to-avoid-urban-rural-divide-on-ev-chargers/552561/> See also, <https://pubs.naruc.org/pub/32857459-0005-B8C5-95C6-1920829CABFE> [↑](#footnote-ref-91)
92. https://crea.coop/2019/08/27/two-colorado-co-ops-unveil-ev-charging-stations/ [↑](#footnote-ref-92)
93. https://www.electric.coop/oklahoma-co-ops-commit-to-electric-vehicle-charging-network/ [↑](#footnote-ref-93)
94. <https://www.cooperative.com/remagazine/articles/Pages/co-ops-see-electric-school-bus-builds-interest-electric-vehicles.aspx> [↑](#footnote-ref-94)
95. NC Electric Cooperatives, "North Carolina’s Electric Cooperatives Expand Electric Vehicle Charging Network with New DC Fast Chargers," December 2019. [Online]. Available: https://www.ncelectriccooperatives.com/who-we-are/spotlight/north-carolinas-electric-cooperatives-expand-electric-vehicle-charging-network-with-new-dc-fast-chargers/. [Accessed July 2020]. [↑](#footnote-ref-95)
96. <https://www.ncelectriccooperatives.com/who-we-are/spotlight/n-c-electric-cooperatives-awarded-more-than-700000-in-volkswagen-settlement-funding-for-10-electric-vehicle-charging-stations/> [↑](#footnote-ref-96)
97. https://www.cooperative.com/remagazine/articles/Pages/co-ops-see-electric-school-bus-builds-interest-electric-vehicles.aspx [↑](#footnote-ref-97)
98. Forbes, "Redlining's Legacy of Inequality: Low Homeownership Rates, Less Equity for Black Households," 11 June 2020. [Online]. Available: https://www.forbes.com/sites/brendarichardson/2020/06/11/redlinings-legacy-of-inequality-low-homeownership-rates-less-equity-for-black-households/#497a7cd42a7c. [↑](#footnote-ref-98)
99. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-99)
100. Atlas EV Hub, "25 Percent of Approved Utility Investment Going to Underserved Communities," December 2019. [Online]. Available: https://www.atlasevhub.com/data\_story/25-percent-of-approved-utility-investment-going-to-underserved-communities/. [Accessed July 2020]. [↑](#footnote-ref-100)
101. Atlas Public Policy, "25 Percent of Approved Utility Investment Going to Underserved Communities," 2 December 2019. [Online]. Available: https://www.atlasevhub.com/data\_story/25-percent-of-approved-utility-investment-going-to-underserved-communities/. [↑](#footnote-ref-101)
102. See NC Clean Energy Technology Center, 50 States of Electric Vehicles, Quarterly Report for 2nd Quarter 2020. See also, https://static1.squarespace.com/static/5ac5143f9d5abb8923a86849/t/5f2a0de7be7dca54d7828958/1596591595829/Q2-20\_EV\_execsummary\_Final.pdf [↑](#footnote-ref-102)
103. https://www.electrifyamerica.com/pricing [↑](#footnote-ref-103)
104. See <https://roboticsandautomationnews.com/2019/05/01/top-20-electric-vehicle-charging-station-companies/22138/> ; https://www.electrifyamerica.com/how-ev-charging-works/ [↑](#footnote-ref-104)
105. https://www.delaware.coop/btp [↑](#footnote-ref-105)
106. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-106)
107. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-107)
108. 16 U.S.C. Section 791a, *et seq.* [↑](#footnote-ref-108)
109. *Id* at Section 824(f)*.* [↑](#footnote-ref-109)
110. *Id* at Section 824i-k. [↑](#footnote-ref-110)
111. See <https://pubs.naruc.org/pub/32857459-0005-B8C5-95C6-1920829CABFE> [↑](#footnote-ref-111)
112. <https://www.psc.state.md.us/wp-content/uploads/Order-No.-88997-Case-No.-9478-EV-Portfolio-Order.pdf> [↑](#footnote-ref-112)
113. <https://static1.squarespace.com/static/5ac5143f9d5abb8923a86849/t/5f2a0de7be7dca54d7828958/1596591595829/Q2-20_EV_execsummary_Final.pdf> [↑](#footnote-ref-113)
114. https://www.smeco.coop/news/cooperative-review/202008/articlethreejump [↑](#footnote-ref-114)
115. Links to specific analysis of these advocacy positions can be found at <https://pubs.naruc.org/pub/32857459-0005-B8C5-95C6-1920829CABFE> [↑](#footnote-ref-115)
116. See https://www.evgo.com/charging-plans/; https://electrek.co/2020/06/30/evpassport-wants-to-provide-39-mo-unlimited-charging-on-major-ev-charger-networks/ [↑](#footnote-ref-116)
117. See <https://electrek.co/2019/08/12/kwh-pricing-ev-drivers-miss-benefits/> [↑](#footnote-ref-117)
118. <https://www.cooperative.com/programs-services/bts/energy-access/Documents/Secure/Advisory-Advancing-Energy-Access-for-All-case-study-Cobb-EMC-Oct-2019.pdf> [↑](#footnote-ref-118)
119. Roanoke Electric Cooperative, "Roanoke Electric Co-op announces new discount rate option for electric vehicles," December 2019. [Online]. Available: https://www.roanokeelectric.com/2019/12/roanoke-electric-co-op-announces-new-discount-rate-option-for-electric-vehicles/. [Accessed July 2020]. [↑](#footnote-ref-119)
120. There is some confusion as to whether managed charging is a form of V2G services. As discussed subsequently, whereas managed charging requires utility control of the EV charging station, which is one-directional, V2G requires a bi-directional charging system with the capability to meter or read bi-directionally. [↑](#footnote-ref-120)
121. 119 <https://www.cooperative.com/programs-services/bts/Documents/TechSurveillance/Surveillance-Article-EVSE-Load-Control-Strategies-Jan-2019.pdf> [↑](#footnote-ref-121)
122. California Air Resources Board, "Zero Emission Vehicle Program," [Online]. Available: https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program/about. [Accessed July 2020]. [↑](#footnote-ref-122)
123. California Air Resources Board, "Zero Emission Vehicle Program," [Online]. Available: https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program/about. [Accessed July 2020]. [↑](#footnote-ref-123)
124. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-124)
125. See https://www.iaenvironment.org/newsroom/energy-news/iowa-utilities-board-approves-settlement-requires-firstever-evaluation-of-alliants-iowa-coal-generation [↑](#footnote-ref-125)
126. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-126)
127. https://www.washingtonpost.com/climate-environment/2020/09/23/california-electric-cars/ [↑](#footnote-ref-127)
128. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-128)
129. <https://www.cobar.org/Portals/COBAR/TCL/2020/February/Feb_Features-Energy.pdf> [↑](#footnote-ref-129)
130. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-130)
131. Regulatory Assistance Project, "Roadmap for Electric Transportation," February 2020. [Online]. Available: https://www.raponline.org/ev-roadmap/. [↑](#footnote-ref-131)
132. Atlas EV Hub, "Electric Utility Filings Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/electric-utility-filings/. [Accessed July 2020]. [↑](#footnote-ref-132)
133. Forbes, "Redlining's Legacy of Inequality: Low Homeownership Rates, Less Equity for Black Households," 11 June 2020. [Online]. Available: https://www.forbes.com/sites/brendarichardson/2020/06/11/redlinings-legacy-of-inequality-low-homeownership-rates-less-equity-for-black-households/#497a7cd42a7c. [↑](#footnote-ref-133)
134. Atlas EV Hub, "Public Funding Awards Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/medium-and-heavy-duty-vehicle-electrification/. [Accessed July 2020]. [↑](#footnote-ref-134)
135. For rural co-ops, poor internet connection may be particularly common and challenging to overcome. Several participants in CEPCI’s EV charging pilot experienced challenges related to weak internet connection [26]. Please add in the citation from note 26 here. [↑](#footnote-ref-135)
136. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-136)
137. Consumer Reports, "More States Hitting Electric Vehicle Owners with High Fees, a Consumer Reports Analysis Shows," September 2019. [Online]. Available: https://www.consumerreports.org/hybrids-evs/more-states-hitting-electric-vehicle-owners-with-high-fees/. [↑](#footnote-ref-137)
138. Atlas EV Hub, "New Tool Delivers Insights on Highway Revenue Losses," May 2020. [Online]. Available: https://www.atlasevhub.com/weekly\_digest/new-tool-delivers-insights-on-highway-revenue-losses/. [Accessed July 2020]. [↑](#footnote-ref-138)
139. Atlas EV Hub, "Road Network Funding Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-139)
140. California Air Resources Board, "California takes bold step to reduce truck pollution," June 2020. [Online]. Available: https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution?utm\_source=EV+Hub+Newsletter&utm\_campaign=13f83a454b-EMAIL\_CAMPAIGN\_2019\_01\_07\_05\_37\_COPY\_01&utm\_medium=email&utm\_term=0\_173e047b1f-13f83a454b-. [Accessed July 2020]. [↑](#footnote-ref-140)
141. California Air Resources Board, "California takes bold step to reduce truck pollution," June 2020. [Online]. Available: https://ww2.arb.ca.gov/news/california-takes-bold-step-reduce-truck-pollution?utm\_source=EV+Hub+Newsletter&utm\_campaign=13f83a454b-EMAIL\_CAMPAIGN\_2019\_01\_07\_05\_37\_COPY\_01&utm\_medium=email&utm\_term=0\_173e047b1f-13f83a454b-. [Accessed July 2020]. [↑](#footnote-ref-141)
142. ZEVStates.us, "Multi-State ZEV Task Force," [Online]. Available: https://www.zevstates.us/. [Accessed July 2020]. [↑](#footnote-ref-142)
143. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-143)
144. Transportation & Climate Initiative, "Transportation & Climate Initiative," [Online]. Available: https://www.transportationandclimate.org/. [Accessed 15 10 2019]. [↑](#footnote-ref-144)
145. P. Portillo, "15 States Take Historic Action on Transportation Pollution," July 2020. [Online]. Available: https://www.nrdc.org/experts/patricio-portillo/15-states-take-historic-action-transportation-pollution. [Accessed July 2020]. [↑](#footnote-ref-145)
146. <https://www.natlawreview.com/article/pedal-to-metal-15-states-and-dc-seek-to-achieve-100-zero-emission-vehicle-sales-new>; see also, https://www.nrdc.org/experts/patricio-portillo/15-states-take-historic-action-transportation-pollution. [↑](#footnote-ref-146)
147. Id. [↑](#footnote-ref-147)
148. <https://energyoffice.colorado.gov/zero-emission-vehicles/colorado-ev-plan-2020> [↑](#footnote-ref-148)
149. Alternative Fuels Data Center, "Plug-In Electric Vehicle Deployment Policy Tools: Zoning, Codes, and Parking Ordinances," [Online]. Available: https://afdc.energy.gov/bulletins/technology-bulletin-2015-08.html. [Accessed 23 10 2019]. [↑](#footnote-ref-149)
150. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-150)
151. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-151)
152. Energy Solutions, "Plug-In Electric Vehicle Infrastructure," November 2016. [Online]. Available: Plug-In Electric Vehicle Infrastructure. [↑](#footnote-ref-152)
153. Atlas EV Hub, "Laws and Regulations Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/laws-regulations-and-legislation/. [Accessed July 2020]. [↑](#footnote-ref-153)
154. Electrek, "Rivian wins big as Colorado passes electric vehicle direct sales law," March 2020. [Online]. Available: https://electrek.co/2020/03/25/rivian-wins-big-as-colorado-passes-electric-vehicle-direct-sales-law/. [↑](#footnote-ref-154)
155. *Electric Storage Participation in Markets Operated by Regional Transmission Organizations & Independent System Operators*, Order No. 841, 83 FR 9580, 162 FERC ¶ 61,127, at P 78 (2018), *order on reh’g*, Order No. 841-A, 84 FR 23902, 167 FERC ¶ 61,154 (2019), *aff’d sub nom. Nat’l Ass’n of Regulatory Util. Comm’rs v. FERC*, 964 F.3d 1177 (D.C. Cir. 2020). [↑](#footnote-ref-155)
156. *Wholesale Competition in Regions with Organized Electric Markets*, Order No. 719, 73 FR 64100 (Oct. 28, 2008), 125 FERC ¶ 61,071 (2008), *order on reh’g*, Order No. 719-A, 74 FR 37776 (Jul. 29, 2009), 128 FERC ¶ 61,059 (2009), *order on reh’g*, Order No. 719-B, 129 FERC ¶ 61,252 (2009)). [↑](#footnote-ref-156)
157. Participation of Distributed Energy Resource Aggregations in Markets Operated by Regional Transmission Organizations and Independent System Operators,   
     Docket No. RM18-9-000; Order No. 2222, 172 FERC ¶ 61,247 (Sept. 17, 2020) [↑](#footnote-ref-157)
158. https://www.evplusgridworkshop.com/ [↑](#footnote-ref-158)
159. https://www.naruc.org/taskforce/ [↑](#footnote-ref-159)
160. https://www.cooperative.com/topics/distributed-energy-resources/Documents/Secure/LH\_NRECA\_GT\_DER\_Report\_FINAL\_7.2.19\_330PM.PDF [↑](#footnote-ref-160)
161. https://www.cooperative.com/topics/distributed-energy-resources/Pages/Secure/State-Retail-Policy-Summaries.aspx [↑](#footnote-ref-161)
162. https://www.cooperative.com/programs-services/government-relations/Pages/Secure/GR-Policy-Issues-Tracker.aspx [↑](#footnote-ref-162)
163. https://www.cooperative.com/programs-services/ecba/documents-and-publications/document-library/DocumentLibrary/Secure/2018\_distributed\_energy\_resources\_compensation\_and\_cost\_recovery\_guide.pdf [↑](#footnote-ref-163)
164. U.S. Department of Energy, "Clean Cities Coalition Network," [Online]. Available: https://cleancities.energy.gov/about/#:~:text=As%20part%20of%20the%20U.S.,other%20fuel%2Dsaving%20technologies%20and. [Accessed July 2020]. [↑](#footnote-ref-164)
165. Atlas EV Hub, "Electric Utility Filings Dashboard," July 2020. [Online]. Available: https://www.atlasevhub.com/materials/electric-utility-filings/. [Accessed July 2020]. [↑](#footnote-ref-165)