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Gearing Up for Electric Vehicles: Residential EVSE Program Design for Co-ops

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SUBJECT MATTER EXPERT FOR QUESTIONS ON THIS TOPIC

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ARTICLE SNAPSHOT:

What has changed?

Electric vehicles (EVs) present new opportunities for electric co-ops in a rapidly changing electric market. Although EVs currently comprise less than 2 percent of light-duty vehicle sales, that number is expected to grow quickly to 20 or 30 percent of sales in the next decade alone (BNEF 2017a, Forbes 2017). Reduced battery costs (BNEF 2017a) are expected to drive much of this rapid growth by allowing manufacturers to build cheaper long-range EVs, decreasing major barriers[1] to EV adoption, such as range anxiety and initial cost. With larger EV batteries, consumers will need higher capacity chargers to fuel their vehicles in an acceptable amount of time. This high capacity charging will be provided by Level 2 electric vehicle supply equipment (EVSE), which supplies 240 V AC power to the onboard charger of an EV, as opposed to the slower charging provided by 120 V Level 1 EVSE.

What is the impact on electric cooperatives?

Increased adoption of EVs and Level 2 EVSE in co-op territories presents several opportunities for co-ops, including the ability to:

- Be their members' trusted energy advisor by educating and engaging on the benefits of EVs, including how and when to charge them;
- Increase electricity sales through EV charging;

[1] For more information about range anxiety and other barriers to EV adoption, read our related Tech Advisory: Alleviating Misconceptions about Electric Vehicles.

NRECA America's Electric Cooperatives

- Provide grid stability by shaping and managing EV load (e.g., charge when renewable generation is plentiful; curtail during system or demand charge peaks) (ICCT 2017).
- Reduce transportation-related emissions to the atmosphere (UCS 2018).[2]

The benefits above can be achieved by assisting members with Level 2 EV charging in the home.

What do cooperatives need to know or do about it?

To date, both utilities and co-ops have focused mainly on public and workplace charging to publicize EVs and reduce range anxiety. Fewer have promoted residential charging. However, since more than 70 percent of EV charging takes place at home (INL 2015a), co-ops who proactively plan for and promote residential Level 2 EVSE will be able to capture the benefits above for a large portion of the EV charging load.

With these opportunities also comes risk for co-ops who do not take steps to integrate EVSEs into their portfolio of products and services. In the absence of education, incentives, and controls, EV charging could eventually increase peak loads and drive capacity bottlenecks on the distribution network, raising the cost of service to all members.

Co-ops have a wide range of options, from simple to complex, for managing the impacts of EV charging by promoting residential Level 2 EVSE. Because co-ops are very diverse, no one option will suit every co-op's needs. This paper provides guidance for developing residential Level 2 EVSE programs, including (1) a discussion of EVSE technology, (2) key decisions that will help shape a co-op program, and (3) eight program concepts that can be tailored to an individual co-op's strategy. These program concepts are designed to help co-ops engage with and educate their members about EV charging and to ensure that the EVSE equipment installed in member homes allows the co-op to achieve its load shaping and management goals.

EV GROWTH AND THE OPPORTUNITY FOR RESIDENTIAL CHARGING

Improved performance and decreasing costs of battery packs, one of the costliest components of an EV, are fueling two key trends likely to speed EV adoption. First, improved and cheaper batteries mean that new EVs have longer range than ever before, increasing their appeal to the consumer as a viable means of transportation. Second, decreased battery costs result in a lower sales price of an EV. Since EVs are cheaper to power and maintain than gasoline or diesel vehicles, decreasing EV sales prices are leading to parity of total cost of ownership. Although consumers pay about 13 percent more to purchase an EV now (BNEF 2017b), total cost of ownership is already lower for mid-sized EVs (Palmer et al. 2018).

Despite trends indicating EVs becoming mainstream in the future, current EV owners tend to be well educated and well off (CSE 2018). Most EV owners have college or graduate degrees, live in single family homes, and own their homes. Only 21 percent of EV owners in California have an annual household income less than $100,000. As EVs reach cost parity with IEC vehicles, however, we expect that EV owner demographics will become similar to the demographics of new car owners overall.

Many co-ops already have EVs on their radars, and have started to promote them by offering EV rebates and installing public and workplace charging stations. These efforts have helped to decrease barriers members may have to pur-

[2] The last three of these opportunities also align with the goals of environmentally beneficial electrification.

chasing EVs, such as lack of familiarity and range anxiety. However, public charging stations can be two to three times more expensive to install than residential EVSE (INL 2015b), and their load may be challenging to manage, since a consumer likely wants the EV charged as quickly as possible. In addition, more than 70 percent of EV charging takes place at home (INL 2015a). Co-ops who proactively plan for and promote residential Level 2 EVSE, therefore, will be able to capture several benefits related to EVSE, including (1) improved member relations through increasing engagement and positioning as the trusted energy advisor, (2) increasing sales with a flexible load that can be managed and shaped to variable generation, and (3) reducing emissions from transportation.

FIGURE 1: Examples of EVSE. Top: Level 1 EVSE for Nissan Leaf (image courtesy of Richard Kelly). **Bottom: Connected Level 2 EVSE with phone app** (image provided by eMotorWerks)

EV CHARGING EQUIPMENT EXPLAINED

EV charging involves equipment both inside and outside the vehicle. EVSE resides outside the vehicle and primarily provides current regulation and fault detection to comply with applicable safety standards (Figure 1). The EVSE supplies AC power to the charger onboard the EV, which converts the power to DC and charges the batteries. Some EVSE models provide additional functionality, such as information displays, charging timers, and network connections, so that the EVSE may be controlled remotely by the user, often using a smartphone app, or the utility through a charge control platform.

EV owners choose between Level 1 and Level 2 charging at home (**Table 1**). Level 1 EVSE plugs into a 120V outlet, whereas Level 2 EVSE uses 240V on a dedicated circuit. Level 2 EVSE provides significantly faster charging, but costs more to purchase. Level 2 EVSE requires an electrician for proper installation. Whereas Level 1 EVSE are included on a power cord connecting the EV to the outlet and often included with the EV, Level 2 EVSE are usually purchased separately for $500-$1000[3] and mounted on a wall or pedestal. Depending on the wiring of the home, upgrades for Level 2 EVSE may need to accommodate a dedicated 240V circuit of 40 A or greater, depending on the nameplate rating of the equipment.[4] Other considerations when purchasing Level 2 EVSE are whether it is hardwired or plugged into an outlet, whether or not it is "smart" and can communicate and be controlled over a network, and whether it is capable of revenue-grade metering.

[3] Based on online survey of retail prices for Level 2 EVSE, April 2018.

[4] By code, EVSE can draw up to 80% of the rated current on the circuit. Thus Level 1 EVSE on a 20 A circuit will draw at most 16 A, and Level 2 EVSE on a 40 A circuit will draw up to 32 A.

TABLE 1: Characteristics of Level 1 and Level 2 EVSE *Source: US EPA (2013)*

EVSE Type	Volts	Amps	Miles per hour of charge	Best Applications	EVSE cost	Additional requirements
Level 1	120	9.6–16	2–5	Short range (less than 100 mile) BEVs, plug-in hybrids	Typically included with EV	None
Level 2	240	12–80	10–60	Long range (200+ miles) BEVs	$500–1,000	200 A service to house, dedicated circuit, installation costs

Load profiles of single Level 1 and Level 2 EVSE are characterized by their maximum power draw. Whereas a Level 1 EVSE draw 1.2 to 1.9 kW, Level 2 EVSE typically draw 2.9 to 7.7 kW, and up to 17 kW for the highest capacity charging currently available from Tesla. Charging a given EV with a Level 1 EVSE will produce a lower peak but a longer duration compared to a Level 2 EVSE. For example, a 100-mile charge on an EV with an efficiency of 30 kWh per 100 miles[5] would take 16 hours at 1.9 kW using Level 1 EVSE at 16 A, but only 4 hours at 7.7 kW using a Level 2 EVSE at 32 A. Consequently, the load of a Level 2 EVSE is about four times larger, but about 4 times shorter than that of a Level 1 EVSE.

Because Level 2 EVSE is a larger load, provides charge control capabilities, and is expected to become more popular than Level 1 EVSE, promoting Level 2 EVSE will help co-ops take advantage of the benefits that EV charging presents.

Co-ops can help members by addressing two main barriers to EV adoption: cost and information.

It is key to have EV-savvy co-op staff who can answer members' questions.

BARRIERS TO RESIDENTIAL EVSE ADOPTION

Residential Level 2 EVSE will be a critical piece of EV infrastructure for both members and co-ops, since this equipment will service the majority of members' vehicle charging needs and is the point at which charging can be controlled. To increase use of Level 2 EVSE in their territories, co-ops can help members by addressing two main barriers: cost and information.

Cost Barriers

First costs associated with the EVSE and its installation can be significant. Current online pricing of Level 2 EVSE is about $500 to $1,000. Depending on the degree of service and wiring upgrades necessary, installation costs can range from a few hundred to one or two thousand dollars (U.S. EPA 2013). Although some members may desire the faster charging that comes with Level 2 EVSE, many may not be able to justify or cover the additional costs. The co-op can provide financial incentives in the form of rebates, financing, and discounted electricity rates to help overcome this barrier.

Information Barriers

For a member considering an EV purchase, many questions arise. How and where do I charge my car? What equipment do I need? Who can install that equipment? How much money can I save? Where do I start? Co-ops have the opportunity to educate their members about charging options for EVs, as well as guide them through the purchase, installation, and operation of EVSE. This hands-on approach may be especially appealing for co-ops who position themselves as a trusted energy provider or are exploring a service-oriented business model. Key to lowering this barrier are EV-savvy staff who can help members through the process. Many co-ops, such as Lake Region

[5] Based on average EV efficiency: https://www.fueleconomy.gov/feg/evsbs.shtml

Electric Cooperative (EC), have recognized the need to build knowledge and experience on EVs and be prepared to help members when they begin to purchase EVs in increasing numbers.

LAYING THE FOUNDATION FOR EVSE PROGRAMS

Every co-op is unique in its geography, demographics, and level of EV readiness. As a result, no one-size-fits-all residential EVSE program exists. Instead, each co-op that is considering a residential EVSE program should determine its goals for the program and its role in supporting EVSE adoption. A co-op's approach will depend on several considerations, such as how actively it will promote EVSE, the rate of EV adoption in its service territory, cost and information barriers, existing incentives, regulatory requirements, and EV rate structures.

In developing the program concepts for residential EVSE in the following sections, we assume that the barriers to EV adoption have generally been overcome. In reality, co-ops may promote EVs in tandem with EVSE. We also assume that EVSE installations take place in single- and small multi-family dwellings (e.g. townhomes), in which the home has space for the EVSE and dedicated metering. We have not developed concepts for larger multi-family residences like apartments, however elements of the concepts may be adapted to those situations.

EVSE programs have three key stages: procurement, installation, and operation, each with key program design decisions, summarized in Figure 2 and outlined below:

Procurement

Ownership: In most cases, the member owns the EVSE. However, the co-op could own the equipment and lease it to the member as part of a service offering.

Market channel: The member will purchase the EVSE through a distribution channel, such as an online or brick-and-mortar retailer, an EV dealer (with the purchase of an EV), a co-op group buy program, or a third-party vendor that produces EVSE and potentially manages charging networks.

Approved EVSE: The co-op may wish to encourage or require members to buy EVSE models that meet certain hardware requirements. For example, some EVSE vendors are beginning to offer onboard revenue-grade metering that can eliminate the need for additional EV submeters for EV rate structures. Others provide network connectivity, so that charging can be remotely controlled by the user (e.g., with a smart phone app) or coordinated by the co-op. The protocol for communication between connected EVSE and the control platform may be proprietary or open, depending on EVSE manufacturer. Proprietary platforms can be well integrated and

FIGURE 2: Key stages of an EVSE program, and design considerations for each stage

highly functional because one manufacturer designs and controls the hardware (EVSE) and software (control platform). Open platforms such as Open Charge Point Protocol,[6] however, allow the co-op to use all EVSE that are compatible with the open platform, avoiding lock-in to a particular manufacturer. Co-ops should carefully decide which method suits their needs.

Financial incentives: The co-op may wish to provide financial incentives for a variety of reasons, including reducing first-cost barriers to the membership, providing opportunity to engage with members as their trusted EV and EV charging advisor, and being able to specify the EVSE models purchased (see previous section, "Approved EVSE"). Financial incentives may be offered through familiar approaches like rebates or on-bill financing, or through less conventional avenues such as reward points.

Member charge management is an effective way to shift EV charging to off-peak hours, while allowing members to charge their vehicles when they need to.

To offer incentives to members, some co-ops may need to prove clear financial benefits to the co-op as well. The return on investment is related to the size of the financial incentive offered, the expected electricity sales of the EVSE load, the co-op's rate structure, and ultimately, the co-op's objectives for offering the incentive in the first place, which could range from increasing electric sales to mitigating exposure to peak wholesale prices. For example, in the relatively straightforward case where a co-op aims to promote EV ownership and capture additional sales, one might only need to weigh the size of the incentive against the anticipated incremental electric sales. For an average EV that consumes 30 kWh per 100 miles of driving, is charged at home for 10,000 miles of driving per year, and nets $0.02/kWh[7] in revenue for home charging, this yields $60 per year in net revenue to the co-op. In this simple example, a rebate of $200 would be recouped in just over three years.

Installation

Installation guidance: For the member, the installation process may be confusing and inconvenient. The co-op can reduce the information barrier here by educating members on the installation process, managing the installation process (including identifying the wiring and service upgrades needed), and recommending electricians.

Financial incentives: As in the procurement phase, the co-op should determine if incentives to offset the cost of the installation will benefit the co-op and its membership. Likely incentive methods are rebates and financing.

Operation

The final key program element is how the EVSE will be operated once installed. Co-ops have two main options for managing charging. They can indirectly manage charging by encouraging members to charge at desired times using time-of-use or other non-flat rate structures,[8] or they can directly control charging (ICCT 2017).

Member charge management: Especially while EV penetration is low in its service territory, the co-op will likely rely on its members to charge during off-peak hours. The co-op can encourage off-peak charging through whole-house time-of-use (TOU) rates or EV-specific rates. Since member control does not require direct communication and control with the EVSE, members can purchase less expensive, non-communicating EVSE. Communicating EVSE, however, will allow members to manage charging remotely and gain insights into their

[6] http://www.openchargealliance.org

[7] As we discuss later in this article, many co-ops offer reduced rates during off-peak hours for EV charging. For this example, we assume that the EV is charged during reduced rate periods, at a rate that is $0.02/kWh more than the co-op's wholesale cost.

[8] For more information about Rates for EVs, see our related *TechSurveillance* article coming soon: Rate Options That Support Electric Vehicle Adoption.

TABLE 2: A sampling of cooperative EV rates and EVSE rebates

Cooperative	Location	Geography	Rates and Rebates
Berkeley EC	SE South Carolina	High-growth urban	**Time of Day Rate:** $0.31/kWh on peak (4 hr summer, 3 hr winter), $0.06/kWh off peak.
Lake Region EC	Central Minnesota	Rural	**EV Rates:** Working to develop EV-specific rates. **EVSE Rebate:** Up to $500.
New Hampshire EC	Central and Northern New Hampshire	Rural	**EV Rate:** $0.23/kWh on peak (7am – 9pm), $0.087/kWh off peak (9pm – 7am). **EVSE Rebate:** $300.
Randolph EMC	Central North Carolina	Rural	**EV Rate:** $0.3642/kWh on peak (4pm – 7pm), $0.0843/kWh off peak (6am – 4pm & 7pm – 11 pm), $0.0302/kWh super off-peak (11pm – 6am). **EVSE Rebate:** $500.
Wake EMC	Central North Carolina	Mixed urban and rural	**EV Rate:** $0.1094/kWh on peak (6am – 10pm), $0.0895/kWh off peak (10pm – 6am).
Wright-Hennepin CEA	Central Minnesota	Mixed urban and rural	**EV Charge Rate:** $0.054/kWh (available during charge time of 11pm – 7am). **EV TOU Rate:** $0.1715/kWh on peak (12 pm – 10pm weekdays), $0.0521/kWh off-peak (all other hours and holidays). **EVSE Rebate:** $200.

EV's electricity consumption, valuable features for some. Member charge management is an effective way to shift EV charging to off-peak hours, while allowing members to charge their vehicles when they need to. This approach is often preferred by co-ops and EV owners (ICCT 2017). Many utilities and co-ops already offer TOU or EV-specific rates. A sampling of those rates is shown in Table 2.

Both EV and whole-house TOU rates have their challenges. As discussed earlier, EV rates may require a separate meter. TOU rates must have off-peak rates that are low enough to encourage members to charge at those times, and on-peak rates that are not so high as to deter members from signing up.

Co-op charge management: To fully capture the benefits of EVs, such as mitigating system peaks, reducing demand charges, or using excess renewable generation, the co-op can control EVSE directly. Demand response (DR) programs are perhaps the most familiar co-op control approach and allow the co-op to mitigate system peaks and their associated demand charges. Other co-op charge management approaches may be useful once EVs comprise a large portion of load within a co-op and member control starts to cause system peaks at times of day when TOU or EV rates decrease. For example, if EV off-peak hours begin at 9pm and 100 members commence charging at that time, then the system sees a sharp increase in demand of 900 kW or more. Co-op control processes can mitigate this sharp increase in demand by staging charging in a neighborhood and at the system level. To ensure that a vehicles are ready when members need them, some EVSE allows members to input the amount of charge they need and when (e.g. "I want my vehicle 80 percent charged by 7am."), giving the co-op a window of available charge times.

While EV penetration is low, member charge management is an effective option for co-ops; when penetration increases, more advanced strategies are needed to avoid peaks.

Key to all of these co-op charge management strategies are the ability to communicate with the EVSE and a control platform to manage control events. Several vendors, such as ChargePoint, eMotorWerks, Greenlots, and Siemens provide control platform solutions. In selecting a control platform for DR and smart charge management, co-ops will make an important, long-term commitment to both hardware and software and must ensure that members' EVSE products will continue to function properly on the network, even as the electric vehicle market continues its rapid evolution.

Summary: Both member and co-op charge management shift EVSE load to periods of low-cost or excess generation. Guiding the member to charge during off-peak times with special rates is an effective way to control load and requires little co-op staff time and financial resources. Thus, while EV penetration is low, a co-op is likely to use member charge management to encourage off-peak charging. Member control does not require communicating EVSE. As EV adoption and/or variable generation increases, member charge management may no longer beneficially shape EVSE load, but instead cause peaks at the beginning of off-peak periods. The co-op will likely need to employ more advanced strategies like orchestrated charging to avoid peaks. To do so, the co-op must communicate with the EVSE directly, which requires staff resources, a charge control platform, and connected EVSE in member homes.

EVSE PROGRAM CONCEPTS

To plan for EV adoption or justify an EVSE program, some co-ops may first need to collect data on EV charging behavior and vehicle usage. Wright-Hennepin Cooperative Electric Association, for example, is conducting a pilot to collect information on EV penetration, charging behavior, and the effects of low temperatures on charging efficiency. They plan to use this information to assess the financial impact of EVs based on saturation and peak load. For other co-ops, simply knowing that EVs are being purchased in their areas is enough to start preparing for future broad adoption with a residential EVSE program.

Our research explored eight program concepts that can be tailored to a specific co-op's needs. We organize the concepts in three groups: Education and Partnerships, Traditional Program Strategies, and EVSE as a Service (Figure 3). Based on our interviews with co-ops, most will want to start building experience and engaging members with education, partnerships, and familiar approaches like rebate programs. Once a co-op has built that experience and EVs represent a significant portion of total load, then

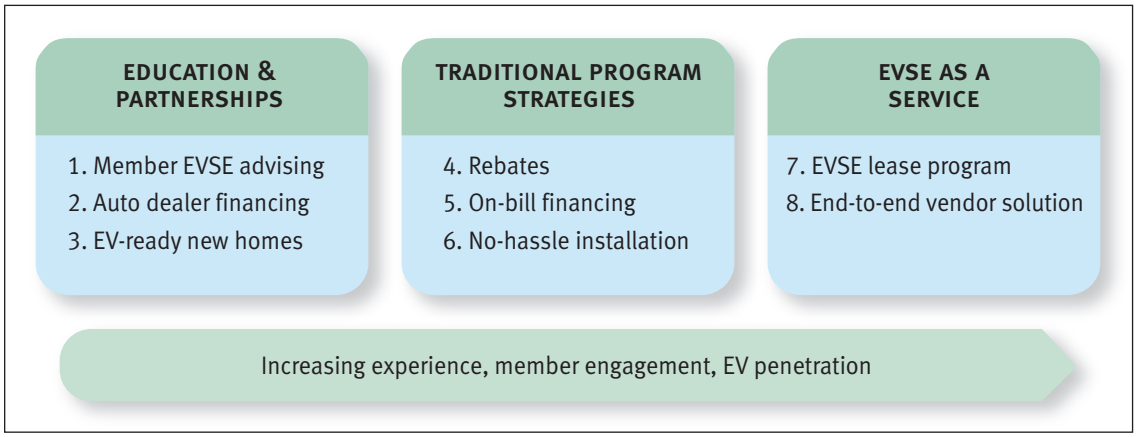

FIGURE 3: Summary of program concepts in terms of level of effort and EV maturity

the EVSE as a Service concepts may become attractive. Below we discuss each concept, related co-op activities, and benefits and challenges. We discussed these ideas with several co-ops across the country, and incorporate feedback from those conversations as well. At the end of this section, Table 3 summarizes the opportunities and risks associated with each program concept.

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.[9]

   Several co-ops, including Berkeley EMC and Platte-Clay EC, noted that this may be a good place to start, since co-op staff builds EV knowledge and experience, and the program requires relatively few resources.

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.

   Some co-ops we interviewed noted that partnerships with dealers were 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. One co-op, however, expressed strong interest in this approach, citing better customer experience and retention as a motivating factor for the dealers. Co-ops likely need to be vendor neutral 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. Brunswick EMC, for example, is already working with developers to build energy efficient new homes. The added cost of a dedicated circuit would provide good value to members purchasing new homes. 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.

   Many co-ops interviewed were likely to take this approach, as rebate programs are already familiar to staff and would

[9] Under the Alternative Fuel Infrastructure Tax Credit, the U.S. government provides a tax credit of 30% of the purchase and installation cost of EVSE. Additionally, many states and local air quality jurisdictions provide tax and other incentives for EVSE. Comprehensive information can be found at http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx.

allow them to promote EVSE without owning the equipment. Drawbacks may include low installation rates, if members do not understand the installation requirements and process.

Rebate programs are by far the most common residential EVSE programs among co-ops. Co-ops offering such programs include Wright-Hennepin CEA, Benton Rural Electric Cooperative (REC), People's EC, New Hampshire EC, Lake Region EC, and Randolph EMC (Table 2). Rebates 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.

Rebate programs are by far the most common residential EVSE programs among co-ops.

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.

   Benton REC currently offers low-interest (3 percent) financing of up to $2,000 for EVSE equipment and installation.

6. **No-hassle installation:** Once a member has purchased an EVSE off 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 market-

place 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 3: Opportunities and risks related to 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 to member. • Provides easy process for repayment.	• 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.

WHEN TO ACT

As EV penetration increases, co-ops have a significant opportunity to engage and educate their members, increase electricity sales, and provide grid stability by managing the load through residential charging equipment. Given the expected influx of EVs over the next decade, this means gaining familiarity with residential EVSE programs and technologies today to be prepared. Co-ops especially need to develop strategies for shaping EV load to avoid system peaks. As Brunswick EMC noted, EVs are positive for the co-op, but they realize they must shape load when EVs reach high penetration. Because the EVSE installed today may need to be controlled at some point in the future, co-ops should start thinking about how they wish to address EV charging in the coming years and be prepared to evolve in technological sophistication as the market matures.

Co-ops need to be proactive and prepare to take action once EV penetration is significant in their area.

Co-ops should also consider the risks of inaction regarding EV charging. Although EVs may be a minor aggregate load for co-ops at present, their growth is expected to cause significant impact if left unmanaged. Co-ops will need to ensure that they have enough generation to supply the increased load of EVSE, and a robust distribution network to supply that load. In the absence of education, incentives, and controls, EV charging could eventually increase peak loads and drive capacity bottlenecks on the distribution network, raising the cost of service to all members.

Therefore, a key question is: when should a co-op take action? Early adopters may have few examples to follow, but will be able to get out ahead and be prepared. Late adopters risk missing the opportunity to manage the EVSE that members install before any co-op programs begin, but may streamline their efforts by learning from experiences of earlier adopters. Since EV growth is expected to occur rapidly, and because many of the opportunities related to EV charging are related to how the charging occurs and with what type of equipment, we recommend that co-ops be proactive, preparing for EV charging now, and taking action once their members begin to purchase EVs in significant numbers.

Because no one residential EVSE program would be appropriate for all co-ops, each co-op has several key decisions to make in designing a program. Considerations such as desired EVSE characteristics (e.g., smart connectivity, revenue grade metering), control strategy and rates, and the level of member education and involvement will be key to a program's success.

Of course, co-ops may use any combination of the concepts above to craft near-term programs, as well as plan for the future. What is the co-op's ultimate goal with EVSE, and what program(s) will help the co-op achieve that goal? Wright-Hennepin CEA's goal, for example, is exploring the opportunity to be their members' one-stop-shop for EVSE, guiding the member through procurement, helping with the installation, and controlling the EVSE. Co-ops can actively take steps today to meet their future goals for residential EVSE. ■

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- To find more resources on business and technology issues for cooperatives, visit our **website**.

BUSINESS AND TECHNOLOGY STRATEGIES
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The Distributed Energy Resources (DER) Work Group, part of NRECA's Business and Technology Strategies department, is focused on identifying the opportunities and challenges presented by the continued evolution of distributed generation, energy storage, energy efficiency and demand response resources. For more information, please visit **www.cooperative.com**, and for the current work by the Business and Technology Strategies department of NRECA, please see our **Portfolio**.