NRECA
America's Electric Cooperatives

July 23, 2021

Submitted electronically to VTO@ee.doe.gov

Re: **Request for Information (RFI) on Integrating Electric Vehicles onto the Electric Grid**

To Whom It May Concern:

The National Rural Electric Cooperative Association (NRECA) respectfully submits the following comments in response to the U.S. Department of Energy's (DOE) Request for Information (RFI) on Integrating Electric Vehicles onto the Electric Grid (DE-FOA-0002528).

NRECA is the national trade association representing nearly 900 local electric cooperatives and other rural electric utilities. America's electric cooperatives are owned by the people that they serve and comprise a unique sector of the electric industry. From growing regions to remote farming communities, electric cooperatives power 1 in 8 Americans and serve as engines of economic development for 42 million Americans across 56 percent of the nation's landscape.

Electric cooperatives operate at cost and without a profit incentive. NRECA's member cooperatives include 62 generation and transmission (G&T) cooperatives and 831 distribution cooperatives. The G&Ts generate and transmit power to distribution cooperatives that provide it to the end of line co-op consumer-members. Collectively, cooperative G&Ts generate and transmit power to nearly 80 percent of the distribution cooperatives in the nation. The remaining distribution cooperatives receive power directly from other generation sources within the electric utility sector. Both distribution and G&T cooperatives share an obligation to serve their members by providing safe, reliable, and affordable electric service.

We appreciate the opportunity to provide NRECA's perspective in response to DOE's RFI. Electrification of the transportation sector creates both opportunities and challenges for the electric sector, and co-ops will play a critical role in the success of the transformation now underway. Electric vehicles (EVs) must be integrated in a way that does not impair the reliable or cost-effective delivery of electric power that Americans have come to expect and rely on every day. The impact of EVs on the grid should be considered in conjunction with the electrification of other sources of energy demand and the grid of the future together with—and not in isolation from—other technological, economic, and public policy changes affecting the electric utility industry. These changes are interrelated, and they should be evaluated together when identifying and addressing the benefits, risks and infrastructure needs of transportation electrification.

Electric co-ops are already planning for what widespread EV adoption could mean for their operations in terms of cost, reliability, and quality of life for the communities they serve. Many co-ops are implementing managed charging strategies both through direct control programs and rate structures to focus most EV charging during off-peak times of day which can limit peak demand charges and the immediate need for infrastructure upgrades. Some co-ops are also building and managing public EV charging stations in addition to adding charging stations to their headquarters facilities.

Still, many questions remain for co-ops as they plan for a future of widespread EV adoption, including but not limited to:

- How quickly will EV penetration in rural communities grow?
- When and how will public charging in rural communities with less population density than urban and suburban areas make economic sense?
- How and to what extent will fleet electrification add load?
- What are the infrastructure needs at the distribution and transmission level needed to meet the demand?
- How will costs be managed in a way to not disproportionately impose costs on consumers who are not using EVs and/or who cannot afford these cost increases?

More federal support is needed to help electric cooperatives develop solutions for their consumer-members in response to these questions. In general, upgrades to transmission and distribution grid infrastructure by co-ops and other electric utilities will be required over time to handle the increased load and changing patterns of electric demand that result from widespread EV adoption. Federal financial support and technial assistance is vital to ensure these upgrades keep pace with EV adoption, while also providing continued reliability and resiliency of the grid.

Planning will be essential to making this a reality. It must be based on realistic long-term and short-term forecasts and must holistically incorporate resource planning, carbon policies, resource adequacy, and reliability. It must consider who may benefit from transportation electrification and allocate related investment costs appropriately. Finally, planning must be flexible enough to account for the uncertainty in identifying the benefits and burdens borne by various consumers, which may shift even as EV adoption spreads.

Overall, we believe that the benefits of transportation electrification are best addressed through decision-making at the state and local levels, and electric co-ops are well positioned to do that as they are owned by the communities they serve and remain trusted energy advisors to their consumer-members.

We appreciate the opportunity to address the following specific questions included in DOE's RFI.

Category 1: An evaluation of the use of electric vehicles (EV) to maintain the reliability of the electric grid – DOE has interest in:

1) **The use of electric vehicles for demand response, load shaping, emergency power, and frequency regulation;**
    a. **Results from pilots or programs demonstrating the effectiveness of EVs in reducing peak loads or flattening load curves through bi-directional electricity flow,**
    b. **Study results on the use of EVs for grid or ancillary services, such as frequency regulation,**

c. **Evaluation techniques and considerations on changes to the reliability and resilience metrics to integrate EV loads, including considerations of adjusted critical load criteria associated with EV adoption.**

As Americans continue to adopt EVs at an increasing pace, the electricity used to charge EVs will increase. Although increased electricity sales are generally advantageous to co-ops, the time of day that EV charging occurs can determine whether or not it is beneficial to the co-op from a cost perspective. Co-ops that pay peak demand charges are motivated to minimize the amount of charging that occurs during peak hours. Co-ops that pay time-varying rates will benefit if they can shift EV charging to lower cost periods. Although the strategy for control and the optimal time to charge varies from co-op to co-op, it is clear that leaving the load unmanaged can cause negative impacts once EV adoption reaches a critical level which could ultimately harm the consumer-members at the end of the line who own the co-op.

It is important to consider the various ways a co-op (and other utilities) could interact with an EV and the EV's owner. Managed charge programs address the demand response attribute of the EV, including a goal for as many EVs as possible to charge off-peak (in geographies where it makes the most sense). This helps to flatten load curves, in many cases use night-time wind generation, and utilize distribution system assets more effectively. All of this can be accomplished using existing technology and a variety of programs that can be designed to meet the needs of local consumers. This is being done without the expense of bidirectional charging or vehicle-to-grid (V2G) programs and could even defer the need for expensive upgrades to the distribution system. Consumer education about these programs will be vital to their success.

NRECA and Central Electric Power Cooperative in South Carolina piloted eight electric vehicle supply equipment (EVSE) and three control strategies in 2019. On average, each participant used about 120 kWh per month for vehicle charging, ranging from 90 to over 200 kWh per month. The electricity delivered to the vehicles provided about 300 to almost 900 miles of driving per month based on EPA-rated EV ranges. The amount of load available for control is the average load requested during peak hours on non-control days during the direct load control period of the pilot. The load available for control is about 4 to 35 percent of the typical load during charging, which is related to how often the vehicle requests charge during peak hours. For the study, the load available for control during peak hours averaged 5 kW in total, or 0.63 kW per vehicle, with about one of the eight EVSE (12%) requesting charge. If the EVSE and load control platform work reliably, most or all of the load available can be shifted to times of lower cost and lower demand.

Use cases for EVs such as frequency regulation and bidirectional charging or V2G should be approached with caution. In many cases, even if the technology evolves, the use case may not make sense to pursue. While EV adoption is growing, the vast majority of Americans have little to no experience with EVs or the charging technology. A rush to deploy complicated V2G use cases upon the car-buying public will likely cause confusion and concern and could hinder widespread EV adoption. Additional work should be conducted to understand V2G issues from the consumer perspective. Roanoke Electric Cooperative in North Carolina has a V2G pilot program underway to explore whether this capability can assist the co-op in shaving peak demand and thus save money for the co-op and their consumer-members at the end of the line.[1]

[1] https://www.cooperative.com/news/Pages/Roanoke-Electric-Tests-Innovative-EV-to-Grid-Charger.aspx

One area we view as presenting a unique value proposition regarding V2G is with regard to electric school buses. A number of NRECA members are working with their local communities to explore adding electric school buses to their local fleets because of the public health benefits. School buses follow a predictable schedule and could be controlled in a way, such as primarily charging during off-peak hours, that might have meaningful benefits to the co-op and community. More research is needed in this area and co-ops could provide valuable insights to help explore these issues.

To maximize the value of EVs and grow adoption, focus should be on reducing the total cost of ownership through cost-effective and simple managed charge programs that have been demonstrated to benefit both the vehicle owner and the utility.

2) **The potential for the reuse of spent electric vehicle batteries for stationary grid storage;**
    a. **Studies, pilot results, or information on approaches and use cases for the reuse of spent batteries, near-term and long-term viability, and cost effectiveness,**
    b. **Information on the ability of EVs to provide backup generation for emergency situations, including policies or standards that might limit implementation.**

Many of today's EVs are not able to provide backup power to homes during outages. In addition, it is important to consider that the primary purpose of EVs to consumers is transportation, and that serving as a backup power source will remain a secondary purpose. Relying too heavily on EVs serving as a backup power source would not be advisable for utility planning at this point.

However, recent announcements by auto manufacturers indicate that over time the trend will be to enable EV owners to power their homes during outages. Such features may well encourage more EV adoption. As these capabilities are added to EVs, it is critical that the safety of utility crews remains paramount. For example, the same types of precautions taken for home generators should be considered when EVs may be powering the home.

Batteries used in EVs are expected to last for several years, and as such may not be available as a stationary storage source to the extent previously expected. At the same time, it is important that recycling EV car batteries becomes cost effective to limit the exposure to supply chain risks posed from certain foreign sources that currently dominate the market. The DOE-funded ReCell Center at Argonne National Lab, in collaboration with other DOE national labs and universities, could deliver results in EV battery recycling that may mitigate these risks and ultimately support further growth in the U.S. EV market.

Category 3: The impacts to the electric grid of increased penetration of electric vehicles:

1) **The distribution grid infrastructure needed to support an increase in charging capacity;**
    a. **Results or forecasts on the local impacts of increasing penetrations of electric vehicles. Include effects on operation and control and forecasts for increased load or the need for infrastructure upgrades to respond to increasing penetrations. Results are sought for light-, medium-, and heavy-duty EV impacts.**

Electrification of the transportation sector, and the increased flexibility of this newly electrified demand, will require substantial distribution infrastructure investment over time to meet increased average local electric demand and to meet increased demand in new locations (e.g., EV charging stations). Significant transmission infrastructure investment will also be required to meet increased average electric demand and changes in the spatial distribution of electric demand among load centers. Newly electrified energy demand will necessitate investment in new broadband telecommunications infrastructure to enable continued reliable operation of the distribution system and necessary communication with consumers (especially in rural communities). Newly electrified energy demand will require a telecommunication backbone in order to provide grid services to distribution system operators or regional system operators.

Over time, electrification of the transportation sector will require additional generation investment to ensure resource and energy adequacy to meet increased average electric demand and changing consumption profiles. This investment challenge is more complex with increased reliance on intermittent energy sources. Particular attention will be needed to ensure that generation investment is adequate in amount and in operational characteristics to meet the demands of electrification while ensuring grid stability, security, and reliability.

Data shows that EV adoption is often geographically localized and can create pockets of higher electricity consumption among households that are connected to the same transformer. This phenomenon is often referred to as the “clustering effect.” Driving patterns, demographics, and other factors interrelate to create clusters. Even if adoption is low at the regional level, it is likely that EV ownership will be concentrated in particular areas or clusters. This makes the use of managed charging programs critical to the successful rollout of EVs on a large scale. However, there will still be situations where distribution transformers will need to be replaced and where older feeders may need to be upgraded.

Every EV clustering situation results in different load impacts and co-ops will need to address these based on their specific circumstances. Planning for the impacts of increased EV adoption on the distribution system will be critical. Tools to analyze these impacts using the co-op or other utility’s specific inputs would be beneficial. Federal government financial support to develop these tools for data analysis as well as to make necessary distribution system upgrades will be critical to achieving benefits for consumers as the transportation sector electrifies and more is demanded from the electric sector.

2) **The strategies for integrating electric vehicles onto the distribution grid while limiting infrastructure upgrades;**
    a. **Potential strategies or approaches for integrating electric vehicles onto the distribution grid while limiting infrastructure upgrades,**
    b. **Results or studies on the specific infrastructure impacts of increased EV charging in underserved communities and any infrastructure requirements or upgrades that might be needed to serve these communities, include information or data on strategies for mitigating upgrades.**

As the aggregate load of EVs increases, co-ops and other electric utilities will need to address impacts in two areas:

- **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.
- **Power procurement**: One of the benefits of EVs is increased electricity sales, 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 intermittent renewable resources increase their share of the power supply, utilities may need to match flexible loads like EVs to the available supply. Thus, planning for EVs must be based on realistic long-term and short-term forecasts and must be integrated holistically within the context of resource planning, carbon policies, resource adequacy, and reliability.

Cooperatives in one state have analyzed the costs associated with replacing a single, 32-bay gas station with an equivalent EV charging station. The costs of the 32 EV charging units would be just under $5 million along with needing to add a $2 million distribution substation nearby coupled with 3-4 large transformers to provide the approximate 11 MW of maximum power needed. In total, the generation required for this one 32-bay station is equivalent to powering either 6,500 homes, or 16 Walmart Supercenters under normal conditions.

Managing where and when charging occurs will be critical to limiting the need for infrastructure upgrades or incurring high costs for charging during peak periods. Charge control strategies fall into two main approaches: indirect and direct control. Indirect control provides signals via financial or other incentives that influence consumer-member charge behavior. Under these strategies EV owners can use either Level 1 or Level 2 chargers to charge their vehicles. Direct control is managed by the utility or a third party, often through a Level 2 charger, and includes auto demand response (DR) and flexible charging services. Consumer education programs and information on charging locations and programs with incentives will be critical to the success of these control strategies. Education must also extend to workforce training as EVs proliferate throughout the country, including to rural communities.

3) **The changes in electricity demand over a 24-hour cycle due to electric vehicle charging behavior;**
    a. **Anticipated changes or forecasts in electric load over a 24-hour cycle as a result of residential electric vehicle charging. Include approaches (and results) for mitigating those impacts, such as time-of-use rates whole house or EV only (include adoption rates of programs, capability for submetering and billing) and smart charge management.**

In the short term, EV adoption is likely to increase average electricity demand and accelerate demand growth; in the long-term, electric demand growth could be moderated by improved efficiency in electricity use and by the operational flexibility of EVs and other newly electrified demand sources. At the same time, the interaction of electrification of energy consumption and new, more flexible electric demand may increase some customer and utility peak loads, particularly in the short term, and may shift costs among retail customers (onto customers with less flexible demand).

We expect that daily load patterns from EV charging will vary by region and across utilities. Some could experience issues because of the "duck curve" phenomenon, that is lots of solar generation during the day which then wanes just as consumers arrive at home and want to plug in their EVs to charge overnight.

Further, change in demand will depend on the extent to which there is fleet electrification and associated charging facilities sited in communities. Such new sources of demand will require extensive coordination and communication between the fleet owners and the co-op or other utility during the planning stage and going forward.

4) **The load increases expected from electrifying the transportation sector**
    a. **Magnitude and timeframe for anticipated load increases for the distribution and transmission level from electrification of fleets (local, regional, and long-haul). Report on challenges, technology gaps, policy barriers, and communication standards and protocols needed.**

Early and often communication with the electric utility will be critical for maintaining grid reliability and managing costs as new loads are added to the system to support EV charging. There are already examples of 1 MW charging stations being built to support fleet electrification. Electric co-ops and other utilities need to be integrated at the very beginning of planning for such facilities by the project developers, or other relevant planning authorities where applicable, to avoid unintended consequences.

The greatest challenge to electric co-ops in meeting EV charging requirements may be managing the impacts of localized pockets of higher electricity consumption among EV charging households connected to the same distribution transformer. This clustering effect can require transformers to deliver up to 4 times the normal amount of electricity, potentially leading to transformer overloading and accelerated transformer aging. Electric co-ops will need to manage EV charging both temporally and spatially to minimize financial and grid impacts that can result from clustering. This will take time and careful planning, again making coordination with co-ops and other utilities critically important.

5) **The potential for customer incentives and other managed charging stations strategies to shift charging off-peak;**
    a. **Rate design or other program approaches that will encourage "good" charging behavior by consumers so that negative impacts are mitigated and capacity upgrades are minimized,**
    b. **Information on implementing separate billing rates or tariff structures for EV charging. Report on metering of the EV load, including additional metering and billing information technology infrastructure**

Co-ops are using innovative rate designs and programs to incentivize consumer-members to charge when it is most beneficial from a cost and reliability perspective for the grid. The widespread use of advanced metering infrastructure (AMI) by co-ops has made the use and success of these programs possible. There are many co-ops already using time-of-use (TOU) pricing to incentivize charging during off-peak times. Going a step further, some co-ops divide their TOU pricing into three periods rather than two, and offer the lowest rate during "super off-peak" times of day, such as midnight to 6 a.m. Using another approach, some co-ops are offering an EV subscription rate whereby consumer-members pay a flat monthly fee to charge their EVs during off-peak periods up to a certain amount of kWh. The co-op provides a Level 2 charger at no cost to the consumer-member and the consumer-member agrees to allow the co-op to curtail the charger's load when necessary during peak hours. The co-op owns the charger and can actively manage the EV load, while encouraging consumer-members to charge off-peak.

6) **The technology needed to achieve bi-directional power flow on the distribution grid**
    a. **Information on the challenges and barriers for achieving bi-directional flow (vehicle to grid) and other integration approaches (such as vehicle to home, vehicle to microgrid). Provide an assessment of their likelihood, anticipated timeframe, and challenges that needs to be addressed to facilitate implementation.**

At this time, V2G capabilities are far from being commercially available and ready for widespread deployment and adoption. V2G is still very speculative overall in terms of benefits to the grid, especially for non-fleet applications such as residential use. Significant RD&D funding will be needed to advance V2G to be ready for such a scenario.

7) **The implementation of smart charging techniques**
    a. **Information on smart charge management systems that have been developed and demonstrated, including the system capabilities and grid services provided; requirements for EVs, charging equipment, and network/system operators; and the ability to mitigate the impact of uncontrolled EV charging on grid operations. Challenges and barriers, or improvements/enhancements needed for widescale adoption are also of interest to DOE.**

Mitigating the impact of uncontrolled EV charging is critical to grid reliability and avoiding peak demand costs that could harm the co-op and its consumer-members. Using a combination of direct and indirect control programs as described above will be critical to managing the impacts of EV charging on the grid. Consumer education will be a vital component to the success of these programs.

Increased EV charging will change patterns of electric use, making it important for co-ops to be able to access and manage charging data to optimize their systems for continued reliability. Third-party providers of EV charging need to coordinate with their electric utilities to ensure the co-op or other utility has the necessary data to manage these impacts properly.

Category 4: Research on the standards needed to integrate electric vehicles with the grid, including communications systems, protocols, and charging stations, in collaboration with the National Institute for Standards and Technology (NIST):

1) **Technology hurdles or standards work that are needed for the implementation of smart charging techniques. Include an assessment of their potential benefit. Information is also sought on aggregation of these loads, implementation with third-parties and approaches or limitations for animating the market.**
2) **The need for cross-sectoral standards harmonization (e.g. data commonality, minimum level of critical information exchange, etc.) to achieve interconnection and interoperability across technology domains.**

3) **Standards and protocols needed to advance Vehicle to Everything (V2X) viability and grid resilience.**
4) **Standards for the protection and safety of DC connected systems.**

Uniform national EV equipment standards, including communications and controls, are critical to reducing the cost of building out charging infrastructure and for V2G adoption. As standards are developed and adopted it is critical that electric utilities have a role in the process to avoid unintended consequences. Further, it is important that small entities such as electric cooperatives participate in the process because they face unique resource challenges that should be addressed at the outset. Leaving electric cooperatives and other utilities out of the standards development process could inadvertently result in lower or delayed EV adoption across the country, in particular in rural areas where the cost to deploy EV charging infrastructure may make less economic sense in the short term, and leave these communities behind in the transformation of the transportation sector.

Category 5: The cybersecurity challenges and needs associated with electrifying the transportation sector:

1) **Information on any data sharing and controls access scenarios associated with EV charge control or third-party aggregators/providers. Report on any cyber-security concerns and mitigation strategies.**
2) **Insights on the development of holistic cybersecurity approaches and harmonization across the interfaces of the EV, charging, and grid ecosystems.**
3) **The role of cybersecurity metrics for high-power charging stations and EV smart charge management across networked, grid connected systems such as reliability, resilience, etc.**

Increased EV charging will change patterns of electric use, making it important for co-ops to be able to access and manage charging data to optimize their systems for continued reliability. As discussed above, third-party providers of charging must coordinate with their co-ops to ensure they have the necessary data to manage these impacts properly. As part of this data information flow, efforts should be made to maintain the integrity of the respective networks between the third-party providers and the co-ops to avoid cybersecurity risks. For example, it is critical to avoid creating systems where malware could move from a charging platform to a utility SCADA network and potentially compromise the grid. Cybersecurity risks should be mitigated to the fullest extent possible to avoid risking electric reliability. There should be focused efforts to ensure on the front end that third-party providers and vendors of the components needed to build the EV charging stations are building in cybersecurity protections wherever possible and appropriate.

In conclusion, electric cooperatives are investing in EVs and EV programs to support consumer-members. Co-ops will play a vital role in the adoption of EVs in their communities through tailored rates, infrastructure deployments and education. Co-ops want to partner with the federal government and other entities on the build out of EV charging infrastructure to ensure the communities they serve are not left out of the impending transformation in the transportation sector, while continuing to deliver safe, affordable, and reliable electricity. Co-ops should be eligible for any government incentives for EV infrastructure such as grants and financing, particularly to support charging infrastructure and grid upgrades that will be needed to support increased load due to EV adoption.

Thank you for considering our comments. Please contact me at stephanie.crawford@nreca.coop or 703-907-5732 if you have any questions regarding these comments.

Sincerely,

Stephanie Crawford

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