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Farm Vehicle Electrification

Additional submitted attachment is included below.

CALIFORNIA ENERGY COMMISSION

ELECTRIC PROGRAM INVESTMENT CHARGE 2021-2025 (EPIC 4)
RESEARCH CONCEPT PROPOSAL FORM

The CEC is currently soliciting research concept ideas and other stakeholder input for the EPIC 4 Investment Plan. For those who would like to submit an idea for consideration, we ask that you complete this form and submit it to the CEC by 5:00 p.m. on **July 2, 2021**.

To submit the form, please visit the e-commenting link, https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=20-EPIC-01, enter your contact information, and then use the "choose file" button at the bottom of the page to upload and submit the completed form. Thank you for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

   David Meyers
   415.722.2261
   dmeyers@polarisenergyservices.com

2. Please provide the name of the contact person's organization or affiliation:

   Polaris Energy Services

3. Please provide a brief description of the proposed concept you would like the CEC to consider as part of the EPIC 4 Investment Plan. What is the purpose of the concept, and what would it seek to do?

   Farm Vehicle and Equipment Electrification: the purpose is to accelerate the electrification of diesel/gasoline-burning farm vehicles and equipment and integrate electric farm vehicles (EFV) with the grid to align charging with grid decarbonization goals and employ EFV batteries for behind the meter supply of peak loads when necessary and Vehicle-to-Grid (V2G) services when available.

4. In accordance with Senate Bill 96, please describe how the proposed concept will **"lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals."** For example, what technical and/or market barriers or customer pain points would the proposed concept address that would lead to increased adoption of clean energy technologies? Where possible, please provide specific cost and performance targets that need to be met for

increased industry and consumer acceptance. For scientific analysis and tools, what data and information gaps would the proposed concept help fill, what specific stakeholders will use the results, and for what purpose(s)?

The project will address barriers to farm vehicle electrification and grid integration including:

1. Lack of high-capacity, rapid charging infrastructure for farms.
2. Lack of V2G capabilities for EFVs.
3. Unclear and/or insufficient incentives for farm vehicle electrification.
4. Lack of tools to manage and optimize fleets of EFVs to manage operator costs and capture emerging grid services opportunities.
5. Lack of understanding of how the times and duration of farm vehicle usage interacts with profiles of existing agricultural loads to enable co-optimizatio of the two with grid needs.

To address these the project concept would:

1. Characterize and quantify the EFV opportunity to meet statutory goals, the economics and benefits/barriers for owners/operators on a stand-alone basis.
2. Characterize and quantify the opportunity for EFVs to provide V2L and V2G services and the operational requirements and hurdles for integrating with agricultural loads and the grid.
3. Develop/adapt electric vehicle supply equipment (EVSE) that is suitable for the Ag environment.
4. Integrate charging and V2G capabilities with existing irrigation pump service points.
5. Work with manufacturers to develop V2G capabilities for EFVs.
6. Develop software for fleet management to maximize the benefits to farmers of EFV adoption.
7. Develop software to optimize EFV fleets in tandem with agricultural loads to achieve the greatest benefits for farmers and the grid.

Stakeholders who would use the results include:

1. Energy policy makers will have data to develop markets and rates that incentivize coordinated operation of EFVs and agricultural loads to achieve decarbonization, reliability and cost goals.
2. EFV and EVSE manufacturers will use the results to define product requirements to meet the EFV opportunity in California.
3. Agricultural Energy Users will be able to quantify all value streams from electrification to support purchase decisions of EFVs and will have access to standardized hardware and software to extract those value streams.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the technology at scale?

   Off the shelf EVSE and V2G systems for agricultural end uses are not widely available and this research would break that logjam and bring those enabling technologies to market. Costs would be reduced compared to current solutions to the extent they exist but because market prices are not available, this cannot yet be quantified.

   Electric farm vehicles are approximately 10X more energy efficient than diesel tractors, which is 3-4X the improvement of other heavy duty vehicles. The carbon improvement is 1.6X that for natural gas vs. diesel, 2X that for renewables' share, for a total of 30-40X carbon improvement over current equipment. By aligning charging with renewables' availability, 100% decarbonization is achievable and with the overlap of ag operations in regions with signifcant solar generation and the potential for V2G, farm vehicle electrification can support decarbonization of other end uses.
   - ~9 Million tons/year reduction in CO2 from diesel to electric
   - 500 – 1,000 MW battery capacity
   - ~6,500 hours/year for charge/discharge
   - ~6 months/year minimal daily usage --> available as stationary storage

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.
   1. Availability of one or more V2G-capable electric tractors.
   2. Availability of a stand-alone EFV charging station.
   3. Availability of an integrated irrigation pump supply/EFV charging station.
   4. Demonstration of EFV V2G capability.
   5. Demonstration of EFV/Irrigation scheduling integration.

7. Please provide references to any information provided in the form that support the research concept's merits. This can include references to cost targets, technical potential, market barriers, etc.
   1. https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-energy-efficiency-compared-conventional-diesel
   2. https://thebusinessjournal.com/central-valley-tops-list-of-u-s-ag-counties/
   3. https://www.cdfa.ca.gov/agvision/docs/Agricultural_Loss_and_Conservation.pdf
   4. https://www.eia.gov/tools/faqs/faq.php?id=73&t=11

5. "California average grid electricity used as atransportation fuel in California (subject to annual updates)"
6. https://www.truckinginfo.com/10143724/renewable-diesel-biodiesel-california
7. https://www.youtube.com/watch?v=xcpi4vR-_44
8. https://www.ers.usda.gov/webdocs/publications/74658/60128_eib159.pdf?v=3804.1
9. https://www.arb.ca.gov/msei/ordiesel/agfuelstudy2018.pdf
10. http://www.waterandenergyprogress.org/library/05006.pdf