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Direct-DC-DC Systems with DERs to Support Future MD&HD EV Fleet Loads

Additional submitted attachment is included below.

**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:

   Kenji Tabery
   Email: kenji.tabery@pairedpower.com
   Phone: 650-701-7247

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

   Paired Power, Inc.

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?

   As part of the EPIC 4 Investment Plan, we strongly encourage the CEC to consider a research concept on measuring and validating the avoided cost savings and resiliency cost savings from DC-DC systems with DERs for MD/HD EV fleets, in any of the following applications where utility distribution systems are most constrained and air quality impacts are most detrimental to surrounding disadvantaged communities as identified by CalEnviroscreen 3.0: 1) Agriculture (on-farm tractor fleets/tractor trailers at processing plants 2) Ports (MD/HD EV fleets). Many agricultural, port, transit agency, and energy consulting firm stakeholders have approached and demonstrated great interest in Paired Power's direct-DC-DC approach to enable more access to flexible renewable energy loads to support their MD/HD electric vehicle fleet transition. The purpose of this concept is to evaluate the following outcomes: 1) Current load optimization models only take into account grid-tied systems, but what this concept proposal would research is the optimal mix-load model with off-grid power for MD/HD EV fleets by utilizing DC-DC systems with DERs (Direct-DC). 2) Evaluate from a planning perspective the cost benefit of deploying off-grid DC-DC w/ DERs solutions (instead of upgrading new electric distribution/transmission systems and substations to handle the additional load) 3) Measure and verify the economic, resiliency, energy efficiency, and safety benefits of off-grid DC-DC systems with DERs and measure the savings benefit to the IOUs and ratepayers.

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)?

As electric distribution and transmission system planners are beginning to anticipate large public charging loads, a more detailed analysis is necessary to prepare for the rollout of charging infrastructure to support this transition. The proposed concept addresses/solves the following technical and market barriers:

1) Deploying additional distributed energy resource assets (DC-DC systems w/ DERs) to where it would otherwise be cost-prohibitive due to utility grid service or geographic limitations.
2) Mitigate and potentially eliminate PSPS events for a specific territory and enabling V2G services for demand response or act as backup power source for designated critical facility sites
3) Most EPIC investments to date have been for pilots of less than 25% of the total EV fleet. EDGE and other CEC modeling indicate that the necessary make-ready infrastructure to support EVSEs requires special attention and investment. The costs that make up this investment include transformers, meters, breakers, wires, conduit, and associated civil engineering work. These costs and time frames can be highly variable and difficult to predict. DC-DC systems with DERs are custom designed to meet present and future EV loads, and their costs and timeframes are generally stable and predictable.
4) The outcome of this research concept would provide electric planners and CEC modeling tools with a case study / resource on how to develop a plan/blueprint model for DC-DC systems with DERs to support 100% fleet electrification with a mix of off-grid DC-DC systems with DERs and utility power.

5) Lastly, this research proposal could inform future ICA maps to identify areas of capacity gaps and if it's an ideal fit for off-grid DC-DC systems with DERs to support deployment of EV fleets in that area.

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?

   If the research concept is successful then it would identify the following outcomes:
   1) Identify total DC-DC system costs among a coordinated number of distributed energy assets and the grid.
   2) Identify any cost gaps and weaknesses in the design to improve on cost efficiencies of the system's hardware and software as well as improve overall performance of the system.
   3) Evaluate and verify known benefits and quantify financial value to IOUs and ratepayers: grid-infrastructure avoided cost savings; resiliency savings; V2G service and demand response; energy efficiency savings; GHG emission reductions; air quality improvements; and economic impacts (job creation).

   The potential of the DC-DC system architecture with DERs is the ability to enhance the grid (Utility 2.0) to support new MD/HD EV loads while drastically reducing costs to IOUs (e.g. avoided utility infrastructure upgrades), protect grid assets from reduced grid impacts of MD/HD EV fleet loads, and reduce costs passed onto ratepayers (e.g. more predictable/stable load profile that flattens the "duck curve").

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.

   The following quantitative / qualitative metrics would be used to evaluate the impacts of the proposed research concept and include, but not limited to:
   - Assess overall costs for the delivered solution, including both initial capital costs as well as long-term operating costs.
   - Assess overall costs for comparable utility grid tied system (e.g. upgrade equipment costs) + energy and demand costs (operating costs)
   - Meter, measure, and verify the energy delivery (kWh) from each component of the direct-DC-DC system with DERs: Solar PV system, EVSE, battery energy storage, controllers, inverters.
   - Measure and validate GHG emission offsets per kWh basis.
   - Financial value of resiliency, safety (reduced wildfire threat) and V2G services, including critical power backup loads

- Assess and verify economic benefits of reduced grid impacts (shifting and reducing energy and demand load profiles)
- Assess and survey fleet operator and facility manager satisfaction with the resultant solution
- Assess and survey community feedback on local environmental and economic gains (jobs created) from project.

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.

   Transportation accounts for nearly 50% of California's GHG emissions as of 2018. Rising vehicle ownership and increased vehicle miles traveled are some of the factors that contribute towards rising emissions and adversely impacts the State of California's zero-emission goals of 2045. MD/HD EV fleet adoption will be a critical key to reducing transportation emissions and air quality impacts over the next two decades, and charging infrastructure will be a critical component to enabling that transition. Also, utility infrastructure costs and time frames can be highly variable and difficult to predict. To illustrate this point, the Port of Long Beach and the Port of Los Angeles were awarded $8 million each by the CEC for charging infrastructure installations to support new battery-electric yard tractors in 2017. The Port of Long Beach spent $6.7 million on construction and service upgrades, while the Port of Los Angeles spent only about $2 million in construction costs and used a more significant portion of funding to purchase charger hardware itself. These projects illustrate how site-specific needs drastically affect charging infrastructure costs, and how costs can vary widely even when the environment or goals appear similar. We encourage research and evaluation to demonstrate that direct-DC-DC systems with DERs are able to meet present and future EV loads, and their costs and timeframes are generally stable and predictable, and are getting better as we see battery energy storage prices reaching price parity to fossil fuel equivalents by 2022. Finally, future State investments are going to reach a major barrier where current project prices for L2 / DC Fast Charger installations (with average total cost of $1,332/kW for Level 2 connectors and $2,000/kW for DC fast chargers) will inflate dramatically over current $/kW levels due local distribution service constraints and will trigger new investment in utility infrastructure that does not necessarily enhance grid reliability, safety, security, resiliency, and cost savings for the IOUs and ratepayers. DC-DC systems with DERs can offer better TCO for L2 / DCFC project costs ($/kW) with MD/HD EV fleets, and further research and evaluation is requested for EPIC investments in the sectors of agriculture, ports, transit, and construction.