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On Questions

Additional submitted attachment is included below.

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Submitted to:
California Energy Commission
Docket Unit, MS-4
Re: Docket No. 19-ERDD-01
1516 Ninth Street
Sacramento, CA 95814-5512

Include the docket number 19-ERDD-01 and Research Idea Exchange in the subject line and send to docket@energy.ca.gov

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The CEC staff is seeking input from interested stakeholders on the following questions:

1. **Of the candidate use-cases and vehicle types listed above, which ones should we prioritize in this solicitation and why?**

   a. Will distribution capacity constraints be a major barrier to the deployment of the charging infrastructure needed for that use-case in the short- to medium-term?
   b. Will vehicles and charging equipment be readily commercially available in the short- to medium-term?
   c. Are there market and policy influences driving electrification in the use-case now?
   d. Are there use-cases that would particularly benefit from the reliability and resiliency value of the DER strategy?
   e. Are there vehicle types that are particularly suited to providing reliability services to the grid or to individual buildings during an outage?
   f. What incentive or funding mechanisms already exist to support MDHD fleet operators looking to electrify?
   g. What is the total potential market size in California for the use-case?
   h. Which use-cases have the most potential to replicate the DER package and achieve a meaningful scale?

SwRI Comment:

Distribution capacity constraints may not be a major barrier in the short term due to the low volume of BEVs in use and a strategic support from DERs to stay within the constraints. Assuming 5% of all registered vehicles to be upgraded to BEVs, we can assume that both vehicles and charge equipment will be readily commercially available for planning short term DER strategies. Emission policy is a major driver for electrification while efficiency improvements follow as a close second. SwRI believes that use cases with extremely repetitive drive routes and power/energy demands will immediately benefit from the DER strategy. Based on the nature of use cases amenable to electrification and likely to benefit from DER strategy the vehicle types most suitable for each of the questions above are listed in the table below.

Use Case	a	b	c	d	e	f	g	h	Class
Transit buses	Y	Y	Y	Y	Y	*	+	Y	HD
School buses	Y	Y	Y	Y	Y	*	+	Y	MD
Delivery vehicles - Beverage	Y	Y	Y	Y	N	*	+	Y	MD
Delivery vehicles - Parcel	Y	Y	Y	Y	N	*	+	Y	MD
Off-road work vehicles and equipment - Construction	N	N	N	N	N	*	+	N	HD
Off-road work vehicles and equipment - Agriculture	N	N	N	N	N	*	+	N	HD
Off-road work vehicles and equipment - Airport Ground Support Equipment (GSE)	N	N	Y	N	N	*	+	N	MD
Off-road work vehicles and equipment - Transport Refrigeration Units (TRU)	N	N	N	N	N	*	+	N	HD
Off-road work vehicles and equipment - Drayage and other short-haul trucks	N	N	Y	N	N	*	+	N	HD
Municipal vehicles - Refuse trucks	Y	Y	Y	N	N	*	+	Y	HD
Municipal vehicles - Street sweepers	Y	Y	N	Y	N	*	+	N	MD
Municipal vehicles - Maintenance trucks	Y	N	N	N	Y	*	+	N	MD/HD
Yard trucks	Y	N	Y	N	N	*	+	Y	HD
Port equipment	N	N	Y	Y	Y	*	+	N	MD

* - Federal and state BAA's with cost share propositions. Largest incentive for fleet operators is higher fuel economy, lower emissions/health issues, comfort and quiet operation. At the fleet level they translate to large savings and better worker health

+- Total registered medium and heavy-duty vehicles in the state of California as of 2015 are 987,817. Assuming a 5% fleet change rate per year and median price of $400,000 per vehicle an estimated market size for conversion to BEVs is about $20B per year

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2. What is the best way to characterize the grid impacts and other costs associated with deploying MDHD BEV charging infrastructure without a managed charging/DER strategy?

a. What metrics should be used to evaluate the cost and performance of the baseline incumbent technology? Metrics currently under consideration include:
b. Itemized balance of system costs considering both site host costs and utility costs,
c. ii. Carbon intensity,
d. iii. Cost of delays associated with upgrading upstream distribution systems/substations, and
e. iv. Risks associated with long-term investments in permanent upgrades.
f. What information about existing grid infrastructure, beyond the Integration Capacity Analysis (ICA) maps, is needed to evaluate capacity constraints that could limit deployment of MDHD BEV charging infrastructure?

SwRI Comments:

A metric related to load patterns can be added beyond the grid infrastructure constraints.

Assuming 5% of 2015 registered MD/HD vehicles are converted to BEVs per year, median fast charge power demand per vehicle to be 500 kW if all these vehicles plugged into the grid at the same time for charging the power demand would be .05*987817*500 = 24.7 GW. Although the 5% fleet conversion is aggressive, it may still be a good representation if all off-highway and port vehicles are also considered. Assuming an average battery pack size of 100 kWh on the MDHD fleets, peak energy demand would be .05*987817*100 = 5 GWh.

Without a managed DER strategy, the peak demand could be a metric to design needed power and energy margins for the grid. By mapping current grid constraints without DER, current fleet positions and estimating future fleet positions, best locations of the DER can be determined to avoid service interruptions and increased cost of electricity generation.

This map allows identification of DER locations closest to the desired fast charging locations. This will allow buffering of the load demands and increase probability of the exceeding the capacity constraints of distribution networks. SwRI proposes a simulation model of the grid network and predicted load epicenters. Validating the simulation model with existing grid data will allow higher confidence in identification of optimal DER locations for the first round of infrastructure upgrade.

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3. **How does the target technology need to improve?**
   a. What are the current balance of system costs associated with deploying DERs as a non-wires solution for integrating MDHD BEV charging equipment?
   b. What publicly available resources provide visibility into these costs?
   c. What types of costs can be further reduced through innovation and require demonstration (e.g., soft costs, software, design, hardware, permitting, interconnection, etc.)?
   d. What is the revenue-generation potential and business model for the targeted technology (e.g., customer bill savings, low carbon fuel standard, wholesale market participation, distribution grid services, resiliency, etc.)?
   e. What metrics can be used to evaluate cost and performance attributes of the targeted technology?
   f. How can those metrics be normalized across different use-cases and project sizes (e.g., ratio of PV size to stationary energy storage size, ratio of soft costs to hardware costs, load factor on the utility distribution system, resiliency/reliability metrics)?
   g. How well can the targeted technology meet the operational requirements of the priority use cases?

SwRI Comments:

Inductive charging technologies suffer from inefficiencies of alignment despite autonomous vehicle positioning for charging. Moreover, fast charging with increased power requires solutions to additional issues such as EMI effects on human health. On the communication between charger and the vehicle, built in intelligence is needed to recognize various lithium ion chemistries and the constraints on charge profiles. If DER energy storage solutions are built near the charging stations their chemistry and aging will also need to be considered for best discharge and charge management. Typical metrics include increased durability of battery packs that use these intelligent optimized charge stations, messaging to consumers about the opportunity of lower billing during off peak periods, better consumer health, comfort of charging without connecting heavy wires and so on. SwRI is patenting a test-based charge profile generation process for various chemistries and can bring that to benefit any funded effort in this area.

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4. What level of investment would be needed from EPIC to make a meaningful difference on this issue?

a. What size of a project should we be targeting (MW, MWhs, number of charging ports, number of vehicles, etc.)?
b. What portion of the DER equipment costs should be covered by EPIC in order to appropriately incentivize site host participation?

SwRI Comments:

SwRI has extensive experience in fleet testing operation and field evaluation. With over 100 acres of available grounds, SwRI can potentially offer space for a pilot charging station with multiple charge ports, its 5 MW solar facility with permission from local utility CPS and operator RES and exercise multiple MDHD vehicles at this facility for showcasing various use cases mentioned in this GFO. Currently SwRI has permission to use 125 kW of power and 500 kWh of energy storage from the solar installation and will pursue permissions for larger chunks of power and energy if there is interest from CEC. If EPIC can fund the charge station build, lease/buying of targeted MDHD vehicles and the labor such a pilot project will become an infrastructure benchmark for generating data that can guide future planning and regulatory endeavors.

SwRI recommends using one of each category of following vehicles that seemed most aligned with the DER strategy.

- Transit Bus (SwRI can work local transit company VIA to facilitate the use of their bus)
- School Bus (SwRI is located in close proximity to several school fleets)
- Delivery Vehicle – beverage
- Delivery Vehicle - Parcel (SwRI can work with Amazon and Rivian)
- Municipal Maintenance Trucks (Collaborations with CPS and City of San Antonio)
- Municipal Refuse Trucks

With six suggested charge ports, the benchmark charge station or DER location at SwRI would be targeting 6 MW peak power and 1.2 GWh energy storage. It is expected that the project from this GFO would support installation of stationary energy storage system of 1 GWh energy with a peak power capability of 6 MW. The solar installation would be the primary supplier and the stationary DER will play the role of a buffer and support. The charge station would show case both grid to vehicle and vehicle to grid use cases. SwRI believes a generic DER strategy does not exist, and the charge station will play the role of the DER operator to identify and optimize this strategy to maximize the value to the utility and the vehicle owners. Strong data-based evidence can be generated from such optimization to determine needed rewards and penalties. Rewards for best matching deterministic and non-deterministic duty cycles and penalty price to be paid to the vehicle owners for "being available" and for the "actual use as DER".