DOCKETED	
Docket Number:	19-ERDD-01
Project Title:	Research Idea Exchange
TN #:	231464
Document Title:	National Fuel Cell Research Center Comments on Docket 19-ERDD-01 Jan 10, 2020
Description:	N/A
Filer:	System
Organization:	National Fuel Cell Research Center
Submitter Role:	Public
Submission Date:	1/10/2020 4:46:26 PM
Docketed Date:	1/10/2020

Comment Received From: National Fuel Cell Research Center
Submitted On: 1/10/2020
Docket Number: 19-ERDD-01

NFCRC Comments Docket 19-ERDD-01 Jan 10, 2020

Additional submitted attachment is included below.

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January 10, 2020

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

Subject: Response to Request for Comments on Grant Funding Opportunity Concept for DER Implementation Strategies to Support MDHD Vehicles: Docket Number 19-ERDD-01

The National Fuel Cell Research Center (NFCRC) submits these comments on the forthcoming Electric Program Investment Charge (EPIC) program solicitation to address the strategic deployment of DER to enable and improve the cost effectiveness of integrating electric vehicle charging equipment with the currently existing utility infrastructure.

Our initial comment is that the definition of vehicles included in the solicitation should be expanded from only battery electric vehicles (BEV) to include hydrogen fuel cell electric vehicles (FCEV). The reasons for this are:

1. Many common heavy duty vehicle operating cycles include high capacity factors, heavy payloads, long distances, and operation in areas with vehicle weight limits, which can be difficult to meet using BEVs[1,2].

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[1] S. Sripad and V. Viswanathan, "Performance Metrics Required of Next-Generation Batteries to Make a Practical Electric Semi Truck," *ACS Energy Lett.*, vol. 2, no. 7, pp. 1669–1673, 2017.

[2] E. Çabukoglu, G. Georges, L. Küng, G. Pareschi, and K. Boulouchos, "Battery electric propulsion: an option for heavy-duty vehicles? Results from a Swiss case-study," *Transp. Res. Part C Emerg. Technol.*, vol. 88, pp. 107–123, Mar. 2018.

2. The amplitude and dynamics of fast charging necessary to maintain high electric vehicle capacity factor directly lead to the infrastructure overloading and power quality issues that this solicitation is concerned with.
3. Hybrid battery and hydrogen fuel cell electric vehicles can be both charged from the grid and powered by hydrogen made from renewable grid power at any time of the day – battery electric vehicles are projected to be capable of meeting medium duty and heavy duty vehicle operating requirements[3].
4. Due to favorable economies of scale, transitioning away from conventional vehicles to hydrogen fuel cell based vehicles has been projected to be economically advantageous versus BEVs for the target use-cases outlined in the request for comments document[4] [4].
5. Renewable hydrogen can be generated through electrolysis paired with renewable energy. Electroylzers can provide many of the same benefits as other forms of controllable DER through modulation of hydrogen production. Advanced systems are capable of reverse operation, producing electricity by using the prior generated hydrogen.

For small fleets of medium or heavy duty vehicles, electric recharging infrastructure may be the cheapest refueling option. However, in instances where a) a high number of fleet vehicles need to be refueled or recharged, b) development of widespread electric vehicle fast charging could lead to local grid overloads, c) vehicle end use is well suited for a fuel cell based platform,

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[3] J. Kast, R. Vijayagopal, J. J. Gangloff Jr, and J. Marcinkoski, "Clean commercial transportation: Medium and heavy duty fuel cell electric trucks," Int. J. Hydrogen Energy, vol. 42, no. 7, pp. 4508–4517, 2017.

[4] L. Beshilas, "Fuel Cell Electric Buses in the USA | State, Local, and Tribal Governments | NREL." [Online]. Available: https://www.nrel.gov/state-local-tribal/blog/posts/fuel-cell-electric-buses-in-the-usa.html. [Accessed: 09-Jan-2020].

and/or d) synergies between the applications of mobile or stationary use of hydrogen can be developed[5], the vehicle definition should be expanded to include fuel cell based vehicles.

In response to specific questions, NFCRC has the following responses:

Question 1.i: 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?

Current projections indicate that at the currently low BEV penetration level, capacity constraints will not affect BEV expansion. However, if large fleets that are centrally located begin to electrify, local distribution systems that are well sized for the current load will be over-utilized. In addition, if fast charging technology is implemented without smart controls and proper equipment, rapid load changes will affect local power quality and potentially overload the local system. In these instances, electricity distribution – depending on the application sector – can be a major barrier to the economic deployment of a widespread charging infrastructure. For large fleet sizes (e.g., transit buses of big municipalities, large port equipment) the upgrade of the current electric infrastructure to support the increased load and reliability features required by the battery charging might become less economical than other electrified transportation methodologies. In many instances, the full electrification of a vehicle fleet can significantly increase site electrical demand. When large payload, fast refuelling, and large fleet size are required, hydrogen refuelling and fuel cell-based vehicles are usually more economical than battery-based transportation – even when based on renewable hydrogen.

[5] Examples include industrial uses (such as the generation of high temperature heat or as an input to chemical processes), long term energy storage, and the supply of firm power.

Question 1.iii: Are there market and policy influences driving electrification in the use-case now?

In the State of California, both market and policy drivers are almost fully ready to support the electrification via battery-based transportation. Market drivers are also growing nationwide and worldwide; however, supporting and coordinated policy actions are generally lagging behind out-of-state.

Policy actions are missing in terms of supporting the use of all zero emissions energy generation technologies in the distribution sector. Policymakers should allow the integration of distributed generation resources with a technology-agnostic perspective. For example, the use of both energy storage (e.g., battery, hydrogen) and DER (e.g., solar, fuel cells) into micro-grids would allow improving reliability and resiliency of the grid.

Question 1.iv: Are there use-cases that would particularly benefit from the reliability and resiliency value of the DER strategy?

Specific use-cases in which a DER strategy could have a short-term positive effect could be small municipalities and neighborhoods, ports, industrial areas. In some urban environments there may not be sufficient space and access to electric infrastructure to introduce solar and new electric infrastructure but there may be sufficient space to deliver renewable gas to a fuel cell to renewably charge electric vehicles. In high energy density applications (e.g., ports) a similar combination of renewable electricity delivered via wires and electrical infrastructure and delivered via renewable fuel and stationary fuel cells will likely be required (and lowest cost) to deliver the amount of renewable energy demanded.

Question 1.v: Are there vehicle types that are particularly suited to providing reliability services to the grid or to individual buildings during an outage?

Both battery and fuel cell-based vehicles could provide grid support as auxiliary power units during an outage. Fuel cell vehicles are already equipped to do this in Japan. These FCEV could operate for longer time once a hydrogen network and supply is provided.

Question 2.i: What metrics should be used to evaluate the cost and performance of the baseline incumbent technology?

The metric currently under consideration are valuable. It is suggested to include the Total Cost of Ownership (TCO) of the system under consideration against the baseline. Moreover, an evaluation of the sustainable use of every resource (i.e., energy, material) necessary. For example, it is necessary to understand whether the amount of material required to build all the batteries for both vehicles and grid support is comparable to the one available. It is of paramount importance that the rate of use of a new resource is sustainable. In addition, information on the overall (both direct and indirect) carbon and air pollution emissions should be given. Direct emissions are emissions associated to the direct use of the incumbent technology. Indirect emissions are those associated to auxiliary processes that do not necessarily occur at the site of use, but that would not occur otherwise.

Question 4.i: What size of a project should we be targeting (MW, MWhs, number of charging ports, number of vehicles, etc.)?

Large projects should be incentivized to spur the market and the use of BEV and FCEV by new customers. MW-scale projects with a number of vehicles deployed greater than 50 (i.e., big transit agencies) should be targeted.

Respectfully submitted,

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