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Docket Number:	17-EPIC-01
Project Title:	Development of the California Energy Commission Electric Program Investment Charge 2018 â€“ 2020 Triennial Investment Plan
TN #:	215911
Document Title:	Emre Can Kara Comments: Mobility of the Future In the Context of Power Systems
Description:	N/A
Filer:	System
Organization:	Emre Can Kara
Submitter Role:	Public
Submission Date:	2/10/2017 4:57:10 PM
Docketed Date:	2/10/2017

Comment Received From: Emre Can Kara
Submitted On: 2/10/2017
Docket Number: 17-EPIC-01

Mobility of the Future In the Context of Power Systems

Additional submitted attachment is included below.

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The Energy Commission is currently soliciting ideas and stakeholder input for the 2018 – 2020 EPIC Triennial Investment Plan. For those that would like to submit an idea for consideration in the 2018-2020 EPIC Triennial Plan, we ask that you complete the form below. Submittals are due by **5:00 p.m. on February 10, 2017.**

Part 1. Initiative Description and Purpose:

1. Please provide a brief description of the proposed initiative:

Today, in the United States, there are approximately 8 vehicles for every 10 people, and the mobility industry have been dominated by private car ownership. However, with the advancements in self-driving vehicles, machine learning and control systems, alternative business approaches are blooming that shift private car ownership paradigm towards carsharing, car hailing and ride sharing models. In addition, with the increasing push towards vehicle electrification, there is an increasing coupling between human mobility needs and power infrastructure. As a result, unique business approaches and technical problems emerge. We propose an initiative that deals with similar issues named “mobility of the future in the context of power systems”.

2. What technical and/or market barriers would the proposed initiative help overcome? For scientific analysis and tools, what knowledge gaps would the proposed initiative help fill?

The proposed initative would address knowledge gaps in modeling the interconnected dynamics between human mobility and power systems, serve as a funding platform for different business models for future of mobility ideas that combine value streams from mobility, wholesale markets, and distribution systems benefits. Furthermore, the spatio-temporal dynamics of electric vehicle charging and its impacts on the distribution systems can be studied in more scrutiny, without assumptions on travel patterns, EV charging demands.

Part 2. Benefits and Impacts

3. If this initiative is successful, either fully or partially, what would be the expected impact? Who are the primary users and/or beneficiaries?

The initiative would have significant impact on various sectors in California, including transportation and clean energy. It will also support state's clean energy and transportation goals. We believe that ratepayers, regardless of their income and location, would benefit from improved access to mobility powered by clean energy. It will also facilitate educating and convening public and policy makers.

4. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed initiative:

Co-optimization and simultaneous operation of the mobility and power systems could result in individual and sociatal benefits in the following areas:
--- Increased number of electric vehicles results in a more flexible distribution grid, which benefits the ratepayers.
--- Energy arbitrage opportunities that might arise from a more dynamic tarriff structure can be leveraged by the mobility companies.
--- Electric vehicles can be treated as mobile storage units providing additional flexibility where and when its needed, helping buildings in an emergency or supporting the distribution system.
--- Electric vehicles can also increase the local air quality in the cities.
--- Both the power infrastructure and the transportation infrastructure can be optimally scheduled and used.
The proposed initiative would play a statewide role in establishing metrics that can quantify such benefits under different business cases.

5. Please provide a list of peer-reviewed references that support the responses for questions 3 and 4. Proposed initiatives that include peer-reviewed references will be given stronger consideration.

[1] Pavone, M. (2016). Autonomous mobility-on-demand systems for future urban mobility. In Autonomous Driving (pp. 387-404). Springer Berlin Heidelberg.
[2] Alizadeh, M., Wai, H. T., Goldsmith, A., & Scaglione, A. (2017, January). Optimal Electricity Pricing for Societal Infrastructure Systems. In Proceedings of the 50th Hawaii International Conference on System Sciences.
[3] Alizadeh, M., Wai, H. T., Chowdhury, M., Goldsmith, A., Scaglione, A., & Javidi, T. (2015). Joint Management of Electric Vehicles in Coupled Power and Transportation Networks. IEEE Transactions on Control of Network Systems.
[4] Kara, E. C., Macdonald, J. S., Black, D., Bérges, M., Hug, G., & Kiliccote, S. (2015). Estimating the benefits of electric vehicle smart charging at non-residential locations: A data-driven approach. Applied Energy, 155, 515-525.
[5] Nicolas, L., & Moura, S. J. (2016). Optimal Routing and Charging of Electric Ride-Pooling Vehicles in Urban Networks.
[6] Erdoan, S., & Miller-Hooks, E. (2012). A green vehicle routing problem. Transportation Research Part E: Logistics and Transportation Review, 48(1), 100-114.

6. (For technologies only) What competitive advantages does the proposed technology solution have over current benchmark technologies? If the technology is beyond the prototype stage, what strategies do you suggest to bring to scale?

Part 3. Connection to Energy Commission's EPIC Framework
Energy Commission staff have developed a draft strategic framework to guide the CEC's planning and implementation of EPIC across triennial investment cycles. One of the objectives of the draft strategic framework is to communicate a consistent set of priorities for organizing current and future EPIC investments.

7. Please indicate which of the following strategic framework themes you feel the proposed initiative best fits within:
    - Advance Technology Solutions for Deep Energy Savings in Building and Facilities
    - Accelerate Widespread Customer Adoption of Distributed Energy Resources
    - Increase System Flexibility from Low-Carbon Resources
    - Increase the Cost-Competiveness of Renewable Generation
    - Create a Statewide Ecosystem for Incubating New Energy Innovations
    - Maximize Synergies in the Water-Energy-Food Nexus
    - Develop Tools and Analysis to Inform Energy Policy and Planning Decisions
    - Catalyze Clean Energy Investments in California's Underrepresented and Disadvantaged Communities

If Other, Please Specify