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Enable products and solutions that enable the use of solar for charging the electric vehicle

I sincerely hope that you would consider this application even though it is a little late. Unfortunately, I was under the misguided impression that the deadline for submission was midnight on 2/10. Would truly appreciate your kind consideration in this matter.

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:

The proposed initiative aims to promote products and solutions that enable the use of solar for charging the electric vehicle. The lack of adequate charging infrastructure has been a big barrier in the adoption of electric vehicles. Most affordable electric vehicles in the market today have limited range (<100 miles) and hence require daily charging of the EV. Most of the charging is done at home due to the lack of charging infrastructure in commercial building and work places. As a result, most of the EVs sit idle during the day and only get charged at home in the evening. Many car manufactures are attempting to integrate solar solutions in a car to address this issue. Listed below are some examples are the integration of solar in an EV: (a) 2017 model of Toyota Prius Prime with solar cells embedded on the car roof, (b) the debut of "Hanergy Solar R", an EV model from Hanergy Group using high efficiency devices like GaAs embedded in on the car chassis (c) the proposal for the use of solar concentrator based charging structure by Ford CMax5 and (d) proposal for the design of a solar car from Sono Motors. Also, some startup companies have come up with innovative designs that enable turnkey installation of solar carports without expensive drilling and trenching work.

Integrating solar with EVs can have many benefits beyond just the transportation sector. Since solar can generate energy during the day and it can be stored in the car battery this is a truly "distributed energy resource (DER)". Enabling Research and Development in this area supports CEC's goal to "Accelerate Widespread Customer Adoption of Distributed Energy Resources". Since the EV battery is already priced into the car's value, this DER solution is much more cost competitive compared to a stand-alone solar-storage solution. Additionally, since the solar generation and charging of the EV occurs during the day it benefits the ratepayer by offsetting peak tariff rates if the EV were to be charged at work.

Most importantly it addresses range anxiety - a key barrier in the adoption of EV. Our proposal is an innovative and mobile vehicle attached solar charging solution that can generate over 20 miles of charge per day or 140 miles of charge per week. Given that an average US commuter travels ~30 miles per day, this charging solution, meaningfully address the range anxiety concerns of a consumer. Such a solution will facilitate, the growth of the EV market, accelerate the adoption of distributed energy resource and help utilities and ISOs address and mitigate issues related to addition of renewable energy resources and EVs on the grid.

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 growth of EV market faces multiple challenges. While consumers are hesitant to adopt EVs, the utilities and the ISOs have their own struggle as EVs plug into the grid which lead to supply and demand imbalances on the grid. The initial development of EV charging infrastructure, funded by the DOE, sparked growth between 2010-2014 and provided EV owners with more confidence and less range anxiety. As a result the growth in EV market was remarkable initially, however as the overall landscape supporting EVs tapered off in 2015 so did the the rate of adoption of EV.

The proposed solution addresses bottlenecks in EV adoption multiple ways. From an EV owner's perspective, the system addresses range anxiety, a key driver concern. First, this system is attached to the EV and generates energy close to the battery of the EV giving the owner a nearly "anywhere, anytime" charger. Secondly, the system is expandable, allowing sufficient charge generation to meaningfully address range anxiety unlike other solutions. For example, the solar mounted roof in a Prius generates very little charge because it is limited in size by the area of the car roof. Finally, it helps the rate-payer because it offsets peak charging rates as the car is charged from solar during peak demand time.

From the perspective of utilities and ISOs, this system charges the battery off-grid during the day, reducing the need to charge the EV at home in the evening. This helps to reduce the steep ramp in the "neck" of the duck-curve. Additionally, consumers that own EVs and also have solar on their homes typically tend to install a larger system to allow for increased consumption by their EVs. However, with the commercialization of this product, home owners can reduce the amount of PV on their roof and instead add PV to their cars using this system. This addresses the over-generation issues from the addition of PV on the grid, thereby reducing the depression seen on the "body" of the duck curve.

Essentially we are proposing a solution that can be a win-win from both the consumer's perspective and the utility perspective.

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 primary beneficiaries of the initiative are EV Owners, EV suppliers, and the ISO. EV Owners receive the instant benefit of nearly "anywhere, anytime" charging for their vehicles, nearly eliminating the need to plug in their vehicles to recharge. We expect this to have a stimulative effect on the sales of EVs, as increased range confidence should drive increased adoption. Finally, the ISO and utilities will benefit from the initiative, as this system charges the EV battery off-grid during the day, reducing the need to charge the EV at home in the evening. This helps to reduce the steep ramp in the “neck” of the duck-curve. Also, consumers that own EVs and also have solar on their homes typically tend to install a larger system to allow for increased consumption by their EVs. However, with the commercialization of this product, home owners can reduce the amount of PV on their roof and instead add PV to their cars. This addresses the over-generation issues from the addition of PV on the grid, thereby reducing the depression seen on the “body” of the duck curve.

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

The key metrics of success are the adoption of the technology and corresponding adoption of EVs. The results of this adoption would be generally reduced CO2 emissions from transportation in California and the mitigation of the generation/load "duck curve" described previously.

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.

The benefits of using solar for charging EVs have been described in many publications and is well understood. Listed below are articles and publications that articulate the benefits of combining solar with storage and EVs:

http://users.ece.utexas.edu/~baldick/papers/electricvehicleutility.pdf

http://www.sdforward.com/sites/sandag/files/Emerging_Technologies_Final082614.pdf
http://www.renewableenergyworld.com/articles/print/pvw/volume-3/issue-2/solar-energy/solar-storage-and-evs-a-powerful-trifecta.html

https://www.greentechmedia.com/articles/read/this-is-why-it-makes-sense-to-pair-solar-with-electric-vehicles

https://www.cleanpower.com/2015/electric-vehicles-and-solar/

http://climateprotection.org/portfolio-item/ev-white-paper-touts-benefits-of-going-electric/

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?

We see very few solutions that combine solar with EVs, because most people are driven by “traditional” thinking that the only space available for solar in a car is its chassis. Because of limited area available for solar either the energy generated is low (Toyota Prius) or the solution uses non-standard materials like GaAs (Hanergy), or it needs to be coupled with a complex external solution like a concentrator carport (Ford CMax) to generate more energy. These solutions are intrinsically flawed as they lead to a sub-optimal, or a high cost or a complex product.

We acknowledge that charging stations may be seen as a competitive substitute to the product. However, the installation of charging stations is capital intensive and slow to happen. Rather than spending hundreds of thousands of dollars developing each charging station, that money could be spent once developing this product, which can be deployed for only a few thousand dollars on every EV. This proposal is more easily commercialize-able, inexpensive and truly “where-you-need-it-when-you-need-it”, in a way that no charging station can be.

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