Summary of Comments

Proposal 10-01-13T Electricity Ranked # 3

Smart Photovoltaic PHEV/EV Charging System Using Second-Life Lithium Batteries

Jae Wan Park, UC Davis

PROJECT OBJECTIVE:

- Proposes to prove the feasibility of a smart photovoltaic battery charging station for electric drive vehicles that is powered by solar photovoltaic panels and supported by high-power lithium traction batteries. The "Smart PV" charging station described will have sufficient energy storage to support the all-electric range of a PHEV-40.

FUNDING RECOMMENDATION:

- Recommended for funding. Eligible for funding contingent upon a satisfactory response to request for clarification for minor modifications.

PUBLIC INTEREST BENEFITS:

- The proposed technology has the potential to reduce California electricity consumption on the grid by 5.8 million kWh per year, assuming 5% of PHEV/EV drivers use the Smart PV charging station to generate 10.2 kWh of solar power per day.

STRENGTHS:

- Well qualified PI and team at the UC Davis Green Transportation Laboratory.

WEAKNESSES:

- No significant weaknesses noted.

CLARIFICATIONS / CONDITIONS:

- Needs to address specific concerns regarding charge/discharge use of the second life lithium batteries as suggested by one technical reviewer.

California Energy Commission Energy Innovations Small Grant (EISG) Transportation Program **GRANT APPLICATION COVER PAGE**	**FORM A**

a. Project Title: Smart Photovoltaic PHEV/EV Charging System Using Second-Life Lithium Batteries

b. Project Subject Area: (*Indicate the one that most applies)*

☐ Vehicle Technologies ☒ Transportation Systems

c. Applicant Category:

☐ Individual ☒ Academic Institution
☐ Small Business ☐ Non-Profit

d. Grant Funding Requested: $94,250 ☒ Hardware $95K ☐ Modeling $50K

e. Proposed Project Duration: 12 months *(maximum duration 12 months)*

f. Principal Investigator/Project Manager: *(serves as single point of contact for all communications)*

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Position/Title:	Assistant Professor, Mechanical & Aerospace Engineering	

g. Proprietary/Confidential Information:

☒ NO – Proposal does not contain proprietary information, unrestricted distribution authorized.

☐ YES - Proposal contains proprietary information, restrict distribution and disclosure.
(clearly mark and label those sections that are proprietary on all copies)

h. Application Status *(include only prior submissions on same concept)*

☒ First Submission ☐ Second Submission ☐ Third Submission

Provide the proposal number(s) assigned to prior submission(s): **N/A**

i. Indicate the Solicitation Number Listed on the Solicitation Notice: 10-01T

j. Indicate the Solicitation Number Printed on the Application Manual Used: 10-01T
(the solicitation numbers listed in items i and j must match)

k. Principal Investigator/Project Manager Certification: To the best of my knowledge, I certify that the information contained in this grant application package is true, and discloses all requested information.

Principal Investigator/Project Manager Signature:_____ **Date**: **Mar. 28th, 10**

Reserved for EISG Program Administrator Use		
Solicitation	Date Received	Proposal Number Assigned
10-01T E		

PROJECT SUMMARY

Smart Photovoltaic PHEV/EV Charging System Using Second-Life Lithium Batteries

Principal Investigator: Dr. Jae Wan Park, UC Davis Department of Mechanical and Aeronautical Engineering

The U.S. transportation sector is responsible for a significant portion of the nation's fossil fuel consumption and greenhouse gas emissions. Awareness about energy consumption in transportation has been growing during recent years, due in part to rising gasoline prices and concerns about climate change. California is particularly vulnerable to impacts of climate change, and the state is therefore taking a progressive approach towards reducing greenhouse gas emissions in the transportation sector.

Plug-in hybrid electric vehicles (PHEV) are regarded as a promising technology for the near future because they consume less gasoline than conventional cars. However, the advancement of a fleet of PHEVs brings about certain challenges. Current methods of electricity generation rely heavily on carbon-intensive fuel sources like petroleum, coal and natural gas. The use of electric power in transportation can have a significant impact on greenhouse gas emissions in California if alternative energy sources are explored. Another challenge facing PHEVs is the cost of the traction battery that drives the vehicle; adding a large lithium-based battery can nearly double the cost of a car. The high cost of traction batteries has influenced automakers to pursue ideas for "second-life" applications of those batteries. A second-life battery could conceivably be used for non-traction applications when diminished energy storage capacity has rendered the battery unsuitable for providing power directly to a vehicle.

Solar power is an attractive renewable energy source because it can be converted to electricity with almost zero net GHG emissions by using photovoltaic (PV) panels. The work described in this proposal will develop and test a charging station for PHEVs and other electric-drive vehicles (EV). This charging station will be powered primarily with solar PV panels, and the energy generated by the PV panels will be stored using second-life lithium traction batteries. The charging station will feature a Smart Grid Interface that allows supplemental charging using grid electricity only at times when grid demand and energy prices are low.

Previous research in this field has proven the concept of using solar power to support vehicles to be technically feasible. The development of a vehicle charging station represents a new, innovative application of renewable energy for the transportation sector. The results of this research will lead to cost savings for California PHEV/EV drivers and reduced strain on the electrical grid.

STATEMENT OF WORK

Smart Photovoltaic PHEV/EV Charging System Using Second-Life Lithium Batteries

Principal Investigator: Dr. Jae Wan Park, UC Davis Department of Mechanical and Aeronautical Engineering

Project goals

The goal of this project is to determine the feasibility of a smart photovoltaic battery charging station for electric drive vehicles that is powered by solar photovoltaic panels and supported by high-power lithium traction batteries. The "Smart PV" charging station described in this proposal will have sufficient energy storage to support the all-electric range of a PHEV-40.

Project tasks

Project Tasks	Performance/Cost Objectives
Acquire photovoltaic module(s) and MPPT controller	Minimum power at STC: 1.5 kW Maximum cost: $7,500
Acquire lithium ion traction battery	Minimum capacity: 2 x (16 kWh) Maximum cost: $4,500
Demonstrate that PV module can be used to charge traction battery (DC) with high efficiency	Target efficiency, PV to battery: 96%
Demonstrate capability of SGI to control grid vs. solar charging with PG&E Smart Meter	System shall completely avoid using grid electricity during peak period.
Demonstrate that footprint of PV array can store sufficient energy for a PHEV-40 within one day of sunlight	Footprint: 15 m^2 Energy generated: 10 kWh Maximum time frame: 10 hours
Demonstrate that the Smart PV charging station can safely charge a PHEV/EV energy storage system within an acceptable charging time	Maximum charging time: 8 hours SOC accuracy: 1%

Reporting requirements

Submit Progress reports and final reports in accordance with the proposed Project Schedule/Deliverables chart.