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California Energy Commission
DOCKETED
12-EPIC-01
TN 72666
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January 27, 2014

To: Researchers and Other Interested Parties: QUESTIONNAIRE for 2015-2017 Triennial Investment Plan for the Electric Program Investment Charge

Questionnaire for applied research and development, technology demonstration and deployment, and market facilitation

The Electric Program Investment Charge (EPIC) provides electric public interest investments in applied research and development, technology demonstration and deployment, and market facilitation for clean energy technologies in accordance with California Public Utilities Commission's May 31, 2012, Phase 2 Decision 12-05-037, as modified.[1] The California Energy Commission, Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric Company (SDG&E), and Southern California Edison Company (SCE), as the four administrators of the program, submitted coordinated investment plans to the CPUC for consideration on November 1, 2012. In November, 2013, CPUC Decision 13-11-025 modified and approved the first triennial investment plans of each program administrator. The portion of the EPIC Program administered by the Energy Commission will provide funding for applied research and development, technology demonstration and deployment, and market facilitation for clean energy technologies and approaches for the benefit of ratepayers of PG&E, SDG&E, and SCE.

Energy Commission staff is implementing its first EPIC investment plan, as modified and approved by the CPUC.[2] Competitive solicitations for initiatives in the first EPIC investment plan will be published soon. A schedule of upcoming EPIC funding opportunities and feedback opportunities for the Energy Commission's first EPIC investment plan is available online at www.energy.ca.gov/research/epic/.

The CPUC EPIC schedule calls for EPIC administrators, including the Energy Commission, to submit a proposed second EPIC investment plan by May 1, 2014.[3] To meet this schedule, Energy Commission staff is now developing the second triennial investment plan for EPIC funds collected in 2015-17. The plan must be approved by the CPUC. Staff estimates the plan may include $340 million for applied research and development, technology deployment and demonstration, and market facilitation. As part of this information gathering process for the second EPIC investment plan, the Energy Commission seeks ideas from interested parties on proposed initiatives in the topic areas of the electricity system "Value Chain," specifically grid operations/market design, generation, transmission, distribution, and demand-side management. The Energy Commission's second EPIC investment plan will build upon and follow the initiative format of the first triennial EPIC investment plan located at: www.energy.ca.gov/research/epic/documents/final_documents_submitted_to_CPUC/2012-11-01_EPIC_Application_to_CPUC.pdf as modified and approved by the CPUC in Decision 13-11-025, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M081/K773/81773445.PDF.

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[1] *http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF*

[2] Energy Commission, October 2013, The Electric Program Investment Charge: Proposed 2012-14 Triennial Investment Plan, in Application of the California Energy Commission for Approval of Electric Program Investment Charge Proposed 2012 through 2014 Triennial Investment Plan, Attachment 1, http://www.energy.ca.gov/research/epic/documents/final_documents_submitted_to_CPUC/2012-11-01_EPIC_Application_to_CPUC.pdf, as modified and approved by the CPUC in Decision 13-11-025, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M081/K773/81773445.PDF.

[3] CPUC Decision 12-05-037, Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013-2020, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF, page 31. CPUC Decision 13-04-030 modified Decision 12-05-037.

***This is only a Request for Information; ple*ase do not submit proposals for funding**. Initiative ideas received, in response to this request, will be considered by Energy Commission staff in developing the second EPIC investment plan for funds collected in 2015-2017.

If you have applied research, development, technology demonstration, deployment or market facilitation ideas, please complete the attached initiative template. This template asks you to discuss your idea, identify why this research is appropriate for public funding, and include the issues/barriers that are impeding full market adoption of the clean energy technology/strategy addressed. Proposed initiatives will be compiled and posted on the Energy Commission website at: www.energy.ca.gov/research/epic/.

Here are some guidelines for completing the template:

1. The information contained in your initiative should be no more than three pages.
2. Complete one template per initiative. Multiple templates may be submitted, one for each separate initiative.
3. All proposed initiatives must advance science or technology and offer a reasonable probability of providing benefits to California Electric Investor Owned utilities (IOU) ratepayers and must meet the following criteria:
   a. Focus on energy efficiency and demand-side management, generation, transmission and distribution, grid operation and market design issues.
   b. Support state energy policy.
   c. Consider opportunities for collaboration and co-funding with other entities.

Please e-mail suggested initiatives in a downloadable, searchable format such as Microsoft® Word (.doc) or Acrobat® (.pdf) by February 13, 2014. Please include the docket number 12-EPIC-01 and indicate "EPIC second investment plan" in the subject line. Send the completed initiative questionnaire to:

docket@energy.ca.gov and include in the CC line: Prab.Sethi@energy.ca.gov

A public workshop is scheduled in February, 2014 to focus on market facilitation. A draft second investment plan will be released in March, 2014 and a public workshop will be conducted to receive comments on the draft second investment plan.

Sincerely,

Laurie ten Hope
Deputy Director
Energy Research and Development Division

(This is a Request for Information only - Complete Pages 1 and 2 for each initiative)

Title of Proposed Initiative: PEV Second-Life Batteries Applications: Solar Firming & Regulation

Investment Areas (Check one or more) – *For definitions, see First Triennial Investment Plan, page 12*:

☐ Applied Research and Development

☒ Technology Demonstration and Deployment

☐ Market Facilitation

Electricity System Value Chain (**Check only one**): *See CPUC Decision 12-05-037, Ordering Paragraph 12.a. http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF.*

☒ Grid operations/market design

☒ Generation

☐ Transmission

☐ Distribution

☐ Demand-side management

Issues and Barriers:

Between January 2011 and January 2014, more than 60,000 plug-in electric vehicles (PEVs) were sold in California, heralding a new automotive segment dependent on large-format battery storage systems. Cumulatively, the lithium-ion battery systems in these vehicles represent over 1,500 megawatt-hours (MWh) of electrical energy storage. Due to the high performance requirements (power and energy capacity) of PEV batteries in automotive use, lithium-ion battery cells, modules, and even entire battery packs will likely have residual power and energy capacities upon retirement from vehicle use, leading to potential "second-life" applications that promise considerable economic and environmental benefits for California, and will simultaneously facilitate the state's zero-emission vehicle (ZEV), Renewables Portfolio Standard (RPS), and greenhouse gas (GHG) emission reduction goals. However, a viable future market for second-life applications of used PEV batteries must first overcome a combination of technical, regulatory, and market barriers in order to achieve its full potential.

Initiative Description and Purpose:

This proposed initiative would deploy up to 200 MWh and 100 MW of repurposed PEVs batteries co-located with utility-scale renewable energy generation facilities in order to demonstrate how technical, regulatory, and other barriers can be overcome and help establish a new energy market supporting California's clean energy goals.

In addition to potentially providing low-cost and advanced energy storage capabilities to meet California's energy storage, renewable energy, and grid reliability goals, the repurposing of PEV batteries for second-life applications will facilitate the development of the PEV market, another important state goal aimed at reducing criteria and greenhouse gas emissions, by increasing the total lifetime value of PEV battery and lowering the risks and costs associated with the commercialization of PEVs.

Though advanced lithium-ion battery packs are able to provide a wide-range of functions across nearly every sector of the electricity sector, including back-up power supply, load shifting, grid support, ancillary services, and transmission and distribution asset deferral, these systems may potentially provide the greatest system and financial value, through the firming of intermittent energy generation and participation in California's Non-Generator Resource Regulation Energy Management (NGR-REM) and NGR non-REM markets.

Specifically, energy storage has been recognized as a possible compliment to support issues identified with Variable Energy Resources (VERs), such as medium to large-scale solar photovoltaic generating facilities. In general, solar and wind fueled generation whose output is generally not dispatchable by system operators have been identified as resources potentially requiring integrated advanced energy storage systems. At the grid level, storage resources can respond to price and dispatch signals to behave in a manner that is conducive to overall grid needs but that does not address the exposure to risk associated with VER's Scheduling Coordinators (SC). In particular, while the California Independent System Operator (CAISO) dispatches energy in 5 minute increments to balance VER forecast error and other needs, the cost of that dispatch associated with VER forecast error is allocated to the VER SC. Battery storage is particularly useful in addressing short-term energy requirements due to its ability to rapidly change from a resource that produces energy (discharge) to a load that consumes energy (charge) without changes to the resource configuration.

The recent deployment of NGR by the CAISO provides a new opportunity for resources that have the capability to operate as both generation and as load. Unlike the model for traditional resources that presumes operation in the production mode (discharging energy to the grid), NGR allows a resource to also act as load and purchase energy directly from the wholesale market. The primary advantage of operating as an NGR is to allow the battery storage portion of the resource to participate in the market outside of the renewable generation production hours and with the dispatch capabilities of the storage capacity during all hours without the constraint of the maximum resource capacity output that is predominate by production

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Proposed Technology Demonstration and Deployment Operating Paradigm:

- The solar photovoltaic (PV) resource and the battery storage operate as a single resource at a single point of interconnection (existing) with a single meter
- The combined PV and storage resource is modeled and operates as a NGR in the CAISO market
- The storage portion of the resource can charge directly by purchasing energy directly from the wholesale market as needed.

This configuration would require that the CAISO accept the concept of a hybrid resource that has maximum output capacity that is only available on PV production hours and could only certify for Ancillary Service (AS) capability in limited hours. This configuration makes the "hybrid" model ripe for operational testing as a pilot.

Because the PV output of the resource is an energy-only resource, the NGR would operate under the Non Regulation Energy Management (Non-REM) option which allows for participation in all AS products as well as energy products. The ability to submit real-time economic energy bids provides the opportunity to purchase charging energy when prices are favorable (sometimes negative) allowing self-management of SOC and optimize AS capacity market opportunities. Furthermore, AS regulation provides the best value proposition due to the relatively high capacity payments. In the proposed configuration depending on the PV forecast, it is possible that regulation could be provided during PV production hours under the Non-REM option as long as the total resource output doesn't exceed the interconnection capacity.

Stakeholders:

In addition to California electricity ratepayers, major stakeholders include utilities, energy generators, automobile manufacturers, third-party automotive recycling, refurbishment, and supply companies, the California Independent System Operator, and advanced energy system integrators.

Background and the State-of-the-Art:

Over the past three years, the California Center for Sustainable Energy (CCSE) has partnered with private, government, and academic partners including the National Renewable Energy Laboratory (NREL), San Diego Gas & Electric (SDG&E), AeroVironment Inc., the BMW Group, Ricardo, Electricore, the University of California, Davis, and the University of California, San Diego to study the viability of PEV battery systems in grid support, energy market, renewables integration, and utility-customer applications. This research has constituted the most in-depth and single longest continuous research effort focused on second-life applications for PEV batteries. Over this period, CCSE and partners have completed the following efforts and deployed the following systems: (1) assessment of potential second-life applications for used batteries and development of real-world duty-cycles for these battery storage systems, (2) techno-economic analysis of potential markets for repurposed PEV batteries, (3) acquisition of used PEV battery packs and modules of multiple lithium chemistries for initial benchmark and laboratory testing, (4) down-selection and deployment of 68 kWh of used PEV battery packs and modules in long-term field testing within the UC San Diego microgrid, (5) deployment of a 100 kW/160 kWh energy storage system using retired battery packs from BMW MINI E vehicles, and (6) investigation of the benefits and feasibility of standardizing PEV battery systems.

These research activities and real-world system deployments have been jointly funded through government funding, including the California Energy Commission (CEC) and the U.S. Department of Energy (DOE), as well as private industry including automotive manufacturers and battery suppliers. Additional major PEV second-life battery application research efforts and deployments include partnerships between General Motors and ABB, Nissan and Sumitomo, refurbishment of used and damaged PEV battery packs by ATC Technologies of Oklahoma, and research conducted by NREL, Sandia, and Oakridge National Laboratories.

Based on the research to date, PEV batteries are capable of operating within acceptable temperature, voltage, roundtrip efficiency, and state-of-charge limits when tested in applications including area regulation, load following, customer-side demand charge management, back-up power supply, and solar generation firming. Additionally, second-life PEV batteries hold the potential to out-compete new lithium and lead-acid battery technology in terms of system payback.

Justification:

Through the Zero-Emission Vehicle (ZEV) Action Plan and Executive Order B-16-12, the Governor's Office has targeted the goal of 1.5 million ZEVs on California roads by 2025. The great majority of this goal will be met by the deployment of plug-in electric vehicles with highly advanced lithium-ion battery systems ranging in size from 5 to 85 kilowatt-hours (kWh) and representing some 30,000 total MWh of battery energy storage. With an expected lifetime of 5 to 8 years in automotive use, this cumulative resource of advanced batteries could ultimately prove to be either a vast asset to California or, alternately, a vast environmental, economic, and societal liability.

At the same time, California is committed to a 33% RPS standard by 2020, with possibly higher RPS goals soon to follow. As a result, regulators and grid operators have projected the need for significantly more energy storage capacity on California's grid, including the 1.325 gigawatts (GW) of capacity recently mandated by the California Public Utilities Commission (CPUC).

This project will demonstrate the practical application of PEV battery systems in renewables firming and ancillary market applications while simultaneously improving the value proposition and environmental benefits of plug-in electric vehicles. Both of these objectives are critical to achieving the state's clean air, GHG, and renewable energy goals, with demonstration and deployment projects in support of these goals therefore appropriate for public funding.

Ratepayer Benefits (Check one or more)**:**

☒ Promote greater reliability

☒ Potential energy and cost savings

☐ Increased safety

☒ Societal benefits

☒ Environmental benefits - specify

☒ GHG emissions mitigation/adaptation in the electricity sector at the lowest possible cost

☒ Low emission vehicles/transportation

☒ Waste reduction

☒ Economic development

Public Utilities Code Sections 740.1 and 8360:
Please describe how this technology or strategy addresses the principles articulated in California Public Utilities Code Sections 740.1 and 8360. The California Public Utilities Code is available online at www.leginfo.ca.gov/cgi-bin/calawquery?codesection=puc.