STATE OF CALIFORNIA

EPIC TRIENNIAL INVESTMENT PLAN 2015-17
Proposed Energy Research Initiative
Questionnaire

CALIFORNIA ENERGY COMMISSION

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

Title of Proposed Initiative (Short and concise): Vehicle-to-Grid Resource Modeling, Forecasting and Control

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

California Energy Commission
DOCKETED
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Issues and Barriers:

There is considerable uncertainty in the potential value that plug-in electric vehicles can provide the grid. Validated methodologies for energy modeling of electric vehicle fleets are still in their infancy, and beyond understanding simply the load, the flexibility of that load while meeting mobility objectives is largely unknown. This uncertainty makes market interactions very challenging.

Additionally, to tap the full potential of the grid connected batteries that plug-in vehicles represent, an understanding of the impacts of bi-directional flow on the distribution system is necessary to support adoption at scale. A distributed fleet of electric vehicles supporting transmission level reliability objectives may inadvertently cause problems in the distribution system in which they reside. Confidence for distribution system operators is necessary for their support in access to wholesale markets and the transmission system.

Finally, while an aggregation of electric vehicle resources may be able to supply these services in theory, control technology has not been demonstrated that can coordinate the

Initiative Description and Purpose:

This initiative will support the following:

- Development of robust, validated, and scalable load modeling techniques that can be applied both regionally and locally.
- Market interactions for plug-in electric vehicles through probabilistic forecasting of electric vehicle fleet load and the flexibility of that load to become a grid-resource.
- Development of methods that examine all value streams that electric vehicle batteries can claim in grid operations, including those that require bi-directional power flow.

- Integration of electric vehicle resource modeling with distribution system models through the incorporation of spatially-resolved distributed PEV load and resource models.
- Development and deployment of control algorithms to provide and build confidence in the resources that have been modeled through the previously described methods.

Stakeholders:

CAISO, IOUs, PEV OEMs, Charging station companies.

Background and the State-of-the-Art:

- What research development and demonstration has been done or is currently being done to advance this technology or strategy (cite past research as applicable)?
    - Some modeling tools have been developed that can create regional load estimations for electric vehicles (LBNL, University of Austin, Texas, University of Michigan).
    - Research is being done to develop controls algorithms for coordinated charging of electric vehicles (UC Berkeley, LBNL, UCLA)
    - Demonstrations of electric vehicles providing regulation is currently underway (LBNL's LA AFB PEV Pilot, Pilots in PJM territory with University of Delaware,).
- Describe any public and/or private successes and failures the technology or strategy has encountered in its path through the energy innovation pipeline: lab-scale testing, pilot-scale testing, pre-commercial demonstration, commercial scale deployment, market research, workforce development.
    - The efforts in this area are scattered and not well coordinated. The approach is fragmented and needs to be systematic.
- Identify other related programs and initiatives that deal with the proposed technology or strategy, such as state and federal programs or funding initiatives (DOE, ARPA-E, etc.).
    - Most of the efforts seem to be around demonstrating capabilities, and include:
        - ESTCP – V2G pilot at LA Air Force Base
        - CEC – Pilot at LA Air Force Base
        - University of Delaware and PJM pilots.

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Justification:

The governor's goal of 1.5M ZEV's by 2025 combined with other goals of the state (DR, storage, clean energy) provides a huge opportunity to invest in planning and operations of electric vehicles, provide leadership to gather industry support and integrate these as resources to support other goals. EV's span behind-the-meter charging in all sectors and can increase the consumer's understanding of when electricity is being consumed and how to integrate it with other resources to deliver value to all stakeholders. Public funds are an ideal way to organize and plan research and deployment initiatives up front, support fundamental research in this area and lead the development and execution of the vision to minimize costs over the long term.

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

Describe specific benefits (qualitative and quantitative) of the proposed initiative

This initiative describes the next steps for enabling Vehicle-to-Grid interactions. It will allow them to provide grid reliability services at a very low cost. These services will help counter balance the added instability and uncertainty in grid operations due to variable renewable energy adoption in the power system. The cost to harness these storage devices has the potential to be considerably lower due to the fact that the majority of their cost is covered by their primary function of motive power. The potential revenue that EV owners could garner from providing these services could lower the overall cost of ownership of plug-in electric vehicles, increasing their adoption rate.

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.

The successful integration of electric vehicles into a smart electric grid will enable lower cost procurement of reliability services for transmission and distribution systems. Better understanding of electric vehicle loads and their impact has the potential to defer distribution investments and make better planning decisions that will ultimately reduce the cost of electricity for all ratepayers. Additionally, converting this distributed load into distributed assets allows for EV owners or OEMs to reduce the cost of ownership of these clean technologies, which should speed up adoption and reduce transportation sector environmental impacts.