

Title of Proposed Initiative (Short and concise):

High Energy Density Solid Polymer Lithium Battery for Distributed Energy Storage

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

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| California Energy Commission DOCKETED 12-EPIC-01 |
| TN 72574 FEB 13 2014 |

Issues and Barriers:

Describe the issues and barriers that are impeding full market adoption of the proposed clean energy technology or strategy (such as cost, integration, or lack of information).

Residential/Small commercial demand-side management and distributed renewable generation with lithium battery energy storage in residential and small commercial application is still very limited and restricted due to:

- 1) Inconsistent performance, poor life, and high cost of conventional lithium ion battery used in harsh environment and conditions such as rooftop, outdoor, wide ambient temperature, and inaccessibility of HVAC systems
- 2) Lighter and more compact battery solutions that are easily deployed
- 3) Unclear economic benefits for demand-side management and behind-the-meter energy storage in residential and small commercial application

Initiative Description and Purpose:

How will this technology or strategy help address the issue/issues? Describe knowledge to be advanced to overcome critical barriers. Include the recommended funding level (minimum and maximum) for each project under this initiative.

Seeo DryLyte Solid Polymer Electrolyte Lithium Battery can operate in harsh environment and extreme condition (-40°C to +70°C) without compromising its performance and life. Its present technology offers high gravimetric energy density provides flexibility to incorporate with PV panel for rooftop and wall-mounted installation. The Seeo technology also has a superior safety performance due to its proprietary solid dry polymer electrolyte system that avoids use of flammable electrolytes used in other systems.

With the EPIC initiative, Seeo would develop the next generation of its technology of higher energy density batteries that would offer lighter and more compact batteries (400 Wh/kg and 700 Wh/l) while maintaining the same performance independent of ambient temperature and reliability of its existing technology. This would also offer batteries with lower cost per unit of energy (\$/kWh) that would translate into lower installment costs for IOUs, commercial and residential end-users.

Seeo would expect to achieve this development work within the time period of the investment plan and have a working battery system of 5 - 10kWh for residential installation by the end of the program, with a technology that is one third of the weight of today's lithium-ion technology with a chemistry that has the potential to achieve the industry cost targets. Estimated funding is \$1.5 million to \$2.0 million.

Stakeholders:

Identify the stakeholders who support the initiative.

Municipality utilities, Investor-owned utilities, energy service companies, energy optimization companies (demand management), inverter manufacturers and commercial and residential PV owners.

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)?
Seeo has been developing the solid polymer electrolyte lithium batteries since 2007. Seeo has developed a complete battery system from electrochemical cell to modules and complete battery system. Seeo is in the process of commercialization of its technology, where demonstration and deployment of systems is a core part of the company's strategy. Seeo is testing and evaluating its technology in lab and field testing environments (e.g. DOE SunShot Initiative)
- 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.

With support from the Department of Energy's SunShot Initiative, Seeo has partnered with SunEdison to develop an Energy Storage System (ESS) that pairs Seeo's battery pack with control analytics designed to optimize performance of a joint solar and energy storage installation. The program combines a field demonstration with an evaluation of financing structures that can be deployed to accelerate the adoption of distributed PV with advanced energy storage.

Seeo was awarded funding from the Department of Energy as part of the Smart Grid and Energy Storage demonstration program. This 4-year project supports development and deployment of a battery pack using Seeo's proprietary nanostructured polymer electrolyte. The battery pack is targeted for utility-scale storage operations with an initial focus on Community Energy Storage applications.

Seeo received a grant from the California Energy Commission in support of the Department of Energy Smart Grid and Energy Storage Demonstration program. The Energy Commission grant provides cost share funding to Seeo.

- 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.).
Other industry related programs and initiatives include EPRI's collaborative research and development (R&D) with investor owned utilities, and DOE Smart Grid and Energy Storage demonstration programs.

Justification:

Describe how this technology or strategy will provide California IOU electric ratepayer benefits and provide any estimates of quantified annual savings/benefits in California, including:

- Name of sector and estimated size and energy use.
Energy Storage for demand side management and photovoltaic. Today this market is still early stage and mainly comprised of demonstration programs.
- Quantifiable performance improvements for the proposed technology/strategy.
The improvements would result in a 50-100% increase in the energy density.
- Maximum market potential, if successful.
Maximum market potential if successful is estimated to be 1GWh by 2020
- Number of direct jobs created in California.
Presently Seeo has about 50 employees and would expect to increase the number of employees in the near term by 25 to address these opportunities. Longer term the number can be significantly higher depending on the commercial success of the company.
- Why this research is appropriate for public funding.
Seeo energy storage technology is well suited for residential and commercial demand-side management and paired with photovoltaic integration due to its low cost of ownership, high gravimetric energy density, safety performance and reliable performance independent of ambient temperature. This allows California IOU electric ratepayers to maximize their investment by effectively managing their demand and energy charges and optimize the photovoltaic utilization.

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

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.

For the reasons mentioned above we are convinced that Seeo's technology and the initiative outlined addresses the principles articulated in California Public Utilities Code Sections 740.1 and 8360.