California Energy Commission
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STATE OF CALIFORNIA

EPIC TRIENNIAL INVESTMENT PLAN 2015-17

Proposed Energy Reserch Initiative Questionnaire

Title of Proposed Initiative: Transactive Energy as Grid-scale Storage

Investment Areas: Technology Demonstration and Market Facilitation

Electricity System Value Chain: Distribution

Issues and Barriers:

Most existing mechanisms for building renewable energy decouple the "green" from the power – this happens with both RECs and feed-in tariffs. These mechanisms end up undervaluing storage on the grid, as they undermine carbon incentives for buying renewable energy as it is being produced. The recent storage initiative in CA takes a big step towards addressing this failure. The two clean-tech startups sponsoring this initiative – VCharge and Sunamp – have been working together to produce a type of grid-scale storage in the form of aggregated thermal-storage heat pumps in residential and multi-building heating and cooling settings. The concept of using transactive load – that is, load "patient" enough to transact meaningfully with the grid – has been gaining support globally: PNNL/IBM, GWAC, and LBNL all champion the concept of transactive load as grid-scale storage. However, there are a number of lower-level barriers in general and in CA specifically, including:

- **Equating grid-scale storage with large physical objects.** This perspective can be traced back to the DOE's push for developing chemical batteries. This view undermines a cost-effective alternative. For example, the 2 MW VCharge grid-scale storage asset in PA costs $100 per kW; the recent KEMA storage report referenced by the CA storage initiative suggests distribution values of $300-$500 per kW.
- **Tiered electricity rates.** For the particular transactive load asset in this initiative, we are providing homeowners with a lower-carbon alternative to fossil fuel for home heating. Tiered rates do not take into account whole-house energy use as a baseline and therefore are a barrier to adoption. This is especially problematic for a future with 75-95% renewables, where HVAC will need to transition away from fossil fuels.
- **Metering for information, not for market settlement.** Our position is that the key barrier to responsive load is failure to settle energy use on actual metered data. It is a travesty that so much money has been spent on smart meters and so little residential load in the United States settles on actual metered data.
- **Eschewing markets**. It is dangerous to equate distributed generation with retail and thermal plants with markets, and that the focus of clean tech funding should be on how to present information to consumers. This undercuts the economic driver for rewarding storage: a market transaction between two parties based on the value of the exchanged good (power).

Initiative Description and Purpose:
The high-level goal is to see transactive load become an integral part of long-term distribution planning, viewed as a key tool for unlocking the potential of distributed generation. At the same time the value streams in the electricity sector of the transactive load asset – at the distribution, energy, and transmission levels – can radically change the lifecycle costs of residential heating and cooling. VCharge has demonstrated how aggregated electric thermal storage heaters (with straight resistive load) can provide energy benefits and transmission-level benefits while cutting heating costs for homeowners by building transactive load assets in Pennsylvania and Maine. At the same time, Sunamp has demonstrated a new thermal storage heating technology that can be driven by heat pumps instead of straight resistive heaters. The two companies have begun collaborating together as they realize that there is enormous synergy between their two core technologies. Initial demonstrations and trials with SSE in Ireland are underway to validate the value of a small Irish transactive asset to the network companies, with plans developing to deploy joint Sunamp/VCharge technology in Northern Scotland and Scottish islands with weak distribution systems.

California has taken the most innovative posture in the world with respect to creating incentives for utilities to develop grid-scale storage. Without these PUC-driven incentives, the natural structure of IOUs incentives them to poorly utilize their systems, since their profits are proportional to the amount of infrastructure they own. CA is attempting to solve this problem by classifying storage as a type of IOU infrastructure and mandating investment in this infrastructure.

Sunamp and VCharge believe it is critical for the global dialog about storage and distribution operations that our products and story be part of the CA dialog about storage as it develops.

Stakeholders:
In addition to ratepayers – who benefit both as ratepayers and as homeowners with a greener and more economical HVAC option – stakeholders include property managers for large residential apartment complexes, smart grid stakeholders and researchers such as PSERC, GWAV, EPRI, and LBNL, utilities, owners and builders of distributed generation, community choice aggregators, and potentially electric vehicle manufacturers. Sunamp and VCharge have approached MCE Clean Energy about setting up summer meetings to discuss innovations in power purchase agreements where a load aggregator pledges to match wind and solar output with load in a manner respecting local distribution constraints. Chris DeMarco, head of PSERC U.W. Madison has agreed to actively participate in the initiative and Sila Kilacote of LBNL has expressed an interest in the approach.

Background and the State-of-the-Art:
The largest project involving transactive load is the PNNL/IBM/BPA Smart Grid Stimulus project. In addition there has been work by LBNL on demand response as grid-scale

storage, and the Low Carbon London project has explored the ability of demand response reacting to dynamic tariffs to engage in what they call "wind twinning." However, we believe that the most technologically advanced demonstration of this technology is in VCharge's Pennsylvania asset, which is providing regulation services of the highest quality to PJM as VCharge runs the asset to co-optimize between regulation prices and energy prices (as a PA energy supplier).

Justification:
The initiative targets the HVAC residential sector, both single home and multi-unit, with a goal of reducing home heating and cooling energy use by 40% while making the distribution network more resilient and improving the economics of distributed renewable energy by transforming these heating systems into low-cost grid scale storage. Achieving these goals for 30% of homes (4,000,000) would result in cost savings of 300 million dollars a year and would mitigate 100 thousand metric tons of carbon annually. This initiative will benefit California ratepayers by providing them with more options for procuring local clean energy, lowering their bills, and improving the quality of HVAC This initiative will stimulate retrofits in homes and managed properties that will lead to many California jobs. The research is appropriate for public funding in California because of its innovative approach to grid-scale distribution-tied storage – the most likely path to commercialization will involve publicly supported demonstration used to demonstrate a new class of grid-scale storage to the CA PUC. It is unlikely that this is an approach that the network companies will voluntarily fund for demonstration, although once it is approved by the CA PUC they will stand to benefit significantly.

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, lowest possible cost
- ☐ Low emission vehicles/transportation
- ☐ Waste reduction
- ☑ Economic development

Public Utilities Code Sections 740.1 and 8360:
The initiative is compatible with the guidelines in 740. It enhances the smart grid by reducing the distance between distributed generation and points of use as per 8360. It improves operating efficiency for homes and large residential complexes and reduces operating costs. It takes a unique approach to enabling substantially more renewable energy on the California grid.