DOCKETED	
Docket Number:	20-EPIC-01
Project Title:	Development of the California Energy Commission Electric Program Investment Charge Investment Plans 2021-2025
TN #:	238661
Document Title:	Paired Power, Inc. Comments - RIPE -- Revolutionary Irrigation Project for Energy
Description:	N/A
Filer:	System
Organization:	Paired Power, Inc.
Submitter Role:	Applicant
Submission Date:	7/2/2021 2:06:29 PM
Docketed Date:	7/2/2021

Comment Received From: Paired Power, Inc.
Submitted On: 7/2/2021
Docket Number: 20-EPIC-01

RIPE -- Revolutionary Irrigation Project for Energy

See attached document.

Additional submitted attachment is included below.

ELECTRIC PROGRAM INVESTMENT CHARGE 2021-2025 (EPIC 4)
RESEARCH CONCEPT PROPOSAL FORM

The CEC is currently soliciting research concept ideas and other stakeholder input for the EPIC 4 Investment Plan. For those who would like to submit an idea for consideration, we ask that you complete this form and submit it to the CEC by 5:00 p.m. on **July 2, 2021**.

To submit the form, please visit the e-commenting link, https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=20-EPIC-01, enter your contact information, and then use the "choose file" button at the bottom of the page to upload and submit the completed form. Thank you for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

   Tom McCalmont
   Email: tom.mccalmont@pairedpower.com
   Phone: 650-701-7247

2. Please provide the name of the contact person's organization or affiliation:

   Paired Power, Inc.

3. Please provide a brief description of the proposed concept you would like the CEC to consider as part of the EPIC 4 Investment Plan. What is the purpose of the concept, and what would it seek to do?

   There is a significant challenge to electrification of water pumping in California due to constraints in grid capacity. For example, there are situations in the Central Valley and agricultural locations within the state where the local utility either doesn't have distribution lines or has lines of insufficient capacity to provide water pumping for irrigation. We have met with the members of one California Farm Bureau who are looking for solutions to this problem (as an example of the interest). Paired Power has technology for directly charging batteries from solar power, and Polaris has technology for responding to grid capacity signals such as demand response. We have together discussed an innovative project in which a solar system could be used to charge a mobile battery (such as in an electric tractor), and the energy in that mobile battery could in turn be combined with grid power to provide sufficient power to drive an irrigation pump, even in locations where the grid capacity alone would not be sufficient to power that pump. Since the battery would be mobile (on a tractor), it could easily be moved around from one field to the next to accommodate underpowered pumps in various locations. This could expand the ability to irrigate fields that would otherwise lie fallow due to insufficient pumping capacity and therefore provide a great benefit to agriculture in California. In addition, delivering electricity from a combination of solar and battery storage can offset the grid during capacity constraints when increases in grid power are coming predominantly from fossil fuels (natural gas plants). By offsetting such demands, this microgrid pilot could greatly reduce GHG emissions from irrigation pumps and could serve as a test case to scale fleet electrification of agricultural vehicles across the state.

4. In accordance with Senate Bill 96, please describe how the proposed concept will **"lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals."** For example, what technical and/or market barriers or customer pain points would the proposed concept address that would lead to increased adoption of clean energy technologies? Where possible, please provide specific cost and performance targets that need to be met for increased industry and consumer acceptance. For scientific analysis and tools, what data and information gaps would the proposed concept help fill, what specific stakeholders will use the results, and for what purpose(s)?

   In locations with insufficient utility distribution lines for water pumping (for example, locations that are near the end of the line or where no lines are present), the cost to upgrade those lines or provide new lines can be substantial. Utilities may charge hundreds of thousands of dollars per mile to provide or increase capacity of distribution lines. In comparison solar power is relatively cheap today and could be combined with electric tractor technology that is also riding down a steep cost curve as electric vehicles become prevalent.

   A demonstration project as we described in #3 above would show that the investment in a direct-DC solar+storage system combined with existing grid power to drive pumping stations could be delivered at lower cost than the cost to upgrade the distribution lines in that same location. Little research has been performed to date on direct-DC systems and their many benefits relative to DC-AC systems (such as traditional solar interconnected with the grid, which is a lower efficiency, hybrid system).

   In addition, the flexibility of the mobile battery would allow the same power solution to drive multiple water pumps within a nearby geography (several farm fields relatively close together), further extending the economic benefit across multiple pumping stations. If on the other hand, that had to be done by extending distribution lines to multiple pumps, the costs would be far higher.

The solution described here would be of great interest to farmers who today do not have a good solution to extend water pumping and irrigation to locations with insufficient grid capacity. The data gleaned from a demonstration project such as described here would be invaluable in developing a broader microgrid strategy for water pumping throughout California. This will benefit farmers with insufficient pumping and electric capacity today as well as utilities who are struggling to provide expanded distribution lines into agricultural regions where the costs of those investments are not easily amortized. It will also provide a roadmap to policy makers interested in making policy decisions and additional investments that will support more rapid electrification of agriculture.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the technology at scale?

   The distributed energy direct-DC system proposed here could greatly improve the value proposition for water pumping throughout the state. It could lower overall energy and infrastructure costs for farmers and utilities as they seek to meet the demands for power in one of California's most important industries, agriculture. In addition, the flexibility provided by storing solar energy in a mobile battery during peak solar hours and then redelivering it at peak grid demand times when needed for water pumping could greatly alleviate the "duck curve" problem and provide greater energy resiliency for irrigation pumping. If this research concept were to be replicated and scaled across California's agricultural regions, it will shape the load and generation profiles more evenly (reducing excess solar capacity on the grid when that energy is not needed and redelivering the energy during associated steep ramp rates when it is needed).

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.

First, we would measure and assess overall costs for the delivered solution, including both initial capital costs as well as long-term operating costs. We would also meter and measure the energy delivery from each component of tbe system: the grid, the solar system, the EV charger, and the mobile battery. Analyzing the source of each kWh and how those kWh can be combined in innovative ways to meet the needs of the pumps will demonstrate the benefits of a direct-DC system vs. over an exclusively grid-connected architecture alone. Other quantitative measurements would include assessments of GHG reductions, the financial value of increased resiliency for pumping, and an assessment of the value and capabilities of "V2G" (vehicle to grid) solutions. We would also assess customer satisfaction with the resultant solution, involving California farmers in designing and delivering a solution that is optimal for their farming operations including their irrigation needs that they would not otherwise be able to attain through grid power alone.

7. Please provide references to any information provided in the form that support the research concept's merits. This can include references to cost targets, technical potential, market barriers, etc.

   The typical water pumping station in California requires about 200 HP, which is roughly equivalent to 150 kW of electricity. At 240VAC, that would require a utility service capacity of at least 800A, which is larger than the typical farm's existing service. In addition, the 200 HP pump could require 150 to 1,000 kWh of electricity per day, depending on how many hours per day it needs to run. A solar system sized at 30 to 100 kW can deliver 150 to 500 kWh per day. A distributed energy direct-DC system combined with a mobile tractor battery could both augment and reduce the amount of grid power required to drive the pump as well as permit time-shifting of the energy to a time of day when the pump optimally needs to run. We see few market barriers to this solution as all the elements of the solution already exist: solar power, battery technology, and electric vehicles are all well established with proven vendors and products. V2G technology is not yet widely available in vehicles; however, all EV vendors are working to add this capability to their vehicles through the new ISO 15118 standard, so this should be a solvable problem within the project timeframe. Grid power already exists but is frequently capacity constrained. Therefore, it is through the unique combination of these technologies in a direct-DC architecture that the secret sauce exists and can be developed with relatively little risk. EPIC investment is needed to move this important research opportunity forward and demonstrate the unique benefits of a direct-DC, distributed energy architecture combined with traditional utility power.