PROGRESS REPORT for EPC-19-060

Third Public Workshop Summary

Workshop date July 12, 2022

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Staff Workshop for the Third Public Workshop for Comments on Long Duration Energy Storage Scenarios

The workshop was held via Zoom on July 12, 2022, as advertised at https://www.energy.ca.gov/event/workshop/2022-07/proposed-final-scenarios-assess-role-long-duration-storage-workshop. The presentation and video recording were posted for public comment. This workshop summary documents primarily the comments that were received after the workshop and the associated follow up.

Agenda

UC Merced's project team will present an update of their analysis of the value of LDES to California's energy grid, to reach California's clean energy goals established by Senate Bill 100 (SB 100) (De León, 2018). Input collected from researchers, vendors, advocates, community members, and other interested parties participating in the workshop will guide the team's upcoming development of the final scenario to assess California's energy storage needs.

At the workshop, the project team will:

1. Present a study of the effect of time horizon and the energy capital cost of LDES on the duration selected by an optimization model. This study identifies the required time horizon needed to capture the value of LDES appropriately. It also shows the extent to which the cost of LDES will need to be reduced to motivate adoption of longer durations of storage.
2. Present a study to understand how the value of LDES changes under 39 scenarios with different generation mixes, transmission expansion, storage costs, and storage mandates.
3. Present a study of the minimum cycles per year needed to balance supply and demand to better understand the roles of diurnal, cross-day, and seasonal storage applications.
4. Define an approach for using the RESOLVE Capacity Expansion Model to assess LDES in 365-day optimization for a range of grid scenarios.

CEC staff and the UC Merced project team will seek feedback from the public, stakeholders, and other attendees.

LEGAL NOTICE

Summary of public comments and responses

Public input was requested to be submitted by July 26, 2022 at **https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=20-MISC-01**. One document was submitted to that site from CESA.

CESA's input reflects a careful analysis of our work and made three primary points:

1. UCSD's research demonstrates the urgency of considering longer optimization time-horizons within capacity expansion models across California's planning venues.
2. UC Merced's proposal to include variable-cost storage candidate resources should consider RTEs that range from 35% to 85%.
3. UC Merced should include a high-cost lithium-ion sensitivity and a low solar sensitivity to their proposed scenarios and studies.

Summary of our response to CESA:

1. **Modeled time horizon** We appreciate CESA's support of the need for using the longer time horizon for the modeling and agree that this should be a priority. We understand that E3 is working to be able use the new modeling toolkit soon, but we are not in a position to speak to when E3 will begin using it for their public analysis.

   We are currently studying the accuracy of our 'critical time steps' approach to reducing the computational complexity and hope to complete that in the next couple of months. We look forward to sharing this study with CESA and the rest of the community. We do not currently plan a comparison between our 'critical time steps' approach and the approach that E3 is using in the new modeling toolkit, which identifies representative days throughout the year and then maps those days onto a 3-year period. It will be interesting to see how the two approaches differ in their results.

2. **Round-trip efficiency modeled for candidate LDES** Although our communication of our plans was not very complete in the public workshop, in our previous documentation, we have proposed to study a range of efficiencies between 50% and 80%. In response to CESA's suggestion to sample efficiencies as low as 35%, we are pleased to extend that range on the low side. Our recent studies of EIA data also find that modern lithium batteries that are cycled most every day are reporting monthly discharge energy to be 90% of monthly charging energy. So, we propose to explore the full range of 35% to 90%.
3. **Additional sensitivity analysis for high-cost lithium-ion and low-solar** We have been debating about the best way to address the importance of the modeled cost of lithium-ion batteries. We recall that CESA has sometimes reported the results as a cost relative to the lithium-ion cost. We are interested in this approach relative to modeling a range of lithium-ion costs. The selection of LDES for diurnal applications can mostly be documented by reporting the cost of the LDES relative to the assumed cost of the lithium-ion batteries. However, we anticipate that reducing the costs of all storage will reduce the overbuild of solar, so using a fixed cost for lithium-ion batteries and reporting

the LDES results as a cost relative to the lithium-ion battery cost would not give the full story. Thus, we will plan to explore more than one lithium-ion battery cost model. We welcome suggestions from CESA and CEC about what range of costs would be useful.

The suggestion to model times of prolonged low-solar resource is, of course, very important. However, we propose that the primary approach for addressing this situation will be to use cross-sector storage. For example, we anticipate that the world is investing in the capability to generate and store large quantities of hydrogen to use for transportation and heating applications. If a cross sector capability is created to be able to tap that large, stored resource, the first question is whether there would be adequate resources to be able to tap the hydrogen to power the grid at a needed power level. The second question is the amount of energy (hydrogen) that will need to be stored to get through the longest "solar drought." Answering this latter question will require understanding the world's storage for transportation and heating. As a rough estimate, we know that today the world uses about 1/3 of energy for electrical power, 1/3 for transportation and 1/3 for heating. Depending on the fraction of transportation and heating applications that are electrified, we anticipate that the size of the hydrogen storage will be more driven by the transportation and heating applications. Thus, while we may easily define a number of scenarios, predicting the size of hydrogen storage needed to get through low-solar times may be difficult.

In addition to the comment submitted to the docket, we received some private communications.

After the workshop, we received public comments from the following:

Organization or individual	Their query	Our follow up
Jim Fiske	Question "The cost of energy from storage depends heavily on how many hours per year that storage is used. If your models tell us how many hours storage would be used at a specific cost that information could be factored into LCOE models to tell us how much energy from storage would cost. Would iteration of this procedure tell us how much real world storage would actually be used?"	Zoom meeting on July 14, 2022
Jordan Kearns of Antora Energy	We are very interested in your CEC project to develop Scenarios to Assess the Role of Long Duration Storage Workshop. We had trouble joining the workshop yesterday but would greatly appreciate the time to connect with you to share some comments and to learn more about the direction of your LDES scenario development.	Zoom meeting on July 26, 2022 (see below)

Antora Energy was interested in our proposal to invest in hardware and then monetize the product of that hardware. While our proposal was to invest in electrolyzers and sell hydrogen, Jordan Kearns has been modeling investment in electricity-to-heat hardware and monetizing the thermal energy. He shared the following data for us to use in our modeling:

Electric Boiler Capex: $15-$50/kW uninstalled equipment $50-$100/kW installed (Source: vendor quotes)

Opex: 2% of capex/yr (Source, aligns with vendor estimates)

Electric Boiler Efficiency: 99% (Vendor Material)

Heat Value: EIA Industrial Natural Gas Price with 80% fuel-to-steam efficiency (Source, also central with our own experience)

Carbon intensity of natural gas: 52.91 kg/MMBTU (Combustion only), 73.365 kg/MMBTU (CARB Lifecycle)

We will be pleased to explore this in parallel with the studies of the electrolyzers and hydrogen.