

PROGRESS REPORT for EPC-19-060

February 2022

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Commission Agreement Manager: Jeffrey Sunquist

What we planned to accomplish this period

1. We will complete the Deliverable for Task 4.2
2. We will continue to meet with stakeholders and community representatives to gather inputs and request feedback
3. We will implement the changes needed to run the new RESOLVE with variable time steps and share this with E3.
4. We will continue the five SWITCH studies and will begin reporting more consistently on their status.

What we actually accomplished this period

1. Draft Grid Scenario for Task 4.2

The Draft Grid Scenario Summary was submitted. Feedback was received from our CAM and revisions are underway for submission of the final version by March 7, 2022.

2. Stakeholder and collaborator meetings: During the month of February, we met with:

- Roderick Go at E3
- Sarah Kurtz gave a presentation entitled “Gaining Perspective on Long-Duration Storage” for the LDESAC. A copy of the presentation is attached for reference.
- Ranjan Gupta of StorEdgeAI
- Patricia Hidalgo-Gonzalez gave an open presentation on some results obtained using SWITCH

3. Implement variable time steps into RESOLVE code

Modifications have been made to use variable time steps in RESOLVE. The changes are documented in the Grid Scenario Summary. The modifications have been tested on the toy model. The time saved for the solver to solve the toy model is about 75% if the initial scan turns out to be of adequate accuracy. The time saved by the two-step process for this small model is only 10%. We are preparing to test the variable time steps on a full-scale model for which we suspect that the time difference will be greater. The times found in this trial are summarized in Table 1.

Table 1. Solver time for use of variable time steps compared with standard 8760-hour optimization

Scenario name	Timepoints	Optimize		Time for solver
		Expansion	Dispatch	
Test2007_battery	8760	X	X	23.5 seconds
Test2007_battery_CTS	1449	X		3.9 seconds
Test2007_battery_hourly_dispatch	8760		X	17.5 seconds
Two-step process sum				21.4 seconds

To test the implementation of the model, the Test scenario used standardly by E3 was modified to induce it to adopt some storage using a scenario similar to the one reported in the December monthly report. The toy model includes only solar, wind, gas and battery for the resources. For the version of the toy model presented here, the second gas with carbon capture was removed, the carbon emissions was reduced by a factor of ten, and the price of the battery was reduced. This forced the model to overbuild solar, curtailing the solar except when the battery was being charged. With large curtailment, the selection of the solar and battery to be built has high uncertainty. Also, the critical timepoints were selected for a 2015 data set, so did not optimally identify the critical times.

A comparison of the results of running the model in the three ways is presented in Fig. 1.

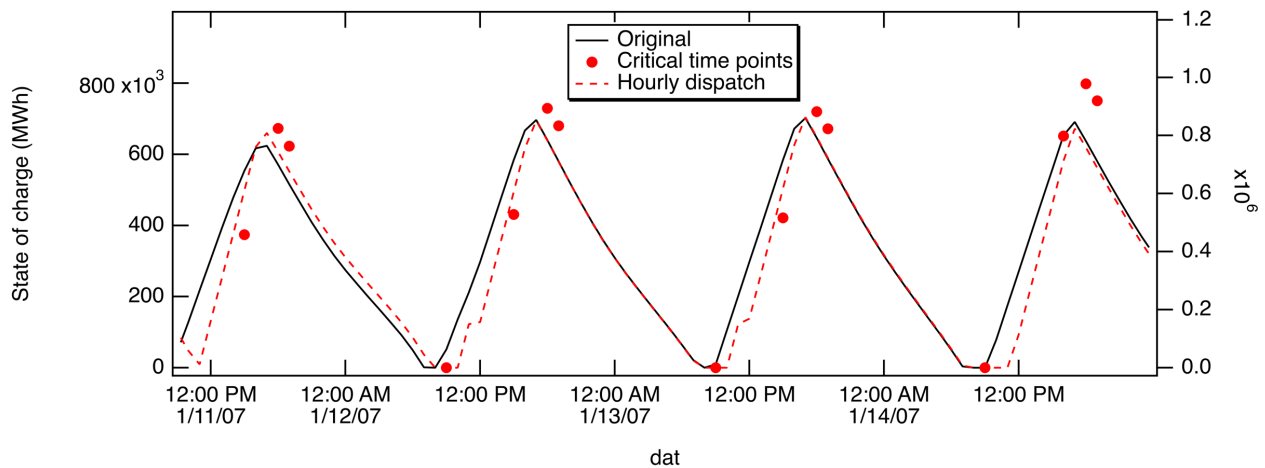


Fig. 1. Comparison of state-of-charge modeling for scenario with 8760-hour and 1449-hour (critical time points only) for a toy simulation that forced batteries to be adopted and used.

4. Five SWITCH studies and other paper updates

From our previous list of papers,

- both #5a and #8 were accepted and are now in press
- #6 received reviewer comments and is being prepared for resubmission
- #5b is being finalized for submission.

Regarding the 5 SWITCH studies

Study 1:

Staaecker, M. et al, “The value of long-duration energy storage and its interaction with a zero-emissions western North-America electricity grid”

Status: This study is nearing completion and an early rough draft of the manuscript is being developed.

Study 2:

The objective of this study is to identify cost targets for different LDES clusters to become competitive.

Status: This study will start in June 2022.

Study 3:

Sanchez-Perez, P. and Serna Torre, P. et al. “Infrastructure and economic opportunities for California to leverage WECC resources to achieve 100% RE by 2045”

The objective of this study is to analyze the benefits in electricity prices and overall cost reduction from allowing imports from outside California. The analysis looks at impacts on supply and storage infrastructure and in-state required generation. Particularly focusing on the impacts related to LDES duration and operation. We perform a systematic study by analyzing capacity expansion optimal results from varying allowed imports in 2050 from 100% (no constraint on imports) and monotonically decreasing allowed imports by 10% all the way down to 0% (California independent from the rest of the WECC).

Status: Ongoing study. We expect to have a manuscript draft by April 2022.

Study 4:

Srivastava, A. and Serna Torre, P. et al. “Impacts of re-designing planning and operational reserves rules on capacity expansion and operation”

The objective of this study is to understand the infrastructure impacts and storage needs of defining reserves in different ways for a zero emissions grid. Ultimately, this study will help regulators

understand expected needed storage infrastructure to be able to satisfy reserves requirements as they might evolve over time (2050 reserves requirement design).

Status: Ongoing study. We expect to have a manuscript draft by May 2022.

Study 5:

“Optimizing cross-sectoral energy and storage needs for Western North America”

The objective of this study will be to understand how the deployment and operation of LDES changes as we incorporate flexibility from other sectors such as

1. Energy efficiency, electrical vehicles (as a static load), and heating electrification
2. Hydrogen modeling

In terms of hydrogen modeling, SWITCH can build for each load zone and period:

- Electrolyzers
- Liquefiers
- Hydrogen tanks
- Fuel cells

In this set up, hydrogen is modeled as a storage technology that can use liquifiers and fuel cells in each load zone. We will consider modeling a demand for hydrogen production (cross-sectoral), for example from transportation.

Status: We will start this study in June 2022.

How we are doing compared to our plan

We have made great progress, but we still have a long way to go.

Significant problems or changes

Invoicing is still behind. We have now completed the invoice through September 2021 and have begun work on an invoice through December 2021.

What we expect to accomplish during the next period

1. We will complete final version of the Deliverable for Task 4.2
2. We will continue to meet with stakeholders and community representatives to gather inputs and request feedback
3. We will extend the implementation of the variable time steps to the PSP scenario.

4. We will continue the SWITCH studies #1, #3 and #4 and will begin reporting more consistently on their status.
5. We will prepare the deliverable for Task 3.4.

Status of Milestones and Products.

Task #	Task	Deliverable	Due date	Status
1.2	Kick-off meeting	Updated budget	9/18/2020	Complete
1.3	CPR Meeting #1	CPR Meeting #1	TBD	
	CPR Meeting #2	CPR Meeting #2	1/21/22	Complete
1.4	Final meeting	Final Meeting	11/11/22	
		Schedule for closeout	11/18/22	
		Draft and Final Written Products	11/18/22	
1.5	Progress Reports & Invoices	Progress Reports	Monthly	Ongoing
		Invoices	Monthly	Ongoing
1.6	Final Report	Draft Outline	6/30/22	
		Final Outline	TBD	
		Draft Report	8/30/22	
		Final Report	10/31/22	
		Written Responses to Comments on Draft Report	9/15/22	
1.7	Match funds	Status letter	9/9/20	Revision submitted
1.9	Subcontracts	Final subcontracts	TBD	Completed
1.10	TAC	List of potential members	9/9/20	Completed
		List of TAC members	TBD	Completed
		Documentation of TAC member commitment	TBD	Completed
1.11	TAC Meetings	Draft TAC meeting schedule	10/1/20	Completed
		TAC meeting 1	11/4/20	Completed
		TAC meeting 2	8/5/21	Completed
		TAC meeting 3	2/3/22	
		TAC meeting 4	11/2/22	
		Note, each meeting need multiple actions		
		Final TAC meeting schedule	TBD	Completed

		Draft TAC meeting agenda	TBD	First one completed
		Backup materials	TBD	First one completed
		Final TAC Meeting agenda	TBD	First one completed
		TAC meeting summaries	TBD	First one completed
2.1	Data assembly	Draft baseline description	2/4/21	Completed
		Final baseline description	2/25/21	Completed
2.2	Confirmation of baseline data and approach	Draft modeling approach description	2/4/21	Completed
		Final modeling approach description	2/25/21	Completed
2.3	Implementation of baseline data into models to create initial baseline scenario	Summary of baseline model results	3/23/21	Completed
		CPR Report #1	15 days prior	Completed
3.1	Evaluate and document future energy storage technology alternatives	Draft storage Technology summary	7/2/21	Completed
		Final storage technology summary	8/12/22	
3.2	Define representative future energy storage technology alternatives	Draft proposed storage scenarios summary	4/1/22	Would like to change to 6/1/22
		Final	8/12/22	
3.3	Evaluate and document future energy electricity generation technology alternatives	Draft electricity generation technology summary	8/2/21	Completed
		Final	8/12/22	
3.4	Define representative future electricity generation technology alternatives	Draft proposed electricity generation scenarios summary	4/1/22	
		Final	8/12/22	
4.1	Multi-day model optimization	Summary of multi-day baseline model results	9/2/21	Completed
		CPR #2	Summer	
4.2	Grid scenario selection	Draft grid scenario summary	2/8/22	Completed
		Final	3/7/22	In progress

5.1	Preliminary Scenario Analysis	Draft preliminary analysis summary	4/4/22	Would like to change to 5/4/22
		Final	5/16/22	
5.2	Final scenario analysis	Draft final analysis summary	6/10/22	
		Final	8/12/22	
6.1	Initial public meetings	Opening workshop presentation materials	11/17/20	Completed
		Northern CA workshop	12/3/20	Completed
		Southern CA workshop	12/3/20	Completed
		Opening workshop summary	1/8/21	Completed
6.2	Public workshop for grid scenario selection	Agenda	11/2/21	Completed
		Presentation materials	11/2/21	Completed
	Public workshop with CEC and TAC to present proposed scenarios		11/16/21	Completed
		Workshop summary	11/23/21 Summarize public comments: 12/17/21	Completed
6.3	Public workshop for preliminary scenario analysis	Agenda	After 5.1 draft	
		Presentation materials	After 5.1 draft	
	Public Workshop with CEC and TAC to present preliminary analysis		After 5.1 draft	
		Workshop summary	After 5.1 draft	
6.4	Public Workshop for Final Scenario Analysis	Agenda	7/1/22	
		Presentation materials	7/1/22	
	Public workshop with CEC and TAC to present final analysis		7/15/22	
		Workshop summary	7/22/22	
7	Evaluation of Project Benefits	Kick-off meeting benefits questionnaire	9/18/20	Completed
		Final meeting benefits questionnaire	10/14/22	

8	Knowledge transfer activities	Draft initial fact sheet	7/23/20	Completed
		Final initial fact sheet	7/30/20	Completed
		Draft final project fact sheet	7/21/22	
		Final project fact sheet	7/28/22	
		Draft knowledge transfer plan	12/31/20	Completed
		Final knowledge transfer plan	2/26/21	Completed
		Draft knowledge transfer report	8/30/22	
		Final knowledge transfer report	10/31/22	