Comments of the California Energy Storage Alliance (CESA) on the CAISO SB 350 Study Framework

Submitted by	Company	Date Submitted
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Introduction:

CESA appreciates the opportunity to comment and review the framework and assumptions of the California Independent System Operator's (CAISO) SB 350 Study. This study is an important step in formulating California's views and decisions regarding greater regionalization. Given the potential implications of this study, parties should work to ensure assumptions, scenarios, and sensitivities sufficiently reflect both industry trends and crucial operating realities of the grid.

In these comments, CESA offers some key messages, and also responds to questions as raised in the comments response template.

CESA's Comments:

CESA's comments focus in large part on the assumptions and portfolio build-outs developed by Energy and Environmental Economics (E3). These 'upstream' inputs to the production simulation and subsequent study assessments will greatly influence the outcomes of the study.

CESA appreciates the challenge E3 faces in its role in the study and understands that many assumptions must be made. In this effort, E3 must balance between using existing credible data sources and using reasoned forward-looking data points or estimates.

CESA does not understand all the details of E3's model and so comments from the perspective that some key considerations may have been understated. To the extent that these considerations already factor into E3's work, then CESA respectfully requests further details and documentation.

1. **E3's assumptions regarding energy storage require updates.**

E3 provides an array of storage options, along with 'mid-range' cost expectations for its RESOLVE model to select from building portfolios, subject to other constraints regarding regionalized control, out-of-state siting limitations, and transmission rate assumptions. CESA offers several comments on this aspect of the study.

First, the lowest projects storage costs should be used instead of the mid-range case, given the steep declines in storage costs already underway and anticipated in storage. Utility RFOs can create intense competition, leading to selection of technologies and suppliers with the lowest available costs. Meanwhile, overstatements of storage costs will inappropriately change the resource mix by RESOLVE and could, among other effects, errantly direct excess build-outs of transmission in pursuit of more diversified renewables. Such transmission costs will likely be substantial.

The sources of the study assumptions about storage costs are not clear to CESA. CESA recommends that the study use the Lazard Report from late 2015 as a basis for its assumptions and for developing forward looking price declines. This Lazard report calculates the unsubsidized low-end Levelized Costs of Lithium Ion Energy Storage as $347/kWh ($486 installed), Flow Batteries at $290/kWh ($372 installed), and Pumped Hydro storage (PHS) as $188/kWh ($244 installed).[1] By comparison, E3's low-end values appear to be materially higher at approximately $590/kwh for lithium-ion and $390/kwh for Flow batteries. The Lazard report also offers different breakdowns of system costs, e.g. capital costs. To further reconcile these costs, the CAISO should direct the purchase of cost data from valid suppliers, e.g. Navigant may have more viable cost-date to use.

The costs of storage should also be changed to reflect longer-contract periods. Specifically, larger "bulk" storage resources like PHS should include a case for a 30-year contract (vs. a more conventional 20-year contract), as such financing structures were explicitly contemplated at the Bulk Storage workshop jointly organized by the California Energy Commission (CEC), the California Public Utilities Commission (CPUC), and the CAISO, and are typically used to amortize the cost of long-lived assets like transmission[2]

Additionally, lower-end storage cost estimates are also reasonable because many storage projects are capable of providing additional services or operating in multiple-use applications. In these configurations, the resources can accrue additional benefits, lowering the net or actual cost of the storage element. The RESOLVE model can reflect this by picking energy storage on

[1] "Lazard's Levelized Costs of Storage Analysis" Version 1.0, November 2015, pg. 20.
[2] *See* materials from "Joint California Energy Commission and California Public Utilities Commission Long-Term Procurement Plan Workshop on Bulk Energy Storage, November 20, 2015, http://www.energy.ca.gov/calendar/index.php?eID=2535

the lower-end of cost-projections. Multiple use-applications may involve distribution service and wholesale service, transmission service or deferral and wholesale service, or customer functions and wholesale service. Additionally, the intra-hour benefits of energy storage may be significant and do not appear to be valued in the RESOLVE model.

Finally, the RESOLVE model should enforce some new bulk or other storage in California, in part to provide local capacity and in part to reflect long-standing California practices of siting much planning capacity inside the state. These resources will play key roles in integrating renewables (such as ramping capability, Ancillary Services, and moderation of peak energy costs), in addition to other benefits such as avoiding new transmission or transmission upgrades, etc. and so could greatly influence model's determination of an optimal portfolio of renewables.

2. Storage durations should be more logically structured when input to RESOLVE.

CESA believes RESOLVE should be able to select from a realistic set of storage projects. To do this, RESOLVE should include storage projects that range from two to twelve hours in duration with the capability to cycle two or more times daily, maybe for less than the full energy output of the longest-duration resources. These ranges of storage duration are much more likely to fit with actual storage installations, and may also keep RESOLVE more realistic in its deployment of storage. Per E3's slides, E3 may be detailing a twelve-hour or even twenty-four hour duration pump-hydro project. Such projects may greatly overstate the costs of storage by 'building' a vastly oversized storage system. Such extremely long-duration projects are likely less applicable to grid needs in the WECC and especially California, particularly if designed to operate in support of the duck-chart's twice-daily peaks unless they are needed to address weekend over-generation issues, in which cases those assumptions should be made explicit..

CESA believes 2, 4, 6, 8, and 12-hour duration storage projects should be included as options in RESOLVE. These durations reflect projects input based on an array of factors, such as the 2-hour minimum requirement for SGIP storage projects, the four-hour Resource Adequacy (RA) requirements, and six and eight-hour durations possible for many technologies. To assess sensitivities, the study could also potentially include storage with durations as low as 30-minutes which could presumably supply Regulation only.

3. Sub-hourly modelling is essential to fully understand the system operating challenges.

It is well known that there can be significant changes in the system conditions when adjusting from day-ahead forecasts to hour-ahead forecasts to real-time actual conditions. The CAISO's actual operation of the market and dispatch of resources adjusts off of the decisions made in the day-ahead and hour-ahead plans in directing real-time operations. Modelling provided in the CPUC's LTPP proceeding demonstrated that the impacts of forecast uncertainty, especially as it relates to non-dispatchable renewable resources, can be very significant. Serious reliability problems can result if these conditions are not properly accounted for with appropriate

amounts of highly flexible resources. As a minimum, some of the scenarios being evaluated should be tested with a sequential simulation analysis that most closely represents how the CAISO actually operates the electric grid. Relying solely on hourly simulations will leave potentially critical issues unexposed and lead to misinformed decisions.

4. **E3's should also model storage as a transmission service with socialized costs to determine when deployment of storage as transmission better supports renewable integration and a less expensive portfolio.**

In a case where storage serves as transmission, the storage resource may be shown through the CAISO Transmission Planning Process (TPP) to provide overall economic benefits, qualifying as an "economic" project in TPP. This could occur by reducing curtailments, (including those required for contingency and maintenance planning), and providing voltage support, blackstart, or other non-market services. The costs for storage in this case would be socialized. Since E3 committed to model transmission solutions in Scenario 3, CESA believes a large storage-as-transmission project should be looked at.

5. **WECC wide societal benefits should be separated to provide visibility into beneficiaries, including California ratepayers versus other ratepayers.**

With a complicated grid, potential benefits may accrue to different grid users in unpredictable ways. Given the directives of this study, efforts should be made to determine which benefits flow to which grid users, especially in light of the CAISO's recent "TAC Options Issue Paper," which could allocate the cost of new transmission approved under a west-wide construct to different sub-regions based on the relative benefits to those sub-regions. Production-cost simulations typically show total system changes for costs, but the distribution of these costs or cost-savings are not necessarily equally distributed nor equivalent to end-user costs. Moreover, contractual costs, potentially outside of the production cost simulation can still flow to end-users. Assumptions that all resources are sufficiently compensated to stay in operation also likely indicate a need for out of market capacity costs. To the extent practicable, indications of cost implications and distribution would benefit the study.

The study methodology does not appear to consider energy storage grid benefits such as distribution infrastructure avoidance/deferral. Nor does it consider the customer reliability benefits that could accrue from on-site energy storage. While CESA understands that these benefits may not fit into the modeling methodology, it is important to recognize two points. The first is that these additional benefits for storage differentiate storage from other overgeneration solutions like export and curtailment. The second is that the effective costs of energy storage in a grid-wide context will be lower if these additional benefits partly offset the cost of the energy storage resources.

6. **RPS Statute, CPUC perspectives, and other realistic considerations should limit, or at least inform, the modeling of large out-of-state build-outs of renewables.**

Generally, California's RA program ensures sufficient physical resources exist to support grid operations for Californians. This philosophy has historical underpinnings and presumably will continue in some form into the future. The modeling should reflect this. Scenarios that potentially and unreasonably consider vast out-of-state builds, including build-outs for integration solutions, should be avoided. To illustrate how this RA practice may require in-state capacity, consider the contracting for Flex RA resources. The CAISO studies the 'need', and then the CPUC typically adopts those needed levels as RA procurement targets. This RA target is thus met with contracting for mostly physical resources. RA rules generally limit the amount of generic, non-specified resources that can be 'counted' as Flex RA, indicating in-state solutions are likely needed. Moreover, the analysis should consider the need for siting new resources to address local capacity reliability needs, and the potential use of storage to meet those needs and reduce the potentially considerable curtailments indicated in the CAISO's latest 50% RPS studies. Such actions will provide economic and jobs benefits to California that should be reflected in the study.

Statutory requirements for RPS should also direct considerations of out-of-state resource build-outs. While E3 likely contemplated this matter via interpretations of the RPS "buckets", CESA recommends a somewhat conservative approach be used.

Finally, if not already addressed, competition for out-of-state renewable sites should be considered in assessing costs for out-of-state build-outs. Such competition might reflect effects of the Clean Power Plan, the ITC extension, and other state programs outside of California which could drive renewable build outs disconnected from California's 50% RPS.[3] Relatedly, the potential for increased integration needs by out-of-state areas should inform or limit some of the non-California fleet's ability to provide potential integration services to California.

7. **Sensitivities with transmission costs and with transmission 'friction' should be included.**

Transmission projects can be complicated and costly by the need to permit and pay for right of ways across large distances, potentially with numerous jurisdictional overseers, parties, etc. If not already addressed, E3's work should conservatively represent this challenge with realistic transmission costs estimates and timeframes.

[3] *See* Western State RPS or clean energy related goals at http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/11/Renewable-Portfolio-Standards.pdf

1. Do you think the proposed study framework meets the intent of the studies required by SB350? If no, what additional study areas do you believe need to be included and why?
Comment: *No Comment.*

2. Five separate 50% renewable portfolios are being proposed for 2030 as plausible scenarios for the purpose of assessing the potential benefits of a regional market. Are these portfolios reasonable for that purpose, and if no, why?
Comment: CESA believes more focus on intra-California RPS is needed. The portfolios directed by the RESOLVE model will substantially influence the production simulation results. Unrealistic scenarios may distort the interpretation of the study and could lead to inappropriate actions. To this end, CESA recommends more focus on in-state renewable build-outs, as well as more aggressive assumptions about grid-changes elsewhere.
3. To develop the five renewable portfolios the RESOLVE model makes a number of assumptions resulting in a mix of renewable and integration resources for the scenario analysis (rooftop solar, storage, retirements, out of state resources etc.) Do you think the assumptions associated with developing the renewable portfolios are plausible? If no, why not?
Comment: The RESOLVE model remains difficult to assess. CESA believes numerous assumptions may be inaccurate, though CESA appreciates E3's efforts to include realistic and prudent assumptions. Specifically, the costs for energy storage appear to be inflated. These costs should be lowered at least to the low-end levels expressed in the Lazard Levelized Costs of Energy Storage study. Storage 'options' in RESOLVE should primarily center on 2, 4, 6, 8, and 12 hour energy storage capable of twice-daily cycling. Adding in some levels of 30-minute storage with high cycling capability as well as a requirement for RESOLVE to select some large bulk storage sited inside California also seems appropriate. Please see CESA's above comments for more information.
4. The renewable portfolio analysis assumes certain costs and locations for the various renewable technologies. Do you think the assumptions are reasonable? If no, why not?
Comment: CESA believes these assumptions may not reflect non-California related renewables expansion. Such expansions could both create competition for out of state resources, increasing costs, and reduce the ability to resolve overgeneration challenges in California by exporting the power. Moreover, other states are pursuing the economic benefits of resource development to serve California and have high, low-cost renewables potential themselves; they are unlikely to forego those benefits in favor of absorbing energy exports from California. Please see

CESA's above comments for more information.

5. The renewable portfolio analysis makes assumptions about the availability and quantity of out-of-state renewable energy credits ("RECs") to California. Do you think the assumptions are plausible? If no, why not?

Comment:
These assumptions should link to RPS statute as well as to long-standing preferences for in-state 'bucket #1' resources to be the primary resource for RPS compliance as well as for Resource Adequacy rules, including for Flex RA, to require in-state resources. The policy reasons for favoring in-state RPS development under the "bucket" system will remain in the future and should be considered.

6. The renewable portfolio analysis makes assumptions about the ability to export surplus generation out of California (i.e., net-export assumptions). Do you think these assumptions are reasonable? If no, why not?

Comment:
CESA understands the role of exports in supporting California's grids. A key component of the study should be to show how these exports exist today. Today's levels of exports may reflect likely levels of export capability.
As noted in CESA's comments above, RPS plans in other states' and other drivers for out of state renewables should inform the model. Presumably, such build-outs could occur due to policy drivers, the ITC extension, the Clean Power Plan, or other factors. RESOLVE and subsequent production cost simulations should reflect the potential realities in the grid both in how out-of-state build-outs are contemplated and in how much integration capabilities other Bas may have during certain periods. For instance, under certain scenarios and conditions, it may be unrealistic to overly assume that surrounding areas will have the ability or willingness to absorb large quantities of renewable energy from California; they may in fact expect and desire to develop and export such energy to California, not the other way around. Some development patterns bear this out. For example, some of the Energy Imbalance Market (EIM) benefits to date have accrued to PacifiCorp through increased exports of surplus renewables to California, reducing the need for curtailments in those areas.

7. Does Brattle's approach for analysis of potential impact on California ratepayers omit any category of potential impact that should be included? If so, what else should be included?

Comment:
No Comment.

8. Are the methodology and assumptions to estimate the potential impact on California ratepayers reasonable? If not, please explain.

Comment:
No comment.

9. The regional market benefits will be assessed based assuming a regional market footprint comprised of the U.S. portion of the Western Interconnection. Do you believe this is a reasonable assumption for the purpose of this study? If not, please explain.

Comment:
As CESA understands it, this level of assumption may be excessive at this time. For now, a more prudent look should focus solely on PacifiCorp, as they are the only publically known party pursuing PTO status, with some sensitivities looking at entities that have expressed some interest in joining the CAISO, primarily as PTOs where the Day-Ahead hourly commitment benefits could be captured. Generally, assumptions for a regional market should be done on a BA by BA basis.

10. For the purpose of the production cost simulations, Brattle proposes to use CEC carbon price forecasts for California and TEPPC policy cases to reflect carbon policy implementation in rest of WECC. Is this a reasonable approach? If not, please explain.

Comment:
These assumptions should reflect the price effect of Aliso Canyon's emissions, if applicable.

11. BEAR will be using existing economic data, and generation and transmission data from E3, the CAISO, and Brattle. These data are currently being developed. Are there specific topics that you want to be sure to be addressed regarding these data?

Comment:
As explained above, energy storage cost assumptions should be lower than those currently assumed by E3. Downward cost trajectories for storage should be steep. Storage costs could also be lowered to reflect the potential for storage to provide additional benefits not readily reflected in the model, lowering the net cost of some storage projects. The analysis should also incorporate some restrictions on the use of import/export transmission. Even today, the

CAISO operates with some legacy transmission contracts still intact.
Costs and timing for transmission build-outs should also be conservative. Transmission expansions can be complicated and difficult, with difficult to determine completion times. CESA is concerned that understatements of these costs could lead to inaccurate study results and misdirected portfolios.

12. The economic analysis will focus on the electricity, transportation, and technology sectors to develop the economic estimates of employment, gross state product, personal income, enterprise income, and state tax revenue. These results will be further disaggregated by sector, occupation, and household income decile. Do you think these sectors are the appropriate ones on which to focus the job and economic impact analysis? If no, why?

Comment:
No comment.

13. Under the proposed study framework, both economic and environmental impacts of disadvantaged communities will be studied. Based on the study overview do you think this satisfies the requirements of SB350?

Comment:
No comment.

14. The BEAR model will evaluate direct, indirect, and induced impacts to income and jobs, including those in disadvantaged communities. Do you think additional economic analysis is required? If yes, what additional analysis is needed and why?

Comment:
No comment.

15. The environmental analysis will evaluate impacts to California and the west in five areas – air quality, GHG, land, biological, and water supply. Do you think additional environmental analysis is required? If yes, what additional analysis is needed and why?

Comment:
No comment.

16. The environmental analysis presentation identified a number of potential indicators for the various impacts. Are the indicators sufficient? If no, what additional indicators would you suggest?
Comment: *No comment.*
17. Other
Comment: *No comment.*