BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Develop an Electricity Integrated Resource Planning Framework and to Coordinate and Refine Long-Term Procurement Planning Requirements.	Rulemaking 16-02-007 (Filed February 11, 2016)

COMMENTS OF THE CALIFORNIA ENERGY STORAGE ALLIANCE ON THE ADMINISTRATIVE LAW JUDGE'S RULING SEEKING COMMENT ON STAFF PROPOSAL ON THE PROCESS FOR INTEGRATED RESOURCE PLANNING

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In accordance with the Rules and Procedure of the California Public Utilities Commission ("Commission"), the California Energy Storage Alliance ("CESA")[1] hereby submits these comments on the *Administrative Law Judge's Ruling Seeking Comment on Staff Proposal on Process for the Integrated Resource Planning*, issued by Administrative Law Judge Julie A. Fitch on May 16, 2017 ("Ruling").

I. INTRODUCTION.

The Integrated Resource Planning ("IRP") process represents a new frontier of grid planning for California. Previously, the Commission conducted modeling analysis to identify grid reliability needs in the Long-Term Procurement Planning ("LTPP") proceedings. Now, with

[1] 8minutenergy Renewables, Adara Power, Advanced Microgrid Solutions, AES Energy Storage, AltaGas Services, Amber Kinetics, American Honda Motor Company, Inc., Bright Energy Storage Technologies, BrightSource Energy, Brookfield, Consolidated Edison Development, Inc., Customized Energy Solutions, Demand Energy, Doosan GridTech, Eagle Crest Energy Company, East Penn Manufacturing Company, Ecoult, EDF Renewable Energy, ElectrIQ Power, eMotorWerks, Inc., Energport, Energy Storage Systems Inc., Geli, Green Charge Networks, Greensmith Energy, Gridscape Solutions, Gridtential Energy, Inc., Hitachi Chemical Co., IE Softworks, Innovation Core SEI, Inc. (A Sumitomo Electric Company), Johnson Controls, LG Chem Power, Inc., Lockheed Martin Advanced Energy Storage LLC, LS Power Development, LLC, Magnum CAES, Mercedes-Benz Energy, National Grid, NEC Energy Solutions, Inc., NextEra Energy Resources, NEXTracker, NGK Insulators, Ltd., NICE America Research, NRG Energy, Inc., Ormat Technologies, OutBack Power Technologies, Parker Hannifin Corporation, Qnovo, Recurrent Energy, RES Americas Inc., Sharp Electronics Corporation, SolarCity, Southwest Generation, Sovereign Energy, Stem, STOREME, Inc., Sunrun, Swell Energy, UniEnergy Technologies, Viridity Energy, Wellhead Electric, and Younicos. The views expressed in these Comments are those of CESA, and do not necessarily reflect the views of all of the individual CESA member companies. (http://storagealliance.org).

the release of the Staff Proposal on the Process for Integrated Resource Planning ("Staff Proposal"), the state is now moving away from resource-specific procurement requirements and mandates, and making steps toward grid planning that optimizes around not just grid reliability, but also greenhouse gas ("GHG") emissions, Renewable Portfolio Standard ("RPS") procurement, and a number of other important state policy goals, including but not limited to energy efficiency, transportation electrification, and disadvantaged communities ("DACs"). Unlike IRPs in other states, the IRP in California will also involve multiple state agencies and multiple load-serving entities ("LSEs").

Overall, CESA commends the Commission for spearheading efforts to implement an IRP process while incorporating informal feedback in the months leading up to the Staff Proposal. However, CESA has concerns about the complexity of the process, modeling tools, and the number of different modeling results that will ultimately make it a very contentious proceeding and very difficult to determine the "optimal" path forward in terms of resource procurement. In these comments, CESA offers its views and recommendations on the overall IRP process, the RESOLVE model, and key sensitivities and costs for energy storage and electric vehicle ("EV") charging.

II. GUIDING PRINCIPLES.

Question 1: Are the guiding principles for IRP articulated in Chapter 1 of the Staff Proposal adequate and appropriate for Commission policy purposes? What changes would you recommend and why?

CESA supports the eight Guiding Principles as outlined in the Staff Proposal. To be fully consistent with P.U. Code Section 454.52(a)(1), however, CESA recommends that the Commission expand the first principle to read: "The structure and design of the IRP process should prioritize minimizing long-term customer costs while meeting the state's other policy goals, *which includes appropriately accounting for the full range of benefits of various supply*

and demand-side resources [emphasis added]." As proposed in the Staff Proposal, the Commission would run the risk of focusing exclusively on identifying resource needs exclusively on a least-cost basis rather than expanding the focus to account for the full range of benefits that resources can provide, which P.U. Code Section 454.52(a)(1) outlines as strengthening the diversity, sustainability, and resilience of the grid, enhancing distribution systems and demand-side energy management, minimizing localized air pollutants, and supporting disadvantaged communities. In many cases, resources that best meet these other policy objectives are not necessarily the lowest cost in the strictest sense. In other words, optimizing procurement for the most reliable and least cost resources may not optimize for the cleanest resources, or for the resources that diversify the resource mix, or support customer choice and disadvantaged communities. When the benefits are fully accounted for and quantified, then CESA believes that the IRP process can appropriately procure for the resources that minimize customer costs. The first principle as currently written may cause higher-cost resources to not be procured in the IRP process because the full range of benefits is not accounted for.

III. OVERALL IRP PROCESS.

Question 3: Comment on the overall IRP process proposed in Chapter 2 of the Staff Proposal, beginning with the California Air Resources Board (CARB) establishing greenhouse gas planning targets for the electricity sector and ending with the Commission procurement and policy implementation. What changes would you recommend and why?

At a high level, CESA supports the IRP process as laid out in the Staff Proposal. CESA believes the approach is reasonable and follows a logical process. However, CESA's concern is in the implementation of this IRP process. There are open questions as to how the Commission will review and aggregate the LSE Plans into a single statewide portfolio while evaluating those

plans for "reasonable consistency" with the Reference System Plan and the state's goals for GHG reductions, grid reliability, and cost effectiveness.[2] Greater clarity is needed on how "reasonably consistent" is defined. Does the aggregated single statewide portfolio need to fall within a certain range in 'closeness' to the Reference System Plan? If the Reference System Plan is intended to serve as an 'anchor' for all resource procurement, then it may be reasonable to set a quantified range for the level of RPS procurement and GHG emissions reduction in which the aggregate of the LSE Plans must fall within.

At the same time, while this approach would work more clearly for procurement authorizations, there may be challenges in quantifying compliance within a certain range if LSE Plans included proposals for new or expanded programs and/or modified tariffs, given the uncertainty in estimating program uptake or changes in resource operations in response to tariff modifications. For example, tariff modifications to incentivize 'shifting' of load from solar overgeneration periods in the mid-day to early evening peak loads may not provide the full intended effects. CESA recommends that these program and tariff impacts be estimated to the best of the Commission's ability while accounting for any actualized shortfalls in subsequent IRP cycles.

IV. 2017 IRP PROCESS.

Question 4: Do you support the Staff Proposal's characterization of the purpose and outcomes of the first round of IRP in 2017-2018? Why or why not?

CESA understands that the 2017-2018 IRP is intended to be a learning exercise to establish a formal process for filing and reviewing LSE plans, define the relationship between the IRP and procurement, and align processes across Commission proceedings as well as

[2] Staff Proposal, p. 22.

external processes such as the Integrated Energy Policy Report ("IEPR") at the California Energy Commission ("CEC") and the Transmission Planning Process ("TPP") at the California Independent System Operator ("CAISO"). Following this 'test run' of the IRP, a repeatable structure and framework can then be applied to future two-year IRP cycles beginning in 2019. CESA agrees that the 2017-2018 IRP should be used as a trial run of the IRP process but also recommends that the Commission make clear that the 2017-2018 IRP validate the use of the RESOLVE model – the capacity expansion model developed by Energy and Environmental Economics ("E3") to produce least-cost portfolios for generation and transmission under different future conditions.

In particular, the 2017-2018 IRP should include a process by which to benchmark the RESOLVE model with other industry-accepted and industry-tested grid planning models. The Staff Proposal may already indirectly achieve this benchmarking by allowing each LSE to use their proprietary modeling tools to toggle Reference System Plan assumptions and scenarios and provide potential alternative needs assessments. However, CESA believes that LSE's modeling efforts may not provide a clear benchmark result since a part of their focus will be on adapting the Reference System Plan assumptions and scenarios to their local distribution grid conditions and configurations. CESA thus recommends that the Commission conduct its own benchmarking analysis using industry-tested grid planning models, such as PLEXOS®, which was previously used in the LTPP proceedings. If the Commission is unable to conduct such a benchmarking analysis due to time and staff constraints, there should be opportunities for non-LSE stakeholders to conduct modeling analysis using Reference System Plan assumptions but with other grid-planning models to validate the RESOLVE model. These non-LSE analyses should be thoroughly considered in the development of the Preferred System Plan.

While there may be understandable reasons for holding off on the public release of the RESOLVE model, CESA is concerned that stakeholders have not had a chance to review and test first-hand the RESOLVE model ahead of the release of the Reference System Plan. The multiple informal webinars have been helpful to hear the overview of how the RESOLVE model works, but stakeholders would benefit from an advanced release to understand how the RESOLVE model will use the various assumptions and scenarios to produce its results.

Additionally, CESA supports the use of the 2017-2018 IRP to identify system-wide opportunities for joint investments of capital-intensive, long-lead-time resources such as bulk storage to achieve SB 350 goals. Given the unique procurement challenges for bulk storage resources, 'forcing in' bulk storage into a candidate plan will provide a more direct evaluation of its value in reducing GHG emissions and enhancing grid flexibility, and more importantly, to support near-term decisions to establish a procurement pathway if value is significant across multiple future conditions. For bulk storage resources, the Staff Proposal proposes to potentially open a new track or proceeding to consider these issues, which CESA fully supports.

V. MODELING IN 2017-2018.

Question 7a: Do you support use of the RESOLVE modeling approach for development of a Reference System Plan in 2017-2018? Why or why not?

CESA supports the use of RESOLVE modeling for the development of the Reference System Plan in 2017-2018. In this critical learning period, CESA also recommends that the Commission conduct parallel modeling using PLEXOS to more thoroughly model operational constraints at a sub-hourly level, considering the RESOLVE model models supply and demand on an hourly basis, with hourly constraints for the Planning Reserve Margin ("PRM"), load, and RPS procurement. CESA believes this 'benchmarking' and 'validation' of the RESOLVE model is critically needed to ensure that real-time flexibility needs are met, especially as flexibility

needs increase with increased renewables penetration. Without this parallel modeling approach, there is no other means proposed in the Staff Proposal to explicitly validate the RESOLVE model for capturing real-time flexibility needs.

CESA raises this point because Flexible Resource Adequacy ("RA") requirements are not explicitly modeled in RESOLVE. Rather, E3 explains that it establishes 'flexibility reserve requirements', which are developed exogenously through analysis of five-minute variability and hour-ahead forecast error, to serve as a constraint to identify flexibility needs based on system economics – *i.e.*, least-cost combination of curtailment and new investment.[3] Additionally, renewable curtailment is structured as a backstop to provide downward flexibility reserves that can be curtailed on a five-minute basis. However, CESA views this approach to modeling flexibility needs is a critical limitation of the RESOLVE model that does not account for sub-hourly *operational* flexibility needs that can only be captured through power flow analysis integrated with dispatch and unit commitment, such as through PLEXOS.

CESA believes that intra-hour modeling is needed to shift from a focus on reliability assessments to have sufficient capacity to meet peak load, to a broader focus on reliability and economic assessments to address overgeneration and flexibility/ramping needs as well. Typically, real-world ramping needs exceed the modeled hourly average ramping needs, which overlook the variability challenges involved in dealing with known/predictable load or net load changes as well as uncertainty challenges involved in dealing with randomness that is inherently unpredictable yet correlated with the portfolio and load make-up. In models run by Wellhead Electric Company that were admitted into the record in the Commission's LTPP proceeding,[4]

[3] Staff Proposal, p. 37.

[4] *Modeling Submission of Wellhead Electric Company, Inc. in Response to the Administrative Law Judge's Ruling Discontinuing Phase 1A and Setting Forth Issues for Phase 1B,* submitted on May 8, 2015, R-13-12-010.

significantly higher levels of overgeneration were identified in intra-hour periods under the 33% RPS scenario by 2019, a time-based granularity often overlooked in hourly modeling simulations. As compared to its hourly simulation using the same RPS and load shape assumptions, the five-minute simulation showed a 37% increase in gigawatt-hours of overgeneration and a 125% increase in the number of hours of overgeneration. Wellhead conducted an additional 5-minute interval analysis of a 37% RPS by 2019 scenario that showed overgeneration in as much as 18% of the hours in a single month.[5] This analysis not only points to the need to conduct more granular sub-hourly analyses to replicate the CAISO's real-time operations, but also highlights how the reliability and policy issues related to overgeneration and curtailment will likely occur even before 2019, generally near the 33% RPS goal.

The intra-hour assessments will therefore incorporate the operational needs of the grid as part of the grid planning process. The 'needs' of the RA portfolio – i.e., the need for greater flexible RA capacity – will also therefore be factored into the Reference System Plan and the Preferred System Plans prepared by the Commission and load-serving entities ("LSEs"), respectively. As a result, the Commission could much better ensure that the IRPs comports with guiding principles and statutory goals.

VI. GREENHOUSE GAS EMISSIONS SCENARIOS TO BE MODELED.

Question 8a: Are the four GHG emissions levels for the electric sector recommended to be analyzed by staff the appropriate ones? Why or why not?

The Staff Proposal plans to use the higher range of the GHG emissions constraint (62 MMT) as the default assumption for the RESOLVE model runs, while testing moderate (52 $MMTCO_2$/year), large (42 $MMTCO_2$/year), and extra-large (30 $MMTCO_2$/year) GHG emissions

[5] *Comments of the Wellhead Electric Company, Inc. to the California Independent System Operator Corporation's May 8, 2015 Filing*, filed on May 29, 2015, R-13-12-010.

levels in 2030 as the constraints. CESA recommends that the Commission use the large 2030 GHG emissions level (42 $MMTCO_2$/year) as the default constraint for the model, as achieving a 50% RPS would require significantly more GHG emissions reductions than assumed in the Staff Proposal. A Union of Concerned Scientists ("UCS") study in 2015 showed that achieving a 50% RPS target would lead to GHG emissions falling to 41.1 $MMTCO_2$/year. The current default assumption used in the Staff Proposal would not even achieve a 33% RPS, according to UCS, which would lead to GHG emissions dropping to 52.4 $MMTCO_2$/year.[6] Without a more stringent GHG emissions constraint in 2030, CESA believes that the 2017-2018 IRP will be less informative and may lead to the conclusion that no action is currently necessary to meet California's GHG emissions reduction and RPS goals. While the 50% RPS by 2030 is imbedded in the model as a constraint, as CESA understands it, the default GHG emissions level constraint will be needed to establish the GHG Planning Price to be used to inform the LSE Plan and associated LSE-specific modeling efforts.

Question 8b: What alternative targets do you recommend and why?

CESA recommends that the Commission use the large 2030 GHG emissions level (42 $MMTCO_2$/year) as the default constraint for the model. The extra-large GHG emissions reduction constraint can then be used as the other sensitivity, which would decrease the modeling runs necessary and simplify the analysis of the model results. CESA finds no need to model the less stringent GHG emissions level constraints as they do not align with the RPS goals and would lead to 'no action needed' conclusions.

[6] James H. Nelson and Laura M. Wisland. *Achieving 50 Percent Renewable Electricity in California: The Role of Non-Fossil Flexibility in a Cleaner Electricity Grid*, August 2015, p. 17.

VII. MODELING ASSUMPTIONS.

Question 9: Do you have any specific changes to recommend to the modeling assumptions detailed in Chapter 4 and Appendix B of the Staff Proposal and the associated spreadsheet Scenario Tool? What are they and why? Indicate a publicly-available source of your recommended assumptions?

As a default assumption, the Staff Proposal plans to exogenously model 470 MW of energy storage, which is the estimated amount of energy storage already procured, and identify any additional energy storage resource needs on a least-cost basis.[7] CESA finds this default assumption does not align with the statutory requirement to have California's three investor-owned utilities ("IOUs") procure at least 1,325 MW of energy storage resources by 2020, in addition to requiring California's Community Choice Aggregators ("CCAs") and Energy Service Providers ("ESPs") procure at least 1% of their 2020 load of energy storage resources.[8] Estimates for energy storage procurement by the CCAs can be derived from their resource procurement planning documents. For example, Marin Clean Energy ("MCE") estimates that it will likely need 6 MW of energy storage installed by 2024.[9] Meanwhile, for Sonoma Clean Power ("SCP"), almost 4 MW of energy storage may need to be installed by 2024 with projected

[7] Staff Proposal, p. 40.

[8] Assembly Bill 2514, Section 2836(a)(1): "2836. (a) (1) On or before March 1, 2012, the commission shall open a proceeding to determine appropriate targets, if any, for each load-serving entity to procure viable and cost-effective energy storage systems to be achieved by December 31, 2015, and December 31, 2020."

D.13-10-040, p. 2: "This decision establishes a target of 1,325 megawatts (MW) of energy storage to be procured by Pacific Gas and Electric Company, Southern California Edison Company and San Diego Gas & Electric Company by 2020, with installations required no later than the end of 2024 … This decision further establishes a target for community choice aggregators and electric service providers to procure energy storage equal to 1 percent of their annual 2020 peak load by 2020 with installation no later than 2024, consistent with the requirements for the utilities."

[9] MCE 2017 Integrated Resource Plan, February 2017, p. 19. https://www.mcecleanenergy.org/wp-content/uploads/2017/02/MCE-2017-Integrated-Resource-Plan.pdf

retail demand of 391 MW by 2020.[10] These requirements and associated procurements as established by Assembly Bill ("AB") 2514 and D.13-10-040 must be met and should be exogenously included in the default assumptions.

In addition to the procurement amounts required under D.13-10-040, the default assumptions should also include an estimate of the deployments tied to the Self-Generation Incentive Program ("SGIP"), which will make $448 million in incentives eligible for behind-the-meter energy storage systems. By one industry estimate, the state's behind-the-meter energy storage market is expected to grow by a cumulative 623 MW to 1,242 MW of deployed capacity by 2020. These deployment projections depend on a number of factors, such as the rate of market uptake, the duration of the energy storage systems, and the portion of projects that are paired with solar and take advantage of the Federal Investment Tax Credit ("ITC").[11] These funds are already allocated and available to behind-the-meter energy storage systems and therefore should be considered exogenous in the RESOLVE model runs.

Furthermore, the Commission may also wish to consider higher default assumptions for energy storage given the 500 MW of programs and investments for energy storage systems as authorized under AB 2868.[12] Each of the IOUs are directed to file applications for up to 166.66 MW of energy storage programs and investments with priority towards public-sector and low-income customers. While this is strictly an authorization rather than a requirement, it may be helpful to include considering the disadvantaged community goals of the IRP.

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[10] Sonoma Clean Power Community Choice Aggregation Implementation Plan and Statement of Intent, January 2015, p. 25. https://sonomacleanpower.org/wp-content/uploads/2015/01/2015-SCP-Implementation-Plan.pdf

[11] Utility Dive and Strategen Consulting. *Customer-Sited Energy Storage in California: A Practical Guide to $448 Million of Incentives*, pp. 1-2. http://www.utilitydive.com/library/sgip/

[12] AB 2868, Section 2838(b) and Section 2838(c): https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2868

After accounting for D.13-10-040 requirements, SGIP deployments, and AB 2868 requirements for energy storage systems in the default assumptions, the RESOLVE model should optimize for least-cost additions of incremental energy storage needs. E3 notes that RESOLVE has additional options for planned energy storage resources to include "1,325 MW by 2020" and "1,325 MW by 2020 + 500 MW",[13] yet the Staff Proposal uses the "No Mandate" scenario setting as its default assumption, which CESA finds unreasonable given the current regulatory requirements and available programs. CESA thus recommends use of the "1,325 MW by 2020 + 500 MW" as the default baseline assumption for energy storage in RESOLVE.

Additionally, CESA finds it unreasonable how the Staff Proposal notes that the quantity of short-duration storage in the adopted portfolio may differ from what regulated LSEs are currently required and/or authorized to procure, which will serve as the basis for recommending a lowering or raising of the target.[14] CESA believes that this should not be allowed and that targets should only be raised up since the state is statutorily required to comply with AB 2514, which should be forced into the model given how it is mandated.

For the long-duration bulk storage scenario, the Staff Proposal proposes to model 1,000 MW of new pumped storage by 2022 as a 'forced in' resource in RESOLVE. However, CESA believes that the Commission and E3 should consider modeling this candidate plan to more accurately reflect a likely future scenario based on potential projects in the pipeline. These potential projects currently in development include:

- Eagle Crest Energy's 1,300-MW Eagle Mountain Project near Desert Center, California
- Brookfield Renewable's 280-MW Mulqueeney Ranch Pumped Storage Project near the City of Tracy, California

[13] E3. *RESOLVE Documentation: CPUC 2017 IRP Inputs & Assumptions (Draft)*, May 2017, p. 26.
[14] Staff Proposal, p. 13.

- National Grid's 393-MW Swan Lake North Pumped Storage Project near Klamath Falls in Oregon
- Magnum's 160-MW Magnum CAES Project near the Delta, Utah

Many of these projects have already received most or all of their required major permits and approvals and have the existing transmission capacity to meet California's identified grid needs. As CESA notes below, these projects just need a procurement pathway once its benefits are quantified in the RESOLVE modeling. Given the ongoing development of these projects and the potential for these projects to utilize existing transmission capacity to meet grid needs, CESA recommends that the Commission adjust this scenario to model between 1,300 MW and 2,100 MW of bulk long-duration energy storage. In doing so, this scenario result will be more meaningful and will inform the development and potential procurement of these projects.

VIII. MODELING OUTPUTS AND METRICS.

Question 10: Are the modeling outputs and metrics in Chapter 4 of the Staff Proposal reasonable? What changes would you suggest and why? Be as specific as possible about how to quantify your recommended metrics.

CESA finds these modeling outputs and metrics to be reasonable. One area of concern for CESA is in how RESOLVE evaluates the decision to build or not build energy storage, which is done independently of renewable generation. E3 notes that candidate energy storage resources are attributed capacity value commensurate with their ability to sustain capacity output across duration of four hours and is attributed to the energy storage resource, not to the renewable generation co-located with it – *i.e.*, it does not impact the Effective Load Carrying Capacity ("ELCC") of solar and wind resources. CESA believes that this is a lost opportunity in the IRP process as there are significant opportunities to firm renewable capacity through co-location as well as potential for retrofitting existing renewable resources. In addition, there are opportunities for energy storage to be retrofitted to existing peaker plants that serve to reduce GHGs and

reduce its operating costs. A new gas turbine peaker system combined with a battery storage system has been estimated to reduce GHG emissions by 60%.[15] It also sets up the plant to eventually be fully 'repowered' with energy storage, leveraging the existing interconnection capacity and thereby reducing development costs, as the Commission moves toward a cleaner future.

IX. SENSITIVITIES.

Question 11: Are the sensitivities defined in Chapter 4 of the Staff Proposal reasonable? What changes would you suggest and why?

The Staff Proposal proposes to include sensitivities for high and low future energy storage costs and zero-emission vehicle charging that responds to grid conditions ("ZEV Flex"). CESA finds these sensitivities of the Staff Proposal to be reasonable, although CESA offers recommendations to adjust the sensitivity for low energy storage costs.

X. FUTURES.

Question 12: Are the alternative futures proposed to be modeled in Chapter 4 of the Staff Proposal the appropriate ones? What changes would you suggest and why?

CESA supports identifying and modeling "futures" that bookend various outcomes around reliability and GHGs. In particular, CESA supports the use of a "Flex Challenged" future to be an important future given the limitations of the RESOLVE model to measure intra-hour operational flexibility. This future includes high load, low solar photovoltaic ("PV") costs, high energy storage costs, and early retirement of fossil generators (retiring after 25 years instead of 40 years). Given that energy storage is a potential flexibility option, CESA does not believe that the Flex Challenged future should include high energy storage cost assumptions, eliminating

[15] Inside Edison, "SCE Unveils World's First Low-Emission Hybrid Battery Storage, Gas Turbine Peaker System." April 18, 2017. http://insideedison.com/stories/sce-unveils-worlds-first-low-emission-hybrid-battery-storage-gas-turbine-peaker-system

energy storage as a potential mitigating resource and forcing the model to select from a number of alternative flexibility options. CESA notes that many of the increasing flexibility challenges facing California's grid stems from the increasing penetrations of solar resources, which create a higher net load ramp,[16] combined with the lack of resources with fast start, fast ramp, and low minimum operating levels.[17] CESA thus finds it unreasonable to virtually eliminate energy storage as a flexibility solution in this scenario by assuming high energy storage costs when energy storage is not the cause of these flexibility challenges. Instead, the Flex Challenged future should take the mid-estimate for energy storage costs.

XI. COSTS.

Question 13: Is the cost analysis summarized in the Staff Proposal appropriate and sufficient for the Commission to assess tradeoffs among alternative futures and choose the appropriate level of GHG emissions reductions in the electric sector by 2030 for which to plan? Explain.

CESA supports the Staff Proposal's use of the Lazard *Cost of Storage Analysis v2.0* to assume the current and future costs of energy storage technologies. The Staff Proposal uses the low, mid, and high range of Lazard's estimates for lithium-ion battery storage for the frequency regulation use case and for flow batteries for the peaker replacement and transmission use cases.[18] CESA supports the use of Lazard's estimates, which are generally industry accepted and robust in terms of the coverage of capital cost by technology and use case. However, CESA recommends that the Commission use the low-end estimates for current and projected costs given that the Lazard report may be already outdated. Other market analysis suggests that costs

[16] *Proposed Decision Adopting Local and Flexible Capacity Obligations for 2018 and Refining the Resource Adequacy Program*, issued on May 25, 2017, p. 9.

[17] *Flexible Resource Adequacy Criteria and Must-Offer Obligation Phase 2: Supplemental Issue Paper*, published on November 8, 2016, p. 6.

[18] E3. *RESOLVE Documentation: CPUC 2017 IRP Inputs & Assumptions (Draft)*, May 2017, pp. 40-42.

may be lower. The International Renewable Energy Agency ("IRENA"), for example, has conducted a more recent cost analysis and identified $350/kWh as the low-end range for lithium-ion battery storage capital costs in terms of energy, which is what will lower than the $491/kWh used as 2018 capital cost assumptions and near the 2030 capital cost assumptions in the Staff Proposal.[19]

CESA also recommends that the capital cost projections for battery storage technologies be more aggressive given new updated market reports projecting faster declines. The Staff Proposal uses a 28% capital cost decline, for example, for the low-end capital cost of energy for lithium-ion batteries (a drop from $491/kWh in 2018 to $352/kWh in 2030). DNV GL conducted an analysis for the World Energy Council that projected a 70% decrease in energy storage costs by 2030.[20] In a similar analysis through 2030, IRENA projected nearly 60% cost declines in vanadium flow batteries and more than 50% cost declines in various lithium-ion battery technologies.[21]

Table 1: CESA's Recommended Energy Storage Capital Costs

Resource	Source	2018	2030	% Change
Li-Ion Battery	Lazard (Low)	$208/kW	$150/kW	27.9%
		$491/kWh	$352/kWh	28.3%
	Lazard (Low) + DNV GL	$208/kW	$63/kW	70%
		$491/kWh	$148/kWh	70%
Flow Battery	Lazard (Low)	$1,710/kW	$1,313/kW	23.2%
		$229/kWh	$176/kWh	23.1%
	Lazard (Low) + IRENA	$1,710/kW	$1,026/kW	60%
		$229/kWh	$137/kWh	60%
Pumped Storage	Lazard	$1,310/kW	$1,310/kW	0%
		$131/kWh	$131/kWh	0%

[19] IRENA Workshop. *Battery Storage Costs and Market Outlook to 2030*. March 15, 2017.

[20] *E-Storage: Shifting from Cost to Value*. World Energy Council report prepared by DNV GL. January 21, 2016. https://www.dnvgl.com/news/report-world-energy-council-forecasts-70-percent-drop-in-energy-storage-costs-by-2030-warns-of-cost-value-misperceptions--54126

[21] IRENA Workshop. *Battery Storage Costs and Market Outlook to 2030*, March 15, 2017.

CESA therefore recommends that the default cost assumptions reflect the low-end range of the Lazard estimates, while testing for cost sensitivities at even lower ranges in accordance with other market reports from IRENA and DNV GL.

XII. RISKS.

Question 14a: Are there any other risks or criteria that should be considered in the portfolio analysis described in the Staff Proposal?

CESA supports the potential risks identified in Table 4.4.[22] CESA adds that 'optionality' should be considered the Commission's analysis of portfolio risk. Specifically, the Commission may wish to pursue 'no regrets' investments that support the grid in emergency grid situations as seen in the Aliso Canyon emergency energy storage procurements, which were made possible by the Commission taking early action to direct energy storage procurements through San Diego Gas and Electric Company's ("SDG&E") 2016 Preferred Resources Local Capacity Requirements ("LCR") Request for Offers ("RFO"). As part of its efforts to comply with LCR needs and AB 2514 targets, SDG&E issued its 2016 Preferred Resources LCR RFO on February 26, 2016, with offers for utility-owned turnkey projects due May 16, 2016. The Commission issued Draft Resolution E-4791 on May 12, 2016 in light of the moratorium on the Aliso Canyon gas storage facility[23] that directed Southern California Edison Company ("SCE") to procure in-front-of-the-meter energy storage in expedited RFO, while simultaneously authorizing SDG&E to also procure energy storage if needed. SDG&E subsequently notified turnkey project bidders in the 2016 Preferred Resources LCR RFO if proposed projects can be expedited to meet a

[22] Staff Proposal, pp. 44-45.

[23] This moratorium affected grid reliability in Southern California since the Aliso Canyon gas storage facility is the sole gas supply resource for 18 fast-ramping natural gas generation facilities (9,800 MW in total) in the LA basin during summer peak periods. Removal of Aliso Canyon from service has created a great concern about reliability during summer 2016, when peak demand for natural gas reaches 3,211 Bcf (a very substantial 61% comes from electric generation facilities).

December 31, 2016 online date, receiving responses from three such bidders. Ultimately, SDG&E was successful in contracting for and installing 37.5 MW (150 MWh) of energy storage that came online by January 31, 2017, representing the fastest deployment of energy storage and even the largest lithium-ion battery facility in the world.[24]

The Aliso Canyon emergency procurement was also a testament to the benefits of early action taken by the Commission. Although the action was not intentional for these situations, progress in making energy storage procurements pursuant to AB 2514 requirements and in compliance with D.13-10-040 allowed energy storage projects from the 2016 Preferred Resources LCR RFO to be re-purposed for an unexpected emergency grid condition. This type of optionality is important to meeting emergency grid needs, which may spring from a gas leak like with the Aliso Canyon facility, significant outages of the transmission and distribution system, and/or errors in forecasts for grid conditions. This type of optionality cannot be readily quantified but can be realized through short-term investments and actions that put certain resources and/or projects on track for procurement, such as with bulk energy storage.

Bulk energy storage projects require a long-lead-time to reach commercial operation, with expected online dates as early as 2022 or 2023 for the projects mentioned in CESA's response to Question 9, above. Short-term actions to explore and potentially pursue procurement pathways for bulk energy storage may have intrinsic optionality value as a backstop flexibility solution if the RESOLVE model is later found to underestimate grid flexibility needs and/or other emergency grid conditions arise. Considering that the Commission still needs to validate RESOLVE, CESA is concerned that there may be a possibility that the model does not adequately capture all grid flexibility needs, especially sub-hourly ramping and flexibility needs.

[24] David Wagman. "Energy Storage Rose from California Crisis." May 8, 2017. http://spectrum.ieee.org/energywise/energy/the-smarter-grid/california-crisis-tests-energy-storage-supply-chain

In addition, there are some concerns related to RESOLVE only modeling 37 representative days to capture supply and demand conditions, which may overlook extreme weather or outage events. Moving to procure explore or procure certain resources as a backstop to grid flexibility needs may reduce the risk to these errors in modeling. This optionality can be provided not only by bulk energy storage resources but a number of other resources as well.

Question 14b: How should the risks associated with not achieving the State goals listed in Table 4.4 of the Staff Proposal be defined and quantified? Propose an appropriate and feasible methodology and explain how the cost of reducing each risk can be quantified.

Many of the risks identified in Table 4.4 of the Staff Proposal can be quantified in RESOLVE or through additional Commission analysis outside of RESOLVE. The one risk that may be difficult to quantify but is still a critical analysis in assessing potential risks is the need for diversity in the portfolio. The Commission correct in stating that there may be potential risks to overdependence on single, large projects or on single technologies, which the Commission plans to assess through a qualitative review for portfolio diversity.

These risks are borne out in different ways. There may be financial risk to overreliance on a single project or technology, if costs for alternative projects or technologies drop faster than predicted, leading to ratepayers miss out on significant value from lower-cost resources to achieve the same grid services while meeting the state's energy and environmental goals. Alternatively, a single project or technology may be susceptible to volatile commodity prices. There may be physical risks if a key input for a single project or technology is unable to access its key inputs due to, for example, a transmission outage or natural gas supply 'outage' (*e.g.*, Aliso Canyon gas storage facility moratorium). There may be procurement risks as well that are in some ways directly tied to financial risk for a single project or technology as resources with shorter timelines enjoy the flexibility of coming online faster but are generally smaller in scale and reduce the cost-curve savings potential from the technology while resources with longer

timelines are larger in scale to meet large magnitude grid needs and have more established low costs but may face challenges in meeting different or changing grid conditions.

All of these risks are difficult to quantify and it may be prudent for the Commission to just conduct a qualitative review. In some ways, this type of risk analysis for portfolio diversity may already be done by the RESOLVE model runs for various sensitivities. Some of the procurement risks of long-lead-time resources are assessed through the three candidate plans, while the financial risks are evaluated through the sensitivities for varying cost assumptions for different types of resources. These sensitivity cases should be closely reviewed in conducting this risk analysis. The Commission may also wish to consider how the various sensitivities may be correlated to identify the likely futures and the risk density of any portfolio. For example, the assumptions for battery storage and EVs are strongly correlated since any capital cost reductions in lithium-ion batteries increase the cost-effectiveness of grid-scale energy storage and increase the deployment of EVs, which may affect the corresponding assumptions in the RESOLVE model. In many ways, this may also increase the potential for ZEV charging flexibility and demand response ("DR") potential for 'shift' services.[25]

XIII. DISADVANTAGED COMMUNITIES DEFINITION.

Question 15a: Is it appropriate to use communities scoring at or above the 75th percentiles in the California Environmental Protection Agency's CalEnviroScreen 3.0 Tool as the definition of "disadvantaged" for IRP analysis purposes? Why or why not?

The CalEnviroScreen definition may be appropriate as it combines pollution burdens, socioeconomic factors, and other population characteristics of different communities. However, perhaps due to the weighting of these various factors, the CalEnviroScreen definition of DACs

[25] Lawrence Berkeley National Laboratory. *Final Report on Phase 2 Results: 2025 California Demand Response Potential Study*. March 1, 2017, p. 7-13.

does not always coincide with communities that have low household incomes. For example, the CalEnviroScreen may overlook certain rural communities. According to one analysis, only about 20% of the affordable multi-family properties in California as defined by Section 2852 eligibility requirements are located in DACs identified by the CalEnviroScreen.[26] While there is a strong correlation between communities with low income and with being located in these disproportionately environmentally affected areas,[27] it is important to have low-income communities explicitly covered in this definition of DACs. CESA therefore recommends that the definition of "disadvantaged communities" include low-income communities, such as by using the percentage of the Area Median Income as an additional criterion as done in Single-Family Affordable Solar Housing ("SASH") Program and the Multifamily Affordable Solar Housing ("MASH") Program. Similarly, and to avoid unintended outcomes, the Commission needs to be sure IRP implementation does not result in communities which are not "low-income" being included simply because they are a subpart of a broader area identified by the CalEnviroScreen as a DAC. Generally, CESA recommends the use of similar definitions across proceedings.

CESA also notes that the CalEnviroScreen 3.0 has been released (and not yet adopted) and has not been widely implemented in other Commission proceedings. In conducting analysis with the CalEnviroScreen 3.0 for a different proceeding, CESA found a decent number of census tracts were marked as "NA" to indicate the lack of complete data to generate a composite index

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[26] *Joint Proposal by the California Housing Partnership, California Environmental Justice Alliance, Brightline Defense Project, Natural Resources Defense Council, and National Housing Law Project (Nonprofit Solar Stakeholders Coalition) on Implementation of Assembly Bill 693*, submitted on August 3, 2016 in R.14-07-002, pp. 18-19.

[27] Elena M. Krieger, Joan A. Casey, and Seth B.C. Shonkoff. *A framework for siting and dispatch of emerging energy resources to realize environmental and health benefits: Case study on peaker power plant displacement*. Energy Policy, May 27, 2016. http://www.sciencedirect.com/science/article/pii/S0301421516302798

score, indicating a major data limitation for using the CalEnviroScreen for the IRPs. These issues raise implementation concerns for the CalEnviroScreen.

XIV. DEMAND-SIDE RESOURCES.

Question 16a: Is the treatment of these resources in the staff's recommended approach reasonable? What changes would you suggest and why?

CESA finds the Staff Proposal's general approach to eventually represent the location-specific costs and benefits of demand-side resources to be reasonable. The Staff Proposal notes the ongoing work the Distributed Resources Plan ("DRP") and Integrated Distributed Energy Resources ("IDER") proceedings, which will be valuable inputs to future model runs.

Question 16b: What additional information, other than modeling, might materially affect these resources? Provide specific sources of publicly available information, what question(s) the additional information would help address, and why you think the information should be used.

How demand-side resources can function not only as load but also as supply-side resources should be considered by the Commission in analyzing the RESOLVE model results. This may already be covered by the default assumptions for advanced demand response or in providing capacity, but the modeling results may create a bias toward relying more on supply-side resources to provide needed capacity or other grid services. CESA notes that behind-the-meter energy storage systems are currently providing supply-side demand response through the Demand Response Auction Mechanism and through participation in the Proxy Demand Response model at the California Independent System Operator ("CAISO").

XV. SHORT-TERM INVESTMENTS, ACTIONS, OR PROCUREMENT.

Question 18: Has staff identified the correct areas for analysis to determine the need for short-term investment or procurement activities, including: bulk storage, out of state wind, and geothermal resources? What changes or additions would you recommend and why?

CESA supports the authorization of short-term procurement if reliability needs over the next one to three years are identified. CESA also supports the Commission's potential consideration of a new track or proceeding to explore any capital-intensive, long-lead-time resources (*e.g.*, out-of-state wind, large-scale pumped storage) that the IRP analysis may indicate is likely to be beneficial. However, in conducting this analysis for long-lead-time resources, CESA recommends that the Commission expand the window of the analysis to beyond 2038, the proposed 20-year look-ahead window, and to explore even longer-term 30- or 40-year analysis since bulk energy storage resources are long-lived, reliable assets with more than 60-year lifespans. For bulk energy storage projects in particular, benefits may persist beyond typical contract terms for smaller resources, which puts bulk storage projects at a disadvantage compared to shorter-lived assets when it comes to cost recovery over a shorter contract term. Therefore, it may be beneficial for the Commission to consider modeling that extends to potential 2050 RPS and GHG reduction goals.

CESA also recommends that the Commission discuss what the 'thresholds' or 'indicators' are for opening a new track or proceeding to explore any capital-intensive, long-lead-time resources. In setting these thresholds and indicators from the outset, it will be clearer what the Commission is looking for and may better guide modeling efforts.

Furthermore, while CESA does not oppose the modeling of out-of-state wind resources from Wyoming and New Mexico, the Commission should also consider the potential risks of assuming the development of these out-of-state resources or of the new transmission investments needed. Unlike bulk energy storage resources, which are currently being developed in California or being developed outside of California while leveraging existing transmission capacity, out-of-state wind resource development is outside the purview of in-state resource procurement and

control. For example, transmission investments would require coordination with other state agencies.

When or if a new track or proceeding is opened, there are several key electricity market and regulatory issues related to the procurement and cost recovery of long-lead-time resources. The challenge for long-lead-time resources such as bulk storage is in the cost allocation of these projects given the system-wide benefits of these resources to multiple LSEs. Currently, there is no adequate multi-LSE procurement mechanism. Second, long-lead-time resources and cost allocation between multiple LSEs requires evaluation in this proceeding. Bulk storage resources, for example, provide significant benefits to the grid in the form of reduced curtailment, emissions, and production costs, especially in a solar-dominant renewables portfolio.[28] However, bulk storage face barriers to procurement such as extensive licensing requirements, geotechnical and engineering studies, and cost allocation of new transmission lines.[29] These challenges are not unique to bulk storage and are similar to general development issues affecting utility-scale development.

XVI. TRANSPORTATION ELECTRIFICATION.

Question 19a: Do you support the Staff Proposal's approach to characterizing transportation electrification and the uncertainties and impacts associated with it? Explain.

CESA supports the Staff Proposal's approach to characterizing transportation electrification but believes that the default assumption to have no flexible EV charging from 2018-2030 does not accurately reflect likely base case scenarios for California given the

[28] Shucheng Liu. "A Bulk Energy Storage Resource Case Study with 40% RPS in 2024," presented at the 2015-2016 Transmission Planning Process Stakeholder Meeting on February 18, 2016.

[29] Collin Doughty, et al. "Bulk Energy Storage in California," California Energy Commission Staff Paper, published in July 2016, pp. 18-19. http://www.energy.ca.gov/2016publications/CEC-200-2016-006/CEC-200-2016-006.pdf

proposed rate designs in California's General Rate Case proceedings and Transportation Electrification applications. CESA thus recommends that the default assumption for flexible EV charging be the mid scenario setting, which sets the fraction of flexible EV charging at 4% in 2018 to 20% in 2030.

XVII. REFERENCE SYSTEM PLAN DEVELOPMENT.

Question 20a: What methodology should staff use to develop a recommendation for the portfolio to include in the Reference System Plan?

CESA supports the Staff Proposal's methodology for developing a recommendation for the portfolio to include in the Reference System Plan. If CESA's recommended revisions to the default assumptions, sensitivities, and futures are adopted, CESA believes that the Commission will be better positioned to address the three questions outlined in the Staff Proposal, which will lead to the development of a Reference System Plan that more accurately reflects grid conditions and ensures progress toward the state's policy goals.

Question 20b: If you recommend a scorecard-style approach, what weight should be given to each state goal in Table 4.4 of the Staff Proposal?

CESA does not recommend a scorecard-style approach, as it would raise significant disagreement over the weights of each state goal. Flexibility should be maintained to address each of the state goals.

XVIII. RELATIONSHIP BETWEEN IRPS AND PROCUREMENT.

Question 30a: Describe your reaction to the Staff Proposal's characterization of how IRP development and approval will lead to actual resource procurement in the next few years.

CESA supports the two proposed procurement checkpoints in the Staff Proposal that occur when the Reference System Plan is released and when the Preferred System Plan replaces the Reference System Plan. In particular, as long as current regulatory requirements and programs are accurately represented, CESA supports the use of the IRP analysis to adjust

resource-specific targets, such as those for energy storage resources. Such resource-specific target setting may be appropriate when the targets are intended to support market transformation and drive continued learning and experience with procurement and contracting for these resources, as it was done for the RPS.

Question 30d: How should the Commission ensure that LSEs comply with their approved IRPs? Describe your preferred approach in detail, with reference to the IRP statutory requirements.

Following the release of the Reference System Plan and Preferred System Plan, the Commission has another opportunity to gather information on resource costs and benefits during the actual procurement activity, which may come in the form of a competitive solicitation or program/tariff modification. CESA understands that the model may not always be precise in terms of resource capital and development costs/processes, and recommends that the Commission maintain some flexibility in allowing LSEs to procure the appropriate amount of resources depending on the market response. As long as the LSE is able to demonstrate reasonableness for under-procuring or over-procuring the quantity of a particular resource type in the IRPs, CESA believes that it is unnecessary to artificially limit procurement in any way. A blend of informational guidance and resource target setting may be appropriate in linking planning and procurement, which ensures minimum procurement of certain resources to meet urgent grid reliability needs and/or make progress toward the state's policy goals while providing flexibility for the LSEs to 'bank' procurement activities to future IRP cycles due to unexpected development/deployment barriers, higher-than-expected resource costs, etc.

XIX. DISADVANTAGED COMMUNITIES IMPACTS IN PROCUREMENT.

Question 32a: Do you support the Staff Proposal's approach to assessment of the impacts of procurement on disadvantaged communities? What changes would you recommend and why?

E3 has indicated that RESOLVE does not have the functionality to incorporate locational information on air quality and DACs. Given the limitations in fully considering DACs and quantifying DAC impacts in the planning and modeling process, CESA recommends that the Commission consider DAC requirements in procurement practices and guidelines, which can more easily guide resource procurements and deployments in DACs and act as a screen for resource procurements and deployments. Once these DAC requirements are met in one cycle of the IRP, these resource procurements and deployments can be incorporated as exogenous variables in subsequent IRP cycles, thereby ensuring that they are incorporated in planning efforts as well.

Question 32b: What specific quantitative and/or qualitative showings should LSEs be required to provide to demonstrate how disadvantaged communities were considered in the development of their IRPs?

One potential approach to ensure procurement in DACs would to establish a "preferred location/customer" to procure or deploy renewables, energy efficiency, energy storage, and EV charging stations in DACs. This would be the inverse of the "preferred resource" approach that the Commission has taken to ensuring that the LTPP met identified grid reliability needs while advancing its RPS goals and adhering to the loading order established by the Commission. In a similar way, the "preferred location/customer" approach seeks to meet identified grid reliability needs by siting resources in DACs to the greatest degree possible first. The Commission has ensured this by establishing preferred resource procurement minimums, and a similar preferred location/customer minimum could be applied on the demand-side as well.

XX. ALIGNMENT OF IRP PROCESS WITH OTHER PROCEEDINGS.

Question 34a: Are there obvious opportunities for alignment across Commission proceedings that the staff should consider in developing a process alignment workplan?

The ongoing resource-specific proceedings should be incorporated in the IRP as exogenous factors and should be updated accordingly as policies, requirements, and procurements change in those proceedings. CESA supports the Staff Proposal in this regard as a clear alignment plan and feedback loops between the IRP and other resource-specific proceedings are outlined. As proposed, however, the vetting of IRP inputs and outputs will be done internally among Commission staff. CESA recommends that stakeholders be allowed to be more involved. For example, this could be done through an IRP Working Group in each resource-specific proceeding to come to a consensus on the inputs and outputs that will be incorporated into the IRP proceeding. This will reduce the concern that many resource-specific or issue-specific stakeholders will not have their input and feedback drowned out among the multitude of perspectives in the IRP proceeding.

Question 34b: What would be the benefits to coordinating proceedings to align based on these opportunities?

CESA believes that the IRP can greatly inform other resource- and issue-specific proceedings. By identifying the need for advanced DR to meet grid needs and state policy objectives, the DR proceeding will have more specific goals set to realize the modeled needs for energy storage by aligning price signals or by developing DR programs that pay for load consumption during the mid-day and provide ramping in the evening. In addition, if the modeling results show significant need for EV flexible charging, the Commission will have guidance to develop grid-integrated rates to incentivize EV charging to follow similar charging patterns.

XXI. REGIONAL PLANNING.

Question 37: How should the IRP process and analysis take into account the potential for CAISO regionalization?

Regionalization is an important factor that will impact IRP processes and analyses. CESA believes that the current approach of modeling out-of-state wind as a candidate plan to be sufficient for the 2017-2018 IRP as long as the benefits and limits of imports of out-of-state renewables, exports of in-state renewable, and cost assumptions for new transmission investments are accurate and reasonable. Risks of out-of-state resources and associated investments must also be accurately accounted for.

XXII. CONCLUSION.

CESA appreciates the opportunity to submit these comments on the Staff Proposal and looks forward to working with the Commission and stakeholders to establish an effective IRP process and ensure informative and actionable modeling results for the Reference System Plan.

Respectfully submitted,

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