CAISO
250 Outcropping Way
Folsom, CA
Attn: Kim Perez

RE: Moorpark Subarea Local Capacity Alternative Analysis Study: Draft Preferred Resource Scenarios Comments

July 5, 2017

Dear CAISO,

The Clean Coalition greatly appreciates the strong efforts of the California Energy Commission and CAISO alike to develop a careful consideration of renewable alternatives to the proposed natural gas peakers in the Moorpark Subarea. We commend all parties involved on their excellent and thoughtful work developing the scenarios and analysis to facilitate a better considered decision and appreciate the opportunity to comment.

The Clean Coalition urges CAISO to develop a fourth alternative using a much larger component of PV solar/storage hybrid projects in the mix to supplant both Puente and Ellwood projects. We anticipate that the advantages of solar/storage hybrid projects would be greater than those of the predominantly storage mix proposed currently. We also anticipate that a failure to include a scenario with high deployment of solar/storage hybrid projects may distort the analysis of the capability of a distributed energy resources (DER) mix to meet local capacity requirements. Such a mix would also appear less cost effective, because stand-alone storage lacks the local renewable generation component and associated energy and Federal Investment Tax Credit contributions that do not apply to stand alone storage facilities.

The 25 MW of solar/storage capacity in the proposed scenarios is unrealistically low, given that many communities around the country are meeting their needs with much larger scale projects, including locally near Oxnard. Since these projects can have dramatically different dispatch characteristics and provide reactive power with advanced inverters, we urge CAISO to develop a case study reflecting the capacity of such projects to meet the energy needs of the Moorpark sub area.

Other load serving entities in Arizona and Hawai'i have demonstrated that such projects are fully capable of meeting all required services that would otherwise be provided by the Puente Power Project. The Moorpark sub area has a vast capacity for employing solar resources in combination with energy storage as well as significant opportunities for cost effective demand response[1] to meet the needs of the area.

We therefore recommend including a fourth scenario with a minimum of 115 MW of solar/storage hybrid and 25 MW of stand-alone storage to compare to the scenario 1 mix (25 MW hybrid, 114MW+ of stand alone storage).

**A. Solar/Storage Hybrid projects at 25MW and larger scales are winning competitive bids as core components of the energy mix.**

Solar/storage hybrid projects can and likely would meet far more than 25MW of subarea capacity. In recent years, solar/storage hybrid projects at larger scales have crossed into cost effectiveness. Since these projects have better dispatch and reactive power characteristics to many alternatives, failure to include them would artificially make the overall characteristics of the DER mix appear less able to meet capacity requirements.

Cost-effective, dispatchable solar plus storage projects are winning competitive bids to provide precisely the kinds of services that Puente Power

[1] Demand Response Potential for California SubLAPs and Local Capacity Planning Areas: An Addendum to the 2025 California Demand Response Potential Study" Lawrence Berkeley National Laboratories (April 2017)

Project would provide in communities such as Tucson, AZ and Kaua'i, HI. Facilities of this kind would avoid or reduce a great many of the potentially significant impacts of the Puente Power Project. Furthermore, the use of solar and storage may be superior for meeting objectives of deploying facilities on brownfield sites. Because ground mounted solar facilities are highly modular, the precise acreages available are not necessary to establish in order to accommodate a single large facility. This also means that construction times are exceptionally short in order to have full deployment by 2021.

Several example projects of a scale that would *by themselves* fill or exceed the 25MW allocation follow.

**1. Kaua'i AES Solar and Storage Project delivers 28MW of resilience and reliability services at 11 cents per kWh.**

Critically, solar plus storage project are now cost competitive with fossil fuel sources around the country. Reliable DER projects of similar scale are quickly coming online to deliver precisely the full suite of services that the Puente Power Project would provide. For example, in January 2017, Kaua'i Island Utility Cooperative and AES Distributed Energy, Inc. announced a power purchase agreement for the delivery of 28 MW solar photovoltaic power and 20 MW of five-hour duration storage at a cost of 11 cents per kWh.[2] This project was developed to displace the current fossil fuel powered system and deliver incremental dispatchable capacity, reliable power and stable rates to ratepayers for a utility that had already seeing up to 100% penetration of distributed PV capacity relative to peak load. This project is expected to be operational within two years of the signing of the PPA. Utilizing advanced inverters, such systems could provide power generation, reactive power, and short circuit duty at a competitive cost, relative to

[2] "KUIC and AES Distributed Energy Announce Plan to Construct Innovative Renewable Peaker Plan on Kaua'I Utilizing a Hubrid Solar and Battery Storage System," *Kaua'I Island Utility Cooperative*, http://kiuc.coopwebbuilder2.com/sites/kiuc/files/PDF/pr/pr2017-0110-AES%20Solar.pdf, 10 Jan 2017.

the adverse impacts of the Puente Power Project or costs of supplemental synchronous inverters. Given the economies of scale that could result from the installation of ten similarly sized projects throughout the Moorpark area and cost trends, the realized costs of such an approach would likely be lower than that achieved on Kaua'i.

**2. Tucson Electric Power delivers 100MW of solar with 120 MWh of storage at $45 per MWh**

NextEra Energy's Tucson Electric Power project presents a compelling example of real world feasibility. As reported, this project delivers on a PPA all in at $45 per MWh. For comparison, the unsubsidized cost appears to be approximately $90 per MWh.[3] This is both fully consistent with Lazard's estimates and in line with the pricing of the Kaua'i project, but at a much larger scale.

**3. Smaller projects at Salt River, AZ and Minster, OH demonstrate competitive feasibility of solar and storage**

Two smaller solar plus storage projects, the Salt River Project in Arizona[4] and the Village of Minster municipal project,[5] also demonstrate the real-world feasibility of such approaches. Although these are 20MW and 3MW/3MWh projects, the fact that both were implemented following a competitive process and are reportedly economically viable strongly suggests that such solutions are viable.

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[3] "How can Tucson Electric get solar + storage for 4.5¢ /kWh?" *Utility Dive* http://www.utilitydive.com/news/how-can-tucson-electric-get-solar-storage-for-45kwh/443715/ 30 May 2017.

[4] "Salt River Project signs PPA for 20 MW solar+storage project" *Utility Dive* http://www.utilitydive.com/news/salt-river-project-signs-ppa-for-20-mw-solarstorage-project/441015/ 24 April 2017.

[5] "Inside the first municipal solar-plus-storage project in the US" *Utility Dive,* http://www.utilitydive.com/news/inside-the-first-municipal-solar-plus-storage-project-in-the-us/421470/ 5 July 2016.

4. **The Valencia Gardens Energy Storage project demonstrates the feasibility in California of solar plus storage microgrid solutions.**

Similarly, the Valencia Gardens Energy Storage (VGES) project in San Francisco will add 750 kW / 750 kWh of energy storage to the roughly 800 kW of rooftop solar that is already interconnected to the distribution grid within the Valencia Gardens Apartments. The VGES project will increase solar hosting capacity of the feeder line segment by at least 50% (i.e., enabling at least 400 kW of additional solar to be interconnected to the local distribution grid) and will demonstrate the economics of utilizing energy storage for provisioning grid services through wholesale markets. Furthermore, the project will include a study of islanding capacity to demonstrate the full set of costs and benefits to providing community microgrid resilience to priority loads within the neighborhood, including those at the Valencia Gardens Apartments and nearby PG&E customers.

## B. Solar and storage alternatives are feasible and cost effective based on levelized cost projections and the federal investment tax credit.

A high solar/storage hybrid alternative would reflect the reality that the cost trajectories of these technologies will make these applications as peaker replacements increasingly competitive as costs decline. Beyond the unsubsidized cost trends, storage associated with solar receives a Federal Investment Tax Credit (ITC) that stand-alone storage is not currently eligible for, rendering solar/storage a potentially more cost-effective solution than the 114MW of storage to be modeled in this study.

Certainly, the unsubsidized, levelized costs of various solar alternatives have been estimated to be a fraction of natural gas peaker costs. According to Lazard's latest Levelized Cost of Energy Analysis, the unsubsidized, levelized cost of a typical large gas peaker (100 to 200MWAC) ranges between $165/MWh to $217/MWh in the United States (Appendix, L2 & L8).[6] Taking into account reasonable fuel cost

[6] Lazard's Levelized Cost of Energy Analysis, v. 10.0 (December 2016).

variations of +/- 25% expands the range on either end by $10/MWh (Appendix, L5). While US domestic natural gas production is forecast to increase slightly, it is important to note that pricing is also trending up:

> "New natural gas export capabilities and growing domestic natural gas consumption contribute to the forecast Henry Hub natural gas spot price rising from an average of $3.17/MMBtu in 2017 to $3.43/MMBtu in 2018."[7]

Furthermore, nearer-term trading data for summer 2017 deliveries indicate as high as a 41% above-average price,[8] which could be very reasonably applied to the high-end LCOE would result in a spot peaker price of ~$306/MWh.

Even if we were to be generous in assuming that the Puente Power Project PPA aligns more with the low end of the gas peaker price range (which is more representative of much large plants), we can see that the fuel cost comprises nearly 22% of the total LCOE (Appendix, L12). Additionally, the gas peaker has a minimum of $6/MWh of fixed O&M plus $5/MWh of variable O&M costs, whereas in comparison against all categories of non-residential solar photovoltaic (PV), the solar PV fixed O&M cost averages only $5.25/MWh, with no variable maintenance costs. On the high side, the total O&M costs for a gas peaker actually surpass the contribution from fuel cost to the price of the gas plant (Appendix, L13). Actual LCOE for the gas facility will be higher if it is operated less frequently and at lower capacity, while GHG and criteria emissions will be proportionately higher if greater use is made of its capacity.

In contrast, the companion analysis of solar levelized costs places the solar component of solar and storage facilities at $50 to $90 per MWh.[9] As noted in the CEC Staff Assessment of the Puente Power Project, rendering such power dispatchable will require a storage component. We note that unlike natural gas

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[7] EIA short-term energy outlook 5/9/17.

[8] EIA short-term energy outlook 5/9/17.

[9] Lazard's Levelized Cost of Energy Analysis, v. 10.0 (December 2016).

peakers, such storage facilities can provide a much broader array of services throughout the year than natural gas peakers alone, such as frequency and voltage regulation. (See discussion of avoiding cost of synchronous condensers below.) Companion estimates place unsubsidized levelized cost comparisons of 400MWh peaker replacement storage in the range of $275 to $400 per MWh[10] before incentives and subsidies. Since these costs are declining on the order of 14% per year and are expected to decline by 40% in the next five years, the commitment to natural gas today has the consequence of locking ratepayers into more expensive energy for decades to come, even though alternatives are likely to be cheaper even without subsidies or support by 2020.

Given that a combined solar and storage facility would not necessarily require the same scale of storage and current price trends, beating a $316 spot price is well within the realm of feasibility. In fact, using the same lens of unsubsidized, levelized cost to the purchasing utility, Lazard's preliminary analysis of such an illustrative offering located in the U.S. Southwest placed the cost of an approximately 200$MW_{AC}$ PV and 110$MW_{AC}$ storage combined plant at $92/MWh, utilizing either crystalline or thin film, with the attendant battery system sized to a 52% capacity factor (equal to usable energy capacity of ~400$MWh_{DC}$) (Appendix, L3). When the effect of the Investment Tax Credit is figured in for the solar technologies, we see a further reduction of $12/MWh (Appendix, L4), pointing to an effective price of $80/MWh. When solar projects are co-located with storage facilities, the ITC applies to both.

Not surprisingly, several installed or in deployment projects are delivering consistent power to displace fossil fuel uses in real world applications at delivered prices of between $45 and $110 per MWh, which is significantly lower than the likely costs of the Puente Power Project.

Even if solar plus storage costs are somewhat higher, this does not render the technology as an infeasible alternative. CEQA does not mandate the adoption of the

[10] Lazard's Levelized Costs of Storage, v. 2.0 (December 2016)

lowest cost alternative, but rather requires consideration and sometimes adoption of alternatives which can avoid potentially significant effects, which can include high than necessary carbon emissions, smog, health impacts from particulate matter and a lack of resiliency.

Finally, the Solar Investment Tax Credit provides a 30% credit for residential, commercial, or utility solar development which can include storage components. However, this credit is unavailable to storage only systems. Thus, a solar/storage project may prove more cost effective. As a result, in the real-world application, a full DER solution to meet the Moorpark capacity needs is likely to involve much more solar/storage hybrid projects and much less stand-alone storage projects.

**C. Solar and storage projects in the Moorpark area have demonstrated strong feasibility of the necessary components in this service area.**

Solar/storage hybrid projects are clearly feasible in this case, particularly in light of the solar and storage projects that have been successful in the Moorpark area. For example, the clear feasibility of solar only projects in the Moorpark area is demonstrated by the recent success of the 1 MW Calle Real Solar Photovoltaic project in Goleta, which has produced 10% more energy over five years than initially projected in 2010.[11] Since then, costs have declined and efficiency has risen. Additionally, the Commission recently approved 15 MW of 4-hour duration energy storage in Santa Paula (part of the Moorpark area) as part of SCE's 2014 energy storage solicitation, precisely representing an example of the scale and capabilities required and available from non-emitting local resources. Furthermore, other on-going solicitations are likely to deliver both generation and storage capacity to meet local capacity and resilience needs. Certainly, the solar generation component of any peaker replacement project is highly cost effective and avoids potentially significant impacts.

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[11] "Santa Barbara County Solar Project Exceeds Projected Output Resulting in initial Savings of $1.2 million," *County of Santa Barbara*, https://www.countyofsb.org/asset.c/2875, 2 May 2017.

1. **The Moorpark area has hundreds of megawatts of demonstrated solar siting opportunity.**

Not only have the necessary technologies been deployed in cost effective projects nationally and locally, but the Moorpark subarea also hosts enough solar siting opportunity to allow for cost effective deployment of DER capacity vastly in excess of identified reliability and resilience needs.[12] For example, solar siting surveys of a section of Orange County (which is geographically similar to the Santa Barbara area) have identified some 160 MW of built environment siting opportunity, without considering opportunities on brownfields of various sizes or greenfield groundmount options. Given that the initial authorization for this procurement in D.13-02-015 cited siting limitations as a rationale for proceeding quickly in the Big Creek/Ventura local area, this greater siting flexibility associated with distributed solar argues strongly for consideration of alternative DER approaches to meeting local need. Furthermore, since distributed solar is substantially faster to install than construction (or replacement, in case of catastrophic failure) of a natural gas plant, CAISO would be remiss to undervalue the role that solar/storage hybrid systems can play.

**D. The additional cost of synchronous condensers can be avoided entirely through the use of storage with advanced inverters**

Both the Energy and Utility Commissions have suggested the use of clutches and synchronous condensers to provide voltage regulation, but storage with advanced inverters can provide better voltage and frequency regulation with much faster enhanced frequency response (less than 1 second) than can synchronous condensers, and at a vastly lower cost. In fact, solar generation and storage facilities using advanced inverters represent an example of a superior solution to any of these proposals to meet both generation and voltage stabilization.

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[12] Solar Siting Survey: SCE Preferred Resources Pilot, *Clean Coalition,* http://www.clean-coalition.org/resource/solar-siting-surveys/sce-prp/.

Solar/storage hybrid systems can thus be used to stabilize voltage by modulating the output of real power or by injecting or absorbing reactive power from the grid as reactive power compensation or dynamic reactive power control.[13] Such facilities have been deployed cost-effectively to provide grid resilience and reliability in Hawai'i, California, and elsewhere. These projects have demonstrated that these solutions can provide short circuit duty and voltage maintenance services with faster response times using advanced inverters. In fact, many existing inverters can serve this function with only a software upgrade, saving the need for expensive hardware modifications to existing plants or for installations of entirely new facilities.

Thus, in addition to the competitive cost of energy delivery from solar/storage hybrid solutions, such solutions also generate value in the form of avoided costs from having to have supplementary facilities to deliver voltage and frequency regulation services, making DER solutions even more feasible economically than direct price comparisons show.

**E. Demand Response is a more cost-effective approach to meeting capacity needs**

We note that the 80 MW of Demand Response resources may understate the potential for DR resources to meet local capacity requirements. In particular, we would point to a recent study by the Lawrence Berkeley National Laboratories, which found that in the Big Creek/Ventura area approximately 260MW of demand response opportunity could be potentially obtained at a cost of $100 per MWh. [14] Clearly, such an approach is both technically feasible and cost effective.

[13] National Renewable Energy Laboratory, "Advanced Inverter Functions to Support High Levels of Distributed Solar," *NREL*, http://www.nrel.gov/docs/fy15osti/62612.pdf, Nov 2014.

[14] "Demand Response Potential for California SubLAPs and Local Capacity Planning Areas An Addendum to the 2025 California Demand Response Potential Study" Lawrence Berkeley National Laboratories (April 2017) at 61.

**Conclusion: Develop a Scenario 4 with high solar/storage hybrid use.**

The Clean Coalition anticipates that solar/storage hybrid projects will provide superior performance to meet all local capacity needs more cost effectively. Therefore, these conditions would warrant CAISO analyzing a mix of at least 115MW of solar/storage hybrid projects with 25 MW of stand-alone storage in this study.

Respectfully submitted,

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