

From: Como, Joe

To: Peevey, Michael R.; Florio, Michel Peter; Peterman, Carla J.; Ferron, Mark J.; Sandoval, Catherine J.K.

cc: Fitch, Julie A.; Charles, Melicia; Colvin, Michael; Kamins, Sara M.; Khosrowjah, Sepideh; Baker, Amy C.; Brown, Carol A.; Stevens, Brian

Subject: Analysis prepared by ORA for Track 2 of the LTPP proceeding (R.12-03-014)

Dear President Peevey and Commissioners:

Attached for your information is testimony prepared by ORA for Track 2 of the 2012 Long-Term Procurement Planning (LTPP) proceeding. At least one advisor indicated an interest in seeing this analysis even though this testimony is not part of the record.

Track 2 focused on determining whether California's system resources in 2022 are sufficient to support the State's goal of meeting 33% of demand with renewable portfolio standard (RPS) resources.

Shortly before the due date for service of the testimony, an Assigned Commissioner and Administrative Law Judge Ruling cancelled Track 2, indicating "[t]here has been some indication that system flexibility needs may be low or non-existent depending on the level of local capacity procurement authorized in Track 4."

The modeling ORA had already completed estimated whether additional resources will be needed in 2022 to balance supply and demand. The results are presented in the attached testimony. ORA similarly concluded that there is no immediate need to authorize procurement to meet system flexibility needs.

We would be happy to discuss this further with you or your advisors.

Thank you.

Joe Como
Office of Ratepayer Advocates

ORA's testimony in the 2012 Long Term Procurement Proceeding, Track 2:
Executive summary
(January 2014)

The California Public Utilities Commission (CPUC) oversees biennial Long-Term Procurement Plan (LTPP) proceedings to “ensure that California’s major investor-owned utilities (IOUs) can maintain electric supply procurement responsibilities on behalf of their customers.”¹ In these LTPP proceedings, resource needs are evaluated ten years into the future for the entire electric system in California and also for transmission-constrained local areas.

Parties to the LTPP proceeding opened in 2012, Rulemaking (R.)12-03-014, considered issues related to “system variability” in Track 2 of that proceeding. A series of workshops explored the methodologies associated with understanding and quantifying system variability. “System variability” is the interaction of changes in supply and demand, while “operational flexibility” refers to the resources needed to respond in real time to changes in supply and demand. California faces increased system variability because of its increasing reliance on intermittent renewable resources including wind and solar and it is therefore important to plan for adequate operational flexibility to meet system variability.

¹ Scoping Memo and Ruling of Assigned Commissioner and Administrative Law Judge, issued May 17, 2012, in Rulemaking (R.) 12-03-014, p. 2. Available at <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=60474>

Parties were on the verge of filing testimony when a ruling was issued September 16, 2013, cancelling Track 2 of the proceeding. The following summary contains highlights of testimony prepared in late 2013 for the Office of Ratepayer Advocates (ORA)² by Robert M. Fagan and Patrick Luckow of Synapse Energy Economics. The complete testimony is attached.

Track 2 of the 2012 LTPP focused on determining whether California's electric system resources³ in 2022 are sufficient to support the State's goal of obtaining 33% Renewable Portfolio Standard (RPS) resources to meet demand. Track 2 modeling estimated whether or not such additional resources will be needed in 2022 to balance supply and demand, taking into account the many system operational details projected for that year, including load growth, the ability of the transmission system to import resources from outside the system, the outage and response rates of generating units, and whether intermittent renewable resources provide more than 33% of California's energy in 2022.

ORA's Track 2 testimony reported the results of ten alternative Track 2 modeling scenarios ("ORA Scenarios") that Synapse executed on behalf of the ORA. Synapse used the Plexos modeling tool⁴ to run the ORA Scenarios, starting with benchmark input files that the CAISO used for its Track 2 modeling.

² The Division of Ratepayer Advocates was renamed the Office of Ratepayer Advocates effective September 26, 2013, pursuant to Senate Bill No. 96 (Budget Act of 2013: public resources), which was approved by the Governor of California on September 26, 2013.

³ The system resources at issue are under the control of the California Independent System Operator Corporation (CAISO), which manages the flow of electricity for about 80 percent of California and a small part of Nevada, which encompasses all of the investor-owned utility territories and some municipal utility service areas.
<http://www.caiso.com/about/Pages/OurBusiness/UnderstandingtheISO/default.aspx>

⁴ The Plexos modeling tool is an hourly production cost simulation model used for resource planning.

Synapse’s results show the projected patterns of electric power resource availability in 2022 during either i) all hours of the year, or ii) during just the hours in the projected peak summer month (July);⁵ and how these patterns are affected by key scenario assumptions. The ORA Scenarios focus mainly on the impact of different levels of preferred resource (i.e., energy efficiency (EE), demand response (DR), solar photovoltaic (PV))⁶ deployment by 2022. A few ORA Scenarios address import limitations and the potential addition of resources given the retirement of the San Onofre Nuclear Generating Station (SONGS) resource.⁷

Table 1 below shows a generally progressive reduction in identified “shortage” amounts from CAISO’s base run shortage level of 2,621 MW (an amount that does not consider any effect of Track 1 authorizations not explicitly included in CAISO’s base model⁸) in 2022. As incremental EE, DR, or PV is deployed (supplemental to the amount assumed in the CPUC scoping memo for the given scenario), or when demand response resources are assumed to be available for a different (“shifted”) 6-hour window – namely, from 1 p.m. to 7 p.m. instead of from 11 a.m. to 5 p.m. – the modeled shortage level declines.

⁵ Some model runs were executed for all 12 months of 2022; and some ORA scenarios were executed just for July, the month in which demand is usually highest.

⁶ Preferred resources also include combined heat and power (CHP) and storage. Primarily to minimize the permutations of modeling cases, in this examination we have not executed any modeling runs that varied the underlying case (base, Transmission Planning Process (TPP), high distributed generation (DG)/demand side management (DSM)) assumption for CHP deployment or storage (50 MW). To the extent that additional CHP or storage resources are deployed beyond that assumed for the case, our results will underestimate the system “headroom”, or exaggerate any “shortage” finding.

⁷ Authorization of resources to address the SONGS outage are part of Track 4 of the 2012 LTPP proceeding.

⁸ CAISO has stated that the Moorpark sub-area of Big Creek Ventufo sail H resource, and preferred Track 1 procurements were excluded from its modeling.

In scenarios using the base load forecast and high levels of EE, DR, PV, and shifted DR availability, the “shortage” amount disappears (ORA Scenario 6), as it does in ORA Scenario 5 (high EE only). Excess available capacity during the tightest hour of the year is also observed in the model’s results for CAISO’s high DG/DSM scenario.

The analysis shows how different levels of resource deployment in 2022, across different net load forecasts, would lead to modeled surplus or shortage of resources at different points in time in that year. Generally, many modeled scenarios indicate shortages that occur for extremely brief intervals during one day of one summer month, with surplus capacity for the rest of the hours of the year. Modeled scenarios using more aggressive pursuit of preferred resources exhibit surplus capacity even during the tightest hour of the year.⁹

Modeling results that show occasional “shortages” do not imply that conventional gas-fired gas turbine or combined-cycle generation should be authorized for procurement at this time in an amount equal to the shortage capacity amount. The projected *patterns and duration* of modeled surplus or shortage should be evaluated when considering procurement decisions.

The modeling does not address the optimal timing for any resource procurement that is warranted or the best method of procurement. Based on current modeling results, ORA recommends limiting any procurement authorization to preferred resources.

⁹ It is notable that these scenarios, with higher levels of EE, DR and PV – and all other ORA Scenarios - contain no explicit assumptions for increased storage resources (e.g., up to 1,325 MW that may come to fruition by 2022 as authorized in the Decision 13-10-040) other than the 50 MW of storage authorized in Decision 13-02-015.

Table 1
Summary Results Plexos Hourly Modeling – July 2022 – ORA Scenarios

| Scenario | Modeled Peak Shortage H I MW | Duration of shortage days I | Modeled Headroom Commitments |
|--|------------------------------|-----------------------------|-----------------------------------|
| CPUC Scenarios Executed by CAISO | | | |
| Base | | | |
| TPP HOct ¹⁰ | Revision | | |
| High D DSM | | | |
| ORA Scenarios - Base Load | | | |
| Shift DR Available | | | DR p m instead |
| High DR | Shift DR Available and | | High DR separate from S Available |
| High PV | | | |
| High PV and Shift DR Available | | | |
| High EE | | | |
| High DR Shift DR | High PV | | |
| Relax SCE Import | Shift DR Available and | | in area gen |
| Relax CA Import | Shift DR Available and | | Use High D DSM case i limit |
| Available High DR Import | MW Addition High DR | Shift DR Relax CA | Add MW SCE Track |
| ORA Scenarios - TPP Load | | | |
| Mid EE DR and DR Available and Mid PV H Sept | TPP inputs posting I | | |

Notes

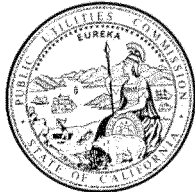
Track of resource not considered MW in these runs. It was used all shortage headroom for surpluses in

CAISO scenarios exclude any preferred resource at the preferred resource assumptions from the Track sc

[End of Summary]

¹⁰ Initial TPP results provided in the August 26th, 2013 LTPP workshop showed 5,359MW of shortage with a duration of 16 hours over 4 days. Afterwards, CAISO updated the model with new demand response assumptions and updated minimum and maximum capacities for some generating resources.

Docket: : R. 12-03-014
Exhibit Number : _____
Commissioner : _____
Admin. Law Judge : _____
ORA Witnesses : Robert M. Fagan
 Patrick Luckow



OFFICE OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

**TESTIMONY OF
ROBERT M. FAGAN AND PATRICK LUCKOW,
SYNAPSE ENERGY ECONOMICS,
ON BEHALF OF THE OFFICE OF RATEPAYER
ADVOCATES**

Final - Post Track 2 Cancellation – October 23, 2013

Order Instituting Rulemaking to Integrate
and Refine Procurement Policies and
Consider Long-Term Procurement Plans
Track 2

(RM.12-03-014)

San Francisco, California
September, 2013

TABLE OF CONTENTS

Introduction and Statement

Track Modeling

Approach

Preferred Resource and Other Assumptions
Modeling Results of a Shortage

Load and Output

ORA Scenario Results

Patterns of Surplus

Patterns of Resource Output

Resource Output by Month
Additional Assumptions

Procurement Timings

Base Case vs TPP Forecasts as Basis for

Track Treatment of Demand

Critical Resource

Important Assumptions

CAISO Track Modeling
Conclusions

Witness Qualification

Witness Qualification Disclosure

INTRODUCTION AND SUMMARY OF TESTIMONY

Q What is the purpose and scope of this

A The primary purpose of this testimony is to provide an alternative Track modeling analysis on behalf of the California Office of Public Utilities (OPU) using the Plexos modeling tool to run the ORA scenarios posted by the California Independent System Operator (CAISO) in connection with the completion of its modeling work.

Synapse's results show the preferred alternative during either just the hours of the projected peak summer months. The key patterns are scenario assumptions. The ORA scenarios show levels of preferred resources and response. A few ORA solar photovoltaic (PV) limitations and the potential phase of this proceeding that will be presented given the retirement of the San Onofre Nuclear Resource.

We also discuss these results in the context of the integration of renewable resources and possible procurement actions. We subsequently recommend actions informed by the state's loading order policy.

Q How does your analysis inform procurement

The driving factors affecting both the procurement strategy to meet the state's needs and the new analyses uses information from the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) load forecasts. The analysis ultimately shows how different levels of different net load forecasts at different points in time may result in shortages that occur for a year or more in a month with surplus capacity for most of the year.

¹ Some model runs were executed for all 12 months of 2022; and some ORA scenarios were executed just for the indicated "tight" month, July.

² Preferred resources also include combined heat and power (CHP) and storage. Primarily to minimize the permutations of modeling cases, in this examination we have not executed any modeling runs that varied the underlying case (base, Transmission Planning Process (TPP), High distributed generation (DG)/demand side management (DSM)) assumption for CHP deployment or storage (50 MW). To the extent that additional CHP or storage resources are deployed beyond that assumed for the case, our results will underestimate the system "headroom", or exaggerate any "shortage" finding.

scenarios using more aggressive pursuit of high
CPUC CEC high levels of EE, DR and PV – and all other
tightest hour of the year

In our opinion modeling results that imply
conventional gas fired gas generation on HFO would be
equal to the shortage capacity commitments last
time. The patterns and duration of modeled surplus or shortage
taken into account when considering procurement

The modeling itself says nothing about the
procurement that is warranted by the needs of the
procurement. California's history of resource
based resource development is a warning sign for
this issue and explain our position that the
only way is the best course at this time

Q How does your analysis account for
effects on any Track determination

A CAISO's analysis and the ORA Scenario
authorized during the 2013 Decision include 1,325 MW of CC
southern CA Southern California Edison's
located in the SCE territory if not the CAISO
Creek Ventura Moorpark substation and the preferred
Scenarios include increasing the capacity of
for or exceed the Track but were less or more
the Big Creek Ventura fossil authorization for

The analysis also considers the reliability
concerns in the absence of SONEL's requirements
need by including three ORA Scenarios in the
SCE territory are minimally required to meet
the local generation requirements in the
presence of increased generation in southern
transmission improvements and other actions
Scenarios an additional 500 MW of resource
model and in the other two ORA Scenarios

³ It is notable that these scenarios, with higher levels of EE, DR and PV – and all other ORA Scenarios -
contain no explicit assumptions for increased storage resources (e.g., up to 1,325 MW that may come to
fruition by 2022 as considered in the 9/3/2013 Proposed Decision in R. 10-12-007), other than the 50
MW of Track 1 resource authorized in Decision 13-02-015.

⁴ See D.13-02-015, Ordering paragraphs 1 and 2 at pages 130-131.

⁵ The Plexos model contains separate locations for SCE, Pacific Gas and Electric Company (PG&E) Bay,
PG&E Valley, and San Diego Gas & Electric Company (SDG&E).

⁶ We make no recommendations here about additional Track 4 needs. We run this Scenario to allow the
Plexos modeling to explicitly account for the presence of another resource. We structure this resource as
a 500 MW GT in the model but it serves only as a proxy resource available to meet peak period needs and

greater levels of distributed generation and improvements but no explicit additional Track

Q Please summarize your modeling results

A Table below summarizes the key findings for comparison the CAISO's runs of Scoping

doesn't imply that a GT is required to obtain the available capacity represented by the proxy unit. To the extent that Track 4 results in additional resources deployed by 2022 beyond the case assumptions we use, the results of our Track 2 modeling runs will underestimate the system headroom, or exaggerate any shortage finding.

Table Summary Results PIRex oSsc ehnoaurriloys Modeling July

| Scenario | Modeled Peak Hour | Duration of Peak | Modelled Comment |
|--|-------------------|------------------|----------------------------------|
| CPUC Scenarios Executed by CAISO | | | |
| Base | | | |
| TPP HOct ⁷ | Revision 1 | | |
| High D DSM | | | |
| ORA Scenarios - Base Load | | | |
| Shift DR Avail | | | DR p m instead of a m |
| Shift DR Avail and High DR | | | High DR smp shift DRo Avail |
| Hi PV | | | |
| Hi PV and Shift DR Avail | | | |
| High EE | | | |
| Hi EE Hi PV Hi DR Shift DR | | | |
| Shift DR Avail and Relax SCE | | | in area gen SCE |
| Shift DR Avail and Relax CA | | | Use High D DSM case import limit |
| MW Addition Shift DR Avail High DR Relax CA Import | | | Add MW SCE Track proxy |
| ORA Scenarios - TPP Load | | | |
| Mid EE DR and DR Avail and mid PV HSept TPP inputs posting I | | | |

Notes

Track fossil resource not Biogn sGrdeerke dV einnt utrhae s eH rsuhrsr t ageBo dteMW daxitese n surpluses increase I by this amount

CAISO scenarios exclude any mp f e a e k r e d erxecseoputr cteo atutehsoeruzteanattiaoint umpt ipa m the Track scoping memo

⁷ Initial TPP results provided in the Aug 26th, 2013 LTPP workshop showed 5,359MW of shortage with a duration of 16 hours over 4 days. Afterwards, CAISO updated the model with new demand response assumptions and updated minimum and maximum capacities for some generating resources.

Q Please explain the detailed results seen

A Table shows a generally positive amount from CAISO's base resource to consider any effect of Track 1 model in amount assumed in the CPUC scoping demand response resources hour window namely from modeled shortage level declines

In scenarios using the base DR availability the shortage amount ORA Scenario High EE only capacity tightest hour of the year is DSM scenario

Q Does shortage imply a LTPP cycle

A No As seen in testimony the shortage indication suggests approved resources and project as the system may need for all the details inherent in the modeling system. The details include outage capability limits on RPS renewable resources that possible I maximum DR potential assumptions

Q What is your opinion on the detailed

A In our opinion it is likely that parameters over time will meet shortage needs in

- Outage rates for supply resources day could decrease as California ancillary service incentives and the CAISO markets service in California in
- As Track solutions are transmission upgrades I

⁸ CAISO has stated that they have excluded the Moorpark sub-area of BC/V fossil resourced, and preferred Track 1 procurements.

WECC balancing a maximum simultaneous transmission into California or the CAISO balancing area currently modeled in the Plexos environment.

- RPS requirements are not likely to dip below increase and even in the absence of incremental flexibility constraints using high levels of PV or wind resources other resources to be available as capacity.
- Demand response HDR I potential high HDR I levels from the ¹¹ Scenario tool for the load reduction that may be needed.
- The IEP already shows a lower peak mid case than the IEP. However, the extent that load growth trends over time reduce residual procurement needs is very LTP. In planning cycle all else equal.

Q Please summarize your conclusions.

A We find that deploying gas peakers and renewable resources in our region, no conventional fossil firm generation, shortage is minimal and sufficient to meet resources that could be available to fill in particular targeted levels of demand. DR cases that need be available on a very. Lastly we note here that the existing OTC units scheduled for policy management under performing preferred resources are reflected without any date extensions.

⁹ WECC – Western Electricity Coordinating Council. Federal and regional initiatives will continue to improve coordination and transmission system utilization efficiencies across the western region.

¹⁰ Our modeling results account for any unit commitment effects that may be present. Those effects could, in theory, lead to de-commitment of resources in the day-ahead time frame because of solar PV or wind resources meeting need in certain intervals. But our modeling of high PV scenarios does not increase the amount of shortage seen in those intervals – shortage is decreased.

¹¹ The current “high” level is 2,963 MW; mid-DR levels are 2,595 MW. Scenario Tool, v6.

TRACK 2 MODELING

Approach

Q What is Track modeling

A Track of the LTPHoit's system as opposed to local resources support the State's goal of modeling Track modeling consists of analyzing resources will be needed in taking a myriad of system operational details CAISO uses Plexos a detailed Synapse uses Plexos in support of Plexos. In short, hourly capture the capability of provide energy and required resources include all supply consisting of multiple different fuels and import hour to balance out within referred to as Step method is intended to aggregate of all resources the year

In order to properly account model includes a detailed Coordinating Council loads and resources outside of the state

Q Please explain your Scenarios using different CAISO

A Synapse obtained a license used the same version of monthly model runs for on only as this is of the base scenario TPP and High D DSM cases and shifted to the window utilized by CAISO in their runs

Q Please explain how you

¹² PLEXOS 6.208 R08

A Synapse downloaded the CAISO spreadsheet
 Huly I TPP cases. HSheApugmsbter
 I We then ran each of the base moT
 to ensure consistency with the AdSO reWalf
 our results to be consistent with the AdSO
 parameters for each of those cases for
 combinations of input assumptions used a
 scenario as specified in the LC PoUFC
 PV resources We used the I f i d g i n t h i n c f e u n e
 Scenario tool to form the ORA resource
 did the same for the incremental EER as
 the TPP case starts out with and we used
 mid incremental EER assumptions for the
 forecast We explain the ORA scenarios

Preferred Resource and Other Assumptions – ORA Scenarios

Q What are the ORA Scenarios

A ORA Scenarios are different scenarios
 defining alternative Plexos scenarios for
 month in the Plexos modeling environment
 some cases We show short aged ad r o y p i w a l l u
 most constrained month From the scenarios
 order to develop full year udrucrea tsi hoonr tcaugrev eosr
 headroom over the entire year The B e s a m e d a H
 D DSM cases as well as the I G R A y S w i e n r d a o r w i o o f a d
 demand response resources

Q What combinations of preferred ORA scenarios

A We model different levels of DR a
 transmission import limit scenario wh
 increased MW to h a m W e a n d o n e w h
 local generation compared to a full time
 increase scenario was based on the h C i A g h i m p o
 D DSM case The SCE local generation
 see how the system would respond for SCE
 generation through transmission ¹³ W e n d n o t r e t e l a t t
 the Plexos model structure of the SCE
 generation from meeting less than a
 violation amount Has part of the

¹³ We note that CAISO has stopped enforcing the SCE in-area generation minimum of 40% as of October 1, 2013. http://www.caiso.com/Documents/TechnicalBulletin-ImportLimitDefinitionandManagementinSupport-Under-FrequencyLoadShedding_UFLS.pdf.

model does not have sufficient time to generate
response resource availability shifts to
a m t o p m window uatriilabzleed cbhya nCgAeIsS O
different combinations make bl ap t hbee lsoewt loifs
combinations modeled

Table ORA Scenarios Assumption Parameters

| | Incremental Small PV | DR Capacity | DR Capacity | DR Availability | SCE Import Limit | EA Import Limit | Contract or Fossil Fuel Addition |
|---------------------------------------|----------------------|-------------|-------------|-----------------|------------------|-----------------|----------------------------------|
| CPUC Scenarios as Run by CAISO | | | | | | | |
| Base | | M W M W | | M W M W | | | |
| TPP | | M W | | M W M W | | | |
| High DSM | | M W | M W | M W M W | | | |
| ORA Scenarios - Base Load | | | | | | | |
| Shift DR Avail | | M W M W | | M W M W | | | |
| Shift DR Avail and High PV | | M W M W | | M W M W | | | |
| High PV | | M W | M W | M W M W | | | |
| High PV and Shift DR Avail | | M W | M W | M W M W | | | |
| High EE | | M W M W | | M W M W | | | |
| High EE High PV High DR | | M W M W | M W | M W M W | | | |
| Shift DR Avail and Relaxed CA Import | | M W M W | | M W M W | | | |
| Shift DR Avail and Relaxed CA Import | | M W M W | | M W M W | | | |
| MW Addition High DR Relaxed CA Import | | M W M W | | M W M W | | | |
| ORA Scenarios - TPP Load | | | | | | | |
| Mid EE DR and DR Avail and Mid PV | | M W M W | | M W M W | | | |

Source CPUC Scenario Tool v Synapse

¹⁴ Incremental small PV.

Q Please discuss the level of preferred Scenarios

A Most of the assumptions in the Scenario Tool have been and the accompanying Scenario Scenarios through we provide in different combinations are parameters for DR Scenarios and we modified the internal generation minimum level and Scenario we added MW for a Track resource addition along with high DR level and all DR scenarios retained the TPP gross load availability values to reflect the availability

Q Please describe in detail the revised availability

A Default inputs to the model are based on a month to month based on it clear that utilization of these resources pushed the window out to shortage hours

We shifted the hour window for SCE and SDE DR resources limited. The IOUs potential load drop lighting load can all be CAISO models a low amount of DR assume that DR programs could currently document such availability resource system operates if showing how the overall system parameter in particular has a key late afternoon early evening summer

Q Please describe in detail the revised capability

A The production cost model to the power required to serve significant cost was imposed model to take further advance this sensitivity We make at this

shortage levels on the SCE system that transmission reactive support would be additional in operation with greater levels of imports into

Q Please describe in detail the comparative study

A We used the higher CA imports to evaluate the High D DSM case which was level of MW in MW. We presume that this increase is a simplification from the presence of greater generation in the High D DSM case. We also use the same model in MW of additional generation in the same case.

Q How did you determine which permutation

A We wanted to illustrate the three most reactive variables on modeled surplus and deficit. PVs might be considered something that could be introduced to increase greater levels of generation in MW during the shortage hours with higher levels of PV. The dispatchers would need to be needed when those higher levels of PV are

Our selection of the next level gap from the mid level is intended to show how the procurement of preferred resources in California's energy policy is needed to meet energy needs which places a burden on the EE, DR and distributed generation. In this context we support the procedure before contemplating the procurement of con

MODELING RESULTS AND PATTERNS OF SURPLUS/SHORTAGE

Load and Resource Output Patterns

Q What does the CAISO region load and resource base case the shifted DR data show in terms of levels of preferred resources?

A Figures through the CAISO region also shows the projected load pattern on that summer day in the hours roughly MW between these hours

¹⁵ As noted, CAISO has stopped enforcing this minimum generation restriction as of October 1, 2013.

¹⁶ Energy Action Plan II, p. 2.

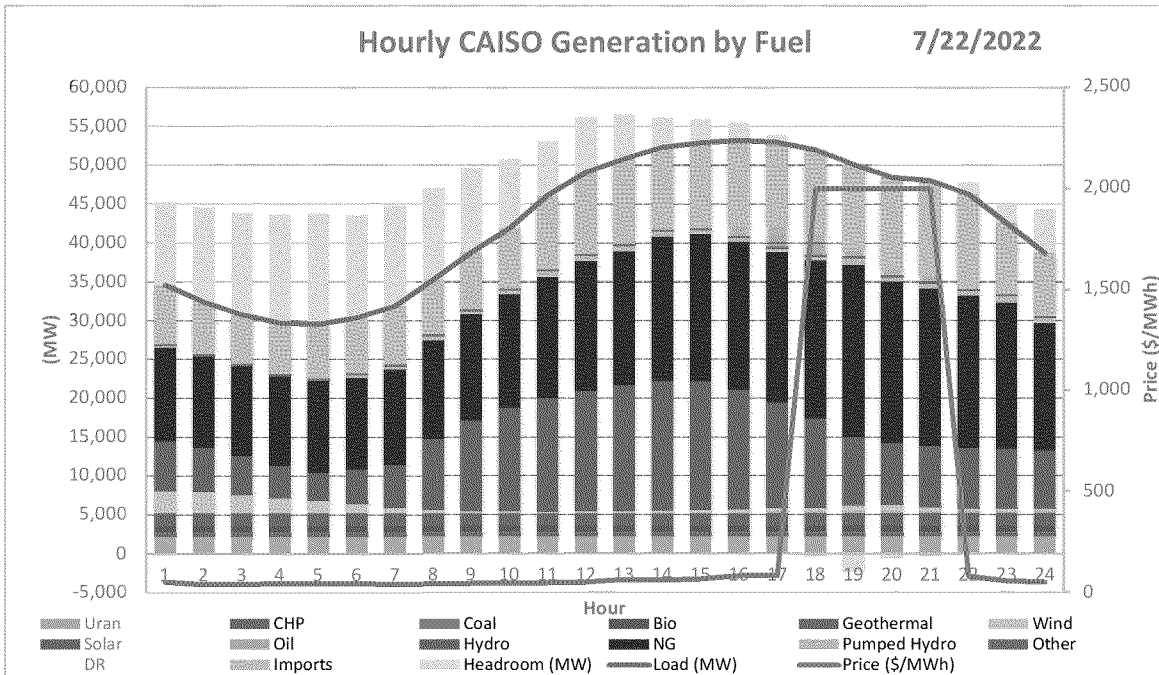


Figure 1: Hourly CAISO resource output, headroom, load, and price July 22 2022, CAISO Base Case

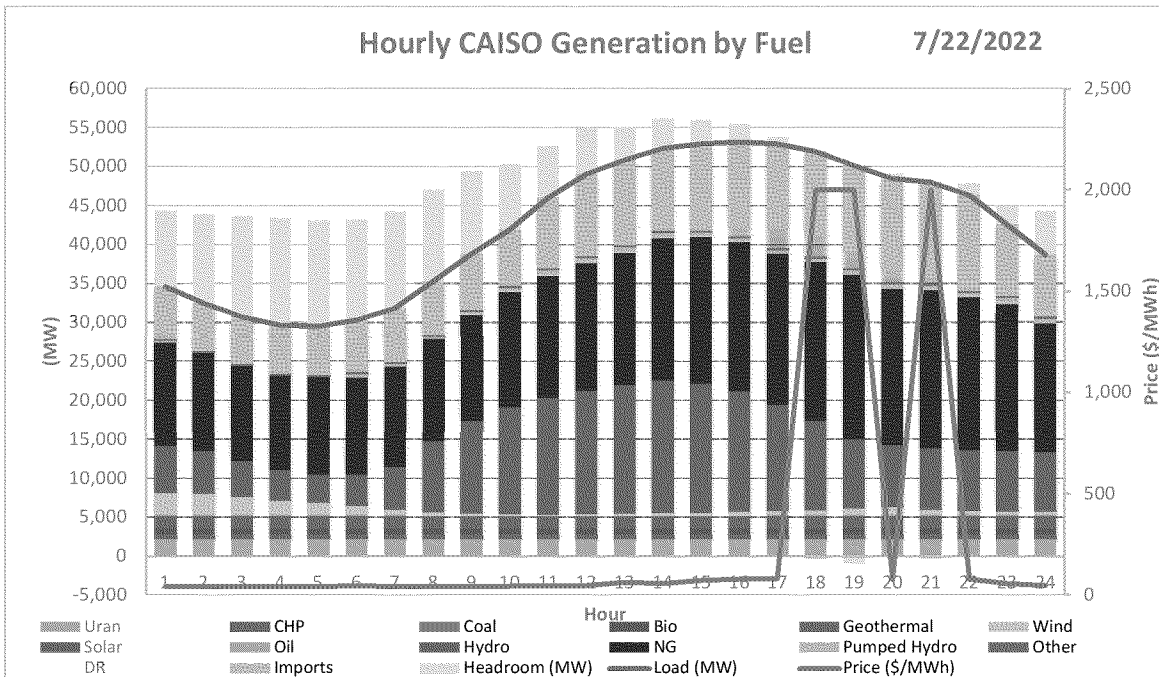


Figure 2: Hourly CAISO resource output, headroom, load, and price, July 22 2022 Base Case w/ Shifted DR Availability (ORA Scenario 1)

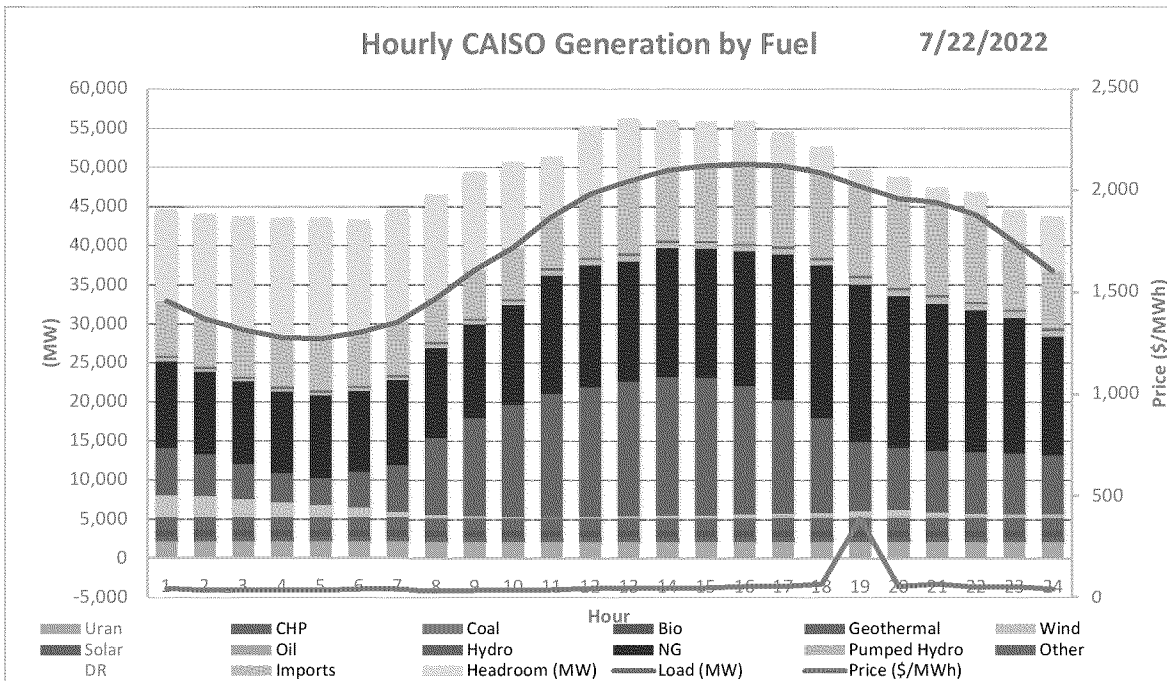


Figure 3: Hourly CAISO resource output, headroom, load, and price, July 22 2022 High Preferred Resources + Shifted DR availability case (ORA Scenario 6)

Q Please explain the patterns shown in Figure 3.

A Figure 3 illustrates the base case of four hours of high demand. The price spike effectively serves as a proxy for shortage in that the demand is shifted out to PM and there is significantly lower demand during those hours. The shortage at PM is significantly lower than during the peak hours of the day when high levels of solar are available. The stacked bar chart shows that the shortage exists in all hours. The MW headroom is the lowest during the price spike in the tightest hour. The proxy price associated with a shortage is significantly higher than the base case price.

ORA Scenario Modeling Results

Q What are your summary results from Table 1?

A Table 1 lists the key ORA scenarios and includes CAISO results for each scenario.

¹⁷ This result is an artifact of the specific hourly outages for the day, along with the combination of other resource output and load at those hours.

Table Summary of Model Input Results for Highest Shortage

| Scenario Name | Scoping Memo CAISO Runs | | | | | ORA Scenarios | | | | | | | | |
|------------------------------|----------------------------|------|-------------|-----------------|----------------------------|-----------------|--------------------------|-----------------|-------------------------------------|-------------------------------------|------------------------------------|---|-----------------------------------|--|
| | Base | TPP | High DG/DSM | Base modified 1 | Base modified 2 | Base modified 3 | Base modified 4 | Base modified 5 | Base modified 6 | Base modified 7 | Base modified 8 | Base modified 9 | TPP modified 10 | |
| Scenario elements | Base | TPP | High DG/DSM | Shift DR Avail | Shift DR Avail and High DR | Hi PV | Hi PV and Shift DR Avail | High EE | Hi EE, Hi PV, Hi DR, Shift DR Avail | Shift DR Avail and Relax SCE Import | Shift DR Avail and Relax CA Import | 500MW Track 4, Shift DR Avail, High DR, Relax CA Import | Mid EE/DR and DR Avail and Mid PV | |
| Metric | | | | | | | | | | | | | | |
| Extreme Shortage Headroom | Hour | | or | | | | | | | | | | | |
| Duration of shortage days | hours | | | | | | | | | | | | | |
| Peak Load | Base | TPP | Base | Base | Base | Base | Base | Base | Base | Base | Base | Base | TPP | |
| Incremental DR Availability | Mid | Low | High | Mid | Mid | Mid | Mid | High | High | Mid | Mid | Mid | Mid | |
| Incremental Event DR | Mid | Zero | Mid | Mid | High | Mid | Mid | Mid | High | Mid | Mid | High | Mid | |
| Incremental SCE Import Limit | Mid | Zero | High | Mid | Mid | High | High | Mid | High | Mid | Mid | Mid | Mid | |
| Duration of Modeling Run | | | m | m | m | uly | uly | uly | uly | uly | area uly | in gen uly | No change uly | |

P

Q Please explain the results in Table

A In general Table 6 illustrates that the most extreme period in the simulation is the preferred resources. The grid has a high availability for demand response resources and procurement of mid to high voltage for more than four hours over the base case. For cases with a shortage magnitude and duration that rely

Q What do the results show for the SORA Scenario?

A The results first show that during the critical hours on peak days a maximum hourly shortage of 0.5 MW is seen in CAISO's base run. The total duration of shortage for all other variables is less than 1 hour. For the SORA Scenario, the shortage values are

ORA Scenario shows the real-time market clearing price. The MWCA import limit window. The addition of MWCA with high DR and shifted DR limit reduces the shortage to 0.5 MW.

Q What do the results show for the TPP Scenario?

A We ran one scenario using the resource inputs and retained the modeled shortage drops to 0.5 MW.

Q What do the results show for the High DR Scenario?

A Based on the High DR scenario, the shortage is mitigated with significant

Patterns of Surplus/Shortage

Q What do the modeling results show over the course of all hours of

A The data show that the prevalence of solar resource is high

¹⁸ No defined limit exists on the ability of DR resources to be available after 5 PM.

evening rather than mid afternoon. The annual pattern shows this annual pattern according to magnitude of shortage or surplus. The annual duration curve for the CAISO base case modeled hours over the year exists across the California considerations in the RFS out of service. The relative robustness of resource adequacy for

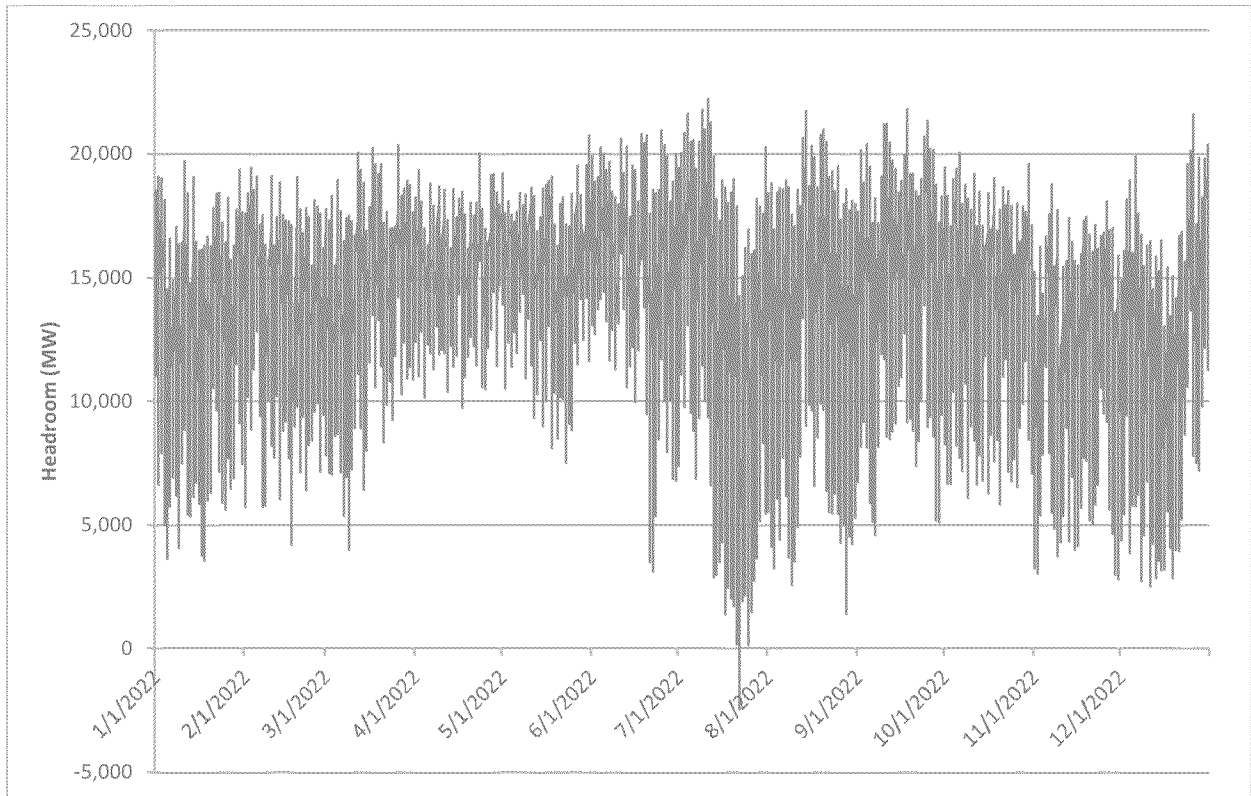


Figure 4: Annual headroom under the Base case assumptions, sequential hours of the year

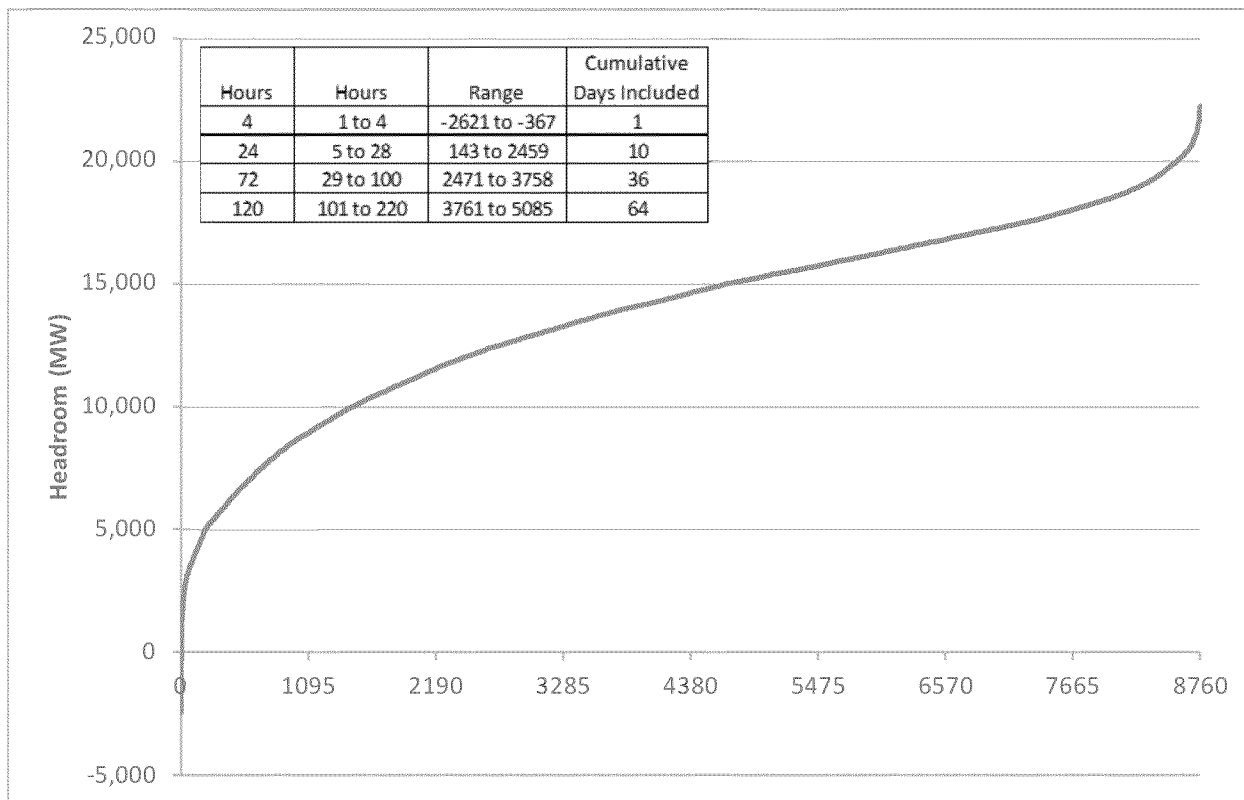


Figure 5: Annual headroom duration curve under Base Case assumptions (headroom +, shortage -)

Notes

Positive values are surplus at the start of the year and negative values are shortage. The x-axis represents hours in the year. The inset table shows the first 120 hours of the year, with the first column indicating the hours of the shortage and the second column indicating the hours of the surplus.

Q The annual duration curve shows the distribution of headroom for the ORA Scenarios.

A Yes. We developed a set of graphs for the duration for the ORA Scenarios.

Q What do the shortage headroom patterns look like?

A Figures 5 and 6 show these patterns. The shortage headroom patterns are sorted from lowest to highest headroom. The shortage headroom patterns are sorted from lowest to highest headroom. The shortage headroom patterns are sorted from lowest to highest headroom. There are only a few scenarios with adjusted timing of shortage headroom. Upwards of 10,000 MW of shortage headroom is seen if the timing is left.

¹⁹ Headroom is defined as Available Capacity + Imports – Load – Reserve Provision.

energy efficiency and emissions rate in all MW of the hours

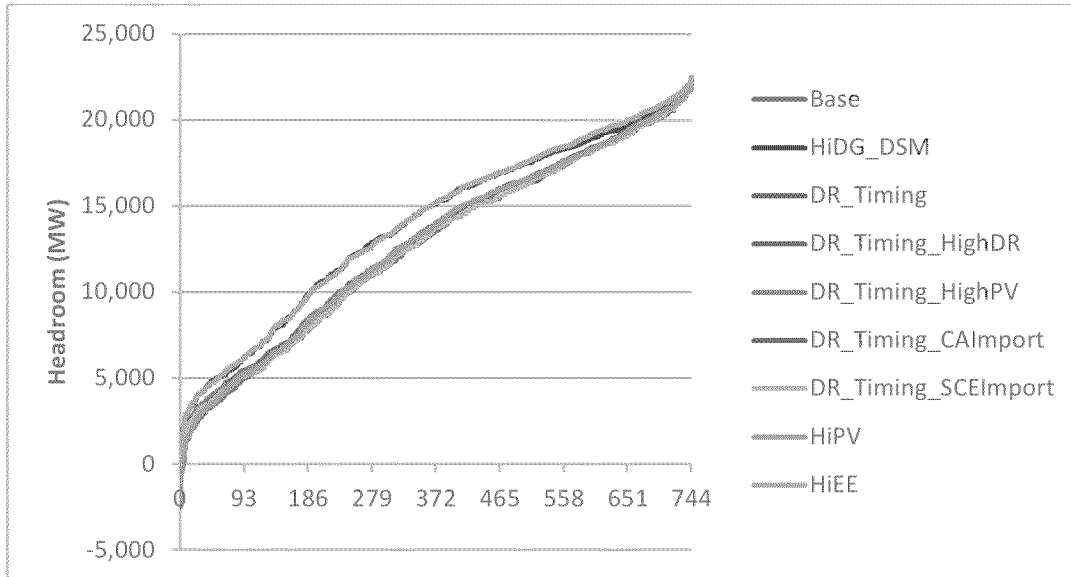


Figure 6: July 2022 Headroom Duration Curve (all hours)

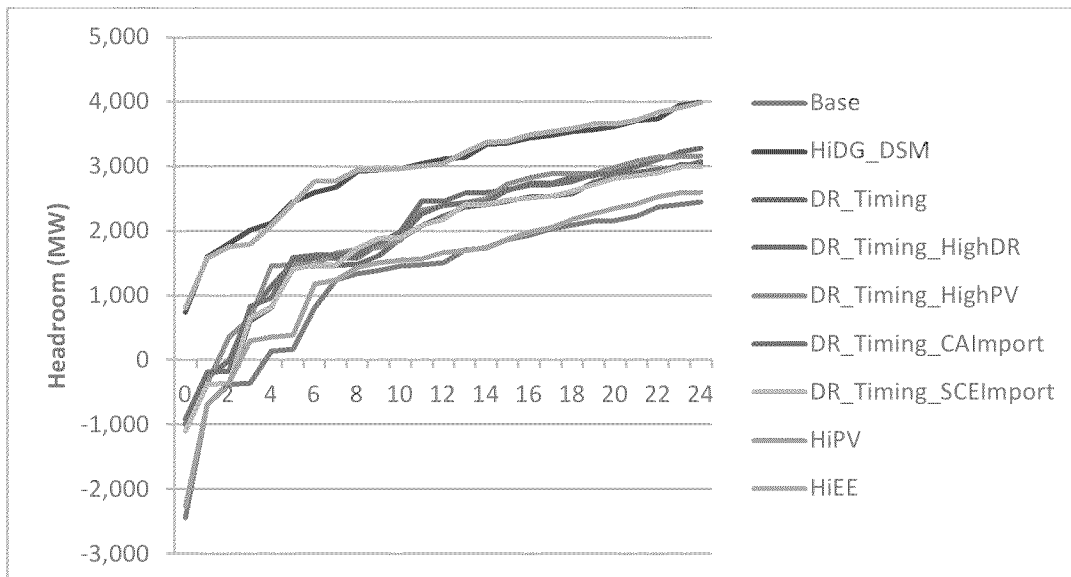


Figure 7: July 2022 Headroom Duration Curve (top 24 hours)

Patterns of Preferred Resource Output

Q How do the hourly PV patterns align with
 A Solar PV facilities are distributed between
 terms of consistent hourly output as a result

trend for both the peak day and the July average. The figures show total solar output peak is going to be in the case of High and Mid assumptions and there remains significant potential for 6 PM MW with high incremental small PV assumption.

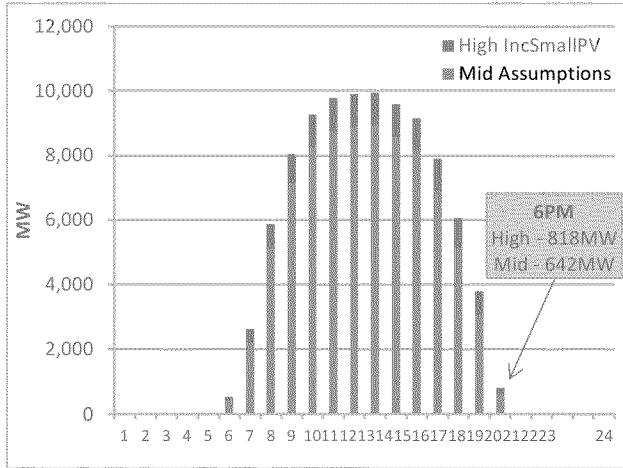


Figure 8: July 22 CA Solar PV output

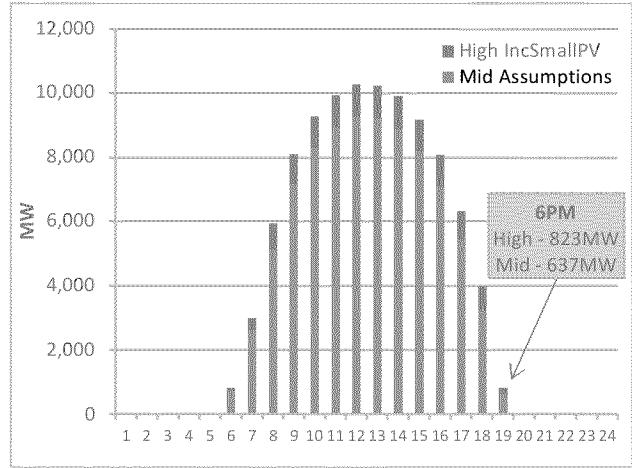


Figure 9: July Avg CA Solar PV output

Q How do the hourly wind patterns align with solar output?
 A See Figures 8 and 9. The wind facilities are also distributed consistently throughout the day. The consistent hourly output as a result of this pattern between the peak day and the July average is shown in the following table.

To some extent, the tight correlation between solar and wind output during this critical late afternoon period is a result of the geographic proximity of the solar and wind resources. It is important to recognize that stochastic weather patterns can occur during the summer months, which could result in a mismatch between solar and wind output. However, the overall pattern during July has seen a ramp up in wind output while solar output is ramping down.

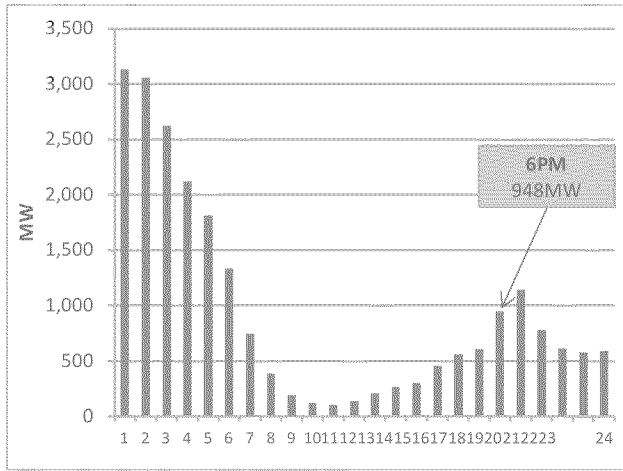


Figure 10 : July 22 CA Wind output

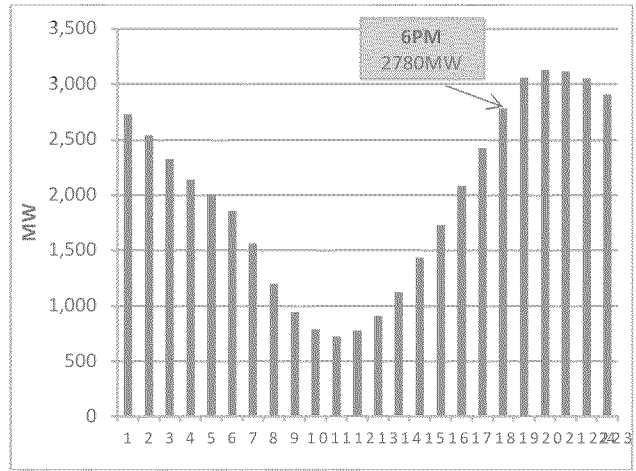


Figure 11: July Avg CA Wind output

Q How to the combined hourly wind and solar output in the base case and the high wind scenario on the day of identified shortages?

A Figure 12 shows the combined hourly wind and solar output in the base case and the high wind scenario on the day of identified shortages. The chart shows that the combined output is significantly higher during the day, peaking at 10,000 MW around 12 PM. The high wind scenario (Solar High) peaks at 10,000 MW, while the mid wind scenario (Solar Mid) peaks at 9,500 MW. The low wind scenario (Solar Low) peaks at 8,000 MW. The combined output is significantly higher during the day, peaking at 10,000 MW around 12 PM. The high wind scenario (Solar High) peaks at 10,000 MW, while the mid wind scenario (Solar Mid) peaks at 9,500 MW. The low wind scenario (Solar Low) peaks at 8,000 MW. The combined output is significantly higher during the day, peaking at 10,000 MW around 12 PM. The high wind scenario (Solar High) peaks at 10,000 MW, while the mid wind scenario (Solar Mid) peaks at 9,500 MW. The low wind scenario (Solar Low) peaks at 8,000 MW.

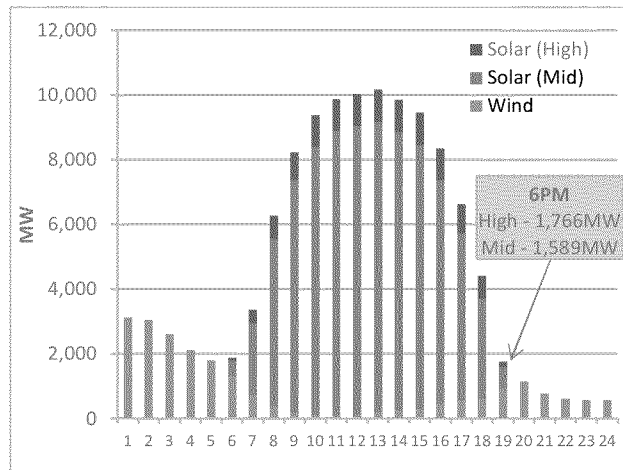


Figure 12 July 22 CA Wind + Solar Output

Q How is DR utilized throughout the month?

A DR is only actually called upon on the day of identified shortages. The amount of DR that must be used is dependent on the total usage.

Throughout the month, DR is used approximately 1,000 MW in the hours between noon and the peak.

DR output during all of July CAISO database as selected ORA Scenarios

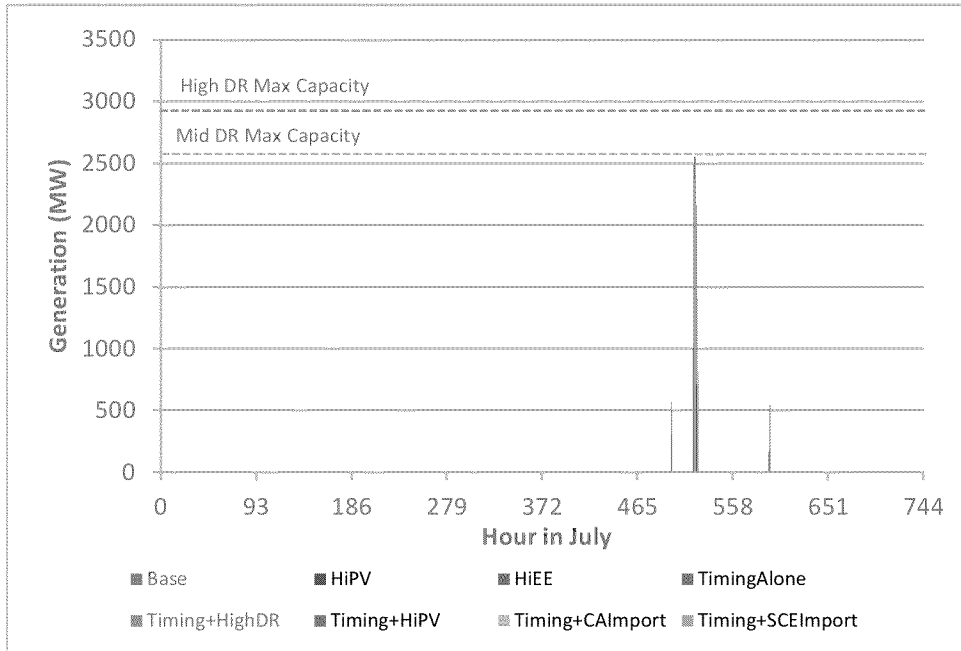


Figure 13: DR Generation in all hours of July

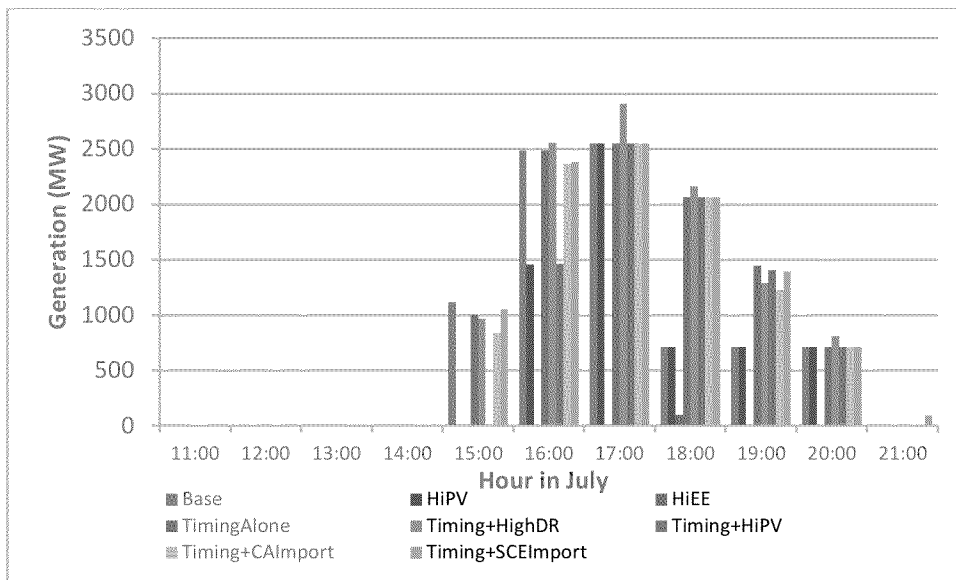


Figure 14: DR Generation on July 22

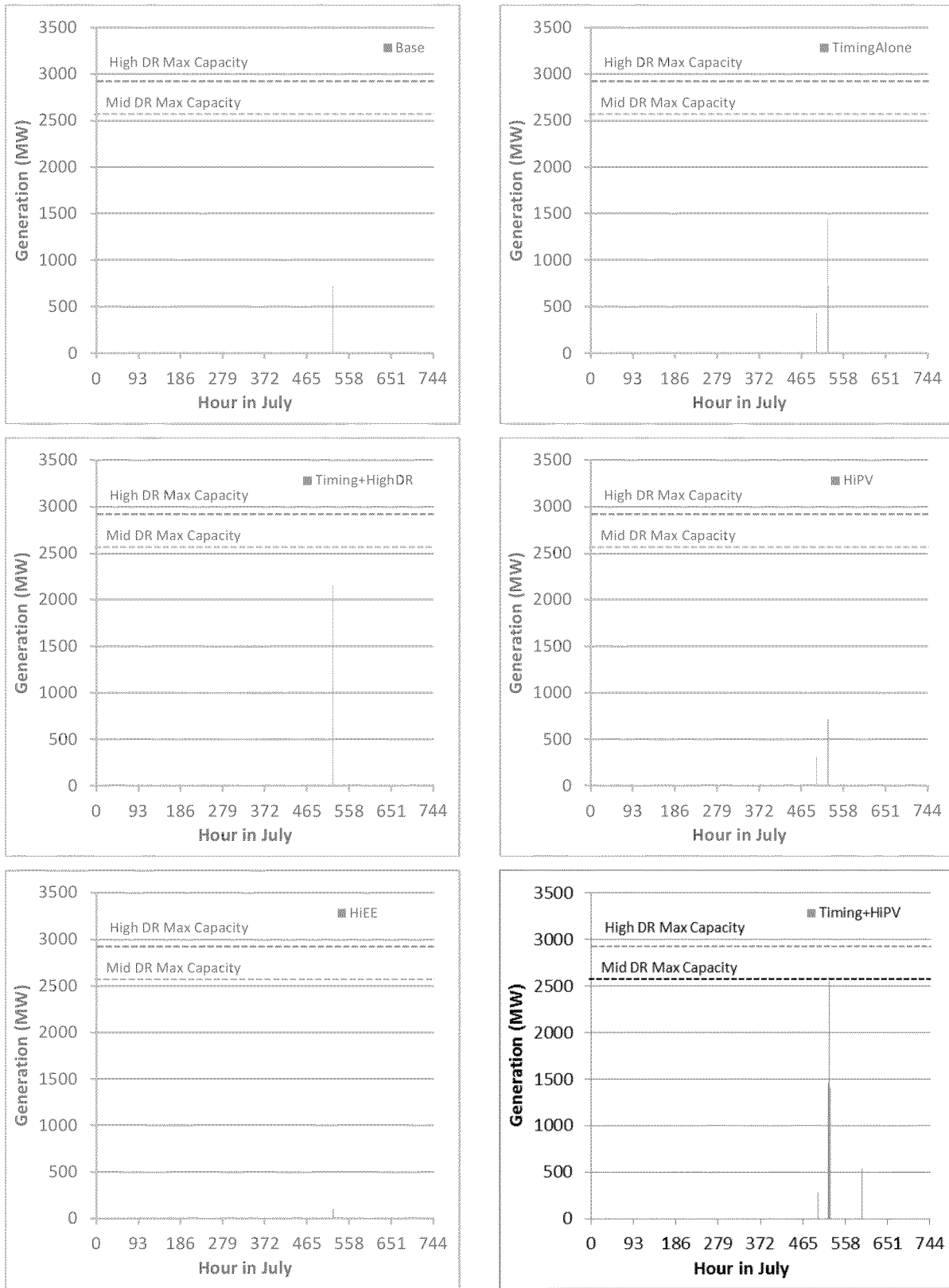


Figure 15: July DR utilization for selected **DR** Scenarios

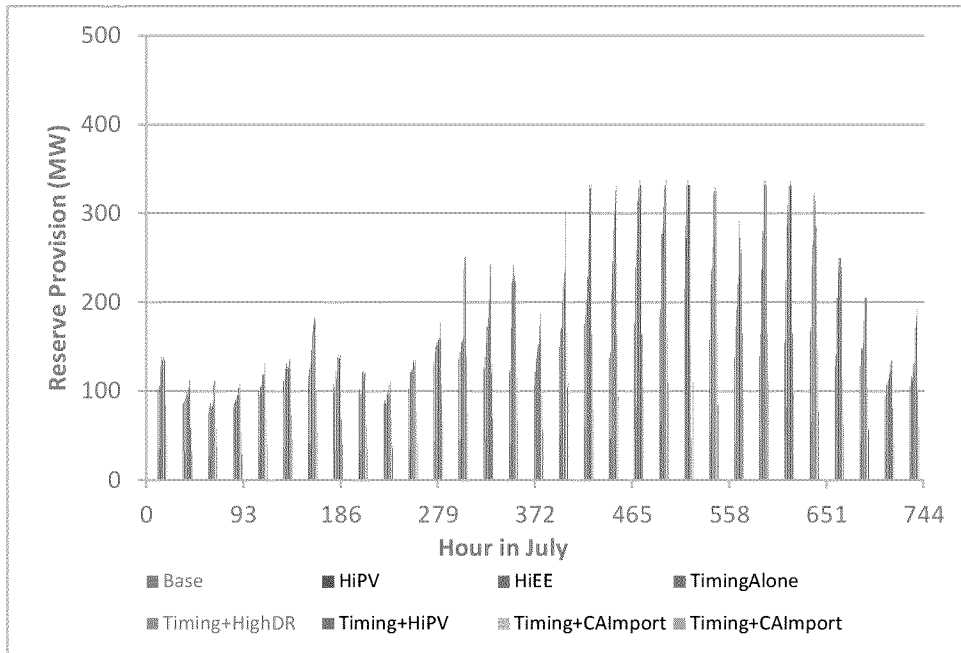


Figure 16: DR Reserve Provision all hours of July

As is seen in Figures 15 and 16, the critical hours of the month are limited to the afternoon and evening hours. The DR reserve provision is significantly higher during these hours, indicating that prices spike higher during these hours. This is due to the limited use of resources during the extreme stress period. The stress occurs on just one day in the modeled period.

As seen in Figure 16, DR provides significant reserve during the afternoon and evening hours of the month.

Resource Outages During Peak Summer Month

Q: What resources are not available in the modeled period? Please comment on the base case.

A: Total modeled outage levels in MW vary where shortage hours are greatest when MW is highly constrained. These outages can be reduced by projecting summer peak month outages.

Several major units are out of service during peak load including Palmdale High Desert and the Escondido Unit at La Paloma in the Pecos region.

coupled with²⁰ RA of renewable outages these four of capacity that when combined with improvements could eliminate the shortage on July

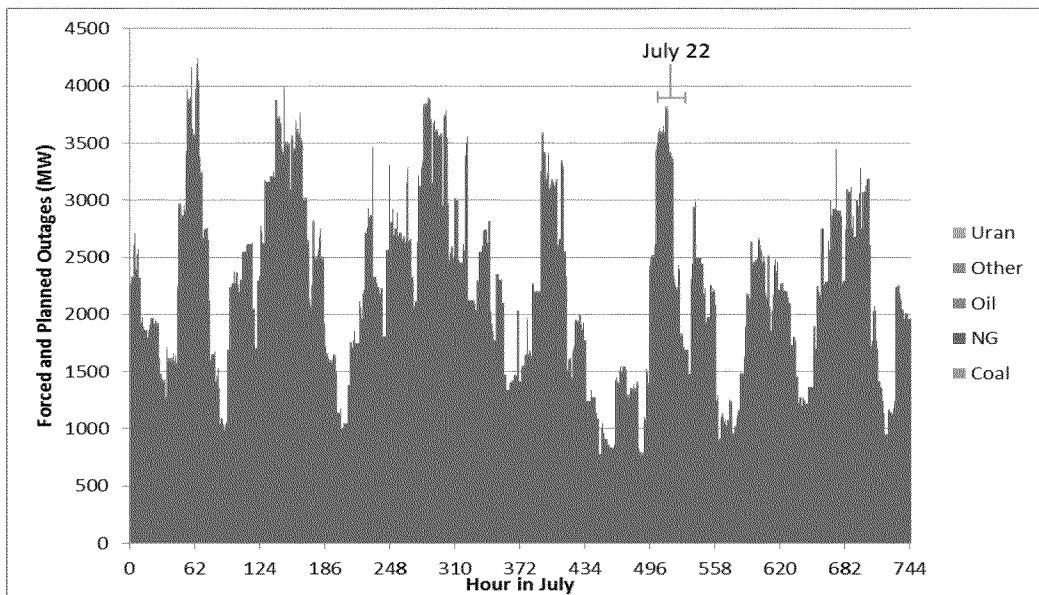


Figure 17: Modeled CA Outages in July 2022

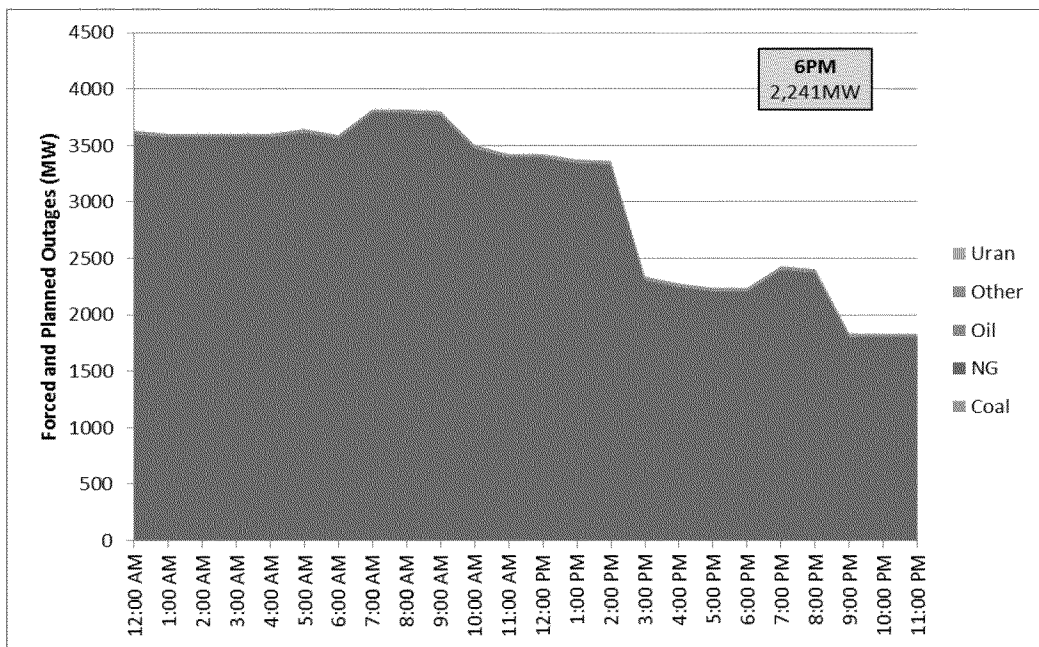


Figure 18: Modeled CA Outages on Peak Day (July 22, 2022)

²⁰ The RA construct is undergoing possible change to incorporate the value added of flexible units, and possibly increasing the RA obligation period beyond 1 year. Those changes could increase incentives to improve performance during peak periods.

ADDITIONAL DISCUSSION

Procurement Timing and Mechanisms

Q Is advance procurement based on the Track analyses you've conducted?

A Both preferred and forecast procurement ensure their deployment when a host of variables number of variables. Contingency procurement resources is sensible though advanced procurement the LTPP process could better secure their ev

Advanced procurement of forecast resources in the order I would only be needed if the resource need is not met.

Advanced procurement of forecast resources in the order I would only be needed if the resource need is not met. If there was no mechanism in place beyond those modeled as a contingency, Tables and I

Neither of these conditions is likely to be met in the case of a shortage amounting to a few hours on the extreme end. It is otherwise to obtain additional capacity to meet a shortage.

Those mechanisms include deployment of forecast resources is reflected by the inputs for very infrequently available from existing units. This is reflected in the model market mechanisms that could lead to new plants and ancillary services. The existence of the resource is also reflected in the model market mechanisms that could lead to new plants and ancillary services.

Base Case vs. TPP Forecasts as Basis for Procurement Decisions

Q What are the key differences in the assumptions?

²¹ CPUC decision on Track 2 in 2014.

²² OTC resources retire by 2020.

²³ Those markets continue to undergo refinement to reflect the increasing value of capacity that exhibits flexible operating characteristics. Such refinement includes CAISO's changes to the energy market to incorporate a flexible ramping constraint into the unit commitment and dispatch provision, and changes to intertie scheduling timeframes in accordance with FERC's Order 764.

²⁴ The RA construct is also undergoing possible change to incorporate the value added of flexible units, and possibly increasing the RA obligation period beyond 1 year. Those changes would increase incentives for market-based development of new resources.

A The TPP and base case used different assumptions for load²⁵ incremental EE project IDRs as assumptions. The TPP scenario uses²⁶ a and the base case uses a low PV increment and the base scenario uses a mid increment. The TPP and all cases use the same project IDRs. The TPP and all cases use the same project IDRs. The TPP and all cases use the same project IDRs. Both PV and non-PV load and combined load scenarios projections for gross load that the TPP scenario is a managed net demand with a higher than average demand.

Q Is it reasonable to consider the high end when assessing procurement needs?

A Possibly. This element is so sensitive to the base case demand that procurement decisions for system need to be based on the peak.

Q Is it also reasonable to consider the low end of the TPP does?

A Yes, but again as a sensitivity study. The extreme sensitivity to the base case.

Q Can you comment on the relative merits of decisions on either the base or the TPP case?

A Yes. The system capacity need determination. The Resource Adequacy program then adds a margin which in part provides a safety margin. Commission's use of a capacity requirements is based on peak load. However, for system capacity, more than a peak load is needed because it is unlikely that the CAISO region load areas at the same time.

Track 1, Track 4, and OTC Retirement Assumptions

Q How are assumptions concerning new assets or consideration in Track reflected in the T

²⁵ This is the term used in the CPUC Scenario Tool spreadsheet.
²⁶ Form 1.5c.
²⁷ Form 1.5b.

A Some of the authorized TEA&O barsees ocuarscee modeling Notably TrachK excepte f s r i s d a f e present in the modeled assumpbf on h e l a u t h o n l y e fired resources are consideif d e i d n O t R A e S C A I n S a O i b greater levels of preferred r T e s a c k r c e s a u t s l s e m i t a Table below shows which T a n d k w h i c a h u t a h r o e r i e x a c t l No resources potentially avare abhel f i d e n T r a c k except in one sensitivity O R A s S u e n e s i t h a t m a authorized can be subtracteda l f r o a n y a n y i T r a n d k e s Track authorization H o r r e s u l t t r s a n a s m i s s i s i n g o n f process H T P P I e f f o r t s I i n t e n d s a p p e a t t h a t a the California import limit i t m p o e t s i n c h f e a s e d e x i external systems I can direckly maekeed up part

| | CC | CT | Storage | Tr Preferred Resources Excluded |
|--------------|------------------------------------|-------------------------|---------|--|
| SDE | | | | Excluded |
| SCE | | | | Excluded |
| Big Creek | Ve Fix u r a d e | Ex cl u d e | Ad | Excluded |

Table 4: Track 1 Resources reflected in the Track 2 Modeling

Q How are OTC resources t r e a t e d i n g t h e C A A
A All OTC resources are a s i s m e n d s i r e t i o f e d a n y potential extension of retirement date is con
Q What effect could an extendeed retirement
A Any extended retirement dates r f d n c a n y h e Track need by roughly the level of output o
Q Please discuss the roldeate i e f x t a e n n y s i o n o f f o p r plants
A Extension of OTC retireme n i t n s d u a r t a e n s c e c o p u o l l d i cost avoidance measure o r t h e c C A T i s O g e r e t g i p l a n most scenarios with success faup a c p i r t e y f e o r u t e p d u t r e f s r o o units with an extended retirevmeernyt b d r a i t e e f m p i e g r h i t o d Total air emissions from OTC d u n i o t s r w h o s a b i l i t y would likely be very low as f g e n e i a t h l e y t e m e y g w o ancillary ser²⁸ v i c T o r s e q u e m e r e x t e n t s O T C r e t i r e m e a bridge to a period whemi s s o i m e n c c o a m p a i n i a t t y i o a

²⁸ The California Air Resources Board (ARB) and the State Water Resources Control Board (SWRCB) may allow, or be more open to, an OTC extension intended only as an extreme day backup, with extremely limited or no cooling water withdrawals and air emissions. Certain OTC units could be fully offline (i.e., mothballed) for 9 months, available as a backup only for predicted extreme peak days during the summer.

increases in preferred resources would be unlikely to place OTC extension could serve as a contingency for gas fired resources near or around the Park. Their testimony does not address the alternative insurance policy vs other app

Critical Periods for System Resource Need

Q What do the modeling results show especially those periods when it is most likely to

A As seen in the modeling results the H howe sections critical periods peak early in the the concern is essentially fall in the relatively broad array of resources do not necessarily feed into construction to years sampling flexibility during any base scenario period whatsoever in the high D DSM scenario registered about spring afternoon reveals that the system is stressed based on current supply resources in CAISO and California to retirements. The main difference between in the base case modeling and the critical hour is shifted a head slightly later late afternoon decline

Import Considerations

Q What statewide import limits are used in

A The model uses summer peak CAISO's high DSM case use contributes to the shortage in the key

Q What other transmission limits are used

A The imports into SCE and the SCE service area total load violation occurs

Q Please discuss the import limitations

²⁹ Track 4 testimonies of SCE and SDG&E.

³⁰ Numerous presentations by stakeholders have used or cited the so-called "duck graph" when highlighting the potential late afternoon/early evening ramping concerns that may exist when the state has more solar resources online. For example, as presented by the CAISO during the February, 2013 en banc "Capacity Summit".

Generally, the import limit and associated system to see zero modeled scenario conditions without adding transmission improvements and or increased generation requirements could increase the need determination.

California has always depended on natural gas to maximize the utilization of its renewable integration resources. WECC with the coordination on CAISO and CA as a whole will need to increase in the overall. CAISO to tap into existing resources during the days and reduce potential infrequent periods with tight system resource.

CAISO Track 2 Modeling

Please comment on CAISO's assumptions of Track

CAISO's implementation of the Track scoping memo assumptions excluding the preferred resources. Except for the supported the case, CAISO has also run sensitivities exploring they use for such sensitivities particularly for the hours of the day. Many of our

Please comment on CAISO's results

We have replicated CAISO's results on our own systems. Last minute corrections in our modeling from solar PV resources that affect the modeling.

³¹ This is seen in the material made available by CAISO on how the Southern California Import Transmission (SCIT) limited is affected by numerous factors; and is evidenced by the values used by CAISO in its modeling of the transmission limits for the base case, vs. the high DG/DSM case.

³² For example, PacifiCorp and the CAISO have signed a Memorandum of Understanding that could result in PacifiCorp resources being available to be directly dispatched in the CAISO energy markets, and continued efforts to establish a WECC-wide energy imbalance market to improve the scheduling and coordination of power flows across the western regions. Some of this coordination is driver by the FERC's rulings (Order 764) on improved transmission scheduling between balancing areas.

³³ Many factors would influence the extent to which California path import capacity could be better utilized with existing assets, or could be increased with increased transmission capacity.

CONCLUSIONS/RECOMMENDATIONS

Q What is your overall conclusion regarding the ability to provide service in the CAISO region by

A We find that deploying gas peaker resources and ensure sufficient system flexibility levels of resources EE and DR restoration plans are economically beneficial. Also, investments in resources that reflect high incremental costs are not being made during the critical period.

In our opinion, no additional resources are needed because the duration and pattern of demand does not exist to develop incremental capacity. Those resources include in-state gas peakers and are considered in the high demand period.

Select OTC resources can be used if preferred resource development timelines fall short. OTC resource goals are reached.

We also note that transmission system constraints, especially low hanging fruit transmission, may require supply alternatives noted in the CAISO Transmission Plan for the San Diego area.³⁴ Alternative resources can help to improve resources to be dispatched under tight conditions.

Q Does this conclude your testimony?

A Yes

³⁴ Preliminary Reliability Plan for LA Basin and San Diego, Draft, August 30, 2013. Prepared by Staff of the California Public Utilities Commission, California Energy Commission, and California Independent System Operator.

WITNESS QUALIFICATIONS – ROBERT M. FAGAN

Q. Please state your name, position and business address.

A. My name is Robert M. Fagan. I am a Principal Associate with Synapse Energy Economics, Inc., 485 Massachusetts Ave., Cambridge, MA 02139. I have been employed in that position since 2005.

Q. Please state your qualifications.

A. My full qualifications are listed in my resume, on the following pages. I am a mechanical engineer and energy economics analyst, and I have examined energy industry issues for more than 25 years. My activities focus on many aspects of the electric power industry, especially economic and technical analysis of electric supply and delivery systems, wholesale and retail electricity provision, energy and capacity market structures, renewable resource alternatives including on-shore and off-shore wind and solar PV, and assessment and implementation of energy efficiency and demand response alternatives.

I hold an MA from Boston University in Energy and Environmental Studies and a BS from Clarkson University in Mechanical Engineering. I have completed additional course work in wind integration, solar engineering, regulatory and legal aspects of electric power systems, building controls, cogeneration, lighting design and mechanical and aerospace engineering.

Q. Have you testified before the CPUC before?

A. Yes, in Track 1 of this proceeding, and in the A.11-05-023 SDG&E need case. I have also testified in numerous state and provincial jurisdictions, and the Federal Energy Regulatory Commission (FERC), on various aspects of the electric power industry including renewable resource integration, transmission system planning, resource need, and the effects of demand-side resources on the electric power system.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the California Public Utilities Commission's Office of Ratepayer Advocates (ORA).

WITNESS QUALIFICATIONS – PATRICK LUCKOW

Q. Please state your name, position and business address.

A. My name is Patrick Luckow. I am an Associate with Synapse Energy Economics, Inc., 485 Massachusetts Ave., Cambridge, MA 02139. I have been employed in that position since I started work at Synapse in 2012.

Q. Please state your qualifications.

A. I am an Associate at Synapse, with a special focus on calibrating, running, and modifying industry-standard economic models to evaluate long-term energy plans, and the environmental and economic impacts of policy/regulatory initiatives.

Prior to joining Synapse, I worked as a scientist at the Joint Global Change Research Institute in College Park, Maryland. In this position, I evaluated the long-term implications of potential climate policies, both internationally and in the U.S., across a range of energy and electricity models. This work included leading a team studying global wind energy resources and their interaction in the Institute's integrated assessment model, and modeling large-scale biomass use in the global energy system.

I hold a Bachelor of Science degree in Mechanical Engineering from Northwestern University, and a Master of Science degree in Mechanical Engineering from the University of Maryland.

Q. Have you testified before the CPUC before?

A. No.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the California Public Utilities Commission's Office of Ratepayer Advocates (ORA).