Docket No.: A.14-11-012

Exhibit No.: _____

Date: March 25, 2015

Witness: Robert M. Fagan

PREPARED TESTIMONY OF ROBERT M. FAGAN ON BEHALF OF SIERRA CLUB REGARDING SOUTHERN CALIFORNIA EDISON 2013 LOCAL CAPACITY REQUIREMENTS REQUEST FOR OFFERS (LCR RFO) FOR THE WESTERN LOS ANGELES BASIN

PUBLIC VERSION

I. INTRODUCTION AND KEY FINDINGS AND RECOMMENDATIONS

Q. Please state your name, position, and company.

A. My name is Robert M. Fagan. I am a Principal Associate at Synapse Energy Economics, based in Cambridge, MA.

Q. Please summarize your qualifications.

A. I am a mechanical engineer and energy analyst with roughly 30 years of professional experience, focusing on electric power industry issues. My resume is attached.

Q. On whose behalf are you testifying?

A. In this docket I am testifying on behalf of the Sierra Club.

Q. Have you testified before the California Public Utilities Commission (CPUC) before?

A. Yes. I testified before the CPUC in the 2012 and 2014 Long-Term Procurement Plan (LTPP) dockets,[1] in the San Diego Purchase Power Tolling Agreement docket,[2] in the Residential Order Instituting Ratemaking (OIR) proceeding,[3] the San Diego Rate Design Window (RDW) proceeding,[4] and have submitted pre-filed testimony in the Southern California Edison (SCE) General Rate Case Phase 2 proceeding.[5] In those dockets I testified on behalf of the California Office of Ratepayer Advocates (ORA).

Q. What is the purpose of this testimony?

A. The purpose of this testimony is to address Southern California Edison's results and evaluation and selection processes associated with their Request for Offers (RFO) for local capacity requirements (LCR) in the Western Los Angeles basin. That RFO was issued in response to the CPUC's authorization for local resource procurement pursuant to the Track 4 and Track 1 decisions in the 2012 LTPP proceeding.[6]

Q. What steps did you follow in conducting your review?

A. I reviewed Southern California Edison's testimony and attachments, including the Independent Evaluator report. I helped develop discovery questions for SCE. I analyzed the results of the selection process, focusing on the valuation processes used. Based on my review, I formed opinions on the overall reasonableness of the selected portfolio.

[1] R.12-03-014, R.13-12-010.
[2] A.11-05-023.
[3] R.12-06-014.
[4] A.14-01-027.
[5] A.14.-06-014.
[6] Decision 13-02-015, February 13, 2013 (Track 1 of the 2012 LTPP); and Decision 14-03-004, March 13, 2014 (Track 4 of the 2012 LTPP).

Q. What are your findings and recommendations?

A. My key findings and recommendations are summarized below.

1) SCE's imposition of significant limits on In-Front-of-Meter Energy Storage was unreasonable and would result in costly additional fossil fuel procurement.

In finalizing its bids, SCE decided to restrict the choice of economic in-front-of-meter energy storage (IFOM ES) to 100 MW.[7] Prior to this restriction, SCE's optimization runs showed over 400 to over 900 MW of IFOM ES as the most economic resource.[8] SCE's 100 MW IFOM ES limitation resulted in unnecessary increased total cost of LCR resource deployment and under-procurement of ES resources that would provide significant grid benefits.

SCE's IFOM ES limitation appears arbitrary. It is not supported by information available from the California Independent System Operator (CAISO) on storage interconnection and charging issues.[9] SCE also attempted to justify the IFOM ES limitation by asserting the ancillary service benefits ascribed to IFOM ES by SCE in its own model are exaggerated, but did not provide adequate support for this contention.[10] On the contrary, ancillary service benefits attributed to IFOM ES resources are fundamentally logical, following from the technical merits of the resource. The Independent Evaluator even states "[redacted]."[11]

SCE's restriction on IFOM ES resulted in additional procurement of fossil fuels. In particular, the proposed 98 MW Stanton Energy Center peaker was selected after the IFOM ES restriction was imposed. This indicates the proposed Stanton Energy Center is

[7] *See, e.g.,* SCE-1 Testimony at pages 53, 57-58.
[8] SCE-1 Testimony at page 57.
[9] As noted in the testimony, CAISO's "Energy Storage Interconnection: Draft Final Proposal," November 18, 2014, contains highly relevant material addressing SCE concerns about interconnection and charging issues for storage resources.
[10] At page 53 of its testimony, SCE states "In addition, SCE's valuation of IFOM ES offers assumed unconstrained operations in CAISO markets leading to significant assessed AS [ancillary service] revenues from participating in AS markets during all hours. Current uncertainty around the interconnection of IFOM ES, which may result in restrictions on charging ability during peak hours, and uncertainty on how IFOM ES will actually participate in CAISO markets, warranted SCE to assume that its IFOM ES valuation results may be higher than what will be achieved." This qualitative statement is the extent of SCE's support for its assertion.
[11] [redacted]

less economic than IFOM ES bids.[12] In addition, as a proposed peaker intended to operate at very low capacity factor, its benefits are primarily limited to providing resource adequacy. In contrast, IFOM ES benefits include energy, capacity (resource adequacy), and ancillary service benefits.[13] The ability to provide such flexible operation, seen with the IFOM ES resource, will increasingly be needed as California progresses to higher penetrations of renewables and likely continues to reduce overall greenhouse gas emissions.

2) Procurement of gas-fired generation should be reduced to its 1,000 MW minimum.

Although SCE was authorized to procure a 1,000 MW minimum of gas-fired generation (GFG), SCE's final selection consists of 1,452 MW of GFG (a 644 MW combined cycle facility at Huntington Beach, a 640 MW combined cycle facility at Alamitos, a 98 MW combustion turbine peaker at Stanton, and 70 MW of fossil-fuel back-up generation in the preferred resource category). As part of its assessment of remaining resource selection if increased IFOM ES resources are included in a final selection set, SCE should consider lower levels of GFG.

Several factors merit reducing the total amount of GFG selected toward minimum requirements. First, the Loading Order requires SCE to procure preferred resources and energy storage to the fullest extent possible.[14] As set forth above, additional IFOM ES should be procured and, in accordance with the Loading Order, displace procurement of fossil fuels rather than increasing the total amount of resource procurement or reducing the level of resources from other categories.

Second, minimizing new long-term fossil fuel commitments will better prepare SCE for likely future requirements, such as a higher RPS, needed to decarbonize the energy sector. Reducing GFG procurement to the minimum requirement puts SCE in a better position to continue undertaking procurement of the least expensive and shortest time-to-deployment preferred resources.

Third, to facilitate reductions in greenhouse gas (GHG) pollution, SCE should reduce, if not minimize, its reliance on gas-fired *energy* when considering LCR resource procurement, which fundamentally is addressing a local *capacity* need. Selection of more than 1,284 MW of gas-fired combined-cycle energy generation may not support this aim. Other procurement proceedings, such as the next round of the LTPP, are better venues to

[12] [redacted]
For example, I compute overall ancillary service benefit share to be roughly [redacted] for the Stanton peaker, based on the information provided in response to CPUC Set 1, Question 1, Attachment 2 of 2, the worksheet tab labeled "Component Discounted All Offers." The comparable value for IFOM ES resources, based on the selected 100 MW offer, is [redacted].

[14] See, for example, Track 1 Decision 13-02-015 at page 11.

address the myriad issues associated with GHG reduction planning and in particular the optimal role for existing and possibly new gas-fired combined-cycle energy production.

Fourth, expected transmission improvements that have come to pass since the Track 1 and Track 4 Decisions will bolster reliability in the region and support capacity procurement at the lower end of the LTPP Decisions' range. The California Independent System Operator approval and inclusion in its transmission plan of significant increases in reactive resources and key transmission lines such as the Mesa Loop-in and the Imperial Valley Flow Controller support LCR resource procurement at the low end of the range provided in the Track 1 and Track 4 Decisions.[15]

3) Of the minimum gas generation procured, SCE should consider procuring a larger percentage of combustion turbine capacity resource, and a lower percentage of combined cycle energy resource.

For the GFG selected, an inordinate amount of the SCE-computed economic benefit comes from energy from combined-cycle (CC) resources. In any future policy world with larger levels of renewable resources, it is likely that the net value per MWh (or margin, equal roughly to spot price received minus variable cost of production) of energy from combined cycle units will be lower than has been estimated by SCE using the 33% RPS levels. Combined with Loading Order concerns, and LCR needs driven by a small number of hours per year, SCE should consider specifying a larger percentage of combustion turbine (CT) resources and a smaller percentage of CC resources of its 1,000 MW minimum fossil fuel authorization.

4) SCE should not procure fossil-fueled back-up generation as part of its preferred resources procurement requirements.

Emission-producing, non-CHP fossil-fueled back-up generation (BUGs) should not be part of the procurement reserved for preferred resources and energy storage. 70 of the 75 MW of demand response selections were natural gas back up generation.

II. ANALYSIS OF SCE RESOURCE SELECTIONS

Q. What LCR resources did SCE select for its procurement portfolio?

A. Table 1 lists the resources selected, along with key metrics describing the costs for those resources and the portion of resource benefits that come from providing energy, capacity, or ancillary services (together, these three components make up 100% of any given resource's benefit).

[15] 2013/2014 Transmission Plan, Table 2.6-5: Summary of Proposed Transmission Solutions, Cost Estimates, and Local Resource Reduction Benefits.

Table 1. SCE's Selected Offers – West LA Basin RFO

Resource Type by Category	LCR MW	Net Present Value, $ Millions	Nominal Capacity Costs, $ Millions	Disounted Capacity Costs, $ Millions	Share of Disc. Cap Costs	Discounted Capacity Costs, $/kW-mo	Nominal Capacity Costs, $/kW-mo	Discounted Premium, Contract kW-mo, $/kW-mo	Energy benefit share	Capacity benefit share	Ancillary Service benefit share
DR (BUG=70 MW)	75	[redacted]									
EE	124										
ES (DR) BTM Battery Sm	135										
ES (IFOM) Battery Lg	100										
ES (PLS) Ice	29										
GFG	1,382										
Stanton CT	49										
Stanton CT	49										
Alamitos CC	640										
Hunt Beach CC	644										
RPS PV	38										
Grand Total	1,883										

Source: Synapse tabulation, based on response to discovery.

Q. Please describe the RFO selection results shown in Table 1.

A. Table 1 summarizes SCE's selected resources in the Western LA Basin. It indicates:

- [redacted], or normalized cost, for all alternatives. The discounted premium value provided is essentially the costs minus the benefits associated with the resource, normalized for the contract capacity in kW-month. "Discounted" means that the time value of money and the time period of payments and benefits are accounted for. A "negative" discounted premium (associated with a positive net present value) means that the resource provides a net benefit to ratepayers; a "positive" discounted premium (associated with a negative net present value) means that the resource has a net cost to ratepayers. The costs are based on the resource offer characteristics; the benefits are based on SCE's estimate of the value of energy, capacity, and ancillary service provision provided by the resource.

  That these [redacted] are the least costly of all resources chosen, and indeed provide a positive net benefit, illustrates the importance of SCE continuing to aggressively pursue procurement of these resources in future solicitations.

- In Front of Meter energy storage is [redacted]

- [redacted] of the total "discounted" cost of capacity for the sum of all selected LCR resources is for energy-producing CC resources, and roughly [redacted] of those capacity costs are for gas-fired generation (including distributed gas fired generation in the demand response preferred resource category). This is at least qualitatively at odds with California's Loading Order energy policy and represents a risk of committing ratepayer funds to 20-

plus years' worth of incremental energy generation from greenhouse-gas-emitting gas-fired generation.

- More than [redacted] of SCE-valued benefits associated with the gas-fired CC units come from energy provision.

Q. Is there anything else noteworthy about the comparison between different resource offers shown in Table 1?

A. Yes. It is notable that the cost of [redacted]

Q. Please provide a comparison between the IFOM ES and the gas-fired generation offers, both those selected by SCE for procurement and those not selected.

A. Table 2 below shows comparative economics between the IFOM ES and gas-fired generation offers, both those selected and those not selected by SCE.

Table 2. Comparison Across IFOM ES and GFG Offers – LA Basin

Resource Type by Category	[redacted]
ES (IFOM)	
Other Lg_IFOM (> 50 MW)	
Other Med_IFOM (10 - 50 MW)	
Other Sm_IFOM (< 10 MW)	
Selected IFOM	
GFG	
Other CC	
Other CT	
Selected GFG	

Note/Source: Synapse tabulation from discovery response. LCR Final Offers Remaining MW based on SCE Table VI-11 minus selected resources.

Q. Please explain what Table 2 illustrates.

A. Table 2 illustrates the following:

- A significant amount of IFOM resource was not selected [redacted]. Larger size battery storage offers [redacted] were available for selection, but were not taken by SCE. Not shown in this table is SCE's demonstration of "cost effective" IFOM ES from [redacted]

[redacted] SCE's response to discovery[16] indicates up to [redacted] of IFOM was "drawn" as part of SCE's selection process when considering a range of variables to ascertain the value of a selected portfolio.

- A significant amount of [redacted] remains available. [redacted]

- As noted later in this testimony, GFG, and, in particular CC resource energy valuation is sensitive to assumptions around RPS requirements. To the extent that California's policies going forward lead to higher RPS levels, and a continued push for lower carbon energy, the valuation of resources with benefits highly dependent on energy revenue (CC resources, and to a lesser extent CT resources) may be lower.

III. CRITIQUE OF SCE TESTIMONY/IE REPORT ON INTERCONNECTION AND TARIFF ISSUES, AND THE VALUE OF IFOM ES

Q. Has SCE provided adequate support for its decision to significantly "cap" IFOM ES resources at 100 MW?

A. No. SCE has not provided adequate support to depart from its economics-based "Initial Selection Set" for West LA Basin resources. SCE's optimization tool created a selection of 25 draws. All draws "contained significant amounts of IFOM ES" with Draw 1 having over 400 MW and Draw 25 having over 900 MW of IFOM ES.[17] In [redacted], SCE indicates [redacted] of IFOM ES were among the selected set of resources.

Q. On what does SCE base its decision to limit IFOM ES resource selection to 100 MW?

A. SCE bases its decision to limit IFOM ES provision to 100 MW in the LA Basin on the following:[18]

- Uncertainty around future interconnection requirements and potential tariffs for charging and discharging rates.

- Concerns that the ES resource might need to charge during peak periods.

- Concerns that the ancillary service valuation overestimates actual value.

[16] Sierra Club Set 1, Question 3a, Attachment 2 (confidential response).
[17] SCE-001 at page 57.
[18] As noted at Sections IV.E.2, IV.E.3, and VI.C.3 of SCE-1 Testimony.

Q. Are you persuaded by SCE's explanation of the interconnection and tariff concerns that it uses to justify the significant limits it imposed on IFOM ES procurement?

A. No. In a data request, Sierra Club asked SCE to explain its assertion that uncertainty around interconnection for energy storage led SCE to impose a 100 MW constraint. SCE responded that it was uncertain about (1) the transmission and distribution access charges that may be assessed on IFOM ES, (2) the process for interconnecting these resources, and (3) the potential that charging restrictions may be imposed during the interconnection process.[19] SCE argued that these uncertainties created the risk that its own NPV calculations for storage were too high, so "SCE found it prudent to reduce the amount of risk to customers by constraining the amount of in-front-of-the-meter energy storage."[20]

However, the concerns expressed by SCE have been largely resolved. The CAISO's recent proposal on the interconnection process for energy storage said that SCE's proposed "charging deliverability assessment," which is essentially an assessment to see if additional network transmission upgrades are required to ensure a storage resource can be fully charged, is not needed at this time.[21] This reassurance from CAISO largely dispels SCE's concerns over tariff charging and interconnection issues. CAISO also stated in the Draft Final Proposal that storage "has the potential to increase the efficient utilization of transmission infrastructure and reduce the need for additional transmission upgrades rather than being the cause or driver for additional network upgrades."[22] In short, "unresolved regulatory issues" related to energy storage interconnection and charging/discharging issues do not justify the significant limits SCE imposed on IFOM ES selection.

Q. Are you persuaded by SCE's concern that the inability to charge a battery during peak hours might affect the value of the energy storage resources?

A. No. This concern is unsupported by the record. Instead, evidence suggests that energy storage devices may improve the utilization of the transmission system, rather than be limited by it.

Sierra Club asked SCE in a data request how and why theoretical inability to charge during peak hours was factored into SCE's decision to limit the total IFOM ES resource selection to 100 MW. SCE responded that it was concerned about a scenario where the most valuable use of energy storage would be to provide "regulation down" during peak hours. SCE further argued that "as California's resource mix continues to change over the

[19] Sierra Club Set A.14-11-012 LCR RFO-Sierra Club-SCE-001 Question 05a (1/22/2015).
[20] *Id.*
[21] CAISO, Energy Storage Interconnection, Draft Final Proposal (Nov. 18, 2014) at pp. 29, 32, http://www.caiso.com/Documents/DraftFinalProposal_EnergyStorageInterconnection.pdf.
[22] *Id.* at 32.

next several years (as the CAISO's "duck chart" indicates), it is possible that it will be most economic for storage to charge during peak times. If there are local charging constraints, however, the energy storage device would not be able to charge and realize these potential values."[23]

This concern does not merit limiting storage procurement. As CAISO explains,

> . . . there is no specific system condition when the energy storage facilities must be able to charge. While the idea of a worst-case study may sound appealing**,** it is not clear how a worst case would be defined or that it actually would prevent the storage resource from charging. ... [I]f an energy storage facility is not able to charge under peak conditions**,** then it could be charged during off-peak, such as mid-day when there is excess solar energy or during the night. Thus, no matter how the ISO tries to define a worst-case situation, it cannot definitively demonstrate the impossibility of the resource achieving its full state of charge some time during the 24-hour period.[24]

CAISO is effectively saying that you don't have to charge a storage resource during peak conditions if you are not able to; there are other hours in the day when the resource can be charged. In my opinion, this implies that charging limitation concerns are not sufficient to render a storage device less useful as a LCR resource; it can still be available as an efficient, transmission-utilization-improving, capacity-providing resource during critical periods.

With respect to SCE's concern that a storage resource might not be able to provide "regulation down" if it cannot charge during peak periods, a resource doesn't have to provide "regulation down" in order to provide the core capacity value to be considered a LCR resource.[25] Provision of LCR capacity during times of system stress includes providing energy, spinning reserve, load following up, or regulation up ancillary services, none of which require peak period charging. Being unable to provide regulation down service at certain intervals does not restrict the resource from providing LCR capacity, it just means there is a possibility that at some times it might not be able to provide regulation down service – this does not preclude it from being a capacity resource.

SCE's data request response also references the CAISO "duck chart." Notably, the most severe needs for LCR resources occur in summer afternoons, at periods when the need from the storage resource is for load following up, energy, or spinning reserve. The patterns revealed by the "duck chart" – which are most acute during cool, sunny spring

[23] Sierra Club Set A.14-11-012 LCR RFO-Sierra Club-SCE-001 Question 07a.
[24] CAISO, Energy Storage Interconnection, Draft Final Proposal, November 18, 2014. Page 30-31.
[25] See above, response to question 7a, Sierra Club set 1.

days with minimal air conditional load – do not indicate that storage resources won't be able to provide "ramping up" capacity at the times it is needed.

Q. Assuming SCE is correct that a range of unknowns may affect the value of front-of-meter energy storage, are you persuaded by SCE's rationale of its decision not to perform a sensitivity testing of the potential range of values?

A. No. SCE cites "several challenges" influencing its decision not to conduct a sensitivity valuation, the import of which seemed to be that the analysis was too complicated:

> SCE has not calculated ranges of operational constraints that may be imposed on operations, the impact that the interconnection location has on these constraints, and what the probabilities are for various levels of constraints at each location. Similarly, the potential for capital lease accounting treatment and the resulting debt equivalents impact and related capital structuring issues has not been thoroughly analyzed, and calculating estimates of potential costs and probabilities would have been too time-consuming to complete during the solicitation. Additionally, to produce a sensitivity analysis around those issues would also require an analysis on the resulting selection sets. Given the large amount of interdependence on the offers, such an analysis would have caused delays in the process. Furthermore, the confidence intervals around the described analysis would have been too uncertain to rely upon. Therefore, SCE did not perform a sensitivity analysis on IFOM ES values.[26]

SCE did not perform a sensitivity analysis, but they nonetheless decided that the set of assumptions they used to perform the ancillary services valuation of IFOM ES resources was incorrect, or at least highly uncertain. Given that there appears to be very significant competition between two key resources – IFOM ES and GFG – it seems apparent that it is incumbent upon SCE to somehow determine if their original assumption set about the value of IFOM ES resources is reasonable or not. Based on the information provided by the CAISO in the draft interconnection proposal, I assert that SCE's restriction on the amount of IFOM ES chosen is indeed unreasonable, and their original assessment of IFOM ES value – [redacted] - should stand.

Q. Overall, do you believe SCE is correct to limit in-front-of-meter storage procurement based on the concern that SCE's NPV methodology over-estimates their value?

[26] Discovery Set A.14-11-012 LCR RFO-Sierra Club-SCE-001 Question 6b

A. No. SCE should not have imposed an arbitrary limit on storage procurement, based solely on the concern that the company's own methodology must be over-estimating the value of these resources. CAISO's analysis found no reason to be concerned that IFOM storage will be unable to provide ancillary services when needed, and does not support SCE's conclusion that ES value is overestimated in SCE's analysis.

Q. Do you have any additional observations about SCE's treatment of IFOM ES?

Yes. I am concerned that SCE focused on the purported uncertainties in IFOM ES to justify significant limits on its procurement while seeming to ignore the significant uncertainties resulting from additional long-term commitments to new fossil-fuel facilities. In evaluating potential resources, SCE assumes the RPS remained at 33 percent. However, Governor Brown has set a goal for California to derive 50 percent of its electricity from renewable energy by 2030, only half-way through the contract life of SCE's proposed GFG facilities.[27] As set forth above, higher renewable requirements could decrease the value SCE assigned to gas-fired generation, and in particular, that of combined cycle facilities.

In addition, because energy storage is well suited to assist in the integration of high levels of renewable generation, in contrast to gas-fired generation, investments in storage are not likely to decrease in value with higher renewable requirements. For example, unlike gas-fired generation, battery storage does not have operating limits due to air permitting limitations, it can quickly ramp to full capacity, and is flexible throughout its entire range. Because energy storage can charge and discharge, it essentially has a flexible range twice its nameplate capacity.

IV. ENERGY PRICE/RPS LEVEL ASSUMPTIONS AND POTENTIAL EFFECT ON BENEFITS TO GFG, AND IN PARTICULAR, COMBINED CYCLE RESOURCE OPTIONS

Q. Is it possible that the year-over-year stream of benefits being ascribed to SCE's selected combined cycle resources is exaggerated?

A. Yes. If a policy scenario arises in California that mandates a higher level of renewable resources, the energy benefits ascribed to infra-marginal resources such as the selected combined-cycle units may be lower than SCE's evaluation process indicated. Over [redacted] of the benefits of this selected resource category (both selected units, at Alamitos and Huntington Beach) come from energy, rather than capacity or ancillary service provision (see Table 1). Energy clearing prices under 33% RPS levels will be higher than under scenarios where a higher level of renewables is installed.

[27] Office of Governor Brown Press Release, "Governor Brown Sworn In, Delivers Inaugural Address" (Jan. 5, 2015). http://gov.ca.gov/news.php?id=18828

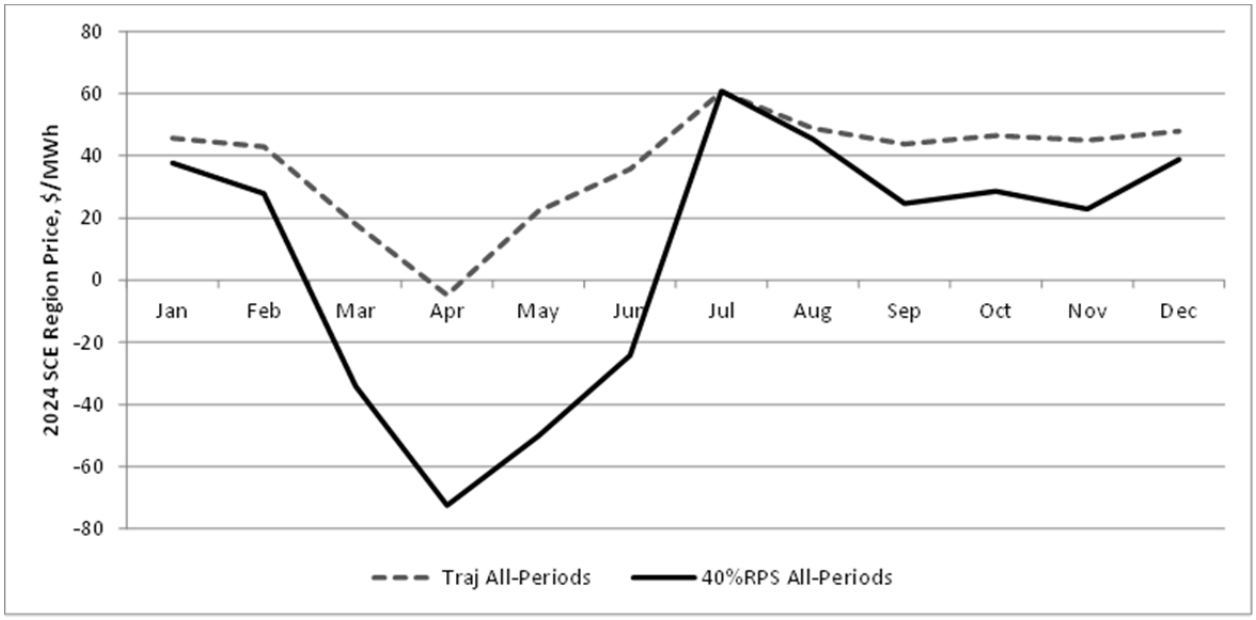
Q. Please describe the information available that would indicate how energy benefits from a new combined-cycle resource in California might change under conditions where a higher level of renewable resources – beyond 33% -- was deployed in California.

A. The 2014 LTPP process included California ISO model runs for a 2024 scenario where 40% RPS resources were assumed; the baseline (or "trajectory" case) level was 33%. Figure 1 below shows the pattern of price differences between the trajectory case and the 40% RPS case in 2024 from the CAISO runs.

Q. How did you produce Figure 1?

A. Figure 1 is taken directly from data provided by the CAISO[28] as "processed results" for the Trajectory scenario and the 40% RPS scenario, run by CAISO using the PLEXOS production cost model, in the 2014 LTPP proceeding. The values shown are for the SCE region for 2024; "all periods" means that the prices are average hourly values, by month, across the year.

Figure 1. Forecast 2024 Prices From 2014 LTPP, SCE Region, Trajectory and 40% RPS Scenarios



Source: Synapse tabulation of values from the CAISO Trajectory and 40% RPS scenarios, for the SCE area, for "all periods."

Q. Please explain what Figure 1 implies for the value of energy from combined cycle resources.

[28] This information was posted by CAISO on the ftp site used to disseminate results to interested parties.

A. While pricing for the spring periods in Figure 1 does not reflect likely exports or different curtailment provisions for renewables, the overall pattern does indicate that under future scenarios with higher levels of renewables in California, the spot price of energy will be lower relative to a trajectory case.

This will have an impact on the net value of energy provision from gas-fired combined cycle resources, because that value is based in part on the spot price of energy. These infra-marginal resources' energy output is valued at the spot price of energy, multiplied by their output.

The same modeling information also reveals that on average, CC resources in California will operate at lower average annual capacity factors in the higher renewables scenario.[29] SCE's dispatch model used in this RFO evaluation assumed 33% RPS for all years beyond 2020. To the extent that California's policy changes to one where a higher standard for RPS is used, then the valuations conducted by SCE in this RFO process likely overestimate the energy benefit provided by CC resources.

Combined cycle resources such as those selected by SCE in this RFO see most of their "benefit" (as computed by SCE) from energy provision. See Table 1. While EE and RPS resources selected in this RFO also garner most of their benefit from energy effects (avoided energy in the case of EE, and energy provision in the case of RPS resources), the combined cycle resources selected rely on a high energy "margin" for [redacted] (Alamitos) and [redacted] (Huntington Beach) of the value that is driving their selection in this process. It is the energy provision that drives their (discounted) premium down.

Without such energy margin, the discounted premium for combined cycle resources would increase. The difference in premium between the CC resource and the IFOM ES resource, already quite favorable for IFOM ES resources, would increase even more, making the IFOM ES resource even more attractive. The CC value would also move closer to the CT value, lending more credence to a decision to install more CTs, and fewer CCs, to make up the GFG minimum.

Q. Would you expect the value of GFG combined cycle facilities to further decrease under a 50% RPS relative to IFOM ES?

A. Possibly, because the same economic forces are at work. However, the value of combined cycle assets will depend on both their vintage and the overall stock of gas-fired assets remaining on the system in future years, along with the effect on spot energy prices

[29] This doesn't specifically illustrate that the capacity factor of a new CC resource would be lower (in fact, the older CC resources would likely be dispatched down first, because newer CCs will likely have a lower average heat rate (i.e., on average be more efficient) than older CCs). However, this RFO process was not intended to produce outcomes where newer CC units are purchased and older CC units operate less often, possibly leading to stranded costs associated with "inefficient" retirement of older CC assets that might, absent the entry of new CC units, continued to provide energy for more years.

of a higher level of renewables. Additional modeling taking into consideration the pattern of resource retirement expected in later years would be needed.

V. SELECTION OF MORE THAN 1,000 MW MINIMUM FOR GAS-FIRED GENERATION

Q. Please summarize SCE's selection of gas-fired generation resource quantities as a share of the minimum gas-fired requirement from the Track 1 Decision.

A. SCE selected 38% more gas-fired capacity resource than the minimum requirement from the CPUC Track 1 / Track 4 Decisions. Including the gas-fired distributed generation selected, the gas-fired share rises to 45% of total LCR capacity (1,382 MW of CC and CT, plus 70 MW of gas-fired DG, equals 1,452 MW, or 452 MW above the 1,000 MW minimum). Procuring only the minimum amount of gas-fired generation both better meets the Loading Order and better prepares SCE for potential future RPS requirements while still remaining highly cost-effective.

VI. SELECTION OF 70 MW OF BACK-UP GENERATION AS PART OF PREFERRED RESOURCE SOLICITATION

Q. Do you have any concerns with the proposed procurement of 70 MW of back-up generation (gas-fired) to meet some of the RFO's preferred resource requirements?

A. Yes. Fossil-fuel fired back up generation is not emission-free. Regardless of the technology chosen, any fossil-backed engine will emit carbon and criteria pollutants. Emissions of criteria pollutants can create air quality and human health concerns.

Demand response events are typically called on days with high electricity demand, which are most likely to be hot summer days when air quality is at its worst.[30] High air pollution levels on these hot, hazy days can be a threat to public health. One study found that the inhaled pollutant level tendency associated with emissions from distributed fossil generation in populated urban centers can be worse than that associated with existing central station generation, on a per-unit-of-energy-delivered basis.[31] SCE is proposing to add 70 MW of fossil-based generation to one of the most polluted air basins in the

[30] *See, e.g.,* He, H.; Hembeck, L.; Hosley, K.M.; Canty, T.P.; Salawitch, R.J.; Dickerson, R.R. High ozone concentrations on hot days: The role of electric power demand and NO_x emissions. *Geophys. Res. Lett.* 2013, 40, 5291-5294.

[31] *See, e.g.,* Heath, G. and Nazaroff, W. Intake-to-Delivered-Energy Ratios for Central Station and Distributed Electricity Generation in California. Atmospheric Environment 2007, 40, 9159-9172. The study found that fossil-based distributed generation "pollutant inhaled" on a per-unit-energy delivered basis can be higher than that of existing central station effects.

country. For example, the South Coast Air Basin is an 8-hour "Extreme" non-attainment area for ozone.[32]

Although the extent of the air quality impacts are not possible to determine until the technology type and location for the 70 MW of generators is known, any fossil-backed engines will have emissions impacts that are greater than what would be seen with preferred resources that are either truly load reducing, or are renewable-based supply sources.

Q. Does this complete your testimony?

A. Yes.

Attachments

1. Fagan Resume

[32] U.S. Environmental Protection Agency. Current Nonattainment Counties for All Criteria Pollutants (as of January 30, 2015). http://www.epa.gov/airquality/greenbook/ancl.html#CALIFORNIA.