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EES Consulting

February 6, 2017

County of Los Angeles
Attn: Mr. Scott Kuhn, Principal Deputy County Counsel
500 West Temple, #648
Los Angeles, CA 90012

SUBJECT: Analysis of Alternatives to Withdrawing Gas from Aliso Canyon Natural Gas Storage Facility

Dear Mr. Kuhn:

EES Consulting, Inc. (EES)[1] was asked by the County of Los Angeles (County) to evaluate the alternatives that would largely mitigate or possibly eliminate the need to withdraw gas from the Aliso Canyon natural gas storage facility (Aliso Canyon) during remaining 2016-17 winter months, the summer months of 2017, and the winter of 2017-18. The County is monitoring developments before the Division of Oil, Gas and Geothermal Resources (DOGGR) and the California Public Utilities Commission (CPUC) relating to Aliso Canyon.

The Southern California Gas Company (SoCalGas) has historically used Aliso Canyon to provide natural gas balancing during winter peak demands and to supply natural gas for electric generation during summer electrical peaks. In response to a massive natural gas leak, orders from DOGGR, a proclamation of Governor Jerry Brown, and legislation prohibited new injections of gas at Aliso Canyon until certain specified actions could be completed, including a comprehensive safety review and public meetings.

[1]EES Consulting, Inc. is a registered professional engineering and management consulting firm, established in 1978, that provides a variety of project solutions to clients involved with electric, natural gas, telecommunications, water, wastewater, and other energy and natural resource related businesses. See Appendix B for further qualifications.

570 Kirkland Way, Suite 100
Kirkland, Washington 98033

Telephone: 425 889-2700 Facsimile: 425 889-2725

A registered professional engineering corporation with offices in
Kirkland, WA and Portland, OR

Executive Summary

Below are EES's assessments of the need to utilize the Aliso Canyon gas storage facility in the short- and long-term.

Winter 2016-17

The approval of gas injection in February 2017 would have no material impact on gas reliability for the two remaining months of this winter season.

The CPUC Revised Report on Aliso Canyon Working Gas Inventory, Production Capacity, Injections Capacity, and Well Availability for Reliability dated January 17, 2017[2] states that "even if injections were authorized this winter a fairly minimal volume of gas could be injected into the field to impact winter reliability" and "even assuming optimistic production rates," there are not a sufficient number of wells available "to assure reliability in the short term"[3]. There "will not be enough completed wells for the 2016/17 winter season nor will there be sufficient wells available to meet a peak summer day demand."[4] The report further states that "[a]fter January, the forecast peak day declines[.]"[5] EES agrees that given the timing of any such approval to allow injection, coupled with the time it would take to inject gas, the approval of gas injection in the short term would have no material impact on gas reliability for the time period February – June 2017.

Summer 2017

Mitigation measures are proving to be successful in reducing the overall demand for gas and gas withdrawals from Aliso Canyon should not be necessary during the summer of 2017.

A recent study posted on the CPUC website, "Aliso Canyon Demand-side Management Impact Summary"[6], demonstrates that the policies implemented to reduce the demand for natural gas in Southern California are working. Continuing to aggressively implement these mitigation measures is the best way to avoid the need to utilize Aliso Canyon. Additionally, the large amounts of rain and snowfall will result in greater generation from hydroelectric facilities during the summer of 2017. The increase in

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[2]CPUC (January 17, 2017) *Aliso Canyon Working Gas Inventory, Production Capacity, Injection Capacity and Well Availability for Reliability.*
http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/AlisoGas1-9-715.pdf
[3]Ibid., p. 2, 5
[4]Ibid., p. 5
[5]Ibid., p. 10
[6]CPUC (January 25, 2017) *Aliso Canyon Demand-Side Management Impact Summary.*
http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/2017_AlisoDSMImpactSummary_01-25.pdf

hydroelectric generation will buy the region time to put additional mitigation measures in place.

While EES believes that the combination of increased hydroelectric generating capabilities and mitigation measures will eliminate the need to withdraw gas from Aliso Canyon, even if there was a desire to withdraw gas the CPUC report noted above indicates that there will not be sufficient wells available at Aliso Canyon to meet peak summer day demand."[7]

Absent an unlikely extreme worst-case case scenario, there should not be a need to withdraw gas from Aliso Canyon during summer 2017.

Winter 2017-18

There is sufficient time to aggressively implement demand-side management and other mitigation measures that will eliminate the need to utilize withdrawals from Aliso Canyon during the Winter 2017-18 season.

As discussed above, the continued and aggressive implementation of demand-side management and other mitigation measures will continue to reduce the demand for natural gas and preclude the need to withdraw gas from or inject gas into Aliso Canyon.

Use of Aliso Canyon as a Last Resort for Withdrawals Can Continue Without Any New Injections.

The minimum gas storage requirement at Aliso Canyon is 5. Bcf. Currently, 14.8 Bcf of gas is stored at Aliso Canyon. Thus, almost 10 Bcf of gas is currently available for withdrawal. Based upon the minimum gas storage requirement of 5 Bcf at Aliso Canyon[8], if needed, gas could be withdrawn at the same rate as the recent withdrawals on January 24 and 25, 2017, for 326 days without the need for any further injections. On January 24 and 25, 2017, an average of 0.025 Bcf per day of gas with withdrawn. Based on the current amount of gas in storage at Aliso Canyon (14.8 bcf), 0.025 Bcf of gas could be withdrawn for 326 days before reaching the 5 Bcf minimum. This strongly supports the argument that there is no need for additional gas injection at Aliso Canyon.

CPUC/California Energy Commission Reports

The various CPUC/California Energy Commission (CEC) reports are confusing, utilize different measurement standards and fail to provide the public with a complete picture of the impact of mitigation measures and the need for withdrawals from Aliso Canyon.

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[7]CPUC Jan. 2017 Reliability Report, p. 5

[8]http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/Letter%20to%20Jimmy%20Cho%20on%20Aliso%20Canyon%20withdrawals.pdf

The January 2017 "Aliso Canyon Demand Side Management Impact Study" that was recently published on the CPUC website is perplexing in that it offers a summary of mitigation efforts calculated in Bcf, kilowatts, megawatts and therms, without establishing either a common measurement standard or baseline to determine the effectiveness of each mitigation measure. Further, the study improperly converts kilowatt-hours to therms based upon the equivalent amount of energy, rather than the actual therms of natural gas that would have been required to generate those kilowatt-hours, resulting in an underreporting by a factor of three or more. As such, there is no summary that synthesizes how effective the mitigation measures have been in meeting demand.

Additionally, reliability reports from the CPUC and CEC on peak demand and the system's ability to supply that demand without Aliso Canyon are confusing and inconsistent. For example, SoCalGas's Triennial Cost Allocation places peak demand at 5.293 Bcf, but its 2016 California Gas Report sets peak demand at 4.939Bcf. At the same time, the Aliso Canyon Gas and Electric Reliability Winter Action Plan states that SoCalGas can provide a maximum of 4.5 Bcf per day without Aliso Canyon, and the report concludes that while risks to energy infrastructure still exist due to the uncertainly of weather and system conditions without Aliso Canyon, conservation and other mitigation measures are expected to meet the energy needs of Southern California in the winter of 2016-17. Yet, on January 24 and 25, 2017, when demand was less than 4.1 Bcf, SoCalGas determined that it was necessary to withdrawal extremely nominal amounts (0.03 Bcf on January 24th and 0.02 Bcf on January 25th) of gas from Aliso Canyon. The SoCalGas withdrawals appear to be inconsistent with the data provided in the action plan and the publicly available information we have reviewed suggests that several avoidable factors led to the withdrawal at Aliso Canyon. A new report on the current reliability situation, which concisely factors in the success of mitigation measures and explains to the public the current reliability situation should be prepared as soon as possible.

Based on CPUC reliability studies, no withdrawal of gas from Aliso Canyon should have been necessary on January 24 and 25, 2017.

An assessment of the winter of 2016-17 identified additional mitigation measures that were expected to help meet demands during the winter of 2016-17, although it found that a winter peak day could drive the need to curtail between 0.3 and 0.7 Bcf of natural gas without the use of gas from Aliso Canyon. The "Aliso Canyon Gas and Electric Reliability Winter Action Plan" dated August 22, 2016[9] states that SoCalGas "can provide a maximum of 4.5 Bcf per day without Aliso Canyon, assuming pipeline capacity of 95

[9] CPUC (August 22, 2017) *Aliso Canyon Gas and Electric Reliability Winter Action Plan*. http://docketpublic.energy.ca.gov/PublicDocuments/16-IEPR-02/TN213406_20160901T073434_Aliso_Canyon_Gas_and_Electric_Reliability_Winter_Action_Plan.pdf

percent."[10] The plan also states that "under normal weather conditions, with no gas withdrawn from Aliso Canyon and reasonable assumptions about utilization rates on pipeline delivering into SoCalGas, the gas system will be able to meet each months daily demand for the winter season from November 1 through March 31."[11]

As noted above, on January 24 and 25, 2017, SoCalGas delivered "almost 4.1" Bcf of gas per day, including withdrawals from Aliso Canyon of 0.03 Bcf of gas on January 24th and 0.02 Bcf of gas on January 25th. The "Aliso Canyon Gas and Electric Reliability Winter Action Plan" stated that it was only on a winter peak day, defined as the coldest day forecasted in a 1-in-10-year period for noncore customer demand (plus 1-in-35 demand for core customers) that there would be a need to curtail about 0.3 Bcf. The weather on January 24 and 25, 2017 was not a winter peak day under this definition. Based upon temperature data obtained from the National Oceanic and Atmospheric Administration's *Climate Data Online*, the lowest temperature observed at Los Angeles International Airport on those two days was 40 degrees. Similar temperatures have been observed at the same location in 22 of the past 30 years. Based on the August 2016 action plan, there should not have been a need to withdraw gas from Aliso Canyon.

The peak rate at which gas was withdrawn on these two days could have been reduced nearly in half by SoCalGas' planned conservation pilot rebate program. No results or activities have been reported on this program since it was approved by the CPUC. The gas withdrawn could also have been offset, in part, by the partial curtailment of natural gas power plants. Based upon the peak gas withdrawal rate, at the most approximately 1,700 MW of electric generation would have needed to be curtailed. This amount of LA Basin generation could likely have been offset by demand response and/or the import of additional electric generation from outside the LA Basin. California has surplus of electric generation and is projected to be able to produce at least 21 percent more energy than it needs by 2020[12]. The 21 percent projection is well above the state mandated 15 percent planning reserve margin.

The nature of these withdrawals and the extent to which other mitigation measures could have been utilized has yet to be fully reported and thoroughly investigated. Several groups have asked the state attorney general to open an investigation into possible manipulation by SoCalGas[13]. Publicly available data obtained from SoCalGas' Envoy system and provided in Appendix C indicates that SoCalGas scheduled less gas to be delivered to their system on January 24th and 25th than on the prior two days, which were warmer. The difference between the amount of gas scheduled on the 23rd and the

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[10]Ibid., p. 4
[11]Ibid., p. 4
[12]Los Angeles Times, February 5, 2017, "Californians are paying billions for power they don't need".
[13]Los Angeles Times, January 24, 2017, "Southern California Gas taps Aliso Canyon amid conservation warnings".

amount of gas scheduled on the 24th and 25th exceeds the amount gas withdrawn from Aliso Canyon.

The protocols for winter withdrawals from Aliso Canyon[14] omit one requirement present in the summer withdrawal protocol[15] that states:

> *Within 30 days after a withdrawal, SoCalGas shall provide the Energy Division of the CPUC and the Division of Oil Gas and Geothermal Resources with a full description of the events leading up to the withdrawal, all actions taken prior to the withdrawal, and any observations and/or recommendations concerning future withdrawals. Further, SoCalGas shall provide a statement certifying that they took all actions needed to avoid electric curtailment and/or a curtailment of gas supply to core customers, consistent with this protocol.*

The information outlined in this requirement would provide valuable information on the nature of the January 24th and 25th withdrawals that has not yet been made public. Adding this requirement to the recent withdrawals as well as any future withdrawals is recommended.

Review of Mitigation Measures

In response to the prohibition on the use of Aliso Canyon, SoCalGas, the Los Angeles Department of Water and Power (LADWP), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) implemented a series of mitigation measures to ease strain on the natural gas system within the LA Basin. Those measures included changes to how the gas and electric systems are managed as well as the implementation of distributed energy resources, such as energy efficiency, demand response, and battery energy storage.

In the summer of 2016, those mitigation measures prevented the need for any curtailments of natural gas use and forestalled the need to withdraw natural gas from Aliso Canyon to maintain electric system reliability. Additional mitigation measures have come on-line since the summer of 2016. For example, in response to the moratorium on gas withdrawals at Aliso Canyon, Tesla Motors Inc. and SCE brought one of the world's largest energy storage facilities, a collection of lithium-ion batteries, on-line on January 30, 2017 at SCE's Mira Loma substation in Ontario, California[16]. In addition, storage facilities of similar size are will be brought on-line by SDG&E with AES

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[14] http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/Winter_2016-17_Protocol.pdf

[15] http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/News_Room/News_and_Updates/Letter%20to%20Jimmy%20Cho%20on%20Aliso%20Canyon%20withdrawals.pdf

[16] Los Angeles Times, January 30, 2017, "Edison and Tesla unveil giant energy storage system"

Energy Storage and by Greensmith Energy Partners with AltaGas. In total, the projects will add 77.5 megawatts of energy storage to the region[17].

The 31 mitigation measures that have been identified are included as Appendix A to this report. Work on implementing many of these measures is listed as "underway" or "continuing", and even some listed as "done"—such as reprioritizing energy efficiency—can continue to be further implemented. The results of energy efficiency, electric demand response, and battery energy storage work done to date in response to Aliso Canyon was reported on September 27, 2016 by the California Public Utilities Commission. However, the results from other mitigation measures, such as the changes to how the electric and gas systems were operated as well as the implementation of natural gas demand response programs by SoCalGas have yet to be analyzed and the impact of *all* mitigation measures generally seems to be excluded from consideration in the technical studies identifying the need to use natural gas from Aliso Canyon.

The success of these mitigation measures is underscored by the reductions in withdrawals form Aliso Canyon over the last year. According to SoCalGas, over the 3-year period from 2012-2015, they withdrew gas from Aliso Canyon an average of 134 out of 151 "winter" days and 70 out of 214 "summer" days[18]. However, since the implementation of mitigation measures over the last year, during which Aliso Canyon was shut down, SoCalGas has withdrawn gas from Aliso Canyon only twice. This demonstrates that the mitigation measures have been extremely successful.

Based upon publicly available studies summarized in Table 1 below, EES finds that there is more than sufficient potential for demand response, energy storage, and energy efficiency to offset the needs for curtailment identified in even the worst scenarios of the technical studies during summer months.

[17]Ibid

[18]Table 2 of "Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin".

Table 1
Assessment of Demand Response, Energy Storage and Energy Efficiency Measures

Mitigation Measure	Levelized Cost	Summer (MW)	Winter (MW)	Winter (MMcf)
Demand Response				
SCE 2025 Potential [1]	<$200/kW-yr	2,917	2,263	-
LADWP 2025 Potential [2]	<$200/kW-yr	583	453	-
SoCalGas Potential [3]		-	-	*TBD*
Energy Storage				
Potential [4]	$321 - $658/MWh	∞	∞	
Energy Efficiency				
SCE 2016-24 Potential [5][6][7]	n/a	1,931	1,448	-
SCG 2016-24 Potential [5][6]	n/a	-	-	26,340
Total		**5,431 - ∞**	**4,163 - ∞**	***TBD***

1) SCE Peak Shedding Demand Response Potential as reported in LBNL 2015 California Demand Response Potential Study.
2) LADWP DR Potential has been estimated by scaling SCE DR Potential by the relative share of load.
3) SCG has implemented natural gas demand response programs, but no results have been estimated or reported.
4) Cost source: Lazard's Levelized Cost of Energy Storage, Version 1.0. There is no upper limit on the amount of electric storage that could be implemented.
5) Energy Efficiency Potential and Goals Study for 2015 and Beyond.
6) No levelized cost supply curve was provided as part of the potential study, but the values provided here are the cost-effective market potential.
7) Although energy efficiency will reduce both summer and winter demand, no winter demand reduction was provided. It has been estimated here.

Recommendations

Based on our findings, EES has the following recommendations for future actions.

Recommendation #1: Continue and, where possible, expand the implementation of mitigation measures already identified and implement additional mitigation measures. Table 2 provides a summary of the mitigation measures that EES believes should be expanded and/or added to future action plans.

Table 2
Mitigation Measure Recommendations

1	Improve coordination between gas and electric scheduling procedures
2	Tighter balancing rules for gas scheduling for non-core customers and non-core customers should be put on notice that frequent Operational Flow Orders may be required
3	Improve utilization of the Castaic pumped storage project to serve peak summer loads
4	Better coordination of gas pipeline maintenance; to the extent possible, schedule maintenance in the shoulder months of October, November and March through May
5	Accelerate investments in demand response programs including smart thermostats, Emergency Curtailment, and Competitive DR Solicitation programs and expand demand response program offerings to target residential customers
6	Invest in custom demand response programs targeted at the areas that would most help alleviate the need for Aliso Canyon withdrawals; prioritize projects that will provide the most relief
7	Encourage the adoption of solar water heating, especially in homes with gas water heating systems
8	Increase customer participation in residential and non-residential AC cycling and agricultural pumping interruptible programs and increase curtailment rights to non-core customers
9	Increase public message efforts to reduce electric and gas usage including Flex Alerts for electric customers and a similar program for gas customers.
10	Use data from SoCalGas advanced meters to target customers who have high gas usage on peak days
11	Accelerate the development and installation of electricity storage projects in the LA basin including, but not limited to, customer-sited storage, thermal energy storage and using EV for storage.
12	Reprioritize energy efficiency projects to target those that would most help alleviate the need for Aliso Canyon withdrawals
13	Offer Strategic Energy Management programs to the largest customers to build energy savings and demand response participation
14	Future energy efficiency projects should target large commercial and industrial customers with seasonal load shapes that peak during peak gas (winter) and electric (summer) seasons
15	SoCalGas should implement behavioral/feedback programs as a way to achieve energy savings with large portions of its customer base quickly
16	Increase gas and electric energy efficiency programs targeted at low income customers that otherwise would likely not invest in such programs
17	Consider investing in demand response programs in the southwest (Nevada, Arizona) in order to free up generation and transmission capacity through contractual relationships that recognize that investments are made in exchange for the rights to gas-fired generation during summer peaking events in the LA basin

Recommendation #2: The parties that prepared the Aliso Canyon winter and summer risk assessments should prepare a report that details the impact to date, and in the future, from the 21 mitigation measures included in the August 2016 "Aliso Canyon Gas and Electric Reliability Winter Action Plan" (Appendix A of this report). The report should include consideration of additional mitigation measures as well as expansions of the existing mitigation measures. The assumptions in the winter and summer risk assessments should be updated accordingly to include the impacts of the mitigation measures.

Recommendation #3: The parties that prepared the Aliso Canyon winter and summer risk assessments should re-evaluate whether or not 1-in-10 and 1-in-35 planning criteria

for non-core and core customers, respectively, are appropriate. An assessment of the likelihood of Scenario 4 (overlapping gas storage and pipeline outages) should also be provided. The curtailments identified in Scenario 4 should be tempered with a statement regarding the actual potential for this scenario to occur.

Background on Aliso Canyon Natural Gas Storage Facility

Aliso Canyon is an oil field and natural gas storage facility in the Santa Susana Mountains in Los Angeles County, California, north of the Porter Ranch neighborhood of the City of Los Angeles. Discovered in 1938 and quickly developed afterward, the field peaked as an oil producer in the 1950s, but has remained active since its discovery. One of its depleted oil and gas producing formations, the Sesnon-Frew zone, was converted into a gas producing storage reservoir in 1973 by the Southern California Gas Company, the gas utility servicing the southern half of California. This reservoir is the second-largest natural gas storage site in the western United States, with a capacity of over 86 billion cubic feet (Bcf) of natural gas.

Historically, the gas storage reservoir was accessed through 115 gas injection wells, along with approximately 38 miles of pipeline internal to the field. Three operators are active on the field: Southern California Gas Company, the Termo Company, and Crimson Resource Management Corp.

A dramatic break somewhere along the length of an 8,750-food injection well casing resulted in a large methane eruption from the field on October 23, 2015, spewing on the order of 60 million cubic feet of methane per day at first, before the pressure was reduced. The well, Standard Sesnon 25 ("SS 25") had originally been installed in 1953, and re-worked as a gas injection well in 1973, but lacked a blowout prevention valve, as it had not been considered a priority given the well's position, at the time, far from a populated area. Fallout from the methane cloud, in the form of oily droplets and persistent noxious odors, caused the evacuation of approximately 2,000 families. On December 4, 2015, SoCalGas commenced drilling a relief well to stop the natural gas leak by plugging the leaking well at its base. The relief well intercepted the base of the leaking well on February 11, 2016, and the company began pumping heavy fluids to temporarily control the flow of gas out of the leaking well. SoCalGas was able to plug the leak permanently on February 18, 2016. Overall, the well is estimated by the California Air Resources Board to have released over 100,000 metric tons of methane as well as other hydrocarbons, the largest such release in U.S. history.

On April 28, 2016, the California State Assembly passed a bill that bans the injection of additional natural gas in Aliso Canyon, effectively shutting it down until a detailed list of actions occur. In addition, Governor Jerry Brown issued an executive order banning natural gas injection until all of the wells have been thoroughly tested for corrosion and leaks. The bill, known as Senate Bill 380, extended the moratorium on gas injection, and

requires the CPUC to consider the feasibility of permanently shutting down Aliso Canyon.

Aliso Canyon is used for two primary functions – to provide gas balancing in the winter for winter natural gas peaking requirements and to provide gas to natural gas peaking generation in the summer during electric system peak demand periods. As part of EES's scope of work, we evaluated alternative options to using natural gas turbines to meet summer electrical peak requirements.

Aliso Canyon provides natural gas service to 17 natural gas fired plants, large hospitals, oil refineries and other large gas consumers. There are three other gas storage facilities in SoCalGas' system, Honor Rancho, Playa Del Rey, and La Goleta. As set forth below in Table 3, the working gas maximum inventory of these three storage facilities is 49 Bcf and the withdraw capacity is 1.8 Bcf.[19] According to a November 2014 SoCalGas Storage Expansion Study prepared by SoCalGas, a 2 Bcf increase in the storage capacity at Honor Rancho is under consideration and, if implemented, could provide additional supply during critical peak periods.

Table 3
SoCalGas Underground Gas Storage Fields Key Operation Characteristics[20]

Field	Location	Working Gas Maximum Inventory (Bcf)	Withdrawal (Bcfd)	Injection (Bcfd)
Aliso Canyon	San Fernando	86.2	**1.9**	0.4
Playa del Rey	Marina del Ray	1.8	**0.4**	0.2
Honor Rancho	Santa Clarita	27.0	**1.0**	0.07
La Goleta	Santa Barbara	20.2	0.4	0.2
TOTAL		**136.1**	**3.8**	**1.1**

Gas storage facilities provide additional gas delivery capacity when gas demand exceeds the amount of gas flowing based on gas schedules submitted the prior day. SoCalGas relies on its storage facilities to manage the mismatch between the gas supplies and gas usage. The withdrawal capabilities are used during the summer to supply gas to natural gas-fired generating plants during peak hourly load events that occur throughout summer day. These events cannot be met with flowing supplies because of the speed and magnitude that these peaks occur.

[19] http://www.energy.ca.gov/2016_energypolicy/documents/2016-04-08_joint_agency_workshop/Aliso_Canyon_Action_Plan_to_Preserve_Gas_and_Electric_Reliability_for_the_Los_Angeles_Basin.pdf

[20] Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin, Prepared by the Staff of the California Public Utilities Commission, California Energy Commission, the California Independent System Operator, and the Los Angeles Department of Water and Power, p. 7.

Summary of Summer 2016

As noted above Aliso Canyon gas storage has primarily been used to provide gas to natural gas peaking generation in the summer during electric system peak demand periods. EES is tasked with determining the feasibility of not using Aliso Canyon gas withdrawals for summer electric peaking purposes. In the summer of 2016, the region was able to do just that. This feat was, in part, due the fact that no "extreme" (1-in-10-year) events occurred but also due to the mitigation measures identified in the "Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin" (April 2016) and employed by gas and electric utilities. The measures included changes to the way the gas and electric systems are managed by the utilities such as tightening the gas balancing rules as well as efforts to make gas and electric customers aware of the risks of curtailments and how they could help avoid curtailments. A full list of the mitigation measures is included as Appendix A to this report.

The measures also included assuring that the 15 Bcf of gas currently stored at Aliso Canyon could be used if needed to avoid curtailments. The "Aliso Canyon Risk Assessment Technical Report" (April 2016) noted that the 15 Bcf of gas available in Aliso Canyon was sufficient to meet the summer reliability needs so long as the necessary gas withdrawal capability was available when needed and effectively managed to meet reliability.

Below is a summary of the highlights of summer 2016.

- The summer reliability assessment estimated that there were 14 days of potential electricity outages that could occur under certain contingencies without the use of Aliso Canyon.
- The Summer Action Plan included 21 mitigation measures that could be used to reduce the risk of electric outages.
- LADWP utilized several of the measures including operating its system differently than under normal conditions to lock in gas burn, halting forward sales and complying with tighter balancing rules.
- There were two heat waves in the summer of 2016 (one in June 18-20 and one in July) and SoCalGas did not withdraw any of the 15 Bcf of gas stored at Aliso Canyon (the last resort before curtailments).
- The following mitigation measures were deployed in response to the heat waves: Flex Alerts, requests for conservation in state buildings, Operational Flow Orders (for gas) for low inventory at the 5% level and SoCalGas warned customers via its Envoy website and other mechanisms.
- An estimated 630 MW and 400 MW of demand response was called on by LADWP and SCE in June and July, respectively, to help reduce demand.

As noted above, mitigation measures were successfully implemented to ensure safe and reliable service within the Los Angeles Basin without withdrawing natural gas form Aliso Canyon.

Summary of Winter 2016-17

As noted above, Aliso Canyon gas storage is primary used to provide gas balancing in the winter for winter natural gas peaking requirements. The assessment of winter 2016-17 found that conservation and other mitigation measures are expected to help meet the energy needs of southern California this winter; however, on a winter peak day (coldest day forecasts in a 1-in-10 for noncore customers plus a 1-in-35 demand for core customers), there is a need to curtail of between 0.3 and 0.7 Bcf of natural gas. The forecasted demand under such a peak day was forecast to be 4.939 Bcf in SoCalGas' most recent 2016 California Gas Report.

In addition, the LADWP/CAISO joint power-flow study found that electric reliability can be satisfied for a 1-in-10-year winter peak electric load conditions.[21] The "Aliso Canyon Gas and Electric Reliability Winter Action Plan" (August 2016) identified 10 new measures, in addition to the 21 measures included in the action plan developed for the summer of 2016, to help reduce the possibility of gas curtailments large enough to cause electricity service interruptions. The new measures included extending tighter gas balancing rules for noncore customers (generating plants, oil refineries, hospitals and other large users) in the winter, creating new balancing rules for SoCalGas when it schedules gas for core customers (residential and commercial customers), setting advance limits on gas consumption by gas-fired generation plants on peak days, initiating focused messaging asking customers to reduce gas use and creating demand response programs to reward lower gas use.

The Aliso Canyon Gas and Electric Reliability Winter Action Plan dated August 22, 2016[22] stated that SoCalGas "can provide a maximum of 4.5 Bcf per day without Aliso Canyon, assuming pipeline capacity of 95%."[23] The CPUC Aug. 22 Reliability Plan also stated that "under normal weather conditions, with no gas withdrawn from Aliso Canyon and reasonable assumptions about utilization rates on pipeline delivering into SoCalGas, the gas system will be able to meet each month's daily demand for the winter season from November 1 through March 31."[24]

On January 24 and 25, 2017, SoCalGas delivered "almost 4.1" Bcf of gas, yet withdrew gas from Aliso Canyon. The prior analysis stated that the SoCalGas system had a

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[21]Page 31 of August 23, 2016 "Aliso Canyon Winter Risk Assessment Technical Report"
[22]CPUC (August 22, 2016) *Aliso Canyon Gas and Electric Reliability Winter Action Plan.* http://docketpublic.energy.ca.gov/PublicDocuments/16-IEPR-02/TN213406_20160901T073434_Aliso_Canyon_Gas_and_Electric_Reliability_Winter_Action_Plan.pdf
[23]Ibid., p. 4
[24]Ibid., p. 4

capacity without Aliso Canyon that was in excess of this level of demand. The weather on January 24 and 25, 2017 was not a winter peak day under this definition. Many have raised concerns about SoCalGas' withdrawal of gas from Aliso Canyon on January 24 and 25, 2017.[25] Further investigation into the circumstances surrounding the timing and necessity of these gas withdrawals is warranted.

Mitigation Measures

There are 31 mitigation measures included in the summer and winter action plans to help avoid gas and electricity curtailments. The measures generally fall into the following categories:

Efficient use of Aliso Canyon, noncore (electric generator, oil refineries, local governments, hospitals and other large users) gas tariff changes, greater operational coordination, LADWP-specific measures, and measures aimed at reducing natural gas and electricity consumption. The full list of mitigation measures is provided as Appendix A of this report.

As noted in Appendix A, some of the mitigation measures have not been fully developed. Some of the notable measures that have not been fully developed include:

1) Use new and existing programs asking customer to reduce gas and electricity consumption
2) Expand gas and electric efficiency programs targeted at low income customers
3) Expand demand response programs
4) Reprioritize existing energy efficiency towards projects with potential to impact usage
5) Reprioritize solar thermal program spending to fund projects
6) Accelerate electricity storage

An analysis of the impact of the closure of Aliso Canyon will show increased likelihoods for curtailments during periods when projected hydro generation is relatively low due to low snowpack (bad water years) and fewer potential curtailments during average and better than average water years. If an analysis were performed for the summer of 2017 the better than average water year we are currently experiencing should result in fewer projected curtailments (all other things being equal). The above average water year may be a short-term circumstance as next year could be another poor water year with low hydro generation; however, the higher hydro generation in the summer of 2017 does buy the region time to put other mitigation measures in place such as Distributed

[25]See Southern California Gas Taps Aliso Canyon Amid Conservation Warnings, Los Angeles Times, January 24, 2017 http://www.latimes.com/business/la-fi-southern-california-gas-20170124-story.html; Letter from Consumer Watchdog and Food & Water Watch dated January 24, 2017 http://www.consumerwatchdog.org/resources/lettertobecerrafeuersocalgas1-24-17.pdf

Energy Resources (DER), demand response, customer communication systems, electricity storage, reprioritization of EE (including low income), solar thermal programs and gas demand response programs.
The success of these mitigation measures is underscored by the reductions in withdrawals form Aliso Canyon over the last year. According to SoCalGas, over the 3-year period from 2012-2015, gas was withdrawn from Aliso Canyon an average of 134 out of 151 "winter" days and 70 out of 214 "summer" days[26]. However, since the implementation of mitigation measures, gas has only been withdrawn from Aliso Canyon on two days. This demonstrates that the mitigation measures have been extremely successful.

Southern California was fortunate that there were no "extreme" peak events during the summer of 2016. However, many of the mitigation measures can be expanded and/or fully implemented to help reduce the potential for curtailments in future summer periods. The remaining sections of this report focus on the mitigation measures that can and should be expanded in order to eliminate the need for any future Aliso Canyon gas storage withdrawals.

Demand Response

In response to the moratorium on Aliso Canyon gas withdrawals, the CPUC directed SCE to target demand response (DR) programs in the LA Basin. SCE responded by engaging in targeted marketing to increase enrollment in their Air Conditioning (AC) Cycling program, increasing enrollment in their emergency curtailment program, offering a rebate for smart thermostats and enrolling in the Peak Time Rebate program, and offering a competitive demand response solicitation.

The results of these efforts as of September 2, 2016, as well as those expected by the end of 2016, are summarized below in Table 4.

Table 4
Summarized Demand Response

Program	Results as of Sept 2, 2016	Expected 2016 Results
AC Cycling	9.5 MW	10 MW
Emergency Curtailment	10 MW	10 MW
Smart Thermostats Load Control	1.5 MW	12 MW
Competitive DR Solicitation	11 MW	11 MW
Total	**32 MW**	**43 MW**

Source: CPUC Aliso Canyon Demand Side Management Activity and Impact Summary (9/27/16)

In addition, LADWP began its own demand response program in the summer of 2016. The program, called SummerShift, targets large commercial and industrial customers and provides a $10/kW incentive for reducing demand during peak summer periods.

[26] Table 2 of "Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin".

Demand response provides a valuable resource for managing peak demands, without the need for natural gas generation. In addition, demand response resources can provide additional value by helping to manage system outages, integrate renewable energy resources, and respond to high market prices. More than 600 MW of demand response was called upon in the summer of 2016 to successfully manage peak summer loads, resulting in up to 540 MW of demand reductions at the highest, on July 28.

A 2016 study of California demand response potential by Lawrence Berkeley National Laboratory (LBNL) estimated SCE's peak shedding demand response potential at 2.9 GW in 2025. Clearly, there is plenty of potential for additional demand response to be acquired.

In addition to the electric demand response discussed above, the CPUC directed SoCalGas to proceed with three natural gas demand response programs, likely the first of their kind in the nation. These programs include:

- A campaign to stimulate voluntary reductions in natural gas use among core customers when the system is expected to be stressed, similar to CAISO's "Flex Alert" campaign
- Another voluntary program for non-core, non-electric generation customers using SoCalGas' electronic bulletin board as a communication channel
- An incentive program offered to 70,000 residential customers with advanced meters that will pilot a rebate used to incent natural gas conservation in response to notifications.

In the January 2017 DSM impact summary, survey responses were provided about perceptions and actions taken for the first of these three programs, but no results have been provided on the natural gas demand impact for any of the three.

The following steps could be considered to further the availability of demand response within the LA Basin.

- While the AC Cycling program has acquired enough customers and load to be a worthwhile demand response resource, it ultimately targets the same loads and the same customers as the Smart Thermostats Load Control program. Smart thermostats offer the additional benefit of energy efficiency savings for utilities and ratepayers, in addition to greater functionality and comfort for homeowners. SCE should consider focusing resources on the program that offers the greatest value and appeal to customers.
- Continue to expand the demand response resources available under the Emergency Curtailment and Competitive DR Solicitation programs. As identified in the LBNL

study, much of SCE's demand response potential is in the commercial and industrial sectors.

- In addition to demand response resources within the LA Basin, SCE or LADWP should consider pursuing demand response resources *outside* of the LA Basin, wherein the programs could be used to free up additional generation and/or transmission resources outside the Basin, that could then be redirected to serve demand within the LA Basin. SCE should also consider acquiring demand response resources from LADWP for a similar outcome.
- LADWP should expand its demand response program offerings to target residential customers.
- In addition to targeting a select set of high-usage customers for its demand response incentive pilot, SoCalGas should use data from its advanced meters to target customers who have high usage *on peak days*.
- SoCalGas should evaluate and publish the impacts of its natural gas demand response programs.

Electric Storage

Similar to demand response programs, electric energy storage can also assist with meeting peak electric system demands. Unlike demand response programs, the potential storage capacity is not limited to the controllable load of end use equipment. In total, 91 MW of storage capacity is expected to be online by January 2017[27].

The CPUC also directed SCE to pursue an expedited procurement of energy storage. The CPUC required that the storage resources must:

- Be located in front of the meter
- Be operational by the end of 2016
- Interconnect in a location that alleviates Aliso Canyon-related reliability concerns
- Qualify for Resource Adequacy credit
- Be price competitive with previous solicitations
- Have a maximum contract term of 10 years

As a result of this solicitation, SCE procured 27 MW of third-party owned storage, but was also acquiring turn-key utility owned storage and storage sited at two natural gas-fired peaking plants. SDG&E received Commission approval for 37.5 MW of lithium-ion storage to be located at two SDG&E substations. According to the January 25 demand side management update, a total of 98.5 MW of storage was online as of January 2017, including the recently completed 80 MWh project that SCE completed with Tesla.

[27] September 2016 "CPUC Aliso Canyon Demand Side Management Activity and Impact Summary"

The following actions should be considered in order to continue the acquisition of energy storage technologies:

- Consider the multiple benefits that customer-sited storage can offer, since it can be operated as a backup resource or used to maximize the use of solar PV production in addition to providing utility-scale grid services.
- Thermal energy storage also provides a viable solution. While some technologies store ice to provide peak cooling needs, other technologies turn hot water tanks into thermal energy batteries, with options to provide load shifting, demand response, and other functions.
- With increasing numbers of electric vehicles (EV) on the road, consider working with EV manufacturers to pilot the two-way use of EV batteries. Such functionality is currently thought to violate battery warranties, but is key to unlocking the full range of grid benefits for electric vehicles.

Energy Efficiency

Energy efficiency measures reduce energy consumption and, as such, have the potential to reduce the peak demand of both electricity and natural gas consumption. The response to the moratorium on Aliso Canyon gas withdrawals included a three-pronged approach toward energy efficiency measures.

1. Increase incentive rates and budgets for solar water heating systems
2. Intensify efforts to acquire energy savings in low-income communities affected by the Aliso Canyon leak
3. Reprioritize existing energy efficiency programs

The expected 2016 savings from these initiatives are summarized in Table 5 below. Note, however, that much of the savings from reprioritizing energy efficiency programs comes from long-standing codes and standards advocacy, and not a response to Aliso Canyon.

While an updated assessment of impacts was published on January 25, 2017, the report uses an improper energy conversion to convert kilowatt-hours to therms. Rather than converting kilowatt-hours to therms on an energy equivalency basis, kilowatt-hours should be converted based upon the equivalent amount of natural gas that they offset at a power plant. Such an assessment would take into consideration the line losses of the electric system and the efficiency of the power plant. As such, the natural gas impact of electric savings may be as much as three times what was reported, or more.

Table 5
Expected 2016 Energy Efficiency Savings

Approach	Expected 2016 Savings
Increase Incentives & Budget for Solar Thermal	140,472 therms
Low-Income Energy Efficiency	353,064 therms (SoCalGas) 710,354 kWh (SCE)
Reprioritize Existing Energy Efficiency	29,100,000 therms
Total	**29,593,536 therms** **710,354 kWh**

Even with the valuable codes and standards work that is a part of energy efficiency programs, the highest contributor to energy efficiency savings is custom industrial projects, which were expected to contribute over 10 million therms in 2016.

The energy efficiency projects at industrial sites should be continued, and future work should be targeted towards customers with high energy consumption as well as customers with load profiles that consume more electricity and natural gas in the peak seasons. SCE and SoCalGas could also consider offering Strategic Energy Management programs to their largest customers. In addition to providing significant energy savings, Strategic Energy Management fosters energy awareness at facilities and may lead to higher participation in energy efficiency and demand response programs.

In the residential and small commercial sector, SoCalGas appears to be targeting measures that can be deployed quickly and easily. In addition to the voluntary reduction and incentive pilots described above, SoCalGas may also consider behavioral/feedback programs as a way to achieve energy savings with large portions of its customer base quickly. After an initial push with quickly-deployed energy efficiency measures, a logical next step would be to strategically target high users with low load factors for more substantial savings with building weatherization and HVAC system measures.

County and Southern California Region Energy Network (SoCalREN) Energy Efficiency Projects

Energy efficiency projects throughout the region are administered by the County through the SoCalREN. The County Office of Sustainability works on energy efficiency projects throughout the County and with over 200 cities through SoCalRen program. As can be seen from an April 6, 2016 letter to the CPUC, the County and SoCalREN have been, and continue to be, ready to assist the CPUC by implementing energy efficiency programs and projects that will help reduce the demand for natural gas in Southern California. A copy of this letter is attached as Appendix D. The County letter provides a list of projects under development that could result in a savings of over 20 million kWh. As more of these projects are funded and come on line, these kWh reductions will be realized.

Natural Gas Scheduling

SoCalGas owns and operates high-pressure gas pipelines that can accept as much as 3.875 Bcf per day of natural gas from several pipelines that connect California to gas producing regions in the southwest and Rocky Mountains. The interaction between constraints on gas deliveries, systems operations features, rapid changes in electricity demand and electric transmission constraints that limit imports into the region is complex.

Noncore gas customers, including natural gas-fired generating plants, are not required to balance their demand and delivery of gas each day. Instead these large users are only required to match up monthly gas demand and gas delivery within a tolerance band of plus or minus 10 percent. Noncore customers can be out of balance by up to 10 percent of their monthly gas use and make up the difference the next month. This is critical because the mismatch between scheduled and actual deliveries is cited as the major reason for withdrawing gas from Aliso Canyon.

The large tolerance band for noncore gas customers was made possible by the large amount of gas storage available in southern California. With the loss of Aliso Canyon, permanent reductions to the tolerance band should be adopted due to the reduction in gas storage availability in southern California. If the tolerance band applied to noncore users was reduced the need for Aliso Canyon gas and the risk of gas and/or electric curtailments could be significantly reduced.

The exception to gas balancing rules occurs when SoCalGas calls on Operational Flow Orders (OFO). An OFO is a warning to customers that the gas system is so far out of balance that the use of storage facilities cannot resolve the imbalance. An OFO notifies customers that they must more closely match their deliveries with their schedules. OFO are considered extreme events. However, OFOs simply order gas users to use the gas supply system more efficiently by forecasting and scheduling their gas supply more closely.

Tightening gas balancing rules for noncore gas users is included in the mitigation measures (as shown in Appendix A). However, a further tightening of the gas balancing rules should be explored and the rules should be made permanent.

Another reason for the inefficient use of the gas supply system is the lack of coordination between electric system and gas system scheduling procedures. Gas purchasers, including electric generators, schedule their gas for the next day at 9:30 am. Those same generators then bid into the California ISO's day-ahead electricity market at 10 am. The California ISO informs bidders if their generation was accepted (i.e. awarded) at 1 pm. The gas pipelines confirm gas deliveries at 2:30 pm, based on the gas schedules that were submitted at 9:30 am. If the generators bid was not accepted by

the California ISO, then the generator is left with scheduled gas and no market for its electricity. The lack of coordination between electric and gas scheduling procedures leads to large mismatches between gas schedules and gas deliveries.

An increase in electric and gas operational coordination is included in the mitigation measures. Starting last summer during a period of gas curtailments, LADWP interacted with SoCalGas and the California ISO to better coordinate gas fuel usage and system planning. This allowed LADWP to better forecast and plan its resources for the next schedule day. This type of coordination should be expanded and the potential to further improve the coordination between gas and electric scheduling procedures should be explored and, ultimately, implemented.

The primary driver behind the expansion of the western Energy Imbalance Market (EIM) is that an EIM will result in the lowest cost and most efficient dispatch of electric generating resources. However, the mismatch between gas and electric scheduling procedures results in large inefficiencies in the manner in which natural gas, an energy commodity, is consumed. The closure of Aliso Canyon could be the impetus to the development of better coordination between gas and electric scheduling and increasing the efficiency of the energy generation.

Castaic Hydroelectric Pumped Storage

The Castaic power plant, designed, built, and operated under a cooperative agreement between DWR and LADWP, is located at the northern end of Castaic Lake's west branch in NW LA County. Regulatory storage for Castaic is provided by Pyramid Lake and Elderberry Forebay. Castaic has seven generators with a maximum rated capacity of 1,275 megawatts.

Water from Pyramid Lake flows through Castaic into Elderberry Forebay, also operated by LADWP, and it can be pumped back through the plant into Pyramid Lake. This type of operation is called pumped storage. Elderberry Forebay has a maximum storage capacity of 32,480 acre-feet and also provides submergence of the pump-generator units when the lake is at its lowest operating levels. Elderberry Forebay is at the southernmost end of the West Branch FERC license boundary.

The "Aliso Canyon Winter Risk Assessment Technical Report" notes that some real-time electric load requirements can be shifted from gas-fired generation to Castaic[28]. Castaic's ability to provide real-time energy deliveries is limited by reservoir elevation and the plant cannot be counted on to provide maximum output for more than a few hours, especially on successive days. In the future reservoir levels should be coordinated such that Castaic's full capability is available during summer peak days. In the short-term, the relatively good water year should help with this coordination. In

[28] Page 38 of the August 22, 2016 "Aliso Canyon Winter Risk Assessment Technical Report"

addition, Castaic's maintenance schedule should be set such that peak summer and winter load periods are excluded.

The loss of Aliso Canyon will result in the decrease of natural gas-fired generating plant's ability to respond to surges in electric load during peaking events in the summer. To compensate for this loss, measures should be put in place to assure that the Castaic pumped storage project's reservoir elevation is maintained during summer days with potentially high peak electric system demands. This will assure that the plant is available to ramp up its generation to meet summer peak demands as they occur.

Transmission Capacity

There is 4,000 MW of north-south transmission capability between northern California and southern California. The availability of capacity on this path during summer peak hours depends on many variables, including loads in the Northwest and California as well as the operating capabilities of hydro, solar, wind and thermal generating plants in both regions.

At peak, approximately 72 percent of the LADWP's electric transmission system's available import capability is committed to importing LADWP, Burbank and Glendale resources from external wind, solar, geothermal, coal and nuclear resources owned by these entities. That leaves 28 percent of LADWP's transmission capacity available to import electricity from outside its system. There is approximately 3,000 MW of transfer capability between the California ISO and LADWP that can, if necessary, be used to replace a portion of its LADWP's natural gas-fired generation. However, typically during the summer 2,500 MW is already flowing with energy from LADWP resources located outside the Los Angeles basin which leaves only 500 MW of capability for additional import energy. The total imports into the LADWP Balancing Authority is approximately 4,700 MW.[29]

There is 10,100 MW of east-to-west transmission capability between the California ISO and Nevada and Arizona. On December 1, 2015 NV Energy joined the western EIM operated by the California ISO. NV Energy's participation in the EIM increased the real-time transfer capability between Nevada and southern California which increased the California ISO's flexibility to respond to real-time gas curtailments.

The ability to increase real-time energy deliveries from the southwest is limited by the relatively small amount of supply available in the southwest. Given the availability of transmission capacity, LADWP and SCE should consider developing or, through PPAs, promoting the development of generating resources in the region. LADWP and SCE should also explore investing in demand response programs in the southwest as a means of freeing up natural gas-fired generation located in the southwest that can

[29]Pages 17-18 and 48 of the April 2016 "Aliso Canyon Risk Assessment Technical Report"

provide power to the LA Basin during summer peaking events. Investments in the southwest should be tied to access to generation from natural gas plants located in the southwest during peak summer days in the LA basin.

Gas Pipeline Maintenance/Compliance Testing

All gas pipeline maintenance and compliance testing schedules that impact southern California gas supply should be set such that the work is not performed during either the high electric demand days in the summer or the high gas demand winter season. Gas pipeline testing and maintenance should be scheduled for low electric and gas demand seasons (i.e. the fall and early spring).

For example, one of the contributing factors to SoCalGas calling for an emergency localized curtailment for the Los Angeles basin on July 1, 2015 was that SoCalGas was completing required compliance testing on a key transmission pipeline (Line 4000). However, in order to end the curtailment episode SoCalGas modified the testing schedule by moving a portion of the work to October. This re-scheduling moved the work away from potentially high electric demand days in the summer while still allowing the pipeline work to be completed before the start of the higher gas demand winter season. This incident highlights the need to schedule gas pipeline work during the shoulder months of October and November and March through May.[30]

An example of poor maintenance planning may have led to the withdrawal of gas from Aliso Canyon on January 24-25, 2017. On January 23, 2017 planned maintenance began at the Honor Rancho storage facility that reduced the available capacity at Honor Rancho by 0.04 Bcf[31]. On January 24th 0.03 Bcf of gas was withdrawn from Aliso Canyon and on January 25th 0.02 Bcf was withdrawn. The 0.04 Bcf reduction in storage capacity at Honor Rancho is nearly identical to the 0.05 Bcf was gas withdrawn from Aliso Canyon in the two days immediately following the beginning of the planned maintenance period at Honor Rancho. This event highlights the need for improved scheduling of planned maintenance. Enduring reduced pipeline and storage facility capabilities due to unplanned maintenance caused by emergencies would be understandable during the winter and summer peak demand months. However, all planned maintenance should be scheduled outside of the peak summer and winter months.

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[30] Appendix A of the April 2016 "Aliso Canyon Risk Assessment Technical Report"
[31] Southern California Gas Company Pipeline/Station Maintenance Schedule, https://scgenvoy.sempra.com/ebb/attachments/1485825973551_SYSIMPT.pdf

Lessons Learned from Shut Down of San Onofre Nuclear Generating Station

The San Onofre Nuclear Station (SONGS), which had a capacity of 2,246 MW, was retired in 2012. Following the unexpected shut down of SONGS the region worked together to address the threats to reliability that could arise due to the loss of 2,246 MW of capacity. This process was similar to the process currently in place to contemplate the reliability threats due to the loss of Aliso Canyon.

During daytime hours solar generating resources, which ramp up in the morning and back down in the evening, made up most of the energy lost due to the closure of SONGS. Natural gas-fired generating resources have been used to maintain local reliability during the shoulder hours when solar projects are ramping up and down. Gas-fired resources are also relied on to balance supply and demand during volatile periods when variable resources like wind and solar are not fully used or unavailable.

The loss of SONGS was made possible by a significant increase in the solar generation in the region and relying on natural gas-fired plants to serve load when solar projects are ramping up and down. The loss of Aliso Canyon impacts the ability of gas-fired projects to ramp up and down. As such, on an energy basis the loss of Aliso Canyon is not nearly as significant as the loss of SONGS. On a resource flexibility basis, the loss of Aliso Canyon is a more significant event. However, with better coordination between electric and gas scheduling and tighter balancing rules for gas scheduling (as discussed above), gas plants should be able to continue to provide the services currently being provided.

Natural Gas-Fired Resources

As noted above, Aliso Canyon provides natural gas to 17 natural gas-fired power plants. The combined capacity of these plants is 9,838 MW. There are some gas-fired generation plants located in southern California, such as the High Desert Generation Facility, that can take gas supply from non-SoCalGas pipelines. These facilities can be used to help mitigate gas curtailments to gas-fired resources on the SoCalGas system. The gas supply to natural gas plants should be coordinated so as to minimize the reliance on Aliso Canyon. Gas plants that have access to other gas pipelines and/or other storage facilities should be mandated to make use those facilities first and rely on Aliso Canyon for emergency purposes only, or not at all.

Renewable Resources

The "Aliso Canyon Winter Risk Assessment Technical Report" notes that, depending on weather conditions, solar and wind in southern California can be used to compensate for electric generation lost due to gas curtailment. Given this, additional solar and wind generation should be expedited in southern California and incentivized with long-term

contracts with the LADWP and SCE. Existing mandates and the growth of renewable energy hungry Community Choice Aggregators (CCAs) in the region should result in additional, significant increases in renewable energy projects in the region. However, priority should be given to the development of renewable resources sited in locations that will lessen the impact of the loss of Aliso Canyon.

Programs Directed at Consumers

The Flex Alert program has been used to encourage electric customers to reduce electric energy consumption. This program was credited with helping alleviate potential curtailments during the summer of 2016. This program should be expanded and used on a routine basis to communicate with electric customers.

There is no similar program for natural gas customers. The only tool used thus far is general marketing campaigns aimed at informing natural gas customers of the need to generally conserve on gas consumption. Marketing campaigns do not result in real-time changes in consumption patterns during peaking events. A program to encourage and, perhaps, incentivize reductions in gas consumption among core (i.e. residential and commercial) customers should be employed in southern California. Incentivizing the purchase and installation of smart programmable thermostats should be pursued as well.

Upcoming CPUC Proceeding on the Future of Aliso Canyon

The CPUC will be opening a proceeding on the future of Aliso Canyon and a final decision is expected by mid-2018.

On January 27, 2017, the CPUC issued a press release stating that at its February 9, 2017, Voting Meeting, the CPUC is expected to vote on opening an Order Instituting an Investigation that will determine the feasibility of minimizing or eliminating the use of Aliso Canyon.[32] The CPUC documentation indicates that it expects a final decision in the matter in mid-2018. Based on the success of the mitigation measures in reducing gas demand, and the recommended actions in this letter, it is EES's opinion that withdrawals from Aliso Canyon are very unlikely to be necessary between now and the end of 2018. As a result, there is time to complete that important CPUC proceeding and the important insights that it will provide on the future of Aliso Canyon.

Cumulative Effect of Mitigation Measures

The loss of the ability to withdraw gas from Aliso Canyon has resulted in significant changes to the manner in which natural gas and electric power are managed and procured. Operating changes, such as tightening the balancing rules for gas balancing,

[32] http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M173/K201/173201227.PDF

have led to a more efficient dispatch of energy (natural gas). The loss of Aliso Canyon has also resulted in the acceleration and re-prioritization of demand response, energy efficiency and energy storage projects. The changes are the result of the 31 mitigation measures included in Appendix A of this report. Several of the measures should also be expanded and additional measures should be explored.

The mitigation measures are largely responsible for the fact that there were no curtailments in the summer of 2016. The mitigation measures greatly improved the efficiency of the gas and electric systems and should be made permanent. In addition, the mitigation measures make good business sense in that they increase the efficiency of the overall use of energy resources. From this standpoint, expanding the mitigation measures and considering the adoption of the additional measures would be a benefit to the region.

Table 6 below summarizes the estimated potential impacts from only demand response, energy storage and energy efficiency programs. The estimates are based on publicly available studies. The impacts of the other mitigation measures should be analyzed and reported, as they are necessary to understanding the full potential impacts of the mitigation measures.

Table 6
Assessment of Demand Response, Energy Storage and Energy Efficiency Measures

Mitigation Measure	Levelized Cost	Summer (MW)	Winter (MW)	Winter (MMcf)
Demand Response				
SCE 2025 Potential [1]	<$200/kW-yr	2,917	2,263	-
LADWP 2025 Potential [2]	<$200/kW-yr	583	453	-
SoCalGas Potential [3]		-	-	*TBD*
Energy Storage				
Potential [4]	$321 - $658/MWh	∞	∞	
Energy Efficiency				
SCE 2016-24 Potential [5][6][7]	n/a	1,931	1,448	-
SCG 2016-24 Potential [5][6]	n/a	-	-	26,340
Total		**5,431 - ∞**	**4,163 - ∞**	***TBD***

1) SCE Peak Shedding Demand Response Potential as reported in LBNL 2015 California Demand Response Potential Study.
2) LADWP DR Potential has been estimated by scaling SCE DR Potential by the relative share of load.
3) SCG has implemented natural gas demand response programs, but no results have been estimated or reported.
4) Cost source: Lazard's Levelized Cost of Energy Storage, Version 1.0. There is no upper limit on the amount of electric storage that could be implemented.
5) Energy Efficiency Potential and Goals Study for 2015 and Beyond.
6) No levelized cost supply curve was provided as part of the potential study, but the values provided here are the cost-effective market potential.
7) Although energy efficiency will reduce both summer and winter demand, no winter demand reduction was provided. It has been estimated here.

As shown above in Table 6, the total potential demand reduction in 2025 without energy storage programs is near 4,200 MW in the winter and 5,400 MW in the summer. The potential capacity associated with energy storage devices are shown as infinite in Table 6. On a resource potential basis this is accurate. The cost-effectiveness of energy storage programs needs to be assessed on a case by case basis, but the multiple value streams provided by energy storage should be considered. As shown above, energy storage devices range in costs from $321 to $658/MWh.

Table 6 of the April 2016 "Aliso Canyon Risk Assessment Technical Report" shows deficits ranging from 1,077 MW in scenario 2 (storage outage) to 4,800 MW in Scenario 4 (storage and pipeline outages). The report shows a 725 MW surplus in Scenario 1 (no outages). The potential savings from demand response and energy efficiency programs shown above in Table 6 are greater than the projected shortages identified in the April 2016 report, demonstrating that these measures could be successfully used to eliminate the need for gas withdrawals from Aliso Canyon.

Conclusions

Based on our investigation and review of relevant materials, EES has the following conclusions.

Conclusion #1: Approval of gas injections at Aliso Canyon beginning in February 2017 would have no material impact on gas reliability for the time period February through June 2017.

Conclusion #2: Mitigation measures are proving to be successful in reducing the overall demand for gas and gas withdrawals from Aliso Canyon should not be necessary during the summer of 2017.

Conclusion #3: Mitigation measures already identified should be continued and aggressively expanded. Table 2 provides a summary of the mitigation measures that EES believes should be expanded and/or added to future action plans.

Conclusion #4: There is sufficient time to aggressively implement demand-side mitigation measures that will eliminate the need to withdrawal gas from Aliso Canyon during the next winter season, winter 2017-18.

Conclusion #5: Use of Aliso Canyon as a last resort for withdrawals can continue without injecting additional gas into the facility. If absolutely necessary, 9.8 Bcf of gas could be withdrawn before the gas storage level was at the mandated minimum of 5 Bcf. Gas could be withdrawn for 326 days at the same rate that it was withdrawn on January 24 and 25, 2017, approximately 0.025 Bcf per day, without the need for any gas injections.

Conclusion #6: Based on publicly available information, there is no indication that the January 24-25, 2017 gas withdrawals from Aliso Canyon were necessary to avoid curtailments. Further investigation is necessary by the CPUC and others to determine the circumstances surrounding the withdrawal and its necessity.

Conclusion #7: The parties that prepared the Aliso Canyon winter and summer risk assessments should prepare a new report that explains the success of the 21 mitigation measures included in the August 2016 "Aliso Canyon Gas and Electric Reliability Winter Action Plan" (Appendix A of this report) and details the ongoing impacts that can be expected in upcoming winter and summer seasons from those and other mitigation measures. The report should include consideration of additional mitigation measures as well as expansions of the existing mitigation measures.

Conclusion #8: All planned maintenance at gas storage facilities and pipelines should be scheduled outside of the peak summer and winter months.

Conclusion #9: The parties that prepared the Aliso Canyon winter and summer risk assessments should re-evaluate whether or not 1-in-10 and 1-in-35 planning criteria for non-core and core customers, respectively, are appropriate. Should you have any questions, please contact me.

Very truly yours,

Gary Saleba
President

Appendix A: Mitigation Measures from Summer and Winter Action Plans

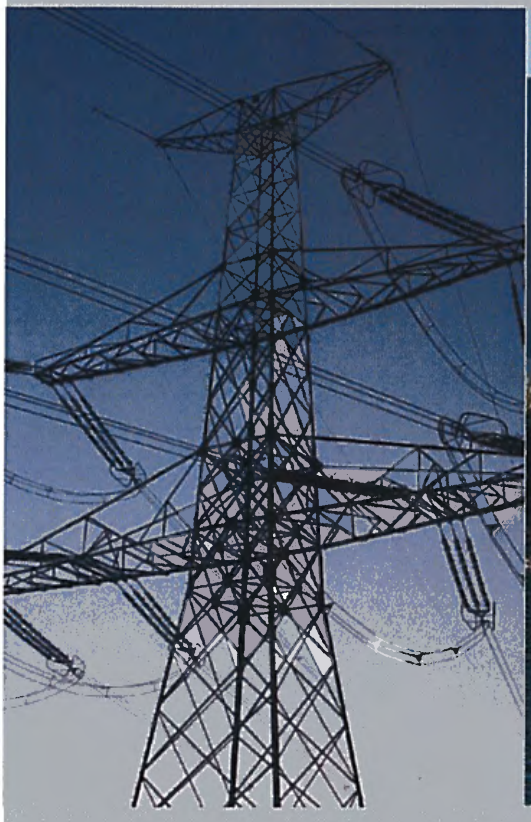
CATEGORY	MITIGATION MEASURE	Status
Prudent Aliso Canyon Use	Make available 15 bcf stored at Aliso Canyon to prevent summer electricity interruptions	Done
	Efficiently complete the required safety review at Aliso Canyon to allow safe use of the field	Underway
Tariff Changes	Implement tighter gas balancing rules. Implement the curtailment settlement agreement (as required by settlement approximately 90 days after Commission Decision, i.e. on or about November 1.	Done; see below for changes for Winter
	Modify operational flow order rule (OFO)	Done
	Call Operational Flow Orders Sooner in Gas Day	On Hold
	Provide market information to generators before cycle 1 gas scheduling	Done
	Consider ISO market changes that increase gas-electric coordination	Continuing
Operational Coordination	Increase electric and gas operational coordination	Done
	Establish more specific gas allocation among electric generators in advance of curtailment	Done
	Determine if any gas maintenance tasks can be safely deferred	Done
LADWP Operational Flexibility	Curtail physical gas hedging	Continuing
	Stop economic dispatch	Continuing
	Curtail block energy and capacity sales	Continuing
	Explore dual fuel capability	Done through September 13, 2016; continue through winter
Reduce Natural Gas and Electricity Use	Use New and Existing Programs Asking Customers to Reduce Natural Gas and Electricity Energy Consumption	Underway
	Expand gas and electric efficiency programs targeted at low income customers	Underway
	Expand Demand Response Programs	Underway for Electricity
	Reprioritize existing energy efficiency towards projects with potential to impact usage	Done
	Reprioritize solar thermal program spending to fund projects for summer and by end of 2017	Underway
	Accelerate Electricity Storage	Underway
Market Monitoring	Protect California Ratepayers	Underway
Gas-targeted Programs to Further Reduce Usage		
	Develop and Deploy Gas Demand Response Program	New for Winter
	Develop and Deploy Gas Cold Weather Messaging	New for Winter

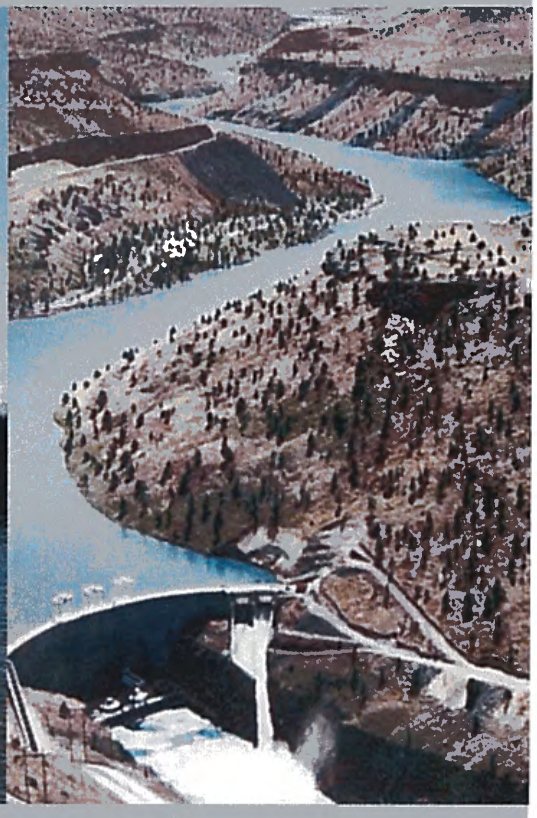
CATEGORY	MITIGATION MEASURE	Status
Winter Operations Changes	Create Advance Gas Burn Operating Ceiling for Electric Generation	New for Winter
	Keep the Tighter Noncore Balancing rules	New for Winter
	Add Core Balancing Rules	New for Winter
Use of Gas from Aliso Canyon	Update the Aliso Canyon Withdrawal Protocol and Gas Allocation Process	New for Winter
Reduce Gas Maintenance Downtime	Submit Reports Describing Rapid Progress on Restoring Pipeline Service	New for Winter
Increase Supply	Identify and solicit additional gas supply sources including more California Natural Gas Production	New for Winter
	Prepare to Buy LNG	New for Winter
Refineries	Monitor Natural Gas Use at Refineries and Gasoline Prices	New for Winter

EES Consulting, Inc.

STATEMENT OF QUALIFICATIONS

January 2017





EES Consulting, Inc.

570 Kirkland Way, Suite 100
Kirkland, Washington 98033
Telephone: (425) 889-2700

1455 NW Irving Street, Suite 200
Portland, Oregon 97209
Telephone: (503) 223-5900

A registered professional engineering
and management consulting firm
www.eesconsulting.com

Background and Experience

Experience

EES Consulting, Inc. (EES) is a registered professional engineering and management consulting firm, established in 1978, that provides a variety of project solutions to clients involved with electric, natural gas, telecommunications, water, wastewater and other energy and natural resource related businesses. Our professional staff members have backgrounds in the areas of engineering, economics, finance, public administration, operations, research and general management. For over 30 years, EES has assisted electric power public utility clients, Independent Power Producers, and large retail customers in North America in meeting the challenges of evolving competitive, regulatory and technical environments. We have a proven track record of success in arenas where the results of a particular project may have far reaching effects on the viability of an organization and the local community.

EES has assisted Los Angeles County, Coachella Valley Association of Governments (CVAG), San Bernardino Associated Governments (SANBAG) and Western Riverside Council of Governments (WRCOG), County of Alameda, City of Solana Beach and the City of San Jose in analyzing the potential for developing CCA programs within their jurisdictions. This analysis included a technical feasibility study, business plan, researching Joint Powers Authority governing documents, discussing marketing plans, and drafting the CPUC required Implementation Plan/Notice of Intent. In addition, EES staff has submitted filings on behalf of LA County in CPUC proceedings. EES Staff continually participate and monitor CPUC proceedings related to rate design issues, such as SCE ERRA filing (A.16-05-009), SCE's request to implement a new non-bypassable charge for Biomass (R 08-08-009), Distributed Energy Resources proceeding (R.14-10-003), Energy Storage & PCIA proceedings (A.15-12-003 & A.15-12-004), IRP & Long-Term Procurement Planning proceeding (R.16-02-007), and Energy Efficiency proceeding (R.13-11-005).

EES brings more than 30 years of experience in effectively helping our clients navigate and even shape California's energy and electrical markets. EES has extensive experience in assisting municipal electric utilities and local government jurisdictions in California with a host of demand side management and electric utility engagements. For example, EES has performed retail revenue requirement, cost of service, and rate design studies for the Municipal Electric Utilities in Palo Alto, Anaheim, Pasadena, Glendale, Alameda, Roseville, and Colton. EES has recently completed engineering/operations studies for the Riverside and Burbank electric systems. A management and operational staff audit was performed by EES on behalf of the Turlock Irrigation District.

At EES, our experienced team of engineers and financial analysts are focused on responsive and cost-effective solutions to the client's power supply needs. EES has developed Integrated Resource Plans for utilities in order to examine the economic, engineering, environmental and

other attributes associated with various generation options. EES's approach is to identify issues associated with the existing resources and power supply contracts, identify options for resolving the issues identified, and conduct a comparison of options in terms of effectiveness, economic costs and benefits, compatibility with existing resources, and any other relevant factors. The results of an integrated resource plan provide a planning framework for moving forward with generation capital projects. As part of providing these services, EES continue to monitor wholesale electric and gas power markets and develop wholesale power price forecasts for our clients.

EES has provided expert testimony for the prudency of the operations and financial accounting for the City of Redding's power supply planning and operations department. EES also helped the municipalities of Moreno Valley, Corona, San Marcos, Palm Desert, Indian Wells, Palm Springs, Cathedral City, and Desert Hot Springs evaluate the formation of a municipal electric utility. This analysis included the forecast of wholesale electric power cost forecast, including delivery costs, as well as the development of each electric utility's power supply costs and non-power supply costs in order to determine the electric utility power revenue requirement and cost of service.

With respect to utility retail rate setting and design, the project team has completed over 500 retail rate studies for electric power public utilities. This area of expertise is a primary business line for EES. The project team routinely conducts training for utility technicians on rate setting on behalf of the California Municipal Utilities Association, the American Public Power Association, the American Water Works Association, and the Northwest Public Power Association.

Key Personnel

EES has a staff of consultants experienced in the area of electric power and natural gas utility studies, and Community Choice Aggregation (CCA) studies.

EES has a senior staff of consultants with over 20 years' experience in advising electric power utilities in financial analysis, cost of service, rate design and wholesale power acquisition. EES has been in operation since 1978 and has assisted electric power and natural gas utilities in North America since the inception of the firm.

Resumes of all key EES personnel are included as Attachment A.

Gary Saleba, President/CEO
M.B.A., Finance, Butler University, Indianapolis, IN
B.A., Economics and Mathematics, Franklin College, Franklin, IN

Gary Saleba has over 35 years of experience in providing consultant services to electric power utilities. Gary started EES in 1978 and has worked for our electric power utility clients ever since. Gary's areas of specialty include overall quality control for EES's projects as well as development of corporate management, financial and strategic planning models primarily for

electric, natural gas and water utilities. He has extensive experience in the areas of utility rate design, revenue requirement analysis, Cost of Service, financial planning, management audits, professional development educational seminars, marketing, consumer research, forecasting, integrated resource planning, cost-benefit analyses, overall strategic planning, power procurement, and mergers and acquisitions.

Having worked as a utility employee, Gary combines an extensive background as both a utility industry expert and a management consultant. He is able to draw upon this professional and educational experience to manage projects including comprehensive water, wastewater, gas and electric cost of service studies, strategic planning, and management critiques for clients throughout North America. His experience extends to alternative fuel cost comparisons, econometric forecasting models, resource planning and reliability studies. Gary has participated in numerous generic utility proceedings, testified before over 200 regulatory bodies and courts of law and coordinated over 500 financial planning, rate study, resource acquisition, and strategic planning studies.

Gary has served on numerous energy and natural resource-related trade associations, including as Chairman of the American Water Works Association Financial Management Committee and Management Division. He has also served on the board of directors for the Northwest Public Power Association and on the Board of Directors for ENERconnect, Inc., a bulk power aggregation and procurement entity serving the municipal utilities in the Province of Ontario. Gary is located in our Kirkland, Washington office.

Anne Falcon, Senior Associate
M.S., Operations Research, Stanford University
B.A., Economics, University of San Francisco, Summa Cum Laude

Anne Falcon has over 20 years of experience providing financial analysis, cost of service and rate design services to electric utility clients. She has been employed by EES since 1993 and she has provided financial analysis assistance to our electric power utility clients since then. Anne provides project management and technical support for all types of economic studies. She has managed projects concerning cost of service and rate design analyses, financial planning including estimation of power and non-power supply costs, and regulatory proceedings for electric, natural gas, water, and wastewater utilities. Her expertise includes restructuring, strategic planning, forecasting, unbundled cost-of-service studies, optimization research, and specialized statistical studies.

Through her research and analysis of the current state of the industry, Anne has assisted many California and Northwest electric power utility clients in preparing for the changes that are taking place. Her work has included developing wholesale power price forecasts, unbundled rates, average embedded and marginal cost-of-service studies, analysis of stranded costs, development of direct access programs, research on Independent System Operators (ISOs) and power markets, development of customer choice programs and conservation, market-based and green rate designs.

At EES, Anne has been involved in all aspects of the integrated resource planning process from the initial identification of demand and supply-side resources to the final ranking of resource portfolios. She has developed numerous decision models for United States and Canadian utilities and performed resource evaluations by applying social costing principles and risk analysis.

Anne applies her extensive economic and technical knowledge in the development of resource-related computer models for use by electric, gas, water, wastewater, and solid waste utilities. Her work also includes the development of a multitude of econometric forecasts for electric, gas, and water utilities. She has developed disaggregate energy and demand forecasts using a variety of forecasting and econometric tools. Anne is located in our Kirkland, Washington office.

Gail Tabone, Senior Associate

M.S., Agricultural and Applied Economics, University of Minnesota
B.S., Economics, University of Minnesota

Gail has over 30 years of experience in short- and long-term utility planning related to both operations and financial analysis. Gail has managed projects concerning power supply planning, load aggregation, cost of service and rate analyses, and regulatory proceedings. Her experience includes power supply management for a large public utility district in the Northwest that diversified from the Bonneville Power Administration. This project included load forecasting, optimization of resource and contract options, procurement and negotiations for power supply, power supply cost estimation, negotiating transmission contracts, auditing of scheduling and dispatching services, rate design and devising customer choice programs.

Gail participated in the deregulation process very early on when she assisted an Alberta municipal utility through the deregulation that occurred in that province resulting in the establishment of a power pool and a grid operating company. She was involved in strategic planning and regulatory intervention for the utility and performed an unbundled cost of service study incorporating the new power supply and transmission costs.

Gail has been actively involved in resource planning, evaluating resource proposals and negotiating contracts for numerous utilities. She has assisted a group of Northwest public utility districts and municipal utilities with load aggregation, evaluation of power supply proposals, and negotiations for supply and transmission contracts. She has also assisted municipal utilities in California in the area of transmission rate design and has worked for municipal utilities with respect to participation in the California ISO.

Gail is skilled at determining clients' needs in the changing utility environment. She develops unique approaches to the analysis of issues facing each client. While her primary focus is economic, she also has a thorough knowledge of the technical issues related to power supply diversification. Gail is located in our Kirkland, Washington office.

Steven Andersen, Manager, Project Evaluations
B.S., Electrical Engineering, University of Washington

Steve has over 15 years of experience in developing wholesale power supply pricing and financial analysis for electric utilities. Steve has been with EES since 1995. Steve's broad knowledge of the engineering field enables him to handle most technical issues and provide economic and technical analyses for utility and industrial clients of EES. He has evaluated power supply proposals for many utilities in the northwest. He has calculated the potential savings in total power supply costs offered by competing suppliers. With his background in power engineering, he is able to assess the technical barriers to potential savings in today's changing electric industry.

Steve has been responsible for managing the interplay of multiple power supply contracts for a major Northwest utility. He has monitored the hourly loads and power schedules of the utility and recommended changes to economically optimize the utility's various resources. He has also negotiated and implemented short and long-term power supply and transmission contracts on behalf of the utility.

Steve has prepared integrated resources plans for both large and small utilities and has performed resource feasibility studies for both utility and industrial clients. He has performed cost of service analyses for many utilities. This analysis includes developing rates for residential, commercial and large industrial customer classes. He has also audited the power supply costs of large industrial corporations and suggested options for reducing their overall costs.

Steve has experience monitoring gas and electric markets and recommending purchases based on potential savings in total power supply costs. He is familiar with the functionality of hourly, daily, monthly, and long-term energy markets. Steve is located in our Portland, Oregon office.

Amber Nyquist, Senior Project Manager
M.A., Economics, Simon Fraser University
B.A., Economics, Western Washington University

Amber has over 10 years of experience. Amber provides analytical expertise for EES in support of economic and financial studies. She offers experience and knowledge to a wide range of topics related to regulated utilities. Her background includes cost of service analysis, electric rate design, Bonneville Power Administration's tiered rate methodology, and other power supply costs or related information. She assists in Integrated Resource Planning as well as independent resource evaluation. Specific resources include demand-side and conservation resources, geothermal, wind, renewable energy credits, gas-fired, and other resources.

In addition to resource planning, Amber uses her background in econometrics and data analysis to develop load forecasts, normalize electric loads according to weather, and to develop market price forecasts. She also conducts conservation program evaluations and provides utilities with statistically significant results, which assist in utility program planning, data collection, and presentation.

Finally, Amber and her staff have performed over 50 conservation potential assessment studies for electric utilities on the west coast. Amber is located in our Kirkland, Washington office.

Colin Cameron, Senior Analyst
M.S., Environmental Science and Engineering, University of North Carolina, Chapel Hill
B.A., Neuroscience and Behavior, Columbia University

Colin provides analytical expertise for EES on economic and regulatory issues. He brings experience in least-cost and econometric model development, benefit-cost analysis, and regulatory research.

Prior to joining EES, Colin worked on energy system modeling teams at the U.S. Environmental Protection Agency and the International Institute for Applied Systems Analysis in Vienna, Austria. In these roles, Mr. Cameron led analysis of energy subsidies, emission taxation, and rapid implementation of new power generation technologies. He has published research on water-energy nexus issues in the United States and on fuel affordability in South Asia. Colin is located in our Kirkland, Washington office.

Ted Light, Project Manager
B.S., Aeronautical & Aerospace Engineering, Purdue University
Certified Energy Manager (CEM)

Mr. Light is a Project Manager with a specialty in energy efficiency and demand-side management. He brings nearly nine years of experience to EES, having worked previously for the Energy Trust of Oregon, the non-profit energy efficiency and renewable energy program administrator for Oregon's investor-owned utilities. He has expertise and knowledge on a broad array of energy efficiency program management and planning topics including: conservation/DSM potential assessments, conservation program planning, program data analysis, and cost-benefit analyses. Mr. Light is a Certified Energy Manager with the Association of Energy Engineers and holds a B.A. in Aerospace Engineering from Purdue University.

Experience and Technical Competence

Through our on-going work in California, EES is presently engaged in designing 20-year resource plans that meet or exceed requirements for renewable energy purchases, energy storage, distributed resources, demand side resources and resource adequacy. Below is a summary of EES's recent and relevant work with four entities.

Name of Firm/Project Title:	**Western Riverside Council of Governments** **Coachella Counsel of Governments** **San Bernardino Associated Governments** **Community Choice Aggregation Study**
Dates of Service:	07/16 – 07/17
Value or Cost of Service:	$150,000
Contact:	Barbara Spoonhour, Director of Energy Programs spoonhour@wrcog.cog.ca.us, (951) 955-8313, (951) 787-7991 (Fax) Katie Barrows, Director of Environmental Resources Kbarrows@cvag.org, (760) 346-1126, (760) 340-5949 (Fax) Duane Baker, Deputy Executive Director dbaker@sanbag.ca.gov, (909) 884-8276, (909) 885-4407 (Fax)
Team Members Participating:	Saleba, Falcon, Tabone, Andersen, Cameron

Services Provided:

- Demonstrated to stakeholders that a CCA is feasible and cost-effective, using an overall financial comparison to Southern California Edison (SCE).
- Developing CCA technical business plan; electric wholesale power market forecast, developed Investor-Owned Utility rate forecast, provided in-depth analysis of electric load forecasts and wholesale power supply costing scenarios, including delivery that includes different levels of renewable supply and demand-side management (DSM).
- Evaluated non-power related costs, examined the potential for energy efficiency and demand reduction and performed an extensive sensitivity analysis that considers variables such as gas and electricity prices, loads, program participation rates, discount rates, and financing scenarios.
- Developed CCA electric power retail rate forecast.

Name of Firm/Project Title:	**Los Angeles County** **Customer Choice Aggregation Business Plan**
Dates of Service:	10/15 – Present
Value or Cost of Service:	$300,000
Contact:	Howard Choy, General Manager, Office of Sustainability hchoy@isd.lacounty.gov, (323) 267-2006, (323) 260-5237 (Fax)
Team Members Participating:	Saleba, Falcon, Andersen, Tabone, Cameron

Services Provided:

- Developed CCA technical business plan; electric wholesale power market forecast, Investor-Owned Utility rate forecast, CCA electric power retail rate forecast, emissions cap-and-trade program impact study; cost-effectiveness of co-generation plants.
- Developed Southern California Edison (SCE) and CCA electric power retail rate forecasts.
- Monitored and participate in electric power retail rate proceedings at CPUC on behalf of LA County.

Name of Firm/Project Title:	**Richland Energy Services** **Integrated Resource Plan**
Dates of Service:	06/15 – 06/16
Value or Cost of Service:	$70,000
Contact:	Sandi Edgemon, Business Services Manager sedgemon@ci.richland.wa.us, (509) 942-7613, (509) 942-7405 (Fax)
Team Members Participating	Saleba, Falcon, Andersen, Tabone, Nyquist
Services Provided: ■ EES evaluated existing resources to determine future net energy and capacity requirements. Evaluated the costs and benefits associated with Richland's existing resources and a variety of alternatives resources that could be deployed to serve Richland. EES also completed a 20-year electric load forecast.	

Name of Firm/Project Title:	**Anchorage Municipal Light & Power (ML&P)** **Integrated Resource Planning Assistance, Engineer-of-Record**
Dates of Service:	06/02 – Present
Value or Cost of Service	$750,000 for 3 years (Contract since 2002)
Contact:	Mark Johnston, General Manager and Chief Operating Officer JohnstonMA@ci.anchorage.ak.us, (907) 223-0942, (907) 263-5828 (Fax)
Team Members Participating	Saleba, Falcon, Andersen, Tabone, Nyquist
Services Provided: ■ Developed the load forecast for resource and financial planning as well as cost of service analysis for the last several years. In addition, the load forecast is used to estimate needed natural gas purchases for ML&P's generating resources. This project is updated every two years. ■ EES is also ML&P's Engineer-of-Record, which entails a periodic assessment of ML&P's generation, transmission, and distribution facilities to determine adequacy, operational efficiency, and maintenance procedures. Developed ML&P's Cost of Service study and provide regulatory support to ML&P in filing with the Regulatory Commission of Alaska.	

In addition, EES has provided integrated resource planning services to the following clients.

IRP and Resource Planning Studies	
■ Los Angeles County	■ San Bernardino County
■ Riverside County	■ City of San Jose
■ Skamania County PUD	■ Montana Power
■ City of Tacoma	■ Northwestern Energy
■ City of San Marcos	■ Moon Lake Electric Corporation
■ Kootenai Electric	■ Lakeview Light & Power
■ Flathead Electric Cooperative	■ City of Ellensburg
■ Emerald PUD	■ Benton REA
■ Chelan County PUD	■ Springfield Utility Board
■ West Kootenay Power	■ Western Montana G&T
■ Aquila Canada	■ Centra Gas
■ Intermountain Gas	■ Kentucky American Water Company
■ Gas Company of New Mexico	■ PEPCO
■ Benton County PUD	■ Yellowstone Valley Electric Cooperative
■ Clallam County PUD	■ City of Indian Wells
■ Clark Public Utilities	■ City of Moreno Valley
■ Cowlitz County PUD	■ City of Port Angeles
■ Franklin County PUD	■ City of Red Deer
■ Grays Harbor County PUD	■ City of Lethbridge
■ Klickitat County PUD	■ City of Medicine Hat
■ Lewis County PUD	■ City of Richland
■ Mason County PUD #3	■ City of Palo Alto
■ Mason County PUD #1	■ City of Anaheim
■ Okanogan County PUD	■ Municipal Electric Association of Ontario
■ Pacific County PUD	■ Northwest Territories Power Corporation
■ Pend Oreille County PUD	■ Ontario Hydro
■ Peninsula Light Company	■ Lower Valley Power & Light

Conservation Plans

EES completed over 30 conservation potential assessments, and specialize in utilizing several different models:

- Completed conservation potential assessments for numerous west coast utilities
- Developed "Handbook for Potential DSM Assessments"
- Developed the Utility Potential Calculator for DSM

EES has developed a reference guide called the "Handbook for Potential DSM Assessments". This handbook provides information on how to conduct potential assessments.

Appendix C: SoCalGas ENVOY Data

Gas Flow Date	Cycle	Receipt Point	Total Scheduled (Dth)
1/22/2017	5	California Producers - Line 85	42,140
1/22/2017	5	California Producers - North Coastal	11,256
1/22/2017	5	California Producers - Other	14,475
1/22/2017	5	Northern Zone	1,316,773
1/22/2017	5	Southern Zone	974,051
1/22/2017	5	Wheeler Ridge - Zone	845,730
		Total	**3,204,425**
1/23/2017	5	California Producers - Line 85	42,004
1/23/2017	5	California Producers - North Coastal	11,256
1/23/2017	5	California Producers - Other	14,337
1/23/2017	5	Northern Zone	1,358,587
1/23/2017	5	Southern Zone	982,273
1/23/2017	5	Wheeler Ridge - Zone	858,080
		Total	**3,266,537**
1/24/2017	5	California Producers - Line 85	25,593
1/24/2017	5	California Producers - North Coastal	10,956
1/24/2017	5	California Producers - Other	14,168
1/24/2017	5	Northern Zone	1,288,411
1/24/2017	5	Southern Zone	903,597
1/24/2017	5	Wheeler Ridge - Zone	838,104
		Total	**3,080,829**
1/25/2017	5	California Producers - Line 85	36,240
1/25/2017	5	California Producers - North Coastal	11,256
1/25/2017	5	California Producers - Other	13,213
1/25/2017	5	Northern Zone	1,334,510
1/25/2017	5	Southern Zone	1,030,279
1/25/2017	5	Wheeler Ridge - Zone	758,687
		Total	**3,184,185**
1/26/2017	5	California Producers - Line 85	33,917
1/26/2017	5	California Producers - North Coastal	10,567
1/26/2017	5	California Producers - Other	12,538
1/26/2017	5	Northern Zone	1,297,028
1/26/2017	5	Southern Zone	978,460
1/26/2017	5	Wheeler Ridge - Zone	799,092
		Total	**3,131,602**

Data obtained from https://scgenvoy.sempra.com on 2/1/2017.
"Available Capacity vs. Scheduled" Microsoft Excel Export for the month of January 2017.
Data has been formatted for clarity.

County of Los Angeles
INTERNAL SERVICES DEPARTMENT
1100 North Eastern Avenue
Los Angeles, California 90063

Telephone: (323) 267-2101
FAX: (323) 264-7135

"To enrich lives through effective and caring service"

County of Los Angeles
Internal Services Department
1100 N. Eastern Avenue
Los Angeles, CA 90063

April 6, 2016

Edward Randolph
Energy Division Director
California Public Utilities Commission

Dear Ed,

Thank you for your call on Thursday, March 24, 2016 inquiring about how the SoCalREN might assist the CPUC to respond to potential energy shortages related to operational failures at the Aliso Canyon gas storage facility. We understand that the issue of concern is that rolling brownouts and blackouts may occur this summer and through the fall due to the restricted availability of natural gas for electricity generation in Southern California.

The SoCalREN stands ready to assist the CPUC and the IOUs to avert energy shortages through a targeted and effective local government education and engagement campaign in affected communities. In addition, the SoCalREN also proposes to accelerate implementation of public agency facility retrofit projects.

Local Government Community Engagement Strategy
As trusted voices in the community, local governments play an important role to engage their communities to understand the concern and take urgent and necessary action to reduce energy demand. **In addition, because local governments are charged with ensuring safety and security in their communities, they have a keen interest in avoiding the disruptive consequences and costs associated with responding to energy outage consequences.**

The SoCalREN is well positioned and prepared to implement an engagement strategy to motivate local governments to promote energy conservation and other energy usage reductions within their own communities through stakeholder engagement, customized messaging, and ongoing support.

The SoCalREN is uniquely positioned to assist with this effort as it has the existing institutional framework and established relationships with the 200+ cities and counties in the affected region. SoCalREN is also experienced in successfully coordinating directly with IOU's as a Program

Administer of energy efficiency programs. The SoCalREN will build on its existing outreach strategies and tailor strategies that will be effective, credible and cause local governments and their constituents to act.

Working in coordination with the CPUC and the local utilities, the SoCalREN will focus on identified target areas of projected energy shortages and implement engagement strategies and messaging for local governments to take action – all of which can be appropriately timed in anticipation of potential energy supply constraints.

Our team is well situated and prepared to take the following actions to help communities achieve measurable energy reductions:

- Collaborate with CPUC, CAISO, IOUs and affected Public Utilities on messaging and coordination strategies;
- Leverage the SoCalREN's extensive network of local governments and stakeholders to disseminate targeted messaging to affected communities using trusted messengers -- beyond cities and counties, this Network includes local Council of Governments, Association of Governments, League of California Cities and other trusted agencies;
- Reach out to leadership and communication leads (Public Information Officers and agency staff) in order to leverage existing local government communication channels to engage the community; i.e: newsletters, public network and channel videos, websites, social media and more;
- Design outreach and education materials that complement and supplement current local utility messages and are customizable for each local government's particular needs, and aligned with the agency's preferred community outreach and communication channel;
- Act as a liaison among local governments and local utilities to answer questions about potential energy shortages and provide resource connections;
- Speak to the compelling local government concerns to avoid energy shortages due to negative repercussions from increased costs, economic and social disruption, community safety concerns, etc;
- Coordinate with local governments to share messages with influential community leaders and organizations, and;
- Ensure the most disadvantaged community members are reached with appropriate in-language messaging and access to additional resources & programs.

As a result of these actions, we anticipate community awareness and actions that will be both significant and timely in response to this potential energy crisis.

While the proposed approach is a seamless incremental addition to the SoCalREN's current outreach activities, the proposed Aliso Canyon action plan is beyond the scope of the current SoCalREN budget. The SoCalREN is in discussions with Gas Company representatives about how the SoCalREN can support planned outreach and mitigation efforts. SoCalREN urges that the CPUC direct Gas Company to coordinate with the SoCalREN on a local government community engagement campaign and to provide appropriate supplemental funding for these expanded SoCalREN activities.

Accelerated Implementation of Public Agency Facility Retrofits

In response to the CPUC's request for the SoCalREN to evaluate opportunities to expedite energy project completion, the SoCalREN anticipates it can realize 18 to 20 million kWh annual savings by December 31, 2016.

The SoCalREN has identified the following tangible actions that the IOUs and the CPUC can take to support expedited completion of public agency projects.

IOU ACTIONS

1) **Apply the SCE 3 cent per kWh additional incentive to all public agency projects.**
   Discussion: Current SCE Local Government Partnership programs receive a 3 cent additional incentive per kWh saved. Providing this same level of incentive to all public agency programs will drive implementation of more energy efficiency projects.

2.) **Review and approve incentive & OBF applications within 30 days of submittal.**
   Discussion: Currently it takes an average of 2 to 3 months for approval of incentive applications. If the project includes an OBF application, then the approval time may take 3 to 4 months. This overly long approval process delays the timely and cost-effective completion of energy efficiency projects by public agencies.

3) **Allow project using customized incentives to start prior to final OBF & incentive approval.**
   Discussion: Currently projects cannot start prior to incentive approval or the project becomes ineligible for incentives. To expedite energy efficiency projects, IOUs can allow projects to move forward absent incentive approval, with the caveat that the public

agency will accept the IOU final review decision regarding the incentive and OBF amounts.

4) **Revise the maximum OBF repayment term from 10 to 15 years.**

Discussion. The IOUs should relax the strict OBF requirements to provide more flexibility in repayment terms. Public agencies cannot take more than 10 years to repay OBF. Many energy efficiency measures have an expected useful life much longer than ten years. As a result, a ten year repayment requirement reduces the ability to undertake more complex and comprehensive projects, such as those involving mechanical systems. Also, with the longer repayment term agencies will be able to bundle a greater number of longer term payback measures with their shorter term payback measures.

5) **Allow bundling of OBF projects among service accounts.**

Discussion: A public agency should be allowed to submit a single OBF application for a project. For example, the SoCalREN was required to submit 27 different applications for 1 city street light project. This costs time and money and is an unnecessary burden to agencies.

6) **Double the OBF funding limit per project from $1 million to $2 million.**

Discussion: Currently the total OBF project limit is $1 million. For a number of agencies their total eligible project exceeds $1 million. The SoCalREN works with agencies to achieve deeper and more comprehensive savings, in alignment with CPUC goals. The current $1 million limit does not support this comprehensive approach for cost effective energy efficiency retrofits.

8) **Reinstate recently removed energy efficiency measures (EEM) affecting currently developed Public Agency projects.**

Discussion: At the beginning of 2016, a significant number of EEMs were removed from incentive eligibility. In some cases, this change affected projects already under design and which were relying on those incentives for funding. To ensure projects move ahead, the IOUs should reinstate those EEMs.

CPUC ACTIONS

1) **Accelerate the Energy Division Parallel Review process.**

Discussion. Currently the Energy Division, through the Parallel Review process, may select a project for review prior to the IOU approval of the incentive. The Review is intended to be done in parallel with the IOU process but, in fact, often happens

sequentially, which may add as much as six months delay to a project. To resolve this issue, the Energy Division can ensure it adheres to or reduces its current 30 day review requirement. Also, the Energy Division should ensure that the Parallel Review process occurs, in fact, in parallel and not sequentially with the IOU process. In addition, projects will benefit if the CPUC allows projects to proceed prior to completion of the Energy Division review. This expedited process should be applied to projects in Southern California that will mitigate the effects from Aliso Canyon.

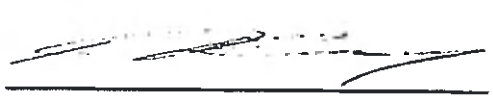
2) **Approve the original request of the SoCALREN to fund a Public Agency Revolving Loan Fund.**

Discussion. This action solves an initial capitalization challenge for public agencies to do energy efficiency projects. Most public agencies do not have energy efficiency projects in their approved budgets. To take action, agencies need 100% funding availability before they can commence a project. If a project is not budgeted but is fully funded through OBF and incentives, the public agency needs interim funding until the project is constructed, the incentive is paid and the OBF is issued. This funding gap typically will be six months during which time the public agency has to carry the project costs. This can be a significant barrier to many projects being started. The RLF will provide the bridge funding for the typical six month gap. This fund is then repaid once the incentives and OBF funds are received. In this way, other agencies can leverage this 'gap' funding. An RLF amount of $1.5 million will expedite the delivery of public agency energy efficiency projects in 2016 and beyond.

3) **Approve the PACE-Plus Program**

Discussion. Los Angeles County launched a residential Property Assessed Clean Energy (PACE) Finance program in June of 2015. Since then, the County has financed, and approved the financing, of over 14,000 residential upgrades which include combinations of HVAC, insulation, ductwork and solar measures. As has been informally reported, many and most of these projects have not utilized CPUC/IOU approved Home Upgrade incentives. The County now has data for all measures implemented in the 14,000 projects implemented since June and has been working with residential PACE providers to develop and propose a new residential incentive (PACE-Plus) which encourages homeowners to go above current code or other energy label equipment baselines. We will soon propose this new incentive as a High Opportunity Program/Project (HOPPS) program under the SoCalREN. We propose that the data acquired from PACE providers in Los Angeles County and the timely review/approval of a PACE incentive can provide critical information to the CPUC and the IOUs/MOUs about what impacts residential PACE is actually having in California – and in particular, the Los Angeles region.

In conclusion, the SoCalREN stands ready to assist the CPUC and the IOUs to help mitigate the effects of the Aliso Canyon failure. We look forward speaking again soon to answer any questions you may have and look forward to working with you on next steps.



Howard Choy
General Manager, Office of Sustainability
County of Los Angeles
Internal Services Department
Administrator of the Southern California Regional Energy Network (SoCalREN)

SOCALREN ENERGY EFFICIENCY PROJECTS UNDER DEVELOPMENT

(may be completed by FY 2016/2017 with CPUC incentives)

	Total Savings:	20,001,130
Agency	**Project Name**	**Estimated kWh Savings**
Cucamonga Valley Water District	Cucamonga Valley WD Well 19 Pumping	163,466
Cucamonga Valley Water District	Cucamonga Valley WD CTL 1B Pump 4 Pumping	28,382
Port of Hueneme	Port of Hueneme Harbor District Lighting	216,907
Conejo Valley Unified	Conejo Valley USD Various Lighting 2	1,874,564
Cucamonga Valley Water District	Cucamonga Valley WD Well 05 Pumping	134,214
Ventura Unified	Ventura USD Various Lighting	1,040,495
Los Angeles County	LAC Whittier Narrows Park Lighting	59,003
Santa Barbara	Santa Barbara Street Lighting 2	12,944
Culver City	Culver City City Hall Mechanical	93,230
Las Virgenes Municipal Water District	Las Virgenes Rancho Sump Pumps	87,068
Culver City	Culver City Police EMS	101,671
Culver City	Culver City Transportation Mechanical	15,990
Santa Monica	Santa Monica Pool Lighting	9,988
Santa Monica	Santa Monica Big Blue Bus Lighting	575,873
Palmdale	Palmdale Street Lighting	413,510
Cucamonga Valley Water District	Cucamonga Valley WD Station 3/3A Pumping	526,442
Long Beach	Long Beach Street Lighting (Phase 1)	752,500
Culver City	Culver City Transportation Lighting	82,263
Irvine	Irvine Transportation Center Lighting	7,577
Huntington Beach	Huntington Beach IISNS (B,C,D,E,F,K)	91,093
WMWD	Western Municipal WD Pumping	233,244
Mission Viejo	Mission Viejo Street Lighting	93,103
Los Angeles County	LAC Washington Security Lighting	29,889
Los Angeles County	LAC Charles White Lighting	12,569
Los Angeles County	LAC Roosevelt Park Lighting	167,218
Los Angeles County	LAC Obregon Park Lighting	50,697
Los Angeles County	LAC Various Pools Mechanical 2	360,623
Huntington Beach	Huntington Beach St. Lt.s (LS-3) g.2; g.3	96,116
Huntington Beach	Huntington Beach Pkg Lot & Park Lt.s (LS-3) H	38,726
Huntington Beach	Huntington Beach Pkg Lot, Park (GS,AL,TOU) J, I	324,995
Culver City	Culver City - City Hall EMS	111,969
Inland Empire Utilities Agency	Inland Empire Lighting Phase 1	228,035

Agency	Project Name	Estimated kWh Savings
Cucamonga Valley Water District	Cucamonga Valley WD Various Well Pumping	462,177
Cucamonga Valley Water District	Cucamonga Valley WD STA-1 B1 & B3 Pumping	91,871
Cucamonga Valley Water District	Cucamonga Pump System Optimization	546,563
Whittier	Whittier Palm Park Pool Mechanical	76,823
Whittier	Whittier Street Lighting	1,095,452
Whittier	Whittier Various Lighting	12,841
Whittier	Whittier Various Mechanical	173,152
Palmdale	Palmdale Various Mechanical 2	48,009
Palmdale	Palmdale Various Mechanical 1	487,796
Downey	Downey Street Lighting	300,000
Irvine	Irvine Safety Lights 1	106,764
Downey	Downey Various Parks Lighting	62,023
Culver City	Culver City Street Lighting	799,751
Palmdale	Palmdale Park Lighting	142,253
Pomona	Pomona Street Lighting	1,081,914
Los Angeles County	LAC Civic Center Mechanical	50,000
Claremont	Claremont Street Lighting	450,180
Las Virgenes Municipal Water District	Las Virgenes Westlake Filter Plant Pumps & VFD?s Project	122,016
UWCD	United Water CD Pumping	493,810
Las Virgenes Municipal Water District	Las Virgenes Westlake Filter Plant LED Lighting Project	42,496
Los Angeles County	LAC Bonelli Pump Mechanical	50,545
Los Angeles County	LAC George Lane Park Lighting	53,513
Long Beach	Long Beach City Place Parking Structure Lighting	368,671
Carpinteria Sanitary District	Carpinteria SD Process Optimization	403,339
Los Angeles County	LAC DPW Headquarters Mechanical	446,556
UWCD	United Water CD Pump Sequence Optimization	565,456
Orange County	OC Manchester Parking Lot Lighting	652,995
Goleta Sanitary District	Goleta Sanitary District Process Optimization 1	658,581
Inland Empire Utilities Agency	Inland Empire Pumping Phase 1	782,879
Newport Beach	Newport Beach Street Lighting	1,150,000

Los Angeles County Building Projects (with completion date)

Energy Project Type/Location	Annual kWh Savings	Annual Therm Savings	Project Completion
RETROCOMMISSIONING			
Industry Sheriff Station	172,803	5,543	3/1/2016
La Cresenta Sheriff Station	104,668	3,741	3/1/2016
West Hollywood Sheriff Station	173,093	4,013	3/1/2016
Lomita Sheriff Station	92,690	3,816	3/1/2016
Los Padrinos Juvenile Hall	1,438,442	45,963	5/1/2016
Carson Library	132,448	4,768	Est. comp 1/1/2017
East Los Angeles Library	105,200	3,787	Est. comp 1/1/2017
Florence/Firestone DPSS	160,000	5,760	Est. comp 1/1/2017
Huntington Park Library	133,928	4,821	Est. comp 1/1/2017
Lancaster Library	194,884	7,015	Est. comp 1/1/2017
Metro East DPSS	262,000	9,432	Est. comp 1/1/2017
Norwalk Library	134,996	4,860	Est. comp 1/1/2017
Adams/Grand DPSS	861,756	31,023	Est. comp 1/1/2017
SUBTOTAL	**3,966,908**	**134,542**	
MONITORING BASED COMMISSIONING			
Cudahy DPSS	123,492	4,446	Est. comp 1/1/2017
Library Headquarters	540,972	19,475	Est. comp 1/1/2017
Sherman Block Building	500,000	18,000	Est. comp 1/1/2017
SUBTOTAL	**1,040,972**	**41,921**	
CHILLER RETROFITS			
Santa Clarita Civic Center	150,000	NA	8/31/2016
Public Works HQ Chiller	325,000	NA	7/1/2015
SUBTOTAL	**475,000**		
LIGHTING UPGRADES			
Olive View Medical Center - LED Parking Lot	155,215	NA	4/1/2016
DHS Administration - LED Parking Lot	93,819	NA	8/1/2015
Various Health Facilities - 28 watt	225,000	NA	2/1/2016
SUBTOTAL	**474,034**		

SOLAR PROJECTS			
DPW Waterworks - Lancaster Field Office	510,000	NA	6/30/2016
DPW Waterworks - Lancaster Maint Yard	208,500	NA	Est. 1/1/2017
Various LA County Sites	1,100,000	NA	Est. 6/30/2017
SUBTOTAL	**1,818,500**		
NET- ZERO ENERGY PROJECTS			
A C Bilbrew	419,715	NA	Est. 8/15/2016
Julian Dixon	451,233	NA	4/1/2016
SUBTOTAL	**870,948**		
PRESSURE REDUCING TURBINE GENERATOR			
DPW Waterworks - Palmdale Pumping Station	1,400,000		Est. 8/19/2016
GRAND TOTAL	**10,046,362**	**176,463**	