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Memorandum

To:	**Sasha Merigan, Eileen Hlavka, Travis Holtby, Robert Hansen, CPUC**
From:	**Amul Sathe, Javi Luna, Guidehouse**
Date:	**October 14, 2022**
Re:	**Southern California Winter Gas Peak Savings Potential Analysis**

Background and Objectives

The California Public Utilities Commission (CPUC) directed Guidehouse to conduct an analysis to inform ongoing discussions related to the decommissioning of the Aliso Canyon natural gas storage facility (henceforth referred to as the Aliso Canyon Analysis). Guidehouse used the 2021 Potential and Goals (PG) Model (described further below) to assess the realistic, maximum achievable potential for winter peak reductions in gas and electricity in the Aliso Canyon service area by expanding ratepayer-funded energy efficiency programs. The objective of the study is to calculate the potential for these energy efficiency (EE) and fuel substitution[1] (FS) programs to reduce winter peak gas use beyond those impacts already generated by the existing IOU goals. This is to ask: what can be done beyond current IOU program goals/plans using similar programs to reduce winter peak gas consumption? The "Aliso Canyon service area" is the combined territories of Southern California Gas (SCG), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE).

This memo describes the steps performed in the Aliso Canyon Analysis and summarizes the results regarding the potential in the Aliso Canyon service area.

Scope

The objective of this analysis was to examine how much additional potential could be obtained in the Aliso Canyon service area using the 2021 PG model to examine alternate scenarios. The PG model is limited to examining potential adjustments to ratepayer-funded energy efficiency programs and producing a calibrated forecast of these programs. Existing EE programs are funded by IOU ratepayers and provide rebates for various EE and FS activities. These are the main programs overseen by investor-owned utilities although utilities are also involved in running certain other programs. There are other ways to increase gas efficiency and fuel substitution in the Aliso Canyon Service area beyond existing EE programs, which are not covered in this analysis.

The following are key elements of the Aliso Canyon Analysis scope:

- Focus on the winter peak period , i.e. gas peak demand hours: 5-10 AM hours on cold winter days,
- Focus on the Aliso Canyon service area, which covers most of Southern California
- Use the 2021 PG Model with its:
    - available technologies, reflecting IOUs' past, current and upcoming programs, and
    - forecasting algorithms which focus on modeling the impact key variables have on customers' technology adoption within current incentive programs.[2]

[1] Fuel substitution is defined as replacing a natural gas fueled technology with an electric powered technology that provides the same service to the end use customer.

[2] Key decision parameters include both financial and non-financial factors and are further described in the 2021 PG Study final report available at: https://pda.energydataweb.com/#!/documents/2531/view

- Allow electric and gas efficiency measures as well as fuel substitution measures to be included in the forecast.
- Retain the 2021 PG Model algorithms and calibration parameters as is with no changes.
- Using existing variables in the 2021 PG model, design scenarios to model in coordination with CPUC staff.
- Forecast over a timeframe that includes 2027 and 2035. Scenario variables that diverge from the 2021 PG study goals scenario are effective starting in the year 2023.

The following are noted items that are excluded from analysis:

- Changes to technology characterization relative to the 2021 PG Study (no new technologies were added, and no new technology data was used)
- Incentives greater than the incremental cost of an EE or FS measure (incremental cost is defined as the cost difference between a high efficiency technology and its standard baseline technology)
- Impacts of non-ratepayer-funded programs or policies on market adoption. These other programs or policies include BUILD and TECH, SGIP, municipal utility programs and state and local building and appliance codes and standards. While existing EE programs focus on incentives for interested customers, other programs may include a focus on technological development, contractor training, compliance requirements or redesigned program delivery.
- Consideration of program delivery mechanisms. The PG model is agnostic to how a program is structured and delivered.
- Codes and Standards, Energy Savings Assistance (i.e. low income), Behavior programs, and custom Industrial programs are excluded from this analysis. These are assumed to remain at the levels as forecasted in the 2021 PG Study. These programs do not have a cost effectiveness screen nor have rebate-driven adoption algorithms in the PG model, so there is not a clear way to model how much these programs could be scaled up.

Modeling Approach

Guidehouse and its partners prepared the 2021 Potential and Goals Study (PG Study) for the CPUC.[3] The PG study develops estimates of energy and demand savings potential of ratepayer-funded energy efficiency programs in the service territories of California's major investor-owned utilities (IOUs) during the post-2021 energy efficiency (EE) rolling portfolio planning cycle. The 2021 Study was conducted using the Potential and Goals Model (PG Model). This model provides a single platform to conduct robust quantitative scenario analysis to examine the complex interactions among various inputs and policy drivers for the full EE portfolio. The primary purpose of the 2021 Study is to provide the CPUC with information and analytical tools to engage in goal setting for the IOU EE portfolios. The study itself informs the CPUC's goal setting process but does not establish goals.

The 2021 PG Study forecasts EE potential at three levels for rebate programs:

- **Technical potential:** Technical potential is defined as the amount of energy savings that would be possible with the replacement of all applicable equipment-based technologies in every building (existing and new construction) with the highest level of efficiency considered in the study, regardless of the cost or cost effectiveness of the replacement. There is no factor for consumer decisions; it is assumed that 100% of customers install every high efficiency technology possible. Technical potential is therefore a far more academic than a practical metric of assessing potential. The output of technical potential is not a focus of the Aliso Canyon Analysis; thus it is not reported.

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[3] Guidehouse. *2021 Energy Efficiency Potential and Goals Study.* August 2021. Available at: https://pda.energydataweb.com/#!/documents/2531/view

- **Economic potential:** The economic potential is calculated as the subset of technical potential available when limited to only measures that pass a specific measure-level cost-effectiveness threshold.[4] Like technical potential, it is a far more academic than a practical metric of assessing potential. For the Aliso Canyon Analysis, CPUC staff directed Guidehouse to loosen cost effectiveness requirements, thus Economic Potential is not reported.
- **Achievable potential:** The final output of the PG study is an achievable potential analysis, which calculates the EE savings that could be expected in response to specific levels of program incentives and assumptions about existing CPUC policies, market influences, and barriers. These incentives, policies, influences, and barriers influence how many consumers are expected to choose to adopt high efficiency technologies. Achievable potential is primarily reported as a net savings value. There are two types of achievable potential:
    - **Economically Achievable potential** is calculated when subject to cost-effectiveness screening and used to inform the utilities' EE goals, as determined by the CPUC. This is **<u>not</u>** used in the Aliso Canyon Analysis.
    - **Technically Achievable potential** is calculated without regard to measure cost-effectiveness screening. It the primary savings output used in the Aliso Canyon Analysis.

Achievable potential is represented in the PG Study several different ways; each way is based on the same data and assumptions, though each serve separate needs and provide necessary perspectives.

- **Incremental first-year net savings** represent the annual energy and demand savings achieved by the set of measures in the first year the measure is implemented. It does not consider the additional savings the measure will produce over the life of the equipment. A view of incremental savings is necessary to understand what additional savings an individual year of EE programs will produce. First year net savings are **<u>most useful in the IOU goal setting process</u>** but has limited to no use in resource planning exercises. The PG study reports annual electric savings (kWh), annual gas savings (therms) and summer peak electric demand savings (kW). For the Aliso Canyon Analysis we further calculated winter peak electric and gas savings.
- **Cumulative savings** represent the total savings in a given year due to all installations made in or after 2023 and that are still active in the current year. It includes the decay of savings as measures reach the end of their useful lives and the continuation of savings as customers re-install high efficiency equipment that has reached the end of its useful life. Cumulative savings are **<u>most useful to inform resource planning exercises</u>** and is the primary output of concern for the Aliso Canyon Analysis. The build-up of cumulative savings is illustrated in Figure 1 which show how installations from 2023 through 2027 contribute to the cumulative savings in 2027.
- **Total system benefit (TSB)** represents the total benefit that a measure provides to the electric and natural gas systems. It includes the total avoided cost benefits less any increase in supply costs. TSB equals net avoided cost benefits (energy and capacity) for energy efficiency measures and is expressed in a dollar value, it is not a measure of cost effectiveness. **<u>It is exclusively used in the IOU goal setting process.</u>** TSB is not a focus of the Aliso Canyon Analysis thus is not reported further in this memo.

[4] The model can use different metrics of cost-effectiveness as defined by the California Standard Practice Manual. This includes the total resource cost (TRC) and the program administrator cost (PAC) tests.

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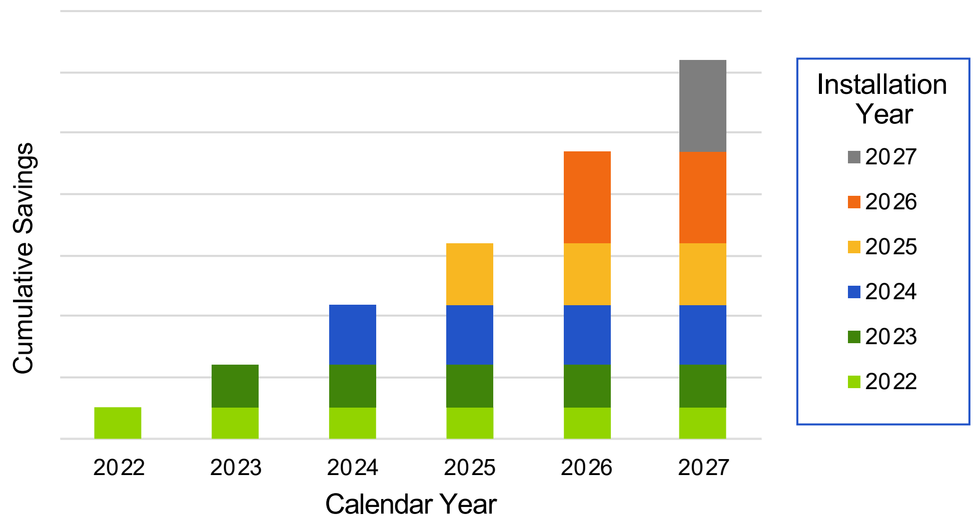
Figure 1: Cumulative Savings Illustration



Many variables drive the calculation of achievable potential. These include assumptions about the way efficient products and services are marketed and delivered, the level of customer awareness of EE, and customer willingness to install efficient equipment or operate equipment in ways that are more efficient. The Guidehouse team used the best available current market knowledge to calibrate achievable potential for voluntary rebate programs. Further details on the modeling methodology can be found in the 2021 PG Study final report published in August 2021.[5]

Once the technically achievable potential is calculated, the model provides additional related outputs including program cost and cost/benefit metrics. The program cost outputs represent the costs to operate the program, i.e. the incentives and program administration costs required to achieve the level of forecasted technically achievable potential. The cost/benefit metrics capture the total costs and benefits of the portfolio of measures that are forecasted in the technically achievable potential. The cost benefit metric used in this analysis is the Total Resource Cost (TRC) test which is commonly used to assess cost effectiveness of IOU EE programs.

Scenario Design

The Guidehouse team worked with CPUC staff to develop scenarios to consider for technical achievable potential for offsetting the Aliso Canyon supply. The combined impact of these variables represents a scenario. The final selected scenarios are listed in Table 1. Additional description of each key variables and each scenario follows below the table. The list of scenario incudes the Scenario 2a from the 2021 PG study which was used to inform the IOU goals. This goals scenario is used as a comparison point to all the other Aliso Canyon Analysis scenarios. Every scenario includes fuel substitution.

[5] https://pda.en ergydataweb.com/#!/documents/2531/view

Table 1. Aliso Canyon Scenarios

Levers Scenario ↓	C-E Test	C-E Threshold	Incentive Levels	Program Engagement	Gas Incentives Available?
Goals (Scenario 2a TRC Reference)	TRC	0.85	50%	Business As Usual (BAU)	Yes
Aliso Canyon 1	N/A†	N/A†	50%	BAU	Yes
Aliso Canyon 2	N/A†	N/A†	75%	BAU	Yes
Aliso Canyon 3	N/A†	N/A†	100%	Enhanced	Incentives End in 2026
Aliso Canyon 4	N/A†	N/A†	100%	Enhanced	Yes

TRC = Total Resource Cost Test; C-E = cost-effectiveness.
Source: Guidehouse

The key variables in Table 1 can be interpreted as follows:

- The PG model is populated with all measures available considered in the study. Measures are representative of past, present, and near future plans for IOU energy efficiency and fuel substitution programs. C-E Test and C-E Threshold are used primarily in the PG study to restrict the forecast to only those measures that are cost effective. In the Goals (Scenario 2a TRC Reference) scenario, the Total Resource Cost (TRC) cost-effectiveness test must result in benefits valued at or greater than 85% of costs over the lifetime of the measure, otherwise the energy efficiency measure is excluded from the analysis. A cost-effectiveness screen is not used for the Aliso Canyon Analysis.
- Incentive level is the incentive made available to customers through IOU programs. Incentives are first calculated for each measure based on a $/kWh and $/therms factor obtained from and consistent with existing IOU programs. We assume current IOU programs cap incentives at no greater than 50% of incremental cost (the difference between the cost of a measure and the business-as-usual activity it replaces) and thus replicate this cap in the PG Model. This is set as our "business as usual" incentive case. In the increased incentive scenarios, the incentives receive a 1.5x and 2.0x multiplicative factor (and caps are increase to 75% and 100% respectively) to simulate larger incentives being made available to customers. It's possible for a measure in the (for example) 50% cap scenario to have a rebate of less than 50% as the percentage only operates as a cap, not a target.
- Program engagement refers to the level of marketing awareness and effectiveness. The reference case uses the default calibrated value for marketing effectiveness, the enhanced case assumes program marketing is enhanced to increase awareness. Note: this variable has limited impact on the results.
- In one scenario, the analysis explores no longer incentivizing natural gas consuming technologies though allowing the market to continue voluntarily adopting without IOU program incentives, this is modeled in Scenario 3. For the purposes of this scenario, the technologies that stopped receiving a rebate in 2026 are listed in Appendix A.

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The scenarios can be interpreted as follows (Note: the scenarios are not described in numerical order for ease of explanation):

- **Goals (Scenario 2a TRC Reference)** is the scenario used to inform the IOU goal setting process. It best describes the amount of savings that can be expected to occur with business-as-usual program design and policy.
- **Aliso Canyon 1** is similar to the scenario used to set IOU goals with the exception that cost-effectiveness screening is removed. Thus, measures which are not cost-effective in terms of their annual net costs and benefits are now included. Incentive levels in this scenario remain consistent with those used in the goals scenario are made available to all measures (not just those that are cost effective)
- **Aliso Canyon 2** is a modification to Aliso Canyon 1 that increases incentive caps from 50% to 75% and incentive basis (the $/kWh and $/therm factors) by 1.5x
- **Aliso Canyon 4** is a modification to Aliso Canyon 1 that increases incentive caps from 50% to 100% and incentive basis (the $/kWh and $/therm factors) by 2.0x
- **Aliso Canyon 3** is a modification to Aliso Canyon 4 where incentive for gas measures are removed starting in the year 2026.

Calculating Winter Peak Impacts

Gas usage in the winter peaks during the hours of 5am to 10am on the coldest days in the winter months. Using this information, CPUC staff defined a metric of the "winter peak period" as 5am -10am on the three highest-usage modeled weekdays in January, February, and March. Averaging across multiple modeled days represents smoothing across daily variation and results in a lower (more conservative) value than if only the peak day or a once-in-ten-years peak day were used as the definition. The winter peak period is a total of 45 hours that span across 9 days. The winter peak impacts reported in this analysis are the average hourly energy savings that occur across the 45-hour winter peak period.

CPUC staff developed a set of winter peak factors to supply to Guidehouse. Based on data from the Database for Energy Efficiency Resources (DEER) data (which also informs the PG Study), these factors represent, for each energy efficiency or fuel substitution measure, the total savings during the 45-hour winter peak period divided by total annual savings. These winter peak factors were made available for both electric and natural gas impacts and are used as multiplicative factors as shown in Equation 1.

Equation 1. Winter Peak Calculation

$$\text{Winter Peak Impact}_i = \frac{\text{Winter Peak Fraction}_i \times \text{Annual Impact}_i}{\text{Hours during Winter Peak Period}}$$

Where:

i = impact type (electric or gas)

Annual impact = the annual impact in kWh (for electric) or therms (for gas)

Hours during Winter Peak Period = 45 hours

CPUC staff provided a mapping of available winter peak fractions to the measure in the PG study that were included in the IOU goals. The Aliso Canyon Analysis results included measures beyond those include in the IOU goals as cost effectiveness criteria were no longer used thus allowing more measures to be included in the forecast. Guidehouse staff mapped these additional measures to available winter peak fractions using CPUC staff's mapping as a guide.

The winter peak electric impacts are then further converted into winter peak gas impacts representing the impacts on gas used to generated electricity. This was calculated using a factor of 3,040 Btu of additional gas use for every KWh of electricity generated during winter peak hours. This is based on CPUC staff calculations showing that during the 5AM-10AM hours on the highest gas use day each winter during the winters of 2018-2019 through 2021-2022, on average 39% of electricity reported by CAISO came from gas use. The CEC reports a statewide gas generation plant heat rate of 7,728 BTU used to produce each KWh.[6] The product of these is 3,040 Btu/KWh.

The winter peak gas impacts reported are the sum of the direct winter peak gas impacts and the winter peak electric impacts on gas.

Calculating Levelized Cost

Calculating the levelized cost allows the cost of conservation to be compared with other distributed energy and supply side resources. The levelized cost of energy is the discounted present value net cost of each measure over a 20-year planning horizon divided by the discounted present value of energy savings over the same period and shown in Equation 2. Consistent with the potential and goals study, net energy savings were used in this analysis.

Equation 2. Generalized Formula for Computing Levelized Cost of Energy

$$\text{LLWWLLWWLLWWLLWWLL CCCCCCWW CCoo EEWWWWWWEEEE} = \frac{\text{PPPP CCoo CCCCCCWWCC}}{\text{PPPP CCoo NNWWWW EEWWWWWWEEEE SSPPLLWWWWEECC}}$$

The costs include all cash flows considered in the TRC screening test. These include incremental equipment costs, less any O&M savings,[7] plus any variable program costs. The equipment costs include technology and installation costs. The equipment costs account for inflation on equipment and labor cost, projected cost reductions over time, and changes in incremental cost due to code baseline changes. The program costs include incentives awarded to free riders, administrative costs, marketing costs, implementation (customer service) costs, overhead, and EM&V costs.

The present value in the levelized cost calculation is computed over a 20-year planning horizon.[8] For measures with lifetimes less than 20 years, the Guidehouse team used a combination of a true cash flow approach and an annuitization approach to calculate the present values. For example, a measure with a 5-year lifetime can be installed exactly four times over a 20-year horizon, and the resulting cash and energy flows repeat exactly four times during the horizon. A measure with an 8-year lifetime can be installed twice during the horizon and receive credit for its full lifetime savings potential each time. To account for the remaining 4 years in the horizon, the costs and benefits over the full measure life are annuitized and assigned to each of the last 4 years. The annuitization step ensures the 8-year measure is not penalized with the full incremental costs when installed in year 17 while only being credited with the final 4 years of benefits.

[6] "Thermal Efficiency of Natural Gas-Fired Generation in California: 2019 Update - Staff Paper," Commission, https://www.energy.ca.gov/publications/2020/thermal-efficiency-natural-gas-fired-generation-california-2019-update-staff

[7] No O&M costs were quantified to 2021 Study measures.

[8] Consistent with the CPUC IRP model and the calculation of the TRC test, the Guidehouse team used the after-tax weighted average cost of capital as the discount rate in this study this value ranges from 7.36% to 7.66% depending on the utility.

An adjustment to the levelized cost of measures that save both gas and electric was necessary. This adjustment split the levelized cost of measures into an electric component and a gas component (based on share of energy savings in Btus generated by gas vs. electric). To fully burden the cost of a measure onto the levelized cost of only gas or only electricity ends up penalizing the measure as appearing overly costly compared to other measures. This same methodology of splitting costs across both gas and electric savings is used in the CPUC's analysis of energy efficiency in the Integrate Resource Plan (IRP). The IRP only focuses on electricity savings and thus needed to appropriately split costs to as to not overburden cost in the IRP for measures that save both electric and gas.

The present value of savings is calculated as the present value of the 20 years of savings for each savings type: annual electric, summer peak electric, winter peak electric, annual gas and winter peak gas.

Note that levelized costs across various electric savings metrics and gas metrics are not additive within their fuel type. When calculating electric levelized cost the same cost numerator is used for all three metrics ($/annual kWh, $/summer peak, $/winter peak) and similarly when calculating the levelized cost for gas the same cost numerator is used for both metrics. We present all five metrics and allow the reader to choose which is best suitable for comparison and use in other planning exercises.

Results

Guidehouse provided an Excel-based results database and viewer containing measure-level data.[9] This section discusses some of the high-level trends and observations in the data.

Figure 2 and Figure 3 present the winter peak savings and associated annual program costs for all measures modeled. These figures show significant increases in savings at very significant increases in program costs. Data later in this section provides additional detail on the savings potential by sector and end use and their associated levelized costs for readers to better understand which areas provide the most value for the cost. Key observations from these graphs are as follows:

- The maximum winter peak savings achieved in these scenarios in 2035 is 3.23 MMcf/peak hour. Achieving this would take more than $500M in annual program costs. This reflects the combined impact of about 175 different energy efficiency and fuel substitution activities that generate gas savings across all sectors.
- All Aliso Canyon Scenario produce more savings than the PG Study Goals Scenario reflective of the impact of removing the cost effectiveness threshold and increasing program engagement.
- The various Aliso Canyon Scenarios produce similar results. While one may believe there should be a larger spread of savings between them, the PG model predicts limited sensitivity of adoption based on incentives alone. This is corroborated by the CPUC 2021 Market Adoption Study which indicated that customers place lower decision weight on upfront equipment cost and more weight on other factors such as environmental impacts, hassle factor, desired features/performance, and social signaling.
- Figure 1 shows gas winter peak savings increase relative to the goals scenario. There is approximately an 115% increase in 2027 and 55% increase in 2035 in the Aliso Canyon Scenarios relative to the Goals Scenarios. Details on which sectors and end uses drive most of these increases can be found in Table 2.
- The significantly increased program costs (incentives + program admin) in Figure 3 indicate that there is a diminishing return on investment; increases in program savings are disproportionally smaller than the required increase in program cost to achieve those savings levels. This may also imply that alternative program designs rather than programs that rely on rebates alone should be considered.
- Program costs for Scenario 3 as illustrated in Figure 3 show a reduction in 2026 as gas incentives are removed. The savings for scenario 3 drop only slightly (not easily observed in the savings figures). We caution that removing incentives is an edge case in the PG model that has not

[9] *Aliso Canyon Analysis Outputs 7-28-22.xls*

previously been tested and urge readers to take Scenario 3 results "with a grain of salt". The model is well calibrated under the assumption that programs continue to offer incentives. As incentives drop to 0% the model essentially is asked to predict natural market adoption which is not what the model was originally designed and calibrated to do.

- The disproportionate increase in program costs relative to savings results in significantly reduced portfolio cost effectiveness (presented in Figure 4). All Aliso Canyon Scenarios have a similar TRC result in the range of 0.2 to 0.3 during the 2023 to 2035 forecast period. Note that the PG model uses the CPUC-approved 2021 Avoided Cost Calculator as its source of avoided costs. Additional documentation of how the PG Model uses avoided cost data can be found in the 2021 PG study report.

Figure 2: Cumulative Savings Potential (Gas Winter Peak)

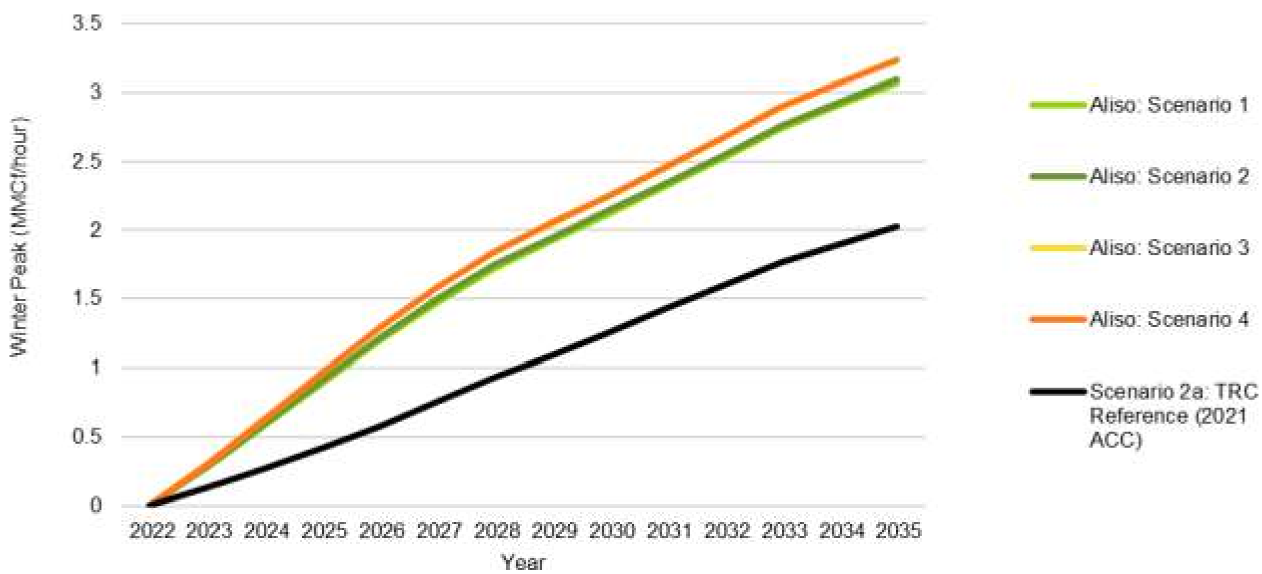

Figure 3: Annual Program Cost

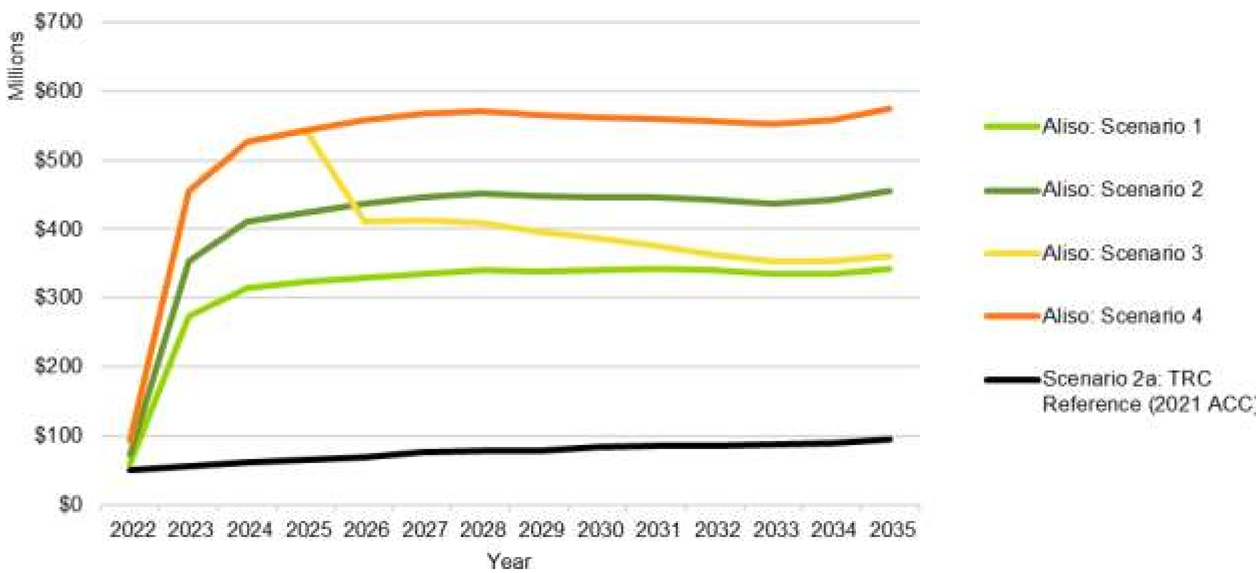

Figure 4: Portfolio Cost Effectiveness

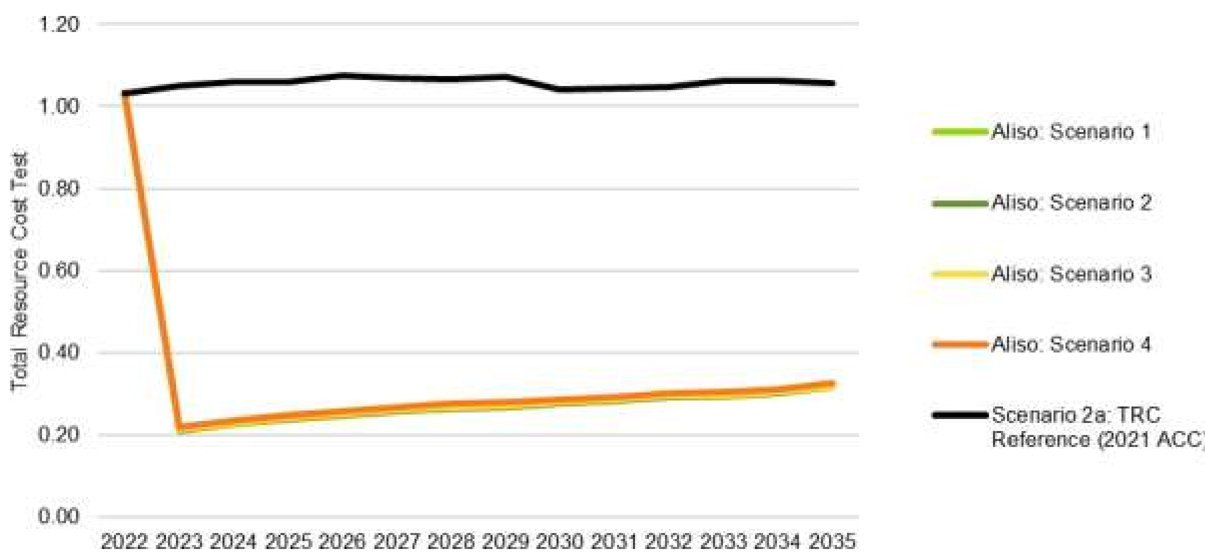

Table 2 breaks down the Aliso Canyon Scenario 2 results by sector and end use. Table 2 shows three key metrics:

1. **Additional winter peak potential** (beyond current IOU program goals/plans) in 2027 and 2035. .
2. **Levelized cost** results using various units of measurement

3. **Total resource cost test** results at the sector and end use level,i.e. cost-effectiveness

Scenario 2 was selected to be displayed in Table 2 because it is the "middle ground" among the range displayed by all the Aliso Canyon Scenarios and because results for other scenarios are similar in magnitude to those presented in Table 2 below. Other scenarios can be found in the Excel results viewer provided. Key observations from this table are as follows:

- Residential water heating and HVAC have the largest potential for winter peak gas savings. After these comes commercial water heating and HVAC. The HVAC end use includes upgrading gas furnaces (either to high efficiency gas units or fuel substitution to an electric heat pump). Similarly, the water heating end use also includes both energy efficiency and fuel substitution opportunities. Detailed data available in the excel spreadsheet suggests that gas efficiency dominates savings in the winter peak period compared to fuel substitution. Meaning customers are driven to choose high efficiency gas equipment over fuel substitution within the current modeling framework.
- $/winter peak gas savings varies from $70/Cf/hour to more than $2,000. Via this metric, Agricultural end uses, industrial process heating, commercial food service and appliances, and residential water heating and whole building end uses are relatively low cost (less than $275/winter peak therm saved).

Aligning the data in Table 2 into a supply curve (Figure 5) shows that not all the above-mentioned low-cost end uses produce significant savings. The largest savings from relatively low cost end uses comes from industrial process heating, commercial appliance/plug loads, and residential and commercial water heating. Commercial followed by Residential HVAC can provide additional substantial savings though at higher cost.

Table 2. Winter Peak Savings by Sector and End Use (Aliso Canyon Scenario 2)

Sector	End Use	Additional Winter Peak Gas Savings (MCf/hour)		Levelized Cost in 2027		Total Resource Cost Test in 2027
		2027	2035	$/Annual Therms	$/Winter Peak Cf/hour	
Ag	HVAC (occupant conditioning)	0.01	0.00	$0.52	$71.23	2.40
Ag	Process Heat	0.48	-0.36	$1.44	$196.12	1.00
Com	Appliances/Plug-loads	43.34	46.73	$1.86	$255.44	0.61
Com	Building Envelope	2.03	0.68	$3.89	$500.21	0.19
Com	Refrigeration	15.15	2.46	$7.64	$600.03	0.42
Com	Food Service	25.36	42.20	$1.58	$215.10	0.44
Com	HVAC	80.62	129.86	$6.18	$404.45	0.21
Com	Water Heating	91.00	83.22	$2.20	$292.79	0.53
Com	Whole Building	13.82	17.31	$2.00	$272.79	0.60
Ind	HVAC	5.16	3.75	$2.41	$301.79	0.34
Ind	Process Heat	66.71	-8.63	$1.10	$149.22	1.07
Res	Appliances/Plug-loads	21.50	74.71	$12.18	$1,299.40	0.07
Res	Building Envelope	4.08	5.92	$17.84	$2,313.58	0.05
Res	HVAC	152.71	287.13	$6.05	$695.45	0.08
Res	Water Heating	154.76	280.90	$1.75	$263.71	0.65
Res	Whole Building	7.03	22.63	$1.23	$166.79	0.99
	Total	**684**	**989**			

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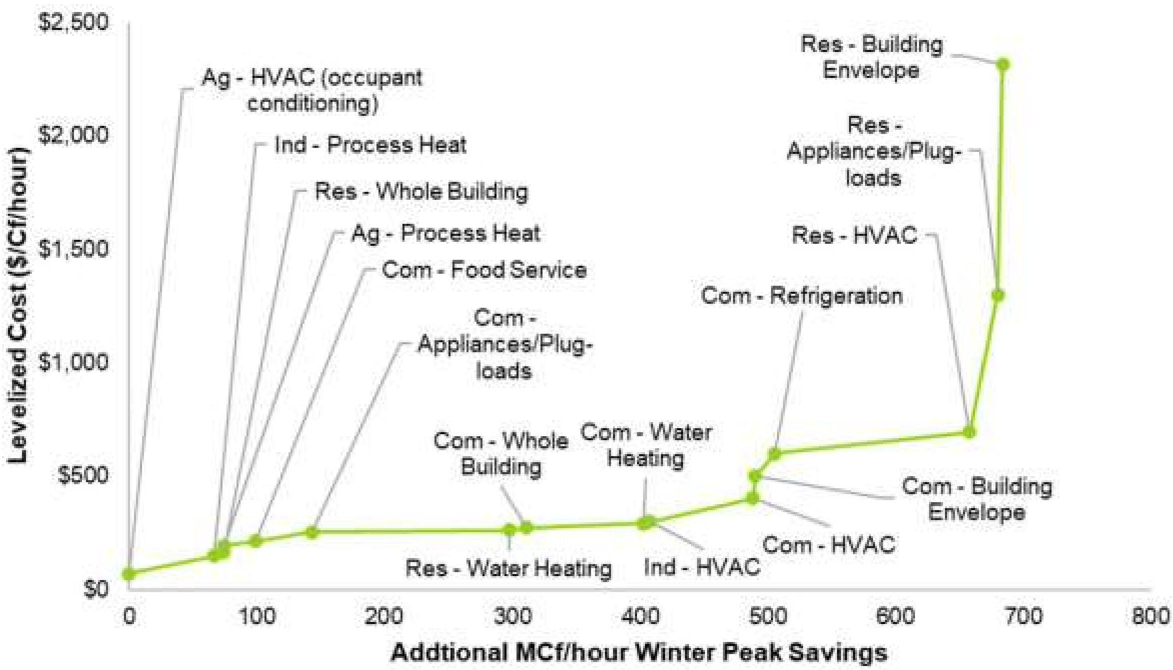
*End uses that only save electricity, no gas savings data is reported

Figure 5: Supply Curve of Additional Winter Peak Savings in 2027



The Excel based *Aliso Canyon Analysis Outputs* file (illustrated below) contains multiple tabs for users to browse the results. If uses pivot tables and pivot charts to provide additional granularity to the graphs presented in this memo.

- The black colored tabs provide key definitions and description
- The green colored tabs provide charts and tables with user editable filters to further explore the data. This includes:
  - **Incremental Achievable Pot.** – The annual first year savings by scenario
  - **Cumulative Achievable Pot.** – The cumulative savings in a given year resulting from the installations starting in the year 2023
  - **Program Costs** – Annual incentive and program administration costs required to meet the incremental achievable savings
  - **Cost Effectiveness** – The portfolio level calculation of various cost effectiveness tests for each scenario
  - **Achievable Potential by End Use** – A breakdown of the annual first year savings into individual end uses
  - **Additional Potential** – The additional cumulative potential the Aliso Canyon Scenarios provide above any beyond current IOU program goals/plans
  - **Levelized Cost by End Use** – The results of the levelized cost of energy savings
- The grey colored tabs contain the detailed model output at the measure level which is further summarized in the green colored tabs described above

Figure 6: Results Viewer Illustration

Comparison to the Phase 3 Report Results

In 2021 CPUC published the Phase 3 Report[10] to "identify viable alternatives to the facility and scenarios that can inform a shorter path to closure" of Aliso Canyon. Of the viable alternatives studied, the third portfolio examined energy efficiency and building electrification.

The Phase 3 report uses the California Energy Commission's forecast of energy efficiency and building electrification (fuel substitution). While the CEC's EE forecast is based on the 2021 CPUC PG study, the CEC's FS forecast is more aggressive than the 2021 PG study. CEC's FS forecast:

- Uses a scenario analysis tool that asks "what if X% of end uses were electrified?"
- Does not use a forecasting algorithm to assess if the analyzed amount of electrification is market achievable

[10] FTI, *Aliso Canyon17-02-002 Phase 3 Report.* December 31, 2021

- Does not factor in consumer decisions in response to programmatic interventions for building electrification

For the above reasons the Phase 3 report represents more of an upper bound of what is possible and is not expected to match this analysis. A comparison of the difference in magnitude of results from the two studies can be found in Table 3. Table 3 shows that the Phase 3 Report forecasts EE + FS demand reduction to be an order of magnitude larger compared to this analysis (1.6 vs. 21 in the year 2027 and 3.2 vs 40 in the year 2035).

Table 3: Comparison to Phase 3 Report Results

Report	Dataset	2027 MMcf/h	2035 MMcf/h
Phase 3 Report	Total Demand	216	201
	EE + FS Potential Demand Reduction	21	40
Guidehouse Study	EE + FS Potential Demand Reduction (Scenario 3)	1.6	3.2
	Demand Reduction from Top 3 Sources (Res Water Heating, Res HVAC, Com Water Heating)	*0.95*	*2.3*

Conclusions

- This study quantifies ratepayer-funded energy efficiency programs' winter gas peak savings potential and cost effectiveness.
- The resulting energy efficiency + fuel substitution market potential of 1.6MMcf/h in 2027 and 3.2MMcf/h in 2035 is significantly lower than the potential reported in the Phase 3 report. This is largely because the Phase 3 Report focused on building electrification potential without regard to program design, end-use customer decisions, or cost limitation factors and used market potential only for energy efficiency.
- The Phase 3 Report[11] showed that without Aliso Canyon there would be a "gas shortfall" of over 300 million cubic feet per day. The Guidehouse analysis shows that existing IOU EE programs will be unable to meet the Aliso Canyon shortfall alone. A combination of non-IOU programs (such as TECH and BUILD), new programs, Market Transformation Framework Initiatives, and broader policy changes may be necessary.
- This study identifies the largest peak gas demand savings potential from relatively low-cost end uses in residential and commercial water heating, industrial process heating, and commercial appliance/plug loads.
- The largest savings from relatively low-cost end uses comes from industrial process heating, commercial appliance/plug loads, and residential and commercial water heating. At higher costs per unit, Commercial and Residential HVAC can provide additional substantial savings.
- This report identified This report and the Phase 3 Report may approximate lower and upper bounds on the potential to reduce gas demand by increasing building electrification.

[11] FTI, *Aliso Canyon17-02-002 Phase 3 Report.* December 31, 2021

Future Research

This analysis provides a preliminary look at how the Potential and Goals study process can inform policy and planning decisions for the Aliso Canyon Service Area. Though this analysis we have identified several areas for additional future research:

- The PG study only quantifies the impact of IOU EE programs in IOU territories. Additional analysis could be conducted to assess the impacts of other programs that encourage fuel substitution.
- Modeling the removal of gas incentives needs to be further examined. The PG model was built and calibrated assuming measures continue to receive rebates unless they are deemed non-cost effective or removed from programs via increasingly stringent appliance standards.

Appendix A

List of gas measures that stop receiving rebates in the year 2026 in Scenario 3.

- Ag | Greenhouse- High EE HVAC Efficient
- Com | Average Existing Commercial Process Washer
- Com | Com Condensing Eff. Gas Storage Water Heater (0.90 & .96ET) - Cold
- Com | Com Condensing Eff. Gas Storage Water Heater (0.90 & .96ET) - Hot-Dry
- Com | Com Condensing Eff. Gas Storage Water Heater (0.90 & .96ET) - Marine
- Com | Com High Eff. Furnace (92 AFUE) - Cold
- Com | Com High Eff. Furnace (92 AFUE) - Hot-Dry
- Com | Com High Eff. Furnace (92 AFUE) - Marine
- Com | Com Instantaneous Gas Water Heater - Cold
- Com | Com Instantaneous Gas Water Heater - Hot-Dry
- Com | Com Instantaneous Gas Water Heater - Marine
- Com | Condensing Eff. Gas Water Heating Boiler (0.90 EF) - Cold
- Com | Condensing Eff. Gas Water Heating Boiler (0.90 EF) - Hot-Dry
- Com | Condensing Eff. Gas Water Heating Boiler (0.90 EF) - Marine
- Com | Condensing Eff. HVAC Boiler (94 AFUE) - Cold
- Com | Condensing Eff. HVAC Boiler (94 AFUE) - Hot-Dry
- Com | Condensing Eff. HVAC Boiler (94 AFUE) - Marine
- Com | ENERGY STAR Combination Oven - Gas
- Com | ENERGY STAR Convection Oven - Gas
- Com | ENERGY STAR Conveyor Broiler - Gas
- Com | ENERGY STAR Conveyor Oven - Gas
- Com | ENERGY STAR Fryer - Gas
- Com | ENERGY STAR Griddle - Gas
- Com | ENERGY STAR Rack Oven - Gas
- Com | ENERGY STAR Steamer - Gas
- Com | Gas Water Heating Boiler (0.82 EF) - Cold
- Com | Gas Water Heating Boiler (0.82 EF) - Hot-Dry
- Com | Gas Water Heating Boiler (0.82 EF) - Marine
- Com | HVAC Heat Recovery/Energy Recovery Ventilator (ERV) - Cold
- Com | HVAC Heat Recovery/Energy Recovery Ventilator (ERV) - Hot-Dry
- Com | HVAC Heat Recovery/Energy Recovery Ventilator (ERV) - Marine
- Com | Ozone Laundry System Retrofit
- Ind | HVAC Equipment Upgrade - Gas - Efficient
- Ind | Process Heat - Efficient
- Min | Efficient Steam Boiler
- Res | Condensing Eff. Furnace (AFUE = 97) - Cold
- Res | Condensing Eff. Furnace (AFUE = 97) - Hot-Dry
- Res | Condensing Eff. Furnace (AFUE = 97) - Marine
- Res | Condensing Eff. Furnace FS (AFUE = 97) - Cold
- Res | Condensing Eff. Furnace FS (AFUE = 97) - Hot-Dry
- Res | Condensing Eff. Furnace FS (AFUE = 97) - Marine
- Res | Efficient Central Boiler - Cold
- Res | Efficient Central Boiler - Hot-Dry
- Res | Efficient Central Boiler - Marine
- Res | Efficient Res Clothes Dryer (Gas)
- Res | Efficient Res Clothes Washer (Gas)
- Res | Efficient Res Dishwasher

- Res | Res Condensing Eff. Small Gas Storage Water Heater (0.88 UEF - 50 Gal) - Cold
- Res | Res Condensing Eff. Small Gas Storage Water Heater (0.88 UEF - 50 Gal) - Hot-Dry
- Res | Res Condensing Eff. Small Gas Storage Water Heater (0.88 UEF - 50 Gal) - Marine
- Res | Res Instantaneous Gas Water Heater - Cold
- Res | Res Instantaneous Gas Water Heater - Hot-Dry
- Res | Res Instantaneous Gas Water Heater - Marine
- Res | Smart Res Dishwasher

(End of Attachment A)