Cost Estimate Regulations for Oil and Gas Operations

Economic Impact Assessment

1. Introduction

The Department of Conservation's Geologic Energy Management Division (CalGEM) supervises the drilling, operation, maintenance, and plugging and abandonment of onshore and offshore oil, gas, and geothermal wells. It carries out its regulatory authority under a dual legislative mandate to encourage the wise development of oil and gas resources, while preventing damage to life, health, property, and natural resources, including underground and surface water suitable for domestic or irrigation purposes. (See Pub. Resources Code, § 3106.) In 2019, protecting public health and safety and environmental quality, including reduction and mitigation of greenhouse gas emissions, was added to CalGEM's mission. (See Pub. Resources Code, § 3011.)

In October 2019, Governor Newsom signed into law Senate Bill 551 (Jackson, Chapter 774, Statutes of 2019) (SB 551) adding Public Resources Code (PRC) section 3205.7, which requires every operator to submit a report demonstrating total estimated costs to plug and abandon all wells and to decommission all attendant production facilities, including any needed site remediation, and to provide data necessary for evaluating an operator's liability for these activities.

To implement the new reporting requirement, PRC section 3205.7 requires CalGEM to establish criteria that operators must adhere to when developing their cost estimates. The statute also requires CalGEM to establish a schedule for operators to submit their initial reports such that at least one-half of the operators are required to submit an initial report by July 1, 2024, and all operators are required to submit an initial report by July 1, 2026, although the first statutory deadline will not be met due to delays in rulemaking. After initial submission, each operator is required to submit an updated report at least once every five years.

The proposed regulations establish the criteria that operators would be required to use when preparing the cost estimate reports required under PRC section 3205.7 and also establish a schedule for operators to submit their cost reports. The purpose of this document is to provide discussion and quantification of the economic impacts resulting from the proposed regulations for cost estimate reports. The estimated impacts are based on CalGEM's internal data sources and consultation with CalGEM's technical experts.

2. Current Oil and Gas Operations and Financial Securities

As of May 2018, California had over 98,800 active and idle oil and gas wells. Operators of these wells will need to plug and abandon them and remediate the well sites at the

end of their useful life. CalGEM also currently tracks more than 9,400 facility settings, which are groupings of interrelated production facilities, such as tanks, pipelines, vessels, and sumps, that are located in the same physical location and may serve one or multiple leases. Decommissioning of these production facilities is a necessary component of the plugging and abandonment and site remediation that will eventually be required.

PRC section 3205.7 directs CalGEM to require "…each operator of an oil and gas well to submit a report to the supervisor [CalGEM] that demonstrates the operator's total liability to plug and abandon all wells and to decommission all attendant production facilities, including any needed site remediation…" The statute also directs CalGEM to "…develop criteria to be used by operators for estimated costs to plug and abandon wells and decommission attendant production facilities, include site remediation." Consequently, the proposed regulations define the specific criteria method that operators shall follow to produce the cost estimates that must be included in the report required by the statute. This analysis assesses the impact of the proposed regulations. The proposed regulations would impact operators and CalGEM through the additional costs that they both would incur to generate, evaluate, and approve cost estimates as indicated by the methods established by the proposed regulations.

The next section provides greater detail on the criteria outlined by the proposed regulations to prepare and report cost estimates for plugging and abandonment, facility decommissioning, and site remediation consistent with current legal requirements.

3. Proposed Regulations on Cost Estimate Reporting

PRC section 3205.7 requires CalGEM to outline a criteria and reporting schedule for oil and gas operators to submit cost estimates for plugging and abandonment, facility decommissioning, and site remediation. The proposed regulations provide two methods for the calculation of cost estimates. Method 1 is the method that CalGEM customized for all onshore oil and gas operations, while Method 2 is an optional method for onshore operations and the required method for offshore operations[1].

Cost Estimation Methods

Method 1 requires operators to use base numbers with multipliers as provided by CalGEM in the regulations. The operator would calculate an aggregated score for each well based on its specific characteristics including location, depth, access, and other risk factors. For well associated costs, the operator would then select the appropriate base well days depending on regional location. Based on the aggregated

[1] Geologic Energy Management Division (CalGEM) (2022) Draft text-"Cost Estimate Regulations for Oil and Gas Operations", Retrieved from: https://www.conservation.ca.gov/index/Documents/Cost%20Estimate%20Regulations%20Discussion%20Draft%20April%202022.pdf

score, the operator would then apply a multiplier to the base well days to determine a cost based on the estimated total days it will take to plug and abandon the well multiplied by the assigned base daily cost rate for the regional location.

Method 1 for production facility decommissioning provides base unit costs for each type of production facility which are then summed to determine the base production facility decommissioning costs. Operators will then apply an additional percentage for permitting and regulatory compliance, mobilization and demobilization, and project engineering and planning. Just as the process for wells, the operator must then determine an aggregated risk score based on the characteristics at each production facility location. Depending on the risk score, a contingency percentage is then applied and added to the cost estimate total. Site remediation follows the same methodology as production facility decommissioning with unit costs for each site remediation activity.

Method 2 provides operators with a list of the items that must be included in each cost estimate, such as the steps needed to complete a plugging and abandonment work plan consistent with existing legal requirements and the list of items that must be decommissioned or remediated at a production facility site. Operators may use any process to develop their cost estimates provided those estimates are supported with quality data that is verifiable, and accurate costs for all checklist items are included in the estimate.

Reporting Deadlines

As required by PRC section 3205.7, the proposed regulations also establish specific deadlines for the submission of Cost Estimate Reports. Reporting groups are based on the production of operators as assessed for calendar year 2021.

- Operators without reported production and with production of 3.5 or less total barrel of oil equivalent (BOE) per well per day in 2021 will report in January 2025. This group includes operators of only disposal injection wells, with Underground Gas Storage (UGS) operations, and all others who did not report any production for 2022.
- Operators with more than 3.5 BOE per well per day in 2021 and the operators of underground gas storage wells who were assessed in accordance with Public Resources code sections 3403.5 in 2021 will report in July 2026.

The proposed regulations allow operators to omit reporting offshore operations within these deadlines and extend their cost estimate reporting to July 2027 because offshore operations were recently subject to additional bonding analysis and increase under PRC section 3205.6.

The proposed regulations require that new oil and gas operators becoming operators after 2021 but before April 1, 2026, submit their cost estimate report by July 2026. New oil

and gas operators becoming operators on or after April 1, 2026, must submit their cost estimate report within 90 days of becoming the operator of a well or production facility. Finally, the proposed regulation requires that all operators provide updated cost estimates five years after their first required submission and every five years thereafter[2].

The following sections will assess the anticipated direct costs of these new cost estimate reporting requirements to operators.

4. Direct Costs of Proposed Regulations

The proposed regulations will generate direct costs for oil and gas operators. The drivers of these direct costs are each operator's number of wells and production facilities (facilities) requiring cost estimates, person-hours needed to prepare cost estimates, and staff/service compensation ($) required per person-hour. Here, it is assumed that site remediation cost estimates would be prepared in tandem with the cost estimates for their wells and facilities. The first two sections respectively describe the analytical approach and calculations of operators' direct costs during the five years of initial cost estimate reporting. Subsequently, the last sections discuss the analytical approach and calculations for the ongoing costs of the proposed regulations.

4.1. Operators' Direct Cost Calculation Approach for the Initial Reporting Period

The population of oil and gas operations owned by each operator is the first item determining the total direct cost incurred by operators due to the proposed regulations. Consequently, this analysis uses CalGEM data to determine the total number of wells and facilities subject to the regulatory requirements. In doing so, this analysis computed proxy estimates of financially insolvent operators and assumed these operators have deserted all their oil and gas operations.

To determine the proxy number of wells and facilities likely deserted by insolvent operators who are not expected to comply with the proposed regulations, this analysis relies on the most current research done related to this issue, which provides a screening methodology to obtain a lower bound count of likely deserted oil and gas operations[3]. This screening methodology is applied to the most recent CalGEM data on wells and production to identify operators with no California production or injection in the past five years. Then, it is assumed that these operators are financially insolvent, and their operations are likely deserted.

[2] Ibid

[3] The analysis/counts of California wells likely to be orphan was prepared following the "simple screen" method used under Boomhower, Judson (et.al.) (2018).

California currently has approximately 1,400 operators owning a total of 98,800 idle and active wells and 9,400 facility settings[4]. Excluding assumed financially insolvent operators[5] (those operators whose wells are known or suspected to be orphan or deserted), a total of 338 operators—24 percent of total operators—own 96,500 active and idle wells (98% of total) and 9,200 facility settings (98% of total) and are expected to report under the regulations. Approximately 72,500 (75%) of these idle and active wells are located onshore in Kern County[6].

For the initial reporting stage, the population of operators was distributed based on the reporting requirements of the regulations and CalGEM's oil and gas production data. Accordingly, 250 operators owning 10,242 idle and active wells and 2,517 facility settings are to report by the first deadline in 2025, and 88 operators owning 84,656 idle and active wells and 6,654 facility settings report in 2026.

This analysis assumes that operators with offshore oil and gas operations will report cost estimates for all their offshore wells and facilities in 2027. That said, it is estimated that a total of 6 operators own 1,612 offshore idle and active wells and 22 offshore facility settings. Finally, it is assumed that all new operators after 2021 through 2026 would report by year 2026 and new operators in and after 2027 would report the same year. Section 4.3.1 on the analytical approach for ongoing costs discusses how numbers of new operators are projected annually ten years after 2021.

Calculating direct costs of the proposed regulations also requires determining the time spent by operators to prepare the required cost estimate reports. To do so, CalGEM's engineers prepared time per well estimates for various types of oil and gas operations. First, the time needed to prepare cost estimates for well plugging and abandonment and for production facility decommissioning was determined separately, with an assumption that site remediation estimates would be prepared in tandem with the cost estimates for their respective wells and facilities.

Second, while developing cost estimates, CalGEM's engineers considered factors such as organizational structure, resource level, efficiencies through economies of scale, and expected quality of the work to be submitted. To accomplish this, operators were grouped into six operation size categories, which were determined based on the number of idle and active wells owned by each operator. Here, the number of wells is used as a proxy to the size and resources of oil and gas operations.

[4] A facility setting is a production "location" that contains a variety of production facilities, which refer to all pieces of equipment and machines used to operate at a production site.
[5] CalGEM is already working on developing cost estimates for those wells and facilities that are considered orphan or deserted or likely so that were not included in this analysis.
[6] Operators' insolvency point estimates inferred using Boomhower's methods and WellSTAR Database (2022), Well and Production Facility data, California Geologic Energy Management Division (CalGEM. Point estimates were validated by CalGEM's engineers.

Finally, while preparing time estimates for various operator size categories, CalGEM's engineers accounted for the two method choices outlined in the proposed regulations. Time estimates for Method 1 (subsequently referred as lower bound estimates) and Method 2 (subsequently referred as upper bound estimates) reflect differences in the level of complexity to prepare cost estimate reports, where Method 2 requires more time and effort to prepare an estimate using an approach that differs from the default approach utilizing CalGEM's customized inputs under Method 1.

The dollar per hour spent rate in preparing cost estimates is the last component used to prepare the direct costs associated with operators' cost estimate reports as required by the proposed regulations. Based on their knowledge of the oil and gas industry, CalGEM's engineers determined that operators would need petroleum engineering services to prepare the cost estimates. They also determined that these types of services currently cost approximately 80 dollars per hour.

The next section discusses operators' direct cost calculations for preparing cost estimates for well plugging and abandonment and production facility decommissioning, both of which include the costs to prepare remediation cost estimate reports for their associated sites.

4.2. Operators' Direct Costs at the Initial Reporting Period

Operators are anticipated to incur total direct costs ranging from $7 million to $8.7 million through the initial reporting period. As noted in prior sections, the proposed regulations require groups of operators existing in 2021 to report initial cost estimates by three deadlines through a three-year period from 2025 to 2027 depending on each operator's oil and gas production levels reported in 2021 or their type of operation (i.e., UGS or disposal injection). Additionally, it is assumed that operators becoming new operators from 2023 through 2026 would submit their initial cost estimate reports in year 2026 and new operators becoming operators in 2027 or later will report in the same year.

Grouping operators by their initial report deadline, direct costs will range from $3 million to $3.6 million for operators reporting by the first year deadline; $3.8 million to $4.9 million for those on the second year deadline, including direct costs for new operators ranging from $256,000 to $300,000; and $186,000 to $195,000 for those on the third year deadline, including direct costs for new operators ranging from $51,000 to $60,000. For all groups, the lowest boundary of the range reflects the scenario where operators choose cost estimate Method 1 for all their onshore operations and cost estimate Method 2 for all their offshore operations. Meanwhile, the upper boundary of the range reflects the scenario where all operators choose cost estimate Method 2 for all their oil and gas operations (see Table 1). Sections 4.2.1 and 4.2.2 break down these cost estimates between wells and facilities.

Table 1. Total Direct Costs to Oil and Gas Operators through the Three-Year Initial Reporting Periods of the Proposed Regulations

Cost Estimate Range	Y1	Y2	Y3	3-Year Total
Lower Bound	$3,039,139	$3,788,533	$185,778	**$7,013,450**
Upper Bound	$3,641,789	$4,885,051	$194,561	**$8,721,401**

4.2.1 Operators' Direct Costs for Well Plugging and Abandonment and Respective Site Remediation

During the initial reporting period, operators will experience direct costs ranging from $4.1 million to $4.7 million to prepare Cost Estimate Reports. Out of this total amount, direct costs will range from $1.9 million to $2.1 million for operators reporting by the first year deadline; $2.1 million to $2.4 million for those on the second year deadline, including $166,000 to $188,000 for new operators commencing operations after 2021 through 2026; and $107,000 to $112,000 for those on the third year deadline, which includes all offshore wells and new wells for operators commencing operations in 2027 (see Table 2). Ranges derive from operator's option to choose either Method 1 or the more costly Method 2.

Table 2. Initial Direct Costs to Operators from Well Abandonment Cost Estimates through the Three-Year Implementation Period of the Proposed Regulations

Cost Estimate Range	Y1	Y2	Y3	3-Year Total
Lower Bound	$1,884,958	$2,124,709	$107,255	**$4,116,922**
Upper Bound	$2,130,070	$2,418,512	$111,646	**$4,660,228**

It is anticipated that a total of 338operators with 96,500 idle and active wells will have to comply with Cost Estimate Report requirements for well pugging and abandonment and respective site remediation. Among the total number of idle and active wells, 1,600 of them are in offshore fields. Costs per well decrease as the size of operators increases and are less under Method 1 (the default cost estimate approach) than Method 2 (operators determine their own cost estimate approach). While absolute costs will rise with the number of wells per operator, the analysis assumes that there would be economies of scale for larger operators, resulting from lower per-well hours for operators with more wells and operational resources.

Table 3 summarizes the number of operators and their associated number of wells by size category, together with their respective cost per well range. It also provides the specific number of offshore wells--broken down by operator size category—requiring Method 2 for computing their cost estimate for well plugging and abandonment and respective site remediation.

Table 3. Population of Operators, their respective Idle and Active Wells, and Cost per Well to Prepare Cost Estimates for Well Abandonment with respective Site Remediation, broken down by Operator Size Category

Operator Size (# of Wells)	Operators	Total Number of Idle and Active Wells	Offshore Idle and Active Wells	Lower Bound Cost-per-Well	Upper Bound Cost-per-Well
[>10,000]	2	49202	26	$6.4	$7.2
[1,000-10,000]	8	32056	1431	$19.5	$22.7
[100-999]	32	10894	79	$130.0	$147.2
[10-99]	135	3798	76	$344.3	$388.1
[3-9]	82	455		$399.5	$451.0
[1-2]	79	105		$588.1	$665.7

Note: Cost-per-Well includes cost estimates for Wells and respective Site Remediation

For new operators after 2021, this analysis anticipates a total of 32 new operators commencing operations from 2023 through 2027. Similarly, it is projected that these new operators will have an average of 17 wells each (see Section 4.3.1 for details on the forecasting process). Thus, it is assumed that new operators would spend an average of $344.30 (with Method 1) to $388.10 (with Method 2) per each of their new wells for preparing their cost estimate reports for well plugging and abandonment and respective site remediation.

4.2.2 Operators' Direct Costs for Production Facility Decommissioning and Respective Site Remediation

During the initial reporting period, oil and gas operators will spend from $2.9 million to $4.1 million to prepare cost estimates for production facility decommissioning and respective site remediation. Considering reporting requirements of the proposed regulations, these total direct costs would range from $1.2 million to $1.5 million for those on the first year deadline; $1.7 million to $2.5 million for those on the second year deadline, including $90,000 to $112,000 from operators becoming new operators after 2021 through 2026; and $79,000 to $83,000 for those on the third year deadline, which includes the reports of all offshore operations using Method 2 and the initial cost estimate reports from operators becoming new operators in 2027 (see Table 4). Ranges for all years reflect variations related to the cost estimate method used, where Method 1 is less costly than Method 2.

Table 4. Initial Direct Costs to Operators from Production Facility Decommissioning Cost Estimate Reports through the Three-Year Implementation Period of the Proposed Regulations

Cost Estimate Range	Y1	Y2	Y3	3-Year Total
Lower Bound	$1,154,181	$1,663,824	$78,523	$2,896,528
Upper Bound	$1,511,719	$2,466,539	$82,914	$4,061,173

CalGEM's engineers computed costs per well for production facility decommissioning and the respective site remediation. In this context, "facilities" refers to production facility, defined by PRC section 3010 as "any equipment attendant to oil and gas production or injection operations including, but not limited to, tanks, flowlines, headers, gathering lines, wellheads, heater treaters, pumps, valves, compressors, injection equipment, and pipelines that are not under the jurisdiction of the State Fire Marshal pursuant to Section 51010 of the Government Code." Accordingly, time and effort needed to prepare cost estimate reporting for production facility decommissioning and respective site remediation depend on the size of oil and gas operations that will require estimates. CalGEM's engineers used the number of wells to account for the size of oil and gas operations and computed the amount of person-hours per well needed to prepare cost estimates for production facility decommissioning and respective site remediation.

Table 5 summarizes the cost per well required for production facility decommissioning cost estimates by operator size category. For operators existing in 2021, these cost per well estimates are applied to the same population of idle and active wells used to compute direct costs for well plugging and abandonment. Variations of cost per well are contingent on the size of the operator, with costs decreasing as the size of operation increases due to economies of scale, resulting from lower per-well hours for operators with more wells and operational resources. Similarly, the cost per well estimate varies by cost estimate method, with Method 2 having higher costs per well because it requires more time to prepare cost estimates than Method 1.

Table 5. Population of Operators, their respective Idle and Active Wells, and Cost per Well to Prepare Cost-Estimate Requirements for Production Facility Decommissioning with respective Site Remediation, broken down by Operator Size Category

Operator Size (# of Wells)	Operators	Total Number of Idle and Active Wells	Offshore Idle and Active Wells	Lower Bound Cost-per-Well	Upper Bound Cost-per-Well
[>10,000]	2	49202	26	$11.20	$16.00
[1,000-10,000]	8	32056	1431	$13.29	$22.68
[100-999]	32	10894	79	$74.16	$112.71
[10-99]	135	3798	76	$190.61	$235.28
[3-9]	82	455		$427.54	$479.01
[1-2]	79	105		$618.38	$695.93

Note: Cost-per-Well includes cost estimate reports for Production Facility Decommissioning and respective Site Remediation

For operators commencing operations after 2021, this analysis computes their direct costs using the new operator and related new well projections ten years after 2021. Thus, this analysis projects a total of 32 new operators from 2023 through 2027, with an average of 17 new wells each. Given this average number of wells per new operator, it is determined these new operators will spend an average of $190.61 to $235.28 per

each of their new wells to prepare their cost estimate reports for production facility decommissioning and respective site remediation.

4.3 Operators' Direct Costs for Ongoing Years

Based on the reporting requirements of the proposed regulations, the analysis considers three types of recurring direct costs. First, it estimates direct costs for the required five-year update of cost estimates for operators in existence in 2021. Second, it estimates the initial reporting costs for new oil and gas operators the ten years (Y4-Y13) following 2027, which is the year all operators who operated oil and gas wells in 2021 must have completed their initial cost estimate reports. Third, it estimates average annualized costs for report updates among new operators starting their operations after 2021. These average annualized costs are also projected for the ten years after 2027.

The next subsections are organized as follows: Subsection 4.3.1 explains the analytical strategy used to compute ongoing direct costs after 2027. Subsection 4.3.2 proceeds with discussing the outcome calculations of such direct costs.

4.3.1. Analytical Approach for Ongoing Costs

To compute direct costs for the five-year updates, the analysis projects the evolution of oil and gas well inventories owned by operators existing in 2021. To accomplish this, the analysis uses CalGEM's administrative data to determine churn rates of existing wells and to forecast new drills executed by existing operators five years after initial cost estimate reports and five years thereafter.

To begin with, the analysis computes churn rates using historical notice of intention (NOI) data from 1986 to 2021[7] and well information data[8]. The NOI data traces all well plugging and abandonment activity over the years. Meanwhile, the well information data provides the most current inventory of all oil and gas wells in California. Consequently, this analysis links both data sources to compute the historical rates of total oil and wells plugged and abandoned every five years. Doing so allows for the discount of the number of plugged and abandoned wells that operators would no longer need to report estimate updates five years after their initial report and five years thereafter.

The analysis then proceeds to project new wells drilled by existing operators five years after their initial cost estimate reports and five years thereafter. This is done using NOI data from 1986 to 2021, which tracks all new well drillings done by operators.

[7] WellSTAR, (2022), Notice of Intention (NOI) data, California Geologic Energy Management Division (CalGEM)
[8] WellSTAR. (2022), Well Information, California Geologic Energy Management Division (CalGEM)

Accordingly, the historical trends of new well drills are used to forecast future new wells added to the total oil and gas well inventories among operators existing in 2021.

Finally, based on their updated well inventories, the recurrent five-year cost updates among operators existing in 2021 are computed. Correspondingly, similar to initial cost estimates, the analysis applies CalGEM's estimated costs per well (for wells and facilities) to the estimated number of wells in order to compute the total costs of preparing report updates for plugging and abandonment, facility decommissioning, and site remediation.

To estimate ongoing annual direct cost for new well operators, the analysis performs projections leveraging historical trends on newly producing oil and gas operators[9]. Using this approach, the number of newly producing oil and gas operators are tracked from 1978 through 2020 using CalGEM's data on oil and gas production volumes. Operators are grouped by their first year of reported oil and gas production through this historical period and the count of wells producing oil and gas is computed for each of the operators at their initial year of production.

Subsequently, using historical trends from 1978 through 2020, the analysis prepared 10-year projections of the number of newly producing operators and their respective number of newly producing wells to compute ongoing annual direct costs for new operators. This forecasting approach only captures new operators drilling new actively producing wells, which is the remaining number of wells needed to account for future changes on total oil and gas well inventory in California. In fact, new operators buying "existing" active and idle well inventories are already considered under the priorly described cost updates among existing oil and gas well inventories in 2021. To compute aggregated ongoing direct costs for new operators, the projected number of newly producing wells is applied to their respective cost per well. The projected average of newly producing wells per new operator is used to determine the average size of new operators and their respective cost per well estimate for plugging and abandonment, facility decommissioning, and site remediation.

4.3.2. Ongoing Direct Costs Calculations

The proposed regulations require that all operators provide updated cost estimates five years after their first required submission and every five years thereafter. Initial reporting deadlines are from 2025 (Y1) through 2027 (Y3). Thus, five years after the first required submission and every five years thereafter, direct costs from report updates will be contingent on the volume of operations reporting at each of these three initial reporting deadlines. On average, recurrent direct costs from reporting updates for all oil and gas operations will annually range from $2.1 million to $2.7 million, depending on

[9] CalGEM's Customized Dataset, (2021), Oil and Gas Production Data, California Geologic Energy Management Division (CalGEM)

the cost estimate method selected by oil and gas operators. Table 6 provides a breakdown of anticipated direct costs from 5-year-updated reports by each of the initial reporting deadlines (Y1-Y3).

Table 6. Recurrent Direct Costs from Cost Estimate Report Updates among Existing Operators every Five Years

Cost Estimate Range	Y1	Y2	Y3	Average of 5-Year-Updates
Lower Bound	$2,908,367	$3,387,943	$129,015	**$2,141,775**
Upper Bound	$3,486,331	$4,397,038	$129,015	**$2,670,795**

Table 7 summarizes the average annual ongoing direct costs from cost estimate reports of new operators, which range from $118,000 to $138,000. As previously explained, the ranges reflect the cost estimate method the operators might select. Additionally, these average annual costs break down into two categories: 1) the average annual cost for preparing initial cost estimate reports for new operators in each year and 2) the average annual cost of report updates from operators who reported as new operators since 2021.

The average costs from new operators reporting their initial cost estimates ranges from $51,000 to $60,000 each year. Five new operators are forecasted annually with a total number of 91 new active wells, an average of approximately 17 wells per new operator. Accordingly, based on CalGEM's estimated cost per well for wells and facilities, it is assumed that each new operator would spend an average of $344 per well (with Method 1) to $388 per well (with Method 2) to prepare well plugging and abandonment costs estimates and an average of $191 per well (with Method 1) to $235 per well (with Method 2) to prepare the production facility decommissioning cost estimates.

Table 7 also summarizes average annual costs for report updates of new operators accumulated since 2021. From 2028 (Y4) to 2037 (Y13), new operators since 2021 will on average incur update costs every five years ranging from $67,000 to $78,000 annually. It is anticipated an average attrition rate of 9 percent of well inventories among new operators every five years after their initial report, the same average attrition rate anticipated for report updates among operators existing in 2021.

Table 7. Ongoing Direct Costs for New Operators, Average Annualized Cost 10 Years after 2027 (Y3 of Regulatory Implementation)

Cost Element	Lower Bound Avg Annualized Ongoing Costs (Y4-Y13)	Upper Bound Avg Annualized Ongoing Costs (Y4-Y13)
Initial Cost Estimates	$51,229	$60,011
Cost Estimate Updates	$66,792	$78,242
Total Ongoing Costs	**$118,021**	**$138,253**

5. Fiscal Impacts of Proposed Regulations

CalGEM will experience fiscal impacts associated with the implementation of the proposed regulations. The new Cost Estimate Report requirements for plugging and abandonment, facilities decommissioning, and site remediation would need additional CalGEM staff time for supporting and overseeing operator compliance with these new requirements. To compute such fiscal impacts, this analysis relies on the same analytical approach used for calculating direct costs to operators. Specifically, it uses the well population of operators and applies anticipated costs per well prepared by CalGEM to reflect the approximate additional workload CalGEM staff will experience to support and oversee the proposed regulations.

Table 8 reports the average cost per well that CalGEM's engineers anticipate will be incurred in various activities supporting and overseeing operators' cost estimates for plugging and abandonment, facilities decommissioning, and site remediation. First, these anticipated costs calculate well plugging and abandonment and production facility decommissioning separately, with each incorporating the associated cost estimate for their respective site remediation. Second, when computing anticipated unit costs for both wells and facilities, CalGEM uses the number of wells owned by operators to account for the size of their oil and gas operations.

Accordingly, CalGEM's engineers anticipate variations in the staff time required depending on the size of each operator. It is assumed that the larger the oil and gas operation, the more proficient an operator is likely to be in producing their cost estimates, which would lower the staff time CalGEM would need to oversee and support them. Lastly, for both wells and facilities, CalGEM separately prepared anticipated staff time cost per well for Method 1 (the lower bound) and Method 2 (the upper bound), where Method 2 would require more time to review cost estimates from operators selecting their own methodology.

Table 8. CalGEM's Staff Time Cost-per-Well needed to Oversee and Support Cost-Estimate Reporting

Operator Size (# of Wells)	Lower Bound for Wells and Respective Site Remediation	Upper Bound for Wells and Respective Site Remediation	Lower Bound for Facilities Respective Site Remediation	Upper Bound for Facilities Respective Site Remediation

[>10,000]	$1.74	$2.14	$2.01	$4.02
[1,000-10,000]	$4.76	$6.02	$2.01	$4.02
[100-999]	$27.76	$34.54	$16.42	$29.11
[10-99]	$120.64	$145.84	$44.91	$78.60
[3-9]	$137.98	$167.68	$134.09	$220.37
[1-2]	$228.31	$277.40	$257.78	$420.95

Note: Cost-per-well estimates produced by CalGEM's engineers based on their technical knowledge and oversight experience of oil and gas industry operations.

Table 9 reports the total fiscal impact to CalGEM in implementing the new requirements of the proposed regulations. Through the five years of initial reporting, CalGEM would need to dedicate staff resources of between $1.8 million to $2.5 million, depending on the cost estimate method selected by operators. Out of this total amount required, it is anticipated that CalGEM will incur costs of $861,000 to $1.2 million for the first deadline year of initial cost estimate reports; $876,000 to $1.3 million for the second deadline year, including $93,000 to $126,000 deriving from initial cost estimates of new operators since 2021; and $53,000 to $58,000 for the third deadline year, with $15,000 to $21,000 deriving from initial costs estimates of new operators starting in 2027.

Table 9. Total Initial Costs to CalGEM from Supporting and Overseeing Cost-Estimate Report Regulations

Cost Estimate Range	Y1	Y2	Y3	3-Year Total
Lower Bound	$861,268	$876,310	$52,576	**$1,790,153**
Upper Bound	$1,195,880	$1,292,526	$58,092	**$2,546,498**

CalGEM anticipates that it would require skills equivalent to an Oil and Gas Engineer classification to fulfill all its support and oversight tasks during the initial filing period. Accordingly, contingent to the cost estimate method selected by operators, it is assumed that CalGEM would need 6.2 to 8.7 personnel years of this classification in the first deadline year; 6.4 to 9.4 personnel years in the second deadline year; and 0.38 to 0.42 personnel years in the third deadline year. Using California Human Resources classifications and staffing cost calculations (i.e., salaries, benefits, operating expenses and equipment), the analysis determined that CalGEM would need to allocate $138,000 per personnel-year.

For subsequent years, CalGEM will need to allocate staff time resources for supporting and overseeing requirements for cost estimate updates from operators existing in 2021, as well as initial and update cost estimates from new operators starting activities after 2021. First, cost estimate updates will occur every five years after each of the three initial reporting years from 2025 to 2027.

CalGEM will need to allocate an annual average ranging from $325,300 to $463,600 of staff time for cost estimate updates from operators existing in 2021. Also contingent on

the cost estimate method selected by operators, it is anticipated that CalGEM will need to annually allocate from $15,400 to $21,000 to support and oversee initial cost estimate reports from new operators each year. New operators starting activities after 2021 will also start reporting cost estimate updates five years after their initial reporting date. Thus, ten years after 2027, the average annual costs for report updates of new operators would range from $20,000 to $27,000.

Similar to initial costs, CalGEM anticipates that it would require skills equivalent to an Oil and Gas Engineer classification to fulfill all its support and oversight tasks for cost estimate reports. Thus, it is anticipated that recurrent cost-estimate updates from operators existing in 2021 would annually require an average of 2.4 to 3.4 personnel-years of this classification, while initial and updated report cost estimates from operators starting after 2021 would annually require an additional 0.26 to 0.35 personnel years. Using California Human Resources classifications and staffing cost calculations (i.e., salaries, benefits, operating expenses and equipment), the analysis determined that CalGEM would need to allocate $138,000 per personnel-year.

6. Benefits of Proposed Regulations

Public Resources Code section 3205.7 requires CalGEM to establish the criteria to be used by operators for estimating costs for plugging and abandonment, facilities decommissioning, and site remediation. The proposed regulations implement this statutory requirement and will inform CalGEM's determinations on requiring additional and acceptable financial security amounts to secure against operators deserting their oil and gas operations under PRC section 3205.3. These benefits cannot be specifically quantified but should increase economic, health, and environmental outcomes for all residents of California's communities who may live or work near oil and gas operations. Although these regulations do not specifically require any plugging and abandonment or decommissioning, the development of a database of cost estimates will improve long-term outcomes by clarifying the specific amount of these liabilities, identifying operators who fail to comply with the cost estimate requirements and are therefore likely to be insolvent or verging on insolvent, and providing CalGEM, policy makers, and community members with information needed to plan for future potential harm that would result from failure to complete plugging and abandonment, facilities decommissioning, and site remediation.

Furthermore, the cost estimate requirements of the proposed regulations will involve operators in the determination of their total liability for plugging and abandonment, facilities decommissioning, and site remediation activities. Extensive academic research has empirically supported that involving regulated entities in the rulemaking determination increases compliance with and support for government policies and

regulations[10]. Thus, involving operators in the cost estimates of plugging and abandonment, facilities decommissioning, and site remediation activities will likely influence higher compliance with future requirements relying upon such cost estimates.

7. Job and Business Impacts of the Proposed Regulations[11]

The proposed regulations will generate direct costs of compliance for California's oil and gas extraction industry. This industry employed an average of 3,800 workers in California in 2021[12]. Around 25 percent of these workers are employed by oil and gas operators with less than 50 workers each and 40 percent are employed by operators with 250 and more workers each[13]. Of the 338 operators actively producing oil and gas in the last five years[14], two operators with more than 10,000 wells made more than 50 percent of approximated profits[15] in the industry in 2021, while 296 operators (88 percent of total operators) with less than 100 wells made 1.5 percent of total profits of the industry that year.

While the proposed regulations generate direct costs for compliance, it is anticipated that they will neither affect business expansion plans nor contribute to the elimination of jobs and businesses in the industry. Assuming all operators choose the more costly Method 2, the average operator would incur total direct costs of compliance equivalent to 0.14 percent of one year of profits[16]. This calculation assumes that those profits will roughly remain at levels similar to 2021 throughout the five-year

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[10] May, P.J., and Wood, R.S..2003. At the Regulatory Front Lines: Inspectors' Enforcement Styles and Regulatory Compliance, Journal of Public Administration Research and Theory, Vol. 13, no/ 2, pp. 117-139; Lachapelle, Erick (et.al.).2021. Citizens' Willingness to Support New Taxes for COVID-19 Measures and Role of Trust, Politics & Policy, Vol. 49, no.3, pp. 534-565

[11] This analysis uses 2021 as its benchmark year because this is the reference year for the reporting requirements of the proposed regulations.

[12] Current Employment Statistics (CES) (2021), Average Annual Employment for the Oil and Gas Extraction Industry in California in 2021, California Employment Development Department, Labor Market Division, Industry Employment Data Search Tool (Official Estimates), https://www.labormarketinfo.edd.ca.gov/cgi/dataanalysis/areaselection.asp?tablename=ces

[13] Quarterly Census of Employment and Wages (QCEW) program, Quarterly Size of Business Data for California, (Q 2: 2021), Table 2B: Number of Employees by Size Category Classified by North American Industry Classification System (NAICS) for California, Oil and Gas Extraction (211), California Employment Development Department, Labor Market Division, Size of Business Report, https://www.labormarketinfo.edd.ca.gov/LMID/Size_of_Business_Data_for_CA.html

[14] Inference obtained using CalGEM's Customized Oil and Gas Production Volume Data (2021), California Geologic Energy Management Division (CalGEM)

[15] This analysis computes total profits for 2021 by subtracting total revenues minus total oil and gas production costs in 2021. Revenues and production costs are computed as follows. First, the natural gas produced is covered from thousand cubic feet (mcf) to barrels of oil equivalent (BOE) and combine it with oil production in 2021. To convert mcf to BOE, total mcf are dived by 6. 6, which is the amount of mcf of natural gas per 1 BOE. Then, revenues are computed by multiplying total BOE of 2021 times the average monthly price ($/bb) of WTI crude oil in 2021, as reported by the U.S. EIA historical price data. Subsequently, oil and gas production costs for 2021 were estimated by multiplying the BOE production of 2021 times the weighted average cost per BOE extracted from the latest expense reports of publicly traded oil and gas operators in California.

[16] Ibid. note xvi explains the approach used to calculate total operators' profits for 2021.

implementation period of the proposed regulation. The WTI price of crude oil averaged $68 in 2021, which is $34 below the $102 dollars as of March 2022[17]. Thus, in the scenario that crude oil prices remain high, the impact on profits would be lower, assuming the cost per barrel remains stable.

Table 10 summarizes the average cost burden that the proposed regulations impose on operators of different sizes. The average cost burden measures the average cost of compliance as a percent of the estimated average profits in 2021across different size categories of operators. For comparison purposes, cost burden measures are calculated under a scenario where all operators select the less costly Method 1 (the lower bound estimate) and another scenario where all operators select the more costly Method 2 (the upper bound estimate).

These average cost burden measures include associated number of operators and the average profit per operator made in 2021 per each size category. Overall, the larger the operator, the less burden the proposed regulations will have on operator profits. On the one hand, ten operators with more than 1,000 wells each will incur an average cost of compliance not larger than 0.1 percent of their profits in 2021. On the other hand, 296 operators with less than 100 wells will incur costs of compliance ranging from 3.4 percent to 5.1 percent of their profits in 2021. Even though the cost of compliance places a larger burden on the profits of the smallest operators, it is assumed that the proposed regulation will not affect their financial sustainability.

Table 10. Oil and Gas Operators' Cost Burden to Comply with Proposed Regulations

Operator Size (# of Wells)	No. of Operators in 2021	Avg Profits per Operator in 2021	Lower Bound Avg Cost Burden per Operator	High Bound Avg Cost Burden per Operator
[>10,000]	2	$1,927,032,320	0.02%	0.03%
[1000-10,000]	8	$376,766,108	0.04%	0.05%
[100-999]	32	$21,457,318	0.41%	0.53%
[10-99]	135	$656,157	3.44%	4.00%
[3-9]	82	$232,633	3.42%	3.84%
[1-2]	79	$79,553	4.49%	5.07%
Total	338	$22,688,667	0.11%	0.14%

Note: Average Cost Burden is the average cost of regulatory compliance as a percent share of average profits made by operators in 2021.

It is anticipated that the costs incurred to comply with the proposed regulation may trigger the need for new jobs in California. Through the first five years of implementation, the proposed regulations would generate average total costs of around $2 million each year. Afterwards, the recurrent cost of compliance with the regulations would range

[17] Petroleum and Other Liquids Data (2022), Historical Cushing. OK WTI Spot Price FOB, U.S. Energy Information Administration, https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=rwtc&f=m

from $400,000 to $500,000 annually. Thus, these cost magnitudes might trigger a need for at least temporary workers to comply with the regulations.

Two elements support this possibility: cost estimates rely upon the staff time needed to prepare cost estimate reports for plugging and abandonment, facilities decommissioning, and site remediation, and around 75 percent of current oil and gas operations subject to the regulation are concentrated in Kern County. The required workload and the geographical concentration might justify the need for additional workers to prepare cost estimate reports. Nonetheless, given the temporary nature of this work, it is assumed that this additional workload is not sufficient to support the creation of new businesses or the expansion of current businesses.

8. Conclusion

The entities directly affected by the proposed regulations will be California oil and gas operators. These include 338 operators owning 96,500 idle and active wells and 9,200 facility settings. Chevron, Aera Energy, and California Resources Production Corporation collectively own almost two-thirds of total idle and active wells in California. Meanwhile, over 80 percent of all idle and active wells are located in Kern County and Los Angeles County.

The total costs associated with the proposed regulations include the direct costs incurred by operators from preparing cost estimate reports for plugging and abandoning all their idle and active wells, for decommissioning all their facilities, and for remediating respective well and production facility sites. CalGEM will also incur additional expenses to support and oversee the new cost estimate report requirements.

Table 11 reports the anticipated costs of the proposed regulations. Depending on the cost estimate method selected by each operator, direct costs range between $8.8 million to $11.3 million during the three-year initial reporting period. Ten years after the initial three-year reporting period, average annualized recurring costs are estimated at between $1.8 million to $2.3 million. During the three-year initial reporting period, total direct costs break down into $6.7 million to $8.4 million for cost estimate reports prepared by operators existing in 2021, $307,000 to $360,000 for cost estimate reports prepared by new operators from 2023 to 2027, and $1.8 million to $2.5 million for CalGEM expenses incurred to support and oversee the new requirements.

The average annualized recurring costs break down into $1.3 million to $1.6 million for cost estimate updates from operators existing in 2021, $118,000 to $138,300 for initial cost estimate reports and report updates from new operators anticipated to become operators after 2021, and $360,900 to $511,900 for CalGEM's support and oversight expenses for initial cost estimate reports of new operators and all cost estimate report updates.

Table 11. Total Direct Costs Associated with the Proposed Regulations

Cost Element	Lower Bound Total of Three-Years Initial Reporting Period	Upper Bound Total of Three-Years Initial Reporting Period	Lower Bound Average Annualized (undiscounted) Recurring Costs (Y4-Y13)	Upper Bound Average Annualized (undiscounted) Recurring Costs (Y4-Y13)
Total Direct Costs to Operators	$7,013,000	$8,721,000	$1,403,000	$1,740,300
Existing Oil and Gas Operators Before 2021	$6,706,000	$8,361,000	$1,285,000	$1,602,000
New Oil and Gas Operators After 2021	$307,000	$360,000	$118,000	$138,300
Fiscal Costs to CalGEM	$1,790,000	$2,546,000	$360,900	$511,900
Total Costs	**$8,803,000**	**$11,267,000**	**$1,763,900**	**$2,252,200**

As a result of the magnitude and distribution of the cost burden across the State, CalGEM has made the following determinations:

- Will benefit the health and welfare of California residents, worker safety, and the environment
- May affect the creation of new jobs within the State of California
- Will not create new business nor eliminate businesses within the State of California
- Will not affect expansion of businesses currently doing business within the state
- Will most likely not affect the ability of businesses within California to compete with businesses in other states

Compliance with the proposed regulations will provide data to ensure that decision makers and the public are aware of the magnitude of these liabilities.