

The Impact of Reduced G&G Activity on Gulf of Mexico Oil and Natural Gas Activities

Prepared For:

The American Petroleum Institute (API)

Prepared By:



CALASH



Executive Summary

Introduction

In its Draft Programmatic Environmental Impact Statement (EIS) for Gulf of Mexico Geological and Geophysical (G&G) Activities, the Bureau of Ocean Energy Management (BOEM) has proposed a number of Alternatives for the future regulation of G&G activity in the Gulf of Mexico. These alternatives (labelled in the EIS as alternative “A” through alternative “G”), propose potential regulatory regimes which would have a widely varying impact on both G&G activity and overall oil and natural gas exploration and production activities in the Gulf of Mexico.

Potential impacts of certain alternatives were not evaluated, such as Alternative A (Pre-settlement June 2013 Alternative), which would revert to requirements in place before a 2013 settlement agreement, and Alternative B (Settlement Agreement Alternative), which would apply requirements agreed to as part of the settlement but that should not be mandatory requirements when the obligations in the settlement are no longer applicable.

Other proposed alternatives (C through G) propose changes ranging from additional seismic source and high-resolution geophysical (HRG) survey protocols, to not allowing any new G&G activity either in specific areas or the entire Gulf of Mexico. The alternatives progressively propose reduced activity levels and thus a greater impact on G&G activities in the Gulf of Mexico. Potential impacts were evaluated for Alternative E (two scenarios) and F.

The EIS issued by BOEM includes estimates of the reduction in seismic activity for the proposed alternatives C through E and are the basis for the impacts estimated in this report. However, while the EIS includes economic impacts for the direct reduction in seismic activity, it does not fully address the impact of reduced G&G activity on Gulf of Mexico offshore oil and natural gas activity. Calash was commissioned by the American Petroleum Institute (API) to provide an independent evaluation of the potential impacts of the proposed alternatives impacts on Gulf of Mexico oil and natural gas exploration and development activities as well as the economic and other impacts of these proposed alternatives.

Impact of Changes

The study projects that reduced G&G activity could lead to reduced offshore exploration, discovery of new reserves, project development, and spending levels. The study further projects that this could lead to lower production, employment levels, and growth in GDP and government revenues.

If G&G activity in the Gulf of Mexico is reduced, this study projects a potential reduction in the total amount of Gulf of Mexico oil and natural gas activity. The size of the impact depends

on two factors: 1) the level of reduction of G&G activity and, 2) whether the reduction is in specific areas or is Gulf of Mexico-wide. Reduced G&G activity could negatively influence the number of wells drilled and oil and natural gas discoveries as well as potential future project development. In fact, the development impacts could be seen later years of the forecast due to reduced discoveries of new oil and natural gas reserves. While operators and G&G contractors typically focus their activity on the most prospective potential oil and gas developments, reduced G&G activity could lead to a long-term reduction in oil and natural gas exploration and development. Of the reviewed scenarios, Alternative F scenario, which would close certain areas to most G&G activity, could have the greatest impact on future development of the studied scenarios. Alternative G, the elimination of new seismic surveys in the Gulf of Mexico, which would undoubtedly have the greatest impact, was not evaluated as it is considered implausible that the agencies would select this as the preferred alternative. While this study estimates aggregate impacts to oil and natural gas activity in the Gulf of Mexico, the impacts to individual operators or geophysical contractors could be much larger depending on the location of a company's leases and the reduced overall market for seismic surveys in the Gulf of Mexico.

Under the Base Case developed for this study, total cumulative spending on offshore oil and natural gas development in the Gulf of Mexico OCS is projected to be in the range of \$685 billion between 2017 and 2035 or around of \$36 billion per year. The study projects:

- A 10 percent reduction in G&G activity could lead to an around five percent reduction in spending (around \$1.8 billion per year).
- A 25 percent reduction in G&G activity could lead to an around 10 percent reduction in spending (around \$3.5 billion per year).
- The closure of specific areas to most new G&G activity (Alternative F) could lead to an average reduction in spending of around 15 percent (around \$5.5 billion per year).

Economic Impact of Proposed Changes

Under the Base Case, the study projects total employment supported from the Gulf of Mexico offshore oil and natural gas industry could rise from about 300 thousand in 2017 to nearly 550 thousand by the late 2030s. The study projects:

- A 10 percent reduction in G&G activities in the Gulf of Mexico could reduce employment by on average 20 thousand jobs per year.
- A 25 percent reduction could reduce employment by an average of around 40 thousand per year.

- In the Alternative F scenario, the study projects that employment could be reduced by around 64 thousand jobs on average per year.

Also under the Base Case developed for this study, the Gulf of Mexico offshore oil and natural gas industry is expected to contribute an estimated \$25.2 billion annually to U.S. GDP in 2017, and is projected to grow to over \$43 billion by 2035. On average, contributions to GDP are projected at around \$35.6 billion during the forecast period (2017 to 2035). The study projects:

- A 10 percent reduction in G&G activity could lead to around a 5 percent reduction in GDP contributions (around \$1.6 billion per year).
- A 25 percent reduction G&G activity could lead to around a 10 percent reduction (\$3.4 billion per year).
- The closure of specific areas in the Alternative F scenario could lead to around a 15 percent reduction on average (\$5.1 billion per year).

Annual government revenues from Gulf of Mexico lease sales, rents, and royalties are expected to rise from about \$5.6 billion in 2017 to \$8.6 billion by 2035 under the base scenario. The study projects that reduced oil and natural gas production due to reduced G&G activity is projected to lead to lower overall government revenues. The study reaches this conclusion primarily as fewer production royalties are likely to be collected due to lower production volumes. This could range from lower production in the range of 65 thousand barrels of oil equivalent per day if G&G activity is reduced by 10 percent, 83 thousand barrels if G&G activity is reduced by 25 percent and 140 thousand barrels under the Alternative F scenario.

While the impact on production in the early years of the forecast is likely minimal, by 2035 barrel of oil equivalent production could be in the range of 180 thousand barrels per day less in the 10 percent reduction scenario, 250 thousand per day less in the 25 percent reduction scenario and 540 thousand per day less in the Alternative F scenario. Reduced government revenues could average around \$260 million (in the 10 percent reduction scenario), \$275 million per year in the 25 percent reduction scenario and \$700 million per year in the Alternative F scenario across the forecast period (2017 to 2035).

The study projects that reduced G&G activity as proposed by some of the BOEM alternative scenarios could lead to reduced offshore exploration, discovery of new reserves, and project development, and spending levels. The study further projects that this could lead to lower production, employment levels, and growth in GDP and government revenues.

Impact Summary

This study projects that the following impacts may result if a proposed alternative which reduces Gulf of Mexico G&G activity is adopted:

Table 1: Potential Differences from Base Case Due to Reduced G&G Activity

Average 2018 to 2035	Base Case	Potential Difference From Base Case		
		10 Percent Case	25 Percent Case	Alt. F Case
O&G Production (BOE)	2,411,255	-63,794	-82,544	-180,149
Employment	426,325	-21,100	-40,504	-63,797
Spending (\$Billions)	\$36.01	-\$1.86	-\$3.58	-\$5.44
GDP (\$Billions)	\$35.60	-\$1.75	-\$3.36	-\$5.11
Government Revenue (\$Billions)	\$8.40	-\$0.26	-\$0.27	-\$0.71

Annual 2035	Base Case	Potential Difference From Base Case		
		10 Percent Case	25 Percent Case	Alt. F Case
O&G Production (BOE)	2,207,798	-181,137	-245,163	-541,496
Employment	524,528	-27,380	-99,523	-133,338
Spending (\$Billions)	\$43.59	-\$2.29	-\$7.67	-\$10.09
GDP (\$Billions)	\$43.16	-\$2.29	-\$7.28	-\$9.67
Government Revenue (\$Billions)	\$8.58	-\$0.56	-\$0.58	-\$1.93

Source: Calash

Table of Contents

Executive Summary.....	2
Introduction.....	2
Impact of Changes	2
Economic Impact of Proposed Changes.....	3
Impact Summary	5
Table of Contents.....	6
List of Tables.....	7
List of Figures	8
Section 1 – Introduction	9
1.1 Purpose of the Report.....	9
1.2 Report Structure.....	10
1.3 Excluded from This Study	10
1.4 About Calash.....	11
Section 2 – Study Methodology.....	12
2.1 Data Development	12
2.2 Limitations of the Report	13
2.3 Impact on Development	13
2.4 Wells Drilled	14
2.5 Projects Executed	16
2.6 Production	17
2.7 Total Spending	18
Section 3 – Macro-Economic Impact	21
3.1 Employment	21
3.2 GDP (Gross Domestic Product)	24
3.3 Government Revenue	26
Section 4 – Conclusions	29
Section 5 – Appendices.....	31
5.1 Extended Methodology	31
5.2 Glossary of Terms.....	34

List of Tables

Table 1: Differences from Base Case Due to Reduced G&G Activity	5
Table 2: Proposed G&G Programmatic Alternatives	9
Table 3: Differences from Base Case Due to Reduced G&G Activity	30

List of Figures

Figure 1: Projected Wells Drilled by Case	15
Figure 2: Projected Projects Online by Case	16
Figure 3: Base Case Projected Oil and Natural Gas Production	17
Figure 4: Potential Oil and Natural Gas Production by Case	18
Figure 5: Projected Base Case Spending and Activity Type	19
Figure 6: Projected Total Annual Spending by Case	20
Figure 7: Projected Base Case Employment by State	22
Figure 8: Projected Total U.S. Employment by Case	23
Figure 9: Projected Total U.S. Employment by Case	24
Figure 10: Projected Base Case GDP by State	25
Figure 11: Projected GDP by Case.....	26
Figure 12: Projected Base Case Government Revenues	27
Figure 13: Projected Government Revenues by Case	28

Section 1 – Introduction

1.1 Purpose of the Report

The currently proposed Gulf of Mexico Geological and Geophysical (G&G) Activities Draft Programmatic Environmental Impact Statement (EIS) issued by the Bureau of Ocean Energy Management (BOEM) includes various alternatives for future regulation of G&G activity in the Gulf of Mexico and other areas of the U.S. offshore continental shelf (OCS). These alternatives are labeled alternative A through alternative G, and propose potential regulatory regimes which would have a varying impact on both G&G activity and overall oil and natural gas exploration and production activities.

Potential impacts of certain alternatives were not evaluated, such as Alternative A (Pre-settlement June 2013 Alternative), which would revert to requirements in place before a 2013 settlement agreement, and Alternative B (Settlement Agreement Alternative), which would apply requirements agreed to as part of the settlement but that should not be mandatory requirements when the obligations in the settlement are no longer applicable.

Other proposed alternatives (C through G) propose changes ranging from additional seismic source and high-resolution geophysical (HRG) survey protocols, to not allowing any new G&G activity either in specific areas or the entire Gulf of Mexico. The alternatives progressively propose reduced activity levels and thus a greater impact on G&G activities in the Gulf of Mexico. (Table 2) Potential impacts were evaluated for Alternative E (two scenarios) and F.

Table 2: G&G Programmatic Alternatives from BOEM EIS

Alternative	Description	Proposed Changes	G&G Activity Impact
A	Pre-Settlement June 2013 Alternative	None	None
B	Settlement Agreement Alternative	Use of site-specific NEPA evaluations, lease stipulation, NTLs, best management practices, and COS guidance	Dependent on implementation and management
C	Alternative A plus additional mitigation measures	Additional survey protocols for airgun and HRG surveys	7% reduction in efficiency and potential for some surveys not to occur at all
D	Alternative C plus Marine Mammal Shutdowns	Adds shut down of all operations for all marine mammals within exclusion zone except bow riding dolphins	14% reduction in efficiency and potential for some surveys not to occur at all
E	Alternative C at Reduced Activity Levels	Reduced Activity Levels - 10%-25%	10%-25% reduction in activity
F	Alternative C plus area closures	Closure of four GoM areas covering parts of the Mississippi Canyon, Atwater Valley, DeSoto Canyon, Vioska Knoll and areas of the Eastern Gulf and High Island	No new G&G activity in specified areas
G	No new activity	No new G&G activity in US Gulf of Mexico	100% reduction in activity

Source: Calash

The EIS issued by BOEM includes estimates of the reduction in seismic activity for the proposed alternatives C through E, and these reductions in activity inform this analysis and are the basis for the impacts estimated by the report. The EIS also includes economic impacts for the direct reduction in seismic survey activity from these proposed alternatives on the G&G industry but do not address the impact of reduced G&G activity on Gulf of Mexico offshore oil and natural gas activity.

Calash was commissioned by the American Petroleum Institute (API) to provide an independent evaluation of the potential impacts of the proposed alternatives related to Gulf of Mexico seismic and geophysical activity on Gulf of Mexico oil and natural gas exploration and development activities. In addition, Calash projected potential impacts on Gulf of Mexico oil and natural gas production, supported employment, GDP, and government revenue. The conclusions set forth in this study are based solely upon government and other publicly-available data and Calash's own expertise and analysis.

1.2 Report Structure

In this report, Calash will first outline the study methodology including the development of data, the proposed alternatives for modifying regulation of G&G activities in the Gulf of Mexico, the limitations of this study and the development of the four scenarios used in the report. The next section will discuss the potential impact on offshore oil and natural gas development, including the impact on projects, production, and spending. The third section examines the potential economic impacts of reduced G&G activity levels, including employment impacts, GDP impacts, and government revenue impacts. The final section presents conclusions. The first appendix provides a more detailed explanation of the analysis used in the report. The second appendix is a glossary of terms.

1.3 Excluded from This Study

This paper is limited in scope to the assessment of the effects of the currently proposed alternatives as described in the previous sections. For ease of use four scenarios have been developed to provide an indication of the potential impacts of reduced G&G activity on Gulf of Mexico oil and natural gas activities. If the proposed alternatives cause a greater reduction in G&G activity than predicted in the BOEM EIS, then the impacts on Gulf of Mexico activity would be expected to be greater as well. The study also includes potential supply chain reductions due to reduced activity levels in the Gulf as projects are delayed due to reduced G&G activity.

This study also excludes the impacts of activity in the Alaskan, Pacific, Eastern Gulf and Atlantic OCS regions.

The study also does not attempt to calculate the effects of the proposed alternatives on midstream or downstream oil and natural gas entities. In addition, the calculated government revenue potential does not include personal income taxes, corporate income taxes or local property taxes. Given the unpredictable nature of advancements in technology and innovation in the oil and natural gas industry, the scope of this paper is limited to the effects that new requirements would have on future activity with the assumption that the methods and equipment mentioned in the proposed alternatives would still be in use at the end of the study period. Overall, given the constraints and assumptions discussed above, it is likely that the costs and economic impacts presented in this study represent a conservative projection of the impact of the proposed alternatives.

1.4 About Calash

Since Calash's creation it has evolved from an oil and natural gas commercial and operational due diligence provider into an award-winning energy advisory firm providing strategy, business advisory, economic analysis, and mergers and acquisitions support services. As a function of Calash's core business, the company is engaged daily in the collection and analysis of data as it relates to the oil and natural gas industry. Calash serves the global community of operating oil and natural gas companies, their suppliers, financial firms, and many others by providing detailed analysis on projects, investments, capital investment and operational spending undertaken by the onshore and offshore industries. Calash analyzes market data from a variety of sources at the project level for projects throughout the world.

Section 2 – Study Methodology

2.1 Data Development

The authors of this report have undertaken a detailed review and analysis of the proposed Alternatives (A through G) and developed a Base Case and three alternative cases to indicate the potential effects of reduced G&G activity on oil and natural gas activities in the Gulf of Mexico. The Base Case is modelled on the Energy Information Administration's March 2017 short term energy outlooks forecasts of Gulf of Mexico oil and natural gas production. The alternative cases include: a case indicating the potential effects of a 10 percent reduction in G&G activity, a case indicating the potential effects of a 25 percent reduction in G&G activity, and a case indicating the potential effects of a closure of certain areas to new G&G activity (Alternative F). The proposed percentage reductions in G&G activity used for these cases are based on BOEM's estimates of the reduced seismic efficiency, and any reduction in activity greater than that estimated by BOEM would likely lead to further reductions in Gulf of Mexico oil and natural gas exploration and production activities. For the purposes of this report Alternative G was not considered because if no new G&G activity were permitted it would be unlikely new oil and natural gas activity could take place in the Gulf of Mexico and it is considered implausible to think that the agencies would select this as the preferred alternative.

This analysis focuses on the likely effects of reduced G&G activity on project development activity and considers that oil and gas operators and G&G contractors typically focus G&G activities on the most prospective oil and natural gas exploration targets and projects, therefore reducing the impact of reduced G&G activity on overall exploration and development activity. Operators will likely focus their G&G activities on those areas where with the highest likelihood for the largest potential oil and natural gas discoveries, and thus a given reduction in the efficiency or number of lines of seismic acquired will be unlikely to have a correspondingly exact proportional impact on overall activity, production, or economic impacts.

Despite this, the potential prospectivity of oil and natural gas targets without G&G surveys and exploration drilling widely varies and operators' assumptions about which areas should be the focus of reduced G&G activity levels would likely lead to errors in the selection of the most prospective areas to target. While G&G activities are primarily used by the oil and natural gas industry to identify potential oil reserves for exploration drilling and to delineate discovered reserves, G&G contractors also provide services such as site surveys for the placements of platforms, monitoring of producing fields, and optimization of well placement in new and existing fields. Later stage (from a project development lifecycle perspective) activities such as these which could be reduced by the proposed alternatives are likely to be high-graded by operators and G&G contractors, leading to the largest impact on exploration and

development activities to be in the exploration and development of new undiscovered or delineated (appraised) fields and the later development of these fields. Due to this, the impact of potential reduction in G&G activities is likely to be felt later in the forecast period.

In order to account for both current active projects and identified prospects, as well as longer-term exploration and development activity that will be developed towards the end of the forecast period into the study's project development activity, Calash incorporated two models into the project development forecast. The near-term activity was developed on known projects or prospects currently under consideration for development, while a longer-term forecast was developed on top of the near-term forecast through the analysis of reserves, oil prices, leasing trends, development trends, historic project sizes and other relevant factors.

Longer term projects were developed by applying historical and current trends within the region to future developments based on undiscovered oil and natural gas resources on a play by play basis to apply the proper costs and timelines to the expected activity. Projects were still delineated by individual timelines and the development scenarios that may be expected of future activity within the region, but were calculated using assumptions on industry trends in production methods instead of on confirmed aspects of the specific projects.

Additionally, the internal costs to BOEM of implementing and administering the proposed alternatives are not calculated in this report.

2.2 Limitations of the Report

The report's authors make no representation as to the effects of the proposed alternatives not specifically in this report and do not discount the possibility that these proposed changes could impose significantly greater engineering, operational, cost or other burdens on industry or regulators. The report's authors' estimates herein of the effects that the proposed alternatives will have on current and future activities are an independent good faith qualitative view arising from a reasonable review of the proposed alternatives as well BOEM's own estimates of the reduction of G&G activity as a result of these alternatives. Enforcement decisions including the issuing of permits by BOEM and other regulators could affect the impacts of these changes. Calash provides this independent view expressly disclaiming any warranty, liability, or responsibility for completeness, accuracy, use, or fitness to any person for any reason.

2.3 Impact on Development

U.S. offshore natural gas and crude oil exploration and production activities provide large contributions to employment, gross domestic product and state and federal government revenues. To quantify the effects of the proposed alternatives, the study forecasted activity

levels for Gulf of Mexico OCS oil and gas activity under current rules (Base Case) corresponding with Alternative A, as well as under a 10 percent reduction in G&G activity (10 Percent Case), a 25 percent reduction in G&G activity (25 Percent Case), and a case where new G&G activity is not permitted in closure areas (Alternative F). The forecasted activity levels include the number of wells drilled, projects executed, total production, and spending. These activity forecasts drive the spending projections from which GDP, employment and government revenue effects are estimated.

Prior to performing exploration and appraisal activities, oil and natural gas operators hire G&G contractors to perform surveys of oil and gas leases. The surveys help operators to understand both surface and subsurface conditions in those leases and to identify and delineate potential exploration and development targets. G&G (with a focus on seismic) is the first stage in developing an offshore oil and natural gas field by analyzing where and what resources may be present. To do this, the industry relies on specialized seismic contractors who provide imaging and data of the geologic formations below the Gulf of Mexico's seafloor.

Seismic contractors own or charter and operate a fleet of vessels that use acoustic imaging techniques to assess the geological formations lying beneath the seafloor. Operations typically involve a vessel towing "streamers", which are sensors used to receive electromagnetic waves in a set pattern (lines) as a seismic source creates sound waves, in a defined area which normally encompasses a group of standardized "blocks" which operators have leased. These boats, or vessels, are highly specialized pieces of equipment that play a pivotal role in the acquisition of this information.

The seismic images and data captured by these vessels provide critical information to properly trained personnel and computer programs which interpret these data received from these surveys. The interpretation of the physical composition of these formations allows geologists, geoscientists, and other experts to then determine the areas in which oil and natural gas may be present. If a potential oil or natural gas target looks promising, the oil company that owns or operates the federal offshore lease may create an exploration plan which involves the drilling of exploration wells.

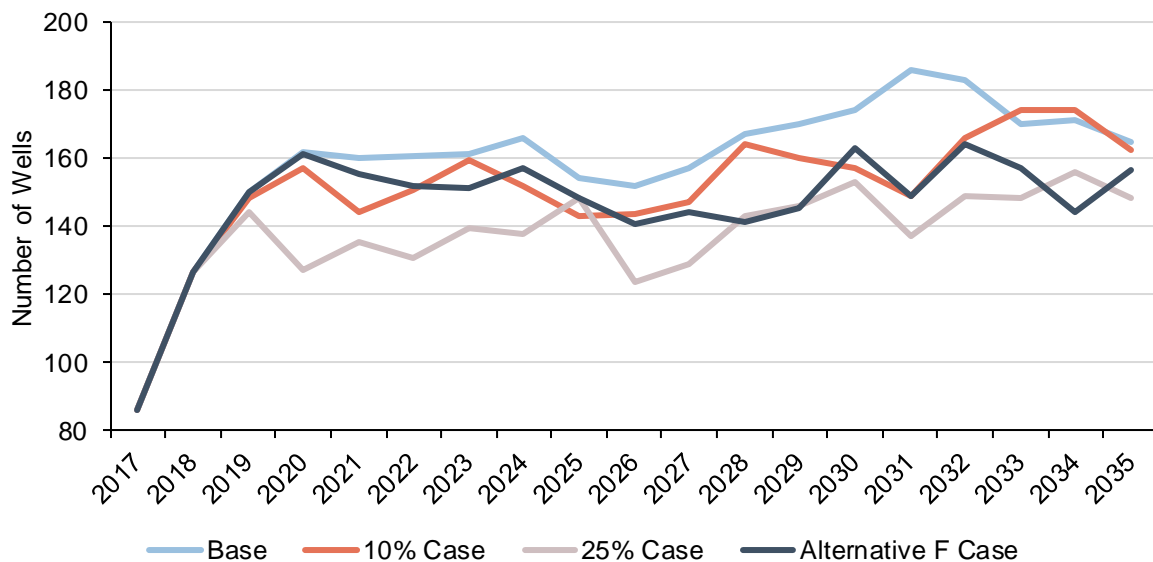
2.4 Wells Drilled

Exploration, appraisal, and development drilling are used to identify, confirm, delineate, and produce oil and natural gas. Drilling is a very capital intensive process employing drilling rigs that require large crews as well as significant quantities of consumables ranging from food and fuel to drill pipe and fluids. Drilling rigs must constantly be resupplied and crewed and thus leads to high levels of activity in the areas and ports that support offshore drilling activity.

Exploration drilling activity may be the first activity type to see a large impact due to reduced G&G activity in the Gulf of Mexico, as operators would be unable to identify new potential targets for drilling. Reductions in exploration drilling due to a lack of available targets also have the knock-on effect of reducing oil and natural gas discoveries which can then be evaluated, appraised, and developed. Appraisal drilling is also likely to decline as operators will have a reduced ability to acquire further G&G data to better understand formations and potential reserves, while development drilling would decline due to reduced levels of development-ready fields discovered due to lower levels of G&G, exploration, and appraisal activity.

In the Base Case, drilling activity in the U.S. Gulf of Mexico is projected to steadily recover from the large downturn starting in 2018 through 2020 before becoming relatively flat with year to year fluctuations due to typical project development and exploration cycles. The region is projected to see approximately 3,000 wells drilled between 2017 and 2035; 1,600 in deepwater and 1,400 in shallow water.¹ (Figure 1)

Figure 1: Projected Wells Drilled by Case



Source: Calash

In the 10 Percent Case, total drilling could decline around 5 percent over the forecast period, while in the 25 Percent Case drilling could decline around 14 percent. In the Alternative F Case the number of wells drilled could decline around 14 percent.

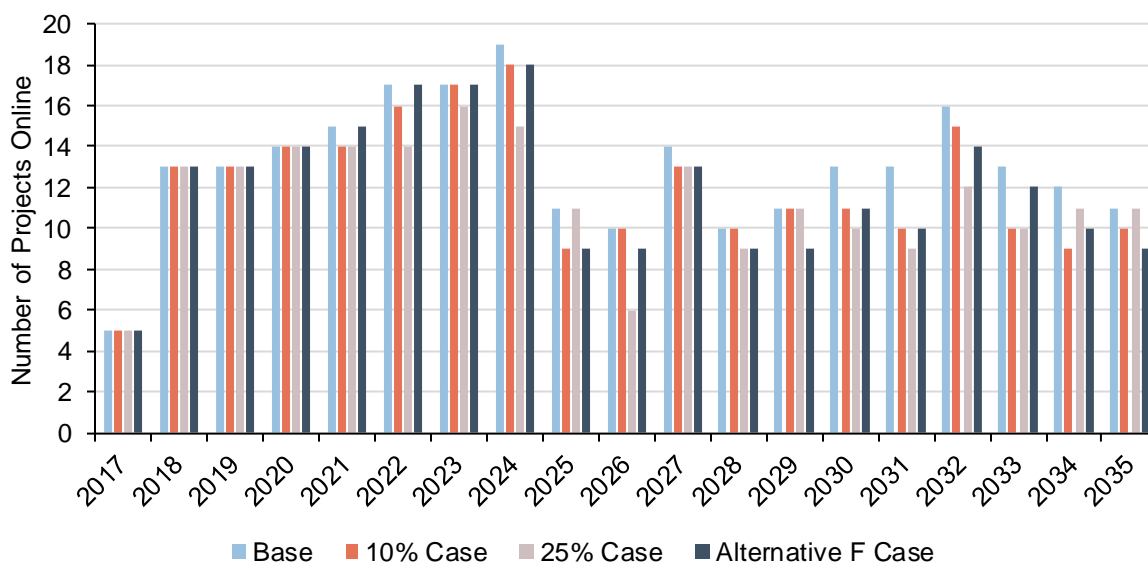
¹ Deepwater is defined as greater than 500 feet for the purposes of this study.

2.5 Projects Executed

Developing an offshore project is a complex process that requires a significant amount of time, planning and high levels of capital investment. Historical project executions and their respective timelines have been the best indicator of overall market health, as they can be viewed as representative of total trends in production, employment and revenue for the broad market. Reduced G&G and exploration and appraisal drilling typically leads to reduced oil and natural gas reserves being discovered and reduces opportunities for project development.

Over the forecasted period of this study (2017-2035) in the Base Case, a total of nearly 250 new oil and natural gas projects are projected to begin production in the GoM. The number of projects online is expected to slowly recover through the early 2020's, although the overall number of new projects is expected to decline over the forecast period as more productive deeper water projects account for a greater share of developments. Due to the lag in effects of reduced G&G activity, the number of projects online is expected to remain consistent across cases through 2020, with the largest effect on projects felt in the later parts of the forecast period. (Figure 2)

Figure 2: Projected Projects Online by Case



Source: Calash

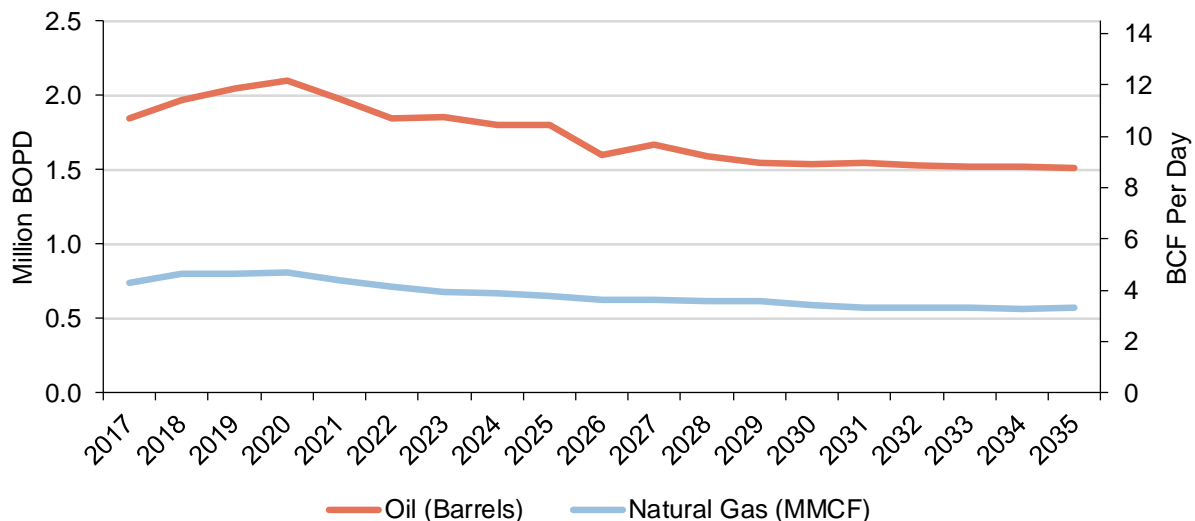
In the 10 Percent Case G&G activity could lead to a decline in new projects of around eight percent across the forecast period with around 230 projects projected to begin production. In the 25 Percent Case, the number of new projects online could be around 220 (around a 12 percent decline), while in the Alternative F Case projects online could decline by over eight percent (around 230 projects).

2.6 Production

The number of projects developed, coupled with reservoir size and reservoir productivity, historically has been the main determinant of oil and natural gas production levels. Most oil and natural gas reservoirs contain a combination of oil, natural gas, water, and other native substances such as sand, sulphur, CO₂, and salt, though some reservoirs may contain nearly all oil or all natural gas.

The Base Case production forecast for this study was modeled after the Energy Information Administration's forecast for the Gulf of Mexico contained in their "2017 Short Term Energy Outlook". This study's forecast is close to but not the same as this forecast. In order to forecast aggregate production, each potential project was modeled based on production curves for similar developments, taking into account the start-up, ramp-up, peak, and decline timing, as well as the expected hydrocarbon mix. The study projects that production in the Gulf of Mexico will be around 2.58 million barrels of oil equivalent (BOE) per day in 2017 across all cases and is projected to peak in 2020, before beginning to decline steadily throughout the forecast period. Cumulative production of oil and natural gas is projected to fall to around 2.2 million barrels of oil equivalent in 2035. (Figure 3)

Figure 3: Base Case Projected Oil and Natural Gas Production

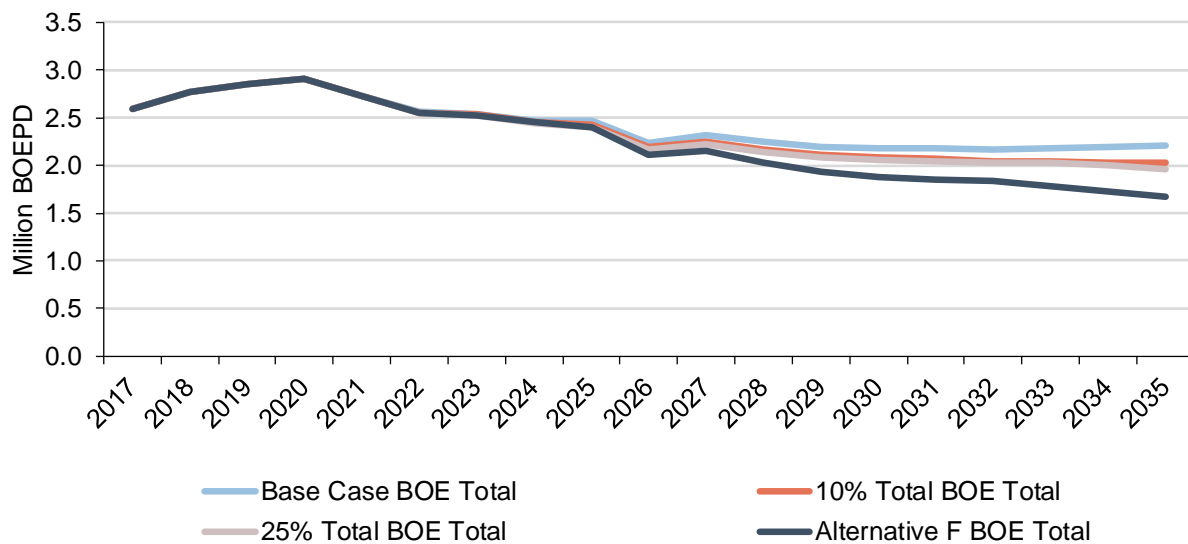


Source: Calash

Over the forecast period (2017 to 2035), in the 10 Percent Case, oil and natural gas production on a barrel of oil equivalent basis could be around three percent lower than the Base Case, while the 25 Percent Case could lead to a roughly four percent reduction in cumulative oil and natural gas production. In the Alternative F Case, cumulative production across the forecast period could decline around seven percent. The outsized decline in production under the

Alternative F Case compared to drilling and projects online is due to the focus of the Alternative F closure areas on highly productive deepwater areas, which could prevent operators from high grading G&G activity towards more potentially more productive targets. (Figure 4)

Figure 4: Potential Oil and Natural Gas Production by Case



Source: Calash

As production is a trailing indicator in activity, the study projects that reduction in G&G activity could be felt especially towards the end of the forecast period. At the end of the forecast period in 2035, production could be around eight percent lower in the 10 Percent Case, around 12 percent lower in the 25 Percent Case, and around 24 percent lower in the Alternative F Case.

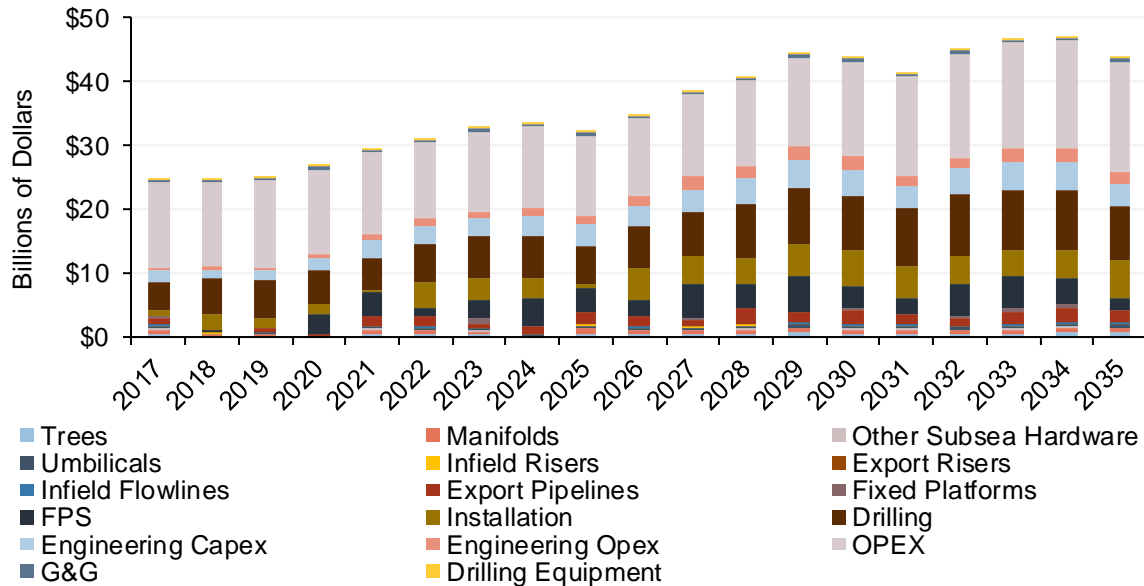
2.7 Total Spending

Offshore oil and natural gas exploration and development are capital-intensive processes. Offshore projects require exploratory G&G surveys, drilling, production equipment, engineering, operational expenditures including the ongoing supply of consumables, and maintenance as well as other spending to be found and developed.

For the purposes of this report, spending is divided into seven main categories: Drilling, Engineering, G&G, Installation, OPEX, Platforms, and Subsea Umbilicals, Risers and Flowlines (SURF). Each category encompasses a major type of exploration and production activity and

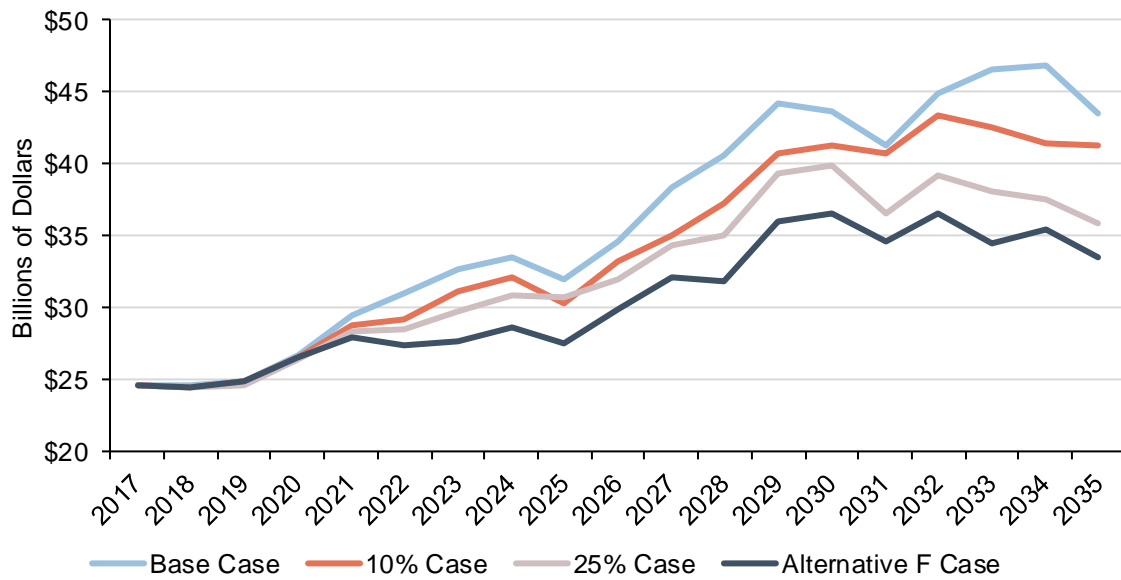
has a significant influence on overall spending. The total cumulative spending from offshore oil and natural gas development in the Base Case is projected to be nearly \$685 billion between 2017 and 2035, a yearly average of around \$36 billion. (Figure 5)

Figure 5: Projected Base Case Spending and Activity Type



Source: Calash

Reduced G&G activity affects not only G&G spending, but almost all categories of spending due to reduced oil and natural gas exploration and development activity. In the 10 Percent Case, total spending could decline by around five percent (around \$1.8 billion per year) across the forecast period. In the 25 percent spending would be reduced by around 10 percent (around \$3.5 billion per year). Under the Alternative F Case, with no G&G activity in key oil and natural areas of the Gulf of Mexico, spending could fall around 25 percent (nearly \$5.4 billion per year). (Figure 6)

Figure 6: Projected Total Annual Spending by Case

Source: Calash

Section 3 – Macro-Economic Impact

Reduced G&G activities in the Gulf of Mexico and corresponding reduced oil and natural gas exploration and development activity and spending should result in less economic activity. Calash utilized an economic analysis model to estimate changes in jobs, GDP, and governmental revenue as a result of Gulf of Mexico reduced G&G activity. The estimates created throughout this section closely parallel spending and activity trends. Employment and GDP effects are calculated using the Bureau of Economic Analysis' (BEA) RIMS II models in order to quantify the effects of domestic spending on the U.S. economy.

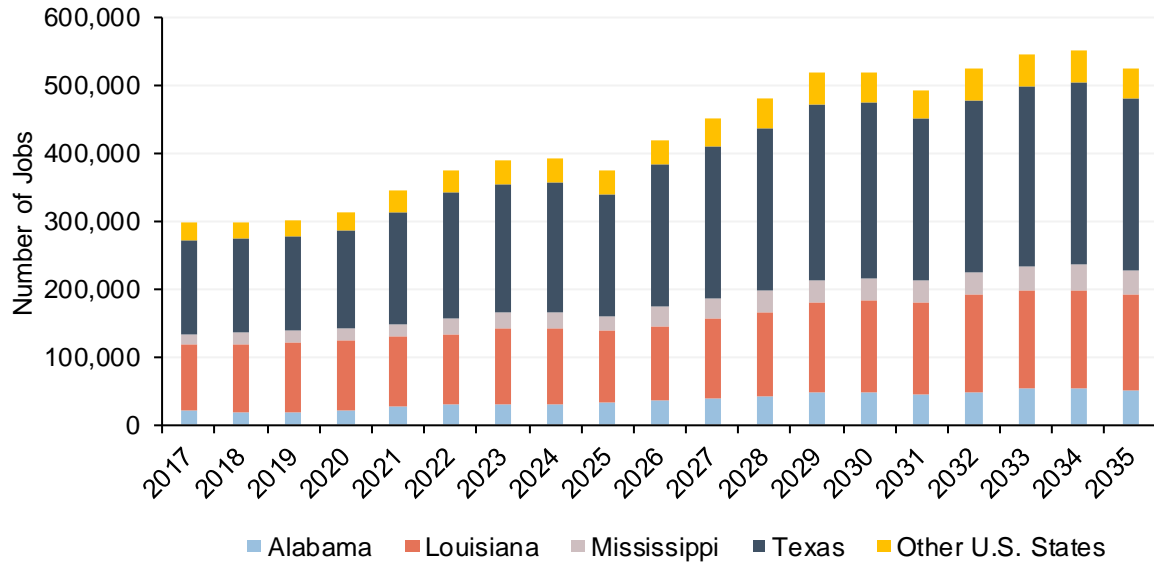
This analysis further underscores the economic impacts of Gulf of Mexico oil and natural gas activity and the impact that reductions in activity levels would likely have on the economy.

3.1 Employment

The offshore oil and gas industry has a long history of significant employment in the Gulf Coast states and the nation as a whole. The industry has historically provided high wages to significant numbers of workers. Despite the significant industry downturn and reduced activity levels due to a long period of low oil prices this study project that the industry is still expected by this study to support around 300 thousand U.S. jobs² in 2017, nearly 100 thousand directly and around 200 thousand in the supply chain and throughout the economy.

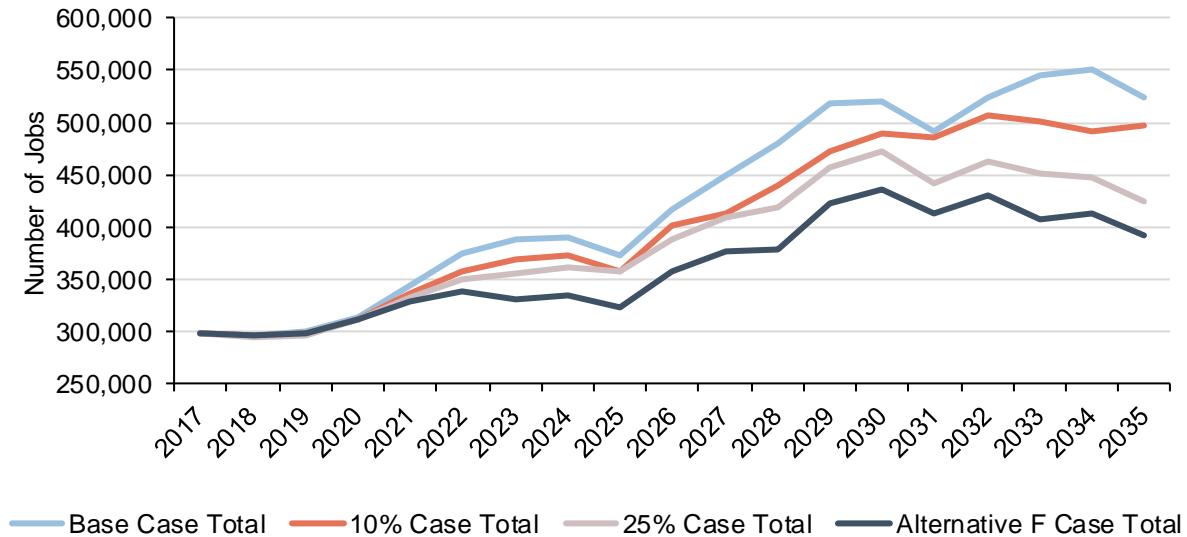
As oil and natural gas prices recover, U.S. employment due to the offshore oil and natural gas industry is expected to grow steadily throughout the forecast, with year to year fluctuations due to project development lifecycles. This growth is likely to be driven by project investment, particularly in deep and ultra-deep waters. Under the Base Case, Gulf of Mexico OCS activity-driven supported employment within the U.S. could grow to as much as 500 thousand jobs (including indirect and induced employment) in the forecast period, with average employment of around 425 thousand jobs throughout the forecast period. The Gulf coast states, especially Texas and Louisiana, are expected to continue to be the most significant beneficiaries of offshore oil and gas employment with an average of around 200 thousand and 120 thousand jobs respectively throughout the forecast period. (Figure 7)

² Includes direct, indirect and induced jobs. Indirect jobs are those related to the oil and natural gas supply chain. Induced jobs are created from more income that is spent throughout the economy.

Figure 7: Projected Base Case Employment by State

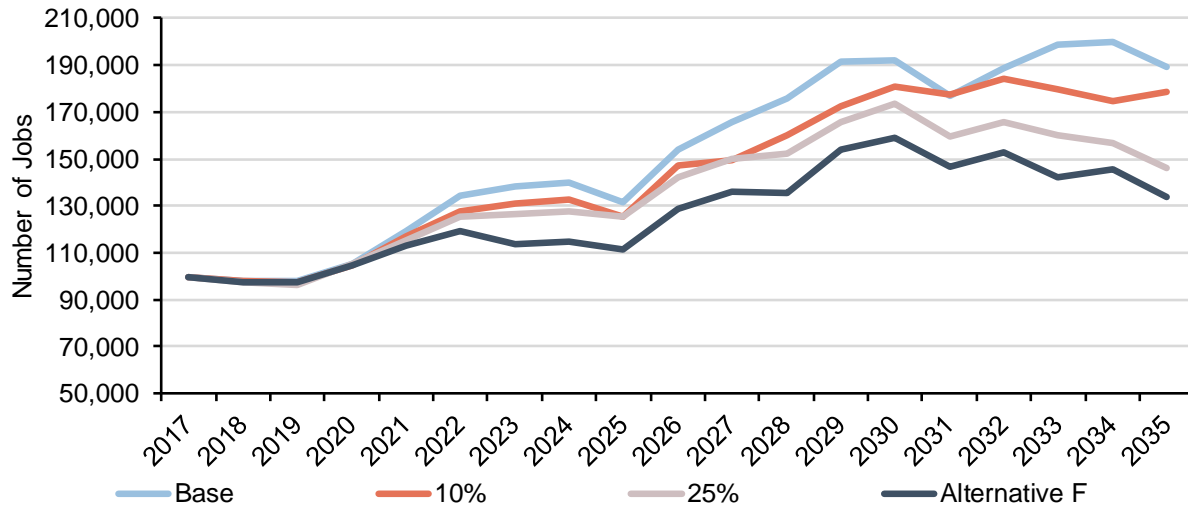
Source: Calash

Reduced G&G activity and the subsequent reduction in drilling and development activity as a result of the proposed alternatives are expected to lead to reduced employment. The study concludes that in the 10 Percent Case on average employment would be reduced by around five percent (more than 20 thousand jobs), in the 25 Percent Case the study estimates a 10 percent reduction in average employment (around 40 thousand jobs), while the Alternative F Case could lead to an around 15 percent reduction in employment (more than 60 thousand jobs). The effect on reduced G&G activity on employment could continue to widen in the later years of the forecast, with 2035 employment reduced by six percent (almost 30 thousand jobs) in the 10 Percent Case, 19 percent (around 100 thousand jobs) in the 25 Percent Case, and 25 percent (more than 130 thousand jobs) in the Alternative F Case. This is due to delayed impact of reduced G&G activity on exploration drilling and project development. (Figure 8)

Figure 8: Projected Total U.S. Employment by Case

Source: Calash

Employment supported by the Gulf of Mexico offshore oil and natural gas industry includes those directly employed by the industry, indirect jobs (jobs created by industry suppliers) and indirect jobs due to increased economic activity. Under the Base Case, in 2017 direct employment in the oil and natural gas industry could be just under 100 thousand jobs, with direct employment across the forecast period averaging around 150 thousand jobs. In the 10 Percent Case average direct employment is expected to be around 144 thousand jobs, while in the 25 Percent Case direct employment could be reduced to around 136 thousand jobs. In the Alternative F Case, direct employment could average around 126 thousand jobs across the forecast period.

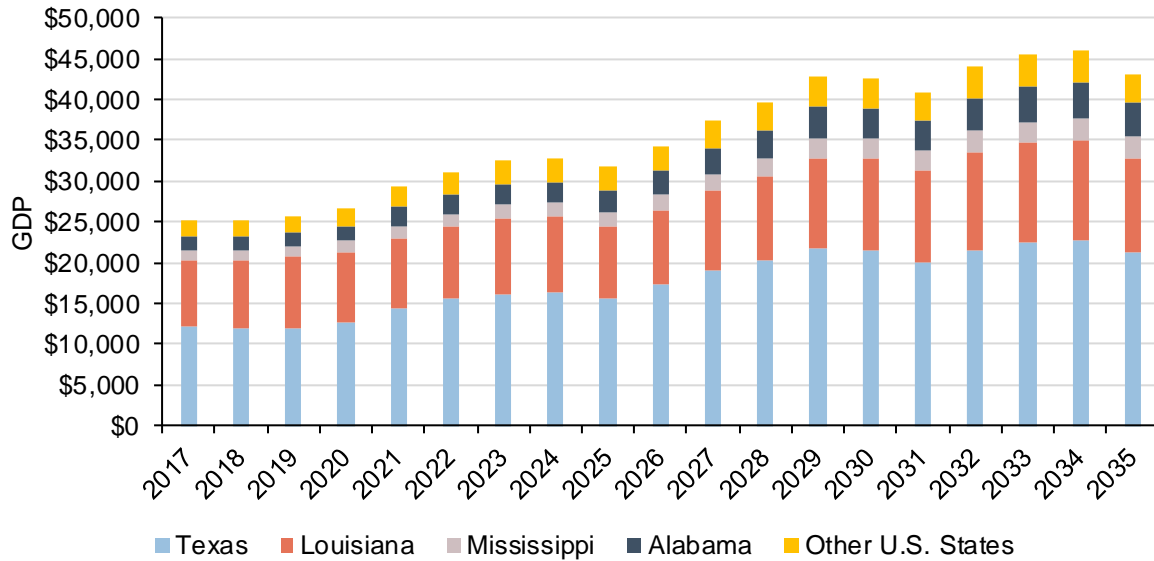
Figure 9: Projected Total U.S. Employment by Case

Source: Calash

3.2 GDP (Gross Domestic Product)

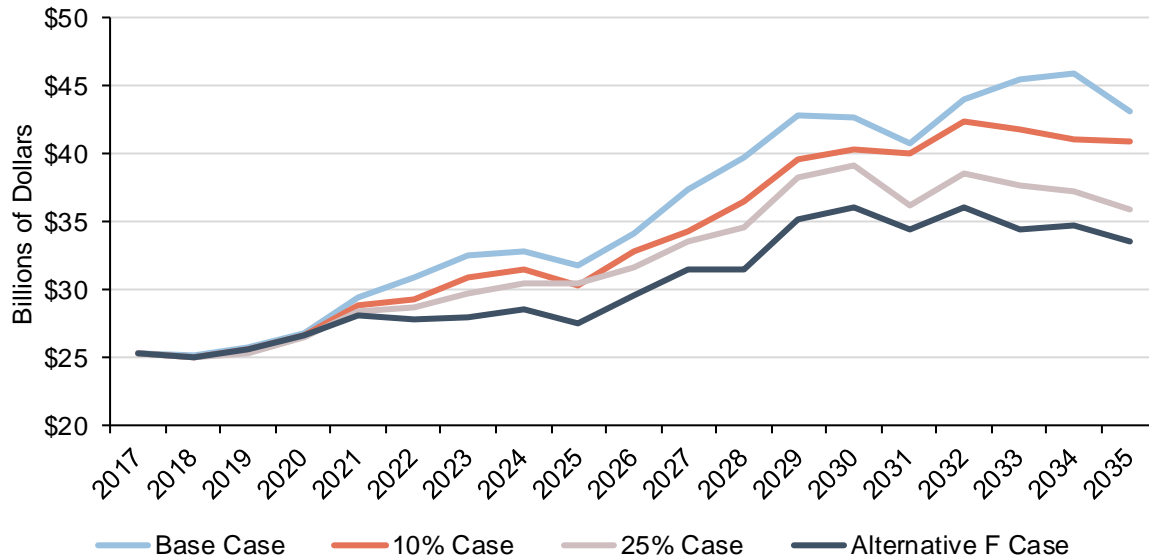
The gross domestic product (GDP) effects of the Gulf of Mexico oil and natural gas industry were calculated as a multiplier on spending within the U.S., as were the GDP impacts of reduced activity due to reduction in G&G activity.

Under the Base Case, the GDP impact of the Gulf of Mexico offshore oil and natural gas industry in the U.S. is estimated at over \$25 billion in 2017, and could continue to grow to around \$43 billion over the forecast period in 2035 – with average annual contributions across the forecast period of around \$35.6 billion. (Figure 10)

Figure 10: Projected Base Case GDP by State

Source: Calash

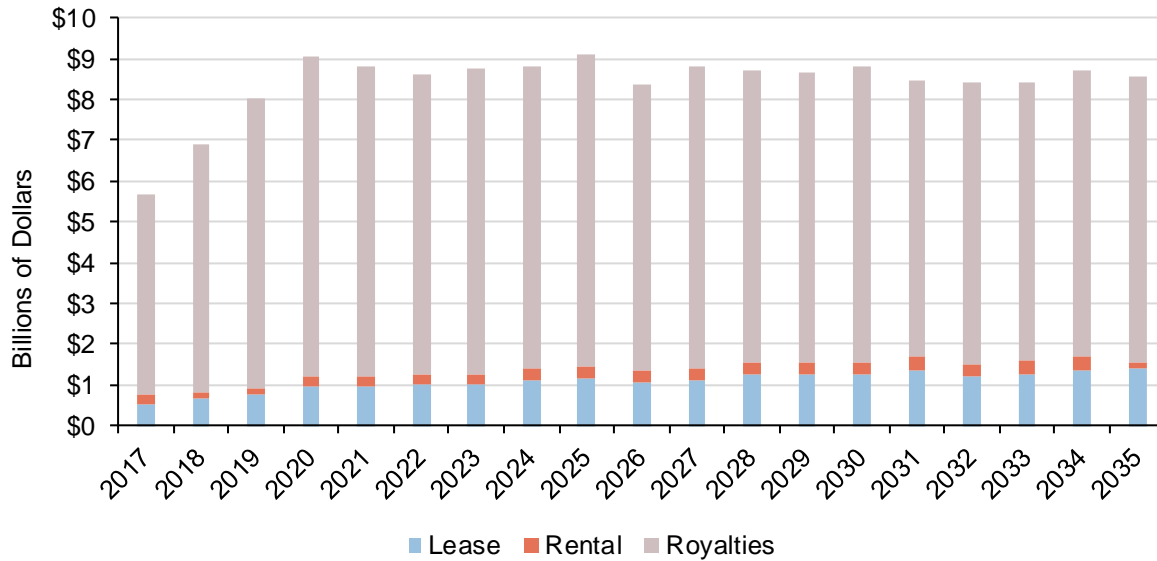
The study projects that in the 10 Percent Case, average GDP contributions could fall by around five percent (around \$1.7 billion per year) across the forecast period, with GDP down a similar percent in 2035. In the 25 Percent Case GDP could decline by an average of around nine percent (around \$3.4 billion per year), with GDP in 2035 down around 19 percent (\$7.3 billion). In the Alternative F Case, GDP could be reduced by an average of around 14 percent per year (around \$5.1 billion per year), with 2035 GDP reduced 22 percent (around \$9.7 billion). (Figure 11)

Figure 11: Projected GDP by Case

Source: Calash

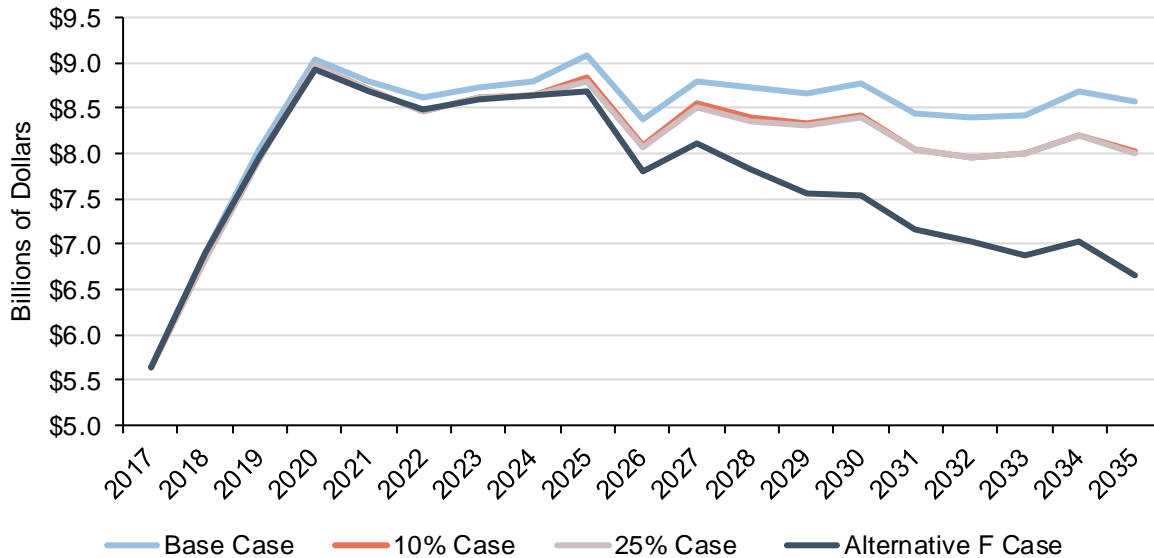
3.3 Government Revenue

Government revenues due to Gulf of Mexico offshore oil and gas operations are currently collected through three main revenue streams: revenue from lease sales, lease rental rates, and production royalties. The distribution of these revenue streams is heavily skewed towards production royalties, which account for around 80 percent of revenues from offshore oil and natural gas activities. Total government revenues from Gulf of Mexico offshore oil and gas royalties have been between just under \$5 billion and over \$8 billion in recent years (due to changes in production levels and fluctuating oil prices). Royalties are by far the biggest contributors to government revenues from Gulf of Mexico oil and natural gas production, with lease and rental income from blocks accounting for the remaining revenues (excluding fees, corporate taxes, etc. which are not included in this study). Under the Base Case, on average government revenues, due to Gulf of Mexico oil and natural gas activities, are projected to be around \$8.4 billion in the Base Case, with cumulative revenues over the forecast period (2017 to 2035) of nearly \$160 billion. (Figure 12)

Figure 12: Projected Base Case Government Revenues

Source: Calash

The study projects that in the 10 Percent Case government revenues could decline around three percent (around \$260 million per year) over the forecast period on average, with an around six percent decrease in 2035. In the 25 Percent Case government revenues could decline around four percent on average during the forecast period, with revenues reduced around seven percent in 2035. In the Alternative F scenario, government revenues could be down around eight percent on average across the forecast period, with 2035 revenues reduced by around 22 percent. (Figure 13)

Figure 13: Projected Government Revenues by Case

Source: Calash

State and Federal governments share in the revenue from the Gulf of Mexico oil and natural gas development. Under GOMESA, beginning in 2007, a percentage of certain Gulf of Mexico offshore revenues were shared with four Gulf coast states and their coastal political subdivisions. The second phase of GOMESA revenue sharing takes effect in 2017, which includes the four states and coastal political subdivisions receiving 37.5% of offshore revenues from an increased area of the Gulf of Mexico, with revenue sharing for the states and the coastal political subdivisions, as well as for the Land and Water Conservation Fund, capped at \$500 million.

The study projects that the effects of the proposed alternatives on state government revenues are relatively smaller compared to the impact on federal revenues due to the low level of revenue sharing currently in place between the federal and state's governments. No reduction in state government revenues is expected in the 10 Percent Case, state revenues could be around \$32 million less if G&G activity in the 25 Percent Case, and in the Alternative F Case state revenues could be nearly \$55 million less over the forecast period (2017 to 2035). Any increase in revenue sharing between state and federal governments would increase the impact of reduced activity on state government revenue.

Section 4 – Conclusions

The Gulf of Mexico oil and natural gas industry has long contributed to the economies of the Gulf coast states and the broader U.S., supporting hundreds of thousands of American jobs, providing many sources of revenue to the federal and states governments and contributing to domestic energy production. Despite activity levels, which are currently depressed due to low oil and natural gas prices, the Gulf of Mexico is still producing near record levels of oil and natural gas due to the long lead time between investment decisions and oil and natural gas production for offshore projects. As oil and natural gas operators continue to adapt to the low oil price by reducing costs to make offshore investments more attractive, oil and natural gas activity levels may increase, including increased Gulf of Mexico oil and natural gas activities.

While some of the proposed alternatives for regulation of Gulf of Mexico G&G activities may have little to no effect on Gulf of Mexico oil and natural gas exploration and production, alternatives that would substantially reduce G&G activity either in the whole Gulf of Mexico or specific areas could have a significant impact on activity. Decreasing operators' ability to locate and discover new oil and natural gas fields could have a longstanding impact on oil and natural gas activity and its economic contributions, with the impact potentially growing larger throughout the forecast period. While this study estimates aggregate impacts to oil and natural gas activity in the Gulf of Mexico, the impacts to individual operators or geophysical contractors could be much larger depending on the location of a company's leases and the reduced overall market for seismic surveys in the Gulf of Mexico.

After analyzing the impacts of reduced G&G activity on Gulf of Mexico oil and natural gas exploration and production, this study has projected that the following effects may result from their implementation:

- An average reduction in the number of wells drilled in the Gulf of Mexico between five and fourteen percent.
- An average in new projects online of eight to twelve percent across the forecast period.
- Decreased spending between \$1.8 billion and \$5.4 billion on average per year, rising to between \$2.3 billion and \$10 billion by 2035.
- Reduced average employment of between 20 thousand and 65 thousand jobs per year, with reduced employment of between 27 thousand and 133 thousand jobs by 2035.
- An average reduction in oil and natural gas production in the range of 0.5 Million Barrels per day from 2017 to 2030.

- A loss of up to 30 thousand jobs in 2017 and average decreased employment of over 80 thousand jobs from 2017 to 2030.
- Reduced oil and natural gas production of between 180 thousand and 540 thousand barrels per day by 2035
- An average loss of between \$1.7 billion and \$5.4 billion of GDP from 2017 to 2035.
- An average loss of between \$260 million and \$700 million of government revenue per year from 2017 to 2035.

Table 3: Potential Differences from Base Case Due to Reduced G&G Activity

Average 2018 to 2035	Base Case	Potential Difference From Base Case		
		10 Percent Case	25 Percent Case	Alt. F Case
O&G Production (BOE)	2,411,255	-63,794	-82,544	-180,149
Employment	426,325	-21,100	-40,504	-63,797
Spending (\$Billions)	\$36.01	-\$1.86	-\$3.58	-\$5.44
GDP (\$Billions)	\$35.60	-\$1.75	-\$3.36	-\$5.11
Government Revenue (\$Billions)	\$8.40	-\$0.26	-\$0.27	-\$0.71

Annual 2035	Base Case	Potential Difference From Base Case		
		10 Percent Case	25 Percent Case	Alt. F Case
O&G Production (BOE)	2,207,798	-181,137	-245,163	-541,496
Employment	524,528	-27,380	-99,523	-133,338
Spending (\$Billions)	\$43.59	-\$2.29	-\$7.67	-\$10.09
GDP (\$Billions)	\$43.16	-\$2.29	-\$7.28	-\$9.67
Government Revenue (\$Billions)	\$8.58	-\$0.56	-\$0.58	-\$1.93

Source: Calash

Section 5 – Appendices

5.1 Extended Methodology

General Methodology

Calash's methodology focused on constructing a tiered "bottom-up" model that separated the complete life cycle of offshore operations and subsequent effects into four main categories – these categories are further developed into cases and presented as the Base Case, 10 percent Scenario, 25 percent Scenario, and Alternative F Scenario. The four main categories are as follows:

- A "Reduced G&G activity" model that independently assesses the impact of reduced G&G activity on Gulf of Mexico oil and natural gas development, primarily through predicting reduced exploration activity and oil and natural gas discoveries.
- An "Activity Forecast" model assessing Calash's projects and project modeling information under which the number of expected projects is developed.
- A "Spending" model based on the requirements of developing projects within the "Activity Forecast."
- An "Economic" model focusing on the economic impact on employment and government revenue from the "Spending" model.

Three (Activity Forecast, Spending, and Economic models) of the four individual subsections were further split into five additional criteria that create an individual "Project" model. These categories include seismic, leasing activity, drilling, infrastructure & project development, and production & operation.

In order to estimate the economic effects and project activity losses through the "Project" model, additional analysis was undertaken to understand which potential projects may be disrupted due to delays and changes to project economics and risk profiles. This was presented through additional analysis of the Base Case and is provided in the three reduced G&G activity scenarios.

Project Development Methodology

In order to account for both currently active projects within the Gulf of Mexico and longer-term prospects that may be developed towards the end of the forecast period into the study's project development activity, Calash incorporated two models into the project development forecast. The near-term activity was developed on known projects or prospects currently under consideration for development (which is unlikely to be impacted by reduced

G&G activity), while a longer-term forecast was developed on top of the near-term forecast through the analysis of reserves, oil prices, leasing trends, development trends, historic project sizes and other relevant factors.

Longer term projects were developed by applying historical and current trends within the region to future developments based on undiscovered oil and natural gas resources in order to apply the proper costs and timelines to the expected activity. Projects were still delineated by individual timelines and the development scenarios that may be expected of future activity within the region, but were calculated using assumptions on industry trends in production methods instead of on confirmed aspects of the specific projects.

With regards to the reduced G&G scenarios, reduced identification of prospects, reduced exploration drilling, and reduced oil and natural gas discoveries impact on potential project development were calculated to identify potential project development impacts.

Project Spending Methodology

This spending analysis accounts for all capital investment and operational spending through the entire “life cycle” of operations. Every offshore oil or natural gas project must go through a series of steps in order to be developed. Initial expenditures necessary to identify targets and estimate the potential recoverable resources in place include seismic surveys (G&G) and the drilling and evaluation of exploration & appraisal (E&A) wells. For projects that are commercially viable, the full range of above-surface and below-water (subsea) equipment must be designed and purchased. Offshore equipment includes production platforms and on-site processing facilities, as well as below-water equipment generally referred to as SURF (Subsea, Umbilicals, Risers and Flowlines). Finally, the equipment must be installed and additional development wells must be drilled. Once under production, further operational expenditures (OPEX) are required to perform ongoing maintenance, production operations and other life extension activities as necessary for continued field production and optimization.

Spending for individual projects was subdivided into sixteen categories covering the complete life cycle of a single offshore project, as well as two additional groups for natural gas processing and operation. Timing and cost for individual categories were assigned based on the previously mentioned project types where prices are scaled according to the complexity and size of the project.

Upon compiling the scenario of overall spending estimates, Calash deconstructed the “local content” of oil and natural gas operations within the studied region. Individual tasks were analyzed on a component-by-component basis to provide an estimate of the percentage of regional, national, and international construction required by offshore operations. Additionally, delineations were made at the regional level in order to project spending for individual states.

Considerations were based on current oil and natural gas development, the proximity to reserves and production, strategic locations such as shore bases and ports, as well as Bureau of Economic Analysis (BEA) data pertaining to each state's present economic distribution.

Economic Methodology

The study's GDP and job data were calculated using the BEA's RIMs II Model providing an input-output multiplier on spending at the industry and state levels for each defined category. Model outputs considered from spending effects include number of jobs and GDP multiplier effects. Further delineation is presented in the form of direct and indirect and induced job numbers, which encompass the number of jobs relating to the spending in that category versus indirect and induced jobs that are created from pass-through spending. For states considered within the study that contained no RIMs II multipliers for specific sectors, state multipliers from economies that most closely paralleled those in question were replicated.

RIMs Categories used:

- Architectural, Engineering, and Related Services
- Construction
- Drilling Oil and Gas Wells
- Fabricated Metal Product Manufacturing
- Mining and Oil and Gas Field Machinery Manufacturing
- Oil and Gas Extraction
- Steel Product Manufacturing from Purchased Steel
- Support Activities for Oil and Gas Operations

Governmental Revenue Development

Governmental revenue data is presented in three categories: bonus bids from lease sales, rents from purchased but not yet developed leases, and royalty payments from producing leases. The projected revenue was calculated under the assumption that the current operating structure of the Gulf of Mexico would remain in place where applicable. Lease sales and rental rates were calculated through the simulation of yearly lease sales within each individual area, while the number of leases acquired was modeled on oil price forecasts, historical rates, and on the estimated amount of reserves in the western and central OCS regions.

The federal / state government revenue split of leases, rents and royalties were modeled under the application of GOMESA (Gulf of Mexico Energy Security Act). As Calash understands GOMESA and phase II of GOMESA beginning in 2017, GOMESA regulations would effectively

split 37.5 percent of OCS bonus bid, rent, and royalty income between the appropriate states. GOMESA has an annual revenue cap of \$500 million for the Gulf States.

Production pricing was calculated using the EIA estimates for both West Texas Intermediate (WTI) spot and Henry Hub natural gas prices³. Additional governmental revenues, such as income and corporate taxes, were considered outside of the scope of this study and are likely to provide additional government revenues throughout the studied period.

5.2 Glossary of Terms

Gross Domestic Product (GDP) – The total dollar value of all goods and services produced over a specific time period

Gulf of Mexico Energy Security Act (GOMESA) – Act signed into law in 2006 which enhances OCS oil and natural gas leasing activities and revenue sharing in the Gulf of Mexico

Lease Sales – Periodic sales of leases by the federal government to offshore areas for the purpose of developing oil, natural gas, and sulfur

Rents – Ongoing rental income paid by leaseholders to the federal government to maintain offshore oil and natural gas leases

Royalties – Income paid by leaseholders to the federal government based on actual oil and natural gas production

Mobile Offshore Drilling Rig – A mobile vessel typically either a drillship or semi-submersible used for drilling offshore oil and natural gas wells

Outer Continental Shelf (OCS) – the submerged lands, subsoil, and seabed, lying between the seaward extent of the States' jurisdiction and the seaward extent of Federal jurisdiction

Pipeline – A conduit of steel or flexible pipes used to transport oil, natural gas, or other fluids between a well and a production platform or to shore

Riser – A pipeline used to convey fluids between a subsea and a surface facility

Royalties – Ongoing payments to the federal government by leaseholders based on the value of produced oil and natural gas

Subsea Equipment – Seabed placed equipment used in the production of oil and natural gas

Topsides – The upper part of a fixed or floating platform used to process oil, natural gas, water and other fluids, control production, and house workers

³ Annual Energy Outlook March 2017, Energy Information Administration

Umbilical – A collection of cables, tubes, and hoses used to control, monitor and provide communications, chemicals, hydraulic and electrical power to subsea oil and natural gas wells

Programmatic Environmental Impact Statement (EIS) – BOEM analysis of potential environmental, social, and economic impacts associated with the proposed oil and gas leasing programs. development on six planning areas of the Outer Continental Shelf.

Geological and Geophysical (G&G) – scientific activities to locate and identify areas with the potential to produce commercial quantities of oil and natural gas.

Prospectivity – The likelihood that a given area contains commercially recoverable quantities of oil and natural gas.



SEAN SHAFER

281-491-5900

s.shafer@calash.com

CAMERON LYNCH

212-392-4809

c.lynch@calash.com

CONTACT