The Gulf of Mexico Oil & Gas Project Lifecycle:

Building an American Energy & Economic Anchor

Prepared For

NOIA
America's Offshore Energy Industry

Prepared By

EIAP
Energy & Industrial Advisory Partners

Executive Summary

Introduction

The Gulf of Mexico oil and natural gas industry will likely continue to be a major source of energy production, employment, gross domestic product, and government revenues for the United States for decades to come. However, a number of proposals have been advanced recently which would likely have a major impact on the industry's activity levels, and the subsequent energy production, employment, gross domestic product, and government revenues supported by the offshore oil and natural gas industry in the United States. Energy and Industrial Advisory Partners (EIAP) was commissioned by the National Ocean Industry Association (NOIA) to develop a report outlining the process and timelines required to develop Gulf of Mexico offshore oil and natural gas projects, the spending required to develop these projects, the employment supported by these projects, and the types of employment and wages supported by these projects. The scenarios developed in this report are based solely upon government and other publicly available data and EIAP's expertise and analysis.

Executive Summary

Although in recent years, offshore project development activity has been reduced, several factors point to increased activity in the coming years. Oil prices continue to return to levels more in line with historical trends, underpinning project economics. The oil and natural gas operator and service communities have worked together to reduce project costs while improving safety and operational performance through initiatives such as advanced technologies and standardization. Additionally, as concerns around global warming continue to increase, the relatively low greenhouse gas emissions of offshore projects compared to other fossil fuel developments have increased their potential attractiveness to operators trying to continue to reduce their carbon emissions. Methane emissions are tightly controlled for offshore operations as offshore facilities are required to recover and sell all produced gas, venting and flaring are closely regulated and require approval, and gas detection systems are widely deployed. The Gulf of Mexico offshore oil and gas industry's carbon intensity is about one-half of that of onshore oil and gas production areas.

To demonstrate the offshore project development process, development activities were divided into five major development stages: pre-development, development, operations, infill drilling and tiebacks, and abandonment and decommissioning. Each stage was then further subdivided into more detailed stages, to account for the main activities required to identify, develop, operate, and decommission an offshore project. In total, 20 detailed categories of a project's lifecycle were identified and described.

For each development category a detailed description of activities, the types of equipment and services, primary company and supplier types, sub-supplier types, and types of direct employment were then developed to provide an overview of this category of project development as well as to demonstrate the activities, companies, and workers required to bring an offshore project to production and safely operate it. Each stage of project development and operation requires a variety of equipment and services, a large number of suppliers, and a diverse group of workers representing the full geographical expanse of the country.

To prepare the project spending and employment analysis of this report two example projects were developed, with one each for deepwater, and shallow water developments. These projects were sized to be in line with recent and planned Gulf of Mexico offshore oil and gas developments.

- For the example deepwater project, total lifetime spending of just over $8.8 billion was projected. Average annual spending was projected at nearly $295 million, with the highest spending levels taking place during project development, when subsea tieback development is taking place, and during decommissioning.
- Annual operational expenditures were estimated at just under $125 million per year during normal operating years.
- For the example shallow water project, total lifetime spending of over $1.3 billion was projected. Average annual spending was projected at $45 million, with the highest spending levels taking place during project development, when infill drilling is taking place, and during decommissioning.
- Annual operational expenditures were estimated at just over $27.5 million per year during normal operating years.

Offshore oil and natural gas project development and operations support significant levels of employment. While the employment impact of oil and natural gas is focused on the Gulf Coast states, every U.S. state experiences employment supported due to offshore oil and gas project development. Project development and operations support a large number of highly paid jobs directly, especially highly paid blue-collar jobs, and additionally support significant employment[1] through the industry's supply chain (indirect jobs), and through increased spending by workers (induced jobs).

[1] Annual Supported Employment or Total Supported Employment are defined as total economywide employment due to industry spending including direct, indirect, and induced jobs. Direct jobs are employment supported by the industry directly or through the initial round of inputs purchased by the final-demand industry. Indirect employment includes the employment in industries that supply and support industry suppliers. Induced jobs are jobs created by increased employee payroll

- On average, throughout the 30-year lifecycle of the example deepwater development, total annual supported employment is projected at nearly 3,640 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of 880 jobs, during the most active years employment impacts peak at nearly 14,450 jobs. During normal operations, total supported employment is projected at around 1,900 jobs.
- Direct employment due to spending associated with the example deepwater project development is projected to average over 1,435 jobs across the example project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of over 2,200 jobs.
- On average, throughout the 30-year lifecycle of the example shallow water development, total annual supported employment is projected at around 615 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of around 135 jobs, during the most active years employment impacts peak at over 1,800 jobs. During normal operations, total supported employment is projected at around 430 jobs.
- Direct employment due to spending associated with the example shallow water project development is projected to average around 230 jobs across the project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of around 390 jobs.
- The analysis of direct jobs created by the example deepwater project indicated that direct jobs created would encompass over 200 different job titles. Some of the most impacted job titles include civil and petroleum engineers, general and operations managers, supervisors, truck drivers, machine setters, operators, and tenders, assemblers and fabricators, project management and business operations specialists, and welders, cutters, solderers, and brazers.
- Based on this analysis, in addition to the large number of diverse jobs due to offshore project development, the quality of employment provided directly by the industry is also well above the national average with an average annual wage of nearly $69,650, around 29 percent higher than the national average of slightly over $54,000.
- On average, the example deepwater project is projected to support average direct annual wages paid of around $100 million, with total direct wages over the project's life cycle of nearly $3 billion.
- On average, the example shallow water project is projected to support average direct annual wages paid of around $16.2 million, with total direct wages over the project's life cycle of over $485 million. (Tables 1 and 2)
- This report identifies more than 200 occupations directly involved in offshore oil and gas development. There are hundreds more occupations whose employment is supported by offshore development either through indirect or induced impacts.

Table 1: Deepwater Project Activity Timeline, Average Spending, and Average Employment

Project Stage	Year Range	Average Annual Spending (Millions)	Average Annual Employment
Pre-Drilling	1 to 2	$8	80
Exploration	2 to 3	$161	1,680
Appraisal	3 to 4	$135	1,400
Design	5	$160	2,320
Development Drilling & Completion	7 to 9	$558	6,260
Hardware Manufacturing	6 to 8	$375	4,010
Facilities Fabrication	6 to 8	$418	4,530
Installation	9 to 10	$225	3,020
OPEX	10 to 29	$124	1,900
Infill Drilling and Tiebacks	20 to 22	$328	3,690
Abandonment and Decommissioning	$30	$370	4,650

Source: Energy and Industrial Advisory Partners

Table 2: Shallow Water Project Activity Timeline, Average Spending, and Average Employment

Project Stage	Year Range	Average Annual Spending (Millions)	Average Annual Employment
Pre-Drilling	1 to 2	$1	10
Exploration	2 to 3	$23	250
Appraisal	3 to 4	$17	180
Design	5	$33	470
Development Drilling & Completion	7 to 9	$48	570
Hardware Manufacturing	6 to 8	$44	470
Facilities Fabrication	6 to 8	$80	880
Installation	9 to 10	$4	320
OPEX	10 to 29	$27	430
Infill Drilling and Tiebacks	20 to 22	$39	600
Abandonment and Decommissioning	$30	$143	1,670

Source: Energy and Industrial Advisory Partners

Economic Impacts of the Offshore Oil and Natural Gas Industry

In 2020, Energy and Industrial Advisory Partners completed a study for the National Ocean Industry Association on the overall impacts of the Gulf of Mexico offshore oil and natural gas industry. That study (The Economic Impacts of the Gulf of Mexico Oil and Natural Gas Industry) estimated that:

- In 2019, the Gulf of Mexico offshore oil and natural gas industry supported an estimated 345,000 jobs in the United States. On average across the forecast period, the Gulf of Mexico offshore oil and natural gas industry is projected to support around **370,000 jobs per year**.
- In 2019, the Gulf of Mexico oil and natural gas industry contributed an estimated $28.7 billion to the U.S. economy. The industry is projected to contribute an average of **$31.3 billion of GDP per year** across the forecast period.
- In 2019, government revenues due to the Gulf of Mexico oil and natural gas industry reached nearly $5.4 billion. Government revenues derived from offshore oil and natural gas activities in the Gulf of Mexico (excluding personal and corporate income taxes and property taxes) are projected to average over **$7 billion per year** across the forecast period.
- From fiscal year 2019, the Gulf of Mexico oil producing states received around $353 million of revenues due to revenue sharing while the Land and Water Conservation Fund (LWCF) received over $1 billion of distributions. State revenue sharing under the Gulf of Mexico Energy Security Act (GOMESA) is projected to average around **$374 million per year** across the forecast period. Contributions to the Land and Water Conservation Fund (LWCF) from GOMESA and non-GOMESA offshore are projected to average around **$1.3 billion per year**.
- Every U.S. state has businesses and jobs that are part of the U.S. Gulf of Mexico oil and gas supply and vendor chain.

Study Limitations

Given the large degree of volatility and uncertainty in oil and gas markets as well as the global economy, the assumptions and forecasts contained in this report are based on reasonable readings of conditions when this report was developed. Uncertainty around commodity pricing and global economic conditions may have significant effects on the impacts described in this report. The report's projections are a good faith view arising from reasonable assumptions based on these potential scenarios and the authors' expertise and experience. Energy and Industrial Advisory Partners provided this independent study while expressly disclaiming any warranty, liability, or responsibility for the completeness, accuracy, use, or fitness to any person or party for any reason.

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Introduction

Purpose of the Report

The Gulf of Mexico oil and natural gas industry will likely continue to be a major source of energy production, employment, gross domestic product, and government revenues for the United States for decades to come. A number of proposals have been advanced recently which would likely have a major impact on the industry's activity levels, and the subsequent energy production, employment, gross domestic product, and government revenues supported by the offshore oil and natural gas industry in the United States. Energy and Industrial Advisory Partners (EIAP) was commissioned by the National Ocean Industry Association (NOIA) to develop a report outlining the process and timelines required to develop Gulf of Mexico offshore oil and natural gas projects, the spending required to develop these projects, the employment supported by these projects, and the types of employment and wages provided by these projects. The scenarios developed in this report are based solely upon government and other publicly available data and EIAP's expertise and analysis.

Report Structure

In this report, EIAP first provides an overview of the study's methodology, then the study describes typical offshore oil and gas project types, the study then provides a detailed overview of typical project development and operation stages, including the types of companies and workers required, subsequently, the study provides overviews of the example projects used to develop this report's forecast, then the report provides a forecast for potential spending levels associated with example project developments. In the next section, the study provides a forecast for the potential overall employment impact of these example projects, followed by a detailed projection of the types of jobs and those jobs' wages supported by offshore oil and natural gas projects. The report then concludes.

Excluded from Study

This paper has been limited in scope to the assessment of the potential impacts of the example projects developed for the report. Given the complicated technical nature of offshore project development, the information provided in this report is an indicative overview only. The economic impacts forecasted in this report are based on publicly available data and EIAP's own knowledge and expertise. The report's forecasts exclude the impacts of state and local taxes, as well as impacts on the downstream oil and gas industry. Additionally, the projected government

revenue impacts do not account for personal income taxes, corporate income taxes or local property taxes. Due to the exclusion of these impacts, it is likely that the economic impacts presented in this study represent conservative projections.

About EIAP

Energy & Industrial Advisory Partners (EIAP) was founded to provide companies, investors, and industry associations across the energy and industrial markets with economic and strategic consulting, as well as M&A and restructuring advisory services from seasoned consultants with significant industry experience. EIAP is a specialist consulting firm that utilizes its deep industry experience and rigorous analytical methodologies to help stakeholders gain the insights they require to make more informed, data-driven decisions.

Our team and our subject matter experts have worked in the industries we cover, and we have maintained that focus throughout our consulting careers. This specialism enables us to provide proprietary insights into the perspectives of key customers, suppliers, and competitors. Our collective experience amounts to hundreds of engagements alongside some of the world's most sophisticated energy and industrial companies, investors, and industry associations.

Every project is bespoke and focused on identifying and understanding the issues facing a business or industry and developing practical solutions. We understand that insight not only comes from the C-Suite but also the shop floor, and the team is just as comfortable in the field as in the board room.

Methodology

Data Development

Initially, offshore project development was divided into five major development stages, pre-development, development, operations, infill drilling and tiebacks, and abandonment and decommissioning. Each stage was then further subdivided into more detailed stages, to account for the main activities required to identify, develop, operate, and decommission an offshore project. In total, 20 detailed categories of a project's lifecycle were identified and described.

For each development category a detailed description of activities, the types of equipment and services required, primary company and supplier types, sub-supplier types, and example types of direct employment were then developed to provide an overview of each stage of project development.

Project Spending

To provide an example of typical project spending (and subsequently economic impacts) over an offshore Gulf of Mexico oil and natural gas project's life two example projects were developed, with one each for deepwater, and shallow water. These projects were sized based on development trends to be in line with recent and planned Gulf of Mexico offshore oil and gas developments. Key development indicators such as the project's number of wells, facilities, oil and natural production, and ancillary equipment requirements were developed. Although these example projects are not based directly on a specific existing or planned project, every effort was made to align the projects' parameters with the types of projects which are likely to continue to be developed in the Gulf of Mexico.

Subsequently, the previously developed categories, as well as the example project parameters were utilized to develop detailed category by category spending forecasts for each activity stage. Spending in each stage was split by activity or equipment type. These spending forecasts were based on both publicly available data, as well as EIAP's internal data on offshore oil and natural gas project spending. Given recent trends in offshore project development costs, all pricing was calibrated to account for lower development costs which have prevailed given current market conditions. Pricing should be considered indicative only, and any change to development costs would be expected to have a subsequent impact on a project's economic impacts.

After the per-category development spending was developed a project development and spending timeline was prepared based on typical project development timelines. In addition to analyzing development timelines based on the development stages, a forecast for the time period over which spending in a given category would take place was also prepared.

Economic Methodology

These spending forecasts were then categorized based on the type of equipment or service involved to identify one or more appropriate RIMS II multiplier industries. The Bureau of Economic Analysis' RIMS II input-output multipliers provides state-level employment and gross domestic product estimates based on industry-specific spending levels. Spending estimates by state (and international) based on historical spending trends were then developed to estimate state and industry spending levels. The RIMS II input-output model and state/industry spending levels were used to calculate overall project related employment levels by year and industry. For each industry, direct and indirect and induced jobs were then calculated.

Once direct employment was calculated, each category and industry direct employment level was mapped to a North American Industry Classification System (NAICS) industry code. NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. economy. An analysis of the Bureau of Labor Statistics Occupational Employment and Wage Statistics (OEWS) survey was then conducted, to analyze job types and wage rates for each of the identified NAICS industries. The Occupational Employment and Wage Statistics (OEWS) survey is a semiannual survey measuring occupational employment and wage rates for wage and salary workers in nonfarm establishments in the United States. This analysis provided a breakdown of detailed job titles by industry, with some job titles then consolidated for ease of analysis. This data was utilized based on detailed industry spending to calculate direct employment by job title as a result of project spending, with some job titles further consolidated due to relatively low employment levels. Subsequently, average annual wages by job title were then calculated based on the BLS OEWS survey data to project potential overall wage payments.

Limitations

Given the large degree of volatility and uncertainty in oil and gas markets as well as the global economy, the assumptions and forecasts contained in this report are based on reasonable readings of conditions when this report was developed. Uncertainty around commodity pricing, global economic conditions, and regulatory regimes may have a significant impact on the projections developed for this study. EIAP makes no representations as to the impacts of potential policy changes on the forecasts of this report. The report's projections are an independent, good

faith view arising from reasonable assumptions based on the authors' expertise and experience. Energy and Industrial Advisory Partners provided this independent study while expressly disclaiming any warranty, liability, or responsibility for the completeness, accuracy, use, or fitness to any person or party for any reason.

Offshore Oil and Gas Project Types

As part of any potential offshore oil and natural gas development, the oil and gas operator must decide on a development concept. Concept selection typically takes place after a number of exploratory and appraisal wells are drilled and extensive engineering has taken place. Typically, operators consider a number of development concepts based on factors including the field's water depth, expected resource size, location relative to other oil and natural gas infrastructure, potential development costs and timelines, the level of reserve risk associated with the field, and prevailing and forecasted oil and natural gas prices.

Development concepts are typically heavily influenced by the field's water depth. In shallow waters, the primary choice for facilities is a fixed platform, a steel structure that is physically attached to the seafloor. Wells are then produced directly to the platform, where oil and natural gas are separated, processed, and exported via pipeline to shore. Larger platforms may contain living quarters, helidecks, and drilling rigs while smaller platforms may be unmanned. (Figure 1)

Figure 1: Walter Oil and Gas Coelacanth Fixed Platform

Source: Walter Oil and Gas Corporation

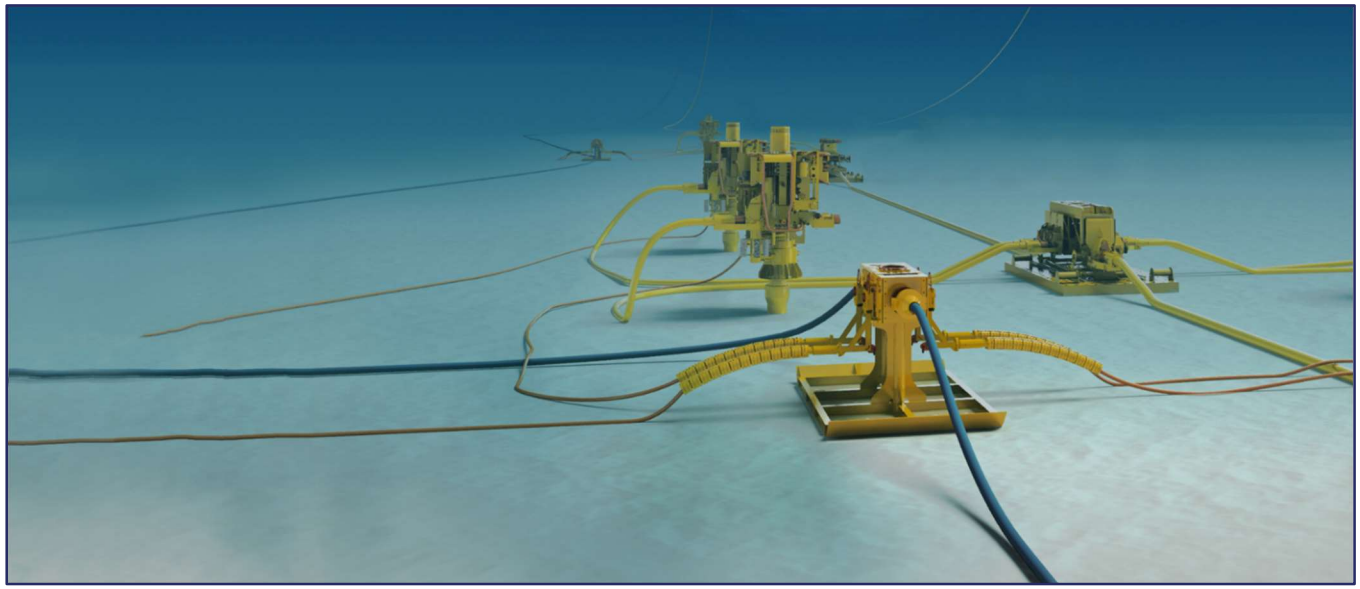
These structures are typically less costly than deepwater infrastructure, although due to the longer period that the Gulf of Mexico's shallow waters have been explored and developed new discoveries and thus projects are increasingly taking place in deepwater areas of the Gulf of Mexico. "Deepwater" as it relates to Gulf of Mexico offshore oil and gas development has steadily evolved over the last 30 years, with deepwater oil and gas developments progressing from 500 to nearly 10,000 feet of water in that period. Most new deepwater developments in recent years have been undertaken in the 5,000 to 7,500 feet of water range. Development of deepwater fields typically takes place with some combination of floating production facilities and/or subsea infrastructure. Floating production platforms are typically held in place by a permanent mooring, with the mooring system dependent on the type of platform (Spar, Tension Leg Platform (TLP), Semi-Submersible, or Floating Production and Storage Unit (FPSO). (Figure 2)

Figure 2: Shell's Mar's B Project / Olympus TLP Floating Production Unit

Source: Shell

While in some cases production takes place directly to the platform, typically subsea wells are utilized, where wellheads and control systems are located on the sea floor and controlled via an electrohydraulic umbilical connected to the well's floating production unit "host". Subsea wells allow reservoirs that may not be directly below the unit to be produced, often allowing the co-development of multiple smaller fields to underpin a larger development. Later in life, the field's operator or other operators with nearby fields often produce new fields to existing floating production units to reduce development costs and support the unit's economic life. (Figure 3)

Figure 3: Subsea Oil and Gas Production System



Source: TechnipFMC

This development concept is termed a subsea tieback and typically requires lower capital costs due to the use of an existing floating production unit, though modifications to the unit typically must take place. As with fixed platforms, separation and processing take place before oil and natural gas are exported via pipelines to shore. All floating production units include amenities such as living quarters, helidecks, and cranes given their large size.

Once an appropriate development concept is identified, development can begin, with larger projects often taking three to five years and billions of dollars of investment before beginning production. Even after production begins operating offshore oil and natural gas projects requires significant continual investment to maintain production from existing wells as well as to identify and develop new resources to underpin the initial investment.

Development Stages

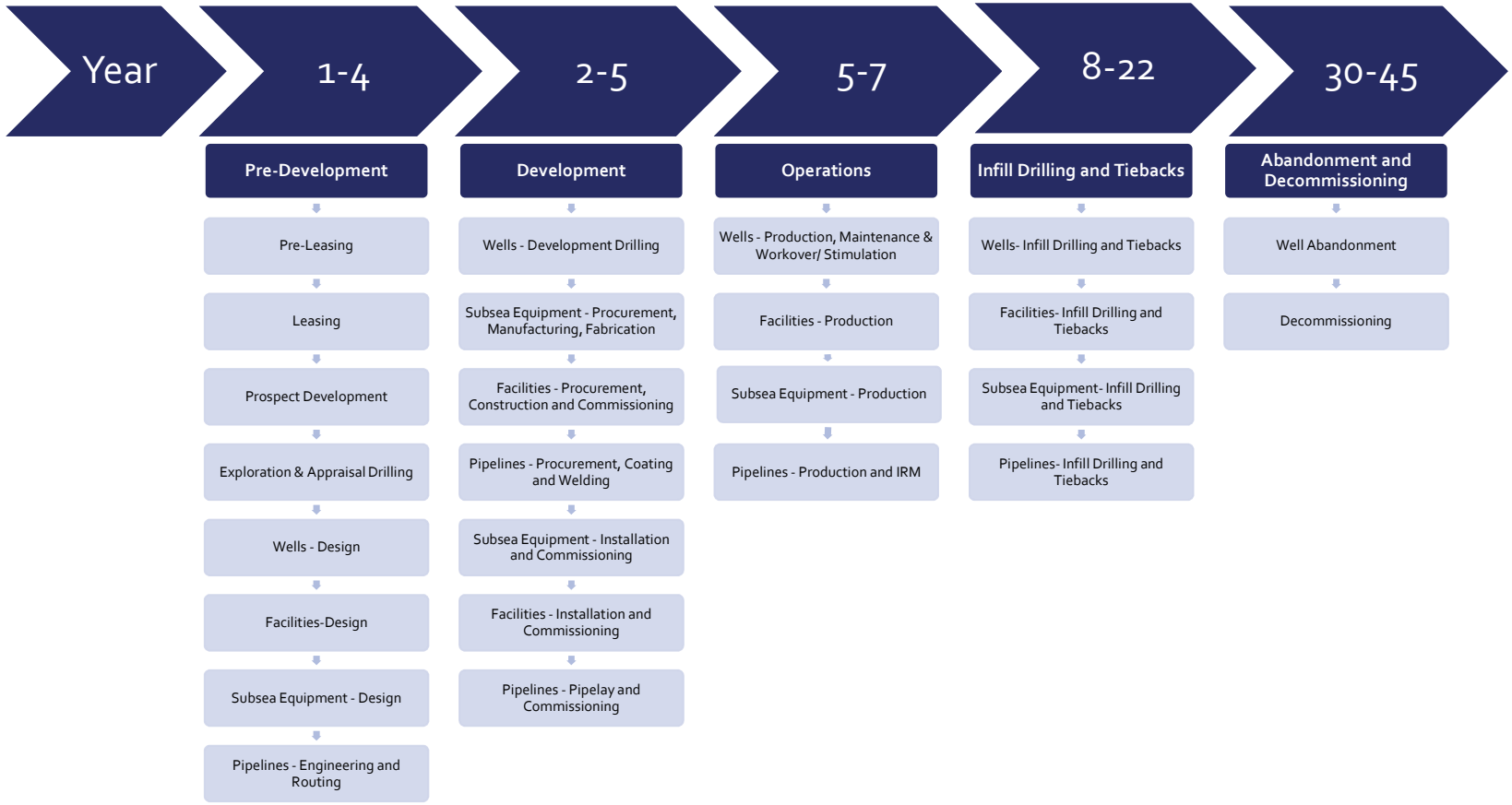
Although in recent years, offshore project development activity has been reduced, several factors point to increased activity in the coming years. Oil prices continue to return to levels more in line with historical trends, underpinning project economics. The oil and natural gas operator and service communities have worked together to reduce project costs while improving safety and operational performance through initiatives such as the use of advanced technologies and standardization. Additionally, as concerns around global warming continue to increase, the relatively low greenhouse gas emissions of offshore projects compared to other fossil fuel developments have increased their potential attractiveness to operators trying to continue to reduce their carbon emissions. Methane emissions are closely regulated for offshore operations as offshore facilities are required to recover and sell all produced gas, venting and flaring are tightly controlled and require approval, and gas detection systems are widely deployed. The Gulf of Mexico offshore oil and gas industry's carbon intensity is about one-half of that of onshore oil and gas production areas.[2]

To demonstrate the offshore project development process, development activities were divided into five major development stages: pre-development, development, operations, infill drilling and tiebacks, and abandonment and decommissioning. Each stage was then further subdivided into more detailed stages, to account for the main activities required to identify, develop, operate, and decommission an offshore project. In total, 20 detailed categories of a project's lifecycle were identified and described.

For each development category a detailed description of activities, the types of equipment and services, primary company and supplier types, sub-supplier types, and types of direct employment were then developed to provide an overview of this category of project development as well as to demonstrate the activities, companies, and workers required to bring an offshore project to production and safely operate it. (Figure 4)

[2] Motiwala, Ama; Ismail, Dr. Huzeifa (2020): Statistical Study of Carbon Intensities in the GOM and PB. ChemRxiv

Figure 4: Major Development Stages and Detailed Categories

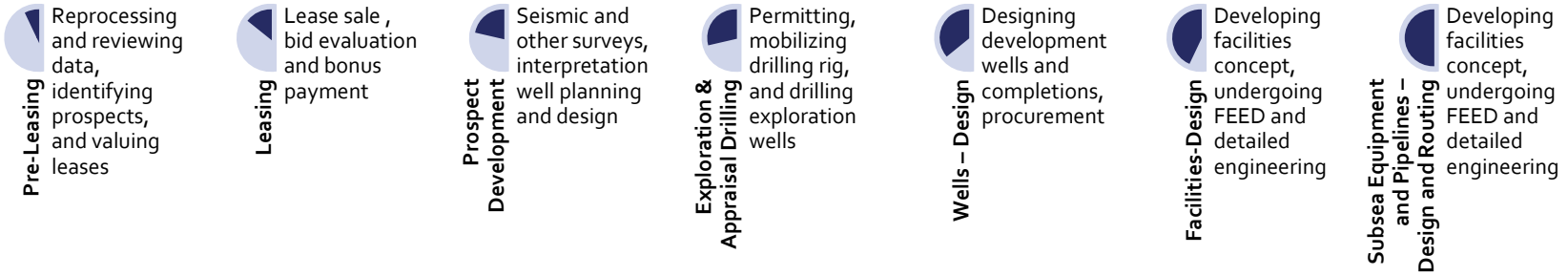


Source: Energy and Industrial Advisory Partners

Pre-Development

The pre-development phase of an oil and natural gas project typically lasts years, requires significant investment from oil and natural gas operators, and requires dozens of companies and hundreds or thousands of employees. The pre-development stages encompass a number of steps including preparing for and participate in lease sales, developing a drilling prospect, drilling exploration, and appraisal wells, and engineering the project's development. (Figure 5)

Figure 5: Pre-Development Stages



Source: Energy and Industrial Advisory Partners

Pre-Leasing

The initial phase of a future offshore oil and natural gas project begins before an operator even leasing the area where an eventual development may take place from the federal government, who through the Bureau of Ocean Energy Management (an agency within the United States Department of the Interior) conducts evaluation, planning, leasing and management of the U.S.'s offshore energy resources. A lease gives an oil and gas operator the opportunity to develop an area of the outer continental shelf (OCS). These areas are divided into blocks, a numbered portion of the OCS. Blocks vary in size, but typical sizes are 5,000 to 5,760 acres. Each block is identified by a specific area and identifying number. Lease sales in the Gulf of Mexico typically take place two times per year, with available blocks in a portion or the whole federal OCS up for lease. Prior to a lease sale operators must determine which available blocks they wish to bid on. To accomplish this oil and natural gas operators will

review existing data including seismic and well data, identify potential prospects (drilling targets), and based on the potential resources in place and the geological risking of those resources, identify what they consider to be an appropriate value for the block. Operators will also consider other factors such as adjacency to existing assets in the operator's portfolio, availability of existing nearby oil and natural gas infrastructure, and potential exploration drilling and development costs, and potential development challenges. The following exhibit highlights the key pre-leasing stages, the detailed activities which take place to complete each project stage, the types of equipment and services utilized, supplier and sub-suppliers active during each project stage, and some example types of employment created during each activity stage. (Table 3)

Table 3: Pre-Leasing Overview

Review and Reprocessing of Existing Seismic and Well Data	**Detailed Activities**	Reprocessing Seismic Data	Reprocessing Well Data	Well Log Review	Data Analysis		
	Types of Equipment and Services	Engineering	Geological & Geophysical Services	Data	Super Computers	Lab Equipment	Software
	Primary Companies and Suppliers	E&Ps[3]	Seismic Companies	Geological & Geophysical Companies	Engineering Companies		
	Sub-suppliers	Computer Manufacturers	Software Suppliers	Data Providers			
	Types of Employment	Geologists	Computer Scientists	Petroleum Engineers	Geophysicists	Landmen	
Prospect Identification and Analysis	**Detailed Activities**	Data Review	Resource Estimation	Resource Risking	Analysis of Existing Prospects	Analysis of Existing or Under Development Assets	
	Types of Equipment and Services	Engineering	Geological & Geophysical Services	Data	Super Computers	Lab Equipment	Software
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Seismic Companies	Geophysical Companies		
	Sub-suppliers	Computer Manufacturers	Software Suppliers	Data Providers			
	Types of Employment	Geologists	Geophysicists	Petroleum Engineers	Accounting and Finance Professionals		
Lease Valuation	**Detailed Activities**	Resource Estimation	Resource Risking	Exploration and Development Cost Estimation	Potential Revenue Estimation		
	Types of Equipment and Services	Software					
	Primary Companies and Suppliers	E&Ps	Seismic Companies	Geophysical Companies	Engineering Companies		
	Sub-suppliers	Software Providers	Data Providers				
	Types of Employment	Geologists	Petroleum Engineers	Accounting and Finance Professionals	Economists	Landmen	

[3] E&Ps are oil and natural gas exploration and production companies (also referred to as operators).

Source: Energy and Industrial Advisory Partners

Pre-leasing work is typically undertaken by operators themselves, with the assistance of engineering, seismic, geological and geophysical companies, and data providers. Most of the work is desktop work, which relies on specialized software and high-powered computers. This work is typically undertaken by highly educated geologists, geophysicists, and engineers with assistance from accounting and finance professionals, computer scientists, landmen, and economists. Completing this pre-leasing analysis and valuation prepares operators to take part in lease sales to potentially acquire the rights to explore and potentially develop a portion of the Gulf of Mexico OCS.

Leasing

After completing pre-leasing work, operators must then bid on leases at a lease sale conducted by the Bureau of Ocean Energy Management (BOEM). In recent years, these lease sales have taken place twice a year and have offered all lease blocks not subject to specific restrictions due to congressional moratorium (such as the moratorium established by the Gulf of Mexico Energy Security Act of 2006). Before a lease sale, operators submit sealed bids for individual blocks. In addition to establishing the size of the operator's bid, these bid documents include information on the operator's geological and geophysical analysis of the block, information establishing the operator's financial ability to pay the bonus and subsequent rents, and their ability to ensure proper clean up would take place in the event of an oil discharge. These bids are then opened and read at the lease sale, which is conducted both in-person and live-streamed. Once all bids are opened, BOEM then provides a summary of the highest bids for individual blocks as well as the total amount of high bids placed. While the BOEM typically awards the lease for a given block to the highest bidder, before bids are officially accepted a number of steps must take place. After a lease sale, the BOEM ensures that high bids meet all relevant criteria and conducts an economic analysis of bids to ensure that received bids meet fair market values. Once a bid is deemed to meet the appropriate criteria, BOEM will publicize the results of bids including through the federal register. Lease terms such as royalty rates and length are typically based on the water depth of the block. Once companies are informed of their successful bid, the BOEM will provide a payment date by which the successful bidder must transmit their bid payment and other fees to BOEM. Once this process is complete, operators can begin to prepare to explore the block for oil and natural gas resources. The following exhibit highlights the key stages of the leasing process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, supplier and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 4)

Table 4: Leasing Overview

Lease Sale	**Detailed Activities**	Lease Sale	Economic Analysis	Fair Market Value Procedures	Post-Sale Activities	Rejected Bid Appeals	
	Types of Equipment and Services	Software	Engineering	Geological & Geophysical Services	Data		
	Primary Companies and Suppliers	E&Ps	Geological & Geophysical Companies	Engineering Companies	BOEM	Law Firms	
	Sub-suppliers	Software Companies	Data Providers				
	Types of Employment	Geologists	Petroleum Engineers	Accounting and Finance Professionals	Economists	Attorneys	Landmen
Bonus Payment	**Detailed Activities**	Lease Bonus Payments	Rental Payments				
	Types of Equipment and Services	Software					
	Primary Companies and Suppliers	E&Ps	BOEM	Law Firms			
	Sub-suppliers	Software Companies	Data Providers				
	Types of Employment	Accounting and Finance Professionals	Attorneys	Regulatory Personnel	Landmen		

Source: Energy and Industrial Advisory Partners

Most work during the leasing process is conducted directly by oil and gas operators and employees of BOEM, with assistance from engineering firms, geological and geophysical data companies, and law firms. The work is led by engineers, geoscientists, lawyers, accounting and finance professionals, landmen, economists, and administrators.

Prospect Development

Once a bid has been successful and the operator has remitted the payment to the BOEM, the work of developing an actionable "prospect" or oil and natural gas drilling target must be completed. While some of this work may have been undertaken prior to leasing, additional work must be carried out, operators typically contract seismic and survey companies to conduct additional survey work on a block to gain a better understanding of surface and subsurface conditions at the site. This work is typically carried out by specialized vessels equipped with seismic and other survey equipment. Once these surveys are completed, new data is combined with existing data (which is often reprocessed using updated software and high-powered computers) to allow geologists, geophysicists, and petroleum engineers to interpret the data and develop a potential drilling prospect. In addition to identifying the prospect, estimates of the potential resources in place and the likelihood of making a discovery are also developed. Cost estimates for both drilling and eventual development are prepared with the assistance of accounting and finance professionals and economists.

Once the decision to potentially move forward with drilling an exploratory well at a given prospect, a detailed well design must be developed. In addition to the technical design of the well, appropriate equipment based on the well's water and target subsurface depth, design, and the nature of the potential reservoir must be selected and tested (such as the type of rig, steel casing, and downhole hardware). Service and equipment providers must also be selected as these companies will typically be involved in the well design. In addition to operators, service companies, rig owners, and equipment providers 3rd party engineering companies and testing companies will also typically be involved to help design the well and ensure that equipment and materials selected for the well meet the technical and safety requirements. Petroleum and mechanical engineers, technical salespeople, geologists, accounting and finance professionals, and supply chain professionals typically assist in the design process. Specialized software and data are utilized to ensure well designs are fit for purpose and safe. The following exhibit highlights the key stages of prospect development, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, supplier and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 5)

Table 5: Prospect Development Overview

Gravity, Magnetic and Seismic Survey	**Detailed Activities**	Survey Planning	Survey Acquisition	Survey Processing	Survey Analysis				
	Types of Equipment and Services	Seismic Vessels	Streamers						
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Seismic Companies	Geological & Geophysical Services	Seismic Equipment Manufacturing Companies			
	Sub-suppliers	Software Companies	Data Providers	Shipyards	Vessels Equipment Manufacturing Companies	Logistics Companies	Fuel & Lubricant Suppliers	Vessel Consumable Providers	
	Types of Employment	Geologists	Computer Scientists	Petroleum Engineers	Geophysicists	Manufacturing Workers	Marine Crew	Logistics and Supply Chain Professionals	Shore base Personnel
Survey Interpretation & Prospect Development	**Detailed Activities**	Survey Interpretation	Prospect Development	Prospect Risking	Prospect Economic Analysis				
	Types of Equipment and Services	Super Computers	Lab Equipment	Software					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Seismic Companies	Geological & Geophysical Services				
	Sub-suppliers	Computer Manufacturers	Software Companies	Data Providers					
	Types of Employment	Geologists	Computer Scientists	Petroleum Engineers	Geophysicists	Accounting and Finance Professionals	Economists		

Source: Energy and Industrial Advisory Partners

Table 5: Prospect Development Overview *(Continued)*

Well Design	**Detailed Activities**	Well Placement	Well Engineering	Equipment Selection	Service Selection				
	Types of Equipment and Services	Software	Lab Equipment	Testing Equipment	Technical Sales				
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Service Companies	Drilling Equipment Manufacturers	Rig Contractors	OCTG Manufacturers	Testing Companies	
	Sub-suppliers	Computer Suppliers	Software Companies	Data Providers	Material Suppliers				
	Types of Employment	Geologists	Petroleum Engineers	Mechanical Engineers	Supply Chain Professionals	Accounting and Finance Professionals			
Well Planning	**Detailed Activities**	Well Drilling Planning	Rig Contracting	Mooring Planning	Equipment Selection	Procurement	Rig Mobilization Planning	Logistics Planning	Support Vessel Contracting
	Types of Equipment and Services	Well Engineering	Technical Sales	Drilling Engineering	Mechanical Engineering	Drill Pipe & Tool Manufacturing			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Rig Contractors	Vessel Companies	Mooring Equipment Providers	Service Companies	Drilling Equipment Manufacturers	OCTG Manufacturers
	Sub-suppliers	Computer Suppliers	Software Companies	Data Providers	Rig Equipment Manufacturers	Material Suppliers	Logistics Companies		
	Types of Employment	Petroleum Engineers	Mechanical Engineers	Supply Chain Professionals	Accounting and Finance Professionals	Logistics Professionals	Operations Professionals	Contracting Professionals	Attorneys

Source: Energy and Industrial Advisory Partners

Once well design is complete, planning for drilling the potential exploration well can begin. The well's design and procurement plan will be finalized by working with all equipment and service suppliers. A drilling rig will be selected either from a rig already contracted by the operator or by identifying an appropriate available rig and beginning work to contract the rig from its owner. Mobilization planning for the rig, support vessels, and other equipment planning will take place. Contracts with all suppliers will be put into place. This work will be conducted by the operator in concert with engineering companies, and their suppliers. This work is conducted by petroleum and mechanical engineers, supply chain, accounting and finance, logistics, operations, and contracting professionals. Once this work has been completed an operator will be prepared to drill an initial exploration well.

Exploration and Appraisal Drilling

Before a well can be drilled in the Gulf of Mexico outer continental shelf a drilling permit (application form permit to drill or APD) must be issued by the Bureau of Safety and Environmental Enforcement (BSEE). Operators, often with the assistance of engineering firms, specialized consulting companies, environmental and archeological consultants, and law firms must submit a large amount of data as part of the permitting process. Once BSEE has determined that the proper paperwork and data has been submitted a technical review begins. The permit application includes data such as the proposed drilling procedures, wellbore schematics, geological and geophysical data, location data, environmental data to ensure that the proposal complies with National Environmental Policy Act (NEPA) requirements, oil spill response plans, casing, and well control equipment information, mooring plans in the event of hurricanes, and other technical data. This data, which is typically submitted through BSEE's online eWell system provides BSEE the necessary data required to approve or deny a permit. Often, BSEE will require additional or corrected data prior to approving the permit. Once approved, permits are posted publicly on BSEE's website. To complete the permitting process a diverse group of specialists is required including petroleum, environmental and civil engineers, lawyers, geologists, geophysicists, marine biologists, ecologists, environmental scientists, and archeologists.

Once permits are approved, the process of drilling a well can begin. First, the drilling rig and all necessary supplies and personnel must be mobilized to the drilling location. Depending on the type of drilling rig utilized the rig may reach the destination under its own power (drillships) or be towed by specialized tugs (semi-submersible and jack-up). (Figure 6)

Figure 6: Various Offshore Drilling Rigs – From Left to Right a Drillship, Semi-Submersible, and Jack-Up Rig

Source: Valaris

Prior to or during mobilization, various systems will undergo tests, and inspections may be undertaken by the U.S. Coast Guard or BSEE. Once on location the rig must be exactly positioned, and either moored with ropes and anchors, jacked down, or positioned with its dynamic positioning system. Seafloor site preparation must be made at the drilling location, safety equipment such as blow out preventers tested, and equipment run such as the wellhead, blow out preventer, drilling riser (which connects the well to the seafloor wellhead), and initial conductor casing string. To accomplish the mobilization and stationing of the rig, oil and gas operators are directly supported by dozens of companies including rig contractors, vessel companies, mooring companies, subsea hardware suppliers, and logistics companies. Hundreds to thousands of workers are required both offshore and to support activities onshore. The following exhibit highlights the key stages of exploration and appraisal drilling, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, supplier and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 6)

Table 6: Exploration and Appraisal Drilling Overview

Permitting	**Detailed Activities**	Prepare Safety Documentation	Environmental Documentation	Archeological Documentation	Finalize Documentation	Prepare Permits	Submit	Review	Permit Issued		
	Types of Equipment and Services	Safety Consulting	Engineering	Environmental Consulting	Archeological Consultants	Permitting Consulting	Legal Services				
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Regulators	Permitting Consultants	Law Firms					
	Sub-suppliers	Software Companies	Data Providers	Environmental Consultants	Archeological Consultants	Safety Consultants					
	Types of Employment	Petroleum Engineers	Attorneys	Civil Engineers	Environmental Engineers	Geologists	Geophysicists	Marine Biologists	Environmental Scientists	Archeologists	
Rig Mobilization	**Detailed Activities**	Rig Preparation	Rig Crewing	Equipment and Supply Loading	Rig Towing	Rig Testing					
	Types of Equipment and Services	Drilling Rig	Rig Inspection and Survey Services	Rig Equipment	Vessels	Logistics Companies	Dock Services	Fuel and Water	Regulators	Rig Consumables	
	Primary Companies and Suppliers	E&Ps	Rig Contractor	Vessel Companies	Mooring Companies	Regulators	Fuel & Lubricant Suppliers				
	Sub-suppliers	Rope Access Companies	Mooring Companies	Positioning Companies	Fuel Suppliers	Helicopter Companies					
	Types of Employment	Engineers	Logistics Professionals	Vessel Crews	Inspectors	Dock Workers	Truck Drivers	Regulatory Personnel	Manufacturing Workers	Rig Crews	Rope Access Technicians

Source: Energy and Industrial Advisory Partners

Table 6: Exploration and Appraisal Drilling Overview *(Continued)*

Rig Stationing	**Detailed Activities**	Site Preparation	Rig Mooring / Positioning	Wellhead Running	Riser Running & LRMP Running	Riser Running & LRMP Running					
	Types of Equipment and Services	Positioning Equipment	Vessels	Subsea Wellhead	BOP & LRMP	Drilling Riser	Conductor Casing	ROVs	Drilling Rig		
	Primary Companies and Suppliers	Rig Contractors	Vessel Owners & Operators	Subsea Hardware Suppliers	Logistics Companies						
	Sub-suppliers	BOP & LRMP Suppliers	Drilling Fluids Suppliers	Hydraulic and Other Fluid Suppliers	ROV Companies	Drilling Riser Manufacturers	Drilling Riser Inspection & Repair	Fuel & Lubricant Suppliers			
	Types of Employment	Engineers	Vessel Crews	Operations Professionals	Rig Crews	Surveyors					
Well Drilling	**Detailed Activities**	Drilling	Well Control	Running OCTG	Mud Logging	Directional Drilling	Mud and Other Logging	Coring	Testing	Tripping	Rigging Down
	Types of Equipment and Services	Drilling Rig	Mud & Drilling Fluids	Cementing	Tubular Running	Well Hardware	Drilling Services	Food, Fuel and Water	Supply Vessels	Equipment Rental	Helicopters
	Primary Companies and Suppliers	Rig Contractors	Mud & Fluid Suppliers	Cementing Services	Casing Equipment Providers	Drilling Hardware Manufacturers	Vessel Companies	OCTG Manufacturers		Tooling Manufacturers	Service Companies
	Sub-suppliers	Steel Companies	Cement Manufacturers	Logistics Companies	Catering Companies	Tooling Manufacturers	ROV Companies	Equipment Rental Companies	Helicopter Companies	Fuel & Lubricant Suppliers	
	Types of Employment	Petroleum Engineers	Supply Chain Professionals	Logistics Professionals	Vessel Crews	Inspectors	Dock Workers	Drilling Crews	Service Company Workers	Service Company Workers	

Source: Energy and Industrial Advisory Partners

Once the drilling rig is in position, tested and the appropriate equipment has been run, drilling can begin in earnest. Drilling an offshore well, especially in deepwater requires a carefully coordinated operation as the well is drilled by the drill bit, mud and other fluids are pumped through the well, new casing strings and other equipment is run and cemented, and the well is constantly monitored both to ensure safety and gather data which is analyzed both on the rig and onshore. In addition to the supplies required in the drilling of the well, the rig, and any supporting vessels have to be constantly resupplied by vessels with fuel, food, water, lubricants, and hundreds of other commodities, hundreds of miles from shore. Workers must be constantly transported to and from shore, typically by helicopters. Weather and ocean conditions must be constantly monitored. Supporting these efforts requires hundreds of direct and sub-suppliers as well as hundreds to thousands of workers ranging from engineers to rig hands to marine crews to catering workers to helicopter pilots.

Once a well reaches its initial subsurface target, operators may decide to drill sidetracks (or additional bores emanating from the initial well bore). Once drilling is completed the operator will, depending on the result of the well and their potential development plan, either temporarily or permanently abandon the well by pumping fluids, cement, and installing hardware. This process ensures the security of the wellbore either permanently or until it can be reentered for use in a potential development. After drilling of the initial well is complete operators and contractors will analyze the data gathered to determine the resources in place and understand if these resources could underpin an economical offshore oil and natural gas development. Often, additional wells known as appraisal wells may be drilled to further evaluate the potential resource. If the operator determines that the resource in place should be considered for development, the design process for a potential development will begin.

The exploration and appraisal drilling process requires hundreds of companies including operators, engineering firms, rig contractors, oil and gas service companies, vessel companies, equipment suppliers, and many other suppliers of specialized equipment and services. Thousands of workers ranging from petroleum engineers to vessel crews, to caterers and ROV pilots are involved.

Well Design

As with exploration wells as described above detailed well designs for all potential development wells (which will eventually produce oil and natural gas) must be developed. While exploration well design typically only includes the well itself, development well design must also account for eventual "completion" of the well which prepares the well and allows it to produce oil and natural gas. In addition to the technical design of the well, appropriate equipment based on the well's water and target subsurface depth, design, and the nature of the potential reservoir must be selected and tested (such as the type of rig, steel casing, and downhole hardware). Service and equipment providers must also be selected as these companies will typically be involved in the well design. In addition to operators, service companies, rig owners, equipment providers, 3rd party engineering companies and testing companies will also typically be involved to help design the well and ensure that equipment and materials selected for the well meet the technical requirements.

Petroleum and mechanical engineers, technical salespeople, geologists, accounting and finance professionals, and supply chain professionals typically assist in the design process. Specialized software and data are utilized to ensure well designs are fit for purpose and safe. The following exhibit highlights the key stages of well design, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, supplier and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 7)

Table 7: Well Design Overview

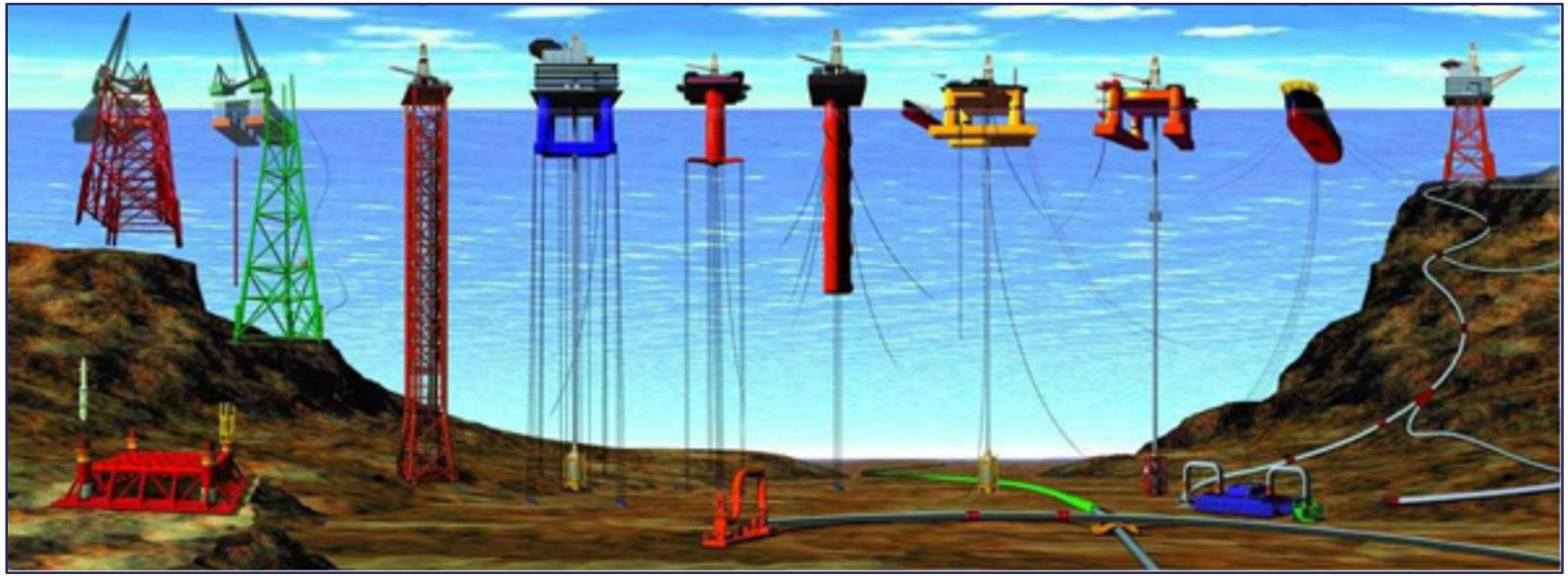
Development Well Design	**Detailed Activities**	Well Placement	Well Engineering	Equipment Selection	Service Selection					
	Types of Equipment and Services	Engineering	Software	Lab Equipment	Testing Equipment					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Service Companies	Drilling Equipment Manufacturers	Rig Contractors	OCTG Manufacturers	Testing Companies		
	Sub-suppliers	Computer Manufacturers	Software Companies	Data Providers	Material Providers					
	Types of Employment	Geologists	Petroleum Engineers	Mechanical Engineers	Supply Chain Professionals	Technical Drafters				
Completion Design	**Detailed Activities**	Completion Engineering	Artificial Lift Selection	Equipment Selection	Service Selection					
	Types of Equipment and Services	Software	Software	Lab Equipment	Testing Equipment					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Service Companies	Completion Equipment Manufacturers	Artificial Lift Providers	Rig Contractors	OCTG Manufacturers	Testing Companies	
	Sub-suppliers	Computer Manufacturers	Software Companies	Data Providers	Material Providers					
	Types of Employment	Petroleum Engineers	Mechanical Engineers	Supply Chain Professionals	Technical Drafters					
Procurement	**Detailed Activities**	Rig Contracting	Service Procurement	Completion Equipment Procurement	Completion Running Procurement	Logistics Procurement	Rental Equipment Procurement	Mud & Drilling Fluids Procurement	Wireline Procurement	Stimulation Procurement
	Types of Equipment and Services	Engineering	Procurement Management Systems	Software						
	Primary Companies and Suppliers	E&Ps	Procurement Management Companies	Engineering Companies	Service Companies	Service Companies	Completion Equipment Manufacturers	Rig Contractors	OCTG Manufacturers	Testing Companies
	Sub-suppliers	Component Manufacturing	Machining	Welding Equipment Suppliers	Equipment Leasing	Law Firms	Insurance			
	Types of Employment	Petroleum Engineers	Mechanical Engineers	Supply Chain Professionals	Procurement Professionals	Technical Sales	Contracting Professionals	Attorneys	Accounting and Finance Professionals	

Source: Energy and Industrial Advisory Partners

Facilities Design

In addition to designing development wells for a potential offshore oil and natural gas development, facilities to collect, process, and export oil and natural gas must also be designed. Depending on the development, a new fixed or floating platform may be utilized, or existing facilities with which the new project can be tied back to may be modified. Typically, operators will consider a number of concepts and develop basic designs with cost estimates before deciding on the most appropriate facility based on water depths, resource sizes, development costs, lead times, and other factors. (Figure 7)

Figure 7: Types of Offshore Oil and Gas Facilities



Source: Oil States International

Once the development concept is finalized, front end engineering and design (FEED) and detailed design work will then take place. During this process, all elements of the facility will be designed including the hull/jacket of the platform, the topsides where oil, natural gas, and water are separated and processed, the risers which connect the platform to wells, mooring systems, control systems, and accommodation (if the platform is manned). The installation plan will also be developed. This process, led by the operator will involve engineering companies with different

specialties, shipyards who will build the hull and topsides, process equipment manufacturers, specialized equipment providers, and installation contractors. Mechanical engineers, naval architects, supply chain, accounting and finance, procurement, and project management professionals, technical salespeople and drafters, and many other specialized professionals lead this process. The following exhibit highlights the key stages of facilities design, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, the suppliers and sub-suppliers that are active during this stage, and some example types of employment created during this activity stage. (Table 8)

Table 8: Facilities Design Overview

Concept Development / Design	**Detailed Activities**	Identify Potential Development Concepts	Identify Potential Hosts and Pipelines	Perform Early Stage Engineering	Confirm Suitability	Estimate Costs	Choose Development Concept				
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Testing Equipment					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Shipyards	Process Equipment Manufacturers	Mooring Equipment Suppliers	Installation Contractors				
	Sub-suppliers	Component Manufacturing	Testing Companies	3D Modeling Companies							
	Types of Employment	Mechanical Engineers	Naval Architects	Supply Chain Professionals	Technical Drafters	Procurement Professionals	Project Managers	Technical Sales	Accounting and Finance Professionals		
FEED / Detailed Engineering	**Detailed Activities**	Finalize Concept	Hull Design	Topsides Design	Riser Design	Processing Equipment Design	Piping Design	Mooring Design	Control System Design	Installation Design	Procurement
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Documentation					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Process Equipment Manufacturers	Shipyards	Topsides Yards	Riser Manufacturers	Installation Companies	Mooring Companies	Control Systems Companies	
	Sub-suppliers	Component Manufacturers	Steel Companies	Mooring Companies	Control Systems Companies	Power Generation Providers					
	Types of Employment	Civil Engineers	Mechanical Engineers	Naval Architects	Supply Chain Professionals	Technical Drafters	Procurement Professionals	Project Managers	Technical Sales	Technical Drafter	Accounting and Finance Professionals
Classification & Testing	**Detailed Activities**	Classification Selection	Engineering & Design Review	Auditing	Material Testing	Tank Testing	Regulatory Review				
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Testing Equipment					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Shipyards	Topsides Yards	Classification Societies	Testing Companies	Regulators			
	Sub-suppliers	Component Manufacturers	Inspection & Survey Companies								
	Types of Employment	Surveyors	Naval Architects	QA/QC Professionals	Project Managers	Regulatory Personnel					

Source: Energy and Industrial Advisory Partners

Subsea Equipment Design

Subsea equipment, which is typically utilized to control producing wells and help transport production to its host facility is another key element of offshore (typically deepwater) developments. While shallow water and some deepwater projects typically produce directly to the host facility through dry tree wells, most deepwater projects utilize subsea production equipment. Subsea production equipment includes the subsea tree, which is mated to a control system to provide well control and manage production, umbilicals which utilize electrical and hydraulic tubing to control wells, manifolds that gather oil and natural gas from wells, pipeline line terminations, and other equipment to produce wells to pipelines which ultimately bring production to the field's host platform for processing. In the same manner as is done for facilities, operators will consider a variety of field layouts and develop basic designs with cost estimates before deciding on the most appropriate concept based on water depths, resource sizes, development costs, lead times, and other factors. Once the development concept is finalized, front end engineering and design (FEED) and detailed design work will then take place. During this process, all elements of the subsea production system will be designed. This process, led by the operator will involve engineering companies with different specialties, subsea equipment manufacturers, and installation contractors. Subsea, mechanical and electronic engineers, supply chain, accounting and finance, procurement, and project management professionals, technical salespeople and drafters, and many other specialized professionals lead this process. The following exhibit highlights the key stages of subsea equipment design, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 9)

Table 9: Subsea Equipment Design Overview

Concept Development / Design	**Detailed Activities**	Identify Potential Hosts and Pipelines	Early Stage Engineering	Confirm Suitability	Estimate Costs	Choose Development Concept			
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Testing Equipment			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Providers	Control Systems Providers				
	Sub-suppliers	Steel Companies	Subsea Chemical Providers	Pipeline Equipment Suppliers	Installation Contractors	Software Companies			
	Types of Employment	Petroleum Engineers	Subsea Engineers	Electrical Engineers	Mechanical Engineers	Technical Drafters	Supply Chain Professionals	Accounting and Finance Professionals	
FEED / Detailed Engineering	**Detailed Activities**	Finalize Concept	Subsea Equipment Design	Subsea Control System Design	Flow Assurance Design	Artificial Lift Subsea System Design	Installation Design	Integration Design	Procurement
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Documentation			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Providers	Control Systems Providers	Artificial Lift Providers	Steel Companies	Fabricators	Installation Contractors
	Sub-suppliers	Steel Companies	Subsea Chemical Providers	Pipeline Equipment Suppliers	Software Companies				
	Types of Employment	Petroleum Engineers	Subsea Engineers	Electrical Engineers	Mechanical Engineers	Technical Drafters	Supply Chain Professionals	Accounting and Finance Professionals	
Testing	**Detailed Activities**	Classification Selection	Engineering & Design Review	Auditing	Material Testing	Regulatory Review			
	Types of Equipment and Services	Engineering	Survey	Software	Lab Equipment	Testing Equipment			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Providers	Control Systems Providers	Installation Contractors	Regulators		
	Sub-suppliers	Steel Companies	Artificial Lift Providers	Software Companies	Subsea Chemical Providers	Pipeline Equipment Suppliers			
	Types of Employment	Petroleum Engineers	Subsea Engineers	Electrical Engineers	Mechanical Engineers	QA/QC Professionals	Project Managers	Regulatory Personnel	

Source: Energy and Industrial Advisory Partners

Pipeline Engineering and Routing

Offshore oil and natural gas projects utilize pipelines for two purposes. For projects utilizing subsea production equipment, infield pipelines or flowlines collect unprocessed oil and natural gas from wells or manifolds and transport these fluids to the host facility for processing. After processing, larger export pipelines then transport processed and separated oil and natural gas either to shore or to interconnects with existing pipeline systems. Designing an appropriate pipeline system for an offshore project requires companies to take numerous factors into account including pipeline routing based on seabed conditions and potential interactions with existing infrastructure, flow assurance concerns especially for infield lines which typically require insulation and chemical injection, sizing, material selections, and installation planning. As with other parts of the development, operators will consider a number of field layouts and develop basic designs with cost estimates before deciding on the most appropriate concept. Once the development concept is finalized, front end engineering and design (FEED) and detailed design work will then take place. During this process, all elements of the pipeline system will be designed. This process, led by the operator, will involve engineering companies with different specialties, steel companies, and installation contractors. Engineers, supply chain, accounting and finance, procurement, and project management professionals, technical salespeople and drafters, and many other specialized professionals take part in this process. The following exhibit highlights the key stages of pipeline engineering and routing, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 10)

Table 10: Pipeline Engineering and Routing Overview

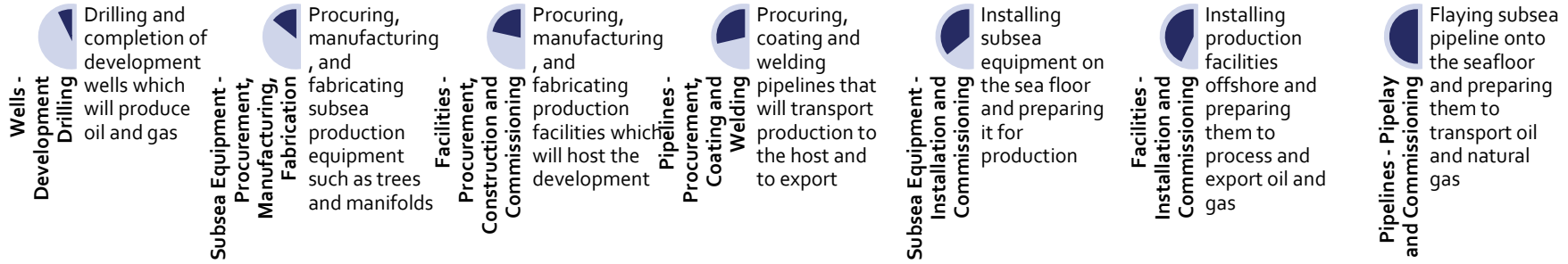
Conceptual Engineering	**Detailed Activities**	Concept Selection	Early Stage Engineering	Cost Estimation	Material Selection	Permitting	Initial Routing	
	Types of Equipment & Services	Design Software	Engineering	Documentation	Procurement			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Contractors				
	Sub-suppliers	Software Companies	Data Providers	Steel Companies				
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Subsea Engineers	Project Managers	Technical Drafters	Accounting and Finance Professionals	
Pipeline Routing	**Detailed Activities**	Data Evaluation	Id Geohazards and Constraints	Routing	Risk Assessment	Route Acceptance		
	Types of Equipment & Services	GIS software	Engineering	Lab Testing				
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Contractors	Seismic Companies	Geological & Geophysical Services	Survey Companies	
	Sub-suppliers	Software Companies	Data Providers					
	Types of Employment	Geologists	Subsea Engineers	Ecologists	Archeologists			
Detailed Engineering	**Detailed Activities**	Route Optimization	Finalize Thickness & Coating	Verification against Codes	Specification			
	Types of Equipment & Services	Design software	Design software	Engineering	Testing	Documentation		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Contractors				
	Sub-suppliers	Software Companies	Data Providers	Steel Companies				
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Procurement Professionals	QA/QC Professionals	Project Managers	Technical Drafters	Accounting and Finance Professionals
Survey	**Detailed Activities**	Seabed Topographical Data, Location of Rock / Coral Outcrops	Soil Investigation	Identify other users	Environmental data collection			
	Types of Equipment & Services	ROVs	Survey Vessels	ROV Tooling and Winch Systems	Sonar	Magnetometer	Core and Bottom Sampler	
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Survey Companies	Subsea Services	Installation Contractors	Regulators	
	Sub-suppliers	ROV Companies	Survey Equipment Manufacturers	Vessel Companies	Positioning Companies			
	Types of Employment	ROV Pilots	Geologists	Equipment Operators	Technical Sales	Inspectors	Surveyors	Regulatory Personnel

Source: Energy and Industrial Advisory Partners

Investment Decision

After design work is completed, operators will consider the projected costs, timelines, carbon footprint, and potential production of a project. If the project meets the operator's and their partners' internal decision-making hurdles the project will then be sanctioned. This is typically known as the final investment decision (FID) and is often made by the company's board of directors. This decision allows contracts to be finalized and work on the development of the project to begin in earnest. As the development of offshore oil and natural gas projects typically requires hundreds of millions to billions of dollars of investment, this decision commits the operator to undertake this high level of spending. Typically, upon this decision being made, long lead items such as facilities and subsea hardware are ordered, and fabrication begins. Other major contracts such as Engineering, Procurement, and Construction (EPC) and installation packages and rig contracts are typically let. After a final investment decision is made, the project's development can begin in earnest with development wells drilling, and subsea equipment, facilities, and pipelines built, commissioned, and installed. (Figure 8)

Figure 8: Development Stages



Source: Energy and Industrial Advisory Partners

Development

Development Drilling

After the final investment decision is made, preparations to drill and complete the development wells can begin. Any well design elements not completed prior to the FID will be completed and well permits will be submitted to BSEE for approval. Procurement will begin based on finalized technical requirements. Bid packages for the major drilling elements will be finalized and sent to approved vendors who meet the project's requirements. Final negotiations will take place with shortlisted suppliers and contracts for major services and equipment let. Once major contracts are completed manufacturing of equipment will begin including equipment needed for rig modifications, downhole tools, wellheads, completion, artificial lift, and directional drilling equipment, drilling and completion hardware, oil country tubular goods (casing and tubing), and sensors and controls. As manufacturing takes place logistics planning for all equipment and other goods (such as cement, mud, drilling fluids, and fuel) will begin. As manufacturing is completed and onshore work such as rig modifications takes place goods will be transported by truck or vessel to a shorebase for loading on to vessels and barges to be transported to the offshore rig. Prior to or during mobilization, various systems will undergo tests. Once on location, the rig must be positioned, and seafloor site preparation undertaken at the drilling location, safety equipment such as blow out preventers tested, and equipment run such as the wellhead, blow out preventer, drilling riser, and initial conductor casing string will be run.

Once the drilling rig is in position, tested and the appropriate equipment has been run, drilling can begin. Once a well reaches its subsurface target, completion operations begin. Completion of an offshore well typically involves stimulation operations with specialized vessels pumping fluids via the drilling rig at high pressures into the well, installation of specialized completions equipment such as tubing, safety valves, and artificial lift equipment, and flow back of the well to prepare it for production. Depending on the timing of development well drilling, individual wells may be temporarily abandoned after drilling for later completion, and running of subsea equipment or subsea hardware such as trees may also be run. Once a well is completed it is ready to begin production when the host is in place and pipelines and control equipment are connected. The following exhibit highlights the key stages of development drilling, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, supplier and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 11)

Table 11: Development Drilling Overview

Procurement	**Detailed Activities**	Technical Requirements Developed	Cost Estimation	Scheduling	Big Packages Prepared	Bids Received	Bid Review	Negotiations	Contracting		
	Types of Equipment and Services	Rigs	Services	Wellheads	Drilling Equipment	OCTG	Drilling & Completion Hardware	Tooling	Directional Drilling	Logistics Services	Sensors & Controls
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Rig Contractors	Equipment Manufacturers	Manpower & Recruiting Services					
	Sub-suppliers	Engineering Project Management Systems	Procurement Management Providers	Component Manufacturers	Heavy Lift Transport Companies	Vessel Companies	Law Firms	Insurers	Software Companies	Shipyards	
	Types of Employment	Petroleum Engineers	Procurement Professionals	Technical Sales	Contract Professionals	Attorneys	Insurance Specialists	Accounting and Finance Professionals			
Manufacturing	**Detailed Activities**	Well Control Equipment Manufacturers	Completion Hardware Manufacturing	OCTG Manufacturing	Artificial Lift Manufacturing	Mud and Fluid Manufacturing	Sensor & Control Manufacturing	Tooling Manufacturing	Directional Drilling Equipment Manufacturing		
	Types of Equipment and Services	Rigs	Wellheads	Drilling Equipment	OCTG	Drilling & Completion Hardware	Logistics Services	Sensors & Controls			
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Completion Hardware Companies	Artificial Lift Companies	Mud and Drilling Fluid Providers	Tooling Companies	Directional Drilling Companies			
	Sub-suppliers	Component Manufacturers	Machine Shops	Steel Companies	Material Providers	Testing Companies		Chemical Companies			
	Types of Employment	Petroleum Engineers	Mechanical Engineers	Technical Drafters	QA/QC Professionals	Welders	Machinists	Assemblers	Equipment Operators	Accounting and Finance Professionals	

Source: Energy and Industrial Advisory Partners

Table 11: Development Drilling Overview *(Continued)*

Transportation and Logistics	**Detailed Activities**	Packaging	Component Transportation	Onshore Logistics	Logistics Equipment Rental	Vessel Transport	Air Transport				
	Types of Equipment and Services	3rd Party Logistics	Trucking	Shorebases	Supply Vessels	Helicopters					
	Primary Companies and Suppliers	Freight Forwarders	Airlines	Trucking Companies	Shorebases	Vessel Companies	Helicopter Companies	Equipment Rental Companies			
	Sub-suppliers	Packaging Suppliers	Fuel & Lubricant Suppliers	Spare Parts Suppliers	Container Rental Companies	Equipment Leasing Companies	Rigging Suppliers	Insurance Companies			
	Types of Employment	Truck Drivers	Pilots	Vessel Crews	Crane Operators	Project Managers	Technical Sales	Insurance Professionals	Accounting and Finance Professionals		
Drilling	**Detailed Activities**	Drilling	Well Control	Running OCTG	Mud Logging	Directional Drilling	Mud and Other Logging	Coring	Testing	Tripping	Rigging Down
	Types of Equipment and Services	Drilling Rig	Mud & Drilling Fluids	Cementing	Tubular Running	Well Hardware	Drilling Services	Food, Fuel and Water	Supply Vessels	Equipment Rental	Helicopters
	Primary Companies and Suppliers	Rig Contractors	Service Companies	Mud & Fluid Suppliers	Cementing Services	Casing Equipment Providers	Drilling Hardware Manufacturers	Vessel Owners & Operators	OCTG Manufacturers	Regulators	
	Sub-suppliers	Steel Companies	Cement Manufacturers	Logistics Companies	Catering Companies	Tooling Manufacturers	ROV Companies	Equipment Rental Companies	Helicopter Companies	Fuel & Lubricant Suppliers	
	Types of Employment	Petroleum Engineers	Supply Chain Professionals	Service Company Workers	Logistics Professionals	Vessel Crews	Inspectors	Dock Workers	Rig Crews	Drilling Crews	Accounting and Finance Professionals
Completion	**Detailed Activities**	Running Completion Hardware	Stimulation	Running Tubing	Running Artificial Lift System	Running Controls & Sensors	Flowback				
	Types of Equipment and Services	Drilling Rig	Completion Hardware	Stimulation Vessels	Mud & Drilling Fluids	Cementing	Tubular Running Services	Well Hardware	Food, Fuel and Water	Supply Vessels	Equipment Rental
	Primary Companies and Suppliers	Rig Contractors	Service Companies	Mud & Fluid Suppliers	Completion Equipment Manufacturers	Artificial Lift Providers	Sensor Suppliers	Stimulation Vessel	ROV Companies	Equipment Rental Companies	Helicopter Companies
	Sub-suppliers	Component Manufacturers	Distributors	Fuel & Lubricant Suppliers							
	Types of Employment	Petroleum Engineers	Supply Chain Professionals	Service Company Workers	Logistics Professionals	Vessel Crews	Inspectors	Dock Workers	Rig Crews	Drilling Crews	Accounting and Finance Professionals

Source: Energy and Industrial Advisory Partners

Development drilling requires hundreds of direct and sub-suppliers as well as hundreds to thousands of workers ranging from engineers to rig hands to marine crews to catering workers to helicopter pilots.

Subsea Equipment Procurement Manufacturing and Fabrication

After a final investment decision is made, subsea equipment which often has a long (multi-year) lead time is one of the first items to be ordered. The longest lead items are typically the major parts of the subsea production system such as trees, manifolds, controls, and umbilicals. Often suppliers may even have been selected prior to FID, in some cases after a competitive bidding process, and in others through long-term agreements between operators and suppliers. Once contracts for equipment are let, subsea equipment manufacturers will place orders with sub-suppliers for the specialized materials and parts required for this equipment. Subsea equipment manufacturing typically requires large metal forgings, specialized corrosion resistant steel parts and tubing, valves, and actuators. Much of this equipment is machined in specialized shops, before being assembled, coated, and tested. While typically a few major contractors will lead the subsea equipment manufacturing and fabrication process, hundreds of sub-suppliers will typically be involved with preparing materials, manufacturing components, providing specialized services such as insulation, cladding and bolting, or testing of equipment. All components will be intensely engineered and tested due to the high potential cost of failure, which could lead to expensive intervention costs and lost production.

The following exhibit highlights the key stages of subsea equipment procurement manufacturing and fabrication, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 12).

Table 12: Subsea Equipment Procurement Manufacturing and Fabrication

Procurement	**Detailed Activities**	Technical Requirements Developed	Cost Estimation	Scheduling	Bid Packages Prepared	Bids Received	Bid Review	Negotiations	Contracting	
	Types of Equipment and Services	Subsea Trees	Subsea Trees	Manifolds	Control Systems	Umbilicals	Jumpers	Flying Leads		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Providers	Control Systems Providers	Steel Companies	Subsea Chemical Providers	Fabricators	Installation Contractors	Logistics Companies
	Sub-suppliers	Procurement Management Companies	Law Firms	Insurers	Procurement Management Services	Software Companies				
	Types of Employment	Subsea Engineers	Mechanical Engineers	Technical Drafters	Cost Estimators	Contract Professionals	Attorneys	Accounting and Finance Professionals		
Manufacturing & Fabrication	**Detailed Activities**	Steel Manufacturing	Materials Preparation	Component Manufacturing	Forging	Machining	Fabrication	Manufacturing	Cladding & Coating	
	Types of Equipment and Services									Coating Services
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Manufacturers	Subsea Umbilical Manufacturing Companies	Fabricators	Component Manufacturers	Steel Companies		
	Sub-suppliers	Material Companies	Valve Manufacturers	Actuator Manufacturers	Forging Companies	Machining Companies	Cladding Companies	Coating Companies	Buoyancy Manufacturers	Welding Companies & Equipment Suppliers
	Types of Employment	Subsea Engineers	Mechanical Engineers	Electrical Engineers	Welders	Machinists	Machine Operators	Coaters	Project Managers	Accounting and Finance Professionals
Assembly and Testing	**Detailed Activities**	Assembly	Integration	Testing	Factory Acceptance Testing	Systems Interface Testing				
	Types of Equipment and Services	Subsea Trees	Subsea Trees	Manifolds	Control Systems	Umbilicals	Jumpers	Flying Leads		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Manufacturers	Fabricators	Testing Providers	Regulators			
	Sub-suppliers	Testing Equipment Providers	Controlled Bolting Companies							
	Types of Employment	Subsea Engineers	Mechanical Engineers	Electrical Engineers	Assemblers	Inspectors	Testing Professionals	Project Managers	Regulatory Personnel	

Source: Energy and Industrial Advisory Partners

Given the large capital expenditures associated with subsea equipment procurement, manufacturing, and fabrication there is a significant employment impact, with jobs created including subsea engineers, mechanical engineers, electrical engineers, welders, machinists, machine operators, coaters, project managers, and accounting and finance professionals.

Facilities Procurement Manufacturing and Fabrication

Construction of a new fixed or floating production facility typically takes multiple years to complete, so operators will typically have selected one or more shipyards and fabrication yards and begun the procurement process prior to making a final investment decision. Once contracting is completed, work on the new facility will commence. Often, the platform's hull and topsides are built at separate yards, with hull construction especially often taking place at large international shipyards. Specialized steel and other components will be ordered, manufactured, and shipped to the appropriate yard. Often, a modularized construction process is utilized, with hull blocks or topsides modules constructed at sub-suppliers and shipped to a yard for assembly. Specialized equipment such as turbines, cranes, and processing modules will be manufactured by suppliers. As the hull or topside structure is completed modules and equipment will be lifted into place and connected to the structure. Once testing and trials take place, foreign built hulls will typically be transported on specialized semi-submersible heavy lift transport vessels to the Gulf of Mexico. Depending on the design of the platform, integration of the hull and topsides may take place either at the topside fabrication yard or offshore. While typically one or more contractors will lead the facility construction process, thousands of sub-suppliers will typically be involved with preparing materials, manufacturing equipment, providing specialized services such as installing electrical systems, bolting, inspection, painting, or testing. All work is typically supervised by both the project's operator as well as a class society to ensure that the completed unit meets all design specifications and will be safe to operate. (Table 13).

Table 13: Facilities Procurement Manufacturing and Fabrication

Procurement	**Detailed Activities**	Technical Requirements Developed	Cost Estimation	Scheduling	Big Packages Prepared	Bids Received	Bid Review	Negotiations	Contracting		
	Types of Equipment and Services	Hulls	Topsides	Processing Equipment	Piping	Chemical Injection Equipment	Control Systems	Chemical Injection Equipment	Tanks	Platform Equipment	Electrical Systems
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Subsea Hardware Providers	Control Systems Providers	Steel Companies	Process Equipment Manufacturers				
	Sub-suppliers	Procurement Management Companies	Law Firms	Insurers	Procurement Management Services	Software Companies					
	Types of Employment	Naval Architects	Mechanical Engineers	Technical Drafters	Cost Estimators	Contract Professionals	Attorneys	Accounting and Finance Professionals			
Hull Fabrication	**Detailed Activities**	Metal Testing	Module Fabrication	Metal Cutting	Welding	Machining	Lifting	Module Assembly	Painting	Testing	
	Types of Equipment and Services	Metal Cutting	Module Fabrication	Welding	Lifting	Integration					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	EPC Companies	Shipyards	Fabricators	Steel Companies	Cutting Companies	Testing Companies		
	Sub-suppliers	Welding Companies	Controlled Bolting Companies	Welding Equipment Suppliers	Cutting Equipment Suppliers	Industrial Gas Suppliers	Painting Companies	Marine Equipment Manufacturers	Machining Companies		
	Types of Employment	Naval Architects	Mechanical Engineers	Electrical Engineers	Welders	Machinists	Machine Operators	Coaters	Project Managers	Crane Operators	
Module & Topsides Manufacturing & Fabrication	**Detailed Activities**	Metal Testing	Process Equipment Manufacturing	Equipment Fabrication	Module Fabrication	Metal Cutting	Welding	Machining	Lifting	Module Integration	Painting
	Types of Equipment and Services	Metal Cutting	Module Fabrication	Welding	Process Equipment Manufacturing	Welding	Process Equipment Manufacturing	Heavy Lift	Process Piping Manufacturing	Integration Services	Testing Services
	Primary Companies and Suppliers	E&Ps	Engineering Companies	EPC Companies	Shipyards	Fabricators	Process Equipment Manufacturers	Steel Companies	Testing Companies		
	Sub-suppliers	Controlled Bolting Companies	Crane Suppliers	Welding Companies	Welding Equipment Suppliers	Meter Manufacturers	Control System Companies	Tank Manufacturers	Compression Manufacturers	Platform Equipment Manufacturers	Machining Companies
	Types of Employment	Chemical Engineers	Mechanical Engineers	Electrical Engineers	Welders	Machinists	Machine Operators	Coaters	Project Managers	Crane Operators	Accounting and Finance Professionals

Source: Energy and Industrial Advisory Partners

Facility procurement, manufacturing, and fabrication require thousands of workers including chemical, mechanical and electrical engineers, welders, machinists, machine operators, coaters, project managers, and crane operators. The following exhibit highlights the key stages of facilities procurement manufacturing and fabrication, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage.

Pipeline Procurement Coating and Welding

Depending on the field layout, offshore oil and natural gas projects may need tens to hundreds of miles of pipelines with diameters ranging from six inches (for infield flowlines) to 30 inches (for larger export pipelines). These pipelines are typically thick-walled and constructed from specialized steel to resist corrosion and pressure. Specialized steel manufacturers typically manufacture these pipes based on the project's specific requirements. After manufacturing pipes are inspected and tested to ensure compliance with technical requirements, pipelines are then coated with specialized coatings and insulation to reduce corrosion and improve flow assurance properties. The following exhibit highlights the key stages of Pipeline Procurement Coating and Welding, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers, and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 14).

Table 14: Pipeline Procurement, Manufacturing, Coating and Welding

Procurement	**Detailed Activities**	Technical Requirements Developed	Cost Estimation	Scheduling	Big Packages Prepared	Bids Received	Bid Review	Negotiations	Contracting
	Types of Equipment	Line Pipe	PLETs, PLEMs	Cement	Specialty Coatings	TCP	Welding Equipment	Insulation	Installation
	Primary Companies and Suppliers	EPC	Pipe Manufacturers	Installation Contractors	Equipment Manufacturers	Vessel Companies			
	Sub-suppliers	Insulation Manufacturers	Coating	Welding Equipment Suppliers	Logistics Companies				
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Technical Drafters	Cost Estimators	Contract Professionals	Attorneys	Accounting and Finance Professionals	
Manufacturing Coating & Welding	**Detailed Activities**	Material Manufacturing	Pipeline Manufacturing	Coating	Insulation	Welding	Bid Review	Negotiations	Contracting
	Types of Equipment	Line Pipe	PLETs, PLEMs	Cement	Specialty Coatings	TCP	Welding Equipment	Insulation Manufacturers	
	Primary Companies and Suppliers	EPC	Pipe Manufacturers	Installation Contractors	Equipment Manufacturers				
	Sub-suppliers	Insulation Manufacturers	Welding Materials	Coating	Welding Equipment Suppliers	Vessel Companies	Logistics Companies		
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Procurement Professionals	Manufacturing Personnel	QA/QC Professionals	Welders	Testing Professionals	Accounting and Finance Professionals

Source: Energy and Industrial Advisory Partners

The pipeline procurement and welding stage of project development requires a diverse supply chain including companies such as pipe manufacturers, installation contractors, equipment manufacturers, insulation manufacturers, welding equipment suppliers, and logistics companies. Workers involved in the process include pipeline and mechanical engineers, procurement professionals, manufacturing personnel, quality assurance professionals, welders, and testing professionals.

Subsea Equipment Installation and Commissioning

As subsea equipment manufacturing and fabrication is completed preparations to install equipment offshore begin. Offshore installation requires intensive engineering and planning to ensure that equipment can be installed safely and efficiently at depths thousands of feet below the water. This engineering is typically completed well ahead of the end of manufacturing. First, subsea equipment and components must be

shipped to shorebases or loading docks. Larger equipment is often fabricated at facilities adjacent to the water, while smaller equipment will be shipped by truck, rail, or air. Once delivered to a shorebase equipment will be packaged for offshore transport, often in specialized baskets and containers or other packaging to enable safe transfer offshore. Some equipment will be loaded onto barges or transport vessels while other equipment (such as umbilicals and some subsea hardware) will be loaded directly onto specialized installation vessels. Large cranes are utilized to transfer this equipment which will then be lashed to ensure safe transport. Once equipment is transported to the field's location, installation can begin. Most subsea equipment will be lowered to the sea floor utilizing specialized subsea construction vessels which are equipped with remotely operated vehicles and specialized heave compensated cranes (which allow the item being lowered to remain steady as the vessel interacts with ocean conditions). Umbilicals will be laid by specialized flex lay vessels which have large carousels to allow the vessel to lay out the umbilical. Large pieces of subsea equipment such as manifolds may require the use of heavy lift crane vessels that have especially large lifting capacities. (Figure 9)

Figure 9: Deep Star Subsea Installation Vessel

Source: TechnipFMC

Once all equipment is installed it must be connected, with crane vessels and ROVs installing equipment such as flying leads and jumpers and actuating connectors. Once connected, equipment will typically be purged, tested, checked to ensure that systems and equipment meet operational requirements, and documented. Once this process is complete the subsea production system will be ready to begin production. The following exhibit highlights the key stages of the subsea equipment installation and commissioning process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 15).

Table 15: Subsea Equipment Installation and Commissioning

Transportation and Logistics	**Detailed Activities**	Packaging	Equipment Transportation	Onshore Logistics	Logistics Equipment Rental	Vessel Transport	Air Transport				
	Types of Equipment and Services	3rd Party Logistics	Trucking	Ports	Supply Vessels	Helicopters					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	EPC Companies	Freight Forwarders	Trucking Companies	Ports	Crane Companies	Vessel Companies	Equipment Rental Companies	
	Sub-suppliers	Packaging Suppliers	Fuel & Lubrication Suppliers	Crane Manufacturers	Shipyards	Rope Suppliers	Lifting Gear Suppliers				
	Types of Employment	Truck Drivers	Logistics Professionals	Supply Chain Professionals	Customs Brokers	Dock Workers	Crane Operators	Vessel Crews	Pilots	Accounting and Finance Professionals	
Equipment Installation	**Detailed Activities**	Site Preparation	Mats and Other Installation Aids	Equipment Lowering	Equipment Placement	Ancillary Equipment Installation	Equipment Hookup	Equipment Commissioning			
	Types of Equipment and Services	ROVs	Mats	Cranes	Vessels	Subsea Trees	Manifolds	Flying Leads	Jumpers		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Contractors	Vessel Companies	Subsea Hardware Manufacturers	Subsea Umbilical Manufacturers	Fabricators	Control System Manufacturers	Service Companies	Equipment Rental Companies
	Sub-suppliers	Fuel & Lubricant Suppliers	Crane Manufacturers	Shipyards	Rope Suppliers	Dynamic Positioning System Manufacturers	Survey Companies	Positioning Companies	ROV Companies	Mat Suppliers	Lifting Gear Suppliers
	Types of Employment	Subsea Engineers	Mechanical Engineers	Vessel Crews	Crane Operators	Divers	Welders	ROV Pilots	Equipment Operators	Testing Professionals	Support Workers
Hookup & Commissioning	**Detailed Activities**	Hookup	Testing	Commissioning	Inspection						
	Types of Equipment and Services	Vessels	ROVs	Installation Equipment	Pre-commissioning spreads	Subsea Acoustic Position Systems	Air & Saturation Diving Systems				
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Companies	Vessel Companies	Subsea Hardware Manufacturers	Subsea Umbilical Manufacturing Companies	Service Companies	Control System Manufacturers	Chemical Companies	Inspection Companies
	Sub-suppliers	Fuel & Lubricant Suppliers	Chemical Companies	Industrial Gas Suppliers	Rental Companies	Survey Companies	ROV Companies	Logistics Companies	Catering Companies	Helicopter Companies	Regulators
	Types of Employment	Subsea Engineers	Mechanical Engineers	Vessel Crews	ROV Pilots	Divers	Electrical Engineers	Support Workers	Helicopter Pilots	Helicopter Pilots	Regulatory Personnel

Source: Energy and Industrial Advisory Partners

Installation of subsea equipment requires a large number of companies, typically led by one or more primary installation contractors including vessel companies, subsea hardware manufacturers, subsea umbilical manufacturers, fabricators, service companies, and equipment rental companies. Many different professions are required to complete this work including subsea and mechanical engineers, vessel crews, crane operators, divers, welders, ROV pilots, equipment operators, testing professionals, and support workers.

Facilities Installation and Commissioning

As facility manufacturing and fabrication is completed preparations to install the facilities offshore begin. Facilities installation requires intensive engineering and planning. Facilities must be transported offshore, depending on the type of facility and the installation plan the transportation method will differ. For floating production units that were integrated at a shipyard, large tugs will tow the unit to its planned installation location. In other cases, platform jackets and topsides will be transported on barges. If required, integration will take place offshore utilizing heavy lift crane vessels capable of lifting up to 15,000 tons at one time. (Figure 10)

Figure 10: Thialf Heavy Lift Crane Vessel

Source: Heerema

Depending on the crane vessel and integration plan one or more lifts may take place, with separate portions or modules being installed separately onto the unit. These vessels may also install suction piles (long steel cylinders used as anchors), and mooring ropes to hold the unit in place, and pull risers that have been pre-laid by a pipeline installation vessel into facilities to transport oil and natural gas production from the seabed to the surface. Once the major components of the facility have been installed, integration must be completed and commissioning begun. Process equipment will be flushed and dried, control systems tested, equipment verified that it is fit for purpose and documented. Before production can begin, class society and regulatory approval will be obtained.

The following exhibit highlights the key stages of the facilities installation and commissioning process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 16).

Table 16: Facilities Installation and Commissioning

Transportation and Logistics	**Detailed Activities**	Loading	Heavy Transport	Towing	Positioning						
	Types of Equipment and Services	Shipyards	Ports	Lifting	Lashing	Heavy Transport	Barges	Tugs	Heavy Lift Vessels	Supply Vessels	Helicopters
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Shipyards	Heavy Transport Companies	Vessel Companies	Crane Companies	Equipment Rental Companies			
	Sub-suppliers	Packaging Suppliers	Fuel & Lubrication Suppliers	Crane Manufacturers	Rope Suppliers	Lifting Gear Suppliers	Helicopter Companies	Positioning Companies			
	Types of Employment	Truck Drivers	Logistics Professionals	Supply Chain Professionals	Customs Brokers	Dock Workers	Crane Operators	Vessel Crews	Pilots	Accounting and Finance Professionals	
Installation & Mooring	**Detailed Activities**	Topsides Integration	Module Lifting	Positioning	Suction Pile Installation	Mooring Line Installation	Mooring Pull In	Mooring Connection	Mooring Tensioning	Sensor Installation	
	Types of Equipment and Services	Heavy Lift Vessels	Positioning Services	ROVs	Mooring Services	Tugs					
	Primary Companies and Suppliers	E&Ps	Engineering Companies	EPC Companies	Installation Contractors	Mooring System Suppliers	Vessel Companies	Chain Suppliers	Mooring Rope Manufacturers	Anchor Manufacturers	
	Sub-suppliers	Fuel & Lubricant Suppliers	Crane Manufacturers	Shipyards	Rope Suppliers	Dynamic Positioning System Manufacturers	Survey Companies	Positioning Companies	ROV Companies	Lifting Gear Suppliers	Testing Companies
	Types of Employment	Naval Architects	Mechanical Engineers	Vessel Crews	Crane Operators	Divers	Welders	ROV Pilots	Equipment Operators	Testing Professionals	Support Workers

Source: Energy and Industrial Advisory Partners

Table 16: Facilities Installation and Commissioning *(Continued)*

Riser Installation	**Detailed Activities**	Riser Spooling	Riser Transport	Riser Lay	Riser Pull In	Riser Equipment Installation	VIV Prevention Installation	Riser Connection	Corrosion Protection Installation		
	Types of Equipment and Services	Spoolbases	Heavy Lift Vessels	Lay Vessels	Positioning Services	ROVs	Riser Services	Buoyancy	VIV Reduction Equipment		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Installation Contractors	Riser System Suppliers	Steel Companies	Fabricators	Buoyancy Manufacturers	Insulation Manufacturers	Coating Companies	Testing Companies
	Sub-suppliers	Steel Companies	Fuel & Lubricant Suppliers	Crane Manufacturers	Rope Suppliers	Dynamic Positioning System Manufacturers	Survey Companies	Positioning Companies	ROV Suppliers	Lifting Gear Suppliers	
	Types of Employment	Naval Architects	Mechanical Engineers	Vessel Crews	Crane Operators	Divers	Welders	ROV Pilots	Equipment Operators	Testing Professionals	Support Workers
Hook-up & Commissioning	**Detailed Activities**	Integration	Flushing & Drying	Control System Testing	Testing	Process Verification	Documentation	Class Society Approval	Regulatory Approval		
	Types of Equipment and Services	Pipefitting	Welding	Flushing & Drying	Electrical Services	Controlled Bolting	Inspection Services	Testing Services	Documentation	Instrumentation & Electrical Services	Manpower & Recruiting Services
	Primary Companies and Suppliers	E&Ps	Engineering Companies	EPC Companies	Chemical Companies	Industrial Gas Companies	Controlled Bolting Companies	Inspection Companies	Regulators	Classification Societies	Manpower & Recruiting Services
	Sub-suppliers	Fuel & Lubricant Suppliers	Chemical Companies	Industrial Gas Suppliers	Rental Companies	Survey Companies	Positioning Companies	ROV Suppliers	Logistics Companies	Catering Companies	Helicopter Companies
	Types of Employment	Naval Architects	Mechanical Engineers	Electrical Engineer	Electricians	Instrumentation & Controls Specialists	Welders	Inspectors	Documentation Specialists	Testing Professionals	Regulatory Personnel

Source: Energy and Industrial Advisory Partners

Installation of facilities requires a large number of companies such as installation contractors, mooring system suppliers, vessel companies, chain suppliers, mooring rope manufacturers, and anchor manufacturers.

Many different professions are required to complete this work including naval architects, mechanical engineers, vessel crews, crane operators, divers, welders, ROV pilots, equipment operators, testing professionals, and support workers.

Pipeline Laying and Commissioning

After manufacturing, coating, and preparation of pipe and related pipeline equipment is completed preparation for installation will begin. Depending on the location and seabed conditions of pipelines work to prepare the seabed for pipeline installation may take place. This can include excavation of trenches, or installation of mats to allow the safe installation of pipelines. These types of operations are typically undertaken by specialized vessels using cranes, trenchers, or other specialized equipment. Depending on the type of pipeline and the designed lay procedures, pipelines may either be loaded directly onto installation vessels at specialized spoolbases where pipe is welded and reeled onto the vessel itself or transported to the lay vessel offshore. Depending on the lay method, as pipe is laid out of the lay vessel offshore, welding and field joint coating of the pipeline may take place on the vessel itself. (Figure 11)

Figure 11: Seven Oceans Pipelay Vessel

Source: Subsea 7

Typically as pipelines are installed, either the lay vessel or another following vessel inspects the pipeline using ROVs to ensure that the pipeline has been laid correctly and is in good condition. If necessary, additional vessels will later backfill trenches, or dump rocks onto pipelines to ensure they remain in place and are not damaged by vessel anchors, fishing equipment, or other hazards.

Once installation is complete, pipelines will be prepared to receive product. This process typically involves cleaning the pipeline, testing it, removing water, inspecting it, and inerting the pipeline with nitrogen to prepare it for the introduction of hydrocarbons. The following exhibit highlights the key stages of the pipeline laying and commissioning process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 17).

Table 17: Pipeline Laying and Commissioning

Excavation	**Detailed Activities**	Excavation of trench	Spooling	Transport and Logistics							
	Types of Equipment & Services	Design software	Subsea excavation tools	Pipe spooler	Cranes	Vessels	Welding equipment	Testing Equipment			
	Primary Companies and Suppliers	Installation Contractors	Dredging Companies	Vessel Companies							
	Sub-suppliers	Equipment Manufacturing	Equipment Rental	Manpower & Recruiting Services	Fuel & Lubricant Suppliers						
	Types of Employment	Pipeline Engineers	Geotechnical Engineers	Field Technicians & Supervisors	Crane Operators	Vessel Crews	Accounting and Finance Professionals				
Pipelay and Welding	**Detailed Activities**	Pipelay	Welding	Confirmation of Lay Parameters	Back Filling Line & Trenching						
	Types of Equipment & Services	Navigation Equipment	Line Pipe	PLET, PLEMs	Directional Drilling Equipment	Pipe Tensioners	Suction Piles	Pipelay Vessel			
	Primary Companies and Suppliers	EPC	Fabricators	Installation Contractors	Vessel Companies						
	Sub-suppliers	Component Manufacturers	Logistics Companies	Fuel & Lubricant Suppliers	ROV Companies						
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Vessel Crews	Crane Operators	Divers	Welders	ROV Pilots	Equipment Operators	Testing Professionals	Support Workers

Source: Energy and Industrial Advisory Partners

Table 17: Pipeline Laying and Commissioning *(Continued)*

Pre-commissioning	**Detailed Activities**	Cleaning, Flooding, Gauging & Testing	Dewatering & Drying	Baseline Inspection	Inerting and Hydrocarbon Intro.		Vessel Companies			
	Types of Equipment & Services	Design software	Cryogenic Tanks & Pumps	Liquid Nitrogen, Helium	Chemicals	Pigs and Intelligent Pigs, ILI tools				
	Primary Companies and Suppliers	Software Companies	Pre-commissioning Services	Industrial Gas Suppliers	Equipment Manufacturers	Equipment Rental	ROV Companies			
	Sub-suppliers	Inspection Equipment Manufacturers	Transport & Logistics	Manpower & Recruiting Services	Component Manufacturers	Catering	Law Firms	Insurance	Regulators	Fuel & Lubricant Suppliers
	Types of Employment	Pipeline Engineers	Mechanical Engineers	Vessel Crews	ROV Pilots	Divers	Support Workers	Helicopter Pilots	Regulatory Personnel	

Source: Energy and Industrial Advisory Partners

Laying and commissioning pipelines requires a large number of companies including fabricators, installation contractors, vessel companies, pre-commissioning, and commissioning providers, component manufacturers, logistics companies, and gas, fuel, and lubricant suppliers. Many different professions are required to complete this stage of the project development process including pipeline and mechanical engineers, vessel crews, crane operators, divers, welders ROV pilots, equipment operators, testing professionals, and support workers.

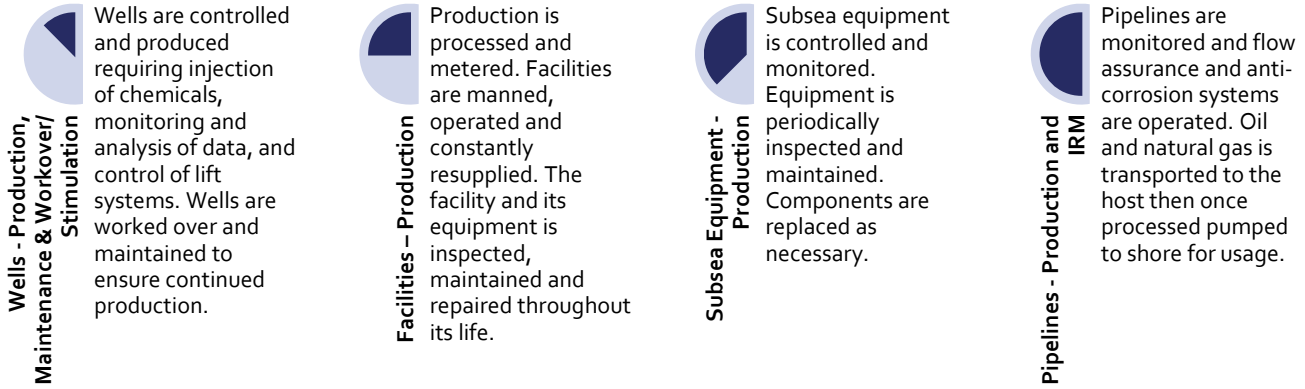
Operations

First Production

After the installation and commissioning process is completed, production at the new offshore project can commence. Typically, production will initially be started from one or more wells and production ramped up as more wells are flowed back to remove debris, and production equipment is brought online. Often, debottlenecking or process optimization will take place to allow facilities to operate at their designed capacity levels. This production ramp-up process can sometimes take multiple years, as additional wells are drilled, tied back to the facility, and brought online. Once production begins, the operational phase of a project's lifecycle begins. Although the initial development may be completed, operating and maintaining an offshore project requires hundreds of companies, thousands of workers, and millions of dollars of annual spending. Wells,

facilities, subsea equipment, and pipelines must be constantly controlled and monitored, and throughout the project's lifecycle workover, inspection, maintenance, and repair operations take place. (Figure 12)

Figure 12: Operations Stages



Source: Energy and Industrial Advisory Partners

Well Production Maintenance and Workover

Oil and natural gas wells are the lifeblood of any project, and ensuring they continue to produce safely and efficiently requires constant work. Wells must be controlled to ensure they are safely producing at the best rate to maintain long-term production, data must be continuously collected, and chemicals (to allow them to flow optimally) must be constantly injected and recovered. Wells must be worked over and stimulated to maintain production, artificial lift systems, and downhole equipment must be replaced. This work can take place either directly from a production unit if a dry tree configuration is utilized or by a drilling rig or specialist intervention vessels if subsea trees are in place. (Figure 13)

Figure 13: Deepwater Asgard Drillship

Source: Beacon Offshore Energy

Third party suppliers will supply the vessels, equipment, and services to complete these operations by supplying tools, intervention equipment, and wireline, coiled tubing, and snubbing units that are used to access the well. Chemicals, proppant, nitrogen, and other consumables are also required. All of these materials must be transported offshore, by supply vessels. While vessel crews and oil and gas workers must be transported to and from shore by helicopters. (Figure 14)

Figure 14: Sikorsky S-92 Helicopter

Source: PHI Group, Inc.

The following exhibit highlights the key stages of the production, maintenance, and workover process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 18).

Table 18: Well Production Maintenance and Workover

Production	**Detailed Activities**	Well Control & Management	Chemical Injection	Data Collection & Processing							
	Types of Equipment & Services	BOPs	Injection Systems	Chemical Tanks	Logging Equipment	Data Processing Systems	Training	Software			
	Primary Companies and Suppliers	Well Services	Equipment Manufacturing	Equipment Rental	Well Logging	Data Management Systems	Software Companies	Training Companies			
	Sub-suppliers	Equipment Manufacturing	Equipment Rental	Manpower & Recruiting Services	Insurance Companies	Spill Response Companies	Fuel & Lubricant Suppliers				
	Types of Employment	Petroleum Engineers	Chemical Engineers	Mechanical Engineers	Control System Operators	Chemical System Operators	Supply Chain Professionals	Logistics Professionals			
Maintenance, Workover / Stimulation	**Detailed Activities**	Engineering	Permitting	Nitrogen Services & Gas Lift	Chemical & Acid Supply, Injection	Well Workover & Repair	Hydraulic Fracturing Materials Provision & Services	Coiled Tubing	Artificial Lift	Stimulation	
	Types of Equipment & Services	Nitrogen Pumps, Tanks, Membrane Units	Chemicals & Chemical Tanks, Pumps	Intervention Tools	Coiled Tubing Units	Proppant	Perforating Equipment	Artificial Lift Equipment	Stimulation Vessels	Intervention Vessels	Intervention Vessels
	Primary Companies and Suppliers	Well Services	Nitrogen Services	Chemical Services	Stimulation	Acidizing	Perforating				
	Sub-suppliers	Equipment Manufacturing	Equipment Rental	Industrial Gas Supply	Chemical Supply	Fuel & Lubricant Suppliers	Proppant Suppliers				
	Types of Employment	Petroleum Engineers	Mechanical Engineers	Service Company Employees	Marine Crew	Manpower & Recruiting Services	Manufacturing Workers	Welders	Machinists		

Source: Energy and Industrial Advisory Partners

Many different professions are required to support well production, maintenance, and workover operations including petroleum, chemical, and mechanical engineers, control system and chemical system operators, and supply chain and logistics professionals.

Facilities Production, Operations, and Maintenance

During the operational phase of a project's lifecycle production platforms act as the hub of offshore oil and natural gas projects. Wells and subsea infrastructure are controlled by systems on the platform, data is gathered to send to shore, chemicals are received and injected into wells and processing systems, production is metered, separated, processed, compressed, and exported to shore via pipeline. Supporting these production activities sometimes requires hundreds of people on the platform. These workers control systems, maintain equipment and the facility itself, ensure the platform safely remains on location, provide for the needs of workers on the platform, and many other functions. Supporting these workers is a huge logistical operation that ensures that all the goods, equipment, and workers needed to operate and maintain the facility are available. Vessels and helicopters deliver to the platform offshore, while onshore, trucks bring deliveries from hundreds of suppliers to shorebases and heliports, workers are flown in from all over the country to work their rotations. (Figure 15)

Figure 15: Thunder Offshore Supply Vessel

Source: Jackson Offshore

Beyond normal operations, facilities will undergo inspection and maintenance throughout their lifecycles. For example, this may include non-destructive testing, repair, replacement, and upgrades of steel, processing equipment, and other systems.

The following exhibit highlights the key stages of facilities production, operations, and maintenance process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage and some example types of employment created during this activity stage. (Table 19)

Table 19: Facilities Production, Operations, and Maintenance

Production, Processing & Metering Operations	**Detailed Activities**	Production	Equipment Control	Chemical Injection	Flow Assurance	Artificial Lift	Metering	Separation	Processing	Export	Safety
	Types of Equipment and Services	Chemicals	Filtration	Hydraulic Fluids	Data Processing	Processing Consumables	Vessels				
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Chemical Companies	Consumable Providers	Hydraulic Fluid Suppliers	Service Companies	Manpower & Recruiting Services			
	Sub-suppliers	Equipment Manufacturing	Transportation & Logistics	Supply Vessels	Helicopter Operators	Catering	Healthcare Providers				
	Types of Employment	Production Engineers	Process Engineers	Instrumentation Technicians	Chemical Engineers	Equipment Operators	Supervisors				
Facility Operations, Resupply & Logistics	**Detailed Activities**	Asset Management	Logistics	Station Keeping	Catering	Lubrication	Power Generation	Utilities	Cleaning	Waste Processing	Personnel Transfer
	Types of Equipment and Services	Asset Management Services	Logistics Services	Cleaning Services	Filtration Services	Electrical and Instrumentation Services	Personnel Transfer Services	Food, Fuel and Water	Medical Services	Vessels	Vessels
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Asset Management Companies	Vessel Companies	Catering Companies	Filtration Suppliers	Cleaning Companies	Water Processing Companies	Helicopter Companies	Instrumentation & Electrical Services
	Sub-suppliers	3rd Party Logistics Companies	Trucking Companies	Cleaning Companies	Fuel & Lubricant Suppliers	Medical Service Companies					
	Types of Employment	Equipment Operators	Logistics Professionals	Supply Chain Professionals	Catering Workers	Dock Workers	Crane Operators	Vessel Crews	Pilots	Support Workers	Inspection Professionals

Source: Energy and Industrial Advisory Partners

Table 19: Facilities Production, Operations, and Maintenance

Facility and Equipment Inspection, Repair & Maintenance [IRM]	**Detailed Activities**	Routine Maintenance	Equipment Inspection	Facility Inspection	Pigging	Inerting	Controlled Bolting	Equipment Replacement	Painting	Corrosion Prevention	Power Generation Maintenance
	Types of Equipment and Services	Engineering	Inspection	Testing	Mechanical Maintenance	Process Equipment Maintenance	Control System Maintenance	Power Generation Maintenance	Tank Cleaning	Electrical & Instrumentation Maintenance	
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Asset Management Companies	Vessel Companies	Accommodation Vessel Companies					
	Sub-suppliers	Inspection & Testing Companies	Controlled Bolting Companies	Welding Companies & Equipment Suppliers	Control System Companies	Power Generation Maintenance Companies	Tank Cleaning Companies	Process Equipment Maintenance Companies	Manpower & Recruiting Services	Instrumentation & Electrical Service Providers	
	Types of Employment	Naval Architects	Mechanical Engineers	Testing Professionals	Rope Access Technicians	Welders	Painters	Equipment Operators	Machinists		

Source: Energy and Industrial Advisory Partners

Facilities production, operations, and maintenance require hundreds of suppliers including engineering and asset management companies, vessel companies, catering companies, filtration suppliers, cleaning companies, water processing companies, helicopter companies, and instrumentation & electrical services. These operations also support large employment levels including jobs such as equipment operators, logistics and supply chain professionals, catering workers, dock workers, crane operators, vessel crews, pilots, support workers, and inspection professionals. (Figure 16)

Figure 16: Asset Management Workers

Source: Danos

Subsea Production, Inspection, Repair, and Maintenance

Subsea production and control systems allow offshore projects to continue to produce oil and natural gas safely and efficiently. As production flows through the subsea system wells and other subsea systems must be controlled via electric and hydraulic systems from their host facility. Data must be continuously gathered and processed. Chemicals must be injected to prevent corrosion, inhibit the build-up of blockages such as wax and hydrate to ensure fluids continue to flow through the system. These chemicals must then be separated from produced fluids. Production and seismic data must be studied to optimize production. Subsea equipment must also be inspected by specialized vessels utilizing remotely operated vehicles, and various components replaced as necessary. Instruments and control systems must be maintained and upgraded. Systems must be flushed to ensure prevent shutdowns. Subsea production, inspection, repair, and maintenance operations require a diverse group of companies to be successful including engineering companies, chemical companies, hydraulic fluid suppliers, service companies, asset management companies, and filtration suppliers.

The following exhibit highlights the key stages of the production, maintenance, and workover process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 20)

Table 20: Subsea Production, Inspection, Repair, and Maintenance

Production, Processing & Metering Operations	**Detailed Activities**	Production	Well Control	Subsea Equipment Control	Equipment Monitoring	Chemical Injection	Flow Assurance	Metering			
	Types of Equipment and Services	Asset Management	Chemicals	Hydraulic Fluids	Reservoir Monitoring	Production Optimization	Data Processing	Seismic	Corrosion Prevention		
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Chemical Companies	Hydraulic Fluid Suppliers	Service Companies	Asset Management Companies	Data Companies	Seismic Companies		
	Sub-suppliers	Manpower & Recruiting Services	Filtration Suppliers								
	Types of Employment	Subsea Engineers	Process Engineers	Instrumentation Technicians	Chemical Engineers	Equipment Operators	Supervisors				
Inspection, Repair & Maintenance	**Detailed Activities**	Subsea Inspection	Subsea Maintenance	Subsea Repair	Hardware Replacement	Control Replacement	Flushing				
	Types of Equipment and Services	Engineering	Inspection	Testing	Mechanical Maintenance	Process Equipment Maintenance	Control System Maintenance	Power Generation Maintenance	Tank Cleaning	Electrical & Instrumentation Maintenance	IRM Vessels
	Primary Companies and Suppliers	E&Ps	Engineering Companies	Vessel Companies	ROV Companies	Tooling Suppliers	Subsea Hardware Manufacturers	Subsea Umbilical Manufacturers	Control System Manufacturers		
	Sub-suppliers	Inspection & Testing Companies	Controlled Bolting Companies	Welding Companies & Equipment Suppliers	Control System Companies	Manpower & Recruiting Services	Instrumentation & Electrical Service Providers	ROV Companies	ROV Companies		
	Types of Employment	Subsea Engineers	Mechanical Engineers	Technical Sales	Testing Professionals	ROV Pilots	Welders	Equipment Operators	Machinists	Vessel Crews	

Source: Energy and Industrial Advisory Partners

Supporting subsea production, inspection, repair, and maintenance operations requires a diverse array of workers including subsea and mechanical engineers, testing professionals, ROV pilots, welders, equipment operators, machinists, and vessel crews. (Figure 17)

Figure 17: Oceaneering E-ROV

Source: Oceaneering

Pipeline Production, Inspection, Repair, and Maintenance

During production operations, pipelines transport unprocessed oil, natural gas, and water to the host production platform for processing, and transport processed oil and natural gas to shore for further processing for use. Infield pipelines typically require the constant injection of chemicals to ensure that they continue to flow and to prevent corrosion. Before export oil and natural gas must be tested to ensure it meets product specifications for its destination and metered so working interest owners and the federal government receive the required payments and royalties. Oil must be pumped, and natural gas compressed to allow them to reach their destinations. Pipelines must be constantly monitored, and periodically inspected with remotely operated vehicles (ROVs) controlled from specialized vessels. Corrosion prevention devices will be replaced, and specialized devices called pigs will be circulated through pipeline systems to clean, inspect them and gather data such as wall thickness and any deviation from baseline inspection data. Supporting pipeline production, repair, and maintenance operations require a variety of companies including engineering, vessel, and chemicals companies, equipment manufacturers and rental companies, manpower and recruiting services, transport and logistics companies, and fuel and lubricant suppliers. The following exhibit highlights the key stages of the pipeline production, inspection, repair, and maintenance process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 21)

Table 21: Pipelines Production, Inspection, Repair and Maintenance

Production	**Detailed Activities**	Flow Assurance	Monitoring	Corrosion Prevention	Pumping	Onshore Processing					
	Types of Equipment	Laboratories	Chemicals	Engineering & Simulation Software	Chemical Injection / Pumping						
	Primary Companies and Suppliers	Engineering Companies	Vessel Companies	Chemicals Companies	Equipment Manufacturers						
	Sub-suppliers	Equipment Rental Companies	Manpower & Recruiting Services	Transport & Logistics Companies	Fuel & Lubricant Suppliers						
	Types of Employment	Pipeline Engineers	Chemical Engineers	Instrumentation Technicians	Equipment Operators	Supervisors					
Inspection & Testing	**Detailed Activities**	General Visual Inspection	Close Visual Inspection of Stabilization Facilities	Check for Type of Coating, Locate any Coating Damage	Cathodic Protection Testing	NDT (various)	UT	Bathymetry	Alternating Current Field Measurement (ACFM)		
	Types of Equipment	ROVs & AUVs	Subsea Cameras	Diving Equipment	Data Storage & Management Systems	IRM Vessels	Pigs, Intelligent Pigs, ILI Tools	Liquid Nitrogen	Cryogenic Vessels		
	Primary Companies and Suppliers	Survey Companies	Vessel Companies	Service Companies	IRM Companies	Testing Companies					
	Sub-suppliers	ROV Companies	Industrial Gas Suppliers	Fabricators	Equipment Rental Companies	Manpower & Recruiting Services					
	Types of Employment	Pipeline Engineers	ROV Pilots	Project Managers	Vessel Crews	Equipment Operators	Integrity Engineers	Testing Professionals	Inspectors		
Repair & Maintenance	**Detailed Activities**	Engineering	Coating & Balance Repair	Anodes Installation	Installation of Repair Clamps	Flange Repair	Marine Growth Cleaning & Debris Removal	Subsea Welding	Scour Protection		
	Types of Equipment	Cutting & Welding equipment	Lift Vessels	Chemicals & Gels	Mechanical Pigs	Nitrogen Pumps	Cryogenic Vessels	Flaring Equipment	Pipe Clamps		
	Primary Companies and Suppliers	Subsea Services	Oilfield Services	Chemicals Suppliers	EPC	Manpower & Recruiting Services	Fabricators				
	Sub-suppliers	Equipment Manufacturers	Vessel Contractors	Inspection, Repair & Maintenance Providers	Industrial Gases	Equipment Rental Companies					
	Types of Employment	Pipeline Engineers	Technical Sales	Project Managers	Integrity Engineers	Equipment Operators	Machinists	Vessel Crews	ROV Pilots	Welders	Testing Professionals

Source: Energy and Industrial Advisory Partners

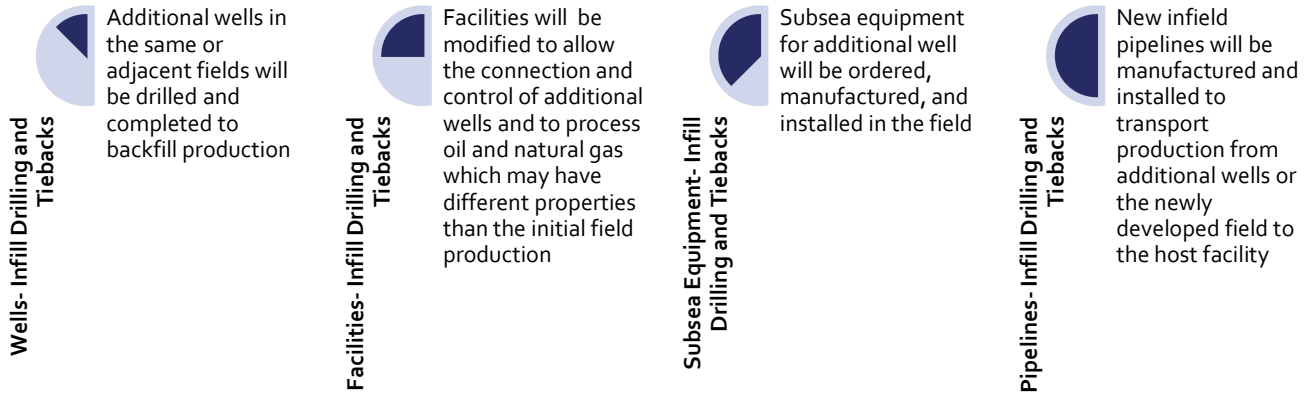
Supporting these operations requires employees with diverse skill sets including pipeline, integrity and chemical engineers, instrumentation technicians, ROV pilots, project managers, vessel crews, equipment operators, testing professionals, and inspectors.

Infill Drilling & Tiebacks

Subsea Tiebacks and Infill Drilling

During the lifecycle of a standalone deep or shallow water offshore oil and natural gas project, production from the wells initially drilled and completed to underpin the project's development will begin to decline. As production declines, processing and oil and natural gas export capacity become available. For shallow water projects, as production begins to decline operators will often drill additional wells into either the same or a nearby adjacent reservoir directly from the platform by leasing a platform drilling rig. These wells will then be completed and brought onto production. For deepwater projects, new wells in the same field which supported the initial development may be drilled, completed, and tied into the host facility, or the operator of the initial project or a 3rd party operator may drill, complete, and tieback a nearby field into the host platform. Infill drilling and subsea tiebacks are thus essentially new project developments with the exception of the platform or floating production system (though platform modifications are typically required due to factors such as differences in the composition of produced oil and natural gas). Although subsea tiebacks and infill drilling do not typically require the same levels of capital development as standalone projects, depending on their scope, the spending (and subsequent employment impacts) of these projects are still significant. Additionally, these projects support the economics of initial field developments and allow them to remain in production for their full intended lifespans. Depending on the scope of the infill drilling or subsea tie-backs the work required may range from just drilling new wells directly from the facility (especially on shallow water projects) to a new field development requiring a similar process to the initial field development apart from the construction of new facilities. (Figure 18)

Figure 18: Infill Drilling and Tieback Stages

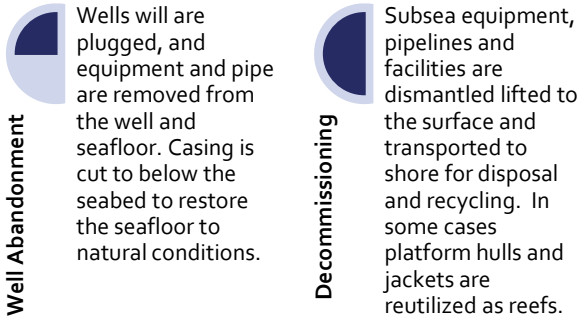


Source: Energy and Industrial Advisory Partners

Abandonment and Decommissioning

As oil and natural gas production declines, and there are no longer nearby economically accessible reserves to tie into a project, fixed and floating production platforms will eventually reach the end of their life. Typically, operators will plan for this eventuality from the beginning of the development process, to ensure that wells, facilities, and other infrastructure can be safely plugged, abandoned, and decommissioned when it is required. (Figure 19)

Figure 19: Abandonment and Decommissioning Stages



Source: Energy and Industrial Advisory Partners

Operators will work with regulators to ensure that abandonment and decommissioning plans meet regulatory requirements through a permitting process. The abandonment and decommissioning process is highly dependent on the type of wells and facilities utilized in project development. Perhaps the most important part of this process is the plugging and abandoning of producing wells to ensure that no environmental pollution is possible. This process can be completed directly from a platform, or by a drilling rig or specialized intervention vessel. Pipe and other equipment will be removed from the wellbore and recycled, cement and other fluids will be pumped into the well, and once a permanent seal is in place, casing cut to below the seafloor. After recovery of casing, wellheads, and other equipment, the subsurface casing will be buried leaving no trace of the well. Floating production facilities will typically be towed back to shore for disassembly, cleaning, and disposal after disconnection, while a fixed platform will be cut into pieces and lifted by crane vessels and placed on barges for transportation to shore, disassembly, cleaning, and disposal or recycling. (Figure 20)

Figure 20: DCV Balder Removes Tension Leg Platform

Source: Heerema Marine Contractors

Steel will typically be sold to recyclers for further reuse. In some cases, hulls or jackets which have not been exposed to hydrocarbons will, after cutting to ensure they would not interfere with marine traffic, be left in place or towed elsewhere to be sunk as part of the Rigs-to-Reefs program which supports the use of decommissioned platforms as artificial reefs to support marine life and habitats, recreational and commercial fishing, and diving. Subsea hardware will typically be cut, lifted to the surface, and placed on barges to be returned to shore for cleaning, and recycling. Pipelines may be removed or abandoned in place after being purged of all hydrocarbons and cleaned. The abandonment and decommissioning process requires significant expenditures on the part of operators who are supported in the process by oilfield service and well control companies, tool manufacturers, vessel companies, manpower and recruiting services, cementing companies, recycling and trading companies, and regulators.

The following exhibit highlights the key stages of the production, maintenance, and workover process, the detailed activities which take place to complete this project stage, the types of equipment and services utilized, suppliers and sub-suppliers active during this project stage, and some example types of employment created during this activity stage. (Table 22)

Table 22: Abandonment and Decommissioning Overview

Well P&A	**Detailed Activities**	Engineering	Permitting	Tubular Cutting & Retrieval	Wellbore Grouting	Casing Cutting and Subsea Hardware Retrieval	Transportation and Logistics	Reuse Component Selection	Refurbishment	Recycling	Scrapping
	Types of Equipment & Services	Engineering	Rigs	Intervention Vessels	Shears & Cutting Equipment	Plugs	Cement & Cement Pump & Tank	Lifting Equipment	Cutting and Milling Tools	Swarf Recovery	
	Primary Companies and Suppliers	Oilfield Service Companies	Well Control Companies	Tool Manufacturers	Vessel Companies	Manpower & Recruiting Services	Regulators	Cementing Companies	Recycling & Trading Companies		
	Sub-suppliers	Equipment Rental	Pump Manufacturing	Vessel Manufacturing & Repair	Hydraulics Suppliers	Recycling & Trading	Training Companies	Tool Manufacturers	Inspection Companies		
	Types of Employment	Petroleum Engineers	Mechanical Engineers	ROV Pilots	Rig Crews	Vessel Crews	Crane Operators	Equipment Operators	Divers	Service Company Personnel	Regulatory Personnel
Production Facilities Decommissioning	**Detailed Activities**	Permitting	Permitting	Hydrocarbon Elimination	Disassembly of Key Components	Heavy Lift	Transportation & Logistics	Reuse Component Selection	Environmental Management	Scrapping and Recycling	
	Types of Equipment & Services	Engineering	Heavy Lift Vessels	Classification	Environmental Services	Cutting and Milling Tools	Containers	Cranes and Rigging	Accommodation Modules	Manpower & Recruiting Services	
	Primary Companies and Suppliers	E&Ps	Vessel Companies	Classification Societies	Environmental Consulting	Equipment Manufacturing	Container Manufacturing & Rental	Manpower & Recruiting Services	Regulators		
	Sub-suppliers	Inspection Companies	Equipment Manufacturing	Scrap & Recycling Companies	Fuel & Lubricant Suppliers	Transportation & Logistics	Training Companies				
	Types of Employment	Naval Engineers	Structural Engineers	Mechanical Engineers	Electrical Engineers	Equipment Operators	Divers	Crane Operators	Vessel Crews	Welders	Technical Sales
Subsea Facilities Decommissioning	**Detailed Activities**	Engineering	Permitting	Hardware Cutting	Hardware Removal	Heavy Lift	Transportation & Logistics	Recycling	Scrapping		
	Types of Equipment & Services	Engineering	Vessels	Cutting Tools	ROVs	Dredging Equipment	Cranes	Debris Clearance & Recovery Systems			
	Primary Companies and Suppliers	Vessel Companies	Equipment Manufacture & Rental	ROV Companies	Crane Manufacturers	Recycling & Trading Companies	Regulators	Tool Manufacturers	Recycling & Trading Companies		
	Sub-suppliers	Equipment Manufacturing	Training Companies	Transportation & Logistics Companies	Fuel & Lubricant Suppliers	Inspection Companies					
	Types of Employment	Subsea Engineers	Mechanical Engineers	Vessel Crews	ROV Pilots	Divers	Technical Sales	Project Managers	Crane Operators	Regulatory Personnel	Welders

Source: Energy and Industrial Advisory Partners

Table 22: Abandonment and Decommissioning Overview *(Continued)*

Pipeline Decommissioning & Abandonment	**Detailed Activities**	Engineering	Permitting	Pigging	Water Flooding	Cutting	Plugging & Burying	Removal	Transportation & Logistics	Recycling	Scrapping
	Types of Equipment & Services	Pigs	Pumps	Shears	Nitrogen	MPSVs					
	Primary Companies and Suppliers	Equipment Rental	Pipeline & Process Services	Tool Manufacturers	Industrial Gas Suppliers	Vessel Companies	Manpower & Recruiting Services	Regulators	Recycling & Trading Companies		
	Sub-suppliers	Transport & Logistics	Equipment Maintenance	Inspection Companies	Classification Societies	Fuel & Lubricant Suppliers	ROV Companies				
	Types of Employment	Pipeline Engineers	Vessel Crews	ROV Pilots	Equipment Operators	Technical Sales	Service Company Personnel	Regulatory Personnel			

Source: Energy and Industrial Advisory Partners

Safely and successfully completing the abandonment and decommissioning process requires a diverse workforce including petroleum and mechanical engineers, ROV pilots, rig and vessel crews, crane and equipment operators, divers, service company personnel, and regulatory personnel.

Example Projects

To develop the project spending and employment analysis of this report two example projects were developed, with one each for deepwater, and shallow water developments. These projects were sized based on development trends to be in line with recent and planned Gulf of Mexico offshore oil and gas developments. Key development indicators such as the number of wells, facilities, oil and natural gas production, and ancillary equipment requirements were developed. Although these example projects are not based directly on a specific existing or planned project, every effort was made to align the project parameters with the types of projects which are likely to continue to be developed in the Gulf of Mexico. The following table describes the high-level project parameters utilized in developing the spending and employment forecast for this report for the example shallow water and deepwater projects. (Table 23)

Table 23: Example Project Parameters

	Shallow Water	Deepwater
Number of Exploration and Appraisal Wells	4	4
Number of Development Wells	8	10
Facility Type	Fixed Platform	Semi-Submersible FPS
Facility Processing (BOEPD)	20,000	75,000
Umbilical KM		150
Infield Flowline KM		75
Export Pipelines KM	30	250
Infill Wells	6	5

Source: Energy and Industrial Advisory Partners

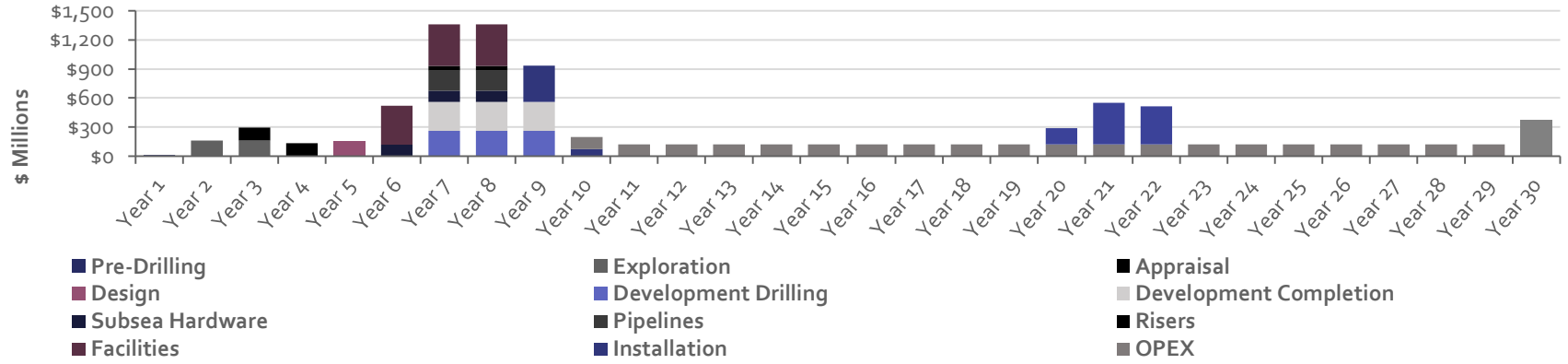
These project parameters were utilized to develop more detailed project parameters, the equipment, and services required to develop the projects, project development timelines, and project spending for both development and operations. These assumptions were based on recently developed offshore oil and natural gas projects and the selected parameters.

Project Spending

After developing the example project parameters and timelines[4], the previously developed categories were utilized to develop detailed category by category spending forecasts for each activity stage. Spending in each stage was split by activity or equipment type. These spending forecasts were based on both publicly available data, as well as EIAP's own internal data and expertise on offshore oil and natural gas project spending. Given recent trends in offshore project development costs, all pricing was calibrated to account for the lower development costs which have recently prevailed given current market conditions. Pricing should be considered indicative only, and any change to development costs would be expected to have a subsequent impact on a project's economic impacts. After the per-category development spending was prepared a project and project spending timeline was produced based on typical project timelines. In addition to analyzing development timelines based on the development stages, a forecast for the time period over which spending in a given category would take place was also developed. Both projects' full lifecycle was estimated at 30 years. Development timelines and overall spending levels and patterns vary by project, so the following should be considered indicative only. Spending was calculated based on the development stage of the project, with three to seven subcategories for each major category calculated. For the example deepwater project, total lifetime spending of just over $8.8 billion was projected. Average annual spending was projected at $295 million, with the highest spending levels taking place during project development, when subsea tieback development is taking place, and during decommissioning. Annual operational expenditures were estimated at around $124 million per year during normal operating years. (Figure 21)

[4] Offshore projects vary in both development timelines and years producing. For ease of presentation both projects were modeled based on a 20-year producing life with one redevelopment. Shorter producing lifespans would lead to decreased economic activity while additional redevelopments would lead to increased economic activity.

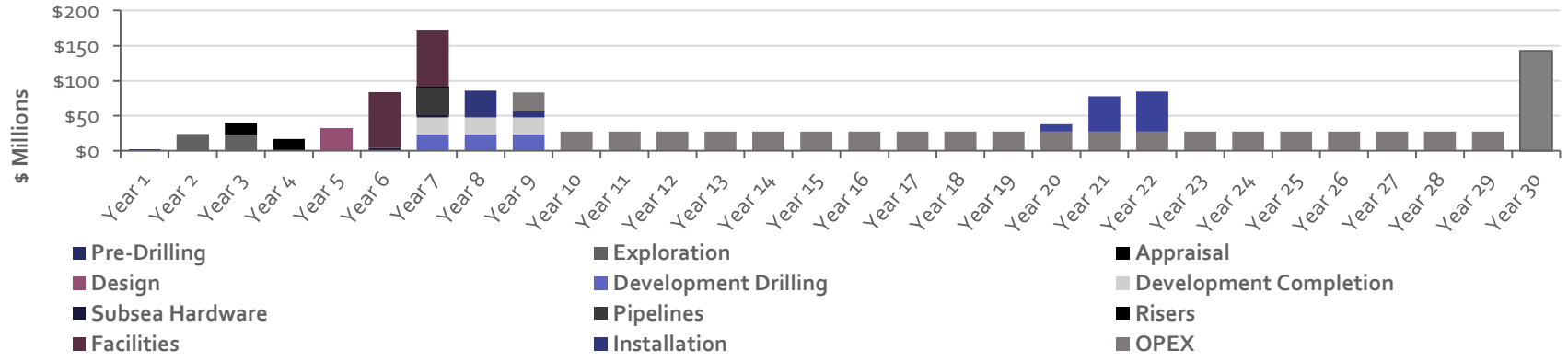
Figure 21: Deepwater Example Project Spending Timeline ($ Millions)



Source: Energy and Industrial Advisory Partners

For the example Shallow Water project, total lifetime spending of around $1.35 billion was projected. Average annual spending was projected at $45 million, with the highest spending levels taking place during project development, when infill drilling is taking place, and during decommissioning. Annual operational expenditures were estimated at just around $27.5 million per year during normal operating years. (Figure 22)

Figure 22: Shallow Water Example Project Spending Timeline

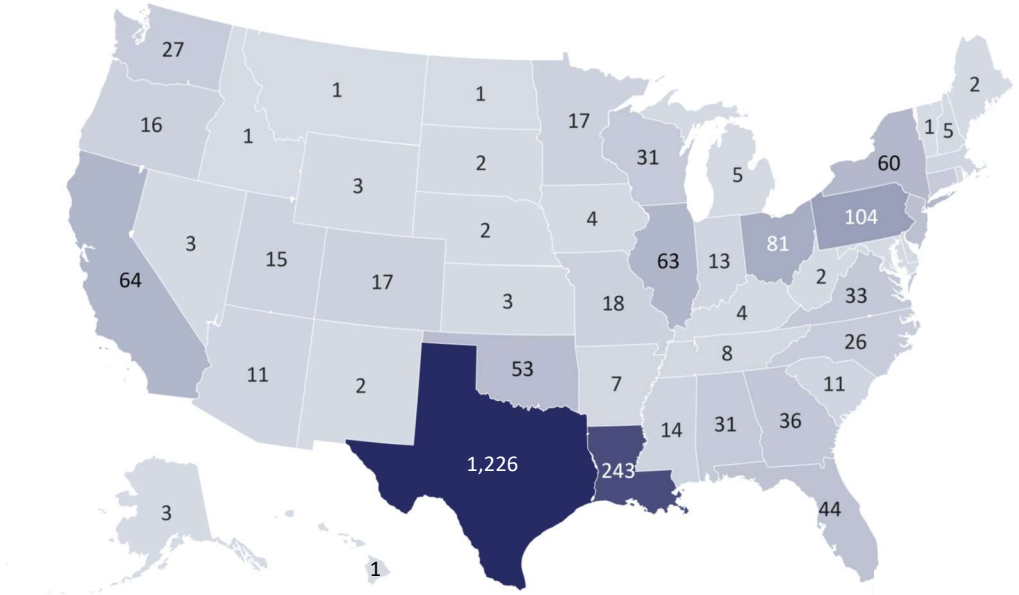


Source: Energy and Industrial Advisory Partners

Overall Employment

Offshore oil and natural gas project development and operations support significant levels of employment. While the employment impact of oil and natural gas is focused on the Gulf Coast states, almost all, if not all states see employment supported due to offshore project development. Project development and operations support a large number of highly paid jobs directly, especially highly paid blue-collar jobs, and additionally supports significant employment through the industry's supply chain (indirect jobs), and due to increased spending by workers (induced jobs). The offshore oil and natural gas industries supply chain is spread throughout the country, while the Gulf Coast states (especially Texas and Louisiana) receive the majority of spending associated with offshore project development, all 50 states are home to industry suppliers. The following figure, which is based on work completed for the EIAP report, "The Economic Impacts of Gulf of Mexico Oil and Natural Gas Industry" highlights over 2,400 US suppliers. This list likely greatly underestimates the number of companies that supply the industry. (Figure 23)

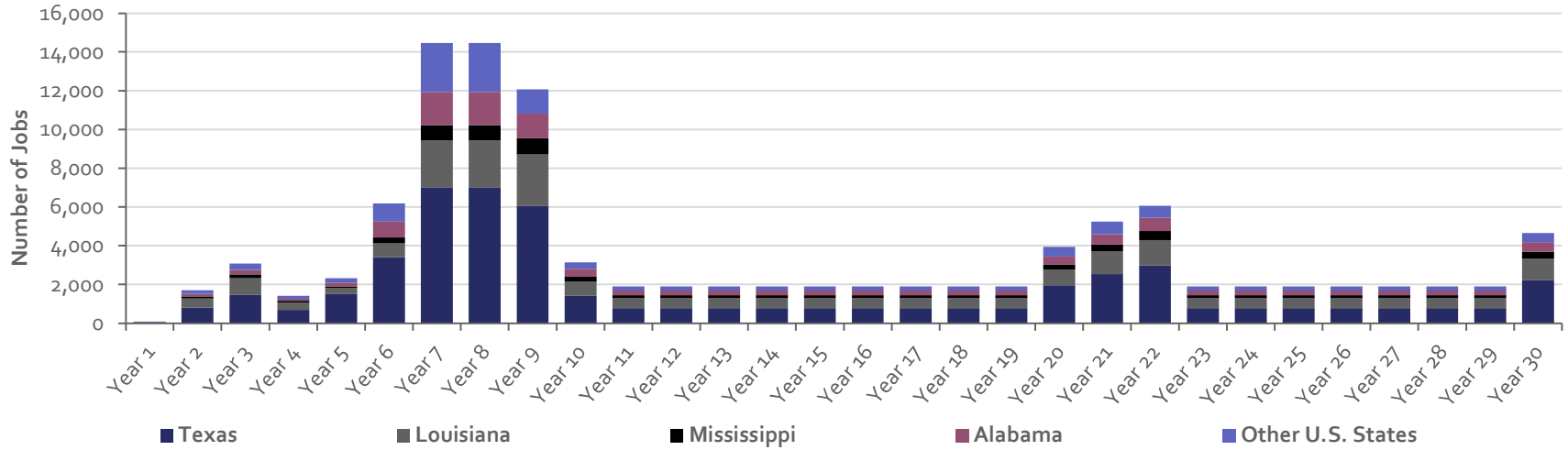
Figure 23: Identified Sample of Offshore Oil and Natural Gas Industry Suppliers by State



Source: Energy and Industrial Advisory Partners

Due to the large costs associated with developing and operating deepwater projects, these projects support significant employment throughout their lifecycles. This is especially true of new standalone developments such as the example project developed for this report. Employment levels vary throughout the life of a project and are highly correlated with spending levels. Employment impacts are lowest prior to leasing and development and highest during periods of intensive activity such as periods when the manufacturing and installation of equipment and facilities for the project takes place, when infill drilling or subsea tieback activity takes place, or when projects are being decommissioned. (Figure 24)

Figure 24: Deepwater Project Employment Impact by Area



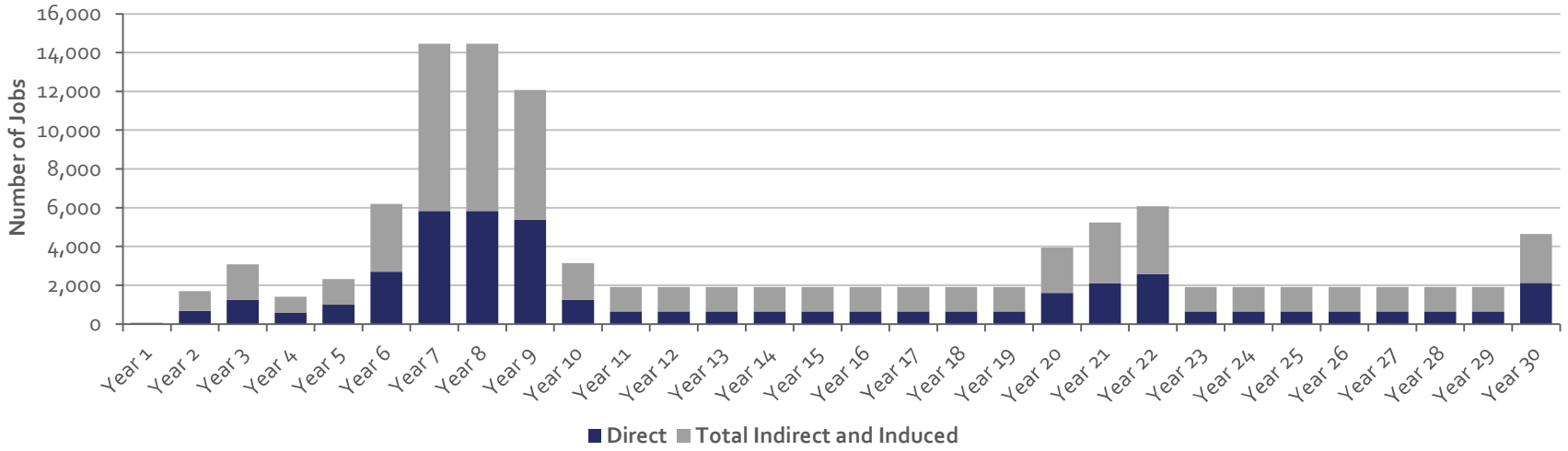
Source: Energy and Industrial Advisory Partners

On average, throughout the 30-year lifecycle of the example deepwater development, total annual supported employment is projected at over 3,640 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of 880 jobs, during the most active years employment impacts peak at over 14,450 jobs. During normal operations, total supported employment is projected at around 1,900 jobs.

Offshore oil and natural gas project development supports employment both through direct employment by the industry, but also indirectly. Indirect employment occurs through the purchases of goods and services by the industry, while induced employment is due to the impact of greater income in the economy. Direct jobs in the context of the offshore oil and natural gas industry are defined as jobs due to direct spending on project development. Jobs at oil and gas operators, service companies, equipment manufacturers, and other direct suppliers involved in project development are classified as direct jobs. Indirect jobs are jobs that are supported by increased spending by these direct suppliers. For

example, as project development spending increases companies must buy additional materials and services from their supply chains to support increased activity. This spending will range from simple office goods to materials used in the manufacture of goods needed for project development. These purchases will differ across different spending categories based on the type of spending taking place and the supply chains required to support it. Induced jobs are defined as increased employment due to additional spending that takes place by direct and indirect workers. As worker's wages increase, they tend to spend more money on other goods and services. Increased direct and indirect employment supported by offshore oil and natural gas projects thus leads to higher spending at restaurants, stores, healthcare providers, car dealers, and other consumer goods sellers. This increased demand leads to increased employment in these sectors. Due to the relatively high wages paid by the industry and its suppliers' many workers have higher discretionary incomes, leading to relatively high induced employment due to industry activity. (Figure 25)

Figure 25: Deepwater Project Employment Impact by Direct and Indirect and Induced Jobs



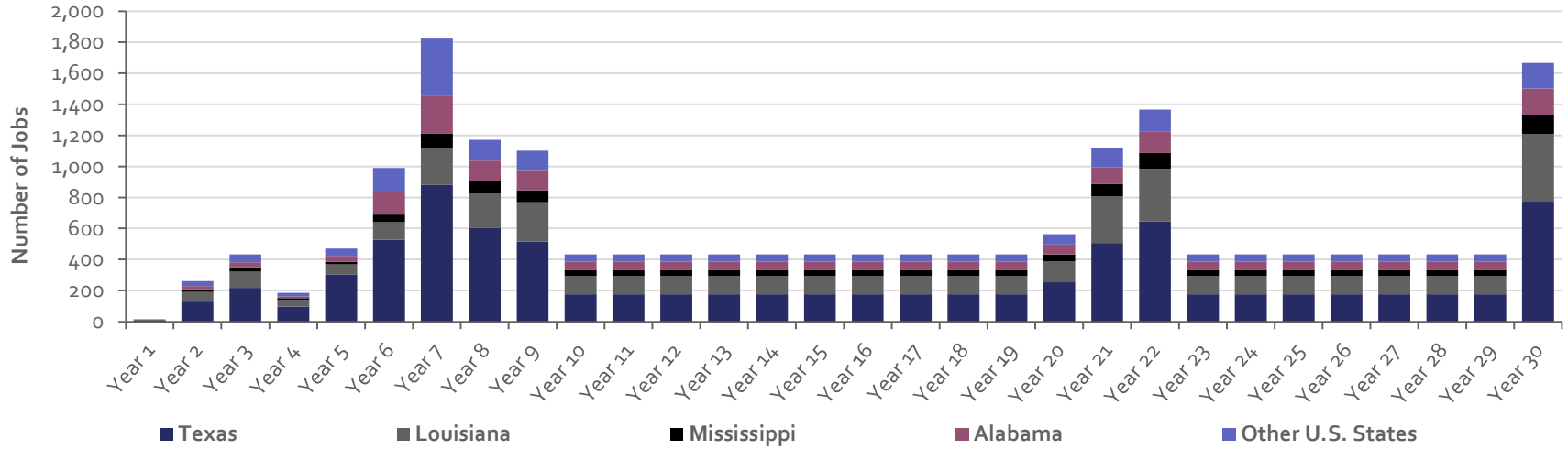
Source: Energy and Industrial Advisory Partners

Direct employment due to spending associated with the example deepwater project development is projected to average around 1,435 jobs across the example project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of over 2,200 jobs.

Due to the relatively lower total spending associated with developing and operating shallow water project projects, these projects tend to support less but still significant employment throughout their lifecycles. Employment levels vary throughout the life of a project and are highly

correlated with spending levels. Employment impacts are lowest prior to leasing and development and highest during periods of intensive activity such as periods where drilling, manufacturing and fabrication of project equipment and facilities and installation of the project takes place, when wells are drilled, or when projects are being decommissioned. (Figure 26)

Figure 26: Shallow Water Project Employment Impact by Area

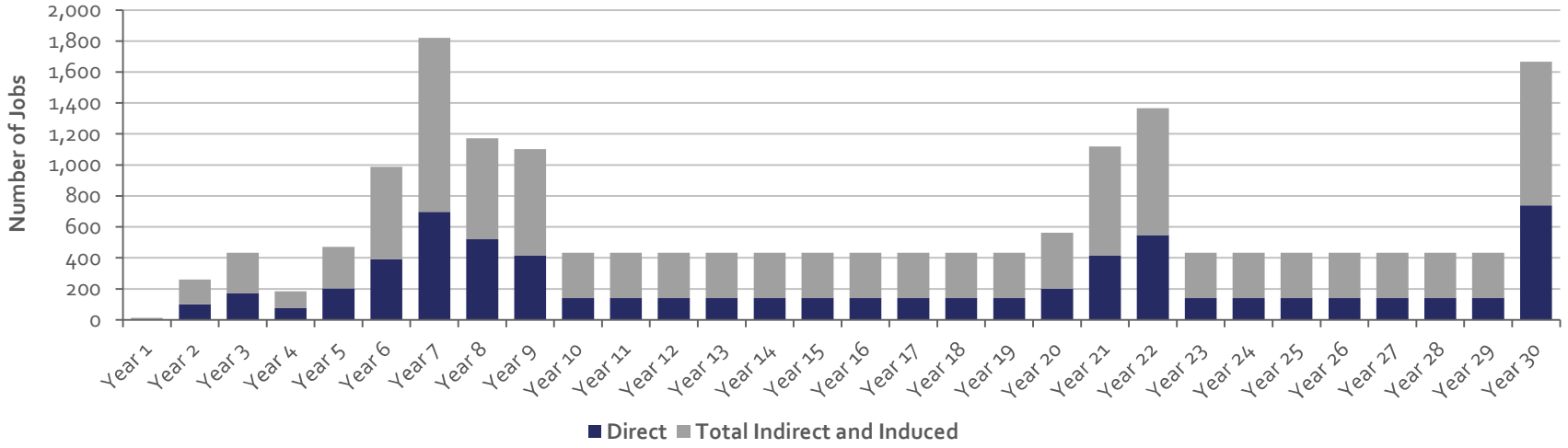


Source: Energy and Industrial Advisory Partners

On average, throughout the 30-year lifecycle of the example shallow water development, total annual supported employment is projected at around 335 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of around 135 jobs, during the most active years employment impacts peak at over 1,800 jobs. During normal operations, total supported employment is projected at around 430 jobs.

Direct employment due to spending associated with the example shallow water project development is projected to average around 230 jobs across the project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of around 390 jobs. (Figure 27)

Figure 27: Shallow Water Project Employment Impact by Direct and Indirect and Induced Jobs



Source: Energy and Industrial Advisory Partners

Detailed Employment and Industry Wages

To better demonstrate the economic and employment impacts of offshore project development, a detailed employment forecast was developed for this report. Once the total employment impacts of the example offshore oil and natural gas projects were calculated, each category and industry direct employment level was mapped to a North American Industry Classification System (NAICS) industry code. NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. An analysis of the Bureau of Labor Statistics Occupational Employment and Wage Statistics (OEWS) survey was then conducted, to analyze job types and wage rates for each of the identified NAICS industries. The Occupational Employment and Wage Statistics (OEWS) survey is a semiannual survey measuring occupational employment and wage rates for wage and salary workers in nonfarm establishments in the United States. This analysis provided a breakdown of detailed job titles by industry, with some job titles then consolidated for ease of analysis. This data was used based on detailed industry spending to calculate direct employment by job title as a result of the example project development. Although the following information is indicative only, it provides an overview of the types of employment and wages supported by offshore project development and operations.

The analysis of direct jobs created by the example deepwater project indicated that direct jobs created would encompass over 200 different job titles. For ease of presentation, only the top 70 job titles are included in the below figure. Some of the most impacted job titles include civil and petroleum engineers, general and operations managers, supervisors, truck drivers, machine setters, operators, and tenders, assemblers and fabricators, project management and business operations specialists, and welders, cutters, solderers, and brazers. (Table 24)

Table 24: Deepwater Project Employment Jobs by Title

Job Title	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Accountants, Auditors, and Actuaries	0	9	17	8	12	23	60	60	57	13	8
Aerospace Engineers, Operations Technologists and Technicians	0	6	11	5	13	1	20	20	19	4	4
Architectural and Civil Drafters	1	16	29	13	36	3	55	55	53	12	12
Architectural and Engineering Managers	1	18	33	15	40	20	82	82	64	14	13
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	0	7	13	6	10	23	52	52	59	14	7
Bus and Truck Mechanics and Diesel Engine Specialists	0	3	6	3	0	1	12	12	27	6	3
Buyers and Purchasing Agents	0	5	10	5	6	32	55	55	29	6	4
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	0	4	7	3	8	8	24	24	12	4	4
Captains, Mates, and Pilots of Water Vessels	0	15	27	12	0	1	51	51	139	24	7
Civil Engineering Technologists and Technicians	1	13	23	10	29	2	44	44	45	10	9
Civil Engineers	1	24	42	19	53	4	79	79	120	26	17
Computer Numerically Controlled Tool Programmers and Operators	0	2	4	2	1	57	72	72	9	1	1
Computer Programmers and Systems Analysts	0	8	15	7	17	9	39	39	28	6	6
Construction and Building Inspectors	0	9	16	7	21	2	31	31	35	8	7
Construction Laborers	0	1	2	1	3	4	9	9	592	120	4
Construction Managers	0	3	5	2	6	2	11	11	98	20	3
Customer Service Representatives	0	9	16	8	3	25	60	60	58	10	5
Electrical and Electronic Engineering Technologists and Technicians	0	6	11	5	13	7	28	28	20	5	5
Electrical Engineers	1	17	31	14	38	15	72	72	56	13	12
Electrical, Electronic, and Electromechanical Assemblers	0	3	6	3	4	41	58	58	13	2	2
Electricians	0	2	3	2	3	26	47	47	37	8	2
Engineers, All Other	0	8	14	6	17	10	35	35	26	6	6
Environmental Engineers, Technologists and Technicians	0	8	15	7	18	2	30	30	28	6	6
Environmental Science and Protection Technicians, and Specialists	0	5	9	4	11	1	17	17	16	4	4
Financial Managers and Examiners	0	4	8	4	6	11	28	28	28	6	4
First-Line Supervisors	0	18	33	15	14	146	258	258	317	78	29
General and Operations Managers	0	16	29	14	23	46	111	111	134	32	17
Heavy and Tractor-Trailer Truck Drivers	0	11	21	9	1	7	50	50	143	40	19
Helpers	0	1	3	1	1	31	54	54	29	12	7
Human Resources Managers and Specialists	0	6	12	5	9	17	43	43	38	8	5
Industrial Engineers	0	8	14	7	14	52	89	89	29	6	6
Industrial Machinery Mechanics	0	2	4	2	1	47	128	128	13	8	7
Industrial Production Managers	0	2	3	2	1	32	49	49	10	2	2
Industrial Truck and Tractor Operators	0	1	2	1	0	24	43	43	12	2	1

Source: Energy and Industrial Advisory Partners

Table 24: Deepwater Project Employment Jobs by Title *(Continued)*

Job Title	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11
Inspectors, Testers, Sorters, Samplers, and Weighers	0	4	9	4	5	68	103	103	25	6	5
Laborers and Freight, Stock, and Material Movers, Hand	0	11	20	9	2	62	132	132	95	19	8
Logisticians	0	5	8	4	6	10	27	27	23	5	3
Machine Setters, Operators, and Tenders	0	7	13	6	1	301	557	557	44	4	3
Machinists	0	3	8	4	2	114	154	154	18	3	3
Maintenance and Repair Workers, General	0	4	8	3	3	34	69	69	33	7	3
Management Analysts	0	5	10	5	7	4	24	24	27	6	4
Market Research Analysts and Marketing Specialists	0	5	9	4	8	11	29	29	23	5	4
Mechanical Drafters	0	5	9	4	10	18	36	36	17	4	4
Mechanical Engineers	1	25	46	22	53	74	168	168	89	19	18
Miscellaneous Assemblers and Fabricators	0	7	18	11	2	301	369	369	45	5	5
Mobile Heavy Equipment Mechanics, Except Engines	0	1	3	1	0	3	11	11	51	11	2
Network and Computer Systems Administrators	0	4	7	3	7	7	21	21	18	4	3
Office and Administrative Support Clerks and Workers	0	14	26	12	22	36	92	92	127	30	14
Operating Engineers and Other Construction Equipment Operators	0	2	3	1	1	1	6	6	322	68	5
Other	9	131	231	107	183	443	1,005	1,005	1,073	255	125
Petroleum Engineers	2	44	79	35	100	9	152	152	140	34	34
Plumbers, Pipefitters, and Steamfitters	0	1	1	1	1	26	30	30	20	5	2
Procurement, Production, Planning, and Expediting Clerks	0	5	9	4	6	38	68	68	28	6	4
Project Management Specialists and Business Operations Specialists, All Other	1	20	37	17	37	19	87	87	125	27	16
Rotary Drill Operators, Oil and Gas	0	0	0	0	0	0	1	1	1	9	9
Roustabouts, Oil and Gas	0	0	1	0	0	1	3	3	5	25	24
Sailors and Marine Oilers	0	19	34	15	0	0	62	62	160	27	8
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	0	3	6	3	6	3	14	14	24	7	5
Sales Representatives, Wholesale and Manufacturing	0	3	7	4	3	65	93	93	18	4	3
Secretaries and Administrative Assistants	1	17	30	14	31	24	83	83	101	23	14
Service Unit Operators, Oil and Gas	0	0	1	0	0	2	4	4	2	23	23
Ship Engineers	0	11	20	9	0	0	36	36	89	15	5
Shipping, Receiving, and Inventory Clerks	0	3	6	3	1	52	82	82	18	3	2
Software Developers and Software Quality Assurance Analysts and Testers	1	17	30	14	35	14	71	71	58	13	12
Surveyors, Surveying and Mapping Technicians and Researchers	1	14	24	11	31	2	46	46	54	12	10
Transportation, Storage, and Distribution Managers	0	5	8	4	1	3	20	20	36	6	2
Welders, Cutters, Solderers, and Brazers	0	6	14	8	2	196	252	252	89	17	6
Total	21	671	1,229	569	998	2,673	5,803	5,803	5,391	1,243	636

Source: Energy and Industrial Advisory Partners

Table 24: Deepwater Project Employment Jobs by Title *(Continued)*

Job Title	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21
Accountants, Auditors, and Actuaries	8	8	8	8	8	8	8	8	19	26
Aerospace Engineers, Operations Technologists and Technicians	4	4	4	4	4	4	4	4	4	9
Architectural and Civil Drafters	12	12	12	12	12	12	12	12	12	23
Architectural and Engineering Managers	13	13	13	13	13	13	13	13	20	33
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	7	7	7	7	7	7	7	7	17	22
Bus and Truck Mechanics and Diesel Engine Specialists	3	3	3	3	3	3	3	3	7	9
Buyers and Purchasing Agents	4	4	4	4	4	4	4	4	17	20
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	4	4	4	4	4	4	4	4	5	8
Captains, Mates, and Pilots of Water Vessels	7	7	7	7	7	7	7	7	27	39
Civil Engineering Technologists and Technicians	9	9	9	9	9	9	9	9	9	19
Civil Engineers	17	17	17	17	17	17	17	17	17	34
Computer Numerically Controlled Tool Programmers and Operators	1	1	1	1	1	1	1	1	19	19
Computer Programmers and Systems Analysts	6	6	6	6	6	6	6	6	10	16
Construction and Building Inspectors	7	7	7	7	7	7	7	7	7	14
Construction Laborers	4	4	4	4	4	4	4	4	5	6
Construction Managers	3	3	3	3	3	3	3	3	3	5
Customer Service Representatives	5	5	5	5	5	5	5	5	22	28
Electrical and Electronic Engineering Technologists and Technicians	5	5	5	5	5	5	5	5	8	12
Electrical Engineers	12	12	12	12	12	12	12	12	18	31
Electrical, Electronic, and Electromechanical Assemblers	2	2	2	2	2	2	2	2	23	24
Electricians	2	2	2	2	2	2	2	2	6	7
Engineers, All Other	6	6	6	6	6	6	6	6	9	14
Environmental Engineers, Technologists and Technicians	6	6	6	6	6	6	6	6	6	13
Environmental Science and Protection Technicians, and Specialists	4	4	4	4	4	4	4	4	4	7
Financial Managers and Examiners	4	4	4	4	4	4	4	4	9	12
First-Line Supervisors	29	29	29	29	29	29	29	29	76	90
General and Operations Managers	17	17	17	17	17	17	17	17	37	48
Heavy and Tractor-Trailer Truck Drivers	19	19	19	19	19	19	19	19	36	45
Helpers	7	7	7	7	7	7	7	7	15	16
Human Resources Managers and Specialists	5	5	5	5	5	5	5	5	13	17
Industrial Engineers	6	6	6	6	6	6	6	6	23	28
Industrial Machinery Mechanics	7	7	7	7	7	7	7	7	21	23
Industrial Production Managers	2	2	2	2	2	2	2	2	12	13
Industrial Truck and Tractor Operators	1	1	1	1	1	1	1	1	9	10

Source: Energy and Industrial Advisory Partners

Table 24: Deepwater Project Employment Jobs by Title *(Continued)*

Job Title	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21
Inspectors, Testers, Sorters, Samplers, and Weighers	5	5	5	5	5	5	5	5	23	27
Laborers and Freight, Stock, and Material Movers, Hand	8	8	8	8	8	8	8	8	36	45
Logisticians	3	3	3	3	3	3	3	3	8	12
Machine Setters, Operators, and Tenders	3	3	3	3	3	3	3	3	61	71
Machinists	3	3	3	3	3	3	3	3	40	42
Maintenance and Repair Workers, General	3	3	3	3	3	3	3	3	14	17
Management Analysts	4	4	4	4	4	4	4	4	8	12
Market Research Analysts and Marketing Specialists	4	4	4	4	4	4	4	4	9	12
Mechanical Drafters	4	4	4	4	4	4	4	4	9	13
Mechanical Engineers	18	18	18	18	18	18	18	18	48	66
Miscellaneous Assemblers and Fabricators	5	5	5	5	5	5	5	5	117	118
Mobile Heavy Equipment Mechanics, Except Engines	2	2	2	2	2	2	2	2	5	6
Network and Computer Systems Administrators	3	3	3	3	3	3	3	3	6	9
Office and Administrative Support Clerks and Workers	14	14	14	14	14	14	14	14	29	39
Operating Engineers and Other Construction Equipment Operators	5	5	5	5	5	5	5	5	7	8
Other	125	125	125	125	125	125	125	125	269	363
Petroleum Engineers	34	34	34	34	34	34	34	34	35	67
Plumbers, Pipefitters, and Steamfitters	2	2	2	2	2	2	2	2	3	4
Procurement, Production, Planning, and Expediting Clerks	4	4	4	4	4	4	4	4	16	20
Project Management Specialists and Business Operations Specialists, All Other	16	16	16	16	16	16	16	16	25	40
Rotary Drill Operators, Oil and Gas	9	9	9	9	9	9	9	9	9	10
Roustabouts, Oil and Gas	24	24	24	24	24	24	24	24	25	25
Sailors and Marine Oilers	8	8	8	8	8	8	8	8	33	48
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	5	5	5	5	5	5	5	5	6	9
Sales Representatives, Wholesale and Manufacturing	3	3	3	3	3	3	3	3	28	30
Secretaries and Administrative Assistants	14	14	14	14	14	14	14	14	23	35
Service Unit Operators, Oil and Gas	23	23	23	23	23	23	23	23	24	24
Ship Engineers	5	5	5	5	5	5	5	5	19	28
Shipping, Receiving, and Inventory Clerks	2	2	2	2	2	2	2	2	18	20
Software Developers and Software Quality Assurance Analysts and Testers	12	12	12	12	12	12	12	12	19	31
Surveyors, Surveying and Mapping Technicians and Researchers	10	10	10	10	10	10	10	10	10	20
Transportation, Storage, and Distribution Managers	2	2	2	2	2	2	2	2	9	13
Welders, Cutters, Solderers, and Brazers	6	6	6	6	6	6	6	6	70	73
Total	636	636	636	636	636	636	636	636	1,606	2,097

Source: Energy and Industrial Advisory Partners

Table 24: Deepwater Project Employment Jobs by Title *(Continued)*

Job Title	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Total
Accountants, Auditors, and Actuaries	26	8	8	8	8	8	8	8	23	481
Aerospace Engineers, Operations Technologists and Technicians	9	4	4	4	4	4	4	4	7	192
Architectural and Civil Drafters	25	12	12	12	12	12	12	12	20	545
Architectural and Engineering Managers	29	13	13	13	13	13	13	13	23	682
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	28	7	7	7	7	7	7	7	24	439
Bus and Truck Mechanics and Diesel Engine Specialists	10	3	3	3	3	3	3	3	14	158
Buyers and Purchasing Agents	11	4	4	4	4	4	4	4	11	326
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	6	4	4	4	4	4	4	4	4	181
Captains, Mates, and Pilots of Water Vessels	48	7	7	7	7	7	7	7	71	617
Civil Engineering Technologists and Technicians	21	9	9	9	9	9	9	9	17	431
Civil Engineers	59	17	17	17	17	17	17	17	46	875
Computer Numerically Controlled Tool Programmers and Operators	1	1	1	1	1	1	1	1	1	276
Computer Programmers and Systems Analysts	12	6	6	6	6	6	6	6	10	312
Construction and Building Inspectors	16	7	7	7	7	7	7	7	13	322
Construction Laborers	325	4	4	4	4	4	4	4	228	1,369
Construction Managers	53	3	3	3	3	3	3	3	38	305
Customer Service Representatives	18	5	5	5	5	5	5	5	28	425
Electrical and Electronic Engineering Technologists and Technicians	9	5	5	5	5	5	5	5	7	239
Electrical Engineers	25	12	12	12	12	12	12	12	20	615
Electrical, Electronic, and Electromechanical Assemblers	4	2	2	2	2	2	2	2	2	273
Electricians	19	2	2	2	2	2	2	2	14	253
Engineers, All Other	12	6	6	6	6	6	6	6	9	297
Environmental Engineers, Technologists and Technicians	12	6	6	6	6	6	6	6	11	282
Environmental Science and Protection Technicians, and Specialists	7	4	4	4	4	4	4	4	6	172
Financial Managers and Examiners	13	4	4	4	4	4	4	4	11	232
First-Line Supervisors	167	29	29	29	29	29	29	29	124	2,058
General and Operations Managers	66	17	17	17	17	17	17	17	54	993
Heavy and Tractor-Trailer Truck Drivers	71	19	19	19	19	19	19	19	68	856
Helpers	20	7	7	7	7	7	7	7	10	359
Human Resources Managers and Specialists	16	5	5	5	5	5	5	5	15	322
Industrial Engineers	11	6	6	6	6	6	6	6	8	474
Industrial Machinery Mechanics	9	7	7	7	7	7	7	7	3	501
Industrial Production Managers	4	2	2	2	2	2	2	2	3	214
Industrial Truck and Tractor Operators	4	1	1	1	1	1	1	1	3	170

Source: Energy and Industrial Advisory Partners

Table 24: Deepwater Project Employment Jobs by Title *(Continued)*

Job Title	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Total
Inspectors, Testers, Sorters, Samplers, and Weighers	10	5	5	5	5	5	5	5	7	474
Laborers and Freight, Stock, and Material Movers, Hand	35	8	8	8	8	8	8	8	43	769
Logisticians	8	3	3	3	3	3	3	3	10	201
Machine Setters, Operators, and Tenders	6	3	3	3	3	3	3	3	2	1,678
Machinists	3	3	3	3	3	3	3	3	1	594
Maintenance and Repair Workers, General	13	3	3	3	3	3	3	3	13	335
Management Analysts	11	4	4	4	4	4	4	4	12	219
Market Research Analysts and Marketing Specialists	10	4	4	4	4	4	4	4	9	227
Mechanical Drafters	7	4	4	4	4	4	4	4	5	237
Mechanical Engineers	38	18	18	18	18	18	18	18	29	1,134
Miscellaneous Assemblers and Fabricators	6	5	5	5	5	5	5	5	1	1,449
Mobile Heavy Equipment Mechanics, Except Engines	27	2	2	2	2	2	2	2	21	183
Network and Computer Systems Administrators	8	3	3	3	3	3	3	3	7	170
Office and Administrative Support Clerks and Workers	63	14	14	14	14	14	14	14	51	857
Operating Engineers and Other Construction Equipment Operators	177	5	5	5	5	5	5	5	125	807
Other	526	125	125	125	125	125	125	125	436	8,036
Petroleum Engineers	67	34	34	34	34	34	34	34	52	1,512
Plumbers, Pipefitters, and Steamfitters	12	2	2	2	2	2	2	2	8	174
Procurement, Production, Planning, and Expediting Clerks	11	4	4	4	4	4	4	4	10	353
Project Management Specialists and Business Operations Specialists, All Other	59	16	16	16	16	16	16	16	50	887
Rotary Drill Operators, Oil and Gas	10	9	9	9	9	9	9	9	0	185
Roustabouts, Oil and Gas	26	24	24	24	24	24	24	24	2	500
Sailors and Marine Oilers	52	8	8	8	8	8	8	8	83	723
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	14	5	5	5	5	5	5	5	9	198
Sales Representatives, Wholesale and Manufacturing	6	3	3	3	3	3	3	3	3	405
Secretaries and Administrative Assistants	49	14	14	14	14	14	14	14	39	777
Service Unit Operators, Oil and Gas	23	23	23	23	23	23	23	23	1	476
Ship Engineers	28	5	5	5	5	5	5	5	47	418
Shipping, Receiving, and Inventory Clerks	4	2	2	2	2	2	2	2	5	329
Software Developers and Software Quality Assurance Analysts and Testers	25	12	12	12	12	12	12	12	21	612
Surveyors, Surveying and Mapping Technicians and Researchers	26	10	10	10	10	10	10	10	20	477
Transportation, Storage, and Distribution Managers	12	2	2	2	2	2	2	2	19	188
Welders, Cutters, Solderers, and Brazers	37	6	6	6	6	6	6	6	26	1,138
Total	2,575	636	636	636	636	636	636	636	2,113	42,968

Source: Energy and Industrial Advisory Partners

Based on this analysis, in addition to the large number of diverse jobs supported due to offshore project development, the quality of employment provided directly by the industry is also well above the national average with an average annual wage of nearly $69,650, around 29 percent higher than the national average of slightly over $54,000.[5] On average, the example deepwater project is projected to support average direct annual wages paid of around $100 million, with total direct wages over the project's lifecycle of nearly $3 billion. (Table 25)

[5] Social Security Administration National Average Wage Index, 2019.

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title

Job Title	Annual Median Wage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Accountants, Auditors, and Actuaries	$77,052	$0	$693	$1,310	$616	$925	$1,772	$4,623	$4,623
Aerospace Engineers, Operations Technologists and Technicians	$94,207	$0	$565	$1,036	$471	$1,225	$94	$1,884	$1,884
Architectural and Civil Drafters	$58,564	$59	$937	$1,698	$761	$2,108	$176	$3,221	$3,221
Architectural and Engineering Managers	$144,293	$144	$2,597	$4,762	$2,164	$5,772	$2,886	$11,832	$11,832
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$0	$313	$582	$269	$448	$1,030	$2,329	$2,329
Bus and Truck Mechanics and Diesel Engine Specialists	$54,190	$0	$163	$325	$163	$0	$54	$650	$650
Buyers and Purchasing Agents	$68,671	$0	$343	$687	$343	$412	$2,197	$3,777	$3,777
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	$62,294	$0	$249	$436	$187	$498	$498	$1,495	$1,495
Captains, Mates, and Pilots of Water Vessels	$68,687	$0	$1,030	$1,855	$824	$0	$69	$3,503	$3,503
Civil Engineering Technologists and Technicians	$60,350	$60	$785	$1,388	$604	$1,750	$121	$2,655	$2,655
Civil Engineers	$99,278	$99	$2,383	$4,170	$1,886	$5,262	$397	$7,843	$7,843
Computer Numerically Controlled Tool Programmers and Operators	$51,829	$0	$104	$207	$104	$52	$2,954	$3,732	$3,732
Computer Programmers and Systems Analysts	$93,031	$0	$744	$1,395	$651	$1,582	$837	$3,628	$3,628
Construction and Building Inspectors	$64,668	$0	$582	$1,035	$453	$1,358	$129	$2,005	$2,005
Construction Laborers	$38,337	$0	$38	$77	$38	$115	$153	$345	$345
Construction Managers	$108,982	$0	$327	$545	$218	$654	$218	$1,199	$1,199
Customer Service Representatives	$41,829	$0	$376	$669	$335	$125	$1,046	$2,510	$2,510
Electrical and Electronic Engineering Technologists and Technicians	$67,530	$0	$405	$743	$338	$878	$473	$1,891	$1,891
Electrical Engineers	$102,438	$102	$1,741	$3,176	$1,434	$3,893	$1,537	$7,376	$7,376
Electrical, Electronic, and Electromechanical Assemblers	$37,409	$0	$112	$224	$112	$150	$1,534	$2,170	$2,170
Electricians	$61,730	$0	$123	$185	$123	$185	$1,605	$2,901	$2,901
Engineers, All Other	$95,156	$0	$761	$1,332	$571	$1,618	$952	$3,330	$3,330
Environmental Engineers, Technologists and Technicians	$78,868	$0	$631	$1,183	$552	$1,420	$158	$2,366	$2,366
Environmental Science and Protection Technicians, and Specialists	$68,473	$0	$342	$616	$274	$753	$68	$1,164	$1,164
Financial Managers and Examiners	$133,418	$0	$534	$1,067	$534	$801	$1,468	$3,736	$3,736
First-Line Supervisors	$72,087	$0	$1,298	$2,379	$1,081	$1,009	$10,525	$18,598	$18,598
General and Operations Managers	$127,095	$0	$2,034	$3,686	$1,779	$2,923	$5,846	$14,108	$14,108
Heavy and Tractor-Trailer Truck Drivers	$46,798	$0	$515	$983	$421	$47	$328	$2,340	$2,340
Helpers	$34,535	$0	$35	$104	$35	$35	$1,071	$1,865	$1,865
Human Resources Managers and Specialists	$90,738	$0	$544	$1,089	$454	$817	$1,543	$3,902	$3,902
Industrial Engineers	$92,528	$0	$740	$1,295	$648	$1,295	$4,811	$8,235	$8,235
Industrial Machinery Mechanics	$58,794	$0	$118	$235	$118	$59	$2,763	$7,526	$7,526
Industrial Production Managers	$116,046	$0	$232	$348	$232	$116	$3,713	$5,686	$5,686
Industrial Truck and Tractor Operators	$40,037	$0	$40	$80	$40	$0	$961	$1,722	$1,722

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$0	$194	$437	$194	$243	$3,304	$5,005	$5,005
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$0	$382	$694	$312	$69	$2,153	$4,583	$4,583
Logisticians	$75,245	$0	$376	$602	$301	$451	$752	$2,032	$2,032
Machine Setters, Operators, and Tenders	$40,872	$0	$286	$531	$245	$41	$12,303	$22,766	$22,766
Machinists	$49,388	$0	$148	$395	$198	$99	$5,630	$7,606	$7,606
Maintenance and Repair Workers, General	$45,949	$0	$184	$368	$138	$138	$1,562	$3,170	$3,170
Management Analysts	$86,666	$0	$433	$867	$433	$607	$347	$2,080	$2,080
Market Research Analysts and Marketing Specialists	$69,354	$0	$347	$624	$277	$555	$763	$2,011	$2,011
Mechanical Drafters	$59,044	$0	$295	$531	$236	$590	$1,063	$2,126	$2,126
Mechanical Engineers	$91,501	$92	$2,288	$4,209	$2,013	$4,850	$6,771	$15,372	$15,372
Miscellaneous Assemblers and Fabricators	$36,096	$0	$253	$650	$397	$72	$10,865	$13,319	$13,319
Mobile Heavy Equipment Mechanics, Except Engines	$55,614	$0	$56	$167	$56	$0	$167	$612	$612
Network and Computer Systems Administrators	$84,403	$0	$338	$591	$253	$591	$591	$1,772	$1,772
Office and Administrative Support Clerks and Workers	$42,443	$0	$594	$1,104	$509	$934	$1,528	$3,905	$3,905
Operating Engineers and Other Construction Equipment Operators	$51,623	$0	$103	$155	$52	$52	$52	$310	$310
Other	$71,543	$644	$9,372	$16,526	$7,655	$13,092	$31,693	$71,900	$71,900
Petroleum Engineers	$138,170	$276	$6,079	$10,915	$4,836	$13,817	$1,244	$21,002	$21,002
Plumbers, Pipefitters, and Steamfitters	$59,323	$0	$59	$59	$59	$59	$1,542	$1,780	$1,780
Procurement, Production, Planning, and Expediting Clerks	$49,485	$0	$247	$445	$198	$297	$1,880	$3,365	$3,365
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$82	$1,633	$3,022	$1,388	$3,022	$1,552	$7,106	$7,106
Rotary Drill Operators, Oil and Gas	$54,848	$0	$0	$0	$0	$0	$0	$55	$55
Roustabouts, Oil and Gas	$45,984	$0	$0	$46	$0	$0	$46	$138	$138
Sailors and Marine Oilers	$43,875	$0	$834	$1,492	$658	$0	$0	$2,720	$2,720
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	$69,576	$0	$209	$417	$209	$417	$209	$974	$974
Sales Representatives, Wholesale and Manufacturing	$77,669	$0	$233	$544	$311	$233	$5,048	$7,223	$7,223
Secretaries and Administrative Assistants	$50,137	$50	$852	$1,504	$702	$1,554	$1,203	$4,161	$4,161
Service Unit Operators, Oil and Gas	$50,324	$0	$0	$50	$0	$0	$101	$201	$201
Ship Engineers	$76,455	$0	$841	$1,529	$688	$0	$0	$2,752	$2,752
Shipping, Receiving, and Inventory Clerks	$37,376	$0	$112	$224	$112	$37	$1,944	$3,065	$3,065
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$102	$1,735	$3,061	$1,429	$3,571	$1,429	$7,245	$7,245
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$62	$866	$1,484	$680	$1,917	$124	$2,844	$2,844
Transportation, Storage, and Distribution Managers	$105,057	$0	$525	$840	$420	$105	$315	$2,101	$2,101
Welders, Cutters, Solderers, and Brazers	$49,018	$0	$294	$686	$392	$98	$9,607	$12,352	$12,352
Total	N/A	$1,772	$52,605	$95,674	$44,185	$85,794	$159,773	$383,799	$383,799

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Accountants, Auditors, and Actuaries	$77,052	$4,392	$1,002	$616	$616	$616	$616	$616	$616
Aerospace Engineers, Operations Technologists and Technicians	$94,207	$1,790	$377	$377	$377	$377	$377	$377	$377
Architectural and Civil Drafters	$58,564	$3,104	$703	$703	$703	$703	$703	$703	$703
Architectural and Engineering Managers	$144,293	$9,235	$2,020	$1,876	$1,876	$1,876	$1,876	$1,876	$1,876
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$2,642	$627	$313	$313	$313	$313	$313	$313
Bus and Truck Mechanics and Diesel Engine Specialists	$54,190	$1,463	$325	$163	$163	$163	$163	$163	$163
Buyers and Purchasing Agents	$68,671	$1,991	$412	$275	$275	$275	$275	$275	$275
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	$62,294	$748	$249	$249	$249	$249	$249	$249	$249
Captains, Mates, and Pilots of Water Vessels	$68,687	$9,547	$1,648	$481	$481	$481	$481	$481	$481
Civil Engineering Technologists and Technicians	$60,350	$2,716	$604	$543	$543	$543	$543	$543	$543
Civil Engineers	$99,278	$11,913	$2,581	$1,688	$1,688	$1,688	$1,688	$1,688	$1,688
Computer Numerically Controlled Tool Programmers and Operators	$51,829	$466	$52	$52	$52	$52	$52	$52	$52
Computer Programmers and Systems Analysts	$93,031	$2,605	$558	$558	$558	$558	$558	$558	$558
Construction and Building Inspectors	$64,668	$2,263	$517	$453	$453	$453	$453	$453	$453
Construction Laborers	$38,337	$22,696	$4,600	$153	$153	$153	$153	$153	$153
Construction Managers	$108,982	$10,680	$2,180	$327	$327	$327	$327	$327	$327
Customer Service Representatives	$41,829	$2,426	$418	$209	$209	$209	$209	$209	$209
Electrical and Electronic Engineering Technologists and Technicians	$67,530	$1,351	$338	$338	$338	$338	$338	$338	$338
Electrical Engineers	$102,438	$5,737	$1,332	$1,229	$1,229	$1,229	$1,229	$1,229	$1,229
Electrical, Electronic, and Electromechanical Assemblers	$37,409	$486	$75	$75	$75	$75	$75	$75	$75
Electricians	$61,730	$2,284	$494	$123	$123	$123	$123	$123	$123
Engineers, All Other	$95,156	$2,474	$571	$571	$571	$571	$571	$571	$571
Environmental Engineers, Technologists and Technicians	$78,868	$2,208	$473	$473	$473	$473	$473	$473	$473
Environmental Science and Protection Technicians, and Specialists	$68,473	$1,096	$274	$274	$274	$274	$274	$274	$274
Financial Managers and Examiners	$133,418	$3,736	$801	$534	$534	$534	$534	$534	$534
First-Line Supervisors	$72,087	$22,852	$5,623	$2,091	$2,091	$2,091	$2,091	$2,091	$2,091
General and Operations Managers	$127,095	$17,031	$4,067	$2,161	$2,161	$2,161	$2,161	$2,161	$2,161
Heavy and Tractor-Trailer Truck Drivers	$46,798	$6,692	$1,872	$889	$889	$889	$889	$889	$889
Helpers	$34,535	$1,002	$414	$242	$242	$242	$242	$242	$242
Human Resources Managers and Specialists	$90,738	$3,448	$726	$454	$454	$454	$454	$454	$454
Industrial Engineers	$92,528	$2,683	$555	$555	$555	$555	$555	$555	$555
Industrial Machinery Mechanics	$58,794	$764	$470	$412	$412	$412	$412	$412	$412
Industrial Production Managers	$116,046	$1,160	$232	$232	$232	$232	$232	$232	$232
Industrial Truck and Tractor Operators	$40,037	$480	$80	$40	$40	$40	$40	$40	$40

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$1,215	$292	$243	$243	$243	$243	$243	$243
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$3,298	$660	$278	$278	$278	$278	$278	$278
Logisticians	$75,245	$1,731	$376	$226	$226	$226	$226	$226	$226
Machine Setters, Operators, and Tenders	$40,872	$1,798	$163	$123	$123	$123	$123	$123	$123
Machinists	$49,388	$889	$148	$148	$148	$148	$148	$148	$148
Maintenance and Repair Workers, General	$45,949	$1,516	$322	$138	$138	$138	$138	$138	$138
Management Analysts	$86,666	$2,340	$520	$347	$347	$347	$347	$347	$347
Market Research Analysts and Marketing Specialists	$69,354	$1,595	$347	$277	$277	$277	$277	$277	$277
Mechanical Drafters	$59,044	$1,004	$236	$236	$236	$236	$236	$236	$236
Mechanical Engineers	$91,501	$8,144	$1,739	$1,647	$1,647	$1,647	$1,647	$1,647	$1,647
Miscellaneous Assemblers and Fabricators	$36,096	$1,624	$180	$180	$180	$180	$180	$180	$180
Mobile Heavy Equipment Mechanics, Except Engines	$55,614	$2,836	$612	$111	$111	$111	$111	$111	$111
Network and Computer Systems Administrators	$84,403	$1,519	$338	$253	$253	$253	$253	$253	$253
Office and Administrative Support Clerks and Workers	$42,443	$5,390	$1,273	$594	$594	$594	$594	$594	$594
Operating Engineers and Other Construction Equipment Operators	$51,623	$16,623	$3,510	$258	$258	$258	$258	$258	$258
Other	$71,543	$76,765	$18,243	$8,943	$8,943	$8,943	$8,943	$8,943	$8,943
Petroleum Engineers	$138,170	$19,344	$4,698	$4,698	$4,698	$4,698	$4,698	$4,698	$4,698
Plumbers, Pipefitters, and Steamfitters	$59,323	$1,186	$297	$119	$119	$119	$119	$119	$119
Procurement, Production, Planning, and Expediting Clerks	$49,485	$1,386	$297	$198	$198	$198	$198	$198	$198
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$10,209	$2,205	$1,307	$1,307	$1,307	$1,307	$1,307	$1,307
Rotary Drill Operators, Oil and Gas	$54,848	$55	$494	$494	$494	$494	$494	$494	$494
Roustabouts, Oil and Gas	$45,984	$230	$1,150	$1,104	$1,104	$1,104	$1,104	$1,104	$1,104
Sailors and Marine Oilers	$43,875	$7,020	$1,185	$351	$351	$351	$351	$351	$351
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	$69,576	$1,670	$487	$348	$348	$348	$348	$348	$348
Sales Representatives, Wholesale and Manufacturing	$77,669	$1,398	$311	$233	$233	$233	$233	$233	$233
Secretaries and Administrative Assistants	$50,137	$5,064	$1,153	$702	$702	$702	$702	$702	$702
Service Unit Operators, Oil and Gas	$50,324	$101	$1,157	$1,157	$1,157	$1,157	$1,157	$1,157	$1,157
Ship Engineers	$76,455	$6,804	$1,147	$382	$382	$382	$382	$382	$382
Shipping, Receiving, and Inventory Clerks	$37,376	$673	$112	$75	$75	$75	$75	$75	$75
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$5,918	$1,327	$1,225	$1,225	$1,225	$1,225	$1,225	$1,225
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$3,338	$742	$618	$618	$618	$618	$618	$618
Transportation, Storage, and Distribution Managers	$105,057	$3,782	$630	$210	$210	$210	$210	$210	$210
Welders, Cutters, Solderers, and Brazers	$49,018	$4,363	$833	$294	$294	$294	$294	$294	$294
Total	N/A	$366,990	$84,453	$47,243	$47,243	$47,243	$47,243	$47,243	$47,243

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24
Accountants, Auditors, and Actuaries	$77,052	$616	$616	$616	$1,464	$2,003	$2,003	$616	$616
Aerospace Engineers, Operations Technologists and Technicians	$94,207	$377	$377	$377	$377	$848	$848	$377	$377
Architectural and Civil Drafters	$58,564	$703	$703	$703	$703	$1,347	$1,464	$703	$703
Architectural and Engineering Managers	$144,293	$1,876	$1,876	$1,876	$2,886	$4,762	$4,184	$1,876	$1,876
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$313	$313	$313	$761	$985	$1,254	$313	$313
Bus and Truck Mechanics and Diesel Engine Specialists	$54,190	$163	$163	$163	$379	$488	$542	$163	$163
Buyers and Purchasing Agents	$68,671	$275	$275	$275	$1,167	$1,373	$755	$275	$275
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	$62,294	$249	$249	$249	$311	$498	$374	$249	$249
Captains, Mates, and Pilots of Water Vessels	$68,687	$481	$481	$481	$1,855	$2,679	$3,297	$481	$481
Civil Engineering Technologists and Technicians	$60,350	$543	$543	$543	$543	$1,147	$1,267	$543	$543
Civil Engineers	$99,278	$1,688	$1,688	$1,688	$1,688	$3,375	$5,857	$1,688	$1,688
Computer Numerically Controlled Tool Programmers and Operators	$51,829	$52	$52	$52	$985	$985	$52	$52	$52
Computer Programmers and Systems Analysts	$93,031	$558	$558	$558	$930	$1,488	$1,116	$558	$558
Construction and Building Inspectors	$64,668	$453	$453	$453	$453	$905	$1,035	$453	$453
Construction Laborers	$38,337	$153	$153	$153	$192	$230	$12,460	$153	$153
Construction Managers	$108,982	$327	$327	$327	$327	$545	$5,776	$327	$327
Customer Service Representatives	$41,829	$209	$209	$209	$920	$1,171	$753	$209	$209
Electrical and Electronic Engineering Technologists and Technicians	$67,530	$338	$338	$338	$540	$810	$608	$338	$338
Electrical Engineers	$102,438	$1,229	$1,229	$1,229	$1,844	$3,176	$2,561	$1,229	$1,229
Electrical, Electronic, and Electromechanical Assemblers	$37,409	$75	$75	$75	$860	$898	$150	$75	$75
Electricians	$61,730	$123	$123	$123	$370	$432	$1,173	$123	$123
Engineers, All Other	$95,156	$571	$571	$571	$856	$1,332	$1,142	$571	$571
Environmental Engineers, Technologists and Technicians	$78,868	$473	$473	$473	$473	$1,025	$946	$473	$473
Environmental Science and Protection Technicians, and Specialists	$68,473	$274	$274	$274	$274	$479	$479	$274	$274
Financial Managers and Examiners	$133,418	$534	$534	$534	$1,201	$1,601	$1,734	$534	$534
First-Line Supervisors	$72,087	$2,091	$2,091	$2,091	$5,479	$6,488	$12,039	$2,091	$2,091
General and Operations Managers	$127,095	$2,161	$2,161	$2,161	$4,703	$6,101	$8,388	$2,161	$2,161
Heavy and Tractor-Trailer Truck Drivers	$46,798	$889	$889	$889	$1,685	$2,106	$3,323	$889	$889
Helpers	$34,535	$242	$242	$242	$518	$553	$691	$242	$242
Human Resources Managers and Specialists	$90,738	$454	$454	$454	$1,180	$1,543	$1,452	$454	$454
Industrial Engineers	$92,528	$555	$555	$555	$2,128	$2,591	$1,018	$555	$555
Industrial Machinery Mechanics	$58,794	$412	$412	$412	$1,235	$1,352	$529	$412	$412
Industrial Production Managers	$116,046	$232	$232	$232	$1,393	$1,509	$464	$232	$232
Industrial Truck and Tractor Operators	$40,037	$40	$40	$40	$360	$400	$160	$40	$40

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$243	$243	$243	$1,118	$1,312	$486	$243	$243
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$278	$278	$278	$1,250	$1,562	$1,215	$278	$278
Logisticians	$75,245	$226	$226	$226	$602	$903	$602	$226	$226
Machine Setters, Operators, and Tenders	$40,872	$123	$123	$123	$2,493	$2,902	$245	$123	$123
Machinists	$49,388	$148	$148	$148	$1,976	$2,074	$148	$148	$148
Maintenance and Repair Workers, General	$45,949	$138	$138	$138	$643	$781	$597	$138	$138
Management Analysts	$86,666	$347	$347	$347	$693	$1,040	$953	$347	$347
Market Research Analysts and Marketing Specialists	$69,354	$277	$277	$277	$624	$832	$694	$277	$277
Mechanical Drafters	$59,044	$236	$236	$236	$531	$768	$413	$236	$236
Mechanical Engineers	$91,501	$1,647	$1,647	$1,647	$4,392	$6,039	$3,477	$1,647	$1,647
Miscellaneous Assemblers and Fabricators	$36,096	$180	$180	$180	$4,223	$4,259	$217	$180	$180
Mobile Heavy Equipment Mechanics, Except Engines	$55,614	$111	$111	$111	$278	$334	$1,502	$111	$111
Network and Computer Systems Administrators	$84,403	$253	$253	$253	$506	$760	$675	$253	$253
Office and Administrative Support Clerks and Workers	$42,443	$594	$594	$594	$1,231	$1,655	$2,674	$594	$594
Operating Engineers and Other Construction Equipment Operators	$51,623	$258	$258	$258	$361	$413	$9,137	$258	$258
Other	$71,543	$8,943	$8,943	$8,943	$19,245	$25,970	$37,631	$8,943	$8,943
Petroleum Engineers	$138,170	$4,698	$4,698	$4,698	$4,836	$9,257	$9,257	$4,698	$4,698
Plumbers, Pipefitters, and Steamfitters	$59,323	$119	$119	$119	$178	$237	$712	$119	$119
Procurement, Production, Planning, and Expediting Clerks	$49,485	$198	$198	$198	$792	$990	$544	$198	$198
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$1,307	$1,307	$1,307	$2,042	$3,267	$4,819	$1,307	$1,307
Rotary Drill Operators, Oil and Gas	$54,848	$494	$494	$494	$494	$548	$548	$494	$494
Roustabouts, Oil and Gas	$45,984	$1,104	$1,104	$1,104	$1,150	$1,150	$1,196	$1,104	$1,104
Sailors and Marine Oilers	$43,875	$351	$351	$351	$1,448	$2,106	$2,282	$351	$351
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	$69,576	$348	$348	$348	$417	$626	$974	$348	$348
Sales Representatives, Wholesale and Manufacturing	$77,669	$233	$233	$233	$2,175	$2,330	$466	$233	$233
Secretaries and Administrative Assistants	$50,137	$702	$702	$702	$1,153	$1,755	$2,457	$702	$702
Service Unit Operators, Oil and Gas	$50,324	$1,157	$1,157	$1,157	$1,208	$1,208	$1,157	$1,157	$1,157
Ship Engineers	$76,455	$382	$382	$382	$1,453	$2,141	$2,141	$382	$382
Shipping, Receiving, and Inventory Clerks	$37,376	$75	$75	$75	$673	$748	$150	$75	$75
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$1,225	$1,225	$1,225	$1,939	$3,163	$2,551	$1,225	$1,225
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$618	$618	$618	$618	$1,236	$1,607	$618	$618
Transportation, Storage, and Distribution Managers	$105,057	$210	$210	$210	$946	$1,366	$1,261	$210	$210
Welders, Cutters, Solderers, and Brazers	$49,018	$294	$294	$294	$3,431	$3,578	$1,814	$294	$294
Total	N/A	$47,243	$47,243	$47,243	$106,157	$144,536	$174,497	$47,243	$47,243

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Accountants, Auditors, and Actuaries	$77,052	$616	$616	$616	$616	$616	$1,772
Aerospace Engineers, Operations Technologists and Technicians	$94,207	$377	$377	$377	$377	$377	$659
Architectural and Civil Drafters	$58,564	$703	$703	$703	$703	$703	$1,171
Architectural and Engineering Managers	$144,293	$1,876	$1,876	$1,876	$1,876	$1,876	$3,319
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$313	$313	$313	$313	$313	$1,075
Bus and Truck Mechanics and Diesel Engine Specialists	$54,190	$163	$163	$163	$163	$163	$759
Buyers and Purchasing Agents	$68,671	$275	$275	$275	$275	$275	$755
Calibration and Engineering Technologists and Technicians, Except Drafters, All Other	$62,294	$249	$249	$249	$249	$249	$249
Captains, Mates, and Pilots of Water Vessels	$68,687	$481	$481	$481	$481	$481	$4,877
Civil Engineering Technologists and Technicians	$60,350	$543	$543	$543	$543	$543	$1,026
Civil Engineers	$99,278	$1,688	$1,688	$1,688	$1,688	$1,688	$4,567
Computer Numerically Controlled Tool Programmers and Operators	$51,829	$52	$52	$52	$52	$52	$52
Computer Programmers and Systems Analysts	$93,031	$558	$558	$558	$558	$558	$930
Construction and Building Inspectors	$64,668	$453	$453	$453	$453	$453	$841
Construction Laborers	$38,337	$153	$153	$153	$153	$153	$8,741
Construction Managers	$108,982	$327	$327	$327	$327	$327	$4,141
Customer Service Representatives	$41,829	$209	$209	$209	$209	$209	$1,171
Electrical and Electronic Engineering Technologists and Technicians	$67,530	$338	$338	$338	$338	$338	$473
Electrical Engineers	$102,438	$1,229	$1,229	$1,229	$1,229	$1,229	$2,049
Electrical, Electronic, and Electromechanical Assemblers	$37,409	$75	$75	$75	$75	$75	$75
Electricians	$61,730	$123	$123	$123	$123	$123	$864
Engineers, All Other	$95,156	$571	$571	$571	$571	$571	$856
Environmental Engineers, Technologists and Technicians	$78,868	$473	$473	$473	$473	$473	$868
Environmental Science and Protection Technicians, and Specialists	$68,473	$274	$274	$274	$274	$274	$411
Financial Managers and Examiners	$133,418	$534	$534	$534	$534	$534	$1,468
First-Line Supervisors	$72,087	$2,091	$2,091	$2,091	$2,091	$2,091	$8,939
General and Operations Managers	$127,095	$2,161	$2,161	$2,161	$2,161	$2,161	$6,863
Heavy and Tractor-Trailer Truck Drivers	$46,798	$889	$889	$889	$889	$889	$3,182
Helpers	$34,535	$242	$242	$242	$242	$242	$345
Human Resources Managers and Specialists	$90,738	$454	$454	$454	$454	$454	$1,361
Industrial Engineers	$92,528	$555	$555	$555	$555	$555	$740
Industrial Machinery Mechanics	$58,794	$412	$412	$412	$412	$412	$176
Industrial Production Managers	$116,046	$232	$232	$232	$232	$232	$348
Industrial Truck and Tractor Operators	$40,037	$40	$40	$40	$40	$40	$120

Source: Energy and Industrial Advisory Partners

Table 25: Deepwater Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$243	$243	$243	$243	$243	$340
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$278	$278	$278	$278	$278	$1,493
Logisticians	$75,245	$226	$226	$226	$226	$226	$752
Machine Setters, Operators, and Tenders	$40,872	$123	$123	$123	$123	$123	$82
Machinists	$49,388	$148	$148	$148	$148	$148	$49
Maintenance and Repair Workers, General	$45,949	$138	$138	$138	$138	$138	$597
Management Analysts	$86,666	$347	$347	$347	$347	$347	$1,040
Market Research Analysts and Marketing Specialists	$69,354	$277	$277	$277	$277	$277	$624
Mechanical Drafters	$59,044	$236	$236	$236	$236	$236	$295
Mechanical Engineers	$91,501	$1,647	$1,647	$1,647	$1,647	$1,647	$2,654
Miscellaneous Assemblers and Fabricators	$36,096	$180	$180	$180	$180	$180	$36
Mobile Heavy Equipment Mechanics, Except Engines	$55,614	$111	$111	$111	$111	$111	$1,168
Network and Computer Systems Administrators	$84,403	$253	$253	$253	$253	$253	$591
Office and Administrative Support Clerks and Workers	$42,443	$594	$594	$594	$594	$594	$2,165
Operating Engineers and Other Construction Equipment Operators	$51,623	$258	$258	$258	$258	$258	$6,453
Other	$71,543	$8,943	$8,943	$8,943	$8,943	$8,943	$31,193
Petroleum Engineers	$138,170	$4,698	$4,698	$4,698	$4,698	$4,698	$7,185
Plumbers, Pipefitters, and Steamfitters	$59,323	$119	$119	$119	$119	$119	$475
Procurement, Production, Planning, and Expediting Clerks	$49,485	$198	$198	$198	$198	$198	$495
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$1,307	$1,307	$1,307	$1,307	$1,307	$4,084
Rotary Drill Operators, Oil and Gas	$54,848	$494	$494	$494	$494	$494	$0
Roustabouts, Oil and Gas	$45,984	$1,104	$1,104	$1,104	$1,104	$1,104	$92
Sailors and Marine Oilers	$43,875	$351	$351	$351	$351	$351	$3,642
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	$69,576	$348	$348	$348	$348	$348	$626
Sales Representatives, Wholesale and Manufacturing	$77,669	$233	$233	$233	$233	$233	$233
Secretaries and Administrative Assistants	$50,137	$702	$702	$702	$702	$702	$1,955
Service Unit Operators, Oil and Gas	$50,324	$1,157	$1,157	$1,157	$1,157	$1,157	$50
Ship Engineers	$76,455	$382	$382	$382	$382	$382	$3,593
Shipping, Receiving, and Inventory Clerks	$37,376	$75	$75	$75	$75	$75	$187
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$1,225	$1,225	$1,225	$1,225	$1,225	$2,143
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$618	$618	$618	$618	$618	$1,236
Transportation, Storage, and Distribution Managers	$105,057	$210	$210	$210	$210	$210	$1,996
Welders, Cutters, Solderers, and Brazers	$49,018	$294	$294	$294	$294	$294	$1,274
Total	N/A	$47,243	$47,243	$47,243	$47,243	$47,243	$144,042

Source: Energy and Industrial Advisory Partners

The analysis of direct jobs created by the example shallow water project indicated that direct jobs created would also encompass over 200 different job titles. For ease of presentation, only the top 55 job titles are included in the below figure. (Table 26)

Table 26: Shallow Water Project Employment Jobs by Title

Job Title	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Accountants, Auditors, and Actuaries	0	4	6	2	2	3	10	8	9	2
Architectural and Civil Drafters	0	1	1	0	7	0	1	1	3	2
Architectural and Engineering Managers	0	1	2	1	8	3	5	3	5	3
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	0	2	3	1	2	3	7	6	5	2
Buyers and Purchasing Agents	0	1	2	1	1	5	8	4	4	1
Captains, Mates, and Pilots of Water Vessels	0	2	3	1	0	0	4	13	7	1
Civil Engineering Technologists and Technicians	0	1	1	0	6	0	1	1	3	2
Civil Engineers	0	1	2	1	11	0	1	6	6	4
Computer Programmers and Systems Analysts	0	2	4	1	3	1	5	3	5	2
Construction Laborers	0	0	0	0	1	1	1	61	15	1
Construction Managers	0	0	1	0	1	0	1	10	3	1
Customer Service Representatives	0	1	2	1	1	4	7	6	4	1
Electrical Engineers	0	1	1	1	8	2	3	1	4	3
Engineers, All Other	0	1	1	0	3	1	2	1	2	1
Environmental Engineers, Technologists and Technicians	0	1	1	0	4	0	1	1	2	1
Financial Managers and Examiners	0	1	2	1	1	2	4	3	3	1
First-Line Supervisors	0	5	9	4	3	22	38	36	23	6
General and Operations Managers	0	3	5	2	5	7	13	13	11	4
Geoscientists, Except Hydrologists and Geographers	0	1	2	1	1	0	2	1	2	1
Heavy and Tractor-Trailer Truck Drivers	0	2	3	1	0	1	5	14	10	4
Helpers	0	0	1	0	0	5	8	3	3	1
Human Resources Managers and Specialists	0	1	2	1	2	2	5	3	3	1
Industrial Engineers	0	1	2	1	3	8	11	3	4	1
Industrial Machinery Mechanics	0	1	2	1	0	7	21	3	5	2
Inspectors, Testers, Sorters, Samplers, and Weighers	0	1	1	1	1	10	14	3	3	1
Laborers and Freight, Stock, and Material Movers, Hand	0	2	3	1	0	9	17	10	7	2
Logisticians	0	1	1	0	1	1	3	2	2	1

Source: Energy and Industrial Advisory Partners

Table 26: Shallow Water Project Employment Jobs by Title *(Continued)*

Job Title	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Machine Setters, Operators, and Tenders	0	2	4	2	0	41	78	9	9	0
Machinists	0	1	2	1	0	17	23	4	4	0
Maintenance and Repair Workers, General	0	1	1	1	1	5	10	4	3	1
Management Analysts	0	1	1	0	1	1	2	2	2	1
Market Research Analysts and Marketing Specialists	0	1	1	0	2	1	3	2	2	1
Mechanical Engineers	0	2	3	2	11	11	15	5	8	4
Miscellaneous Assemblers and Fabricators	0	3	7	4	0	45	58	11	12	0
Network and Computer Systems Administrators	0	1	1	0	1	1	2	2	2	1
Occupational Health and Safety Specialists and Technicians	0	0	1	0	0	1	2	2	2	1
Office and Administrative Support Clerks and Workers	0	2	4	2	4	5	10	12	9	3
Operating Engineers and Other Construction Equipment Operators	0	0	0	0	0	0	1	33	9	1
Other	4	23	41	23	60	112	187	133	105	35
Petroleum Engineers	1	5	7	3	20	1	7	6	14	8
Petroleum Pump System Operators, Refinery Operators, and Gaugers	0	1	2	1	0	0	2	2	3	1
Procurement, Production, Planning, and Expediting Clerks	0	1	1	1	1	6	9	3	3	1
Project Management Specialists and Business Operations Specialists, All Other	0	2	3	1	7	2	6	9	8	4
Rotary Drill Operators, Oil and Gas	0	0	1	0	0	0	1	1	3	2
Roustabouts, Oil and Gas	0	1	2	1	0	0	2	3	8	5
Sailors and Marine Oilers	0	2	4	1	0	0	5	15	8	2
Sales Representatives, Wholesale and Manufacturing	0	1	2	1	1	9	14	3	3	1
Secretaries and Administrative Assistants	0	2	4	2	6	3	8	8	8	3
Service Unit Operators, Oil and Gas	0	2	4	1	0	0	4	3	9	5
Ship Engineers	0	1	2	1	0	0	3	8	5	1
Software Developers and Software Quality Assurance Analysts and Testers	0	1	2	1	7	2	4	2	4	3
Surveyors, Surveying and Mapping Technicians and Researchers	0	1	1	0	6	0	1	2	3	2
Welders, Cutters, Solderers, and Brazers	0	2	4	2	0	30	38	13	9	1
Wellhead Pumpers	0	3	4	2	0	0	4	4	5	1
Total	5	100	172	77	203	390	697	520	413	140

Source: Energy and Industrial Advisory Partners

Table 26: Shallow Water Project Employment Jobs by Title *(Continued)*

Job Title	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Accountants, Auditors, and Actuaries	2	2	2	2	2	2	2	2	2	3
Architectural and Civil Drafters	2	2	2	2	2	2	2	2	2	2
Architectural and Engineering Managers	3	3	3	3	3	3	3	3	3	3
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	2	2	2	2	2	2	2	2	2	2
Buyers and Purchasing Agents	1	1	1	1	1	1	1	1	1	2
Captains, Mates, and Pilots of Water Vessels	1	1	1	1	1	1	1	1	1	2
Civil Engineering Technologists and Technicians	2	2	2	2	2	2	2	2	2	2
Civil Engineers	4	4	4	4	4	4	4	4	4	4
Computer Programmers and Systems Analysts	2	2	2	2	2	2	2	2	2	2
Construction Laborers	1	1	1	1	1	1	1	1	1	1
Construction Managers	1	1	1	1	1	1	1	1	1	1
Customer Service Representatives	1	1	1	1	1	1	1	1	1	2
Electrical Engineers	3	3	3	3	3	3	3	3	3	3
Engineers, All Other	1	1	1	1	1	1	1	1	1	1
Environmental Engineers, Technologists and Technicians	1	1	1	1	1	1	1	1	1	1
Financial Managers and Examiners	1	1	1	1	1	1	1	1	1	1
First-Line Supervisors	6	6	6	6	6	6	6	6	6	10
General and Operations Managers	4	4	4	4	4	4	4	4	4	5
Geoscientists, Except Hydrologists and Geographers	1	1	1	1	1	1	1	1	1	1
Heavy and Tractor-Trailer Truck Drivers	4	4	4	4	4	4	4	4	4	5
Helpers	1	1	1	1	1	1	1	1	1	2
Human Resources Managers and Specialists	1	1	1	1	1	1	1	1	1	2
Industrial Engineers	1	1	1	1	1	1	1	1	1	2
Industrial Machinery Mechanics	2	2	2	2	2	2	2	2	2	3
Inspectors, Testers, Sorters, Samplers, and Weighers	1	1	1	1	1	1	1	1	1	2
Laborers and Freight, Stock, and Material Movers, Hand	2	2	2	2	2	2	2	2	2	3
Logisticians	1	1	1	1	1	1	1	1	1	1

Source: Energy and Industrial Advisory Partners

Table 26: Shallow Water Project Employment Jobs by Title *(Continued)*

Job Title	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Machine Setters, Operators, and Tenders	0	0	0	0	0	0	0	0	0	4
Machinists	0	0	0	0	0	0	0	0	0	3
Maintenance and Repair Workers, General	1	1	1	1	1	1	1	1	1	1
Management Analysts	1	1	1	1	1	1	1	1	1	1
Market Research Analysts and Marketing Specialists	1	1	1	1	1	1	1	1	1	1
Mechanical Engineers	4	4	4	4	4	4	4	4	4	6
Miscellaneous Assemblers and Fabricators	0	0	0	0	0	0	0	0	0	8
Network and Computer Systems Administrators	1	1	1	1	1	1	1	1	1	1
Occupational Health and Safety Specialists and Technicians	1	1	1	1	1	1	1	1	1	1
Office and Administrative Support Clerks and Workers	3	3	3	3	3	3	3	3	3	4
Operating Engineers and Other Construction Equipment Operators	1	1	1	1	1	1	1	1	1	1
Other	35	35	35	35	35	35	35	35	35	54
Petroleum Engineers	8	8	8	8	8	8	8	8	8	8
Petroleum Pump System Operators, Refinery Operators, and Gaugers	1	1	1	1	1	1	1	1	1	1
Procurement, Production, Planning, and Expediting Clerks	1	1	1	1	1	1	1	1	1	2
Project Management Specialists and Business Operations Specialists, All Other	4	4	4	4	4	4	4	4	4	4
Rotary Drill Operators, Oil and Gas	2	2	2	2	2	2	2	2	2	2
Roustabouts, Oil and Gas	5	5	5	5	5	5	5	5	5	5
Sailors and Marine Oilers	2	2	2	2	2	2	2	2	2	3
Sales Representatives, Wholesale and Manufacturing	1	1	1	1	1	1	1	1	1	2
Secretaries and Administrative Assistants	3	3	3	3	3	3	3	3	3	4
Service Unit Operators, Oil and Gas	5	5	5	5	5	5	5	5	5	5
Ship Engineers	1	1	1	1	1	1	1	1	1	2
Software Developers and Software Quality Assurance Analysts and Testers	3	3	3	3	3	3	3	3	3	3
Surveyors, Surveying and Mapping Technicians and Researchers	2	2	2	2	2	2	2	2	2	2
Welders, Cutters, Solderers, and Brazers	1	1	1	1	1	1	1	1	1	5
Wellhead Pumpers	1	1	1	1	1	1	1	1	1	1
Total	140	140	140	140	140	140	140	140	140	202

Source: Energy and Industrial Advisory Partners

Table 26: Shallow Water Project Employment Jobs by Title *(Continued)*

Job Title	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Accountants, Auditors, and Actuaries	13	13	2	2	2	2	2	2	2	19
Architectural and Civil Drafters	4	4	2	2	2	2	2	2	2	2
Architectural and Engineering Managers	6	6	3	3	3	3	3	3	3	5
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	6	8	2	2	2	2	2	2	2	11
Buyers and Purchasing Agents	4	4	1	1	1	1	1	1	1	6
Captains, Mates, and Pilots of Water Vessels	7	10	1	1	1	1	1	1	1	26
Civil Engineering Technologists and Technicians	3	3	2	2	2	2	2	2	2	2
Civil Engineers	6	9	4	4	4	4	4	4	4	8
Computer Programmers and Systems Analysts	8	8	2	2	2	2	2	2	2	10
Construction Laborers	1	44	1	1	1	1	1	1	1	59
Construction Managers	2	8	1	1	1	1	1	1	1	10
Customer Service Representatives	5	5	1	1	1	1	1	1	1	11
Electrical Engineers	4	4	3	3	3	3	3	3	3	2
Engineers, All Other	2	2	1	1	1	1	1	1	1	2
Environmental Engineers, Technologists and Technicians	3	3	1	1	1	1	1	1	1	3
Financial Managers and Examiners	4	4	1	1	1	1	1	1	1	6
First-Line Supervisors	21	35	6	6	6	6	6	6	6	48
General and Operations Managers	11	15	4	4	4	4	4	4	4	20
Geoscientists, Except Hydrologists and Geographers	4	4	1	1	1	1	1	1	1	5
Heavy and Tractor-Trailer Truck Drivers	9	14	4	4	4	4	4	4	4	24
Helpers	2	3	1	1	1	1	1	1	1	3
Human Resources Managers and Specialists	4	4	1	1	1	1	1	1	1	6
Industrial Engineers	4	3	1	1	1	1	1	1	1	2
Industrial Machinery Mechanics	5	4	2	2	2	2	2	2	2	5
Inspectors, Testers, Sorters, Samplers, and Weighers	3	2	1	1	1	1	1	1	1	2
Laborers and Freight, Stock, and Material Movers, Hand	7	7	2	2	2	2	2	2	2	16
Logisticians	2	2	1	1	1	1	1	1	1	4

Source: Energy and Industrial Advisory Partners

Table 26: Shallow Water Project Employment Jobs by Title *(Continued)*

Job Title	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Machine Setters, Operators, and Tenders	5	1	0	0	0	0	0	0	0	1
Machinists	3	0	0	0	0	0	0	0	0	0
Maintenance and Repair Workers, General	3	3	1	1	1	1	1	1	1	5
Management Analysts	3	3	1	1	1	1	1	1	1	5
Market Research Analysts and Marketing Specialists	2	2	1	1	1	1	1	1	1	3
Mechanical Engineers	8	6	4	4	4	4	4	4	4	4
Miscellaneous Assemblers and Fabricators	8	0	0	0	0	0	0	0	0	0
Network and Computer Systems Administrators	3	3	1	1	1	1	1	1	1	4
Occupational Health and Safety Specialists and Technicians	2	3	1	1	1	1	1	1	1	4
Office and Administrative Support Clerks and Workers	9	13	3	3	3	3	3	3	3	18
Operating Engineers and Other Construction Equipment Operators	2	25	1	1	1	1	1	1	1	33
Other	104	141	35	35	35	35	35	35	35	188
Petroleum Engineers	20	20	8	8	8	8	8	8	8	19
Petroleum Pump System Operators, Refinery Operators, and Gaugers	5	5	1	1	1	1	1	1	1	7
Procurement, Production, Planning, and Expediting Clerks	3	3	1	1	1	1	1	1	1	4
Project Management Specialists and Business Operations Specialists, All Other	9	12	4	4	4	4	4	4	4	15
Rotary Drill Operators, Oil and Gas	3	3	2	2	2	2	2	2	2	2
Roustabouts, Oil and Gas	10	10	5	5	5	5	5	5	5	7
Sailors and Marine Oilers	9	12	2	2	2	2	2	2	2	31
Sales Representatives, Wholesale and Manufacturing	3	1	1	1	1	1	1	1	1	1
Secretaries and Administrative Assistants	10	12	3	3	3	3	3	3	3	15
Service Unit Operators, Oil and Gas	12	12	5	5	5	5	5	5	5	10
Ship Engineers	5	7	1	1	1	1	1	1	1	18
Software Developers and Software Quality Assurance Analysts and Testers	5	5	3	3	3	3	3	3	3	4
Surveyors, Surveying and Mapping Technicians and Researchers	4	4	2	2	2	2	2	2	2	3
Welders, Cutters, Solderers, and Brazers	6	5	1	1	1	1	1	1	1	8
Wellhead Pumpers	9	9	1	1	1	1	1	1	1	13
Total	415	548	140	140	140	140	140	140	140	739

Source: Energy and Industrial Advisory Partners

On average, the example shallow water project is projected to support average direct annual wages paid of around $16.2 million, with total direct wages over the project's life cycle of over $485 million. (Table 27)

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title

Job Title	Annual Median Wage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Accountants, Auditors, and Actuaries	$77,052	$0	$308	$462	$154	$154	$231	$771	$616
Architectural and Civil Drafters	$58,564	$0	$59	$59	$0	$410	$0	$59	$59
Architectural and Engineering Managers	$144,293	$0	$144	$289	$144	$1,154	$433	$721	$433
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$0	$90	$134	$45	$90	$134	$313	$269
Buyers and Purchasing Agents	$68,671	$0	$69	$137	$69	$69	$343	$549	$275
Captains, Mates, and Pilots of Water Vessels	$68,687	$0	$137	$206	$69	$0	$0	$275	$893
Civil Engineering Technologists and Technicians	$60,350	$0	$60	$60	$0	$362	$0	$60	$60
Civil Engineers	$99,278	$0	$99	$199	$99	$1,092	$0	$99	$596
Computer Programmers and Systems Analysts	$93,031	$0	$186	$372	$93	$279	$93	$465	$279
Construction Laborers	$38,337	$0	$0	$0	$0	$38	$38	$38	$2,339
Construction Managers	$108,982	$0	$0	$109	$0	$109	$0	$109	$1,090
Customer Service Representatives	$41,829	$0	$42	$84	$42	$42	$167	$293	$251
Electrical Engineers	$102,438	$0	$102	$102	$102	$820	$205	$307	$102
Engineers, All Other	$95,156	$0	$95	$95	$0	$285	$95	$190	$95
Environmental Engineers, Technologists and Technicians	$78,868	$0	$79	$79	$0	$315	$0	$79	$79
Financial Managers and Examiners	$133,418	$0	$133	$267	$133	$133	$267	$534	$400
First-Line Supervisors	$72,087	$0	$360	$649	$288	$216	$1,586	$2,739	$2,595
General and Operations Managers	$127,095	$0	$381	$635	$254	$635	$890	$1,652	$1,652
Geoscientists, Except Hydrologists and Geographers	$130,784	$0	$131	$262	$131	$131	$0	$262	$131
Heavy and Tractor-Trailer Truck Drivers	$46,798	$0	$94	$140	$47	$0	$47	$234	$655
Helpers	$34,535	$0	$0	$35	$0	$0	$173	$276	$104
Human Resources Managers and Specialists	$90,738	$0	$91	$181	$91	$181	$181	$454	$272
Industrial Engineers	$92,528	$0	$93	$185	$93	$278	$740	$1,018	$278
Industrial Machinery Mechanics	$58,794	$0	$59	$118	$59	$0	$412	$1,235	$176
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$0	$49	$49	$49	$49	$486	$680	$146
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$0	$69	$104	$35	$0	$312	$590	$347
Logisticians	$75,245	$0	$75	$75	$0	$75	$75	$226	$150

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Machine Setters, Operators, and Tenders	$40,872	$0	$82	$163	$82	$0	$1,676	$3,188	$368
Machinists	$49,388	$0	$49	$99	$49	$0	$840	$1,136	$198
Maintenance and Repair Workers, General	$45,949	$0	$46	$46	$46	$46	$230	$459	$184
Management Analysts	$86,666	$0	$87	$87	$0	$87	$87	$173	$173
Market Research Analysts and Marketing Specialists	$69,354	$0	$69	$69	$0	$139	$69	$208	$139
Mechanical Engineers	$91,501	$0	$183	$275	$183	$1,007	$1,007	$1,373	$458
Miscellaneous Assemblers and Fabricators	$36,096	$0	$108	$253	$144	$0	$1,624	$2,094	$397
Network and Computer Systems Administrators	$84,403	$0	$84	$84	$0	$84	$84	$169	$169
Occupational Health and Safety Specialists and Technicians	$71,312	$0	$0	$71	$0	$0	$71	$143	$143
Office and Administrative Support Clerks and Workers	$42,443	$0	$85	$170	$85	$170	$212	$424	$509
Operating Engineers and Other Construction Equipment Operators	$51,623	$0	$0	$0	$0	$0	$0	$52	$1,704
Other	$69,169	$277	$1,591	$2,836	$1,591	$4,150	$7,747	$12,935	$9,200
Petroleum Engineers	$138,170	$138	$691	$967	$415	$2,763	$138	$967	$829
Petroleum Pump System Operators, Refinery Operators, and Gaugers	$78,340	$0	$78	$157	$78	$0	$0	$157	$157
Procurement, Production, Planning, and Expediting Clerks	$49,485	$0	$49	$49	$49	$49	$297	$445	$148
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$0	$163	$245	$82	$572	$163	$490	$735
Rotary Drill Operators, Oil and Gas	$54,848	$0	$0	$55	$0	$0	$0	$55	$55
Roustabouts, Oil and Gas	$45,984	$0	$46	$92	$46	$0	$0	$92	$138
Sailors and Marine Oilers	$43,875	$0	$88	$176	$44	$0	$0	$219	$658
Sales Representatives, Wholesale and Manufacturing	$77,669	$0	$78	$155	$78	$78	$699	$1,087	$233
Secretaries and Administrative Assistants	$50,137	$0	$100	$201	$100	$301	$150	$401	$401
Service Unit Operators, Oil and Gas	$50,324	$0	$101	$201	$50	$0	$0	$201	$151
Ship Engineers	$76,455	$0	$76	$153	$76	$0	$0	$229	$612
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$0	$102	$204	$102	$714	$204	$408	$204
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$0	$62	$62	$0	$371	$0	$62	$124
Welders, Cutters, Solderers, and Brazers	$49,018	$0	$98	$196	$98	$0	$1,471	$1,863	$637
Wellhead Pumpers	$59,070	$0	$177	$236	$118	$0	$0	$236	$236
Total	N/A	$415	$7,300	$12,389	$5,513	$17,449	$23,679	$43,496	$33,300

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Accountants, Auditors, and Actuaries	$77,052	$693	$154	$154	$154	$154	$154	$154	$154
Architectural and Civil Drafters	$58,564	$176	$117	$117	$117	$117	$117	$117	$117
Architectural and Engineering Managers	$144,293	$721	$433	$433	$433	$433	$433	$433	$433
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$224	$90	$90	$90	$90	$90	$90	$90
Buyers and Purchasing Agents	$68,671	$275	$69	$69	$69	$69	$69	$69	$69
Captains, Mates, and Pilots of Water Vessels	$68,687	$481	$69	$69	$69	$69	$69	$69	$69
Civil Engineering Technologists and Technicians	$60,350	$181	$121	$121	$121	$121	$121	$121	$121
Civil Engineers	$99,278	$596	$397	$397	$397	$397	$397	$397	$397
Computer Programmers and Systems Analysts	$93,031	$465	$186	$186	$186	$186	$186	$186	$186
Construction Laborers	$38,337	$575	$38	$38	$38	$38	$38	$38	$38
Construction Managers	$108,982	$327	$109	$109	$109	$109	$109	$109	$109
Customer Service Representatives	$41,829	$167	$42	$42	$42	$42	$42	$42	$42
Electrical Engineers	$102,438	$410	$307	$307	$307	$307	$307	$307	$307
Engineers, All Other	$95,156	$190	$95	$95	$95	$95	$95	$95	$95
Environmental Engineers, Technologists and Technicians	$78,868	$158	$79	$79	$79	$79	$79	$79	$79
Financial Managers and Examiners	$133,418	$400	$133	$133	$133	$133	$133	$133	$133
First-Line Supervisors	$72,087	$1,658	$433	$433	$433	$433	$433	$433	$433
General and Operations Managers	$127,095	$1,398	$508	$508	$508	$508	$508	$508	$508
Geoscientists, Except Hydrologists and Geographers	$130,784	$262	$131	$131	$131	$131	$131	$131	$131
Heavy and Tractor-Trailer Truck Drivers	$46,798	$468	$187	$187	$187	$187	$187	$187	$187
Helpers	$34,535	$104	$35	$35	$35	$35	$35	$35	$35
Human Resources Managers and Specialists	$90,738	$272	$91	$91	$91	$91	$91	$91	$91
Industrial Engineers	$92,528	$370	$93	$93	$93	$93	$93	$93	$93
Industrial Machinery Mechanics	$58,794	$294	$118	$118	$118	$118	$118	$118	$118
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$146	$49	$49	$49	$49	$49	$49	$49
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$243	$69	$69	$69	$69	$69	$69	$69
Logisticians	$75,245	$150	$75	$75	$75	$75	$75	$75	$75

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Machine Setters, Operators, and Tenders	$40,872	$368	$0	$0	$0	$0	$0	$0	$0
Machinists	$49,388	$198	$0	$0	$0	$0	$0	$0	$0
Maintenance and Repair Workers, General	$45,949	$138	$46	$46	$46	$46	$46	$46	$46
Management Analysts	$86,666	$173	$87	$87	$87	$87	$87	$87	$87
Market Research Analysts and Marketing Specialists	$69,354	$139	$69	$69	$69	$69	$69	$69	$69
Mechanical Engineers	$91,501	$732	$366	$366	$366	$366	$366	$366	$366
Miscellaneous Assemblers and Fabricators	$36,096	$433	$0	$0	$0	$0	$0	$0	$0
Network and Computer Systems Administrators	$84,403	$169	$84	$84	$84	$84	$84	$84	$84
Occupational Health and Safety Specialists and Technicians	$71,312	$143	$71	$71	$71	$71	$71	$71	$71
Office and Administrative Support Clerks and Workers	$42,443	$382	$127	$127	$127	$127	$127	$127	$127
Operating Engineers and Other Construction Equipment Operators	$51,623	$465	$52	$52	$52	$52	$52	$52	$52
Other	$69,169	$7,263	$2,421	$2,421	$2,421	$2,421	$2,421	$2,421	$2,421
Petroleum Engineers	$138,170	$1,934	$1,105	$1,105	$1,105	$1,105	$1,105	$1,105	$1,105
Petroleum Pump System Operators, Refinery Operators, and Gaugers	$78,340	$235	$78	$78	$78	$78	$78	$78	$78
Procurement, Production, Planning, and Expediting Clerks	$49,485	$148	$49	$49	$49	$49	$49	$49	$49
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$653	$327	$327	$327	$327	$327	$327	$327
Rotary Drill Operators, Oil and Gas	$54,848	$165	$110	$110	$110	$110	$110	$110	$110
Roustabouts, Oil and Gas	$45,984	$368	$230	$230	$230	$230	$230	$230	$230
Sailors and Marine Oilers	$43,875	$351	$88	$88	$88	$88	$88	$88	$88
Sales Representatives, Wholesale and Manufacturing	$77,669	$233	$78	$78	$78	$78	$78	$78	$78
Secretaries and Administrative Assistants	$50,137	$401	$150	$150	$150	$150	$150	$150	$150
Service Unit Operators, Oil and Gas	$50,324	$453	$252	$252	$252	$252	$252	$252	$252
Ship Engineers	$76,455	$382	$76	$76	$76	$76	$76	$76	$76
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$408	$306	$306	$306	$306	$306	$306	$306
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$185	$124	$124	$124	$124	$124	$124	$124
Welders, Cutters, Solderers, and Brazers	$49,018	$441	$49	$49	$49	$49	$49	$49	$49
Wellhead Pumpers	$59,070	$295	$59	$59	$59	$59	$59	$59	$59
Total	N/A	$28,659	$10,631	$10,631	$10,631	$10,631	$10,631	$10,631	$10,631

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24
Accountants, Auditors, and Actuaries	$77,052	$154	$154	$154	$231	$1,002	$1,002	$154	$154
Architectural and Civil Drafters	$58,564	$117	$117	$117	$117	$234	$234	$117	$117
Architectural and Engineering Managers	$144,293	$433	$433	$433	$433	$866	$866	$433	$433
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$90	$90	$90	$90	$269	$358	$90	$90
Buyers and Purchasing Agents	$68,671	$69	$69	$69	$137	$275	$275	$69	$69
Captains, Mates, and Pilots of Water Vessels	$68,687	$69	$69	$69	$137	$481	$687	$69	$69
Civil Engineering Technologists and Technicians	$60,350	$121	$121	$121	$121	$181	$181	$121	$121
Civil Engineers	$99,278	$397	$397	$397	$397	$596	$894	$397	$397
Computer Programmers and Systems Analysts	$93,031	$186	$186	$186	$186	$744	$744	$186	$186
Construction Laborers	$38,337	$38	$38	$38	$38	$38	$1,687	$38	$38
Construction Managers	$108,982	$109	$109	$109	$109	$218	$872	$109	$109
Customer Service Representatives	$41,829	$42	$42	$42	$84	$209	$209	$42	$42
Electrical Engineers	$102,438	$307	$307	$307	$307	$410	$410	$307	$307
Engineers, All Other	$95,156	$95	$95	$95	$95	$190	$190	$95	$95
Environmental Engineers, Technologists and Technicians	$78,868	$79	$79	$79	$79	$237	$237	$79	$79
Financial Managers and Examiners	$133,418	$133	$133	$133	$133	$534	$534	$133	$133
First-Line Supervisors	$72,087	$433	$433	$433	$721	$1,514	$2,523	$433	$433
General and Operations Managers	$127,095	$508	$508	$508	$635	$1,398	$1,906	$508	$508
Geoscientists, Except Hydrologists and Geographers	$130,784	$131	$131	$131	$131	$523	$523	$131	$131
Heavy and Tractor-Trailer Truck Drivers	$46,798	$187	$187	$187	$234	$421	$655	$187	$187
Helpers	$34,535	$35	$35	$35	$69	$69	$104	$35	$35
Human Resources Managers and Specialists	$90,738	$91	$91	$91	$181	$363	$363	$91	$91
Industrial Engineers	$92,528	$93	$93	$93	$185	$370	$278	$93	$93
Industrial Machinery Mechanics	$58,794	$118	$118	$118	$176	$294	$235	$118	$118
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$49	$49	$49	$97	$146	$97	$49	$49
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$69	$69	$69	$104	$243	$243	$69	$69
Logisticians	$75,245	$75	$75	$75	$75	$150	$150	$75	$75

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24
Machine Setters, Operators, and Tenders	$40,872	$0	$0	$0	$163	$204	$41	$0	$0
Machinists	$49,388	$0	$0	$0	$148	$148	$0	$0	$0
Maintenance and Repair Workers, General	$45,949	$46	$46	$46	$46	$138	$138	$46	$46
Management Analysts	$86,666	$87	$87	$87	$87	$260	$260	$87	$87
Market Research Analysts and Marketing Specialists	$69,354	$69	$69	$69	$69	$139	$139	$69	$69
Mechanical Engineers	$91,501	$366	$366	$366	$549	$732	$549	$366	$366
Miscellaneous Assemblers and Fabricators	$36,096	$0	$0	$0	$289	$289	$0	$0	$0
Network and Computer Systems Administrators	$84,403	$84	$84	$84	$84	$253	$253	$84	$84
Occupational Health and Safety Specialists and Technicians	$71,312	$71	$71	$71	$71	$143	$214	$71	$71
Office and Administrative Support Clerks and Workers	$42,443	$127	$127	$127	$170	$382	$552	$127	$127
Operating Engineers and Other Construction Equipment Operators	$51,623	$52	$52	$52	$52	$103	$1,291	$52	$52
Other	$69,169	$2,421	$2,421	$2,421	$3,735	$7,194	$9,753	$2,421	$2,421
Petroleum Engineers	$138,170	$1,105	$1,105	$1,105	$1,105	$2,763	$2,763	$1,105	$1,105
Petroleum Pump System Operators, Refinery Operators, and Gaugers	$78,340	$78	$78	$78	$78	$392	$392	$78	$78
Procurement, Production, Planning, and Expediting Clerks	$49,485	$49	$49	$49	$99	$148	$148	$49	$49
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$327	$327	$327	$327	$735	$980	$327	$327
Rotary Drill Operators, Oil and Gas	$54,848	$110	$110	$110	$110	$165	$165	$110	$110
Roustabouts, Oil and Gas	$45,984	$230	$230	$230	$230	$460	$460	$230	$230
Sailors and Marine Oilers	$43,875	$88	$88	$88	$132	$395	$527	$88	$88
Sales Representatives, Wholesale and Manufacturing	$77,669	$78	$78	$78	$155	$233	$78	$78	$78
Secretaries and Administrative Assistants	$50,137	$150	$150	$150	$201	$501	$602	$150	$150
Service Unit Operators, Oil and Gas	$50,324	$252	$252	$252	$252	$604	$604	$252	$252
Ship Engineers	$76,455	$76	$76	$76	$153	$382	$535	$76	$76
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$306	$306	$306	$306	$510	$510	$306	$306
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$124	$124	$124	$124	$247	$247	$124	$124
Welders, Cutters, Solderers, and Brazers	$49,018	$49	$49	$49	$245	$294	$245	$49	$49
Wellhead Pumpers	$59,070	$59	$59	$59	$59	$532	$532	$59	$59
Total	N/A	$10,631	$10,631	10631.17384	$14,343	$30,320	$38,432	$10,631	$10,631

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Accountants, Auditors, and Actuaries	$77,052	$154	$154	$154	$154	$154	$1,464
Architectural and Civil Drafters	$58,564	$117	$117	$117	$117	$117	$117
Architectural and Engineering Managers	$144,293	$433	$433	$433	$433	$433	$721
Bookkeeping, Accounting, Auditing, and Brokerage Clerks	$44,782	$90	$90	$90	$90	$90	$493
Buyers and Purchasing Agents	$68,671	$69	$69	$69	$69	$69	$412
Captains, Mates, and Pilots of Water Vessels	$68,687	$69	$69	$69	$69	$69	$1,786
Civil Engineering Technologists and Technicians	$60,350	$121	$121	$121	$121	$121	$121
Civil Engineers	$99,278	$397	$397	$397	$397	$397	$794
Computer Programmers and Systems Analysts	$93,031	$186	$186	$186	$186	$186	$930
Construction Laborers	$38,337	$38	$38	$38	$38	$38	$2,262
Construction Managers	$108,982	$109	$109	$109	$109	$109	$1,090
Customer Service Representatives	$41,829	$42	$42	$42	$42	$42	$460
Electrical Engineers	$102,438	$307	$307	$307	$307	$307	$205
Engineers, All Other	$95,156	$95	$95	$95	$95	$95	$190
Environmental Engineers, Technologists and Technicians	$78,868	$79	$79	$79	$79	$79	$237
Financial Managers and Examiners	$133,418	$133	$133	$133	$133	$133	$801
First-Line Supervisors	$72,087	$433	$433	$433	$433	$433	$3,460
General and Operations Managers	$127,095	$508	$508	$508	$508	$508	$2,542
Geoscientists, Except Hydrologists and Geographers	$130,784	$131	$131	$131	$131	$131	$654
Heavy and Tractor-Trailer Truck Drivers	$46,798	$187	$187	$187	$187	$187	$1,123
Helpers	$34,535	$35	$35	$35	$35	$35	$104
Human Resources Managers and Specialists	$90,738	$91	$91	$91	$91	$91	$544
Industrial Engineers	$92,528	$93	$93	$93	$93	$93	$185
Industrial Machinery Mechanics	$58,794	$118	$118	$118	$118	$118	$294
Inspectors, Testers, Sorters, Samplers, and Weighers	$48,592	$49	$49	$49	$49	$49	$97
Laborers and Freight, Stock, and Material Movers, Hand	$34,718	$69	$69	$69	$69	$69	$555
Logisticians	$75,245	$75	$75	$75	$75	$75	$301

Source: Energy and Industrial Advisory Partners

Table 27: Shallow Water Project Average and Annual Wages in Thousands by Job Title *(Continued)*

Job Title	Annual Median Wage	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Machine Setters, Operators, and Tenders	$40,872	$0	$0	$0	$0	$0	$41
Machinists	$49,388	$0	$0	$0	$0	$0	$0
Maintenance and Repair Workers, General	$45,949	$46	$46	$46	$46	$46	$230
Management Analysts	$86,666	$87	$87	$87	$87	$87	$433
Market Research Analysts and Marketing Specialists	$69,354	$69	$69	$69	$69	$69	$208
Mechanical Engineers	$91,501	$366	$366	$366	$366	$366	$366
Miscellaneous Assemblers and Fabricators	$36,096	$0	$0	$0	$0	$0	$0
Network and Computer Systems Administrators	$84,403	$84	$84	$84	$84	$84	$338
Occupational Health and Safety Specialists and Technicians	$71,312	$71	$71	$71	$71	$71	$285
Office and Administrative Support Clerks and Workers	$42,443	$127	$127	$127	$127	$127	$764
Operating Engineers and Other Construction Equipment Operators	$51,623	$52	$52	$52	$52	$52	$1,704
Other	$69,169	$2,421	$2,421	$2,421	$2,421	$2,421	$13,004
Petroleum Engineers	$138,170	$1,105	$1,105	$1,105	$1,105	$1,105	$2,625
Petroleum Pump System Operators, Refinery Operators, and Gaugers	$78,340	$78	$78	$78	$78	$78	$548
Procurement, Production, Planning, and Expediting Clerks	$49,485	$49	$49	$49	$49	$49	$198
Project Management Specialists and Business Operations Specialists, All Other	$81,674	$327	$327	$327	$327	$327	$1,225
Rotary Drill Operators, Oil and Gas	$54,848	$110	$110	$110	$110	$110	$110
Roustabouts, Oil and Gas	$45,984	$230	$230	$230	$230	$230	$322
Sailors and Marine Oilers	$43,875	$88	$88	$88	$88	$88	$1,360
Sales Representatives, Wholesale and Manufacturing	$77,669	$78	$78	$78	$78	$78	$78
Secretaries and Administrative Assistants	$50,137	$150	$150	$150	$150	$150	$752
Service Unit Operators, Oil and Gas	$50,324	$252	$252	$252	$252	$252	$503
Ship Engineers	$76,455	$76	$76	$76	$76	$76	$1,376
Software Developers and Software Quality Assurance Analysts and Testers	$102,042	$306	$306	$306	$306	$306	$408
Surveyors, Surveying and Mapping Technicians and Researchers	$61,823	$124	$124	$124	$124	$124	$185
Welders, Cutters, Solderers, and Brazers	$49,018	$49	$49	$49	$49	$49	$392
Wellhead Pumpers	$59,070	$59	$59	$59	$59	$59	$768
Total	N/A	$10,631	$10,631	$10,631	$10,631	$10,631	$50,166

Source: Energy and Industrial Advisory Partners

Conclusions

Although in recent years, offshore project development activity has been reduced, several factors point to increased activity in the coming years. Oil prices continue to return to levels more in line with historical trends, underpinning project economics. The oil and natural gas operator and service communities have worked together to reduce project costs while improving safety and operational performance through initiatives such as standardization. Additionally, as concerns around global warming continue to increase, the relatively low greenhouse gas emissions of offshore projects compared to other fossil fuel developments have increased their potential attractiveness to operators trying to reduce their carbon emissions. Methane emissions are closely regulated for offshore operations as offshore facilities are required to recover and sell all produced gas, venting and flaring are tightly controlled and require approval, and gas detection systems are widely deployed. The Gulf of Mexico offshore oil and gas industry's carbon intensity is about one-half of that of onshore oil and gas production areas.

- For the example deepwater project, total lifetime spending of just over $8.8 billion was projected. Average annual spending was projected at $295million, with the highest spending levels taking place during project development, when subsea tieback development is taking place, and during decommissioning.
- Annual operational expenditures were estimated at just under $125 million per year during normal operating years.
- For the example Shallow Water project, total lifetime spending of just over $1.3 billion was projected. Average annual spending was projected at $45 million, with the highest spending levels taking place during project development, when infill drilling is taking place, and during decommissioning.
- Annual operational expenditures were estimated at around $27.5 million per year during normal operating years.
- On average, throughout the 30-year lifecycle of the example deepwater development, total annual supported employment is projected at over 3,640 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of 880 jobs, during the most active years employment impacts peak at over 14,450 jobs. During normal operations, total supported employment is projected at around 1,900 jobs.
- Offshore oil and natural gas project development supports employment both through direct employment by the industry, but also indirectly. Indirect employment occurs through the purchases of goods and services by the industry, while induced employment is due to the impact of greater income in the economy.
- Direct employment due to spending associated with the example deepwater project development is projected to average over 1,435 jobs on average across the example project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of nearly 2,200 jobs.

- On average, throughout the 30-year lifecycle of the example shallow water development, total annual supported employment is projected at around 615 jobs. While employment during the first two years of a project's lifecycle is estimated at only an average of around 135 jobs, during the most active years employment impacts peak at over 1,800 jobs. During normal operations, total supported employment is projected at around 430 jobs.
- Direct employment due to spending associated with the example shallow water project development is projected to average around 230 jobs across the project's 30-year lifecycle. Indirect and induced employment is projected to account for an average of around 390 jobs.
- The analysis of direct jobs created by the example deepwater project indicated that direct jobs created would encompass over 200 different job titles. Some of the most impacted job titles include civil and petroleum engineers, general and operations managers, supervisors, truck drivers, machine setters, operators, and tenders, assemblers and fabricators, project management and business operations specialists, and welders, cutters, solderers, and brazers.
- Based on this analysis, in addition to the large number of diverse jobs supported due to offshore project development, the quality of employment provided directly by the industry is also well above the national average with an average annual wage of nearly $69,650, around 29 percent higher than the national average of slightly over $54,000.
- On average, the example deepwater project is projected to support average direct annual wages paid of around $100 million, with total direct wages over the project's life cycle of nearly $3 billion.
- On average, the example shallow water project is projected to support average direct annual wages paid of around $16.2 million, with total direct wages over the project's life cycle of over $485 million

Glossary

Abandonment & Decommissioning	Involves the safe plugging of the hole in the earth's surface and removal and disposal of the equipment used in offshore oil production	NAICS	North American Industry Classification System
Artificial Lift	The use of artificial means to increase the flow of liquids, such as crude oil or water, from a production well	NDT	Non-Destructive Testing
BOED	Barrels of Oil Equivalent Per Day	NEPA	National Environmental Policy Act
BOEM	Bureau of Ocean Energy Management	OCS	Outer Continental Shelf
BLS	Bureau of Labor Statistics	OCTG	Oilfield Country Tubular Goods
Blowout Preventer (BOP)	A specialized valve or similar mechanical device, used to seal, control and monitor oil and gas wells to prevent blowouts, the uncontrolled release of crude oil or natural gas from a well.	OEWS	Occupational Employment and Wage Statistics
BSEE	Bureau of Safety and Environmental Enforcement	OPEX	Operating Expenditure
Casing	Steel pipe cemented in place during the drilling & construction process to stabilize the wellbore. The casing forms a major structural component of the wellbore	PLEM	Pipeline End Manifold
Coiled Tubing	A long, continuous length of pipe wound on a spool utilized during both drilling and well intervention operations. The pipe is straightened prior to pushing into a wellbore and rewound to coil the pipe back onto the transport and storage spool.	PLET	Pipeline End Terminal
Completion	The process of making a well ready for production (or injection) after drilling operations	Perforating	The communication tunnel created from the casing or liner into the reservoir formation, through which oil or gas is produced. The most common method uses jet perforating guns equipped with shaped explosive charges
Directional Drilling	The practice of drilling non-vertical well bores	Pigging	A form of flow assurance where pipeline pigs are used to purge, clean, and/or inspect pipelines to keep them running smoothly
Drilling Riser	A conduit that provides a temporary extension of a subsea oil well to a surface drilling facility.	QA / QC	Quality Assurance / Quality Control
E&P	Exploration & Production	RIMS II	Regional Input–Output Modeling System is a regional economic model developed and maintained by the US Bureau of Economic Analysis (BEA)

EPC	Engineering, Procurement & Construction	ROV	Remotely Operated Vehicle
FID	Final Investment Decision	Sidetracks	Additional bores emanating from the initial well bore
FEED	Front End Engineering & Design	Stimulation	Well stimulation is a well intervention performed on an oil or gas well to increase production by improving the flow of hydrocarbons from the reservoir into the well bore
Flying Lead	Flexible hydraulic hoses connected to control systems in a subsea tree	Subsea Tree	A system of valves, flow paths, piping, and connectors installed on a subsea wellhead to contain and control the flow of fluid from a reservoir or from the surface by injection
		Swarf	Fine chips or filings of stone, metal, or other material produced by a machining operation
GIS	Geographic Information System	Tieback	A connection between a new oil and gas discovery and an existing production facility
IRM	Inspection, Repair & Maintenance	Topside	The upper half of the drilling rig or production platform structure, above the sea level, outside the splash zone, on which equipment is installed
ILI	In-Line Inspection	Tripping	The physical act of pulling the drill string out of the wellbore and then running it back in
Infill Drilling	Adding new wells in an existing field within the original well patterns to accelerate recovery or to test recovery methods	Tubing	Relatively small-diameter pipe that is run into a well to serve as a conduit for the passage of oil and gas to the surface.
Jacket	The steel frame supporting the deck and the topsides in a fixed offshore platform.	Umbilical	Connections used offshore between the subsea equipment and platforms or floating production units and enabling the control from the surface
Jumper	Short segment of flexible pipe with a connector half at either end commonly used to connect flowlines and/or subsea facilities together.	VIV	Vortex induced vibration
LRMP	Lower Marine Riser Package	Workover	The process of performing major maintenance or remedial treatments on an oil or gas well
Manifold	An arrangement of piping or valves designed to control, distribute and typically monitor fluid flow	UT	Ultrasonic Testing
MPSV	Multi Purpose Support Vessels	Wireline	The use of multi-conductor, single conductor or slickline cable, or "wireline", as a conveyance for the acquisition of subsurface petrophysical and geophysical data and the delivery of well construction services such as pipe recovery, perforating, plug setting and well cleaning and fishing

Appendices

Methodology

Spending Methodology

The spending analysis developed for this report attempts to account for the totality of capital and operational spending associated with offshore oil and natural gas project development throughout a project's lifecycle. This includes spending prior to project development such as geological and geophysical surveys, exploration drilling, and engineering; spending during a project's development such as hardware procurement, drilling, and installation; spending during a project's producing life such as operational expenditures and gas processing; and spending at the end of a project's life such as well plugging and abandonment and decommissioning.

Spending for each project is divided into 19 categories, with each category accounting for one general activity type required to find, develop, operate, or abandon an offshore oil and natural gas project. Costs for each category were developed based on general project sizes (and the associated activity levels and equipment requirements of these projects), well counts, water depths, and other factors. Additionally, the distribution of spending over time for each spending category for different project sizes and water depths was developed.

After the overall spending forecast for Gulf of Mexico oil and natural gas activity was developed, spending was allocated to individual states as well as international suppliers. Spending with international suppliers is not analyzed further and accounts for no economic impact in the report. Domestic spending is allocated based on a category-by-category analysis of supply chains and Bureau of Economic Analysis data to provide state specific spending allocations. Distributions are constant throughout the three scenarios presented in this report, although it is possible and perhaps likely that reduced activity levels may lead to changes in supply chains and thus spending distributions.

Economic Methodology

To develop the employment and gross domestic product analysis presented in this report, the Bureau of Economic Analysis' RIMS II input-output multipliers were used. These multipliers provide state level employment and gross domestic product estimates based on industry specific spending levels. For the purpose of this report, economic activity was also divided into direct (directly related to industries involved in the oil and

natural gas supply chain) and indirect and induced (industries not directly involved in the oil and natural gas supply chain as well as economic activity due to increased wages) employment and gross domestic product.

The following RIMS industry categories were used in the development of the report to account for spending by the oil and natural gas industry (all RIMS categories were used in the output of data):

- Mining and oil and gas field machinery manufacturing
- Steel product manufacturing from purchased steel
- Fabricated metal product manufacturing
- Construction
- Drilling oil and gas wells
- Architectural, engineering, and related services
- Support activities for oil and gas operations
- Natural gas distribution

Government Revenue Methodology

Government revenues due to Gulf of Mexico offshore oil and natural gas activity are primarily derived from three main revenue streams, royalties paid on produced oil and natural gas, bonus bids paid to acquire blocks in lease sales, and rents for blocks leased by operators. There are a number of policies that impact royalty and lease payments received by the Federal Government, including royalty relief for certain blocks depending on production levels, and differing rent and royalty regimes for fields in different water depths and blocks leased at different times. Additionally, the value of oil and natural gas produced in the Gulf of Mexico may differ from major indicators such as West Texas Intermediate (WTI) crude due to transportation costs, long-term sales contracts, and differentials due to product quality. To calculate government revenues due to offshore oil and natural gas activities data from the Office of Natural Resource Revenue[6] (ONRR) as well as oil and natural gas price projections from the Energy Information Administration's Annual Energy Outlook 2020[7] and Short-Term Energy Outlook[8] were utilized. In some cases (especially regarding disbursements to states) calendar year data was unavailable. In these cases, fiscal year data was utilized as a stand-

[6] U.S. Department of the Interior, Natural Resources Revenue Data, https://revenuedata.doi.gov/
[7] Annual Energy Outlook 2020, Energy Information Administration
[8] Short Term Energy Outlook, April 7, 2020, Energy Information Administration

in for calendar year data. Lease sale bid revenues and rental revenues were calculated through the simulation of yearly lease sales based on the current 5-year plan. The number of leases acquired and retained was modeled on the oil price forecasts used to develop the report and historical bid number and levels correlated with activity levels.

In 2006 Congress passed the Gulf of Mexico Energy Security Act (GOMESA) which created revenue sharing provisions for the four Gulf oil and gas producing states (Alabama, Louisiana, Mississippi, and Texas) and their coastal political subdivisions. Revenue sharing was enacted in two phases beginning in 2007 and 2017 respectively, with revenue sharing caps of $375 million for fiscal years 2017–2019, $487.5 million for fiscal years 2020 and 2021, and $375 million for fiscal years 2022–2055 enacted. To develop the revenue sharing forecasts in this report, the total projected federal revenues, actual revenue distribution data from the ONRR, analysis of the growth of revenue sharing based on eligible leases, and the revenue sharing caps were considered.

In addition to provisions for revenue sharing with the Gulf of Mexico producing States, GOMESA also included a provision for distributions to the Land and Water Conservation Fund (LWCF). The LWCF, "supports the protection of federal public lands and waters – including national parks, forests, wildlife refuges, and recreation areas – and voluntary conservation on private land. LWCF investments secure public access, improve recreational opportunities, and preserve ecosystem benefits for local communities.".[9] LWCF distributions forecasts are based on total projected federal revenues, actual distribution data from the ONRR, analysis of the growth of revenue sharing based on eligible leases and revenue sharing caps.

[9] Land and Water Conservation Fund, U.S. Department of the Interior

Data Tables

Table 28: Deepwater Project Detailed Spending (Millions)

Project Stage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Pre-Drilling	$14.2	$1.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Exploration	$0.0	$161.2	$161.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Appraisal	$0.0	$0.0	$134.6	$134.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Design	$0.0	$0.0	$0.0	$0.0	$160.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Development Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$261.2	$261.2	$261.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Development Completion	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$297.2	$297.2	$297.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Subsea Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$118.8	$118.8	$118.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Pipelines	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$206.2	$206.2	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Risers	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$50.0	$50.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Facilities	$0.0	$0.0	$0.0	$0.0	$0.0	$400.0	$427.5	$427.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Installation	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$376.3	$74.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
OPEX	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5
Infill Drilling and Tiebacks	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Abandonment and Decommissioning	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	$14.2	$163.0	$295.7	$134.6	$160.0	$518.8	$1,360.9	$1,360.9	$934.7	$197.7	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5

Source: Energy and Industrial Advisory Partners

Table 28: Deepwater Project Detailed Spending (Millions) *(Continued)*

Project Stage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Life Of Field Total
Pre-Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$16.0
Exploration	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$322.3
Appraisal	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$269.1
Design	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$160.0
Development Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$783.6
Development Completion	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$891.5
Subsea Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$356.5
Pipelines	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$412.3
Risers	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$100.0
Facilities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$1,255.0
Installation	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$450.5
OPEX	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$0.0	$2,470.5
Infill Drilling and Tiebacks	$0.0	$0.0	$0.0	$166.6	$426.6	$391.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$984.5
Abandonment and Decommissioning	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$370.0	$370.0
Total	$123.5	$123.5	$123.5	$290.2	$550.2	$514.8	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$123.5	$370.0	$8,841.7

Source: Energy and Industrial Advisory Partners

Table 29: Shallow Water Project Detailed Spending (Millions)

Project Stage	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
Pre-Drilling	$2.0	$0.8	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Exploration	$0.0	$23.3	$23.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Appraisal	$0.0	$0.0	$16.7	$16.7	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Design	$0.0	$0.0	$0.0	$0.0	$32.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Development Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$23.4	$23.4	$23.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Development Completion	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$24.1	$24.1	$24.1	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Subsea Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$4.0	$4.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Pipelines	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$39.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Risers	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Facilities	$0.0	$0.0	$0.0	$0.0	$0.0	$80.0	$80.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Installation	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$38.7	$8.6	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
OPEX	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5
Infill Drilling and Tiebacks	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Abandonment and Decommissioning	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Total	$2.0	$24.0	$39.9	$16.7	$32.5	$84.0	$171.5	$86.2	$83.6	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5

Source: Energy and Industrial Advisory Partners

Table 29: Shallow Water Project Detailed Spending (Millions) *(Continued)*

Project Stage	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Life Of Field Total
Pre-Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$2.7
Exploration	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$46.5
Appraisal	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$33.3
Design	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$32.5
Development Drilling	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$70.2
Development Completion	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$72.4
Subsea Hardware	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$8.0
Pipelines	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$39.5
Risers	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.5
Facilities	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$160.0
Installation	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$47.3
OPEX	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$0.0	$576.5
Infill Drilling and Tiebacks	$0.0	$0.0	$0.0	$10.5	$50.0	$57.3	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$117.8
Abandonment and Decommissioning	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$142.5	$142.5
Total	$27.5	$27.5	$27.5	$38.0	$77.5	$84.7	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$27.5	$142.5	$1,349.6

Source: Energy and Industrial Advisory Partners

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