OCS Study
BOEM 2016-072

MAG-PLAN GOM 2016 Economic Impact Model for the Gulf of Mexico

U.S. Department of the Interior
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

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Abbreviations

AISI	American Iron and Steel Institute
BOEM	US Department of the Interior's Bureau of Ocean Energy Management
BSEE	US Department of the Interior's Bureau of Safety and Environmental Enforcement
CBP	County Business Patterns
DOI	US Department of the Interior
E&D	exploration and development
EIS	Environmental Impact Statement
ESP	Environmental Studies Program
FPSO	floating, production, storage, and offloading
G&G	geological and geophysical prospecting (e.g., seismic surveys)
GOM	Gulf of Mexico
IAGC	International Association of Geophysical Contractors
LNS	Labor Needs Survey
MMS	Minerals Management Service
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act
O&M	operations and maintenance
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OCTG	oil country tubular goods
OSA	onshore area
RPC	regional purchase coefficient
ROS	rest of state
SDP	supply-demand pool
TCS	total commodity supply
TGD	total gross demand

1 Summary

1.1 Purpose

The Bureau of Ocean Energy Management (BOEM) plays a key role in the United States' energy supply by managing the mineral resources on nearly 160 million acres in the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) region. BOEM integrates environmental values into its decision-making processes. To support these analyses, BOEM (formerly known as the Minerals Management Service, or MMS) developed MAG-PLAN, a two-stage input-output model to estimate employment, personal income, and similar economic impacts from OCS activities (Saha et al. 2005).

MAG-PLAN's Stage 1 starts with BOEM estimates of the level of exploration, development, production, and infrastructure likely to result from a proposed OCS lease sale (auction) or set of sales. The model allocates estimated industry expenditures among industry sectors in IMPLAN (a commercial regional economic modeling program and database),[1] then distributes the expenditure-by-sector spending to onshore areas (OSAs). Stage 2 uses OSA-specific IMPLAN multipliers to calculate the jobs, earnings, and output resulting from oil and gas operations on the OCS.

The purpose of this 2016 update is to:

- Improve the profile of industries and their contributions to offshore oil and gas activities in the GOM (also called "industry sector allocations") by revising and expanding descriptions of the industries contributing to geological and geophysical prospecting; subsea installations; floating, production, storage, and offloading vessels; decommissioning; and operations and maintenance (O&M).

- Update and expand the methodology for distributing non-labor expenditures by sector from offshore oil and gas activities to onshore economic impact regions (also called "onshore distributions"). MAG-PLAN 2016 incorporates refined geographic distributions for iron and steel (primary and secondary manufacturing) and umbilicals (equipment used in subsea production systems) as a modified method for the onshore distributions based on supply/demand pools.

- Update and revise the BOEM-defined OSAs and their IMPLAN multipliers and onshore distributions.

- Update the onshore distribution of labor earnings, including identifying activities and sectors for which household expenditures are likely to occur in OSAs other than where the labor is performed. For example, offshore drilling crews have personnel who live outside the five-state region that borders on the GOM and their wages would likely be spent in the state of residence rather than in the GOM region.

[1] IMPLAN (IMpact Analysis for PLANning) is a commercially available input-output analysis (I-O) software package with modeling and data components. I-O is a means of examining relationships within an economy, both between businesses and between businesses and final consumers, that captures all monetary market transactions for consumption in a given time period. The resulting mathematical formulae allow examination of the effects of a change in one or several economic activities on an entire economy (impact analysis). IMPLAN v.3 disaggregates the US economy into 440 industry sectors and can be used to estimate change in employment (jobs), output, and earnings from increases or decreases in economic activity. IMPLAN industry sectors are consistent with NAICS codes.

Data that have not been updated from MAG-PLAN 2012 are contained in the appendices to this report.

1.2 Report Organization

The report is organized as follows:

- Chapter 2 provides an overview of MAG-PLAN, covering basic concepts, logic flow, and other general information. It sets the context for the rest of the chapters. Sections 2.2 and 2.3 introduce basic concepts such as the different types of multipliers used to estimate impacts and the activity types and functions used in MAG-PLAN, respectively.

- Chapter 3 presents the activity to industry sector profiles developed for the 2016 MAG-PLAN GOM update.

- Chapter 4 discusses the three onshore distributions for labor expenditures developed for the industry sectors.

- Chapter 5 describes the onshore distributions for non-labor expenditures for the 440 industry sectors in IMPLAN.

- Chapter 6 presents a sensitivity analysis of the model's results and provides some concluding observations.

2 Introduction

2.1 History

The Outer Continental Shelf Lands Act (OCSLA), as amended, established a policy for managing oil and natural gas on the OCS and protecting the region's marine and coastal environments. OCSLA requires the federal government to prepare and maintain a current five-year schedule of proposed lease auctions. BOEM is the administrative agency responsible for leasing submerged federal lands and evaluates the environmental impacts, including onshore socioeconomic impacts, of oil and gas activities on the OCS.

After the passage of OCSLA Amendments of 1978, BOEM's predecessor agencies began their efforts to model the implications of offshore development on onshore communities. Luton and Cluck (2000) tracked 15 years of data, methodology development, and analyses performed by what is now BOEM's Environmental Studies Program, from the first large-scale studies published in the mid-1980s. In the late 1990s, MMS's Developmental Benefits Model Assessment Team developed a consistent approach to regional economic modeling across OCS regions, and the first OCS Economic Impact Model for the GOM was created soon thereafter. This model used a two-stage, input-output framework to estimate employment, personal income, and similar economic impacts from OCS activities.

By 2005, MMS had developed the second generation of OCS Economic Impact Models, collectively named MAG-PLAN, which extended the consistent approach and incorporated both the GOM and Alaska OCS models into a single software framework (Saha et al. 2005). MAG-PLAN's Stage 1 starts with BOEM estimates of the level of exploration, development, production, and infrastructure likely to result from a proposed OCS lease sale or set of sales (called an exploration and development, or E&D, scenario). The model allocates industry expenditures among IMPLAN industry sectors and then distributes the expenditure-by-sector spending to OSAs. Stage 2 uses input-output multipliers from IMPLAN to estimate employment, personal income, and other economic effects associated with different E&D scenarios by OSA and type or impact.

In 2010, BOEM undertook a major upgrade to MAG-PLAN for the GOM (Kaplan et al. 2012). Called MAG-PLAN 2012, this update moved the model to Access 2010, realigned its structure to accommodate IMPLAN's update from a 506-industry data set to a 440-industry data set, and improved its functionality. The content expansion focused on incorporating deepwater projects that now represent the majority of the oil production and about half the gas production in the GOM OCS (BOEM 2015) and developing updated activity costs.

As the offshore oil and gas industry evolves, BOEM continues to update MAG-PLAN to respond to these changes. MAG-PLAN 2016 is a continuation of BOEM's efforts to update, expand, and refine its socioeconomic impact analysis capabilities.

2.2 Basic Concepts

BOEM uses an input-output (I-O) modeling framework to evaluate the potential impacts of oil and gas activities on the federal OCS. I-O analysis examines relationships within an economy: those between businesses and those between businesses and final consumers. I-O models allow researchers to study how an expenditure (also called an "exogenous shock") affects the entire economy. This approach is limited in that commercial models, such as IMPLAN, are based on national data. That is, they assume that industries in an area will use inputs in the same proportion as the national average.

The onshore and offshore oil and gas industries differ,[2] however, and the onshore industry is substantially larger than the offshore industry. National data may not adequately describe offshore oil and gas activities, meaning BOEM cannot allocate the full expenditures for drilling an offshore well to the drilling and extraction sectors (e.g., IMPLAN Sector 28) and receive accurate results. BOEM's MAG-PLAN model uses a profile of an activity's (e.g., well drilling) constituent industries (e.g., steel, water transportation), then uses a modified "bill of sale" approach[3] to divide the activity's expenditures proportionately among those constituents identified in the profile. To provide context for these industry sector profiles, Chapter 3 describes several of the industry's activities in detail.

Traditional I-O models capture only the economic impacts that occur within a region, meaning interregional expenditures (i.e., when income from the region of interest goes to purchase something outside of the region) are treated as zero. However, for a complete impact analysis of OCS activities, MAG-PLAN must consider the impacts on multiple regions (or OSAs as previously described). Chapters 4 and 5 provide in-depth discussions for the methods and data used to develop the "onshore distributions" which allocate industry activity into specific OSAs to prevent (or at least minimize) leakage in calculating the economic impact.

2.2.1 Activity Types and Activity Functions

The starting point for a BOEM socioeconomic analysis is the identification of a series of discrete activities (e.g., drilling an exploratory well or decommissioning a production structure) and the different types of revenue generated by these activities (e.g., lease bids, rents, and royalties). BOEM's regional resource evaluation offices estimate the oil-and-gas-related activities that could reasonably take place as a result of a proposed project, lease sale, or set of lease sales. These estimates are compiled into an E&D scenario that describes activities likely to occur each year. These E&D activities, called activity types, are associated in MAG-PLAN with activity functions.[4] Table 1 cross-references the activity types in the E&D scenarios with the activity functions in MAG-PLAN 2016. The "cradle-to-grave" (from geological and geophysical [G&G] prospecting to decommissioning) approach is characteristic of BOEM impact analyses. As Table 1 shows, the activity types in an E&D scenario do not necessarily have a 1:1 correspondence to MAG-PLAN activity functions. For example, the installation of a production system starts a 15-year period of O&M.

[2] Also, activity functions for offshore oil and gas activities differ considerably depending on the region (e.g., Gulf of Mexico and Alaska), climate, and water depth. MAG-PLAN's activity functions allocate spending to a variety of sectors, mirroring as closely as possible the flow of spending necessary for an OCS oil and gas project in a given offshore area at a given water depth.

[3] A bill of sale approach requires BOEM to include all spending, so the industry sector profile (considered "direct expenditures") includes all first-round spending, even if the supplying sectors would usually be considered indirect. Direct, indirect, and induced effects are all defined in Section 2.2.2.

[4] Activity functions are essentially production functions, but BOEM uses a different term to avoid confusion with those in IMPLAN and other such data sources.

Table 1. Activity functions and E&D scenario mapping

Activity Types in E&D Scenario	Activity Function in MAG-PLAN
Exploratory well drilled	Geological and geophysical prospecting
	Exploratory well drilling
Non-productive well drilled	Non-productive well drilling
Productive well drilled	Productive well drilling
Platform added	Platform fabrication and installation
	Operations and maintenance (O&M) costs
Subsea added	Subsea completion(s)
	O&M costs
Floating, production, storage, and offloading (FPSO) added	FPSO
	O&M costs
Gas processing facility—offshore	Gas processing facility—offshore
Gas processing facility—onshore	Gas processing facility—onshore
Gas production	Gas processing O&M costs
Pipeline miles added	Pipeline construction
Platform removed—no explosives	Platform removed—no explosives
Platform removed—with explosives	Platform removed—with explosives

2.2.2 Two-Stage Architecture for MAG-PLAN

Figure 1 illustrates the computational flow within MAG-PLAN. IMPLAN calculations and outputs are shown in the thick lines that surround and enter the center box, which holds the MAG-PLAN calculations. In Stage I, the model reads in an E&D scenario that identifies the number and type of activities estimated to occur each year. The activity types are mapped to activity functions (see also Table 1 above). The model looks up the expenditure (cost or shock) associated with the activity (some of which vary by water depth or well depth, or both). The cost is inflated from the year dollars in which the value is stored in MAG-PLAN to the base year dollars for the first year in the analysis. Each activity function is examined to evaluate whether the workers reside in the region in which they work. If not,[5] the model allocates a user-specified percentage of the activity expenditure to labor costs. Non-labor costs are allocated among the different industries according to the industry sector profile for the activity. The non-labor costs are distributed to OSAs by activity and industry while labor costs are distributed to OSAs by activity. Stage 1 output is a year-by-year matrix of costs by industry and OSA.

MAG-PLAN estimates the number of jobs, earnings, and economic output associated with oil and gas activities on the GOM OCS. Stage II estimates other “direct effects” (e.g., employment associated with the spending in Stage I) and the associated “indirect” and “induced” economic effects:

- Indirect effects are associated with the economic activities involved with backfilling a supply chain. For example, drilling a well consumes steel pipe and cement, creating a demand to replenish these commodities; this supports jobs in the steel and cement industries.

- Induced effects occur through household spending of the wages earned from drilling the well and associated activities.

[5] For example, offshore drilling crews have a schedule that permits a worker to reside at some distance from the GOM. This is examined in more detail in Chapter 4.

For these Stage II calculations, MAG-PLAN incorporates multipliers calculated by an I-O model for each region. BOEM uses the commercial program and database developed by IMPLAN for this purpose.

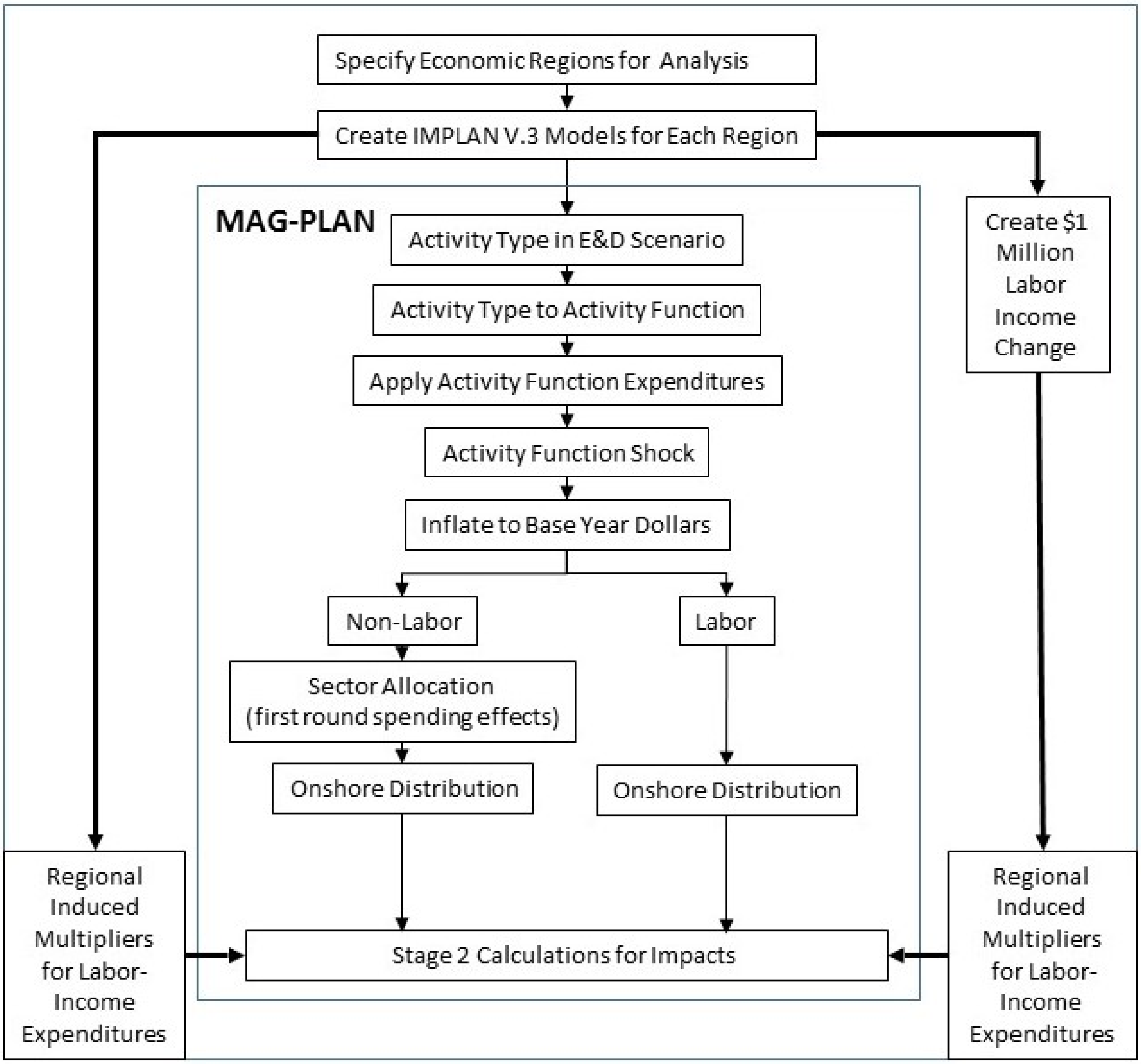

Figure 1. MAG-PLAN and IMPLAN interrelationship

2.3 Running MAG-PLAN

To set up MAG-PLAN for its initial run with a particular set of data, the user must first use IMPLAN to calculate multipliers for each of the OSAs.

2.3.1 Prerequisite IMPLAN Analyses

The overall steps for running IMPLAN analyses before conducting a MAG-PLAN analysis are:

- Identify the geographic OSAs of interest[6]
- Create an IMPLAN model for each OSA
- Generate OSA-specific multipliers for non-labor expenditures
- Create an IMPLAN analysis with a $1 million change in labor income for each OSA[7]
- Create a matrix of induced multipliers by OSA for labor expenditures
- Export and copy into MAG-PLAN for use in Stage II calculations

With IMPLAN Professional v.3 software, the user generates the direct, indirect, and induced multipliers for the non-labor expenditures by industry sector.

2.3.2 Setting Up MAG-PLAN

Before analyzing an E&D scenario, the user must first confirm that the OSAs defined in MAG-PLAN correspond to those in the OSA-specific IMPLAN models. The OSAs must also have the same names and the same set of counties or parishes within them as were used in developing the IMPLAN models. The user will import an E&D scenario, select the offshore modeling area (e.g., western GOM, central GOM, or the combined western and central areas), designate the dollar base year for the analysis and select the start and end years, choose the OSAs to include in the analysis, and import the associated sets of IMPLAN multipliers for labor-income and non-labor expenditures for these OSAs (if that has not already been done for a previous run).[8]

2.3.3 Sample MAG-PLAN Calculation Flow

The logic flow within the white box in Figure 1 illustrates the calculations that take place when the model is executed for a given E&D scenario; see Section 2.2.2. Updated costs (the activity function expenditure) for each activity were revised in development of MAG-PLAN 2012, but these costs have not been further revised for MAG-PLAN 2016. They are included as Appendix A for reference.

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[6] Usually, these correspond to the OSAs already defined in MAG-PLAN.

[7] Running the $1 million change in labor income to calculate the induced effect multipliers replaces the approach in MAG-PLAN 2005, which calculated disposable income, distributed the income among several income categories (as spending patterns differ by income level), and distributed the spending through the personal consumption expenditure matrix to estimate spending by industry sector within Stage I (Saha et al. 2005). All these computational steps are now done within IMPLAN v.3 as the shock to labor income, thus minimizing the need to update the data for each of these data sets within MAG-PLAN.

[8] The user must also select or confirm the remaining input class selections. The default input class selections will normally be acceptable for most analyses.

2.3.3.1 Non-labor Expenditures

Non-labor expenditures are allocated among the 440 IMPLAN industry sectors. This is done by different methods for different activities. Chapter 3 details the industry sector profiles developed for:

- G&G
- Subsea installations
- Floating, production, storage, and offloading (FPSO) vessels
- Decommissioning (with and without explosives)
- Production O&M

The sector allocations for well drilling (exploratory, non-productive, and productive wells), production system installation, onshore and offshore gas processing facilities, and pipeline installation have not been changed from MAG-PLAN 2005 (Saha et al. 2005).

In MAG-PLAN 2016, non-labor expenditures by sector are distributed to OSAs by one of two approaches. The first approach is an industry-specific onshore distribution built from the bottom up by examining company and facility data. The second approach uses IMPLAN's "regional purchase coefficients" (RPCs) as proxies to estimate the proportion of demand supplied from sources within the region ("regional shares" or RSs). Chapter 5 presents the methodology for both methods of onshore distributions for non-labor expenditures. The end result is a matrix of expenditures by industry sector by OSA. The sum of all the Stage 1 non-labor entries should equal the inflation-adjusted non-labor expenditure for the activity.

2.3.3.2 Labor Income Expenditures

MAG-PLAN 2016 has three onshore distributions for labor expenditures. The first assumes that the household expenditures will be made in the OSA where the income is earned. The other two distributions were developed to tailor MAG-PLAN to the offshore oil and gas industry where drilling and production crews might reside at substantial distances from the work site. Chapter 4 describes the data and methods used to develop the labor onshore distributions.

2.3.4 Stage 2 Calculations

In Stage 2, the matrix of expenditures by industry sector and OSA from Stage 1 are multiplied by the eight IMPLAN multipliers to derive the aggregate economic impacts from the activity. The results can be exported as .csv files, summarized into tables, or otherwise processed as needed for BOEM reports. The non-labor expenditures—allocated into industry sectors and distributed to OSAs—are multiplied by the direct, indirect, and induced effect OSA multipliers generated by the regional IMPLAN models. The labor income expenditures—distributed to OSAs by activity function—are multiplied by the induced effect OSA multipliers estimated by the $1 million change in labor income generated in the OSA-specific IMPLAN models. The multiplier represents the number of jobs created in each OSA by a $1 million change in labor income, and is a weighted average of the labor income multipliers for each of the 440 industry sectors for each OSA.

2.4 Revenue Functions in MAG-PLAN

BOEM collects funds from oil and gas operations on the OCS through:

- Bonus bids
- Rental payments
- Royalties on oil and gas production

A bonus is the cash consideration to be paid to the US by the successful bidder for a mineral lease (and is the only bid variable). Rental payments are paid (usually annually) on a lease from the time of the sale until oil and gas production begins on the lease or the lease expires, whichever comes first. Royalties are a percentage of the value of production from the lease.

OCSLA, as amended, establishes revenue sharing between state and federal governments to account for the possibility of drainage of state resources by projects in federal waters.[9] The federal government sets aside 27% of the bonus, rental, and royalty income received from leases within 3 miles of the edge of state waters. The 3-mile band of federal waters is known as the “8(g) zone” after the section of the legislation that created the requirement. The BOEM Economics Division staff calculates the annual “8(g)” and “non-8(g)” revenues for an E&D scenario from which anticipated bonuses, rentals, and royalties are calculated.

MAG-PLAN 2012 estimated disbursement patterns for bonus, rental, and royalty income based on data from the Office Natural Resources Revenue (see USDOI ONRR 2015 for current data). All non-8(g) revenues go to the federal government. That is, 100% of the funds are assigned to the US with the associated IMPLAN Sector 429 (federal government enterprises other than electric utilities). 8(g) revenues are split 73% federal: 27% state. The 73% of 8(g) funds that go to the federal government are allocated to IMPLAN Sector 429. The 27% of the 8(g) funds that go to the GOM states are divided among the states according to the state waters adjacent to the location of the site where the bonus, rent, or royalty was generated.

All state monies are allocated to IMPLAN Sector 432 (state and local government enterprises other than passenger transit or electric utilities).

[9] The Gulf of Mexico Energy Security Act of 2006 established additional revenue-sharing for four Gulf of Mexico states that have OCS oil and gas activities off their coasts. Although the effects of that sharing will become more important, modeling them would increase complexity, and there have been both Administration and Congressional proposals that would modify the sharing provisions for the periods for which BOEM is currently using MAG-PLAN estimates.

3 Activities to Industry Sector Profiles

A reason to subdivide non-labor expenditures for an activity into industry sectors is to capture aspects that are unique to offshore oil and gas operations. Some activities, such as the installation of platform or subsea production systems, are unique to the offshore oil and gas industry. Even for aspects that are common to all oil and gas operations, the proportional use of steel, labor, transportation, and many other factors can vary considerably. For example, allocating all industry expenditures for drilling to IMPLAN Sector 28 (drilling oil and gas wells) would grossly underestimate the waterborne aspects of offshore oil and gas operations because offshore operations are a relatively small part of the combined offshore and onshore drilling industry, which is represented by IMPLAN Sector 28. Water transportation plays an integral part of gathering G&G data, installing subsea systems and FPSOs, decommissioning structures, and transporting production operations and maintenance (O&M) crews to and from the production systems.

MAG-PLAN 2016 uses a three-step approach to developing industry sector profiles for certain activities. The first step is to develop the industry sectors associated with the water-borne nature of some operations. Section 3.1 examines the costs that make up a vessel's day rate. The second step is to develop industry sectors for the non-water-transportation component for the following activities:

- Section 3.2: G&G (or seismic)
- Section 3.3: subsea installations
- Section 3.4: FPSO vessels
- Section 3.5: decommissioning
- Section 3.6: production O&M

The third step is to define the industry sector allocations for the remaining activities (well drilling, production structure and pipeline installation, and onshore and offshore gas processing facilities) based on earlier work. These are described in Section 3.7.

Each section in this chapter begins with an introduction to and an overview of the activity. This provides the context for the industry sectors associated with the activity. As needed, we discuss and incorporate mobilization activities at harbors, installation procedures, and specialized equipment.

3.1 Industry Sectors for Vessel Day Rates

The International Association of Geophysical Contractors provided vessel day rate data for this project (IAGC 2014, IAGC 2015). Section 3.1.1 discusses the primary data for vessel day rates. Though the underlying data are for vessels directly associated with seismic operations, they are used to approximate the costs and categories of spending for all vessel day rates associated with multiple activities. We are indebted to the IAGC for contributing their knowledge and expertise for this effort. Section 3.1.2 uses data from Census's annual survey of service industries to further define and subcategorize the costs included in the IAGC data (Census SAS 2013).

3.1.1 IAGC Data

3.1.1.1 IAGC Data—July 2014

IAGC provided recent, detailed cost data (e.g., mobilization, day rates, and survey durations) on the costs of a seismic trip, which form the foundation for the estimate of a typical trip for other activities that require water transportation; see Table 2 (IAGC 2014). Mobilization costs are $5 million for 2D seismic and 3D seismic, and between $10 million and $15 million for wide azimuth 3D seismic. Day rates are $97,500/day, $325,000/day, and $875,000/day, respectively. IAGC reports survey durations of three months for a proprietary survey and from three to 12 months for a multi-client survey. To estimate typical costs, we examined a four- to six-month trip for 2D seismic, a nine- to 12-month survey for 3D seismic, and a four- to nine-month survey for wide azimuth 3D seismic. Using the midpoint of each trip duration, a 2D seismic survey would cost about $19.8 million, 3D seismic would cost about $108.8 million, and wide azimuth 3D seismic would cost about $331.9 million (the different types of seismic surveys are discussed in detail in Section 3.2.1).

Table 2 shows the substantial differences in the collection of 2D seismic and 3D seismic data. For 2D seismic, mobilization costs represent 25.2% of the total trip cost. For 3D seismic—either narrow or wide azimuth—mobilization costs represent between 3.8% and 4.6% of total trip cost. This is partially due to the fact that 2D seismic collection occurs with a single vessel, while 3D seismic (particularly wide azimuth 3D seismic) involves multiple vessels.

The IAGC information provides additional insight into G&G activities. From the staffing numbers, we see that about half the personnel are ship crew and the other half are seismic crew. On the basis of the pattern seen for G&G (an equal mix of crew involved in vessel duties and crew involved in the technical operations for that activity), we assumed that the personnel for decommissioning and subsea installation would also be split equally between ship crew and technical crew.

The per-day provisioning cost for an extra person can be combined with the crew size and average trip duration to estimate the proportion of the activity cost that would flow to local food preparation and catering services. The provisioning costs range from 0.2% to 1.6% depending on the type of trip.

Table 2. Costs for typical 2D, 3D, and WA 3D seismic sampling trips

Parameter	2D Seismic			3D Seismic			WA 3D Seismic		
	Lower	Upper	Midpoint	Lower	Upper	Midpoint	Lower	Upper	Midpoint
Mobilization			$5,000,000			$5,000,000	$10,000,000	$15,000,000	$12,500,000
Day rate			$97,500	1		$325,000			$875,000
Duration (days)	122	183	152.5	274	365	319.5	122	274	365
Typical cost			$19,868,750			$108,837,500			$331,875,000
Crew—ship	20	30	25	20	30	25	20	30	25
Crew—seismic	25	30	28	25	30	28	25	30	28
Provisioning ($/day/person)			$40			$40			$40
Provisioning cost per trip			$323,300			$677,340			$773,800
Percent of total costs			1.6%			0.6%			0.2%
Mobilization as a percent of type of seismic			25.2%			4.6%			3.8%

Source: IAGC 2014

3.1.1.2 IAGC Day Rate Component Data—May 2015

IAGC provided additional information on the relative relationship of cost components for G&G vessel day rates (i.e., proportions, not absolute values) (IAGC 2015). Table 3 presents the range of values provided by IAGC members and the average value. The data represent all forms of seismic processing (e.g., 2D, 3D, and wide azimuth 3D), which might explain the range in values presented. The largest component is vessel overhead, at 37.5%. The second largest is labor and benefits, at 18.3%. About 16% of the day rate is represented by a mix of components, including repair, maintenance, and support vessels, etc.; food and insurance represent 1.8% and 1.5% of the costs. The sum of the average percent by cost item is 88.1%. The rightmost column in Table 3 shows the IAGC average data scaled to 100%). About 18.2% is in an "other" category. Census data provided a further breakdown of that category (see next section).

Table 3. Day rate cost components for seismic surveys

Cost Component	Range	Average	Scaled
Vessel overhead (including depreciation, finance charges, management overhead, etc.)	High: 60% Low: 22%	37.5%	42.6%
Labor (salaries)	High: 18% Low: 9%	15.0%	17.0%
Benefits	High: 9% Low: 0.3%	3.3%	3.7%
Insurance	High: 2.5% Low: 0.3%	1.5%	1.7%
Food	High: 2.5% Low: 1%	1.8%	2.0%
Fuel and lubricants	High: 16% Low: 5%	13%	14.8%
Other (repair, maintenance, subcontractors, support vessels, logistics)	High: 24% Low: 7.8%	16%	18.2%
Sum of average percent		88.1%	100.0%

Source: IAGC 2015

3.1.2 Census, Service Annual Survey Data

The Census Bureau conducts an annual survey of service industries. Table 4 presents the 2012 Census data for selected business expenses for NAICS 5413 (services: architectural, landscape architectural, engineering, drafting, building inspection, geophysical surveying and mapping, surveying and mapping [except geophysical], and testing laboratories) and NAICS 483 (water transportation) (Census SAS 2013). Indented lines below a total show the variables that are aggregated in the total. For example, employer's cost for fringe benefits is the sum of health insurance, defined benefit and defined contribution plans, payroll taxes, insurance, and other benefits.

We examined the Census data for two purposes:

- Determine whether cost items consistent with those listed in the IAGC "Other" category were identified in the Census data.
- Evaluate the industry expense distribution for the NAICS code in which G&G activities are classified and the industry expense distribution for where the G&G activities take place (i.e., water transportation) to choose the more appropriate profile for offshore G&G activities.

We inspected the results shown in Table 4 and identified cost items that were consistent with repair, maintenance, subcontractors, support vessels, and logistics—the items listed in the IAGC “Other” category.

Water transportation (NAICS 483) includes two cost items that are absent from the G&G list: purchased freight transportation and purchased repairs and maintenance to transportation equipment. This is consistent with the inclusion of container ships and cargo ships within NAICS 483. Although the vessels performing G&G, decommissioning, and subsea installation are large, they do not reach the size of transoceanic container ships, nor do they have the associated freight transportation costs. These cost items do not need to be included in the offshore activity industry profiles.

Table 4. Census data, Service Annual Survey—industry expenses

Item	2012 Expense (Millions)	
	NAICS 5413	NAICS 483
Total operating expenses	191,746	35,094
Gross annual payroll	82,420	5,636
Total employer's cost for fringe benefits	22,309	1,565
Health insurance	*7,696*	*548*
Defined benefit pension plans	*748*	*279*
Defined contribution plans	*3,279*	*128*
Payroll taxes, employer paid insurance premiums (except health), and other employer benefits	*10,586*	*610*
Temporary staff and leased employee expense	7,675	116
Expensed equipment	1,668	70
Expensed purchases of other materials, parts, and supplies	13,191	1,919
Purchased freight transportation		3,781
Expensed purchases of software	846	44
Total purchased electricity and fuels (except motor fuels)	1,106	102
Purchased electricity	*843*	*31*
Purchased fuels (except motor fuels)	*263*	*71*
Total lease and rental payments	6,997	993
Lease and rental payments for machinery, equipment, and other tangible items	*1,123*	*788*
Lease and rental payments for land, buildings, structures, store spaces, and offices	*5,874*	*205*
Total purchased repairs and maintenance	1,372	1,805
Purchased repairs and maintenance to transportation equipment		*1,517*
Purchased repairs and maintenance to machinery and equipment	*967*	*263*
Purchased repairs and maintenance to buildings, structures, and offices	*405*	*25*
Purchased advertising and promotional services	862	758
Cost of insurance		494
Depreciation and amortization charges	4,282	3,827
Governmental taxes and license fees	1,319	360
Total other operating expenses	47,699	8,346
Data processing and other purchased computer services	*744*	*20*
Purchased communications services	*1,129*	*67*
Water, sewer, refuse removal, and other utility payments	*102*	*19*
Purchased professional and technical services	*13,414*	*262*
All other operating expenses	*32,310*	*7,978*

Source: Census SAS 2013

We extracted candidate "Other" costs to compare which NAICS code appeared to be the better fit for offshore G&G operations; see Table 5. The columns labeled "Census" reflect the estimates as calculated from Table 4 and the columns labeled "Scaled" reflect the cost profiles scaled to fit the 18.2% allocated to "Other" in the IAGC data. The line item shares for lease and rental payments for land, buildings, structures, store spaces, and offices is higher for NAICS 5413 (3.1%) than NAICS 483 (0.6%), but the opposite is true for lease and rental payments for machinery, equipment, and other tangible items. The higher costs for land, buildings, structures, and more seen in the NAICS 5413 cost profile are a reason to prefer the NAICS 483 cost profile for supplementing offshore oil and gas activity industry sector profiles. Table 6 is a summary of the subsectorization for "Other" activities in NAICS 483.

Table 5. Comparison of NAICS 5413 and NAICS 483 cost profiles

Item	Census		Scaled		IMPLAN	Sector Name
	NAICS 5413	NAICS 483	NAICS 5413	NAICS 483		
Expensed equipment	0.9%	0.2%	1.1%	0.3%		*Differs according to activity*
Expensed purchases of other materials, parts, and supplies	6.9%	5.5%	8.9%	8.3%		
Expensed purchases of software	0.4%	0.1%	0.6%	0.2%	345	Software publishers
Purchased electricity	0.4%	0.1%	0.6%	0.1%	31	Electric power generation, transmission, and distribution
Lease and rental payments for machinery, equipment, and other tangible items	0.6%	2.2%	0.8%	3.4%	365	Commercial and industrial machinery and equipment rental and leasing
Lease and rental payments for land, buildings, structures, store spaces, and offices	3.1%	0.6%	4.0%	0.9%	360	Real estate
Purchased repairs and maintenance to machinery and equipment	0.5%	0.7%	0.7%	1.1%	417	Commercial and industrial machinery and equipment repair and maintenance
Purchased repairs and maintenance to buildings, structures, and offices	0.2%	0.1%	0.3%	0.1%	39	Maintenance and repair construction of nonresidential maintenance and repair
Purchased advertising and promotional services	0.4%	2.2%	0.6%	3.3%	377	Advertising and related services
Purchased communication services	0.6%	0.2%	0.8%	0.3%	351	Telecommunications
Water, sewer, refuse removal, and other utility payments	0.1%	0.1%	0.1%	0.1%	33	Water, sewage, and other systems
Total of sector percentages	**14.1%**	**11.9%**	**18.2%**	**18.2%**		

Source: Census SAS 2013

Table 6. Subsectorization summary for other activities in NAICS 483 (water transportation)

Item	Percent	IMPLAN	Sector Name
Purchased electricity	0.1%	31	Electric power generation, transmission, and distribution
Water, sewer, refuse removal, and other utility payments	0.1%	33	Water, sewage, and other systems
Purchased repairs and maintenance to buildings, structures, and offices	0.1%	39	Maintenance and repair construction of nonresidential maintenance and repair
Expensed purchases of software	0.2%	345	Software publishers
Purchased communication services	0.3%	351	Telecommunications
Lease and rental payments for land, buildings, structures, store spaces, and offices	0.9%	360	Real estate
Lease and rental payments for machinery, equipment, and other tangible items	3.4%	365	Commercial and industrial machinery and equipment rental and leasing
Purchased advertising and promotional services	3.3%	377	Advertising and related services
Purchased repairs and maintenance to machinery and equipment	1.1%	417	Commercial and industrial machinery and equipment repair and maintenance
Expensed purchases of other equipment, materials, parts, and supplies	8.6%		*Differs according to activity*

Source: Table 5 and IMPLAN 2015

Two cost items in Table 5 could vary according to the activity: expensed equipment and expensed purchases of other materials, parts, and supplies. For the cost profile, these two categories are combined on the assumption that parts, supplies, and materials for the equipment are made by the manufacturers of the equipment.

Table 7 presents the customization of these costs by activity function. G&G activities are distinguished by IMPLAN 256 (watch, clock, and other measuring and controlling device manufacturing), which includes NAICS 334519 (geophysical instruments manufacturing). Subsea installation contains IMPLAN 186 (plate work and fabricated structural product manufacturing) because this industry contributes between 4.5% and 7.2% in the IMPLAN industry production functions for Sectors 36 and 334, both of which had been considered for subsea installation. Decommissioning activities involve severing the platform legs for removal; IMPLAN 220 (cutting tool and machine tool accessory manufacturing) was included for this activity.

Table 7. Customization by expensed equipment and materials

Activity	Expensed Equipment and Materials	
	IMPLAN	Name
G&G	256	Watch, clock, and other measuring and controlling device manufacturing
Subsea installation	186	Plate work and fabricated structural product manufacturing
Decommissioning	220	Cutting tool and machine tool accessory manufacturing
Production O&M		

Source: ERG estimates

No specialized activities are associated with the transport of personnel and supplies for production O&M activities.

3.2 Geological and Geophysical Prospecting

3.2.1 Introduction and Overview

Within the earth's crust, different types of rock have different acoustical characteristics. As a sound wave passes through different layers, the way it is reflected back to the surface reveals some of the characteristics of the rock layers. Seismology includes the study of the vibration of the earth's interior caused by man-made sound pulses. In offshore surveys, the reflected sound waves are picked up by hydrophones (underwater sound detectors); see Figure 2 (Kaplan et al. 2011).

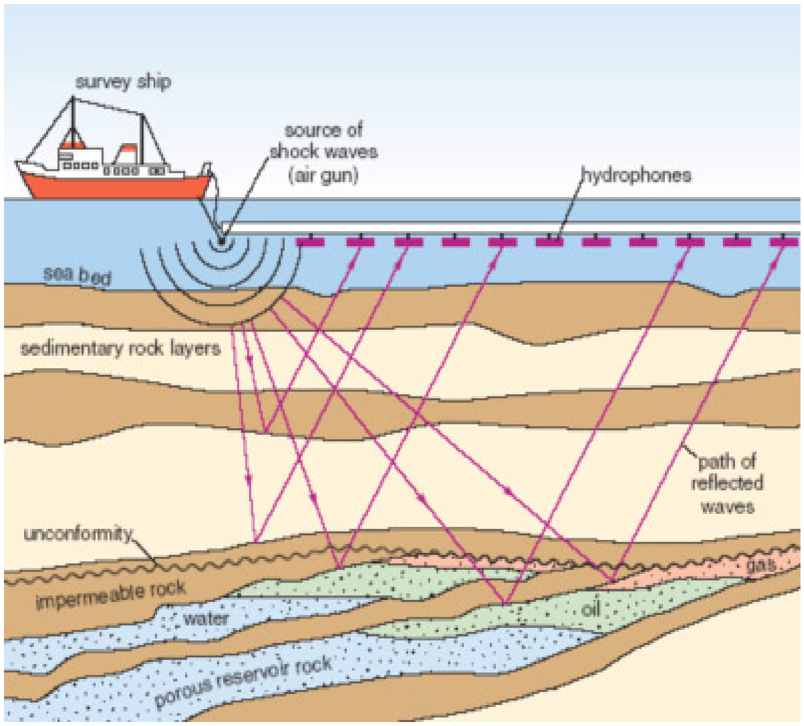

Figure 2. Offshore seismic survey
Source: Rigzone 2014a

Marine seismic vessels use a combination of air guns, water guns, and other acoustic sources to create the pulse needed to take seismic readings. Typical marine seismic sources are air guns and water guns. The first releases compressed air into the water, creating an acoustical energy pulse that penetrates the seafloor. Similarly, a water gun injects water into the surrounding water to create the acoustical pulse (Rigzone 2014a; BOEM 2014).

Regardless of which method is used, the returning pulses are picked up by an array of geophones attached to lines towed by the ship. These arrays are called streamers, and consist of long net-like bands with geophones spaced evenly along the streamer; see Figure 3.

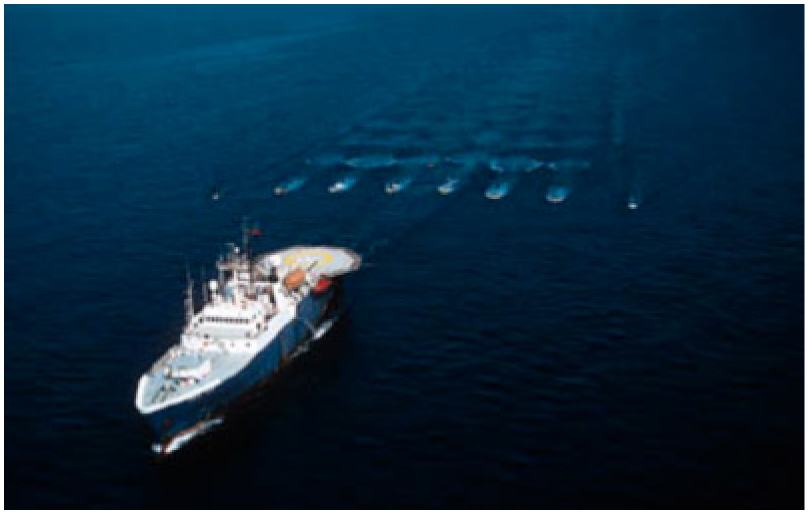

Figure 3. Marine seismic vessel towing multiple hydrophone streamers
Source: Schlumberger 2014

A single vessel can conduct 2D and 3D ("narrow azimuth 3D") seismic surveys. In 2D operations, a single streamer is towed behind the survey vessel. The reflections from the subsurface are assumed to lie below the line traveled by the survey vessel. Thus the image has two dimensions (horizontal and vertical) (OGP 2011). In 3D operations, groups of sail lines are acquired with the same orientation, producing a much denser collection of measurements. Wide azimuth 3D surveys involve multiple vessels making multiple passes over the same area with different lateral separations between source vessels and streamers (OGP 2011).

Figure 4 illustrates the difference between 2D and 3D streamer survey coverage. Spacing between adjacent ship tracks for 2D will typically be greater than 1 km (0.6 mi); spacing for 3D surveys varies, but the data density typically will be 15 to 20 times greater than for 2D surveys (BOEM 2014).

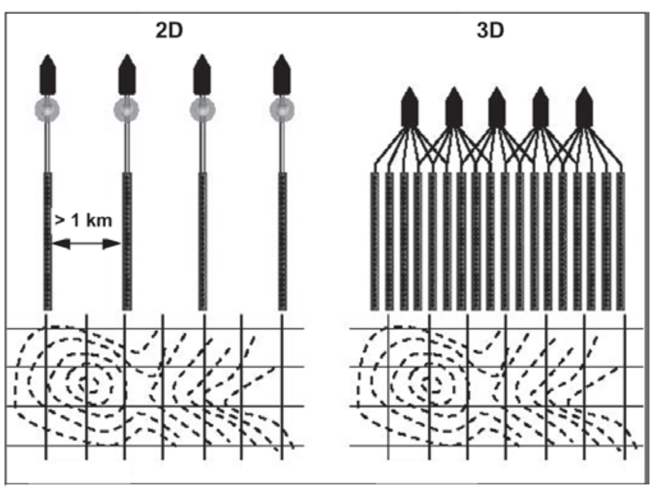

Figure 4. 2D and 3D seismic data collection configurations
Source: BOEM 2014

3.2.2 Vessel Day Rate

The sector allocation for G&G data includes components of both the vessel day rate and the mobilization costs. First, Table 8 integrates the information in Table 3 (IAGC) and Table 4 (Census SAS) to create the sector allocation for the operation of the vessel to collect the seismic data. The "Source" column indicates whether the information comes from Census (Table 4) or IAGC (Table 3). The 16 sectors in Table 8 show the maritime nature of offshore G&G collection, with entries for shipbuilding, ship repair, and water transportation. IMPLAN Sector 369 (architectural, engineering, and related services)—100% of the allocation in MAG-PLAN 2012 for G&G—is now 10.4% of the allocation and represents the specialized seismic crew on the boat.

Table 8. Industry sector profile for G&G data collection activities

MAG-PLAN Inputs	IMPLAN Sector	G&G	Source
Electric power generation, transmission, and distribution	31	0.1%	Census SAS 2013
Water, sewage, and other systems	33	0.1%	Census SAS 2013
Maintenance and repair construction of nonresidential maintenance and repair	39	0.1%	Census SAS 2013
Petroleum refineries	115	14.8%	IAGC 2015 (fuel and lubricants)
Watch, clock, and other measuring and controlling device manufacturing	256	8.6%	Census SAS 2013
Ship building and repairing	290	42.6%	IAGC 2015 (vessel costs)
Water transportation	334	10.4%	IAGC 2015 (ship crew)
Software publishers	345	0.2%	Census SAS 2013
Telecommunications	351	0.3%	Census SAS 2013
Insurance carriers	357	1.7%	IAGC 2015 (insurance)
Real estate	360	0.9%	Census SAS 2013
Commercial and industrial machinery and equipment rental and leasing	365	3.4%	Census SAS 2013
Architectural, engineering, and related services	369	10.4%	IAGC 2015 (seismic crew)
Advertising and related services	377	3.3%	Census SAS 2013
Food services and drinking places	413	2.0%	IAGC 2015 (provisions)
Commercial and industrial machinery and equipment repair and maintenance	417	1.1%	Census SAS 2013
Total non-labor		**100.0%**	

3.2.3 Addition of Mobilization Costs

To fully capture all activities relating to G&G activities, the sector allocation in MAG-PLAN 2016 includes a modified version of Table 8 which incorporates the mobilization costs shown in Table 2. Port and harbor operations are classified as NAICS 488310, which is included in IMPLAN 338 (scenic and sightseeing transportation and support activities for transportation). IMPLAN 338 also includes NAICS 433320 for marine cargo handling.

Table 9 lists the IMPLAN sector percentages for day rates only (exactly as presented in Table 8) and with mobilization costs included. As noted above, mobilization costs for 2D seismic constitute about 25% of the total survey cost, so each percentage shown under "Day Rates" is scaled to sum to the remaining 75%. MAG-PLAN 2016 uses the 3D G&G sector allocation because most of the G&G activity in the GOM is expected to be 3D.

Table 9. Industry sector profile for G&G data collection and mobilization costs

MAG-PLAN Inputs	IMPLAN Sector	Day Rate Sectors	G&G Sectors (Mobilization and Day Rate)	
			2D G&G Sectors	3D G&G Sectors
Electric power generation, transmission, and distribution	31	0.1%	0.1%	0.1%
Water, sewage, and other systems	33	0.1%	0.1%	0.1%
Maintenance and repair construction of nonresidential maintenance and repair	39	0.1%	0.1%	0.1%
Petroleum refineries	115	14.8%	11.0%	14.1%
Watch, clock, and other measuring and controlling device manufacturing	256	8.6%	6.5%	8.3%
Ship building and repairing	290	42.6%	31.9%	40.8%
Water transportation	334	10.4%	7.7%	9.9%
Scenic and sightseeing transportation and support activities for transportation	338		25.2%	4.2%
Software publishers	345	0.2%	0.1%	0.2%
Telecommunications	351	0.3%	0.2%	0.3%
Insurance carriers	357	1.7%	1.3%	1.6%
Real estate	360	0.9%	0.7%	0.9%
Commercial and industrial machinery and equipment rental and leasing	365	3.4%	2.6%	3.3%
Architectural, engineering, and related services	369	10.4%	7.7%	9.9%
Advertising and related services	377	3.3%	2.5%	3.2%
Food services and drinking places	413	2.0%	1.5%	2.0%
Commercial and industrial machinery and equipment repair and maintenance	417	1.1%	0.9%	1.1%
Total non-labor		**100.0%**	**100.0%**	**100.0%**

Source: Table 2; Table 8; ERG estimates

3.3 Subsea Installations

3.3.1 Introduction and Overview

MAG-PLAN 2016 includes subsea systems as an option for an offshore oil and gas production system. Section 3.3.1.1 provides an overview of the equipment associated with subsea systems while Section 3.3.1.2 describes some of the available installation processes. Section 3.3.2 develops an industry sector profile for this activity using a bill-of-sale approach. Section 3.3.3 accounts for installation and investigates subsea system installation as a waterborne activity. Section 3.3.4 presents the industry sector profile.

3.3.1.1 Equipment

The term “subsea system” refers to the equipment, methods, and technology used to develop oil and gas fields below the water surface. Figure 5 provides an example subsea layout. In this example, the subsea production system connects to an FPSO vessel, but subsea systems can connect to any type of floating production structure or a fixed structure with excess processing capacity. The discussion below is based on DNV GL 2014; FMC 2014a–b; OneSubsea 2014; Rigzone 2014b–d; and Haq 2013.

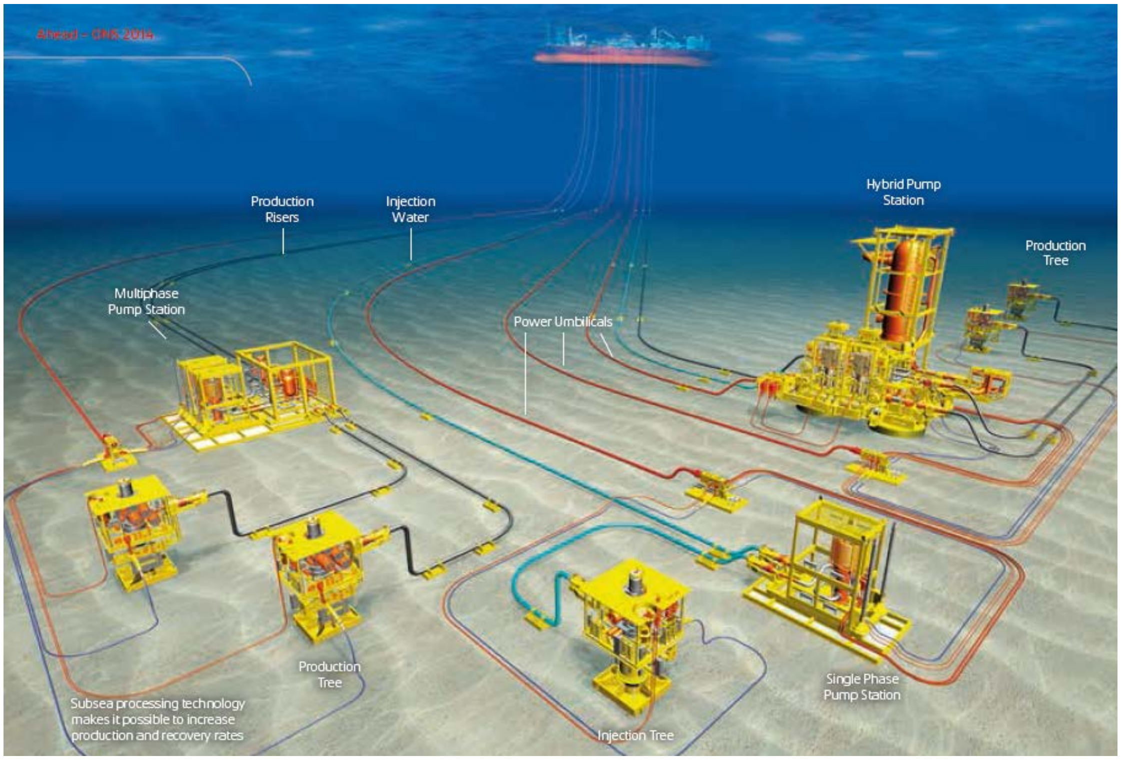

Figure 5. Schematic of production system
Source: FMC 2014a

For the purpose of incorporating subsea systems into MAG-PLAN, we begin the subsea system after the set of valves on top of the well that control the well's flow (called a Christmas tree or XT because the tapering tower of valves resembles a Christmas tree) because the XT costs are included in the well drilling costs.

Manifolds are arrangements of valves, piping, and controls that collect and combine fluid from subsea wells and route the combined flow to a processing unit. They may be placed at a multi-well template, placed at a single well, or located separately with flowlines connecting them to the wells. The left-hand image in Figure 6 illustrates the size of a manifold, while the right-hand image shows a manifold with protection from trawl equipment, anchors, and dropped equipment.

Figure 6. Example manifolds
Source: OneSubsea 2014; DNV GL 2014

Well jumpers are umbilicals that connect wells. They are often located between two fixed positions, e.g., from a well to a manifold, and are designed to accommodate flowline or pipeline movement due to thermal expansion.

Pumps (Figure 7) boost the fluid toward the production structure, relieving the backpressure on the formation. As such, they enhance reservoir flow and increase recovery. Subsea pumps are also used in waterflood operations. Recent technological developments have led to full **subsea separation** and pumping systems. In 2010, the Perdido field in the GOM activated its subsea processing system where the gas flows freely to the topside host while the liquid is pumped (Shell 2010). Other systems perform sand and solid separation or oil and water separation. The discharge of the sand or water at the seafloor means that no energy is expended in bringing the material to the water surface.

Figure 7. Subsea pump
Source: FMC 2014b

Flowlines or pipelines transport the fluids horizontally among the subsea components and to the risers. They might use metal pipes or hoses.

Risers are designed to transport the fluids vertically to the surface. Top-tensioned risers are completely vertical rigid systems and are usually used with tension-leg platforms and spars. Motion compensators (which expand or contract with the motion of the structure) or buoyancy cans (with flexible pipes connecting to the structure) are two methods of addressing the engineering problem of joining a rigid system to a structure that moves with wave action. Steel catenary risers are based on the same curve theory used to build bridges. Hybrid systems, such as the one illustrated in Figure 8, have rigid vertical components topped by buoyancy devices where the system switches to flexible pipes.

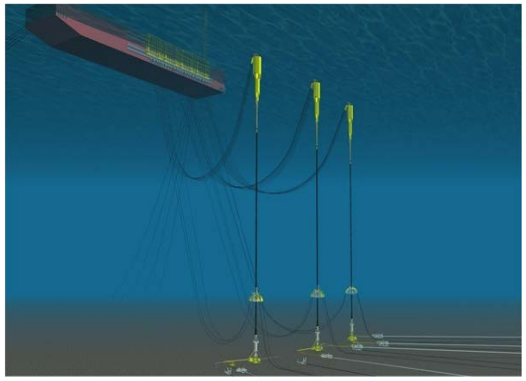

Figure 8. Hybrid riser system
Source: Airborne Oil and Gas 2014

The nerve network of a subsea system, so to speak, is its **umbilicals**—composite cables that link the surface structure to the subsea processing systems, manifolds, subsea trees, etc. Umbilicals may contain fiber optics, steel tubes, thermoplastic hoses, power lines, etc., to serve such diverse functions as communications between the surface structure and subsea processing units, subsea well activation via hydraulics, and chemical injection into the production stream. Figure 9 illustrates the complexity possible in umbilical design.

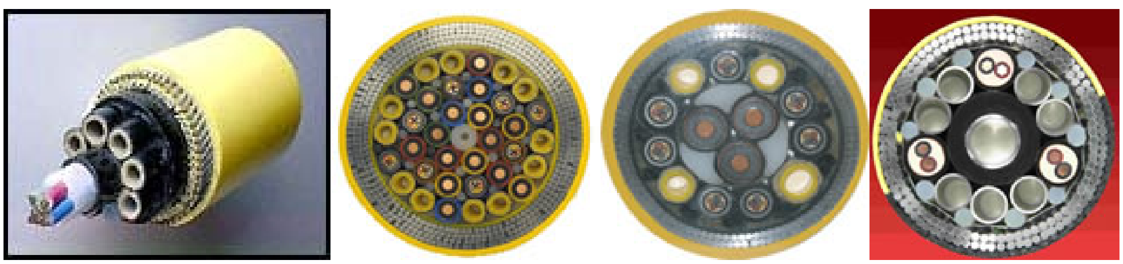

Figure 9. Umbilical cross-sections
Source: UMF 2014a–c

Umbilical manufacture begins with the selection and production of the components. These are woven into bundles and a protective sheath is applied. Steel armor wires may be applied for protection, strength, or ballast. A corrosion-resistant outer sheath completes the package (UMF 2014c).

3.3.1.2 Installation

3.3.1.2.1 Equipment

Installation methods for subsea equipment vary according to the water depth at the site. For shallower waters, crane barges, anchor handling tug supply vessels, and cranes on semisubmersible vessels are feasible methods. A submersible block-and-tackle or sheave method can be used to lower production systems to the seabed, often incorporating a motion compensator or an additional vessel providing tielines for guidance.

Figure 10 illustrates the pendulous method. The left-hand vessel transports the unit to the deployment site and hangs the unit over the water. At the site, a second vessel attaches a line to the unit and travels a set distance away (depending on the water depth). The unit is released and swings down into position (Roveri et al. 2006). Finally, submersible remotely operated vehicles may be used to position equipment on the sea floor when the depths exceed that where divers can operate safely.

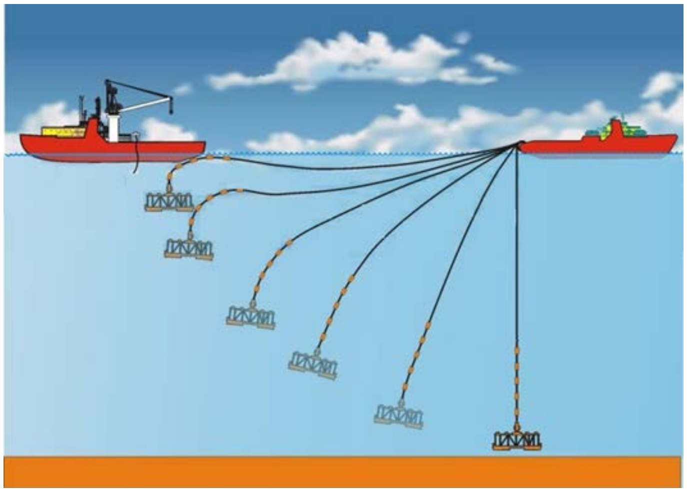

Figure 10. Pendulous deployment method
Source: Roveri et al. 2006

3.3.1.2.2 Pipes and Umbilicals

Specialized vessels are used to lay pipe and umbilicals for subsea operations. The pipe or umbilical is slid off the back of the vessel while the vessel is in transit. The pipe curves downward from the stern through the water until it reaches its final destination on the seafloor. Pipe may be welded in sections on the vessel or coiled on enormous circular spools. Umbilicals are wound on spools for transit and installation. Depending on the angle in which the pipe/umbilical enters the water, the pipe forms the shape of an "S" or a "J" in the water; see Figure 11. The single curve in a "J-lay" puts less stress on the pipe and is more commonly used in deepwater situations (Rigzone 2014e).

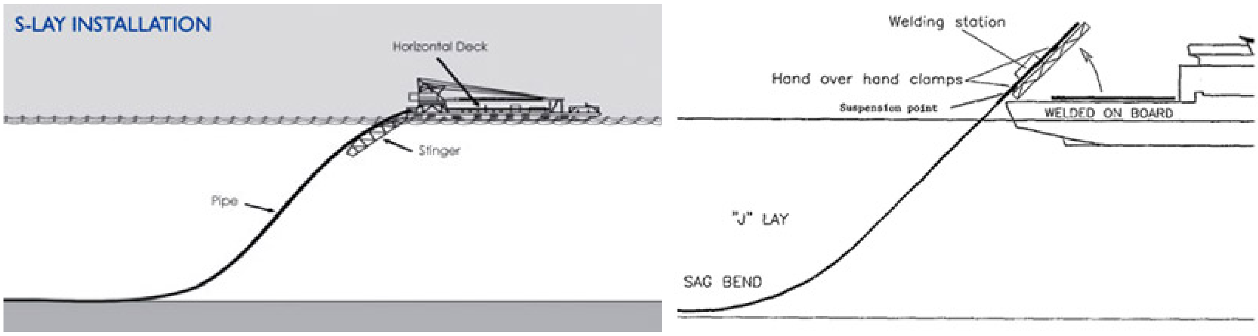

Figure 11. S-lay and J-lay installation
Source: Rigzone 2014e

Figure 12 is an example of a pipe- and umbilical-laying vessel. This one can install pipe with a J-lay or S-Lay method due to its vertical reel. Umbilicals can be laid from below-deck carousels.

Figure 12. Pipe- and umbilical-laying vessel
Source: Technip 2014a

3.3.2 Industry Sector Identification

As the descriptions in Sections 3.3.1.1 and 3.3.1.2 suggest, the spending pattern for subsea oil and gas development in the GOM needs to address both the equipment and installation costs. Equipment costs are discussed in Section 3.3.2.1 and installation is discussed in Section 3.3.3. The final sector distribution is given in Table 16 of Section 3.3.4.

A joint industry project contained detailed cost tables for subsea systems (DNV and Goldsmith Consulting 2000); these are summarized in Table 10. Only the 12-well systems are assumed to have nearby field extensions. The report examined the costs of both vertical ("conventional") and horizontal subsea Christmas trees. Differences in well and subsea equipment costs lead to the conventional trees being about 2% more expensive for six-well systems and 3% to 3.5% more expensive for 12-well systems. The difference in water depth from 4,000 feet to 6,000 feet leads to a less than 0.5% increase in total cost. The material and installation costs for the pipelines and umbilicals are within 2% of each other for the main system. For the extension, the installation cost is 75% of the materials cost.

Table 10. Summary costs for four subsea systems

Parameters	System A		System B		System C		System D	
Number of wells	6		6		12		12	
Water depth (ft)	4,000		6,000		4,000		6,000	
Pipeline size (in.)	12		12		12		12	
Pipeline length (mi)	35		35		35		35	
Infield extension (mi)					5		5	
	Conventional ($000)	Horizontal ($000)	Conventional ($000)	Horizontal ($000)	Conventional ($000)	Horizontal ($000)	Conventional ($000)	Horizontal ($000)
One well hardware	$3,255	$2,570	$3,255	$2,570	$3,255	$2,570	$3,255	*$2,570*
Subsea hardware	$10,977	$10,683	$11,810	$11,050	$10,977	$10,683	$11,810	$11,050
Pipelines and umbilicals (materials)	$91,240	$91,240	$91,240	$91,240	$91,240	$91,240	$91,240	$91,240
Pipelines and umbilicals (installation)	$93,040	$93,040	$93,040	$93,040	$93,040	$93,040	$93,040	$93,040
Infield extension and umbilicals (materials)					$20,499	$20,499	$20,499	$20,499
Infield extension and umbilicals (installation)					$15,749	$15,749	$15,749	$15,749
Total cost	**$214,787**	**$210,383**	**$215,620**	**$210,750**	**$270,565**	**$262,051**	**$271,398**	**$262,418**
Percent difference	2.1%		2.3%		3.2%		3.4%	

Source: DNV and Goldsmith Consulting 2000

For the purpose of developing a bill-of-sale approach to subsea systems, System D, a 12-well system with horizontal subsea trees at a water depth of 6,000 feet, was chosen. Given the minor variations among the four systems described above, the general industry sector profile will not vary dramatically from the example system.

For MAG-PLAN, drilling costs are assumed to include the cost up to and including the installation of the Christmas tree (Kaplan et al. 2011). The $2,570,000 for one-well hardware shown in Table 10 includes the cost of the Christmas tree and its tubing hangers, wireline plugs, and tree cap. These should not be counted as subsea system costs. As derived from the detailed tables in DNV and Goldsmith Consulting (2000), the per-well hardware cost for a subsea system should be $280,000 (for the hydraulic and electrical flying leads and a 6-inch well jumper).

Table 11 summarizes the cost breakdown for a subsea system. The $3,360,000 shown for well hardware is $280,000 times the 12 wells. The costs for the remaining equipment are unchanged. The removal of the Christmas tree costs from the DNV and Goldsmith Consulting (2000) estimate lowers the estimated cost of the system from $262,418,000 to $234,938,000.

Table 11. Example subsea system cost breakdown

Equipment	Cost ($000)	Percentage of Total Cost
Subsea-specific well hardware	$3,360	1.4%
Subsea hardware	$11,050	4.7%
Pipeline end manifolds	$6,150	2.6%
Manifold	$2,000	0.9%
Pipelines	$80,357	34.2%
Umbilicals	$23,232	9.9%
Installation	$108,789	46.3%
Total	**$234,938**	

Source: DNV and Goldsmith Consulting 2000

3.3.2.1 IMPLAN Sectors for Equipment and Umbilicals

The next step is to link each type of the equipment listed in Table 11 to NAICS and IMPLAN industry sectors. The subsea system and its components are summarized in Table 12. The well and subsea hardware, pipeline end manifolds, and well manifolds are all characterized in IMPLAN Sector 206, mining and oil and gas field equipment and machinery.

Table 12. Aligning subsea system costs and IMPLAN sectors

Equipment	Cost ($000)	Percentage of Total Cost		NAICS	IMPLAN	Sector Name
		Individual	Aggregate			
Well hardware	$3,360	1.4%	9.6%	333132	206	Mining and oil and gas field machinery manufacturing
Subsea hardware	$11,050	4.7%				
Pipeline end manifolds	$6,150	2.6%				
Manifold	$2,000	0.9%				
Pipelines	$80,357	34.2%	17.1%	3311	170	Iron and steel mills and ferroalloy manufacturing
			17.1%	3312	171	Steel product manufacturing from purchased steel
Umbilicals	$23,232	9.9%	9.9%		273	Wiring device manufacturing
Installation	$108,789	46.3%	46.3%			See Section 3.3.3 below
Total	**$234,938**		**100.0%**			

Source: ERG estimates and IMPLAN 2015

Pipelines are estimated to be approximately 34.2% of the total subsea system cost (29.9% of the cost is for main field flowlines and 4.3% of the cost is for infield extension flowlines). They can be manufactured by integrated mills (where both the steel and the final product are made) or manufactured from purchased steel. The first category is NAICS 3311 (iron and steel mills and ferroalloy manufacturing), which corresponds to IMPLAN Sector 170 (iron and steel mills and ferroalloy manufacturing). The second category is NAICS 3312 (steel product manufacturing from purchased steel), which corresponds to IMPLAN Sector 171 (steel product manufacturing from purchased steel. Pipelines and other oil country tubular goods might be manufactured in either sector, so we split the allocation equally between IMPLAN Sectors 170 and 171.

We examined the NAICS codes associated with the four umbilical plants in the GOM region (see Table 13) using three commercial databases.

Table 13. NAICS codes for umbilical plants

Company	Location	BOEM Region	NAICS		
			AtoZ	D&B	Demographics*NOW*
Aker Subsea, Inc.	Mobile, AL	AL-1	423810[a]	333132[b]	333132
Oceaneering International, Inc.	Panama City, FL	FL-1		335921[c]	335921/335931[d]
Parker-Hannifin Corp.	Freeport, TX	TX-3	423510[e]	333249[f]	333249
Technip Umbilicals, Inc.	Houston, TX	TX-3	237110[g]/ 211111[h]	541330[i]	

Source: AtoZdatabases 2014; Demographics*Now* 2014; Dun and Bradstreet 2014

a Construction and mining (except oil well) machinery and equipment merchant wholesalers
b Oil and gas field machinery and equipment manufacturing
c Fiber optic cable manufacturing
d Current-carrying wiring device manufacturing
e Metal service centers and other metal merchant wholesalers
f Other industrial machinery manufacturing
g Water and sewer line and related structures construction
h Crude petroleum and natural gas extraction
i Engineering services

Because umbilicals are a relatively new technology for offshore oil and gas operations and NAICS codes are self-assigned by a company, a range of codes is reported. The codes span five major NAICS sectors:

- 21: mining, quarrying, and oil and gas extraction
- 23: construction
- 31–33: manufacturing
- 42: wholesale trade
- 54: professional, scientific, and technical services

This distribution demonstrates how the codes vary depending on whether the establishment focuses on designing them (Sector 54), manufacturing them (Sectors 31–33), installing them (Sector 23), selling them to other companies for installation (Sector 23), or using them itself (Sector 21).

For this project, the focus is on the manufacture of umbilicals. This reduces the industries considered to:

- 333132: oil and gas field machinery and equipment manufacturing
- 333249/333298: other industrial machinery manufacturing[10]
- 335921: fiber optic cable manufacturing
- 335931: current-carrying wiring device manufacturing

The three-digit NAICS industries in which the six-digit industries appear are machinery manufacturing (NAICS 333) and electrical equipment, appliance, and component manufacturing (NAICS 335). The latter group is a better match for umbilical manufacturing. The best matches are IMPLAN Sector 272, communication and energy wire and cable manufacturing (which corresponds to NAICS 33592), and Sector 273, wiring device manufacturing (which corresponds to NAICS

[10] NAICS 333249 is a NAICS 2012 category. The model incorporates IMPLAN 440-sector data based on the NAICS 2007 sectors. Wire and cable insulating machinery manufacturing is in NAICS 333249 in the 2012 data set but in NAICS 333298 (all other industrial machinery manufacturing) in the NAICS 2007 data set.

33593). We examined the IMPLAN multipliers for Sectors 272 and 273 by BOEM OSA. AL-l does not have a multiplier for Sector 272 but has one for Sector 273. FL-1 and TX-3 have multipliers for both sectors. IMPLAN Sector 273 is the only sector occurring in all three BOEM areas with known umbilical production.[11] The 2012 County Business Patterns (CBP) report employment[12] in IMPLAN Sector 273 for Alabama, Florida, and Texas (Census CBP 2015). Because of the availability of IMPLAN multipliers, IMPLAN Sector 273 is used for umbilical manufacturing (as shown in Table 12).

3.3.3 Installation

As shown in Table 11, 46.3% of the subsea cost is installation. Several data limitations were encountered when attempting to assign an IMPLAN sector to the installation of subsea systems. As Figure 12 shows, installation vessels:

- Are much larger than vessels used for crew and supplies transport.
- Contain extremely specialized equipment unique to subsea placement of pipe and umbilicals.

We examined the production function for IMPLAN Sector 334 (water transportation). Table 14 presents the commodities with a contribution of 5% or more. The largest contributor is noncomparable imports at 31%. Though installation vessels might be of foreign manufacture, crews are likely to contain local labor, most pipe is likely to be made domestically, and there are several umbilical manufacturers in the GOM. Also, the production function has no entry for fuel purchases as a retail commodity (IMPLAN commodity 3326 [gasoline stations] or 3331 [nonstore, including fuel dealers]) or a more primary commodity such as refined petroleum products [IMPLAN commodity 3115]).

Table 14. Production function components for IMPLAN 334 (Water Transportation)

Sector	IMPLAN 334 Allocation	Percent
436	Not an industry (noncomparable imports)	31.0%
338	Scenic and sightseeing transportation and support activities for transportation	13.1%
186	Plate work and fabricated structural product manufacturing	7.2%
290	Ship building and repairing	6.9%
360	Real estate	5.5%
339	Couriers and messengers	5.5%

Source: IMPLAN 2014

[11] See Section 5.2.2.3 for the proportions of umbilicals imported into the US and made domestically. The data source (Quest 2015), however, does not track the origin of the components used in the manufacture of the umbilicals (i.e., within the OSA, imported into the OSA but made elsewhere in the US, or imported into the US). The more important umbilicals are to overall spending, the more important it is to account for leakage, and the converse also is true—the effect on the final estimates of not capturing leakage of small sums may not be worth the effort and additional complexity.

[12] We mapped NAICS 2012 to NAICS 2007 to the IMPLAN 440 sector definitions. CBP reports the number of establishments, employment (by size category if not by number), and payroll. We consider employment and payroll to be a better indicator of economic contribution because a single large establishment has a larger impact than a single small establishment. We used employment data because they were more complete than payroll data.

The second largest contributor to Sector 334 is Sector 338 (scenic and sightseeing transportation and support activities for transportation). Table 15 shows this sector's production function components. Though the sector has a component for fuel (refined petroleum products contribute 5.2% to the function), couriers, messengers, and the postal service represent a combined contribution of 20.6%. This would seem reasonable for conducting a tourism-related business, but it seems high for installing subsea production systems. Given difficulties in Sector 334 and 338, we used an alternative approach for determining the sector allocations, described in Section 3.3.4.

Table 15. Production function components for IMPLAN 338 (Water Transportation)

Sector	IMPLAN 338 Allocation	Percent
339	Couriers and messengers	15.0%
338	Scenic and sightseeing transportation and support activities for transportation	7.7%
382	Employment services	5.6%
427	Postal service	5.6%
115	Petroleum refineries	5.2%

Source: IMPLAN 2014

We also examined whether a construction sector might be more representative of subsea system installation (see Appendix B) and found it was not a good match for subsea system installation. Ultimately, we designed an alternate approach to integrate equipment and installation costs for the subsea system activity industry profile, see Section 3.3.4.

3.3.4 Summary Subsea to Industry Sector Profile

Given the difficulties outlined in Section 3.3.3 above and in more detail in Appendix B, we evaluated the activities involved in installing a subsea system:

- Mobilization and demobilization: layout, loading, and vessel preparation
- Crew members
- Supplies for crew members
- Fuel
- Materials consumed during installation

The industry sectors involved would look similar to those for G&G.

Table 16 shows how the equipment and installation costs for a subsea system were integrated with the installation costs derived from the G&G calculations in Table 9. Equipment costs are 53.7% of total costs (see Table 12). We split the 34.2% of the cost associated with flowlines equally between IMPLAN Sectors 170 and 171 because oil country tubular goods and pipelines are manufactured in both sectors. Section 3.3.2.1 explains the rationale for assigning umbilical manufacturing to IMPLAN Sector 273.

Installation costs are 46.3% of the total subsea system cost. The industry sectors listed under "Installation" in Table 16 are reproduced from Table 9 (that is, vessel day rates plus mobilization costs). We assumed that mobilization costs would be relatively high due to the specialized nature of loading the umbilicals and pipelines. We used the 2D seismic mobilization value of 25.2% (compare the percentages in Table 16 and Table 9 under the "Mobilization 2D" columns). The middle column in Table 16 repeats the industry sector allocations from Table 9 with the exception of the substitution of IMPLAN 186 (plate work and fabricated structural product manufacturing) for IMPLAN 256 (watch, clock, and other measuring and controlling device manufacturing), as proposed in Table 7. These installation allocations sum to 100%, but are scaled to 46.3% so that the industry allocations for the equipment and installation sum to 100%. The scaled percentages are shown in the right-hand column of Table 16 and incorporated in the MAG-PLAN model as the subsea sector distribution.

Table 16. Summary sector table for subsea systems activity

MAG-PLAN Inputs	Sector	Mobilization 2D	Subsea Systems
Equipment		**53.7%**	
Iron and steel mills and ferroalloy manufacturing	170		17.10%
Steel product manufacturing from purchased steel	171		17.10%
Mining and oil and gas field machinery manufacturing	206		9.60%
Wiring device manufacturing	273		9.90%
Installation		**46.3%**	
Electric power generation, transmission, and distribution	31	0.1%	0.05%
Water, sewage, and other systems	33	0.1%	0.03%
Maintenance and repair construction of nonresidential maintenance and repair	39	0.1%	0.04%
Petroleum refineries	115	11.0%	5.11%
Plate work and fabricated structural product manufacturing	186	6.5%	2.99%
Ship building and repairing	290	31.9%	14.76%
Water transportation	334	7.7%	3.59%
Scenic and sightseeing transportation and support activities for transportation	338	25.2%	11.65%
Software publishers	345	0.1%	0.07%
Telecommunications	351	0.2%	0.10%
Insurance carriers	357	1.3%	0.59%
Real estate	360	0.7%	0.31%
Commercial and industrial machinery and equipment rental and leasing	365	2.6%	1.18%
Architectural, engineering, and related services	369	7.7%	3.59%
Advertising and related services	377	2.5%	1.14%
Food services and drinking places	413	1.5%	0.71%
Commercial and industrial machinery and equipment repair and maintenance	417	0.9%	0.39%
Sum			**100.00%**

Source: Table 7; Table 9; Table 12; ERG estimates

3.4 Floating, Production, Storage and Offloading Vessels

3.4.1 Introduction and Overview

FPSOs are offshore floating production systems that house both processing equipment and storage for produced hydrocarbons. The basic FPSO design is a ship-shaped vessel, with processing equipment, or topsides, aboard the vessel's deck and hydrocarbon storage below in the double hull. After processing, an FPSO stores oil or gas before offloading periodically to shuttle tankers (Rigzone 2014f; Petrobras 2012; Petrobras America 2007). FPSOs can be used to develop fields where there are no pipelines to transport the hydrocarbons to shore for processing (lack of infrastructure), sea bottom topography precludes pipeline installation (technical hurdles), or it would be uneconomical to install a pipeline (marginal field).

Though FPSOs have been used to develop oil fields since the 1970s, only one has been installed in the GOM—*BW Pioneer*—to develop the Cascade and Chinook fields at water depths of 8,000 to 9,000 feet. *BW Pioneer* entered the GOM in 2010 (Petrobras 2012) and production began in early 2012 (Petzet 2012). Shell plans to develop the Stones field with an FPSO, which would make it the second such floating production system in the GOM (Shell 2014).

Like any other floating production system, it is necessary to connect the structure to the sea bottom. Wood Group Mustang (2014) lists 11 different systems to moor an FPSO to the sea bottom. *BW Pioneer* uses a detachable turret buoy that sinks to a depth of 56m (below storm damage) while the vessel moves to a safer location (Petrobras 2012).

3.4.2 Equipment

Figure 13 is an annotated schematic of *BW Pioneer* while Figure 14 is a picture of the vessel in the steel. We see that the topsides of an FPSO look much like the topsides equipment—such as processing equipment, accommodations, flares, and cranes—found on other floating production systems.

Previous research indicated that hull construction was highly likely to happen outside the US but that there was a dearth of information on any cost breakdown among components (Kaplan et al. 2012). To address this information gap, project team members attended the 5th FPSO Vessel Conference, held in Houston, Texas, on November 12 and 13, 2014. They conducted three interviews, from which three sets of FPSO cost breakdowns were compiled:

- Built for use in the GOM, with topsides built and assembled in the US (Table 17)
- Built for use in the GOM, with both topsides and hull foreign-built (Table 18)
- Foreign-built for use outside the GOM (Table 19)

Some components are comparable over all three types. The hull is foreign-made in all three cases. Project management ranges from 5% to 10%, hull cost ranges from 20% to 23%, assembly of the topsides to the hull is about 5%, and insurance ranges between 1% and 2%.

The largest difference in costs appears to be the mooring system turret. The cost for a detachable turret and mooring system that meets the requirements for operating in the US GOM is approximately twice as high as the cost for foreign projects. Turret and mooring systems represent about 30% to 34% for GOM projects and 15% for foreign projects.

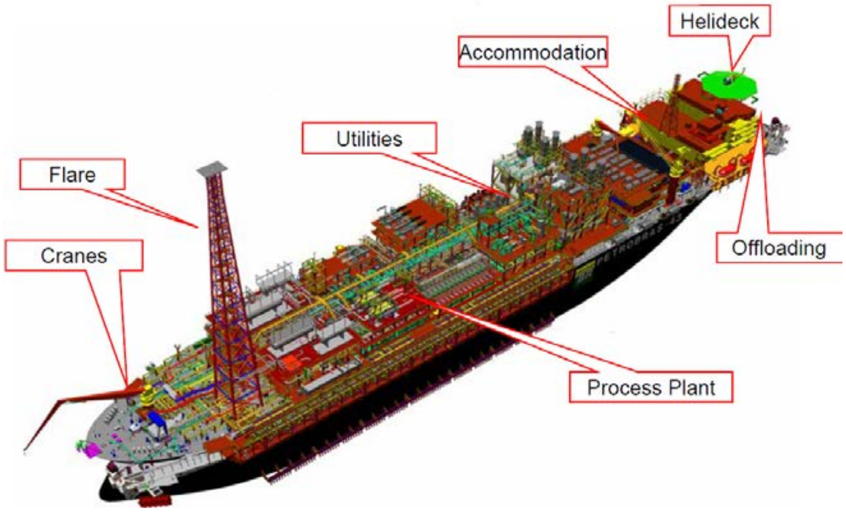

Figure 13. FPSO schematic
Source: Petrobras America 2007

Figure 14. ***BW Pioneer***
Source: Ball 2010

3.4.3 Development of Industry Sector Profile

The project team assumed that new FPSO projects for the GOM would resemble the data in Table 17 meaning the topsides are US-built (see Table 20 for a summary[13]). The cost for assembling the topsides and hull are categorized as labor costs because the components are costed separately.

Given that the turret for the previously mentioned *BW Pioneer* was manufactured by BW Offshore (Norway) and the one for the Shell Stones field will be made by SBM Offshore (Netherlands), it is likely that the turret will not be made domestically (Scandinavian Oil-Gas Magazine 2007; Petrobras 2012; SBM Offshore 2012). As a result, even when the topsides and assembly are assumed to take place domestically, more than 50% of the expenditures will leak out of the US (as shown in Table 20). Consistent with MAG-PLAN 2012, MAG-PLAN 2016 assumes that a fraction of the insurance would be domestically supplied. Table 20 shows the summary sector allocation for an FPSO used in MAG-PLAN 2016.

[13] Note that accommodations are included in hull costs.

Table 17. GOM FPSO cost breakdown: topsides US-built

Major Component	Percent	Subcomponents	Percent	Domestic (Y/N)	If Domestic, Where	IMPLAN Industry
Project management and engineering	10%			Y	Houston, TX	
Hull: refit	20%			N		Shipbuilding
		Ship	50%	N		Shipbuilding
		Conversion	50%	N		Shipbuilding
Topsides (remainder)	25%			Y		Oil and gas field machinery and equipment
Topsides: values for topsides assembled in Corpus Christi, TX; % of the total topside cost		Production equipment	63.5%	Y	Corpus Christi, TX	Oil and gas field machinery and equipment
		Accommodations	0.5%	Y	Corpus Christi, TX	Accommodations included in hull costs
		Generators	15%	Y	Corpus Christi, TX	Motor and generator manufacturing
		Compressors	20%	Y	Corpus Christi, TX	Air and gas compressor manufacturing
		Flare(s)	< 0.5%	Y	Corpus Christi, TX	Oil and gas field machinery and equipment
		Cranes	< 0.5%	Y	Corpus Christi, TX	Oil and gas field machinery and equipment
Assembly of topsides and hull	5%			Y	Corpus Christi, TX	Labor; shipbuilding
Transportation—water[a]	4%			N		Transportation—water (China to GOM)
Turret (mooring system)	34%			Y	Corpus Christi, TX	Complex type for GOM (detachable)
Insurance	25			N		Insurance carriers (large companies are self-insured)
Total	**100%**					

Source: COMM Engineering, Inc. 2014

a Transporting hull to yard that assembles topsides to hull.

Table 18. GOM FPSO cost breakdown: foreign-built

Major Component	Percent	Subcomponents	Percent	Domestic (Y/N)	If Domestic, Where	IMPLAN Industry
Project management and engineering	10%			Y	Houston, TX	
Hull: refit or new	20%			N		Shipbuilding
Topsides	34%			N		
Topsides' subcomponents		Production equipment	67.5%	N		Oil and gas field machinery and equipment
		Accommodations	2.5%	N		Accommodations included in hull costs
		Generators	10%	N		Motor and generator manufacturing
		Compressors	15%	Partial	Unknown	Air and gas compressor manufacturing
		Flare(s)	2.5%	N		Oil and gas field machinery and equipment
		Cranes	2.5%	N		Oil and gas field machinery and equipment
Assembly of topsides and hull	5%			N		Labor; shipbuilding
Transportation and installation[a]	NA[b]					Transportation—water: where topsides and hull are not at the same yard
Turret (mooring system)	30%			N		Complex type for GOM (detachable)
Insurance	1%			N		Insurance carriers
Total	**100%**		**100%**			

Source: COMM Engineering, Inc. 2014

a Transporting hull to yard that assembles topsides to hull.

b Not available.

Table 19. Foreign-built and foreign-operating FPSO

Major Component	Percent	Subcomponents	Percent	Domestic (Y/N)	If Domestic, Where	IMPLAN Industry
Project management and engineering	5%			N		
Hull: refit or new	23%			N		Shipbuilding
Topsides	50%			N		
Topsides' subcomponents		Production equipment	77%	N		Oil and gas field machinery and equipment
		Accommodations	0.5%	N		Accommodations included in hull costs
		Generators	10%	N		Motor and generator manufacturing
		Compressors	10%	Partial	Unknown	Air and gas compressor manufacturing
		Flare(s)	0.5%	N		Oil and gas field machinery and equipment
		Cranes	2%	N		Oil and gas field machinery and equipment
Assembly of topsides and hull	5%			N		Labor; shipbuilding
Transportation—water[a]	NA					Transportation—water: topsides and hull at same yard
Turret (mooring system)	15%			N		Not the complex type for GOM (detachable)
Insurance	2%			N		Insurance carriers
Total	**100%**		**100%**			

Source: COMM Engineering, Inc. 2014

a Transporting hull to yard that assembles topsides to hull.

b No information provided.

Table 20. Summary sector table for FPSO activity

Major Component	Percent	Percent	IMPLAN Industry		Geographic Distribution
Project management and engineering	10%	10.00%	369	Architectural, engineering, and related services	
Hull	20%	20.00%			Rest of world
Generators	3.75%	3.75%	267	Motor and generator manufacturing	
Compressors	5%	5.00%	227	Air and gas compressor manufacturing	
Production equipment	16%	16.25%	206	Oil and gas field machinery and equipment	
Flare(s)	0.125%			Oil and gas field machinery and equipment	
Cranes	0.125%			Oil and gas field machinery and equipment	
Assembly of topsides and hull	5%	5.00%		Labor	
Transportation—water	4%	4.00%		Transportation—water (Asia to GOM)	Rest of world
Turret (mooring system)	34%	34.00%			Rest of world
Insurance	2%	2.00%	357	Insurance carriers	
Total	**100%**	**100%**			

Source: COMM Engineering, Inc. 2014; Kaplan et al. 2012

a Transporting hull to yard that assembles topsides to hull.

b No information provided.

3.5 Decommissioning

3.5.1 Introduction and Overview

Platform decommissioning represents the end of the production life cycle of offshore structures used to produce oil and gas. Decommissioning costs can vary widely due to location and complexity of the facility, number of structures, water depth, weight of structure, and removal method and transportation options. Water depth and weight are considered key variables in determining the decommissioning costs.

This section discusses the distribution of decommissioning costs for fixed platforms, which are generally constructed in the GOM in waters of less than about 400 meters depth (1,300 feet).[14] After the wells are plugged and abandoned, the system is unmoored and moved to a new locale. See Kaiser and Liu (2014) and Liu et al. (2014) for a description of the deepwater structures that would ultimately need decommissioning. Existing literature on the logistics and costs of platform decommissioning has focused on activities in the GOM (Kaiser et al. 2009; TSB 2000; Proserv Offshore 2009).

Sections 3.5.1.1 and 3.5.1.2 discuss the regulatory requirements and recent policies for decommissioning facilities. Section 3.5.1.3 describes the elements of offshore structures. Section 3.5.1.4 outlines the different steps in the platform decommissioning process. Section 3.5.2 develops a list of IMPLAN industry sectors and Section 3.5.3 walks the reader through the process of developing the cost profile and presents the proposed industry sector.

3.5.1.1 Regulatory Requirements

OCSLA requires the decommissioning of wells and platforms that have ended their economic life. OCSLA regulations are administered by Bureau of Safety and Environmental Enforcement (BSEE) and decommissioning requirements are part of every OCS lease (BSEE 2015). BSEE requires that operators apply for a well abandonment or platform removal permit. BSEE reviews the methodology, BOEM prepares a site-specific environmental assessment, and BSEE ensures that the assessment is adequate and imposes any necessary protective mitigation measures as conditions of permit approval.

Federal Register 30 §250.1703 describes the general requirements for platform decommissioning. According to regulatory requirements, the operator of an offshore platform should “permanently plug all wells, remove all platforms…clear the seafloor of all obstructions created by the lease and pipeline right-of-way operations.” Moreover, “decommissioning activities should take place in a manner that is safe, does not unreasonably interfere with other uses of the OCS, and does not cause undue harm to the human, marine, or coastal environment” (MMS 2002). The operator may choose to either keep these activities in house or contract out to a third party.

3.5.1.2 Infrastructure

The offshore infrastructure used to produce oil and gas has different levels of complexity depending on a number of operating, economic, and strategic conditions: see Kaiser et al. (2009) and TSB and CES (2004), among others. Below is a review of the typical elements of offshore installations, summarizing information from these two sources.

[14] This section does not discuss floating production structures, which have a different cost profile. For example, they have no jackets, linking the seabed and the surface, to be removed in decommissioning.

Wells are unique paths from a hydrocarbon reservoir under the sea floor to a surface location. They typically consist of vertical piping protected by a caisson or a well protector (see below). Other associated infrastructure elements may include platforms, sub-sea tiebacks, and pipelines.

Caissons are large-diameter steel pipes that enclose a well. They may range from simple straight pipes to more complicated structures including braces, skirt pilings, and tripods for added support.

Well protectors are structures that use a jacket to support one or more wells. The jacket is made of steel and covers the well conductors (pipes used to transport the hydrocarbons to the topside structure). These conductors rise from the sea floor to above the waterline.

Fixed platforms (see Figure 15) are offshore structures that resemble simple well protectors. They are, however, more complex and include topsides with varying facilities. A fixed platform consists of a deck, foundation, and jacket. The deck often has space for drilling rigs and hydrocarbon production facilities; manned platforms have living quarters for platform crew. The deck is supported by a jacket structure with concrete or steel legs affixed directly to the ocean bottom. The jacket also protects the conductor pipes. Piles support the jacket below the seafloor.

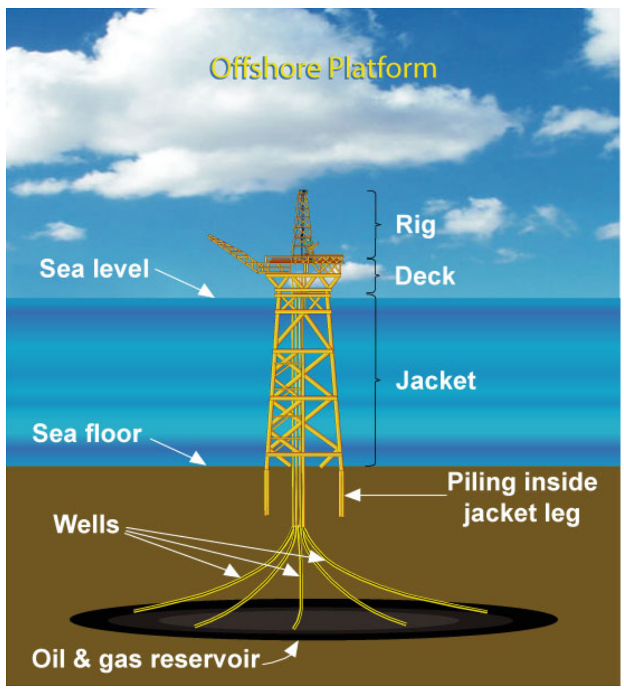

Figure 15. Offshore platform
Source: CA DOC 2015

Pipelines are used to transport fluids between offshore facilities or between an offshore facility and an onshore location. Typically, pipelines are made of steel, but there are also flexible versions made of a combination of thermoplastic and wound steel elements (Technip 2014b). Pipelines differ by diameter, length, and wall thickness, among other factors.

3.5.1.3 Decommissioning Process

The basic steps of the platform decommissioning process, as discussed below, follow Rigzone (2015); additional details can be found in TSB and CES (2004) and Proserv Offshore (2009).

- **Project management, planning, and engineering.** This initial phase usually starts three years before the platform becomes uneconomical to operate. It includes record collection, platform inspection, and an engineering analysis that assesses the offshore platform's structural elements, connections, and lift points (points on the platform where the structure or portion of the structure can be safely lifted by a derrick or crane). If any parts of the decommissioning process are going to be outsourced, this step will also include the bidding process for those parts (e.g., derrick barges, dive services).

- **Permitting.** Obtaining the necessary permits may take up to three years. Permits and approvals are needed from BSEE, the US Army Corps of Engineers, the US Fish and Wildlife Service, the National Oceanic and Atmospheric Agency, and the US Coast Guard, among others. Operators often contract with local consulting firms that are familiar with the regulatory framework to make sure all necessary permits have been properly obtained.

- **Platform preparation.** This step includes all the work that can be performed before the arrival of the heavy-lift vessel (typically a derrick barge or a semi-submersible crane vessel; see Proserv Offshore 2009, Appendix 5.1.2). This phase includes flushing and clearing all pipes and equipment that contained hydrocarbons to remove those residual hydrocarbons, cutting pipe and cables, severing modules (portions of the structure that will be removed separately) from the deck, installing padeyes[15] that provide attachment points for shackles and slings used to lift the modules, and reinforcing the structure to allow for its safe removal.

- **Well plugging and abandonment.** These activities involve filling the well with fluid and placing cement plugs at multiple intervals within the well and in the space between the well and the surrounding casings. Tubing is pulled and casings are removed. The placement of plugs is situational and depends on the well's location, depth, condition, and other parameters (MMS 2002). Well plugging activities may take place with or without the use of a rig to pull tubing and remove casings. A typical rig consists of a mast, hoisting machinery, and attendant equipment. The decommissioning crew will either bring in a small portable rig or use a drilling rig already present at the site if a rig method is chosen. The rigless process uses barges and crane vessels instead to pull tubing and remove casings (Fields and Martin 1998). Typically, decommissioning projects in the GOM are done with a rigless setup.

- **Conductor removal.** Conductors must be removed to at least 15 feet below the ocean floor (MMS 2002). The cost of conductor removal depends on the length and number of conductors and the removal method chosen. There are three different processes for conductor removal: (1) severing, which involves explosive, mechanical, or abrasive cutting; (2) pulling or sectioning, which involves raising conductor segments with hydraulic-driven sets of cylinders called casing jacks; or (3) offloading, in which a crane is used to lift conductor segments to a platform. After conductors are removed, they are transported to an onshore disposal site.

[15] Also called a fairlead; a ring fixed to the vessel structure through which a line is run or to which a line is attached.

- **Mobilization and demobilization of derrick barges for platform removal.** This step is the core of the decommissioning work. Mobilization and demobilization of derrick barges, used to remove the platform components, contribute to a major portion of decommissioning costs (Rigzone 2015). The personnel, equipment, and materials with which the derrick barges will need to be equipped vary given the location (nearer or further offshore, shallower or deeper water) and size and complexity of the decommissioning project. Depending on the decommissioning method used (and the number of pieces into which the platform is divided and the initial size and weight of the platform), derrick barge lifting capacity and number of module lifts required may vary widely, along with cost. The platform removal process may require mobilization and demobilization of other watercraft, diving and abrasive cutting equipment, etc.

Platform jackets may be decommissioned on site or towed to shallow water. Onsite decommissioning involves removing the jacket with a single lift, or severing the jacket abrasively or explosively, and removing the pieces with multiple lifts. "Shallowing" or "hopping" involves cutting and removal above the water line as the structure is towed to shallow waters. Shallowing typically requires multiple cuts and removals until the structure is completely removed (see Figure 16). Platform fragments might be removed to shore or deposited into artificial reef sites. TSB and CES (2004) and CSA (2004) examine different methods of jacket removal in more detail.

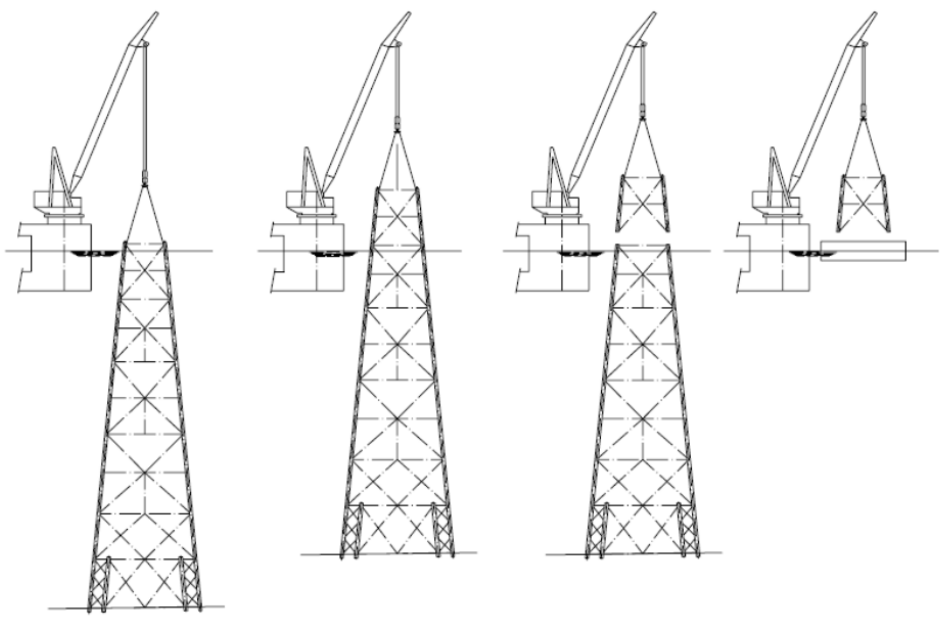

Figure 16. "Shallowing" or "hopping" a large jacket
Source: TSB and CES 2004

- **Pipeline and power cable operations.** Pipelines and power cables may be abandoned in place if they do not constitute a hazard to navigation or commercial fishing operations and do not interfere with other uses of the OCS. Pipelines abandoned in place are flushed, filled with seawater, and then cut and plugged with the ends buried at least three feet below the mud line. The operations are performed by divers or remotely operated vehicles, depending on water depth. Typically, pipelines in the GOM are abandoned in place; there are very few complete removals.

- **Site clearance.** The site clearance operation ensures that no debris or potential obstructions to other users of the OCS remain at the platform location. This phase may require the use of remotely operated vehicles or divers, or both, to identify and remove remaining debris or test trawling, or both, to verify that there are no potential obstructions remaining. Sonar might also be used to confirm clearance in addition to one or more other methods (Proserv Offshore 2009).

3.5.2 IMPLAN Sectors for Decommissioning

To determine the sector breakdown of decommissioning costs, we identified a short list of operations most likely to be associated with each step in the decommissioning process. This section discusses how these operations were mapped to NAICS industries and IMPLAN sectors.

Having examined the types of contractors that might be needed to perform the tasks outlined in Section 3.5.1.3 and the level of granularity in the cost estimates provided in Proserv Offshore (2009), we identified the following NAICS industries as candidates to absorb the different aspects of decommissioning costs:

- NAICS 213112, support activities for oil and gas operations (includes derrick building, repairing, and dismantling at oil and gas fields on a contract basis, dismantling of oil well rigs on a contract basis, and site preparation at oil and gas fields on a contract basis).
- NAICS 483, water transportation (includes barge transportation, freight transportation, passenger transportation, and ship chartering with crew).
- NAICS 4883, support activities for water operations (includes piloting services, port and harbor operations, docking, undocking, and harbor tugboat services).
- NAICS 238910, site preparation contractors (includes blasting and demolition contractors).
- NAICS 481211, nonscheduled air passenger transportation (includes nonscheduled helicopter passenger carriers).
- NAICS 5413, architectural, engineering, and related services (includes hydrographic survey services, which provide sonar services needed for site clearance activities).
- NAICS 541620, environmental consulting services, which may provide government contract labor for various environmental monitoring, such as National Marine Fisheries Service observers.
- NAICS 237120, oil and gas pipeline and related structures construction (includes construction management of oil and gas pipelines).
- NAICS 561990, all other support services (includes diving services).

Table 21 shows the 2007 IMPLAN sectors and corresponding NAICS industries. It should be noted that port operations—when the mobilization and demobilization activities will occur—fall under IMPLAN 338, scenic and sightseeing transportation; the incongruity between the IMPLAN sector title and the activities in the sector is acknowledged. Despite its name, IMPLAN 338 also includes the entire NAICS 488 (support activities for transportation), of which port operations are a part.

Table 21. Correspondence between NAICS codes and IMPLAN sectors associated with decommissioning

Industry Name	NAICS	IMPLAN	Sector Name
Water transportation	483	334	Water transportation
Support activities for water operations	4883	338	Scenic and sightseeing transportation
Support activities for oil and gas operations	213112	29	Support activities for oil and gas operations
Oil and gas pipeline and related structures construction	237120	39	Maintenance and repair construction of nonresidential structures (includes construction management of oil and gas pipelines, as well as blasting and demolition contractors)
Site preparation contractors	238910		
Nonscheduled air passenger transportation	481211	332	Air transportation
Architectural, engineering, and related services	5413	369	Architectural, engineering, and related services
Environmental consulting services	541620	375	Environmental and other technical consulting services
All other support services	561990	389	All other support services (includes professional diving services)

Source: IMPLAN 2015

3.5.3 Bill of Sale Approach to Industry Sector Identification

3.5.3.1 Cost Profile

We developed a preliminary cost profile for decommissioning operations based on information in Proserv Offshore (2009) (see Table 22). Unlike the data on subsea systems, these data include mobilization costs. The largest portion of decommissioning costs, around 40% for platforms in less than 200m (656 feet) water depth and around 60% for platforms in more than 200m, is allocated to IMPLAN 334 (water transportation and its subsectors). IMPLAN 338 (scenic and sightseeing transportation, representing the mobilization and demobilization activities) has the second largest allocation, with 17% to 20% costs going to this sector. IMPLAN 389 (other support services) is more prominent in the decommissioning of platforms in shallow waters (around 15%) than in deep waters (under 5%). IMPLAN 39 (maintenance and repair construction of nonresidential structures) is dominated by a fixed-percent engineering cost estimate and will not likely vary across platforms unless explosives are used. Other industries are allocated no more than 1% of total costs.

Table 22. Costs of decommissioning in the GOM by NAICS and IMPLAN sector as a percentage of total platform decommissioning costs, by water depth

Name	NAICS	IMPLAN	Up to 200m WD		200m+ WD
			Explosive	Non-explosive	
Water transportation	483[a]	334[a]	41.9%	39.2%	53.9%
Scenic and sightseeing transportation	4883	338	21.4%	19.5%	18.2%
Support activities for oil and gas operations	213112	29	11.0%	16.1%	13.6%
Maintenance and repair construction of nonresidential structures	237120 238910	39	9.3%	7.4%	7.5%
Air transportation	481211	332	0.3%	0.2%	0.0%
Architectural, engineering, and related services	5413	369	0.0%	0.0%	0.0%
Environmental and other technical consulting services	541620	375	0.7%	0.0%	0.0%
All other support services	561990	389	15.4%	17.6%	6.8%
Total			**100.0%**	**100.0%**	**100.0%**

Source: ERG estimates based on Proserv Offshore 2009

a Costs associated with water transportation are allocated into the water transportation subsectors in Table 23.

Table 23 shows the first step in integrating the water transportation subsectors into the decommissioning industry profile. Its first section repeats the information from Table 22 except for water transportation: because Proserv Offshore (2009) identified mobilization costs, Table 23 splits the water transportation mobilization costs into the individual industry sectors for vessel day rates identified in Table 9.[16] Table 23 uses IMPLAN 220 (cutting tool and machine tool accessory manufacturing) to better resemble decommissioning activities than IMPLAN 256 (watch, clock, and other measuring and controlling device manufacturing), as proposed in Table 7 (customization by activity function-specific expensed equipment and materials). IMPLAN Sectors 39 and 369 appear twice in. Table 24 presents the consolidated summary.

Table 23. Integration of decommissioning industry sectors

MAG-PLAN Inputs	Sector	Vessel Day Rate	Up to 200m WD Explosive	Up to 200m WD Non-explosive	200m+ WD
Sectors identified in Proserv Offshore 2009					
Scenic and sightseeing transportation	338		21.4%	19.5%	18.2%
Support activities for oil and gas operations	29		11.0%	16.1%	13.6%
Maintenance and repair construction of nonresidential structures	39		9.3%	7.4%	7.5%
Air transportation	332		0.3%	0.2%	0.0%
Architectural, engineering, and related services	369		0.0%	0.0%	0.0%
Environmental and other technical consulting services	375		0.7%	0.0%	0.0%
All other support services	389		15.4%	17.6%	6.8%
Subtotal			58.1%	60.8%	46.1%
Water transportation					
Electric power generation, transmission, and distribution	31	0.1%	0.1%	0.1%	0.1%
Water, sewage, and other systems	33	0.1%	0.0%	0.0%	0.0%
Maintenance and repair construction of nonresidential structures	39	0.1%	0.0%	0.0%	0.1%
Petroleum refineries	115	14.8%	6.2%	5.8%	8.0%
Cutting tool and machine tool accessory manufacturing	220	8.6%	3.6%	3.4%	4.7%
Ship building and repairing	290	42.6%	17.8%	16.7%	23.0%
Water transportation	334	10.4%	4.3%	4.1%	5.6%
Software publishers	345	0.2%	0.1%	0.1%	0.1%
Telecommunications	351	0.3%	0.1%	0.1%	0.2%
Insurance carriers	357	1.7%	0.7%	0.7%	0.9%
Real estate	360	0.9%	0.4%	0.3%	0.5%
Commercial and industrial machinery and equipment rental and leasing	365	3.4%	1.4%	1.3%	1.8%
Architectural, engineering, and related services	369	10.4%	4.3%	4.1%	5.6%
Advertising and related services	377	3.3%	1.4%	1.3%	1.8%
Food services and drinking places	413	2.0%	0.9%	0.8%	1.1%
Commercial and industrial machinery and equipment repair and maintenance	417	1.1%	0.5%	0.4%	0.6%
Subtotal			41.9%	39.2%	53.9%
Sum			**100.0%**	**100.0%**	**100.0%**

Source: ERG estimates based on Table 7, Table 9, and Table 23

[16] Unlike subsea systems, where Table 16 contains the industry sector profile for vessel day rates plus mobilization.

Table 24. Summary sector table for decommissioning activities

MAG-PLAN Inputs	Sector	Up to 200m WD Explosive	Up to 200m WD Non-explosive	200+ WD
Support activities for oil and gas operations	29	11.0%	16.1%	13.6%
Electric power generation, transmission, and distribution	31	0.1%	0.1%	0.1%
Water, sewage, and other systems	33	0.0%	0.0%	0.0%
Maintenance and repair construction of nonresidential structures	39	9.3%	7.4%	7.5%
Petroleum refineries	115	6.2%	5.8%	8.0%
Cutting tool and machine tool accessory manufacturing	220	3.6%	3.4%	4.7%
Ship building and repairing	290	17.8%	16.6%	23.0%
Air transportation	332	0.3%	0.2%	0.0%
Water transportation	334	4.3%	4.1%	5.6%
Scenic and sightseeing transportation	338	21.4%	19.5%	18.2%
Software publishers	345	0.1%	0.1%	0.1%
Telecommunications	351	0.4%	0.3%	0.5%
Insurance carriers	357	0.7%	0.7%	0.9%
Real estate	360	0.4%	0.3%	0.5%
Commercial and industrial machinery and equipment rental and leasing	365	1.4%	1.3%	1.8%
Architectural, engineering, and related services	369	4.4%	4.1%	5.6%
Environmental and other technical consulting services	375	0.7%	0.0%	0.0%
Advertising and related services	377	1.4%	1.3%	1.8%
All other support services	389	15.4%	17.5%	6.7%
Food services and drinking places	413	0.9%	0.8%	1.1%
Commercial and industrial machinery and equipment repair and maintenance	417	0.5%	0.4%	0.6%
Sum		**100.0%**	**100.0%**	**100.0%**

Source: ERG estimates

3.6 Production Operations and Maintenance

3.6.1 Introduction and Overview

Production activities involve bringing the product to the surface, separating the liquid and gas, and removing impurities. Day-to-day activities include monitoring oil and gas production, identifying maintenance and servicing needs, and addressing those needs. For onshore operations, a well site might need to be visited periodically to ensure that all is in working order. For offshore operations, unmanned structures might be inspected by vessel only when there is a problem with production.

Nearshore structures might be staffed eight hours per day, with staff commuting to and from the structure each day. Beyond a certain distance from shore, the workers live on the production structure. They typically have 12-hour shifts for one or two weeks and then a comparable number of weeks off work. Depending on the size and location of the production system, structures might be staffed eight or 24 hours per day and have sleeping quarters for the staff. Offshore operations involve a series of jobs, most of which involve personnel who are employees of the operator. For example, the offshore installation manager is responsible for managing the offshore operations on the platform or vessel, including the health, safety, and welfare of all personnel onboard. The staff might include production technicians who operate the plant and equipment used to produce and process the oil and gas; a production supervisor (depending on the number of production technicians); equipment maintenance personnel; welders; crane operators; a steward to oversee laundry, accommodation, and cleaning services; pipefitters; chef(s); and kitchen support. In effect, a production structure is a mini-city with offices, crew quarters, a galley, and recreation room(s), with a crew including cooks and other service staff (Van Dyke, 1997). For production O&M activities, expenditures might represent replacement of equipment on the topside of the system, operating supplies, workover activities to maintain production from each of the wells, food, communications, insurance, and air or water transport from shore to the structure and back.

3.6.2 Cost Profile and Integration with Water Transportation Costs

Kaplan et al. (2012) developed an initial list of cost components for production O&M costs based on USDOE EIA (2010); these are reproduced in Table 25. MAG-PLAN uses the 200–400m cost profile for the cost profile for water depths the greater than 400m category because USDOE EIA (2010) does not include data for platforms in water depths exceeding 400m.

Table 25. Production O&M costs

2008 Cost Items	0–60m 4 Slots	60m 6 Slots	200m 6 Slots	200–400m 12 Slots
Labor share	25.4%	22.3%	21.4%	19.5%
Payroll overhead	7.1%	6.2%	5.9%	5.5%
Food expense	1.5%	1.4%	1.4%	1.2%
Labor transportation	46.4%	40.1%	38.6%	31.7%
Surface equipment	3.1%	2.6%	2.8%	2.6%
Operating supplies	0.6%	0.5%	0.6%	0.5%
Workover	12.7%	22.3%	22.3%	26.6%
Communications	0.5%	0.6%	0.6%	0.6%
Insurance	2.8%	4.0%	6.5%	11.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Kaplan et al. 2012, Table 30; based on USDOE EIA 2010

Table 26 shows how the cost components were allocated to IMPLAN sectors. For example, for the 4-slot structure, labor cost is 32.5%—the sum of labor share and payroll overhead from Table 25. We scale the data in Table 25 to exclude labor costs. In the 4-slot structure example, the proportion of the total cost represented by operating supplies and workover is calculated as (0.6% + 12.7%) ÷ (1 – 32.5%) or 19.7%. We averaged the cost components for a 6-slot structure before scaling the data. Travel to and from the production system can occur by helicopter or boat; in the absence of detailed information on the relative amounts spent on each mode of transportation, the transportation percentage was split equally between air and water modes.

Table 26. Non-labor production O&M costs to IMPLAN sectors

2008 Cost Items	IMPLAN Sector	0–60m 4 Slots	60–200m 6 Slots	200–400m 12 Slots	IMPLAN Sector Name
Operating supplies and workover	29	19.7%	31.7%	36.0%	Support activities for oil and gas operations
Surface equipment	206	4.6%	3.7%	3.5%	Mining and oil and gas field machinery manufacturing
Labor transportation	332	34.3%	27.3%	21.1%	Air transportation
Labor transportation	334	34.3%	27.3%	21.1%	Water transportation
Communications	351	0.7%	0.8%	0.8%	Telecommunications
Insurance	357	4.1%	7.3%	15.9%	Insurance carriers
Food expense	413	2.2%	1.9%	1.6%	Food services and drinking places
Total		**100.0%**	**100.0%**	**100.0%**	

Source: ERG estimates based on USDOE EIA 2010

Table 27 presents the final industry sectors for production O&M costs. The top part of the table lists the six non-water-transportation sectors identified in Table 26. We assumed that the typical loading/unloading of production structure crews, equipment, and supplies is a much simpler process for a workboat than for the specialized vessels for subsea installation or decommissioning activities. Thus, we began with the water transportation sector profile for 3D seismic with mobilization shown in Table 9 where mobilization accounts for 4.2% of total activity costs. We removed the sectors already accounted for in Table 26 (telecommunications, insurance carriers, and food services and drinking places) along with two other sectors[17] because transportation of crews, equipment, and supplies does not involve specialized personnel or equipment. The set of water transportation sectors were scaled to address the removal of the five sectors from the suite of water transportation plus mobilization cost profile, then performed a second rescaling to integrate these sectors in the production O&M profile.

Table 27. Summary sector table for production O&M

MAG-PLAN Inputs	Sector	Mobilization 3D	Production O&M 0–60m	60–200m	200–400m
Non-water transportation sectors					
Support activities for oil and gas operations	29		19.7%	31.7%	36.0%
Mining and oil and gas field machinery manufacturing	206		4.6%	3.7%	3.5%
Air transportation	332		34.3%	27.3%	21.1%
Telecommunications	351		0.7%	0.8%	0.8%
Insurance carriers	357		4.1%	7.3%	15.9%
Food services and drinking places	413		2.2%	1.9%	1.6%
Subtotal			65.7%	72.7%	78.9%
Water transportation					
Electric power generation, transmission, and distribution	31	0.16%	0.05%	0.04%	0.03%
Water, sewage, and other systems	33	0.10%	0.03%	0.03%	0.02%
Maintenance and repair construction of nonresidential maintenance and repair	39	0.14%	0.05%	0.04%	0.03%
Petroleum refineries	115	18.14%	6.22%	4.95%	3.83%
Ship building and repairing	290	52.37%	17.97%	14.28%	11.06%
Water transportation	334	12.72%	4.37%	3.47%	2.69%
Scenic and sightseeing transportation and support activities for transportation	338	5.36%	1.84%	1.46%	1.13%
Software publishers	345	0.23%	0.08%	0.06%	0.05%
Real estate	360	1.09%	0.38%	0.30%	0.23%
Commercial and industrial machinery and equipment rental and leasing	365	4.20%	1.44%	1.15%	0.89%
Advertising and related services	377	4.04%	1.39%	1.10%	0.85%
Commercial and industrial machinery and equipment repair and maintenance	417	1.40%	0.48%	0.38%	0.30%
Subtotal			34.30%	27.26%	21.11%
Sum			**100.0%**	**100.0%**	**100.0%**

Source: ERG estimates based on Table 9 and Table 26

[17] Architectural, engineering, and related services (IMPLAN 369) and the 8.6% allocated to special equipment; see Table 6.

3.7 Remaining Activities

Saha et al. (2005) developed industry sector allocations for exploratory, non-productive, and productive well drilling; platform installation; onshore and offshore gas processing facilities; and pipeline installation. They included an IMPLAN model of 31 parishes in southern Louisiana which then examined the five IMPLAN sectors that contributed the largest percentage of expenditures in the original data (called "primary sectors" in this discussion). Based on the production function for each of the five primary sectors, the spending was redistributed among the secondary sectors to incorporate first round spending effects. Details about these calculations are provided in the MAG-PLAN 2005 model documentation report (Saha et al. 2005). These activity-to-sector allocations are retained in MAG-PLAN 2016 and are included in Appendix C for reference.

4 Onshore Distributions for Labor

BOEM developed MAG-PLAN to capture distinctive characteristics of the offshore oil and gas industry. One such characteristic is that drilling crews and production crews have staff that reside at great distances from the workplace. That is, household spending associated with four activities are likely to have specialized onshore distributions:

- Drilling
    - Exploratory wells
    - Non-productive wells
    - Development wells
- Production O&M

A second factor in how labor expenditures are handled within MAG-PLAN changed with the 2012 version. The previous approach conducted an “analysis-by-parts” by conducting two separate analyses—one for payroll and labor and the other for intermediate goods. The updated version conducts a series of events (one for each industry sector and one for payroll). But, because each activity involves many industry sectors, each with its own labor percentage, MAG-PLAN 2016 retains the separate analysis approach shown in Figure 1. The IMPLAN models are used to generate multipliers by industry sector and by household spending in each of the economic areas of interest.[18] IMPLAN V.3’s production functions partition the shock to each sector into labor and non-labor components to calculate the direct, indirect, and induced multipliers. The calculations within MAG-PLAN, however, assume that percentages within the industry sector profiles for an activity sum to 100% (see tables in Chapter 3) with a separate variable for the percentage of the amount of the activity expenditures associated with labor (“labor share” or “labor percent”). The need for a separate variable is to address the situations where workers might reside at great distances from the workplace.

4.1 Overview

We compiled studies on the mobility of oil and gas workers.[19] While evaluating the studies, we recognized that a distinction should be made between workers in the drilling phase and those in the operation phase. The combined research indicates that jobs associated with putting new areas into production, such as drilling, are highly likely to be filled with temporary skilled workers coming from outside the GOM. In an area of continuous drilling operations, such as the mature area of the GOM, the temporary nature of these jobs is less obvious. For offshore oil and gas operations, the multiple days on and multiple days off scheduling permits extended commuting for the production operations. This phenomenon was documented in BOEM’s Labor Needs Survey (LNS) (ICF Consulting 2008). Four activity functions (exploratory drilling, non-productive development drilling, development drilling, and production operations and maintenance) have onshore distributions that do not assume a worker lives within the same area as their place of work.

[18] Employment multipliers are in the units of jobs per $1 million. This explains the $1 million shock to create the induced multipliers for household spending in each region.

[19] Bangsund et al. 2012; Bangsund and Hodor 2012; Brasier et al. 2011; Cahuc and Zylberberg 2004; Deller and Schreiber 2012; Fannin et al. 2008; Gramling and Brabant 1986; Keithly 2001; KLJ 2014; ICF Consulting 2008.

Sections 4.2 and 4.3 present the data sources and methodology used to develop the labor onshore distributions drilling and production activities, respectively.

4.2 Onshore Distribution for Drilling Activities

Consistent with the academic studies discussed in Section 4.1 is information from the International Association of Drilling Contractors (IADC). IADC conducted a study on behalf of the drilling industry, following the 2010 *Deepwater Horizon* oil spill. After the spill, a moratorium was placed on new drilling in the GOM and the IADC study spoke on the potential impacts this moratorium could have on the national economy. IADC gathered data from nine offshore drilling contractors and one boat company on the residency of their workers. The data on the residences of 11,875 offshore employees showed that these workers call two-thirds of all US Congressional Districts home (IADC 2010). Figure 17 and Figure 18, provided by IADC (2015) show these workers' residency by district.

As the two maps show, IADC assigned one of seven employment ranges to each congressional district in the US. The first step in transforming these data into a MAG-PLAN-compliant format (i.e., broken down by economic impact area) was to refigure them from a congressional district basis to a county basis. To do so, we used the "Age Groups and Sex: 2010—Congressional District—Census Tract by County" table (Census 2010), which breaks down each congressional district by its constituent counties. Because congressional districts are drawn to contain a specific number of people, many split into multiple counties. Common occurrences include (1) a congressional district comprising a mix of whole counties and portions of counties, and (2) a congressional district consisting of part of one large county, the rest of which is distributed among neighboring districts.

We calculated the proportion of each county's population that fell into each congressional district. Table 28 provides an example of this approach. Alabama Congressional District 1 (CD 1) represents 687,841 people in six counties. Baldwin County lies entirely within CD 1 and contains 26.5% of the population within CD 1; Clarke County lies partially within CD 1 and contains around 2% of the population; and so forth.

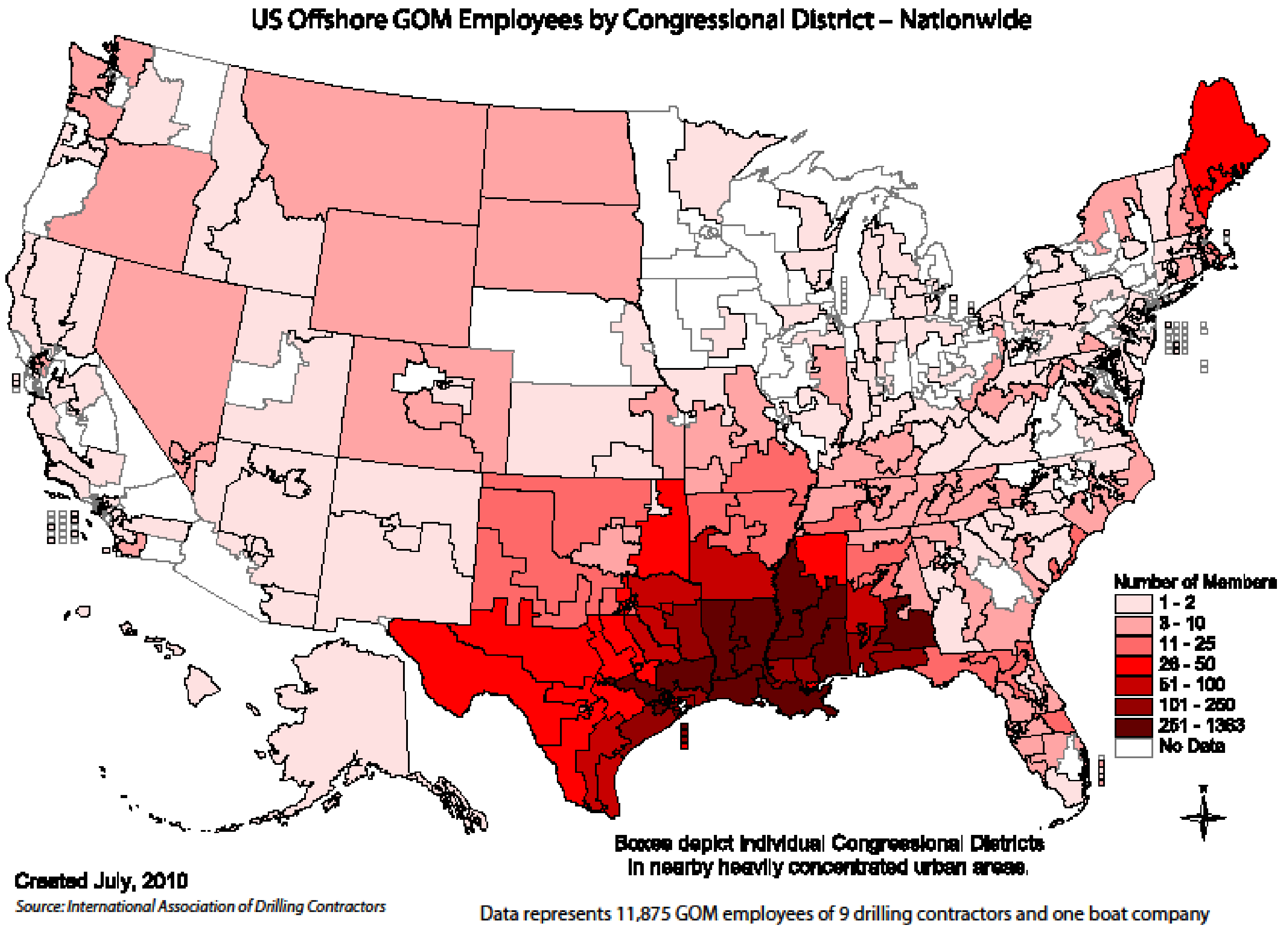

Figure 17. Offshore employee residence map: national

Source: IADC 2010

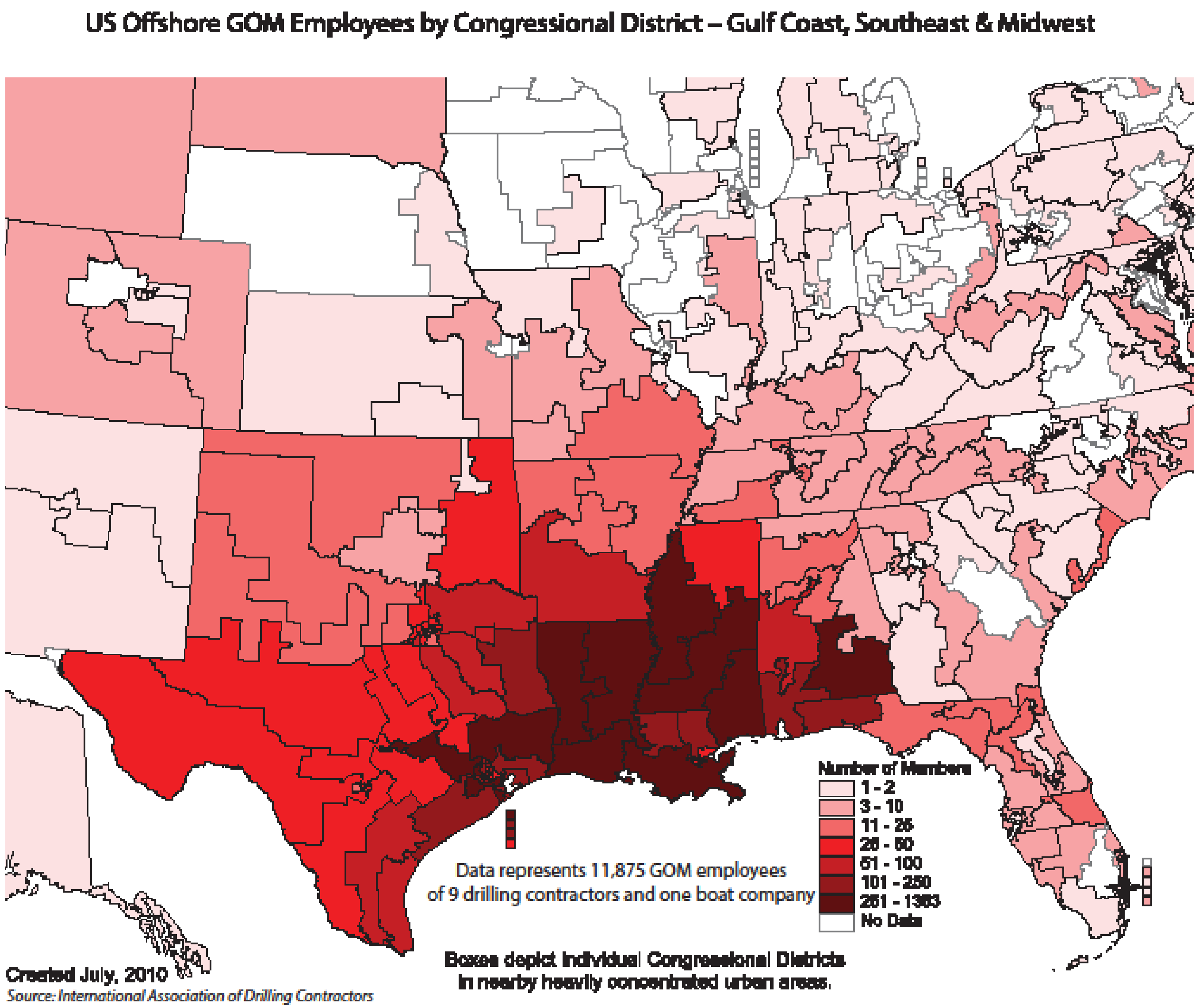

Figure 18. Offshore employee residence map: GOM

Source: IADC 2010

Table 28. Alabama congressional district 1 by county

Congressional District	Congressional District Population	Geographic Area	County Population	Share of Congressional District
1	687,841	Baldwin County	182,265	0.26498
1	687,841	Clarke County (part)	13,616	0.01980
1	687,841	Escambia County	38,319	0.05571
1	687,841	Mobile County	412,992	0.60042
1	687,841	Monroe County	23,068	0.03354
1	687,841	Washington County	17,581	0.02556

Source: Census 2010

We tabulated the IADC employment category for each congressional district. For the first six employment categories, we used the midpoint of the range as the number of offshore oil and gas workers in the district. For example, Alabama CD 1 is in the 101–250 range: see Figure 17 and Figure 18. The midpoint of the range—175.5 workers—is assigned to Alabama CD 1; see Table 29. The final step was to multiply the IADC worker estimate by the portion of the population in each county in CD 1, resulting in 46.5 workers in Baldwin County, 105 workers in Mobile County, etc.

Table 29. Alabama congressional district 1 by county with employment estimate

Congressional District	Congressional District Population	Geographic Area	County Population	Share of Congressional District	IADC Esti-mate	Employment Estimate
1	687,841	Baldwin County	182,265	0.26498	175.5	46.5042
1	687,841	Clarke County (part)	13,616	0.01980	175.5	3.4741
1	687,841	Escambia County	38,319	0.05571	175.5	9.7769
1	687,841	Mobile County	412,992	0.60042	175.5	105.3733
1	687,841	Monroe County	23,068	0.03354	175.5	5.8857
1	687,841	Washington County	17,581	0.02556	175.5	4.4857

Source: Census 2010; IADC 2010; ERG estimates

The exception to the midpoint rule is the last size category, which spans 251 to 1,363 workers. The midpoint of that range is 807 workers, but it could be skewed (by a single district with 1,363 workers, with most others clustered at the lower end of the range). After applying the 807 value for the number of workers in this category to each district and summing the results,[20] we found the anticipated overestimate. The midpoint value was lowered and the total number of workers was recalculated. At a midpoint value of 651, the estimated number of workers in the analysis is 11,873 compared to the 11,875 workers reported in IADC's survey.

Table 30 presents the estimated onshore labor distribution included in MAG-PLAN 2016. The 17% shown for the rest of Mississippi is somewhat higher than anticipated, but it is consistent with the IADC data shown in Figure 17 and Figure 18.

[20] IADC does not have data for Congressional District 16 of Texas or Congressional District 23 of Florida. We suspect this will have minimal impact on our onshore labor distribution. Out of the six counties in these congressional districts, only one—Hendry County, Florida—is in an economic impact area, and it only represents 1% of Florida 23.

Table 30. Onshore labor distribution estimate for drilling activities

OSA	Offshore GOM Employees	Share of Total
TX-1	124	1.04%
TX-2	101	0.85%
TX-3	2,478	20.87%
TX-4	92	0.77%
TX-5	128	1.08%
TX-6	39	0.33%
LA-1	192	1.62%
LA-2	86	0.72%
LA-3	551	4.64%
LA-4	367	3.09%
LA-5	310	2.61%
LA-6	223	1.88%
LA-7	103	0.86%
MS-1	368	3.10%
MS-2	58	0.49%
AL-1	152	1.28%
AL-2	38	0.32%
FL-1	169	1.42%
FL-2	22	0.19%
FL-3	6	0.05%
FL-4	17	0.14%
FL-5	27	0.23%
FL-6	9	0.07%
Rest of TX	1,324	11.15%
Rest of LA	1,161	9.78%
Rest of MS	2,022	17.03%
Rest of AL	760	6.40%
Rest of FL	80	0.67%
Rest of US	866	7.29%
Sum	**11,873**	**100%**

Source: IADC 2015; ERG estimates

4.3 Onshore Distribution for Production O&M Activities

4.3.1 Labor Needs Survey

The ability of offshore production oil and gas workers to live at substantial distances from the work location is discussed in Section 4.1 above. This phenomenon was investigated by the LNS, which developed a distribution of the percent of the labor force by home ZIP code (ICF Consulting 2008). To protect the confidentiality of workers' home addresses, the study aggregated data by one-, two-, or three-digit ZIP codes as well as by state and multistate areas. Table 31, on the next page, is a copy of the ZIP code, area, and percentage data from the LNS.

LNS does not provide a finer breakdown of the data and ZIP code boundaries do not necessarily correspond to county or parish boundaries. For use with MAG-PLAN's production O&M activity function, the onshore distribution for labor needs to be distributed among counties and parishes.

Table 31. LNS onshore distribution for labor in offshore oil and gas operations

ZIP Code	Area	Percent
32	Northern Florida	1.94%
36	Mobile, Montgomery, AL	3.33%
39	Biloxi, Jackson, Southern MS	4.28%
	Arkansas & Tennessee	0.82%
700	Metairie, Chalmette, LA	3.67%
701	New Orleans, LA	0.66%
703	Houma, Donaldsonville, LA	20.78%
704	Hammond, Ponchatoula, Bogalusa, LA	4.62%
705	Lafayette, New Iberia, Abbeville, LA	18.75%
706	Lake Charles, LA	1.40%
	Other southern LA	0.58%
71	Shreveport, LA	4.01%
75–76	Dallas and Fort Worth	0.89%
770	Houston, TX	9.81%
773	Humble, Kingwood, Spring, TX	9.14%
774	Katy, Park Row, Sugarland, TX	1.20%
775	Deer Park, Galveston, Pearland, TX	5.23%
	Other coastal TX	0.69%
78	Austin, Corpus Christi, San Antonio, TX	6.46%
9	West Coast	0.79%
	Other lower 48	0.94%
	Sum	**99.99%**

Source: ICF Consulting 2008, Table 5.4

4.3.2 2016 Methodology Updates for Processing LNS Data

Section 5.4 of the MAG-PLAN 2012 documentation report (Kaplan et al. 2012) presented the initial processing of the LNS data into onshore counties, parishes, and economic impact areas. This approach was updated for MAG-PLAN 2016 by incorporating:

- Census's 2007 Governments Integrated Directory (GID) to create a crosswalk between GOM ZIP codes and counties and parishes (Census GID 2007) and
- American Community Survey 2005–2009 labor force data (Census ACS 2010).

These references bring the labor force data and the ZIP code descriptions into closer temporal alignment with the time the LNS was administered.

Section 4.3.2.1 describes how Census GID 2007 and Census ACS 2010 were integrated to estimate the proportion of the labor force by county and parish. Sections 4.3.2.2 through Section 4.3.2.5 present the onshore distributions for Texas, Louisiana, Alabama-Mississippi-Florida, and the rest of the US, respectively.

4.3.2.1 Methodology

The first step in the methodology is to create a crosswalk between GOM ZIP codes and counties, using Census's 2007 Governments Integrated Directory (Census GID 2007) and noting which counties and parishes fell completely within the LNS ZIP codes and which were only partially within a ZIP code. For all counties and included in the LNS, we downloaded the 2005–2009 labor force data from the American Community Survey (Census ACS 2010). The entire labor force was counted for counties and parishes that lay entirely within the ZIP code. Half of the labor force was counted for counties and parishes that lay partly in the ZIP code. The two exceptions to this approach, one in Texas and the other in Louisiana, are described in Sections 4.3.2.2.1 and 4.3.2.3.1, respectively.

4.3.2.2 Texas

Section 4.3.2.2.1 walks the reader through the approach for three Texas ZIP codes; the same approach is used for the majority of the ZIP codes and states. Section 4.3.2.2.2 discusses classification of the area labelled "Other Coastal Texas" in the LNS, and Section 4.3.2.2.3 summarizes the "rest of Texas" contributions.

4.3.2.2.1 General Method

Table 32 illustrates the calculations for ZIP codes 773, 774, and 775 in Texas. The column "Split" notes how many ZIP codes—if any—a county is divided into. For example, Grimes County is divided between two ZIP codes and has a "2" in the "Split" column; Montgomery County is entirely within ZIP code 773 and has a "1." The column labeled "Weights" is the fraction of the labor force in the ZIP code region that falls within a county. For example, in ZIP code 773, the regional labor force is the sum of the labor force of Montgomery, Walker, and San Jacinto Counties (384,177), half the labor force in Liberty County (28,693), Grimes County (10,175), and Polk County (18,975), and one-tenth the labor force in Harris County (289,548).

Table 32. Texas onshore labor distribution for production O&M

ZIP Code	County	OSA	County Labor Force	Split	Allocation: ZIP Code Labor Force	Weights	LNS Percent	Allocated Percent
773	Grimes	Rest of TX	20,350	2	10,175	1.39%	9.14%	0.13%
	Harris[a]	TX-3	2,895,476	4	289,548	39.58%		3.62%
	Liberty	TX-4	57,386	2	28,693	3.92%		0.36%
	Montgomery	TX-3	309,791	1	309,791	42.35%		3.87%
	Polk	Rest of TX	37,950	2	18,975	2.59%		0.24%
	San Jacinto	TX-4	19,555	1	19,555	2.67%		0.24%
	Walker	Rest of TX	54,831	1	54,831	7.50%		0.69%
774	Austin	Rest of TX	20,691	1	20,691	2.32%	1.20%	0.03%
	Brazoria	TX-3	219,825	2	109,913	12.35%		0.15%
	Colorado	Rest of TX	16,342	2	8,171	0.92%		0.01%
	Fort Bend	TX-3	375,095	1	375,095	42.14%		0.51%
	Harris[1]	TX-3	2,895,476	4	289,548	32.53%		0.39%
	Matagorda	TX-2	27,955	1	27,955	3.14%		0.04%
	Waller	Rest of TX	27,690	1	27,690	3.11%		0.04%
	Wharton	TX-2	30,983	1	30,983	3.48%		0.04%
775	Brazoria	TX-3	219,825	2	109,913	16.45%	5.23%	0.86%
	Chambers	TX-5	22,157	1	22,157	3.32%		0.17%
	Galveston	TX-3	217,685	1	217,685	32.59%		1.70%
	Harris[1]	TX-3	2,895,476	4	289,548	43.35%		2.27%
	Liberty	TX-4	57,386	2	28,693	4.30%		0.22%

Source: ERG estimates based on Census GID 2007 and Census ACS 2010

a Harris County is a special case; see text for details.

Harris County is treated separately because it contains an entire ZIP code (770) plus parts of three other ZIP codes (773, 774, and 775). ZIP code 770 now represents approximately 85% of Harris County's labor force; for consistency with when the LNS was administered, though, we assumed that ZIP code 770 represents 70% of the Harris County labor force and assigned the remaining 30% of the labor force equally over the three partial ZIP codes. ZIP code 773 is assigned one-tenth of the labor force in Harris County, making the labor force in ZIP code 773 an estimated 731,568. Montgomery County, with its labor force of 309,791, accounts for 42.35% of the ZIP code labor force.

The next column, "LNS Percent," is the fraction of the offshore workforce in that ZIP code (see Table 31). The LNS percent is multiplied by the weight to calculate the "Allocated Percent." For Montgomery County, the calculation is 42.35% times 9.14%, or 3.87%.

Because several counties are located in more than one ZIP code, the allocated percentages must be summed back to county totals (Table 33 below). For example, the 1.01% for Brazoria County reflects the 0.15% from ZIP code 774 plus 0.86% from ZIP Code 775. The labor percentage for Harris County reflects the sum of 9.81% from ZIP code 770 (see Table 31), 3.62% from ZIP code 773, 0.39% from ZIP code 774, and 2.27% from ZIP code 775. Table 33 also provides summary statistics for the Texas OSA and the "rest of state" distributions.

Table 33. Texas onshore labor summary by county and OSA for production O&M, Sector 29

County	Percent	County	Percent
Aransas	0.03%	Kennedy	0.00%
Bee	0.04%	Kleberg	0.04%
Brazoria	1.01%	Liberty	0.58%
Brooks	0.01%	Live Oaks	0.01%
Calhoun	0.09%	Matagorda	0.04%
Cameron	0.40%	Montgomery	3.87%
Chambers	0.17%	Newton	0.00%
Duval	0.01%	Nueces	0.37%
Fort Bend	0.51%	Orange	0.00%
Galveston	1.70%	Refugio	0.02%
Goliad	0.03%	San Jacinto	0.24%
Hardin	0.00%	San Patricio	0.04%
Harris	16.08%	Starr	0.06%
Hidalgo	0.72%	Victoria	0.37%
Jackson	0.06%	Webb	0.23%
Jasper	0.00%	Wharton	0.04%
Jefferson	0.00%	Willacy	0.02%
Jim Hogg	0.01%	Zapata	0.01%
Jim Wells	0.05%		

OSA	Percent
TX-1	1.51%
TX-2	1.19%
TX-3	23.17%
TX-4	0.83%
TX-5	0.17%
TX-6	0.005%
Rest of TX	6.54%

Source: Table 32; ICF Consulting 2008, Table 5.4

4.3.2.2.2 Other Coastal Texas

MAG-PLAN 2016 sought to distribute the "other coastal Texas" data, at least in part, to individual OSAs. The first step in that process was to determine which ZIP codes in Texas (1) were coastal and (2) did not appear in the LNS list of areas (ICF Consulting 2008, Table 5.4, reproduced as Table 31 above). As mentioned, LNS combined data where necessary to preserve confidentiality. Red outlines in Figure 19 show Texas ZIP codes enumerated in the LNS, and yellow (779) and green (776) outlines show the two ZIP codes that are coastal and not otherwise reported in LNS for distributing the outstanding Texas labor.[21] Thus, we distributed "other coastal Texas" data to ZIP codes 779 and 776.

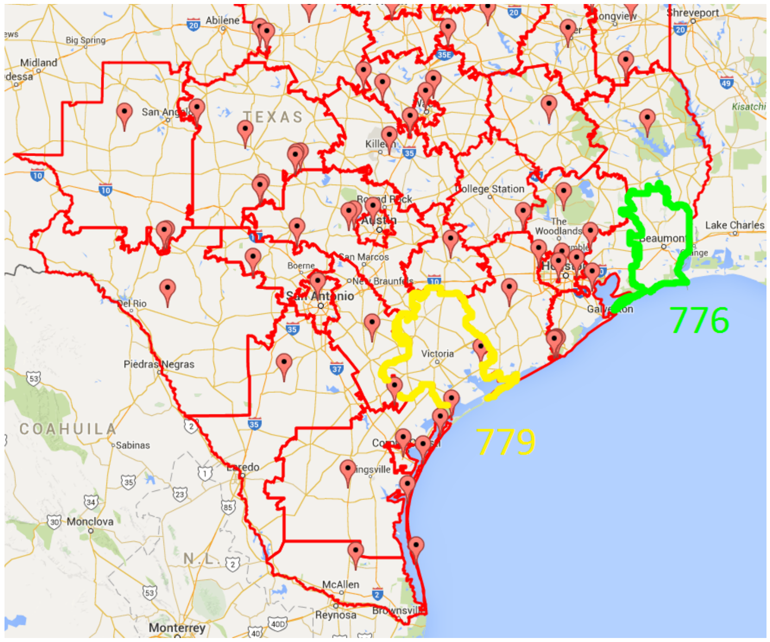

Figure 19. Other coastal Texas distribution
Source: USNaviguide 2007

ZIP codes 779 and 776 contain some counties that are in multiple OSAs. For example, ZIP code 779 contains part of Refugio County (TX-2). The other part of Refugio County is in ZIP code 78, which is included in the LNS as "Austin, Corpus Christi, San Antonio, Texas." Considering both the proximity of ZIP codes 779 and 776 to ZIP codes in the LNS and the equal opportunities to redistribute labor from the rest of Texas to OSAs, we chose ZIP code 779 for two primary reasons. First, it removes a disjunction from LNS's coverage of Texas's coastline—a logical step, since this labor is categorized as "Other coastal TX." Second, it is firmly embedded in Texas and induced spending distributed to ZIP code 779 is more likely to stay in Texas than 776, which shares a substantial border with Louisiana.

4.3.2.2.3 Rest of Texas

With the updated ZIP code definitions and a more definitive crosswalk between the ZIP codes and area boundaries, there are some changes to the LNS area previously considered to be entirely within the "rest of Texas" area. These changes are summarized in Table 34.

Table 34. 2016 update to previously undistributed labor

ZIP Code	Area	Percent	MAG-PLAN 2012 OSA	MAG-PLAN 2016 OSA
75–76	Dallas and Fort Worth	0.89%	Rest of TX	TX-2, TX-6, rest of TX
	Other coastal TX	0.69%	Rest of TX	TX-2, rest of TX
78	Austin, Corpus Christi, San Antonio, TX	6.46%	Rest of TX	TX-1, TX-2, rest of TX

Source: ICF Consulting 2008; Table 5.4; ERG estimates

[21] The two-digit ZIP code Texas 79 is also available. ZIP code 79, however, covers the northwest part of the state and does not qualify as "coastal."

4.3.2.3 Louisiana

4.3.2.3.1 General Method

Table 35 shows the same summary distributions for Louisiana. Jefferson Parish is split between ZIP codes 700, 701, and 703. Since Jefferson Parish does not represent any of those ZIP codes in full, we assigned 33.3% of the Jefferson Parish labor force to each one.

Table 35. Louisiana onshore labor summary by county and OSA for production O&M, Sector 29

County	Percent	County	Percent
Acadia	1.94%	Plaquemines	0.26%
Allen	0.11%	Pointe Coupee	0.02%
Ascension	2.25%	St. Bernard	0.46%
Assumption	1.10%	St. Charles	0.60%
Beauregard	0.19%	St. James	0.02%
Calcasieu	1.01%	St. John the Baptist	0.55%
Cameron	0.04%	St. Landry	1.63%
East Baton Rouge	0.37%	St. Martin	1.70%
Evangeline	1.16%	St. Mary	2.00%
Iberia	2.43%	St. Tammany	2.30%
Iberville	0.03%	Tangipahoa	1.17%
Jefferson	9.00%	Terrebonne	4.96%
Jefferson Davis	0.59%	Vermilion	1.84%
Lafayette	6.86%	Vernon	0.15%
Lafourche	4.36%	Washington	0.46%
Livingston	0.63%	West Baton Rouge	0.02%
Orleans	0.46%		

OSA	Percent
LA-1	1.06%
LA-2	0.34%
LA-3	15.83%
LA-4	14.84%
LA-5	3.88%
LA-6	10.78%
LA-7	3.93%
Rest of LA	3.82%

Source: ICF Consulting 2008, Table 5.4; Census GID 2007; Census ACS 2010; ERG estimates

4.3.2.3.2 Other Southern Louisiana

Distributing LNS's "Other South Louisiana" labor was more straightforward. As Figure 20 below shows, there was only one appropriate ZIP code in Louisiana for the outstanding labor share. ZIP code 707, however, surrounds ZIP code 708, so the latter ZIP was included so as to not create a gap.

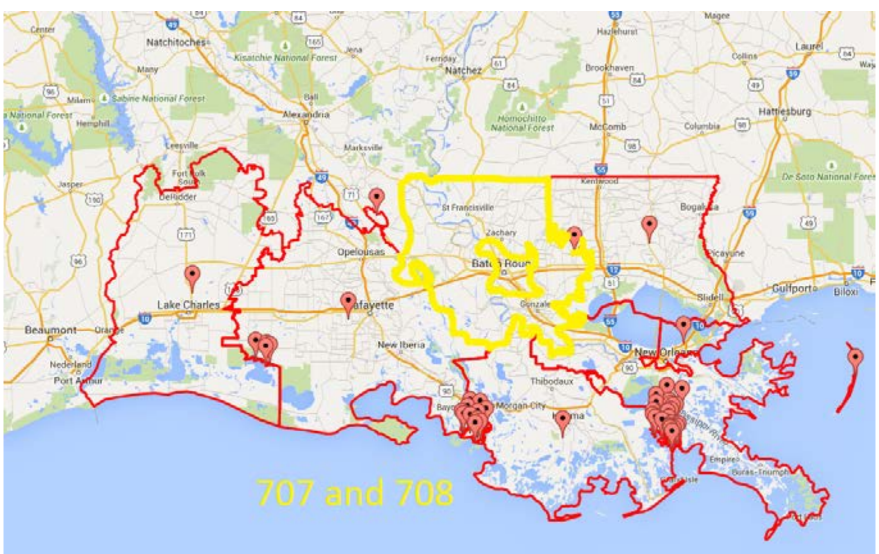

Figure 20. Other southern Louisiana distribution

Source: USNaviguide 2007

4.3.2.4 Alabama-Mississippi-Florida

BOEM revised the OSA definitions in MAG-PLAN 2016 for Alabama, Mississippi, and Florida based on Fannin et al. (in preparation). The areas of economic activity are AL-1, AL-2, MS-1, MS-2, FL-1, FL-2, and FL-3. The specific counties are:

- Alabama: Baldwin, Mobile, Clarke, Conecuh, Escambia, Monroe, and Washington.
- Mississippi: Hancock, Harrison, Jackson, Pearl River, George, Greene, Perry, and Stone,
- Florida: Bay, Escambia, Okaloosa, Santa Rosa, Walton, Calhoun, Franklin, Gadsden, Gulf, Holmes, Jackson, Leon, Liberty, Wakulla, Washington, Bradford, Columbia, Hamilton, Jefferson, Lafayette, Madison, Suwannee, Taylor, and Union.

For these three states, the geographical range of the two-digit ZIP codes in Table 31 above extends beyond the clusters of economic activity identified in Fannin et al. (in preparation). After the percentage-by-county estimates are made with the general methodology, they must be adjusted to shift any percentages that would have been assigned to counties outside the OSA to the counties in the OSAs.

The "Pre-adjustment OSA" column in Table 36 below shows the OSA labor distributions for Alabama and Mississippi including the "rest of" OSAs. From LNS data, approximately 3.33% of the GOM Sector 29 labor force resides in Alabama with 0.96% in AL-1, 0.19% in AL-2, and 2.18% in the rest of Alabama based on the proportion of county labor force to total Alabama labor force (see Table 31 above and Kaplan et al. 2012). To distribute the "rest of" allocations to the OSAs, we first calculated the share of Alabama and Mississippi represented by each OSA with "rest of" areas zeroed out ("Share Without Rest of State OSA" column) and then multiplied the OSA share by the "Pre-adjustment OSA" value for both "rest of" areas. For example, AL-1 represents 83% of Alabama's Sector 29 labor when no share is given to the rest of Alabama. Multiplying that 83% by the labor originally going to the rest of Alabama (2.18%) yields a product of 1.81% ("Proportional Distribution of Rest of State OSA"). Adding that product to the original "Pre-adjustment OSA" value generates an adjusted OSA percentage. The sum of AL-1 and AL-2 is 3.33%, the LNS estimate for the proportion of GOM Sector 29.

Table 36. Alabama and Mississippi OSA adjustment for production O&M, Sector 29

OSA	Pre-adjustment OSA	Share without Rest of State OSA	Proportional Distribution of Rest of State OSA	Post-adjustment OSA
Rest of AL	2.18%	0%	0%	0%
Rest of MS	3.29%	0%	0%	0%
AL-1	0.96%	83%	1.81%	2.77%
AL-2	0.19%	17%	0.37%	0.56%
MS-1	0.86%	87%	2.85%	3.71%
MS-2	0.13%	13%	0.43%	0.57%

Source: ICF Consulting 2008, Table 5.4; Kaplan et al. 2012; Table 31

Table 37 distributes the "Post-adjustment OSA" percentages developed for Table 36 at the county level. The "Pre-adjustment county" column shows the share of Sector 29 labor going to each Alabama and Mississippi county included in an OSA based on the proportion of county labor force to total state labor force. For example, the sum of Baldwin and Mobile Counties (the two counties in AL-1) is 0.96% (with rounding) and the sum of the five counties that make up AL-2 is 0.19%—the same values as in the pre-adjustment column in Table 36.

Table 37, in the column labeled "OSA Share," lists the proportion that each county in an OSA contributes to that OSA, again, the split is based on labor force. Multiplying these percentages by the appropriate "Post-adjustment OSA" share developed in Table 36 generates the adjusted county-level labor distribution. For example, Clarke County, Alabama, originally represented 0.04% of Alabama's Sector 29 labor distribution and 22% of AL-2's labor distribution. Multiplying this 22% by the adjusted AL-2 allocation from Table 36 (0.56%) equals an adjusted labor distribution of 0.13% for Clarke County. Due to rounding, figures may not sum properly in these summary tables.

Table 37. Alabama and Mississippi county adjustment for production O&M

County	OSA	Pre-adjustment County	OSA Share	Post-adjustment County
Alabama				
Baldwin	AL-1	0.29%	31%	0.84%
Mobile	AL-1	0.66%	69%	1.92%
Clarke	AL-2	0.04%	22%	0.13%
Conecuh	AL-2	0.02%	11%	0.06%
Escambia	AL-2	0.06%	33%	0.18%
Monroe	AL-2	0.04%	19%	0.11%
Washington	AL-2	0.03%	15%	0.08%
Mississippi				
Hancock	MS-1	0.09%	10%	0.38%
Harrison	MS-1	0.38%	44%	1.63%
Jackson	MS-1	0.28%	32%	1.19%
Pearl River	MS-1	0.12%	14%	0.51%
George	MS-2	0.04%	33%	0.19%
Greene	MS-2	0.03%	23%	0.13%
Perry	MS-2	0.02%	19%	0.11%
Stone	MS-2	0.03%	25%	0.14%

Source: ICF Consulting 2008, Table 5.4; Census GID 2007; Census ACS 2010; ERG estimates

For Florida, the 1.94% of labor identified in the LNS is split over 24 counties in OSAs FL-1, FL-2, and FL-3. The calculations provided for adjusting the Florida OSAs (Table 38) and counties (Table 39) are identical to those described for Table 36 and Table 37, respectively. A key exception is that the Florida adjustment involves zeroing out labor distributed to certain OSAs in addition to the "rest of" area. For this reason, some OSA counties listed in Table 39 will have no labor distributed to them (unlike their Table 37 counterparts). As above, due to rounding, figures may not sum properly in these summary tables.

Table 38. Florida OSA adjustment for production O&M

OSA	Pre-adjustment OSA	OSA Share Without FL-4, -5, -6, and "Rest of"	Proportional Distribution of FL-4, -5, -6, and "Rest of"	Post-adjustment OSA
FL-4	0.21%	0%	0%	0%
FL-5	0.00%	0%	0%	0%
FL-6	0.00%	0%	0%	0%
Rest of FL	1.20%	0%	0%	0%
FL-1	0.29%	54%	0.76%	1.05%
FL-2	0.17%	31%	0.44%	0.61%
FL-3	0.08%	15%	0.21%	0.28%

Source: ICF Consulting 2008, Table 5.4; Census GID 2007; Census ACS 2010; ERG estimates

Table 39. Florida county adjustment for production O&M

County	OSA	Pre-adjustment County	OSA Share Without FL-4, -5, -6, and "Rest of"	Post-adjustment County
Bay	FL-1	0.06%	19%	0.20%
Escambia	FL-1	0.10%	36%	0.38%
Okaloosa	FL-1	0.06%	21%	0.22%
Santa Rosa	FL-1	0.05%	17%	0.18%
Walton	FL-1	0.02%	6%	0.07%
Calhoun	FL-2	0.00%	3%	0.02%
Franklin	FL-2	0.00%	2%	0.01%
Gadsden	FL-2	0.02%	9%	0.06%
Gulf	FL-2	0.01%	3%	0.02%
Holmes	FL-2	0.01%	4%	0.02%
Jackson	FL-2	0.02%	10%	0.06%
Leon	FL-2	0.09%	55%	0.33%
Liberty	FL-2	0.00%	2%	0.01%
Wakulla	FL-2	0.01%	6%	0.04%
Washington	FL-2	0.01%	5%	0.03%
Bradford	FL-3	0.01%	13%	0.04%
Columbia	FL-3	0.02%	30%	0.08%
Hamilton	FL-3	0.00%	6%	0.02%
Jefferson	FL-3	0.00%	6%	0.02%
Lafayette	FL-3	0.00%	3%	0.01%
Madison	FL-3	0.01%	8%	0.02%
Suwannee	FL-3	0.01%	17%	0.05%
Taylor	FL-3	0.01%	9%	0.03%
Union	FL-3	0.01%	7%	0.02%

Source: ICF Consulting 2008, Table 5.4; Census GID 2007; Census ACS 2010; ERG estimates

4.3.2.5 Rest of US

No changes needed to be made to the LNS for Arkansas, Tennessee, West Coast, and other lower 48 states (see Table 31 and Table 40).

Table 40. LNS unchanged allocations to "rest of US" OSA

ZIP Code	Area	Percent	MAG-PLAN 2012 OSA	MAG-PLAN 2016 OSA
	Arkansas and Tennessee	0.82%	Rest of US	Rest of US
9	West Coast	0.79%	Rest of US	Rest of US
	Other lower 48	0.94%	Rest of US	Rest of US

Source: ICF Consulting 2008, Table 5.4

4.4 Derivation of Labor Percentages

In the activity function definition, MAG-PLAN splits the expenditures associated with each activity function into a labor and a non-labor component. Within an activity function MAG-PLAN allocates the non-labor expenditures to numerous IMPLAN sectors. From there, IMPLAN partitions the shock to each sector into labor and non-labor components to calculate the direct, indirect, and induced multipliers. As a result, the IMPLAN multipliers assume that the household spending associated with that sector occurs in the same economic area as the labor takes place. This implies that the activity function labor percentage for all activities where people are assumed to work near where they live should be set to zero. Doing so will allow IMPLAN to calculate labor spending associated with each of the sectors and allocate that activity in the same area as the other non-labor expenses occur (based on the non-labor onshore distribution by sectors described in Chapter 5).

As described, we determined that four activities required different treatment because labor spending is expected to take place in locations farther from expenditure location. Section 4.2 presents the onshore distribution for labor associated with the three drilling activities (exploratory, non-productive, and development wells). The same distribution is used for all three drilling activities, and it is based on the IADC data collected in 2010. The fourth activity is production O&M. In MAG-PLAN, the installation of a production structure (platform or floating), subsea installation, or FPSO triggers 15 years of production O&M. The onshore distribution for the labor percentages are based on LNS data (ICF Consulting 2008) and described in Section 4.3.

Table 41 presents the labor percentages by activity for incorporation in MAG-PLAN 2016 and the sources for the values. As described, for those activity functions in which labor expenses are expected to occur in the same location as other non-labor expenses, the labor percentage is set to zero.

Table 41. Labor percent by activity function

Activity	Water Depth	Labor Percentage	Data Source
G&G (3D)		0.0%	
Exploratory well drilling		19.9%	Kaplan et al. 2012, Table 24
Nonproductive well drilling		24.2%	Kaplan et al. 2012, Table 25
Development well drilling		23.8%	Kaplan et al. 2012, Table 26
Platform installation		0.0%	
Subsea		0.0%	
FPSO		0.0%	
Onshore gas processing facility		0.0%	
Onshore gas O&M		0.0%	
Offshore gas processing facility		0.0%	
Offshore gas O&M		0.0%	
Pipeline		0.0%	
Pipeline O&M		0.0%	
Platform removed with explosives	0–200m	0.0%	
Platform removed—no explosives	0–200m	0.0%	
	200+m	0.0%	
Production O&M	0–60m	32.5%	Kaplan et al. 2012, based on USDOE EIA 2010
	60–200m	27.9%	Kaplan et al. 2012, based on USDOE EIA 2010
	200+m	25.0%	Kaplan et al. 2012, based on USDOE EIA 2010

5 Onshore Distributions for Non-labor Expenditures

5.1 Introduction and Overview

Unlike the labor portion of an activity expenditure, the non-labor portion is separated into industry sectors. The next step is to distribute these expenditures by sector to OSAs to calculate the Stage 1 MAG-PLAN results. Onshore distributions for intermediate products will reflect the local supply of those products within each OSA. The Stage 1 outputs are multiplied in Stage 2 by IMPLAN multipliers modeled for each OSA analyzed for lease sales in the GOM.

5.1.1 OSAs

MAG-PLAN 2016 incorporates a matrix of spending by industry by user-defined OSA. The 2016 matrix contains:

- 133 counties and parishes BOEM considers in 23 GOM economic impact areas (Fannin and Varnado, in preparation).[22] These are listed in Table 42.
- Five "rest of state" areas for the remaining counties and parishes in Texas, Louisiana, Alabama, Mississippi, and Florida.
- GOM OSA (five-state region).
- "Rest of US" for the other 45 states.
- "Rest of world" for imports.

[22] The economic impact areas have been redefined for the 2016 update.

Table 42. Parishes and counties in BOEM economic impact areas by state

Texas: 37 Counties in Six Economic Impact Areas				
Aransas	Fort Bend	Jefferson (TX)	Montgomery	Victoria
Bee	Galveston	Jim Hogg	Newton	Webb
Brazoria	Goliad	Jim Wells	Nueces	Wharton
Brooks	Hardin	Kenedy	Orange	Willacy
Calhoun	Harris	Kleberg	Refugio	Zapata
Cameron (TX)	Hidalgo	Liberty	San Jacinto	
Chambers	Jackson	Live Oak	San Patricio	
Duval	Jasper	Matagorda	Starr	
Louisiana: 33 Parishes in Seven Economic Impact Areas				
Acadia	East Baton Rouge	Lafourche	St. James	Terrebonne
Allen	Evangeline	Livingston	St. John the Baptist	Vermilion
Ascension	Iberia	Orleans	St. Landry	Vernon
Assumption	Iberville	Plaquemines	St. Martin	Washington
Beauregard	Jefferson (LA)	Pointe Coupee	St. Mary	West Baton Rouge
Calcasieu	Jefferson Davis	St. Bernard	St. Tammany	
Cameron	Lafayette	St. Charles	Tangipahoa	
Mississippi: Eight Counties in Two Economic Impact Areas				
George	Hancock	Jackson	Perry	
Greene	Harrison	Pearl River	Stone	
Alabama: Seven Counties in Two Economic Impact Areas				
Baldwin	Conecuh	Mobile	Washington	
Clarke	Escambia	Monroe		
Florida: 48 Counties in Six Economic Impact Areas				
Alachua	Escambia	Highlands	Liberty	Sarasota
Bay	Franklin	Hillsborough	Madison	Sumpter
Bradford	Gadsden	Holmes	Manatee	Suwannee
Calhoun	Gilchrist	Jackson	Marion	Taylor
Charlotte	Glades	Jefferson	Monroe	Union
Citrus	Gulf	Lafayette	Okaloosa	Wakulla
Collier	Hamilton	Lake	Pasco	Walton
Columbia	Hardee	Lee	Pinellas	Washington
DeSoto	Hendry	Leon	Polk	
Dixie	Hernando	Levy	Santa Rosa	

Source: Fannin and Varnado (in preparation)

In other words, MAG-PLAN uses a 440 by *n* matrix (440 industry sectors by *n* geographic areas) where the row totals sum to 100% to model the onshore distributions. MAG-PLAN 2012 developed top-down onshore distributions in a manner consistent with (1) using IMPLAN data to estimate the proportion of an industry sector that could not be supplied within an OSA for a series of OSAs that decreased in size and (2) being able to redefine the counties or parishes in an OSA within MAG-PLAN without re-coding the model. MAG-PLAN 2016 refines this approach as described below.

5.1.2 Sector Characterization

Kaplan et al. (2012) divided the 440 IMPLAN sectors into four groups:

- **Major, non-local.** These sectors are intimately connected with offshore oil and gas operations and do not vary by the planning area of the lease sale. Onshore distributions for these sectors are developed from detailed analyses of businesses and locations offering these services and commodities; that is, the onshore distributions are built from the "bottom-up."

- **Major, local.** These sectors also are intimately connected with offshore oil and gas operations and have "bottom-up" distributions. However, the onshore distributions for these sectors vary by the planning area of the lease sale.

- **Non-major, non-local.** All other sectors are considered non-major and are developed from national data (called a top-down approach). Onshore distributions for sectors in this category do not vary by planning area.

- **Non-major, local.** Onshore distributions for sectors in this category are developed with a top-down approach but vary by planning area.

For the 2016 update, we re-examined the major and non-major and local and non-local sectors and:

- Redefined the following IMPLAN sectors as major industries:
    - 170, iron and steel mills and ferroalloy manufacturing
    - 171, steel product manufacturing from purchased steel
    - 273, wiring device manufacturing (umbilicals)

- Developed onshore distributions for these sectors based on CBP and Quest data.

- Removed Sector 412 (Other Accommodations) as a major industry.

Section 5.2 discusses the improvements, expansions (i.e., new sectors), and removals considered for sectors with bottom-up distributions.

Section 5.3 discusses potential issues identified on the 2012 top-down approach and the improvements to the model to address them Section 5.4 summarizes the industry sectors in each of the four categories as well as steps taken to ensure that no expenditures go to a region for an industry with 0.0 multipliers for that region and industry combination. The information in Sections 5.2 through 5.4 pertains to the entire GOM region. Section 5.5 identifies which sectors are considered to have different onshore distributions depending on whether a sale takes place in the western or central GOM planning areas, as well as how those distributions would change.

5.2 Bottom-Up Approach

BOEM's focus is on oil and gas operations in the federal offshore waters. There is a need to isolate offshore operations from onshore operations when national data sets present the data on a combined basis. To address this need, bottom-up onshore distributions for 10 IMPLAN sectors were developed in MAG-PLAN 2012:

- 28: drilling oil and gas wells
- 29: support activities for oil and gas operations
- 332: air transportation
- 334: water transportation
- 369: architectural and engineering services
- 412: other accommodations
- 413: food services
- 206: oil and gas field equipment and machinery

- 290: shipbuilding and repairing (for platform fabrication)
- 357: insurance carriers (for insurance policies for well drilling operations)

The distributions for the first seven sectors (i.e., Sector 28 through Sector 413) were based on Gulf Coast Oil Directory (GCOD 2008) data collected during BOEM's analysis of the GOM's oil services contract industry (Kaplan et al. 2011). For Sector 206, the data also came from GCOD (2008), modified to include subsea equipment manufacturers. Kaplan et al. (2012) describe how the onshore distributions for Sectors 206, 290, and 357 were developed.

The effects of the bottom-up distributions on interregional results were examined as part of this effort. As Table 43 shows, four key industries were being substantially distributed to Harris County, Texas. As a result of the findings shown in the table, we examined the bottom-up distributions for these four IMPLAN sectors to determine whether a different approach, using major industry sectors, was warranted. Section 5.2.1 discusses the IMPLAN sectors in NAICS Sector 21 (mining, quarrying, and oil and gas extraction). Section 5.2.2 examines selected manufacturing industries with bottom-up distributions. Section 5.2.3 reviews NAICS Subsector 541—professional, scientific, and technical services—as it relates to IMPLAN 369. Section 5.2.4 discusses the sector removed from the list of industries with bottom-up distributions.

Table 43. Harris County, Texas, and industry distribution

IMPLAN Sector	Sector Name	Harris County
28	Drilling oil and gas wells	85.02%
29	Support activities for oil and gas operations	49.88%
206	Oil and gas field equipment and machinery	43.32%
369[a]	Geological and geophysical prospecting	87.98%

Source: Kaplan et al. 2011

a IMPLAN Sector 369, "Architectural, Engineering, and Related Services," maps to NAICS 5413. NAICS 541360 is Geophysical Surveying and Mapping Services.

5.2.1 IMPLAN Sectors 28 and 29: Drilling Oil and Gas Wells and Support Activities for Oil and Gas Operations

MAG-PLAN distinguishes between drilling oil and gas wells as an IMPLAN sector and as an activity function. For example, for the activity of drilling an exploratory well in 1,600m to 2,400m of water, 27.4% of the non-labor expenditures are allocated to IMPLAN Sector 28. Of this expenditure, 85.02% (or 23.3%—27.4% times 85.02%—of the total) is distributed to the OSA of Harris County. Following the same methodology, we allocated 5% of the non-labor costs for the development well drilling activity to IMPLAN Sector 29 (support activities). Although Harris County receives nearly 50% of the Sector 29 non-labor expenditures, this represents only 2.5% of the non-labor costs of the development well drilling activity. That is, the activity function sector allocation mitigates the impact of the high onshore distribution value.

5.2.2 Selected Manufacturing Industries

We examined onshore distributions for certain key contributors for offshore oil and gas operations. These are described in

- Section 5.2.2.1: IMPLAN Sector 206 (oil and gas field equipment and machinery manufacturing).

- Section 5.2.2.2: oil country tubular goods/IMPLAN Sectors 170 and 171 (steel products from mills and purchased steel).

- Section 5.2.2.3: umbilicals and subsea equipment.
- Section 5.2.2.4: hulls and topsides.

5.2.2.1 IMPLAN Sector 206: Oil and Gas Field Equipment and Machinery Manufacturing

Although GCOD identified locations that served the offshore, it does not distinguish between sales locations and manufacturing locations. We cannot tell if a large proportion of expenditures flow from Harris County to other counties and parishes within the GOM states, and to other locations in the rest of the US and the rest of the world (imports). This would happen if large primary contractors in Harris County subcontract much of the procurement outside the county. Alternatively, Harris County may actually have such a large OSA distribution.

The 2012 CBP data for NAICS 33313/IMPLAN Sector 206 was used to estimate the relative size of the industry by Gulf state; see Table 44 (Census CBP 2015). The county and parish data for employment served as a measure of industry size because it is more complete than payroll data. In addition, the use of employment counts rather than receipts lessens the potentially non-offshore-biasing effects of expenditures for onshore and international activities that flow through headquarter locations. Table 44's third column reports the employment for the county/parish as a percent of total domestic employment. In terms of the entire industry, the employment in Texas (35,723, approximately 46.72%) is roughly equal to that in the 45 non-GOM states (35,791, approximately 46.81%). The employment in Harris County, Texas, represents nearly 28% of total domestic employment in this industry.

IMPLAN Sector 206, however, includes equipment on the topsides of an offshore production system as well as land-based operations. Quest (2011) indicates that approximately about 23% of the offshore oil and gas field equipment originates in the rest of the US. We modified the CBP distribution to take this into account, and the revised distribution is shown in Table 44, column 4. Harris County, Texas, is still the dominant area with 39% of the distribution, but this represents a decrease from the 49% estimate based on the GCOD data (Kaplan et al. 2012, Table 41).

Table 44. 2012 county business patterns—IMPLAN 206 employment

County or Parish	OSA	Percent US	MAG-PLAN Allocation
Mobile	AL_1	0.49%	0.73%
Bay	FL_1	0.23%	0.34%
Alachua	FL_4	0.23%	0.34%
Lake	FL_4	0.01%	0.01%
Marion	FL_4	0.23%	0.34%
Hillsborough	FL_5	0.08%	0.12%
Polk	FL_5	0.01%	0.01%
Calcasieu	LA_1	0.08%	0.12%
Beauregard	LA_2	0.08%	0.12%
Acadia	LA_3	0.08%	0.12%
Jefferson Davis	LA_3	0.08%	0.12%
Lafayette	LA_3	1.39%	2.07%
St. Landry	LA_3	0.08%	0.12%
St. Martin	LA_3	0.31%	0.46%
Iberia	LA_4	0.20%	0.30%
St. Mary	LA_4	0.20%	0.30%
Terrebonne	LA_4	1.69%	2.52%
Jefferson, LA	LA_6	0.38%	0.57%
Plaquemines	LA_6	0.07%	0.10%

County or Parish	OSA	Percent US	MAG-PLAN Allocation
Tangipahoa	LA_7	0.01%	0.01%
Cameron	TX_1	0.08%	0.12%
Bee	TX_2	0.01%	0.01%
Jackson	TX_2	0.01%	0.01%
Jim Wells	TX_2	0.49%	0.73%
Matagorda	TX_2	0.01%	0.01%
Nueces	TX_2	0.12%	0.18%
Victoria	TX_2	0.08%	0.12%
Brazoria	TX_3	0.49%	0.73%
Fort Bend	TX_3	0.91%	1.36%
Galveston	TX_3	0.15%	0.22%
Harris	TX_3	27.91%	39.32%
Montgomery	TX_3	3.02%	4.50%
Liberty	TX_4	0.01%	0.01%
San Jacinto	TX_4	0.01%	0.01%
Chambers	TX_5	0.23%	0.34%
Jefferson, TX	TX_5	0.01%	0.01%
Jasper	TX_6	0.08%	0.12%
	Rest of Alabama	0.03%	0.04%
	Rest of Florida	0.13%	0.19%
	Rest of Louisiana	0.05%	0.07%
	Rest of Mississippi	0.33%	0.49%
	Rest of Texas	13.09%	19.52%
	Alabama	0.52%	0.78%
	Florida	0.92%	1.37%
	Louisiana	4.70%	7.01%
	Mississippi	0.33%	0.49%
	Texas	46.72%	67.35%
	Rest of US	46.81%	23.00%
Total		**100.00%**	**100.00%**

Source: Quest 2011 for the "rest of US" estimate; Census CBP 2015 for all other estimates. Numbers may not sum due to rounding.

5.2.2.2 Oil Country Tubular Goods and IMPLAN Sectors 170 and 171

The term "oil country tubular goods" (OCTG) refers to drill pipe, pipe casings, oil pipes, and similar products used in the petroleum industry. These might be made at integrated steel mills that process iron ore into steel, at mini-mills that recycle scrap steel in electric arc furnaces, or from purchased steel. That is, OCTG would be included in IMPLAN Sectors 170 and 171. Multiple data sources were used to examine which steel plants manufacture OCTG and where the manufacturing sites might be located. Gravity-weighted models account for both the distance goods travel and the ease of said transportation (i.e., steel produced in Michigan might be "closer" to the GOM than steel produced in Oklahoma because large components could be transported on the Mississippi River rather than over land). This approach is used to refine the Sector 170 and 171 distributions. This section describes the logic and geographic areas included for the onshore distributions for steel products.

5.2.2.2.1 Metal Bulletin Plant Database

We extracted a list of pipe and tube mills from the *Metal Bulletin* plant database (Metal Bulletin 2015) and identified plants that listed OCTG as one of its products. We verified that OCTG is manufactured in IMPLAN Sectors 170 and 171. Unfortunately, the database did not contain capacity information for most of the entries, and an onshore distribution could not be developed without this information. Also, although all the listed mills produce OCTG, it is impossible to identify what share of their capacity is dedicated to OCTG production and, of that production, the split between offshore and onshore oil and gas customers.

5.2.2.2.2 American Iron and Steel Institute Map

American Iron and Steel Institute (AISI) data were examined to identify steel plants in the US (see Figure 21).

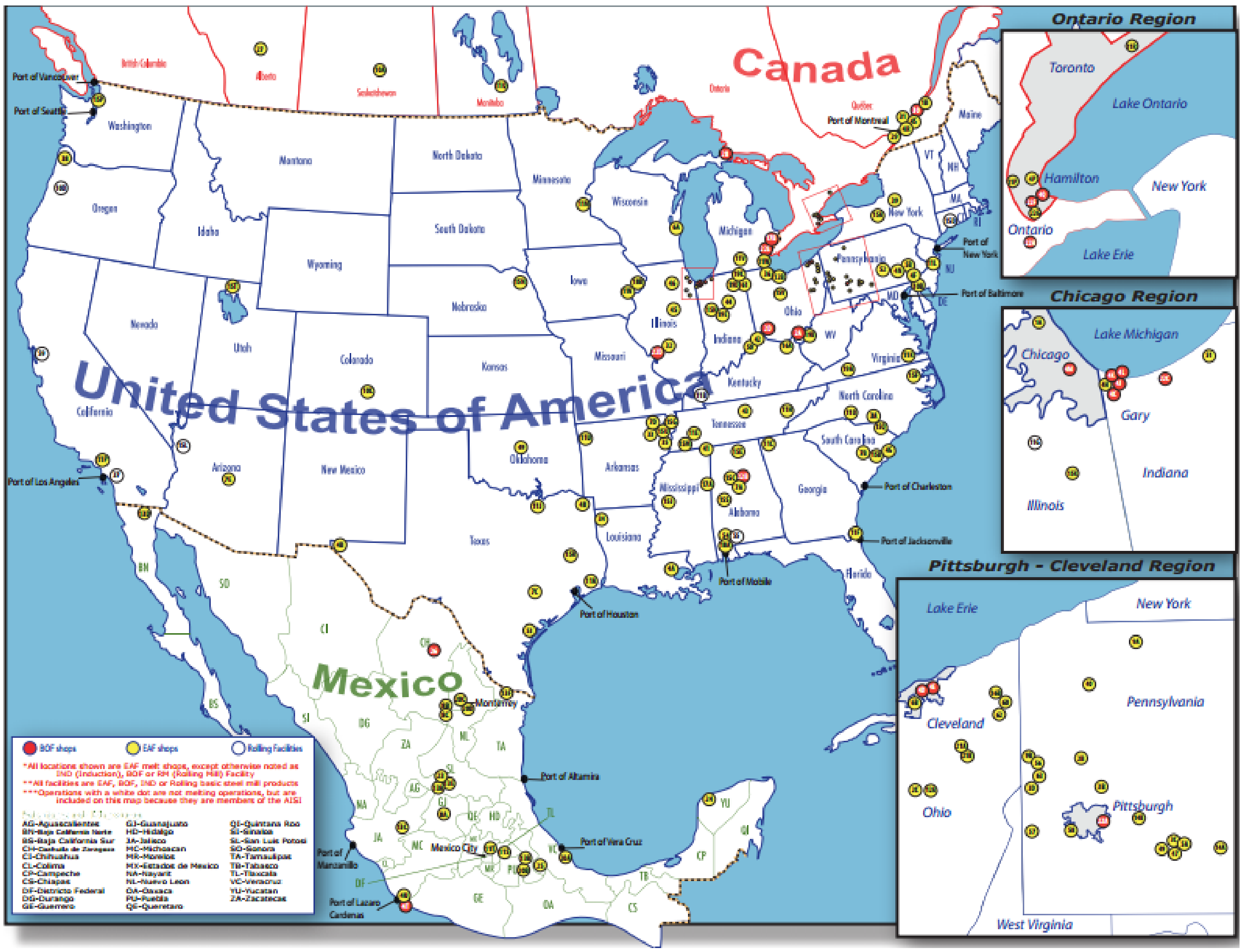

Figure 21. Steel plants of North America

Source: AISI 2013

Red dots mark basic oxygen furnace (BOF) plants, yellow dots mark electric arc furnaces (EAF) plants, open circles are rolling mills. Rolling mills do not melt steel but are included on the map because they are members of AISI. The bottom part of the figure lists the states of Mexico.

5.2.2.2.3 Inland Waterways

As Figure 21 indicates, steel plants are located nationwide. However, we considered plants that had access to water transportation to the GOM to be more likely to supply the GOM than steel plants lacking such access. As a result, we examined the inland and intracoastal US waterways maintained by the Army Corps of Engineers: see Figure 22. These waterways would provide the transportation access for steel to travel from a manufacturing plant to the GOM region.

Figure 22. Inland waterways of the US

Source: NSTPRSC 2007

Altogether, the information in Figure 21 and Figure 22 suggests that steel could travel by barge from Minnesota to the GOM. The upper Mississippi waterway begins in Minnesota and forms part of the border between Minnesota and Wisconsin, then between Iowa and Illinois. The likely route for steel from the Wisconsin mills would be barge transport on Lake Superior or Michigan until it is transferred to the Illinois River, which joins the Mississippi River about St. Louis, Missouri. Although the Missouri River is part on the inland waterway system, Figure 21 does not identify any steel plants in that state.[23] The Ohio River is the transportation artery for Ohio, Indiana, and Kentucky. The Arkansas River provides transportation access to the Mississippi for that state. The Tennessee-Tombigbee waterway serves Tennessee, Alabama, and Mississippi, and the Red and Ouachita Rivers serve Louisiana. For Texas, however, we limited the steel plants to those along the intracoastal waterway.[24] In estimating the onshore distributions, we included the data for the states listed in Table 45.

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[23] The circle marked “22D” in Figure 21 is the US Steel plant in Granite City, Illinois.

[24] For example, the circle marked “48” in the northeast part of Texas is the Joy Global plant (formerly listed as the RP Le Tourneau plant; see Elswick 2012), which manufactures steel plate for aircraft purposes. Gerdau

Table 45. States with access to inland waterways

Minnesota	Indiana	Tennessee	Mississippi
Wisconsin	Ohio	Texas (coastal EIAs only)	
Iowa	Kentucky	Louisiana	
Illinois	Arkansas	Alabama	

Source: Figure 21; Figure 22; ERG estimates

5.2.2.2.4 County Business Pattern Data

The supply chains for steel products used in offshore oil and gas operations could not be traced to specific locations. The 2012 CBP NAICS data for the initial onshore allocation of IMPLAN Sectors 170 (NAICS 3311) and 171 (NAICS 33121/33122) were used, but limited the data to the states and counties listed in Table 45. The distribution is based on the estimated share of employment as a percent of the US total for each industry (see Table 46 and Table 47 for IMPLAN 170 and 171, respectively).

Table 46. 2012 county business patterns—IMPLAN 170 employment

County	State	OSA	Percent Total
Mobile	AL	AL_1	0.56%
Washington	AL	AL_2	2.62%
Collier	FL	FL_6	0.01%
Hillsborough	FL	FL_5	0.14%
Sumter	FL	FL_4	0.26%
East Baton Rouge	LA	LA_5	0.01%
Lafayette	LA	LA_3	0.01%
St. James	LA	LA_5	0.01%
St. John the Baptist	LA	LA_5	0.56%
Tangipahoa	LA	LA_7	0.09%
Harrison	MS	MS_1	0.01%
Perry	MS	MS_2	0.01%
Harris	TX	TX_3	0.82%
Jefferson	TX	TX_5	0.09%
Liberty	TX	TX_4	0.09%
Orange	TX	TX_5	0.56%
Rest of Alabama			7.42%
Rest of Florida			0.79%
Rest of Louisiana			0.19%
Rest of Mississippi			1.69%
Rest of US			84.02%
Total			**100.00%**

Source: Census CBP 2015. Numbers may not sum due to rounding.

Long Steel North America plant in Midlothian, Texas (circle "11J") does not manufacture steel products for the oil and gas industry (Gerdau 2015). The steel plant in El Paso is too far away from water transportation to be included.

Table 47. 2012 county business patterns—IMPLAN 171 employment

County	State	OSA	Percent Total
Mobile	AL	AL_1	0.61%
Washington	AL	AL_2	2.62%
Bay	FL	FL_1	0.61%
Columbia	FL	FL_3	0.03%
Hillsborough	FL	FL_5	0.03%
Lee	FL	FL_6	0.03%
Marion	FL	FL_4	1.31%
East Baton Rouge	LA	LA_5	1.31%
Jefferson	LA	LA_6	0.21%
Lafayette	LA	LA_3	0.03%
Hancock	MS	MS_1	0.61%
Jackson	MS	MS_1	0.21%
Brazoria	TX	TX_3	0.03%
Chambers	TX	TX_5	0.21%
Fort Bend	TX	TX_3	0.21%
Harris	TX	TX_3	6.49%
Hidalgo	TX	TX_1	0.03%
Jefferson	TX	TX_5	0.21%
Liberty	TX	TX_4	2.62%
Montgomery	TX	TX_3	1.31%
Rest of Alabama			8.87%
Rest of Florida			1.64%
Rest of Louisiana			1.43%
Rest of Mississippi			3.87%
Rest of US			65.42%
Total			**100.00%**

Source: Census CBP 2015. Numbers may not sum due to rounding.

5.2.2.3 Umbilicals and Subsea Equipment

Quest (2015) provided information on the amount of umbilical and subsea equipment that was imported or manufactured domestically and the locations of the domestic production (Table 48). Umbilicals are composite cables that link the surface structure to the subsea processing systems, manifolds, subsea trees, etc. (see Section 3.3.1.1 above). They function as the nerve network of a subsea system. Umbilicals are classified in IMPLAN Sector 273, wiring device manufacturing. In 2012, all production was domestic; in 2013, 11% of umbilicals were imports; and in 2014, the percentage of imports dropped to 7%.

Due to the yearly fluctuations, the three-year average for the onshore distribution was used: 94% of the umbilicals are domestically made and 6% is assigned to the rest of the world. Umbilicals are manufactured at four locations in the US: two in Texas and one each in Alabama and Florida. Table 49 lists the onshore distribution for subsea umbilicals based on the three-year average value produced.

Quest (2015) provided similar onshore cost distribution information for subsea hardware. Data were obtained for wet Christmas trees (which are considered within the well cost profile) but not the associated hardware, which has numerous manufacturers and very little trail of origin. Quest reported that it does not track the manufacturing origin of the manifolds, junction plates (j plates), pipeline end manifolds (plems), terminals (plets), jumpers, or other equipment (Quest 2015). The onshore distribution for IMPLAN Sector 206 (oil and gas field equipment), shown in Table 44 above, are assumed to apply to subsea hardware as well as other offshore activities.

Table 48. Production sources for subsea production umbilicals, GOM

Parameter	2012	2013	2014	Average
Value ($mm)	$30.00	$281.10	$85.82	$132.31
Volume (km)	59.9	371.804	136.37	189.36
Domestic ($)	100%	89%	93%	94%
International ($)	0%	11%	7%	6%
	100%	100%	100%	
Domestic (km)	100%	90%	93%	94%
International (km)	0%	10%	7%	6%
	100%	100%	100%	
Mobile, AL ($mm)	79%	33%	61%	58%
Panama City, FL ($mm)	9%	58%	20%	29%
Freeport, TX ($mm)	13%	5%	19%	12%
Houston, TX ($mm)	0%	3%	0%	1%
	100%	100%	100%	100%
Mobile, AL (km)	79%	47%	70%	65%
Panama City, FL (km)	8%	41%	20%	23%
Freeport, TX (km)	13%	7%	10%	10%
Houston, TX (km)	0%	5%	0%	2%
	100%	100%	100%	100%

Source: Quest 2015

Table 49. Onshore distribution for subsea umbilicals—IMPLAN 273

Region	Distribution
Rest of world	6%
Mobil County, AL	55%
Bay County, FL	27%
Brazoria County, TX	11%
Harris County, TX	1%
Total	**100%**

Source: Quest 2015

5.2.2.4 Hulls and Topsides

5.2.2.4.1 FPSOs

The project team collected data on the cost breakdown among various parts of FPSOs. Hulls are consistently reported as being manufactured outside the US. Accommodations were always included in the cost estimate for the hull, so there is no allocation for IMPLAN Sector 412 (other accommodations). In the example where the topsides were US-built, the experts interviewed reported two locations in Texas (Houston and Corpus Christi). Although these might be the headquarters or sales locations for processing equipment manufacturers, we believe the onshore distribution described in Section 5.2.2.1 more accurately represents the manufacturing locations for equipment that is installed on topsides.

5.2.2.4.2 Other Floating Production Systems

Quest (2015) provided data for all floating production systems (semisubmersibles, SPARs, etc.) for five years (2010 through 2014) to have enough observations (eight) to maintain confidentiality of the underlying data; see Table 50. Only one of eight hulls was manufactured in the US, and that was at the Gulf Island site in Aransas Pass.

Table 50. Floating production systems—hull manufacturing—2010 through 2014

Parameter	2010	2011	2012	2013	2014	Average
Value ($ of hulls)	$1,046	$1,090	$331	$299	$470	$647
Volume (# of hulls)	2	3	1	1	1	1.6
Domestic (# of hulls)	0	1	0	0	0	0.2
International (# of hulls)	2	2	1	1	1	1.4
Domestic (# of hulls)	0%	33%	0%	0%	0%	7%
International (# of hulls)	100%	67%	100%	100%	100%	93%
Domestic ($ of hulls)	$0	$258	$0	$0	$0	$52
International ($ of hulls)	$1,046	$832	$331	$299	$470	$596
Domestic ($ of hulls)	0%	24%	0%	0%	0%	5%
International ($ of hulls)	100%	76%	100%	100%	100%	95%
Domestic #						
Aransas Pass (Gulf Island)	0	1	0	0	0	NA
Aransas Pass (Gulf Island)	0%	100%	0%	0%	0%	NA
Domestic $						
Aransas Pass (Gulf Island)	$0	$258	$0	$0	$0	NA
Aransas Pass (Gulf Island)	0%	100%	0%	0%	0%	NA

Source: Quest 2015

Table 51 is the topsides counterpart to Table 50. In this case, seven out of eight topsides were manufactured in the US. The topsides were manufactured and assembled to the hull in two locations, one in Texas and the other in Louisiana.[25]

MAG-PLAN is structured to accommodate one onshore distribution per IMPLAN sector. FPSO hull expenditures were assigned to IMPLAN Sector 436 (noncomparable imports) because these expenditures will not enter the US economy. IMPLAN Sector 290 (shipbuilding and repair) includes all types of vessel construction and repair from supply boats to FPSOs. Using the information in Table 50 and Table 51 for the onshore distribution for IMPLAN Sector 290. For this reason, MAG-PLAN 2016 retains the GOM onshore distribution for IMPLAN Sector 290 from MAG-PLAN 2012, which is reproduced in Table 52.

[25] The spreadsheet provided by Quest had rows for the McDermott facility in Morgan City, Louisiana, but no entries for 2010–2014.

Table 51. Floating production systems—topsides manufacturing—2010 through 2014

Parameter	2010	2011	2012	2013	2014	Average
Value ($ of topsides)	$1,482	$1,423	$1,284	$701	$780	$1,134
Volume (# of topsides)	2	2	2	1	1	1.6
Domestic (# of topsides)	2	2	2	0	1	1.4
International (# of topsides)	0	0	0	1	0	0.2
Domestic (# of topsides)	100%	100%	100%	0%	100%	80%
International (# of topsides)	0%	0%	0%	100%	0%	20%
Domestic ($ of topsides)	$1,482	$1,423	$1,284	$0	$780	$994
International ($ of topsides)	$0	$0	$0	$701	$0	$140
Domestic ($ of topsides)	100%	100%	100%	0%	100%	80%
International ($ of topsides)	0%	0%	0%	100%	0%	20%
Domestic #						
Ingleside, TX (Kiewit)	1	1	2	0	1	1
Houma, LA (Gulf Island)	1	1	0	0	0	0.4
Ingleside, TX (Kiewit)	50%	50%	100%	0%	100%	60%
Houma, LA (Gulf Island)	50%	50%	0%	0%	0%	20%
Domestic $						
Ingleside, TX (Kiewit)	$668	$814	$1,284	$0	$780	$709
Houma, LA (Gulf Island)	$814	$609	$0	$0	$0	$285
Ingleside, TX (Kiewit)	45%	57%	100%	0%	100%	60%
Houma, LA (Gulf Island)	55%	43%	0%	0%	0%	20%

Source: Quest 2015

Table 52. Onshore distribution for shipbuilding and repair—IMPLAN 290

State	County or Parish	Revenue (Millions)	Percent
AL	Mobile	$35.16	0.94%
LA	Iberia	$433.75	11.63%
LA	Jefferson (LA)	$41.16	1.10%
LA	Lafayette	$9.40	0.25%
LA	Lafourche	$0.60	0.02%
LA	Plaquemines	$67.13	1.80%
LA	Saint Mary	$131.85	3.54%
LA	Terrebonne	$387.43	10.39%
LA	Vermilion	$32.05	0.86%
MS	Jackson	$398.00	10.67%
MS	Warren	$249.06	6.68%
TX	Brazoria	$5.24	0.14%
TX	Cameron (TX)	$270.50	7.25%
TX	Galveston	$4.50	0.12%
TX	Harris	$298.42	8.00%
TX	Jefferson (TX)	$19.88	0.53%
TX	Nueces	$420.62	11.28%
TX	Orange	$29.30	0.79%
TX	San Patricio	$895.54	24.01%
Sum			100.00%

Source: Kaplan et al. 2012

5.2.3 IMPLAN Sector 369 (Professional, Scientific, and Technical Services)

As noted in Table 43, nearly 90% of the IMPLAN sector 369 is allocated to Harris County. In MAG-PLAN 2012, 100% of the G&G activity was assigned to IMPLAN Sector 369. This concentration has been mitigated in MAG-PLAN 2016 with the subsectorization of the G&G activity function. IMPLAN Sector 369 is now assigned between 8% and 10% of the G&G activity expenditures.

5.2.4 IMPLAN Sector 412 (Other Accommodations)

Kaplan et al. (2011) identified businesses that designed and built the accommodation modules installed on the topsides of fixed and floating production systems. These businesses were classified as IMPLAN Sector 412 (other accommodations). Accommodation modules were not identified as separate cost components for any type of production system (fixed or floating). Accommodation costs for FPSOs are typically included as part of the hull costs. As a result, no expenditures have been assigned to Sector 412. Thus, IMPLAN Sector 412 no longer has a “bottom-up” distribution.

5.3 Top-Down Approach

As mentioned in Chapter 2 and Section 5.1, MAG-PLAN needs to incorporate a matrix of spending by industry by OSA in Stage 1 in order to use the OSA-specific IMPLAN multipliers to estimate in impacts on employment, earnings, and output. One of the enhancements to MAG-PLAN 2012 was the ability to define new OSAs within the model. This enhancement necessitates the development of a methodology to distribute the spending in the GOM OCS to geographic areas as small as an individual county or parish as well as to the rest of the world. MAG-PLAN 2012 contains five OSAs—rest of Texas, rest of Louisiana, rest of Mississippi, rest of Alabama, and rest of Florida—that contain the counties and parishes not in the OSAs already defined.

The top-down approach uses IMPLAN’s regional purchase coefficients (RPCs) as proxies to estimate the proportion of demand supplied from sources within the region. This simplification does not include all the trading considerations that IMPLAN calculates for a regional share or (RS). The RS is used in a binary decision calculation—demand that is not supplied by a region must be supplied from outside the region and can be calculated as (1-RS) for any region. The process works from larger to smaller OSA, beginning with the rest of the world.

To start, the project team built IMPLAN regional models with 2012 data for:

- “Rest of world” for imports.
- “Rest of US” for the other 45 states.
- GOM (five-state regions).
- Five “rest of state” (ROS) areas for the remaining counties and parishes in Texas, Louisiana, Alabama, Mississippi, and Florida
- 133 counties and parishes in 23 BOEM-defined GOM economic impact areas (also called the “GOM OSAs).

The next sections trace the methods used for estimating the percent of expenditures distributed to OSAs, beginning with the “rest of the world,” through smaller OSAs, and ending with counties and parishes. Each section contains two subsections: the first for non-major industries in IMPLAN Sectors 1 through 319 and the second for IMPLAN Sectors 320 through 440. The rationale for the different approaches is that many of the industries in IMPLAN Sectors 1 through 319 deal with agricultural produce, extracted natural resources, manufacturing products, or goods distributed through wholesale trade. Shipping charges are likely to be a relatively small proportion of total costs, so it would likely be other factors (quality, base price, reliability, etc.) that would lead to the supplier choice. We consider products from IMPLAN Sectors 1 through 319 to be equally likely to come from economic impact areas within a state as the ROS region, based on the available supply in each of the regions.

IMPLAN Sectors 320 through 440 cover retail trade, transportation, and services within the information, finance/insurance, health care, accommodations/food, and other sectors. For the most part, these are services where person-to-person interactions are a key part of the relationship and, thus, are assumed to be locally provided. In this case, "locally provided" means that the distributions are limited to the economic impact areas and not the more distant ROS region.

5.3.1 "Rest of World" Estimate

5.3.1.1 IMPLAN Sectors 1 through 319

The initial assumption is what the US does not produce for itself is supplied by the "rest of world" region. The percent that is distributed to the rest of the world is calculated as:

$$\text{rest of world onshore distribution}_i = 1 - \text{US national RPC}_i$$

for IMPLAN Sectors 1 through 319.

5.3.1.2 IMPLAN Sectors 320 and Higher

We anticipate the services described by Sectors 320 and higher to be provided from regions abutting the GOM (see Section 5.3.3.2). We re-distributed amounts that would have been allocated to the "rest of world" region proportionally among all OSAs.

5.3.2 "Rest of US" Estimate

5.3.2.1 IMPLAN Sectors 1 through 319

The onshore distribution coefficients for the "rest of US" RPCs are derived as:

$$\text{all US RPCs for industry}_i - (\text{all GOM OSAs RPCs for commodity}_i + \text{ROS RPCs for commodity}_i)$$

That is, we start with the proportion distributed to the rest of the US OSA and subtract what is represented by the GOM and rest of State OSAs.[26]

5.3.2.2 IMPLAN Sectors 320 and Higher

We expect the services described by Sectors 320 and higher to be provided from regions abutting the GOM (see Section 5.3.3.2). We re-distributed amounts that would have been allocated to the "rest of US" region proportionally among all economic impact areas.

[26] MAG-PLAN 2012 calculated the proportion distributed to the rest of the US as the difference between the national and total five-state GOM RPC for commodity. Either method will yield similar, but not identical, results in most cases.

5.3.3 "Rest of State" Estimates

5.3.3.1 IMPLAN Sectors 1 through 319

The average RPC values for each of the five ROS regions were calculated. However, both the regional supply quantities and regional demand quantities vary by state. A large state like Texas could have a very a small RPC by producing a small regional supply relative to a large regional demand, but its supply for a given commodity may be larger than a smaller state with a larger RPC. The product of the five-state GOM region total and the ROS total were used to estimate a more accurate weighted average RPC, e.g., as follows:

(total five-state GOM region average RPC for commodity$_i$) × (ROS average RPC for commodity$_{ij}$)

where RPC for commodity$_{ij}$ is the regional purchase coefficient for commodity$_i$ in state$_j$

This approach yields slightly lower RPC values than the original approach, which used the entire state to derive ROS coefficients.

5.3.3.2 IMPLAN Sectors 320 and Higher

IMPLAN Sectors 320 through 440 cover retail trade, transportation, and services within the information, finance/insurance, health care, accommodations/food, and other sectors. For the most part, these are services where person-to-person interactions are a key part of the relationship and, thus, are assumed to be locally provided.[27] This implies that these services would be provided from the regions abutting the GOM and not the inland areas the ROS regions represent. For each IMPLAN sector within a state, the amount that would have been allocated to the ROS region is re-distributed proportionally among the OSAs for that state.

5.3.4 Counties and Parishes

Next, we extracted the following parameters from the "Social Accounts" section from each GOM OSA model:

- Total commodity supply (TCS)
- Total gross demand (TGD)
- Supply-demand pool (SDP) estimates
- Regional Purchase Coefficients (RPC)

The SDP is the maximum amount of regional supply that is available to meet regional demand. It is the ratio of regionally produced net commodity supply to gross regional demand. An SDP of less than one means that the commodity in question will be imported even if none of the regional supply is a domestic export. The RPC is a measure of the actual amount of local demand that is satisfied by local production. For a given commodity, it represents the ratio between county purchases of county output and total net county supply of the commodity. RPCs take into account the situation where a commodity is both imported to and exported from a county. An SDP is the upper limit value for an RPC (Alward et al. 1998).

We examined two approaches for estimating the onshore distribution percentages for individual counties and parishes in the BOEM economic impact areas. In **Approach 1,** the default IMPLAN SDP method is modified to use total commodity supply rather than net commodity supply as follows:

[27] The exceptions are IMPLAN 357 (insurance carriers) and 369 (architectural, engineering, and related services).

$$SDP_{ij} = TCS_{ij}/TGD_i$$

where:

SDP_{ij}	=	Commodity-specific supply and demand pool ratio for $commodity_i$ in $region_j$
TCS_{ij}	=	Total commodity supply for $commodity_i$ in $region_j$
TGD_i	=	Total gross demand in the five-state region for $commodity_i$

In **Approach 2,** the Approach 1 estimate is scaled by the ratio for the average RPC and the SDP estimate such that both the RPD and SDP are calculated with IMPLAN's default methodology:

$$\text{Modified } SDP_{ij} = [TCS_{ij}/TGD_i] \times [ARPCij/DS\text{-}DPij]$$

where:

Modified SDP_{ij}	=	Scaled commodity-specific supply and demand pool ratio for $commodity_i$ in $region_j$
TCS_{ij}	=	Total commodity supply for $commodity_i$ in $region_j$
TGD_i	=	Total gross demand in the five-state region for $commodity_i$
ARPCij	=	Average regional purchase coefficient (IMPLAN default calculation)
DS-DPij	=	Commodity-specific supply and demand pool ratio for $commodity_i$ in $region_j$ (IMPLAN default calculation)

That is, Approach 2 uses the $[ARPC_{ij}/DS\text{-}DP_{ij}]$ parameter to measure the economies of scale in each region. Both approaches generate very similar results. We decided to use Approach 1 for the onshore distributions because it is the more parsimonious model.

5.4 Avoiding Areas with Zero IMPLAN Multipliers

The onshore distributions developed in Section 5.3 may assign expenditures for an IMPLAN sector to an OSA even if the produces no output in that industry. As a result, these expenditures will be modified by a zero multiplier in MAG-PLAN 2016 and will not be factored into the local impacts.

This issue occurs under the top-down approach because RPCs use commodity accounts rather than industry accounts in the distribution calculation.[28] Although commodity accounts follow the 440-sector structure of industry accounts, they are fundamentally different in that a commodity can be produced from different industries. This type of conflation of commodity and industry can result in non-zero local supply of a commodity corresponding to an industry that has no output in that particular OSA (and hence has a zero multiplier). MAG-PLAN cannot correctly process any expenditures assigned to such an industry-OSA combination.

For example, looking at a test case ("rest of Alabama"), we found at least four sectors with onshore distribution to industries that were not present in the region (IMPLAN 57, 172, 175, and 182). This occurs because the corresponding commodities are also produced in other industries. For example, several industries produce each of the following commodities:

- Commodity 3057 (dried/condensed dairy) is produced by industries 55 (fluid milk/butter), 56 (cheese), and 58 (ice cream).

[28] Zero multipliers might also occur as a result of year-to-year data changes as companies go out of business, change focus, or select a different NAICS code to describe their operations. This situation is more common for OSAs with small populations and few businesses in a particular sector.

- Commodity 30172 (aluminum refining) is produced by industry 173 (secondary smelting/alloying of aluminum).
- Commodity 30175 (copper) is produced by industry 177 (copper rolling, drawing, etc.).
- Commodity 30182 (custom rolled forming) is produced by industry 189 (metal tank manufacturing).[29]

We adjusted the onshore distributions, where necessary, to ensure that no expenditures would be assigned to an OSA with a zero IMPLAN multiplier, so avoiding losses of local impacts. Our basic approach was to keep expenditures with missing multipliers within the same state, where possible. The steps taken to reassign the distributions are as follows:

- Find all OSA-IMPLAN industry code combinations that have a zero IMPLAN multiplier and a non-zero onshore distribution.
- Calculate the total onshore percentage associated with zero IMPLAN multipliers by industry/state combination.
- Redistribute the calculated percentage for each industry to counties within the same state with non-missing multipliers, proportionally to the expenditures already distributed to them.
- If no counties with non-missing multipliers are available within the state, assign the calculated percentage to the ROS OSA.
- If the ROS OSA is missing its multiplier, assign the calculated percentage to the "rest of US."

We also cross-checked the bottom-up distributions against IMPLAN multipliers to make sure similar issues did not occur.

5.5 Gulf-Wide Distributions and Regional Variations

5.5.1 Major, Non-local

These nine sectors are intimately connected with offshore oil and gas operations, do not vary by the planning area of the lease sale, and the distributions are built from the bottom up.

- 28: drilling oil and gas wells
- 29: support activities for O&G operations
- 170: iron and steel mills and ferroalloy manufacturing
- 171: steel product manufacturing from purchased steel
- 206: mining, oil and gas field machinery manufacturing
- 273: wiring device manufacturing
- 290: ship building and repairing
- 357: insurance
- 369: architectural, engineering, and related services

[29] IMPLAN commodity accounts are labeled as 30XXX, where XXX is the IMPLAN code of the underlying industry. Hence, commodity 3057 is primarily associated with IMPLAN 57.

The reasons why the onshore distributions are not likely to vary by planning area differ according to the sector. For example, competition within the well drilling and support sectors would minimize the incentive for an operator to select a business on the basis of lease planning area. The next four sectors are goods and products and the onshore distributions are unlikely to differ by lease sale planning area. Competition among the shipbuilding and repair facilities would also minimize the incentive to change suppliers by lease sale planning area. The onshore distribution for insurance is either "rest of US" or "rest of world," and seismic survey companies are clustered in Harris County, so the onshore distribution for these sectors will not vary.

5.5.2 Major, Local

Three additional sectors are connected with offshore oil and gas operations and have bottom-up distributions:

- 332: air transportation
- 334: water transportation
- 413: food services

However, their onshore distributions vary by the planning area of the lease sale.

MAG-PLAN 2016 assumes that for sales in the western GOM, 100% of these services originate from Texas. For sales in the central GOM, 100% these services are assumed to originate from Louisiana, Alabama, and Mississippi.

5.5.3 Non-major, Non-local

IMPLAN Sectors 1 through 319 cover agriculture, extractive industries such as mining and oil and gas extraction, manufacturing, and wholesale trade. With the seven exceptions listed in Section 5.5.1, IMPLAN Sectors 1 through 319 are considered "non-major."[30] The onshore distributions for these sectors are developed with the "top-down" approach described in Section 5.3. Because these non-major sectors typically deal with goods and products, the assumptions for why the onshore distributions do not vary by lease sale planning area are the same as those given in Section 5.3.3.1.

5.5.4 Non-major, Local

For the reasons given in Section 5.3.3.2, the onshore distributions for IMPLAN Sectors 320 and higher[31] are assumed to vary by lease sale location. For sales in the western GOM, 100% of these services are assumed to originate from Texas. For sales in the central GOM, 100% these services are assumed to originate from Louisiana, Alabama, and Mississippi.

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[30] These sectors are IMPLAN 28 (drilling oil and gas wells), 29 (support activities for O&G operations), 170 (iron and steel mills and ferroalloy manufacturing), 171 (steel product manufacturing from purchased steel), 206 (mining, oil and gas field machinery manufacturing), 273 (wiring device manufacturing), and 290 (ship building and repairing).

[31] The exceptions are IMPLAN 357 (insurance carriers) and 369 (architectural, engineering, and related services).

6 Sensitivity Analysis Results and Observations

6.1 Sensitivity Analysis Results

The project team created a series of MAG-PLAN runs for the GOM, each with one example of one activity type occurring in 2030, and exported the Stage I results. We focused on the Stage I results because this is the only place where we can identify the proportion of expenditures for an activity that is lost to the US economy. The loss occurs when expenditures are distributed to the "rest of the world" region. We also examined the proportion of activity expenditures lost to the GOM economy but staying within the "rest of the US" region.

Table 53 presents the results, sorted by the percent of expenditures that remain in the GOM region. Production O&M and decommissioning (with and without explosives) are the activities with the largest percentage of expenditures remaining in the GOM (~94%). The next activity group has from 77% to 81% of the expenditures remaining in the GOM; these are the three well-drilling activities. Offshore gas processing facilities, pipeline installation, and subsea installation retain about 68% to 70% of the spending in the GOM. About 60 percent of the expenditures for platforms and onshore gas processing facilities remain in the GOM.

FPSOs are in a class by themselves, as only 30% of the expenditures are distributed to the GOM. The right-most column in Table 53 lists the "effective" investment—the amount of money that stays in the GOM region—and is calculated as the product of the cost and the GOM percentage.

Table 53. Activity type by percentage of expenditures remaining in GOM region

Activity Type	Cost (Thousands, 2012$)	Percent Distributed to			Effective GOM Investment
		Rest of World	Rest of US	GOM	
Platform O&M (1 of 14 years)	$1,028	3.6%	2.5%	93.9%	$965
Platform removed—with explosives	$1,863	4.0%	2.1%	93.9%	$1,749
Platform removed—no explosives	$1,620	4.3%	2.3%	93.5%	$1,515
Productive well drilled	$8,366	4.5%	14.8%	80.7%	$6,754
Exploratory well drilled including G&G	$15,887	7.4%	14.0%	78.6%	$12,483
Non-productive well drilled	$7,858	4.0%	19.0%	77.0%	$6,049
Gas processing facility—offshore	$599,898	11.5%	18.2%	70.3%	$421,539
Pipeline added (1 mile)	$2,195	5.1%	25.4%	69.5%	$1,525
Subsea added (3-year and 1-year O&M)	$201,499	3.3%	28.5%	68.3%	$137,526
Platform added (0–60m, 3-year and 1-year O&M)	$7,133	10.7%	28.5%	60.9%	$4,340
Gas processing facility—onshore	$98,414	10.3%	30.9%	58.8%	$57,858
FPSO added (3-year and 1-year O&M)	$634,402	62.4%	7.4%	30.2%	$191,896

Source: Costs taken from Kaplan et al. 2012; percent distributed based on MAG-PLAN GOM 2016 Stage 1 expenditure results aggregated over all industry sectors by region

Table 54 presents the same summary table sorted by effective investment. Although an offshore gas processing facility and an FPSO both have a cost of about $600 million, the contribution of an offshore gas processing facility to the GOM economy is more than twice that of a FPSO. Although a FPSO costs about three times more than a subsea system, a FPSO contributes only about 40% more to the GOM economy. Platform installation is in the lower half of the table, but this is a factor of selecting an example in the shallowest water depth (0–60m); the largest production system would fall between the offshore gas processing system and the FPSO in Table 54.

Table 54. Activity type by effective investment

Activity Type	Cost (Thousands, 2012$)	Percent Distributed to Rest of World	Percent Distributed to Rest of US	Percent Distributed to GOM	Effective GOM Investment
Gas processing facility—offshore	$599,898	11.5%	18.2%	70.3%	$421,539
FPSO added (3-year and 1-year O&M)	$634,402	62.4%	7.4%	30.2%	$191,896
Subsea added (3-year and 1-year O&M)	$201,499	3.3%	28.5%	68.3%	$137,526
Gas processing facility—onshore	$98,414	10.3%	30.9%	58.8%	$57,858
Exploratory well frilled including G&G	$15,887	7.4%	14.0%	78.6%	$12,483
Productive well drilled	$8,366	4.5%	14.8%	80.7%	$6,754
Non-productive well drilled	$7,858	4.0%	19.0%	77.0%	$6,049
Platform added (0–60m, 3-year and 1-year O&M)	$7,133	10.7%	28.5%	60.9%	$4,340
Platform removed—with explosives	$1,863	4.0%	2.1%	93.9%	$1,749
Pipeline added (1 mile)	$2,195	5.1%	25.4%	69.5%	$1,525
Platform removed—no explosives	$1,620	4.3%	2.3%	93.5%	$1,515
Platform O&M (1 of 14 years)	$1,028	3.6%	2.5%	93.9%	$965

Source: Costs taken from Kaplan et al. 2012; percent distributed based on MAG-PLAN GOM 2016 Stage 1 expenditure results aggregated over all industry sectors by region

Table 54 includes other artifacts due to the selected options within an activity. For example, pipeline installation is third from the bottom in Table 54. This is because the cost unit is $/mile. If a project involved laying 10 miles of pipeline, the activity would rank above an exploratory well. Similarly, the 14 additional years of O&M associated with a production structure would place the activity, on a cumulative basis, above exploratory well drilling and below gas processing facilities, FPSOs, and subsea systems.

The examination of Table 54, in turn, highlights some differences between the exploratory and production phases in the industry. Once a system goes into production, the O&M expenditures feed the local economy year-in and year-out until it is no longer possible to economically produce. This multi-year level spending effect is enhanced by the thousands of active production systems in the GOM. This is in contrast to drilling operations where the level of activity can fluctuate sharply with oil and gas prices. In other words, whether BOEM considers an activity to be a driver in the GOM economy might also depend on how the Bureau qualitatively values the volatility of whether and when an activity will take place.

6.2 Observations

MAG-PLAN 2016 is only the latest in a series of BOEM's socioeconomic models (e.g., MAG-PLAN 2012 and MAG-PLAN 2005). As such, the MAG-PLAN model continues to be updated in response to industry developments and new data. An examination of BOEM permit data might make it possible to disassociate G&G operations from exploratory well drilling and treat G&G as an independent activity in an E&D scenario. Well costs and the good and services associated with drilling and completing a well will change according to new technologies, water depths, and well depths; the industry profiles for well drilling operations were last updated in MAG-PLAN 2016. New activities, as yet unknown, might need to be defined in future analyses. Methodological pursuits might include an examination of the industry/commodity relationship to develop a conceptually consistent means to avoid distributing industry expenditures to an OSA without multipliers for that industry and OSA combination. With BOEM's commitment to sound socioeconomic analyses, as the industry evolves, so will MAG-PLAN (or its successor).

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Appendix A Activity Cost Summaries

A.1 GOM Activity Cost Summary

Table 55. GOM activity cost summary

Activity Function	Water Depth	Cost Per Unit Thousands $2008	Cost Per Unit Thousands $2015	Labor
Geological and geophysical prospecting (G&G)	0–60m	$2,600	$2,905	0.0
G&G	60–200m	$4,380	$4,894	0.0
G&G	200–400m	$5,324	$5,949	0.0
G&G	400–800m	$6,376	$7,125	0.0
G&G	200–800m	$5,850	$6,537	0.0
G&G	800–1,600m	$11,476	$12,823	0.0
G&G	1,600–2,400m	$18,649	$20,839	0.0
G&G	2,400+m	$19,674	$21,984	0.0
Exploratory drilling	0–60m	$12,381	$13,835	19.89
Exploratory drilling	60–200m	$20,857	$23,306	19.89
Exploratory drilling	200–400m	$25,354	$28,331	19.89
Exploratory drilling	400–800m	$30,364	$33,929	19.89
Exploratory drilling	200–800m	$27,859	$31,130	19.89
Exploratory drilling	800–1,600m	$54,648	$61,065	19.89
Exploratory drilling	1,600–2,400m	$88,803	$99,230	19.89
Exploratory drilling	2,400+m	$93,688	$104,689	19.89
Nonproductive development drilling	0–60m	$7,410	$8,280	24.22
Nonproductive development drilling	60–200m	$9,283	$10,373	24.22
Nonproductive development drilling	200–400m	$11,584	$12,944	24.22
Nonproductive development drilling	400–800m	$14,744	$16,475	24.22
Nonproductive development drilling	200–800m	$13,164	$14,710	24.22
Nonproductive development drilling	800–1,600m	$27,985	$31,271	24.22
Nonproductive development drilling	1,600–2,400m	$34,106	$38,111	24.22
Nonproductive development drilling	2,400+m	$30,073	$33,604	24.22
Development drilling and production	0–60m	$7,889	$8,815	23.84
Development drilling and production	60–200m	$9,820	$10,973	23.84
Development drilling and production	200–400m	$12,191	$13,622	23.84
Development drilling and production	400–800m	$15,450	$17,264	23.84
Development drilling and production	200–800m	$13,821	$15,444	23.84
Development drilling and production	800–1,600m	$29,101	$32,518	23.84
Development drilling and production	1,600–2,400m	$35,412	$39,570	23.84
Development drilling and production	2,400+m	$31,254	$34,924	23.84
Platform fabrication and installation	0–60m	$5,758	$6,434	0.0
Platform fabrication and installation	60–200m	$17,102	$19,110	0.0
Platform fabrication and installation	200–400m	$99,024	$110,651	0.0
Platform fabrication and installation	400–800m	$178,823	$199,820	0.0
Platform fabrication and installation	200–800m	$138,924	$155,235	0.0
Platform fabrication and installation	800–1,600m	$360,887	$403,261	0.0
Platform fabrication and installation	1,600–2,400m	$565,679	$632,099	0.0
Platform fabrication and installation	2,400+m	$587,666	$656,668	0.0
Subseabed		$185,757	$207,568	0.0
Floating, production, storage, and offloading (FPSO)		$587,666	$656,668	0.0
Offshore pipeline construction		$2,070	$2,313	0.0

Activity Function	Water Depth	Cost Per Unit Thousands $2008	Cost Per Unit Thousands $2015	Labor
Offshore pipeline operations and maintenance (O&M)		$280	$313	0.0
Decommission platform (explosives)	0–60m	$1,528	$1,707	0.0
Decommission platform (explosives)	60–200m	$4,445	$4,967	0.0
Decommission platform (explosives)	200–400m	$0	$0	0.0
Decommission platform (explosives)	400–800m	$0	$0	0.0
Decommission platform (explosives)	200–800m	$0	$0	0.0
Decommission platform (explosives)	800–1,600m	$0	$0	0.0
Decommission platform (explosives)	1,600–2,400m	$0	$0	0.0
Decommission platform (explosives)	2,400+m	$0	$0	0.0
Decommission platform (no explosives)	0–60m	$1,757	$1,963	0.0
Decommission platform (no explosives)	60–200m	$5,111	$5,711	0.0
Decommission platform (no explosives)	200–400m	$40,525	$45,283	0.0
Decommission platform (no explosives)	400–800m	$45,198	$50,505	0.0
Decommission platform (no explosives)	200–800m	$42,862	$47,894	0.0
Decommission platform (no explosives)	800–1,600m	$25,133	$28,084	0.0
Decommission platform (no explosives)	1,600–2,400m	$24,973	$27,905	0.0
Decommission platform (no explosives)	2,400+m	$16,692	$18,652	0.0
Offshore gas processing construction		$565,679	$632,099	0.0
Offshore gas processing O&M		$396	$442	0.0
Onshore gas processing construction		$92,800	$103,696	0.0
Onshore gas processing O&M		$360	$402	0.0
Production O&M (structure)	0–60m	$969	$1,083	32.5
Production O&M (structure)	60–200m	$969	$1,083	27.9
Production O&M (structure)	200–400m	$4,249	$4,748	25.0
Production O&M (structure)	400–800m	$4,249	$4,748	25.0
Production O&M (structure)	200–800m	$4,249	$4,748	25.0
Production O&M (structure)	800–1,600m	$10,548	$11,787	25.0
Production O&M (structure)	1,600–2,400m	$10,548	$11,787	25.0
Production O&M (structure)	2,400+m	$10,548	$11,787	25.0
Production O&M (subseabed)		$4,249	$4,748	25.0
Production O&M (FPSO)		$10,548	$11,787	25.0

Source: Kaplan et al. 2012, Chapter 3 ($2008 costs); Chapter 4 (labor percentages)

A.2 Western GOM Activity Cost Summary

Table 56. WGOM activity cost summary

Activity Function	Water Depth	Cost Per Unit Thousands $2008	Cost Per Unit Thousands $2015	Labor
Geological and geophysical prospecting (G&G)	0–60m	$2,261	$2,526	0.0
G&G	60–200m	$4,409	$4,927	0.0
G&G	200–400m	$5,999	$6,703	0.0
G&G	400–800m	$7,186	$8,030	0.0
G&G	200–800m	$6,593	$7,367	0.0
G&G	800–1,600m	$11,046	$12,343	0.0
G&G	1,600–2,400m	$19,635	$21,940	0.0
G&G	2,400+m	$11,088	$12,390	0.0
Exploratory drilling	0–60m	$10,769	$12,033	19.89
Exploratory drilling	60–200m	$20,993	$23,458	19.89
Exploratory drilling	200–400m	$28,567	$31,921	19.89
Exploratory drilling	400–800m	$34,220	$38,238	19.89
Exploratory drilling	200–800m	$31,394	$35,080	19.89
Exploratory drilling	800–1600m	$52,602	$58,778	19.89
Exploratory drilling	1,600–2,400m	$93,500	$104,478	19.89
Exploratory drilling	2,400+m	$52,802	$59,002	19.89
Nonproductive development drilling	0–60m	$7,410	$8,280	24.22
Nonproductive development drilling	60–200m	$8,939	$9,989	24.22
Nonproductive development drilling	200–400m	$16,114	$18,006	24.22
Nonproductive development drilling	400–800m	$19,471	$21,757	24.22
Nonproductive development drilling	200–800m	$17,793	$19,882	24.22
Nonproductive development drilling	800–1,600m	$29,280	$32,718	24.22
Nonproductive development drilling	1,600–2,400m	$37,076	$41,429	24.22
Nonproductive development drilling	2,400+m	$23,205	$25,930	24.22
Development drilling and production	0–60m	$7,889	$8,815	23.84
Development drilling and production	60–200m	$9,465	$10,576	23.84
Development drilling and production	200–400m	$16,863	$18,843	23.84
Development drilling and production	400–800m	$20,323	$22,709	23.84
Development drilling and production	200–800m	$18,593	$20,776	23.84
Development drilling and production	800–1,600m	$30,436	$34,010	23.84
Development drilling and production	1,600–2,400m	$38,474	$42,992	23.84
Development drilling and production	2,400+m	$24,173	$27,011	23.84
Platform fabrication and installation	0–60m	$5,756	$6,432	0.0
Platform fabrication and installation	60–200m	$17,100	$19,108	0.0
Platform fabrication and installation	200–400m	$99,000	$110,624	0.0
Platform fabrication and installation	400–800m	$178,790	$199,783	0.0
Platform fabrication and installation	200–800m	$138,895	$155,204	0.0
Platform fabrication and installation	800–1,600m	$360,810	$403,175	0.0
Platform fabrication and installation	1,600–2,400m	$565,560	$631,966	0.0
Platform fabrication and installation	2,400+m	$587,540	$656,527	0.0
Subseabed		$214,690	$239,898	0.0
Floating, production, storage, and offloading (FPSO)		$587,540	$656,527	0.0
Offshore pipeline construction		$2,070	$2,313	0.0
Offshore pipeline operations and maintenance (O&M)		$280	$313	0.0
Decommission platform (explosives)	0–60m	$1,528	$1,707	0.0

Activity Function	Water Depth	Cost Per Unit Thousands $2008	Cost Per Unit Thousands $2015	Labor
Decommission platform (explosives)	60–200m	$4,445	$4,967	0.0
Decommission platform (explosives)	200–400m	$0	$0	0.0
Decommission platform (explosives)	400–800m	$0	$0	0.0
Decommission platform (explosives)	200–800m	$0	$0	0.0
Decommission platform (explosives)	800–1,600m	$0	$0	0.0
Decommission platform (explosives)	1,600–2,400m	$0	$0	0.0
Decommission platform (explosives)	2,400+m	$0	$0	0.0
Decommission platform (no explosives)	0–60m	$1,757	$1,963	0.0
Decommission platform (no explosives)	60–200m	$5,111	$5,711	0.0
Decommission platform (no explosives)	200–400m	$40,525	$45,283	0.0
Decommission platform (no explosives)	400–800m	$45,198	$50,505	0.0
Decommission platform (no explosives)	200–800m	$42,862	$47,894	0.0
Decommission platform (no explosives)	800–1,600m	$25,133	$28,084	0.0
Decommission platform (no explosives)	1,600–2,400m	$24,973	$27,905	0.0
Decommission platform (no explosives)	2,400+m	$16,692	$18,652	0.0
Offshore gas processing construction		$565,679	$632,099	0.0
Offshore gas processing O&M		$396	$442	0.0
Onshore gas processing construction		$92,800	$103,696	0.0
Onshore gas processing O&M		$360	$402	0.0
Production O&M (structure)	0–60m	$969	$1,083	32.5
Production O&M (structure)	60–200m	$969	$1,083	27.9
Production O&M (structure)	200–400m	$4,249	$4,748	25.0
Production O&M (structure)	400–800m	$4,249	$4,748	25.0
Production O&M (structure)	200–800m	$4,249	$4,748	25.0
Production O&M (structure)	800–1,600m	$10,548	$11,787	25.0
Production O&M (structure)	1,600–2,400m	$10,548	$11,787	25.0
Production O&M (structure)	2,400+m	$10,548	$11,787	25.0
Production O&M (subseabed)		$4,249	$4,748	25.0
Production O&M (FPSO)		$10,548	$11,787	25.0

Source: Kaplan et al. 2012, Chapter 3 ($2008 costs), Chapter 4 (labor percentages)

A.3 Central GOM Activity Cost Summary

Table 57. CGOM activity cost summary

Activity Function	Water Depth	Cost Per Unit Thousands $2008	Cost Per Unit Thousands $2015	Labor
Geological and geophysical prospecting (G&G)	0–60m	$2,678	$2,992	0.0
G&G	60–200m	$4,427	$4,947	0.0
G&G	200–400m	$5,124	$5,726	0.0
G&G	400–800m	$6,136	$6,856	0.0
G&G	200–800m	$5,630	$6,291	0.0
G&G	800–1,600m	$11,732	$13,110	0.0
G&G	1,600–2,400m	$18,614	$20,800	0.0
G&G	2,400+m	$22,558	$25,207	0.0
Exploratory drilling	0–60m	$12,752	$14,249	19.89
Exploratory drilling	60–200m	$21,079	$23,554	19.89
Exploratory drilling	200–400m	$24,402	$27,267	19.89
Exploratory drilling	400–800m	$29,221	$32,652	19.89
Exploratory drilling	200–800m	$26,812	$29,960	19.89
Exploratory drilling	800–1,600m	$55,867	$62,427	19.89
Exploratory drilling	1,600–2,400m	$88,636	$99,043	19.89
Exploratory drilling	2,400+m	$107,420	$120,033	19.89
Nonproductive development drilling	0–60m	$7,410	$8,280	24.22
Nonproductive development drilling	60–200m	$9,346	$10,443	24.22
Nonproductive development drilling	200–400m	$10,883	$12,161	24.22
Nonproductive development drilling	400–800m	$14,013	$15,658	24.22
Nonproductive development drilling	200–800m	$12,448	$13,910	24.22
Nonproductive development drilling	800–1,600m	$27,697	$30,949	24.22
Nonproductive development drilling	1,600–2,400m	$33,639	$37,589	24.22
Nonproductive development drilling	2,400+m	$37,664	$42,086	24.22
Development drilling and production	0–60m	$7,889	$8,815	23.84
Development drilling and production	60–200m	$9,885	$11,046	23.84
Development drilling and production	200–400m	$11,469	$12,816	23.84
Development drilling and production	400–800m	$14,696	$16,422	23.84
Development drilling and production	200–800m	$13,083	$14,619	23.84
Development drilling and production	800–1,600m	$28,804	$32,186	23.84
Development drilling and production	1,600–2,400m	$34,930	$39,031	23.84
Development drilling and production	2,400+m	$39,080	$43,669	23.84
Platform fabrication and installation	0–60m	$5,758	$6,434	0.0
Platform fabrication and installation	60–200m	$17,102	$19,110	0.0
Platform fabrication and installation	200–400m	$99,024	$110,651	0.0
Platform fabrication and installation	400–800m	$178,823	$199,820	0.0
Platform fabrication and installation	200–800m	$138,924	$155,235	0.0
Platform fabrication and installation	800–1,600m	$360,887	$403,261	0.0
Platform fabrication and installation	1,600–2,400m	$565,679	$632,099	0.0
Platform fabrication and installation	2,400+m	$587,666	$656,668	0.0
Subseabed		$185,757	$207,568	0.0
Floating, production, storage, and offloading (FPSO)		$587,666	$656,668	0.0
Offshore pipeline construction		$2,070	$2,313	0.0
Offshore pipeline operations and maintenance (O&M)		$280	$313	0.0

Activity Function	Water Depth	Cost Per Unit		Labor
Decommission platform (explosives)	0–60m	$1,528	$1,707	0.0
Decommission platform (explosives)	60–200m	$4,445	$4,967	0.0
Decommission platform (explosives)	200–400m	$0	$0	0.0
Decommission platform (explosives)	400–800m	$0	$0	0.0
Decommission platform (explosives)	200–800m	$0	$0	0.0
Decommission platform (explosives)	800–1,600m	$0	$0	0.0
Decommission platform (explosives)	1,600–2,400m	$0	$0	0.0
Decommission platform (explosives)	2,400+m	$0	$0	0.0
Decommission platform (no explosives)	0–60m	$1,757	$1,963	0.0
Decommission platform (no explosives)	60–200m	$5,111	$5,711	0.0
Decommission platform (no explosives)	200–400m	$40,525	$45,283	0.0
Decommission platform (no explosives)	400–800m	$45,198	$50,505	0.0
Decommission platform (no explosives)	200–800m	$42,862	$47,894	0.0
Decommission platform (no explosives)	800–1,600m	$25,133	$28,084	0.0
Decommission platform (no explosives)	1,600–2,400m	$24,973	$27,905	0.0
Decommission platform (no explosives)	2,400+m	$16,692	$18,652	0.0
Offshore gas processing construction		$565,679	$632,099	0.0
Offshore gas processing O&M		$396	$442	0.0
Onshore gas processing construction		$92,800	$103,696	0.0
Onshore gas processing O&M		$360	$402	0.0
Production O&M (structure)	0–60m	$969	$1,083	32.5
Production O&M (structure)	60–200m	$969	$1,083	27.9
Production O&M (structure)	200–400m	$4,249	$4,748	25.0
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Production O&M (structure)	200–800m	$4,249	$4,748	25.0
Production O&M (structure)	800–1,600m	$10,548	$11,787	25.0
Production O&M (structure)	1,600–2,400m	$10,548	$11,787	25.0
Production O&M (structure)	2,400+m	$10,548	$11,787	25.0
Production O&M (subseabed)		$4,249	$4,748	25.0
Production O&M (FPSO)		$10,548	$11,787	25.0

Source: Kaplan et al. 2012, Chapter 3 ($2008 costs), Chapter 4 (labor percentages)

Appendix B Evaluation of Construction Industries for Subsea Installation

The project team investigated several ways to model the installation of umbilicals and other parts of subsea systems. The basic question is whether the activity resembles a construction industry or another type of industry. The discussion is complicated because IMPLAN construction sectors do not map to detailed NAICS industries. Companies identify what they do in their selection of a NAICS code or codes. First, we searched 2007 NAICS codes on the Census website and identified possible candidate industries:

- NAICS 237990: other heavy and civil engineering construction (includes development of marine facilities, underwater trenching, caisson construction, etc.).
- NAICS 237120: oil and gas pipeline and related structures construction.
- NAICS 237110: water and sewer line and related structures construction.
- NAICS 237130: power and communication line and related structures construction.

Corroborating this shortlist, Technip uses NAICS 237110 to classify its Houston, Texas, operation (AtoZdatabases 2014).

Second, we examined the IMPLAN sectors associated with construction operations in search of a sector that correlated to subsea installation activities. The 2007 IMPLAN sector options for new construction are:

- IMPLAN 34—construction of new nonresidential commercial and health care structures.
- IMPLAN 35—construction of new nonresidential manufacturing structures.
- IMPLAN 36—construction of other new nonresidential structures.
- IMPLAN 37—construction of new residential permanent site single- and multi-family structures.
- IMPLAN 38—construction of other new residential structures.

Each corresponds to the two-digit NAICS 23. That is, it is not possible to map more detailed NAICS 23 industries to any one of the IMPLAN construction sectors. We examined the production functions for IMPLAN 35 and IMPLAN 36.

Table 58 lists the five top commodities to IMPLAN 35. Lighting fixtures are the primary commodity, representing 15.2% of the expenditures. This makes the sector less suitable: lighting is important in the function of a land-based manufacturing site, but not in subsea systems installation.

Table 58. Production function components for IMPLAN 35

IMPLAN Commodity	Name	Percent
3260	Lighting fixtures	15.2%
3230	Other general purpose machinery	13.4%
3319	Wholesale trade distribution services	7.8%
3115	Refined petroleum products	6.6%
3369	Architectural, engineering, and related services	6.2%

Source: IMPLAN 2014

Table 59 shows IMPLAN 36's top five commodities. They show that this sector is a better fit for subsea installation than IMPLAN 35, with the "plates and fabricated structural products" as an analog for steel, umbilicals, and oil and gas field equipment manufacturing. What is missing is a sector to reflect the fact that the installation is done by a vessel. As a result of this investigation, we decided to model the waterborne aspects of subsea system and umbilical installation.

Table 59. Production function components for IMPLAN 36

IMPLAN Commodity	Name	Percent
3369	Architectural, engineering, and related services	13.5%
3115	Refined petroleum products	11.0%
3319	Wholesale trade distribution services	4.6%
3186	Plates and fabricated structural products	4.5%
3365	Commercial and industrial machinery and equipment rental and leasing services	3.1%

Source: IMPLAN 2014

Appendix C Industry Sector Profiles for Remaining MAG-PLAN Activities

The following tables contain the activity-to-sector allocations in MAG-PLAN GOM 2016 and the labor percentage for each activity. Columns in yellow are from Saha et al. (2005), and the sector allocations for the remaining activities were developed as part of this project.

Table 60. Activity sector profiles for exploratory and non-productive well drilling

IMPLAN		Exploratory Well Drilling						Nonproductive Well Drilling					
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m
LABOR		**19.9%**	**19.9%**	**19.9%**	**19.9%**	**19.9%**	**19.9%**	**24.2%**	**24.2%**	**24.2%**	**24.2%**	**24.2%**	**24.2%**
NON-LABOR													
Oil and gas extraction	20	2.9%	6.7%	9.4%	11.3%	12.8%	13.9%	3.0%	6.7%	9.5%	11.3%	12.8%	13.9%
Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	26	6.5%	4.4%	3.3%	2.7%	2.4%	2.1%	8.6%	5.8%	4.4%	3.6%	3.1%	2.8%
Drilling oil and gas wells	28	22.0%	26.6%	27.8%	27.7%	27.4%	26.9%	21.8%	27.0%	27.9%	27.8%	27.3%	27.0%
Support activities for oil and gas operations	29	1.6%	1.1%	0.8%	0.7%	0.6%	0.5%	0.2%	0.1%	0.1%	—	—	—
Support activities for other mining	30	—	—	—	—	—	—	0.1%	—	—	—	—	—
Electric power generation, transmission, and distribution	31	0.7%	0.6%	0.5%	0.5%	0.5%	0.5%	0.9%	0.7%	0.7%	0.6%	0.6%	0.6%
Natural gas distribution	32	0.2%	0.3%	0.4%	0.4%	0.4%	0.4%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%
Water, sewage, and other systems	33	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Construction of other new nonresidential structures	36	0.5%	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	—	—	—	—	—
Petroleum refineries	115	1.6%	2.5%	3.0%	3.4%	3.7%	3.9%	1.7%	2.5%	3.1%	3.4%	3.7%	3.9%
Petroleum lubricating oil and grease manufacturing	118	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Alkalies and chlorine manufacturing	123	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Carbon black manufacturing	124	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
All other basic inorganic chemical manufacturing	125	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%
Other basic organic chemical	126	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%

IMPLAN		Exploratory Well Drilling						Nonproductive Well Drilling					
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m
manufacturing													
All other chemical product and preparation manufacturing	141	3.7%	2.7%	2.1%	1.8%	1.6%	1.4%	1.1%	0.9%	0.8%	0.7%	0.7%	0.6%
Other plastics product manufacturing	149	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Cement manufacturing	160	3.0%	2.0%	1.6%	1.3%	1.1%	1.0%	3.0%	2.0%	1.6%	1.3%	1.1%	1.0%
Ground or treated mineral and earth manufacturing	167	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Iron and steel mills and ferroalloy manufacturing	170	4.7%	3.4%	2.7%	2.2%	2.0%	1.8%	9.1%	6.3%	4.9%	4.1%	3.6%	3.2%
Steel product manufacturing from purchased steel	171	7.1%	4.7%	3.6%	3.0%	2.5%	2.2%	14.1%	9.5%	7.2%	5.9%	5.1%	4.4%
Primary smelting and refining of nonferrous metal (except copper and aluminum)	176	0.2%	0.1%	—	—	—	—	0.4%	0.2%	0.2%	0.2%	0.1%	0.1%
Plate work and fabricated structural product manufacturing	186	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Machine shops	195	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Valve and fittings other than plumbing	198	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
Plumbing fixture fitting and trim manufacturing	199	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%
Construction machinery manufacturing	205	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
Mining and oil and gas field machinery manufacturing	206	3.4%	2.5%	2.0%	1.7%	1.6%	1.4%	4.9%	3.5%	2.8%	2.4%	2.1%	1.9%
Pump and pumping equipment manufacturing	226	3.2%	2.4%	1.9%	1.6%	1.5%	1.3%	1.0%	0.9%	0.8%	0.7%	0.7%	0.6%
Air and gas compressor manufacturing	227	2.4%	1.6%	1.2%	1.0%	0.9%	0.8%	0.6%	0.4%	0.3%	0.2%	0.2%	0.2%
Material handling equipment manufacturing	228	—	0.1%	0.1%	0.1%	—	—	0.1%	0.1%	0.1%	0.1%	0.1%	—
Bare printed circuit board	242	—	—	—	—	—	—	0.0%	—	—	—	—	—

IMPLAN		Exploratory Well Drilling						Nonproductive Well Drilling					
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m
manufacturing													
Semiconductor and related device manufacturing	243	—	—	—	—	—	—	0.1%	—	—	—	—	—
Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	244	—	—	—	—	—	—	0.0%	—	—	—	—	—
Electronic connector manufacturing	245	—	—	—	—	—	—	0.0%	—	—	—	—	—
Printed circuit assembly (electronic assembly) manufacturing	246	—	—	—	—	—	—	0.1%	—	—	—	—	—
Other electronic component manufacturing	247	—	—	—	—	—	—	0.0%	—	—	—	—	—
Industrial process variable instruments manufacturing	251	1.0%	0.7%	0.5%	0.4%	0.4%	0.3%	0.1%	—	—	—	—	—
Totalizing fluid meters and counting devices manufacturing	252	0.5%	0.3%	0.3%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Watch, clock, and other measuring and controlling device manufacturing	256	3.1%	2.2%	1.7%	1.5%	1.3%	1.1%	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%
Motor vehicle parts manufacturing	283	0.2%	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.2%
Ship building and repairing	290	0.2%	0.4%	0.6%	0.7%	0.8%	0.8%	0.2%	0.4%	0.6%	0.7%	0.8%	0.8%
Boat building	291	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wholesale trade	319	2.1%	2.3%	2.4%	2.4%	2.5%	2.5%	3.1%	3.0%	2.9%	2.9%	2.8%	2.8%
Air transportation	332	1.0%	2.3%	3.2%	3.8%	4.3%	4.7%	1.0%	2.3%	3.2%	3.8%	4.3%	4.7%
Rail transportation	333	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
Water transportation	334	2.0%	4.6%	6.4%	7.7%	8.6%	9.4%	2.0%	4.6%	6.4%	7.7%	8.6%	9.4%
Truck transportation	335	0.8%	0.7%	0.6%	0.6%	0.5%	0.5%	0.8%	0.7%	0.6%	0.6%	0.6%	0.5%
Pipeline transportation	337	0.2%	0.4%	0.5%	0.6%	0.7%	0.7%	0.2%	0.4%	0.5%	0.6%	0.7%	0.7%
Couriers and messengers	339	—	—	—	0.1%	0.1%	0.1%	—	—	—	0.1%	0.1%	0.1%
Warehousing and storage	340	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Telecommunications	351	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%	0.1%
Data processing, hosting, and	352	—	—	—	—	—	—	0.1%	0.1%	0.1%	—	—	—

IMPLAN		Exploratory Well Drilling						Nonproductive Well Drilling					
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m
related services													
Monetary authorities and depository credit intermediation	354	0.4%	0.5%	0.5%	0.6%	0.6%	0.6%	0.5%	0.6%	0.6%	0.6%	0.6%	0.6%
Nondepository credit intermediation and related activities	355	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
Securities, commodity contracts, investments, and related activities	356	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.5%	0.5%
Insurance carriers	357	0.4%	0.7%	1.0%	1.1%	1.2%	1.3%	0.4%	0.7%	1.0%	1.1%	1.2%	1.3%
Insurance agencies, brokerages, and related activities	358	1.5%	1.0%	0.8%	0.6%	0.5%	0.5%	—	—	—	—	—	—
Real estate	360	0.3%	0.4%	0.4%	0.5%	0.5%	0.5%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%
General and consumer goods rental except video tapes and discs	363	1.7%	1.1%	0.9%	0.7%	0.6%	0.6%	0.5%	0.3%	0.3%	0.2%	0.2%	0.2%
Commercial and industrial machinery and equipment rental and leasing	365	3.4%	2.5%	2.1%	1.8%	1.6%	1.5%	1.2%	1.0%	0.9%	0.9%	0.8%	0.8%
Lessors of nonfinancial intangible assets	366	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Legal services	367	3.6%	2.8%	2.4%	2.1%	2.0%	1.8%	3.6%	2.8%	2.4%	2.1%	2.0%	1.8%
Accounting, tax preparation, bookkeeping, and payroll services	368	—	0.1%	0.2%	0.2%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%
Architectural, engineering, and related services	369	3.1%	2.2%	1.8%	1.5%	1.4%	1.2%	3.2%	2.2%	1.8%	1.5%	1.4%	1.3%
Management, scientific, and technical consulting services	374	1.3%	0.9%	0.8%	0.7%	0.6%	0.6%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%
Scientific research and development services	376	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Advertising and related services	377	0.4%	0.6%	0.8%	0.8%	0.9%	0.9%	0.4%	0.6%	0.8%	0.9%	0.9%	1.0%
All other miscellaneous professional, scientific, and	380	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%

IMPLAN		Exploratory Well Drilling						Nonproductive Well Drilling					
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m
technical services													
Management of companies and enterprises	381	3.6%	4.4%	4.6%	4.6%	4.6%	4.5%	3.9%	4.6%	4.7%	4.7%	4.7%	4.6%
Other support services	389	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	0.1%	0.1%	0.1%	0.1%	0.1%
Waste management and remediation services	390	0.2%	0.1%	0.1%	—	—	—	—	—	—	—	—	—
Fitness and recreational sports centers	407	0.3%	0.3%	0.4%	0.4%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.3%	0.3%
Food services and drinking places	413	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Electronic and precision equipment repair and maintenance	416	—	—	—	—	—	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Commercial and industrial machinery and equipment repair and maintenance	417	—	—	—	—	—	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Personal and household goods repair and maintenance	418	—	0.1%	0.1%	0.1%	0.1%	0.2%	—	0.1%	0.1%	0.1%	0.2%	0.2%
Other state and local government enterprises	432	0.1%	0.1%	—	—	—	—	0.3%	0.2%	0.2%	0.1%	0.1%	—
*Not an industry (noncomparable imports)	436	0.5%	0.9%	1.1%	1.3%	1.4%	1.5%	0.5%	0.9%	1.1%	1.3%	1.4%	1.5%
Total Non-labor		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Saha et al. 2005 for data in yellow columns; otherwise Chapter 3 of this report

Table 61. Activity sector profiles for development well drilling, G&G, subsea, FPSO, onshore and offshore gas processing, and pipeline

IMPLAN											
Sector Name	Code	Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
LABOR		**23.8%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
NON-LABOR											
Oil and gas extraction	20	—	—	—	—	5.3%	35.9%	1.1%	16.8%	1.1%	2.1%
Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying	26	5.0%	—	—	—	5.0%	—	4.7%	—	4.7%	—
Drilling oil and gas wells	28	24.4%	—	—	—	—	—	—	—	—	—
Support activities for oil and gas operations	29	5.0%	—	—	—	—	5.1%	—	10.9%	—	3.8%
Electric power generation, transmission, and distribution	31	0.3%	0.1%	0.0%	—	0.5%	0.7%	0.6%	1.6%	0.6%	0.3%
Natural gas distribution	32	0.2%	—	—	—	0.2%	6.2%	0.1%	—	0.1%	—
Water, sewage, and other systems	33	—	0.1%	0.0%	—	—	—	—	—	—	—
Construction of other new nonresidential structures	36	—	—	—	—	10.7%	—	16.1%	—	16.1%	—
Maintenance and repair construction of nonresidential maintenance and repair	39	—	0.1%	0.0%	—	0.1%	0.9%	0.2%	0.8%	0.2%	1.2%
Paperboard container manufacturing	107	—	—	—	—	0.2%	0.1%	—	—	—	—
Printing	113	—	—	—	—	—	—	—	—	—	0.1%
Petroleum refineries	115	0.9%	14.1%	5.1%	—	1.1%	2.3%	4.1%	3.3%	4.1%	1.2%
Petroleum lubricating oil and grease manufacturing	118	0.3%	—	—	—	—	—	—	—	—	—
Petrochemical manufacturing	120	—	—	—	—	—	0.2%	—	0.1%	—	—
Other basic organic chemical manufacturing	126	0.3%	—	—	—	—	—	—	—	—	—
Paint and coating manufacturing	136	—	—	—	—	—	—	—	1.7%	—	—
All other chemical product and preparation manufacturing	141	0.3%	—	—	—	—	—	—	0.1%	—	—
Other plastics product manufacturing	149	0.1%	—	—	—	0.2%	0.2%	0.2%	0.1%	0.2%	—
Other rubber product manufacturing	152	0.9%	—	—	—	0.1%	—	—	—	—	—
Cement manufacturing	160	5.0%	—	—	—	5.0%	—	4.8%	0.1%	4.8%	—
Ready-mix concrete manufacturing	161	—	—	—	—	—	—	0.1%	—	0.1%	—
Concrete pipe, brick, and block manufacturing	162	—	—	—	—	—	—	0.8%	—	0.8%	—
Other concrete product manufacturing	163	—	—	—	—	—	—	1.5%	—	1.5%	—
Ground or treated mineral and earth manufacturing	167	0.2%	—	—	—	—	—	—	—	—	—

IMPLAN											
Sector Name	Code	Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
Miscellaneous nonmetallic mineral products	169	—	—	—	—	—	—	0.2%	—	0.2%	—
Iron and steel mills and ferroalloy manufacturing	170	3.8%	—	17.1%	—	4.8%	0.4%	9.6%	0.2%	9.6%	—
Steel product manufacturing from purchased steel	171	6.7%	—	17.1%	—	22.1%	—	11.3%	—	11.3%	—
Primary smelting and refining of nonferrous metal (except copper and aluminum)	176	0.1%	—	—	—	0.2%	—	0.3%	—	0.3%	—
Copper rolling, drawing, extruding and alloying	177	—	—	—	—	—	—	0.3%	—	0.3%	—
Ferrous metal foundries	179	0.2%	—	—	—	0.8%	0.3%	0.2%	—	0.2%	—
Nonferrous metal foundries	180	—	—	—	—	0.4%	0.2%	—	—	—	—
All other forging, stamping, and sintering	181	—	—	—	—	0.1%	—	—	—	—	—
Plate work and fabricated structural product manufacturing	186	0.2%	—	3.0%	—	0.7%	0.4%	0.6%	0.1%	0.6%	—
Metal tank (heavy gauge) manufacturing	189	—	—	—	—	—	—	0.8%	—	0.8%	—
Spring and wire product manufacturing	194	—	—	—	—	—	—	—	—	—	—
Machine shops	195	0.2%	—	—	—	0.4%	0.2%	0.2%	0.2%	0.2%	—
Turned product and screw, nut, and bolt manufacturing	196	—	—	—	—	0.2%	0.1%	—	—	—	—
Coating, engraving, heat treating and allied activities	197	—	—	—	—	—	—	—	—	—	—
Valve and fittings other than plumbing	198	0.4%	—	—	—	2.0%	0.3%	1.3%	0.1%	1.3%	—
Plumbing fixture fitting and trim manufacturing	199	0.1%	—	—	—	0.4%	0.0%	0.2%	0.0%	0.2%	—
Ball and roller bearing manufacturing	200	—	—	—	—	0.1%	—	—	—	—	—
Fabricated pipe and pipe fitting manufacturing	201	—	—	—	—	2.0%	—	8.7%	—	8.7%	—
Other fabricated metal manufacturing	202	0.1%	—	—	—	—	—	—	—	—	—
Construction machinery manufacturing	205	0.5%	—	—	—	2.0%	0.2%	—	0.1%	—	—
Mining and oil and gas field machinery manufacturing	206	3.6%	—	9.6%	17.1%	—	—	5.7%	0.1%	5.7%	—
Other engine equipment manufacturing	225	—	—	—	—	0.3%	0.2%	—	—	—	—
Pump and pumping equipment manufacturing	226	5.5%	—	—	—	2.0%	0.2%	—	0.6%	—	1.8%
Air and gas compressor manufacturing	227	—	—	—	5.3%	8.7%	3.8%	—	8.1%	—	1.4%
Fluid power process machinery	233	—	—	—	—	0.3%	0.1%	—	—	—	—
Other communications equipment manufacturing	239	—	—	—	—	1.0%	—	1.1%	—	1.1%	1.7%
Bare printed circuit board manufacturing	242	—	—	—	—	0.0%	0.0%	0.0%	—	0.0%	—
Semiconductor and related device manufacturing	243	—	—	—	—	0.2%	—	0.2%	—	0.2%	—

IMPLAN											
Sector Name	Code	Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	244	—	—	—	—	0.0%	0.0%	0.0%	—	0.0%	—
Electronic connector manufacturing	245	—	—	—	—	0.0%	0.0%	0.0%	—	0.0%	—
Printed circuit assembly (electronic assembly) manufacturing	246	—	—	—	—	0.1%	0.1%	0.1%	—	0.1%	—
Other electronic component manufacturing	247	—	—	—	—	0.1%	0.0%	0.0%	—	0.0%	—
Search, detection, and navigation instruments manufacturing	249	2.0%	—	—	—	—	—	—	—	—	5.1%
Watch, clock, and other measuring and controlling device manufacturing	256	0.2%	8.3%	—	—	—	—	—	—	—	—
Lighting fixture manufacturing	260	—	—	—	—	—	—	0.1%	—	0.1%	—
Motor and generator manufacturing	267	—	—	—	3.9%	1.0%	0.5%	—	—	—	—
Relay and industrial control manufacturing	269	—	—	—	—	0.2%	—	—	—	—	—
Communication and energy wire and cable manufacturing	272	—	—	—	—	—	—	0.1%	—	0.1%	—
Wiring device manufacturing	273	—	—	9.9%	—	—	—	—	—	—	—
Motor vehicle parts manufacturing	283	0.2%	—	—	—	—	0.2%	0.2%	0.1%	0.2%	—
Aircraft manufacturing	284	—	—	—	—	—	—	—	0.2%	—	—
Aircraft engine and engine parts manufacturing	285	—	—	—	—	—	—	—	0.3%	—	—
Other aircraft parts and auxiliary equipment manufacturing	286	1.0%	—	—	—	—	—	—	1.2%	—	—
Ship building and repairing	290	0.5%	40.8%	14.8%	—	—	0.1%	—	0.8%	—	0.6%
Boat building	291	0.0%	—	—	—	0.0%	0.0%	0.0%	0.0%	0.0%	—
All other transportation equipment manufacturing	294	—	—	—	—	—	—	1.1%	—	1.1%	—
Institutional furniture manufacturing	299	—	—	—	—	—	—	1.1%	—	1.1%	—
Gasket, packing, and sealing device manufacturing	315	—	—	—	—	0.2%	—	—	—	—	—
Wholesale trade	319	2.4%	—	—	—	3.1%	1.3%	3.5%	0.8%	3.5%	0.8%
Retail—motor vehicle and parts	320	—	—	—	—	—	—	0.1%	—	0.1%	—
Retail—health and personal care	325	—	—	—	—	—	0.3%	—	0.3%	—	0.7%
Retail—sporting goods, hobby, book and music	328	—	—	—	—	—	0.1%	—	0.1%	—	0.3%
Retail—miscellaneous	330	—	—	—	—	—	0.1%	—	0.1%	—	0.2%

IMPLAN											
Sector Name	Code	Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
Retail—nonstore	331	—	—	—	—	—	0.2%	—	0.2%	—	0.6%
Air transportation	332	5.4%	—	—	—	0.2%	0.2%	0.4%	8.3%	0.4%	2.0%
Rail transportation	333	0.1%	—	—	—	2.1%	2.0%	0.2%	—	0.2%	—
Water transportation	334	5.7%	9.9%	3.6%	—	—	—	0.9%	10.8%	0.9%	10.6%
Truck transportation	335	0.5%	—	—	—	2.4%	2.2%	2.5%	0.2%	2.5%	—
Pipeline transportation	337	—	—	—	—	0.3%	3.5%	—	0.1%	—	0.1%
Scenic and sightseeing transportation and support activities for transportation	338	—	4.2%	11.7%	—	—	—	—	—	—	—
Couriers and messengers	339	—	—	—	—	—	0.1%	0.1%	0.1%	0.1%	0.3%
Warehousing and storage	340	0.3%	—	—	—	0.1%	0.1%	—	0.2%	—	0.1%
Software publishers	345	—	0.2%	0.1%	—	—	—	—	—	—	—
Internet publishing and broadcasting	350	0.1%	—	—	—	—	0.1%	—	0.1%	—	0.1%
Telecommunications	351	1.6%	0.3%	0.1%	—	0.3%	0.5%	0.4%	0.4%	0.4%	0.8%
Data processing, hosting, and related services	352	0.1%	—	—	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Other information services	353	0.1%	—	—	—	—	0.1%	—	0.0%	—	0.1%
Monetary authorities and depository credit intermediation	354	0.5%	—	—	—	0.4%	0.5%	0.5%	0.4%	0.5%	0.6%
Nondepository credit intermediation and related activities	355	0.2%	—	—	—	0.2%	0.4%	0.2%	0.5%	0.2%	0.4%
Securities, commodity contracts, investments, and related activities	356	0.5%	—	—	—	0.2%	0.2%	0.3%	0.2%	0.3%	0.2%
Insurance carriers	357	0.8%	1.6%	0.6%	2.1%	—	0.3%	0.8%	1.4%	0.8%	2.4%
Real estate	360	0.5%	0.9%	0.3%	—	0.7%	0.8%	0.6%	0.8%	0.6%	1.9%
Automotive equipment rental and leasing	362	—	—	—	—	—	0.1%	0.2%	—	0.2%	0.1%
General and consumer goods rental except video tapes and discs	363	—	—	—	—	—	0.2%	—	0.2%	—	0.3%
Commercial and industrial machinery and equipment rental and leasing	365	0.4%	3.3%	1.2%	—	—	0.6%	1.0%	0.8%	1.0%	0.8%
Lessors of nonfinancial intangible assets	366	0.1%	—	—	—	0.2%	5.6%	0.2%	3.7%	0.2%	0.2%
Legal services	367	0.7%	—	—	—	0.1%	0.9%	0.1%	0.9%	0.1%	4.6%

IMPLAN											
Sector Name	Code	Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
Accounting, tax preparation, bookkeeping, and payroll services	368	0.2%	—	—	—	—	0.2%	0.1%	0.3%	0.1%	0.5%
Architectural, engineering, and related services	369	4.0%	9.9%	3.6%	10.5%	7.8%	7.8%	6.3%	5.2%	6.3%	39.3%
Specialized design services	370	—	—	—	—	—	0.3%	—	0.2%	—	0.4%
Custom computer programming services	371	—	—	—	—	—	0.7%	—	0.5%	—	0.3%
Computer systems design services	372	—	—	—	—	—	—	—	0.2%	—	0.1%
Other computer related services, including facilities management	373	—	—	—	—	—	—	—	0.1%	—	0.1%
Management, scientific, and technical consulting services	374	0.2%	—	—	—	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%
Environmental and other technical consulting services	375	0.1%	—	—	—	0.2%	0.2%	0.1%	0.1%	0.1%	0.8%
Scientific research and development services	376	0.2%	—	—	—	—	0.2%	—	0.1%	—	—
Advertising and related services	377	0.7%	3.2%	1.1%	—	0.3%	0.7%	0.2%	1.1%	0.2%	1.3%
All other miscellaneous professional, scientific, and technical services	380	0.1%	—	—	—	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%
Management of companies and enterprises	381	4.1%	—	—	—	1.1%	1.4%	0.8%	2.1%	0.8%	1.3%
Employment services	382	0.2%	—	—	—	0.3%	0.6%	0.3%	0.3%	0.3%	1.4%
Office administrative services	384	—	—	—	—	0.1%	0.2%	0.1%	—	0.1%	0.5%
Business support services	386	—	—	—	—	—	6.5%	—	6.4%	—	0.5%
Investigation and security services	387	—	—	—	—	—	—	—	—	—	0.1%
Services to buildings and dwellings	388	—	—	—	—	—	0.2%	—	0.2%	—	0.4%
Other support services	389	0.1%	—	—	—	0.1%	0.2%	—	1.1%	—	1.0%
Junior colleges, colleges, universities, and professional schools	392	—	—	—	—	—	—	—	—	—	0.2%
Fitness and recreational sports centers	407	0.3%	—	—	—	—	—	—	—	—	—
Hotels and motels, including casino hotels	411	—	—	—	—	—	—	—	—	—	0.2%
Food services and drinking places	413	0.1%	2.0%	0.7%	—	0.2%	0.2%	0.2%	0.9%	0.2%	0.6%
Automotive repair and maintenance, except car washes	414	—	—	—	—	—	—	0.1%	—	0.1%	—
Electronic and precision equipment repair and maintenance	416	—	—	—	—	—	—	0.2%	—	0.2%	—

IMPLAN		Development Well Drilling	G&G (3D)	Subsea	FPSO	Onshore Gas Processing Facility	Onshore Gas O&M	Offshore Gas Processing Facility	Offshore Gas O&M	Pipeline	Pipeline O&M
Sector Name	**Code**										
Commercial and industrial machinery and equipment repair and maintenance	417	—	1.1%	0.4%	—	0.1%	—	0.5%	—	0.5%	—
Personal and household goods repair and maintenance	418	0.1%	—	—	—	—	—	0.1%	0.1%	0.1%	0.2%
Postal service	427	—	—	—	—	—	0.2%	—	—	—	0.4%
Other federal government enterprises	429	—	—	—	—	—	—	—	—	—	—
Other state and local government enterprises	432	0.2%	—	—	—	0.4%	0.2%	0.4%	—	0.4%	—
*Not an industry (noncomparable imports)	436	1.1%	—	—	61.1%	—	0.1%	0.2%	2.2%	0.2%	2.3%
Total non-labor		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Saha et al. 2005 for data in yellow columns; otherwise Chapter 3 of this report

Table 62. Activity sector profiles for platform installation, platform removal (decommissioning), and production O&M

IMPLAN			Platform Installation					Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–200m	0–200m	200+m	0–60m	60–200m	200+m
LABOR		**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**32.5%**	**27.9%**	**25.0%**
NON-LABOR													
Oil and gas extraction	20	3.8%	6.2%	7.4%	8.0%	8.5%	8.9%	—	—	—	—	—	—
Support activities for oil and gas operations	29	—	—	—	—	—	—	11.0%	16.1%	13.6%	19.7%	31.7%	36.0%
Electric power generation, transmission, and distribution	31	0.6%	0.7%	0.7%	0.8%	0.8%	0.8%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%
Natural gas distribution	32	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Water, sewage, and other systems	33	—	—	—	—	—	—	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Maintenance and repair construction of nonresidential maintenance and repair	39	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	9.3%	7.4%	7.5%	0.0%	0.0%	0.0%
Paperboard container manufacturing	107	0.1%	0.1%	0.1%	—	—	—	—	—	—	—	—	—
Printing	113	—	—	—	—	—	—	—	—	—	—	—	—
Petroleum refineries	115	0.8%	1.2%	1.5%	1.6%	1.7%	1.7%	6.2%	5.8%	8.0%	6.2%	4.9%	3.8%
Alkalies and chlorine manufacturing	123	—	—	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Carbon black manufacturing	124	—	—	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
All other basic inorganic chemical manufacturing	125	—	—	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Paint and coating manufacturing	136	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Adhesive manufacturing	137	0.3%	0.6%	0.7%	0.7%	0.8%	0.8%	—	—	—	—	—	—
Soap and cleaning compound manufacturing	138	0.4%	0.7%	0.9%	0.9%	1.0%	1.0%	—	—	—	—	—	—
Other plastics product manufacturing	149	0.1%	0.1%	—	—	—	—	—	—	—	—	—	—

IMPLAN		Platform Installation						Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–200m	0–200m	200+m	0–60m	60–200m	200+m
Abrasive product manufacturing	165	0.2%	0.3%	0.3%	0.4%	0.4%	0.4%	—	—	—	—	—	—
Iron and steel mills and ferroalloy manufacturing	170	5.6%	5.3%	5.0%	4.8%	4.6%	4.5%	—	—	—	—	—	—
Steel product manufacturing from purchased steel	171	23.7%	20.5%	17.9%	16.2%	15.0%	14.0%	—	—	—	—	—	—
Aluminum product manufacturing from purchased aluminum	174	—	—	—	—	—	0.1%	—	—	—	—	—	—
Primary smelting and refining of nonferrous metal (except copper and aluminum)	176	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Ferrous metal foundries	179	0.4%	0.3%	0.3%	0.3%	0.3%	0.2%	—	—	—	—	—	—
Nonferrous metal foundries	180	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Plate work and fabricated structural product manufacturing	186	0.9%	1.2%	1.3%	1.3%	1.4%	1.4%	—	—	—	—	—	—
Machine shops	195	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Turned product and screw, nut, and bolt manufacturing	196	0.7%	1.0%	1.2%	1.3%	1.3%	1.4%	—	—	—	—	—	—
Coating, engraving, heat treating and allied activities	197	0.7%	1.1%	1.3%	1.4%	1.4%	1.5%	—	—	—	—	—	—
Valve and fittings other than plumbing	198	3.7%	2.0%	1.4%	1.2%	1.1%	1.0%	—	—	—	—	—	—
Plumbing fixture fitting and trim manufacturing	199	0.7%	0.4%	0.3%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Fabricated pipe and pipe fitting manufacturing	201	2.1%	1.9%	1.6%	1.5%	1.4%	1.3%	—	—	—	—	—	—
Construction machinery manufacturing	205	—	0.1%	0.1%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Mining and oil and gas field machinery manufacturing	206	6.0%	2.8%	1.8%	1.3%	1.1%	0.9%	—	—	—	4.6%	3.7%	3.5%

IMPLAN		Platform Installation						Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–200m	0–200m	200+m	0–60m	60–200m	200+m
Other industrial machinery manufacturing	207	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Air purification and ventilation equipment manufacturing	214	0.1%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Air conditioning, refrigeration, and warm air heating equipment manufacturing	216	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Cutting tool and machine tool accessory manufacturing	220	—	—	—	—	—	—	3.6%	3.4%	4.7%	—	—	—
Speed changer, industrial high-speed drive, and gear manufacturing	223	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Mechanical power transmission equipment manufacturing	224	0.2%	0.3%	0.4%	0.4%	0.4%	0.4%	—	—	—	—	—	—
Other engine equipment manufacturing	225	0.4%	0.5%	0.6%	0.6%	0.6%	0.7%	—	—	—	—	—	—
Pump and pumping equipment manufacturing	226	6.2%	3.0%	1.9%	1.5%	1.2%	1.0%	—	—	—	—	—	—
Air and gas compressor manufacturing	227	4.1%	3.5%	3.1%	2.8%	2.6%	2.4%	—	—	—	—	—	—
Other general purpose machinery manufacturing	230	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Industrial process furnace and oven manufacturing	232	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Fluid power process machinery	233	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Broadcast and wireless communications equipment	238	—	0.1%	0.1%	0.1%	0.1%	0.2%	—	—	—	—	—	—

IMPLAN		Platform Installation						Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–200m	0–200m	200+m	0–60m	60–200m	200+m
Bare printed circuit board manufacturing	242	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Semiconductor and related device manufacturing	243	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Electronic capacitor, resistor, coil, transformer, and other inductor manufacturing	244	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Electronic connector manufacturing	245	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Printed circuit assembly (electronic assembly) manufacturing	246	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Other electronic component manufacturing	247	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Electricity and signal testing instruments manufacturing	253	—	0.0%	0.0%	0.0%	0.0%	0.0%	—	—	—	—	—	—
Motor and generator manufacturing	267	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	—	—	—	—	—	—
Relay and industrial control manufacturing	269	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Heavy duty truck manufacturing	278	4.0%	1.9%	1.2%	0.9%	0.7%	0.6%	—	—	—	—	—	—
Motor vehicle parts manufacturing	283	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Ship building and repairing	290	10.6%	14.9%	17.2%	18.7%	19.5%	20.1%	17.8%	16.6%	23.0%	18.0%	14.3%	11.1%
Boat building	291	0.0%	0.0%	—	—	—	—	—	—	—	—	—	—
All other transportation equipment manufacturing	294	—	—	—	—	0.1%	0.1%	—	—	—	—	—	—
Institutional furniture manufacturing	299	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Surgical appliance and supplies manufacturing	306	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—

IMPLAN		Platform Installation						Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+ m	0–200m	0–200m	200+m	0–60m	60–200m	200+ m
Wholesale trade	319	2.9%	3.2%	3.3%	3.3%	3.3%	3.3%	—	—	—	—	—	—
Air transportation	332	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.2%	0.0%	34.3%	27.3%	21.1%
Rail transportation	333	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Water transportation	334	5.8%	9.3%	11.1%	12.2%	12.9%	13.4%	4.3%	4.1%	5.6%	4.4%	3.5%	2.7%
Truck transportation	335	0.6%	0.7%	0.7%	0.7%	0.7%	0.7%	—	—	—	—	—	—
Pipeline transportation	337	0.2%	0.3%	0.4%	0.4%	0.4%	0.4%	—	—	—	—	—	—
Scenic and sightseeing transportation and support activities for transportation	338	—	—	—	—	—	—	21.4%	19.5%	18.2%	1.8%	1.5%	1.1%
Couriers and messengers	339	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Warehousing and storage	340	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Software publishers	345	—	—	—	—	—	—	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%
Telecommunications	351	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.3%	0.5%	0.7%	0.8%	0.8%
Data processing, hosting, and related services	352	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Monetary authorities and depository credit intermediation	354	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	—	—	—	—	—	—
Nondepository credit intermediation and related activities	355	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Securities, commodity contracts, investments, and related activities	356	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Insurance carriers	357	—	—	0.1%	0.1%	0.1%	0.1%	0.7%	0.7%	0.9%	4.1%	7.3%	15.9%
Real estate	360	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.3%	0.5%	0.4%	0.3%	0.2%
Automotive equipment rental and leasing	362	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Commercial and industrial machinery and equipment rental and leasing	365	—	—	—	—	—	—	1.4%	1.3%	1.8%	1.4%	1.1%	0.9%

IMPLAN		Platform Installation						Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	Code	0–60m	60–200m	200–800m	800–1600m	1600–2400m	2400+m	0–200m	0–200m	200+m	0–60m	60–200m	200+m
Lessors of nonfinancial intangible assets	366	0.5%	0.7%	0.8%	0.9%	0.9%	1.0%	—	—	—	—	—	—
Legal services	367	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Accounting, tax preparation, bookkeeping, and payroll services	368	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Architectural, engineering, and related services	369	5.2%	4.6%	4.1%	3.8%	3.5%	3.4%	4.4%	4.1%	5.6%	—	—	—
Computer systems design services	372	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Management, scientific, and technical consulting services	374	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Environmental and other technical consulting services	375	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.7%	0.0%	0.0%	—	—	—
Scientific research and development services	376	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Advertising and related services	377	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	1.4%	1.3%	1.8%	1.4%	1.1%	0.9%
All other miscellaneous professional, scientific, and technical services	380	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	—	—	—	—	—	—
Management of companies and enterprises	381	1.3%	1.5%	1.6%	1.7%	1.7%	1.8%	—	—	—	—	—	—
Employment services	382	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Office administrative services	384	—	—	—	—	—	—	—	—	—	—	—	—
Other support services	389	—	—	—	—	—	—	15.4%	17.5%	6.7%	—	—	—
Waste management and remediation services	390	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Hotels and motels, including casino hotels	411	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Food services and drinking places	413	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.9%	0.8%	1.1%	2.2%	1.9%	1.6%

IMPLAN			Platform Installation					Platform Removed with Explosives			Production O&M		
								Yes	No				
Sector Name	**Code**	**0–60m**	**60–200m**	**200–800m**	**800–1600m**	**1600–2400m**	**2400+m**	**0–200m**	**0–200m**	**200+m**	**0–60m**	**60–200m**	**200+m**
Electronic and precision equipment repair and maintenance	416	—	0.1%	0.1%	0.1%	0.1%	0.1%	—	—	—	—	—	—
Commercial and industrial machinery and equipment repair and maintenance	417	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.5%	0.4%	0.6%	0.5%	0.4%	0.3%
Other state and local government enterprises	432	0.3%	0.3%	0.3%	0.2%	0.2%	0.2%	—	—	—	—	—	—
Total non-labor		**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Saha et al. 2005 for data in yellow columns; otherwise Chapter 3 of this report

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.