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Subtask 8.3
Evaluation of Workforce Training in the Tuscaloosa Marine Shale Region

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Disclaimer

Executive Summary

The demand for the hydraulic fracturing industry workforce follows the price of oil and gas. As the price of oil has plummeted (because of Covid-19) while preparing this report, so did the oil and gas labor force. This change highlights the cyclical nature of the industry and the challenges for workforce training programs geared toward the industry.

Distressed rural regions with shale reserves, such as the Tuscaloosa Marine Shale (TMS) region of Louisiana and Mississippi, want to leverage hydraulic fracturing to create employment, increase community wealth, and improve the tax base. The specialized expertise of the industry, coupled with its cyclical nature, makes much of its workforce migratory. In turn, workforce training programs need to be flexible and develop transferable skills. Training programs need to focus on the more diversified supply chain industries and not just oil and gas extraction.

The inventory and interviews of existing workforce training programs in the TMS region found that by reaching out to adjacent communities, the region has a significant workforce training capacity. Within the region, Southwest Mississippi Community College has the Oil and Gas Production Technology and a Well Construction program. Nearby there are five (5) more industry-specific oil and gas associate programs. There are three (3) petroleum engineering programs in Louisiana and Mississippi. Both states have strong community college systems that offer the general and specific skills needed by the industry.

Benchmarking against more developed shale regions found the broader TMS region had competitive training programs following similar curriculums. These programs include important skills such as safety, which applies to many industries. Best practices included close ties with industry and cross-cutting knowledge areas and skills (e.g., mechanical, operation monitoring, management, etc.). Where the TMS region, with a 50% black, 47% white, and around 2% Hispanic population, could standout is to promote diversity in the industry, which is 78% white and 73% male.

The skills competency model and skills transferability matrix identified construction as a closely aligned industry. Important knowledge needed includes mathematics and engineering technology; skills needs include operation control, critical thinking, quality control, and monitoring. Ability needs include perceptual speed, oral comprehension, and problem sensitivity. All these skills, with further workforce training, can be applied to manufacturing.

Improving local hiring opportunities will be challenging, and workforce training is important. However, improving K-12 education and soft skills will be even more important as those are the foundations of workforce development.

Introduction

Purpose

The purpose of this report is to examine workforce training programs through evaluation of possible, eventual hiring of local workers, when possible, as well as, the training needs to develop transferable skills for cyclical periods. The report covers the Tuscaloosa Marine Shale (TMS) region of Louisiana and Mississippi.

This work was performed for the Tuscaloosa Marine Shale Laboratory under agreement DE-FE0031575 for U.S. Department of Energy National Energy Technology Laboratory as Subtask 8.3 Evaluation of workforce training programs. It is part of Task 8- Evaluation of the Major Needs/Socioeconomics for the Development of TMS.

Subtask 8.3 Evaluation of workforce training programs through evaluation of possible, eventual hiring of local workers, when possible, the training needs to develop transferable skills for cyclical periods. This will be inclusive of but not limited to:

- Inventory and interview existing workforce training programs in the TMS Region;
- Benchmark workforce training programs in other oil and gas regions and identify best practices; and
- Prepare a skills competency model and skills transferability matrix.

Background

Having a skilled workforce is important for the oil and gas industry, but the industry faces traditional as well as new challenges. The work is often physically challenging and dangerous and is often performed by non-resident workers. The boom-and-bust cycle of the industry, driven by changes in gas and oil prices, has always created problems with keeping and retaining talent. The industry now faces additional workforce challenges, including demographics, technology, and globalization.

Shale plays, such as the emerging Tuscaloosa Marine Shale region, have the potential to create a large number of jobs. Non-resident workers will fill a significant number of these jobs. Still, there are opportunities for resident workers to be hired by expanding oil and gas production. The proper educational programs need to be in place to improve the chances of hiring resident workers. These programs need to develop the current skills needed by the oil and gas industry, but also ensure the trainees' skills are transferable.

Method of Investigation

This report utilizes data from web searches, EMSI Labor Market Analytics software, and interviews. Oil and gas industry workforce requirements and training programs for the study region are compared to national and other developed shale regions in Texas and North Dakota.

Information for curriculum related to Petroleum Technology/Technician CIP Code 15.0903 and Well Drilling/Driller CIP Code 46.0504 programs was collected from the institutions.

Area of Investigation

The study region of the Tuscaloosa Marine Shale Region includes the following parishes in Louisiana: East Feliciana Parish, St. Helena Parish, and West Feliciana Parish. And Amite, Wilkinson, and Pike Counties in Mississippi.

About Oil and Gas Industry and Its Workforce

The Global Oil industry, the United Nations Development Program, and the International Finance Corporation partnered to develop a shared understanding of how to make the oil and gas industry part of sustainable development. The joint report, "Mapping the Oil and Gas Industry to the Sustainable Development Goals: An Atlas," declares that the industry needs to invest in workforce education, training, and technical programs which focus on both technical skills and soft skills (e.g., behavior, management, and communication). Companies need to map these skills and work with the government to plan investments in education and targeted training.

However, the oil and gas industry and workforce training programs often are not aligned. A study of the oil and gas industry workforce needs by the RAND Corporation (Bozick, Gonzalez, et al., 2017) found:

- The industry needs employees with work experience (at least 5 years) and long-term on-the-job training.
- They need workers with cross-cutting knowledge areas and skills (e.g., management, critical thinking, etc.).
- The industry does not communicate its needs well to public workforce programs.
- Most employers do not support college workforce development programs.
- Both colleges and employers report a lack of unwillingness and time as key barriers to partnering.

Industry Workforce Challenges

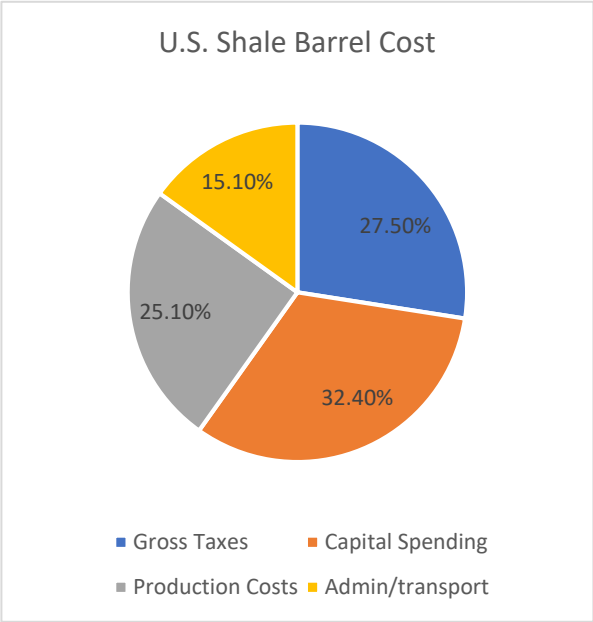
Operating in today's high cost/high-risk environment, the oil and gas industry needs to view education and training as part of its core business (Andrews and Playfoot, 2014). The industry is dependent on the talent and strength of its workforce (Narkhede and Gardas, 2018). As the industry becomes more capital intensive, it expects to need fewer but more educated workers (Jason, 2015). "Attracting and retaining skilled workers will be one of the biggest risks to industry success" (Orr and McVerry, 2007, pg. 18), thus increasing the need for continuing workforce training.

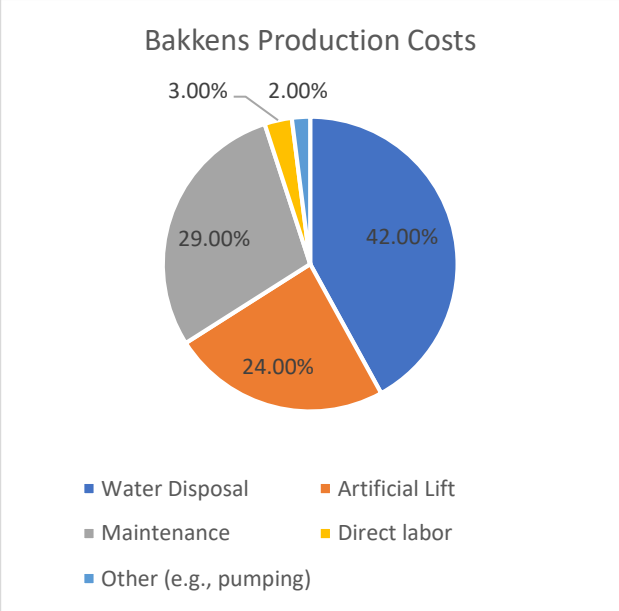
The industry faces severe threats in attracting and retaining talent because of fluctuations in demand from market forces, an aging workforce, a dwindling number of graduates, and a negative image with younger generations. Negative perceptions of the industry are beyond workforce training, companies and energy companies are trying to improve their corporate image (Loveland, Smith, et al., 2019). To address these concerns the oil industry has also become involved with K-12 education to develop oil-and-gas-centric lesson plans (Zou, 2017).

Fluctuating Employment Levels due to Market Forces

Direct labor is a relatively small share of the capital-intensive hydraulic fracturing industry. According to the U.S. Energy Information Administration (2016), the share of direct labor of Bakken lease operating expenses (LOE) is only 3% (see Figure 1). The need for capital led the industry to seek investors who eagerly invested, but now are not seeing the returns they expected (Crowley, 2019). The lack of investor confidence could cause further fluctuations with oil and gas workforce employment while the industry needs to retain the knowledge needed for capital-intensive operations.

Figure 1. Shale Oil Cost Breakdown

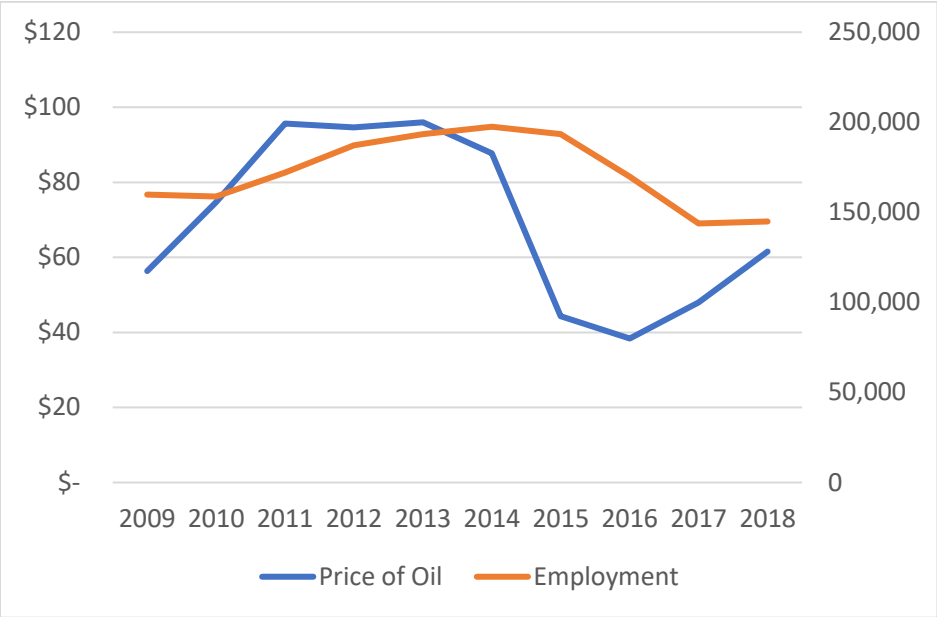




Source: WSJ, 2016; U.S. Energy Information Administration, 2016

Employment in the oil and gas workforce fluctuates depending on the price of oil and gas. According to the U.S. Bureau of Labor Statistics, there were 165,000 employed in US oil and gas extraction in 2009, and this increased to almost 200,000 in 2015 before dropping to around 150,000 in 2019 (see Figure 2). This employment instability makes it difficult for companies to retain knowledge workers and requires programs to help workers transfer their skills to new industries or train new workers when the price of oil goes back up.

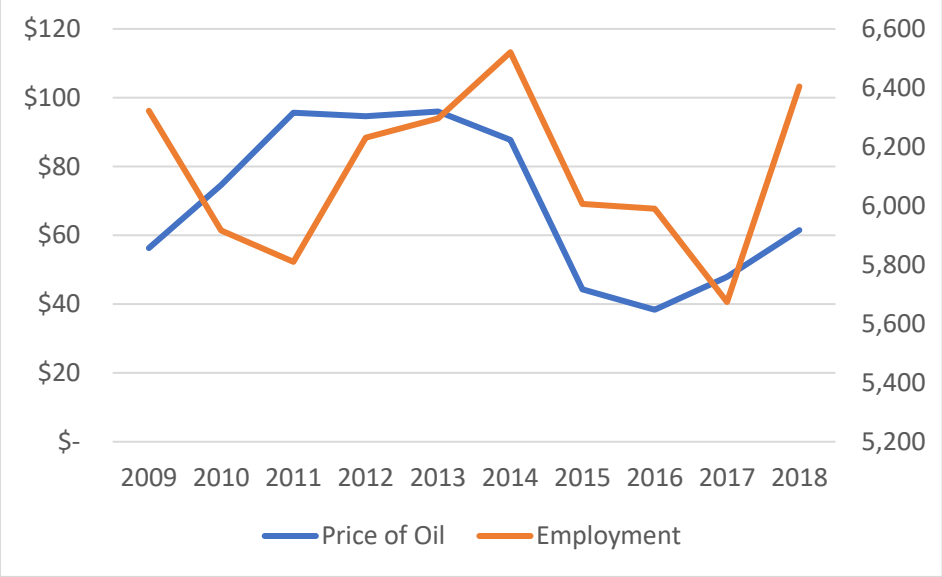
Figure 2. U.S. Oil & Gas Workforce and Price of Oil Per Barrel



Source: Inflationdata.com & EMSI 2019

The TMS has a similar cyclical pattern of employment following a fluctuating oil price (see Figure 3). There has been conventional oil and gas extraction going back to the 1920s but leasing activities for hydraulic fracturing only began in 2008. The first well was dug in the play at the end of 2012, but production dropped off once oil dropped below the breakeven of around $80. The region responded to the need for workers by standing up a Petroleum Production Technology program at Southwest Mississippi Community College.

Figure 3. TMS Oil & Gas Workforce and Price of Oil



Source: Inflationdata.com & EMSI 2019

The Aging Workforce

It is called "the great crew change" as the industry faces the looming retirement of thousands of older workers as the generation of talent hired before the 1986 oil price collapse reaches retirement age. There were few new hires between 1985 and 2000 as successors. The industry is trying to address this loss of knowledge capabilities through several ways, including more reliance on outsourced service providers (Bairi, Murali Manohar, et al. 2013). Like many industries, the oil and gas industry faces the Boomer retirement crisis.

An occupational snapshot of the oil and gas industry for the United States shows that the retirement risk is high (see Table 1). When adding up the percentages of workers within the ages of 45 – 65, 48.3% of workers within the industry are at or near the age of retirement. This growing number of retiring workers brings challenges to companies which search for strategies to retain employees' knowledge while preparing to hire from a competitive selection of new workers (Sumbal, Tsui, See-To, & Barendrecht, 2017).

Table 1. Age Breakdown of Oil and Gas Occupations in the United States

Age	U.S. Population	TMS Workforce	U.S. Workforce	Oil and Gas Industry Jobs	Difference from U.S. Workforce
14 -18	6%	2%	2%	0%	-2%
19 - 24	7%	9%	10%	3%	-8%
25 - 34	14%	20%	22%	23%	1%
35 - 44	13%	22%	21%	26%	5%
45 - 54	**19%**	**21%**	**21%**	**21%**	**0%**
55 - 64	**13%**	**18%**	**17%**	**22%**	**5%**
65 -75	10%	7%	6%	5%	-1%

Source: EMSI 2019

Aging employees take valuable knowledge about the company with them when they leave. Some companies have implemented certain strategies to gather the information and put in files and reports, but this has not sufficed. Industry human resource professionals see the aging workforce as a problem for their industry, with 35% considering it a crisis and 22% a problem in the next 11 to 20 years (SHRM, 2015). The most valuable knowledge that a company loses when an employee retires is who the employee knows (Salvatore et al., 2006) and personal connections, not a taught skill. Situations like these have a substantial economic impact, especially when centrally connected employees are the ones retiring. Companies lose the capacity to quickly train newcomers, making it hard for newcomers to adapt to the work environment (Salvatore et al., 2006). In the oil and gas industry specifically, there is an inconsistency in attempts to retain this knowledge due to falls in oil prices and job layoffs (Sumbal et al., 2017).

Increased Needs for STEM Skills by the Industry

Competencies of today's oil and gas industry are ones that require high amounts of technical training, operation training, and safety training. There is a specific need for workers STEM trained, due to the technological advancement and mathematical needs of the industry. Many STEM educational programs produce workers with educational attainments of a bachelor's degree or higher. A comparison of the TMS regions and four other shale plays in Table 2 shows the differences in educational attainment in the different regions and the need for improved educations.

Table 2. Educational Attainment of Shale Regions

Region	Less Than 9th Grade	9th Grade to 12th Grade	High School Diploma	Some College	Associate Degree	Bachelor's Degree	Graduate Degree and Higher
5 Parish/County TMS Region	3,782 (7.8%)	7,409 (15.2%)	19,352 (39.8%)	8,913 (18.3%)	2,440 (5%)	4,544 (9.3%)	2,199 (4.5%)
28 Parish/County TMS Region	67,698 (5.9%)	114,595 (9.0%)	389,647 (33.8%)	249,927 (21.7%)	66,314 (5.8%)	173,244 (15%)	90,636 (7.9%)
Bakken	4,620 (3.6%)	6,381 (4.9%)	41,346 (31.9%)	30,720 (23.7%)	15,676 (12.1%)	23,481 (18.1%)	7,568 (5.8%)
Eagle Ford	119,063 (13.2%)	88,990 (9.9%)	269,303 (29.9%)	180,712 (20.1%)	60,958 (6.8%)	117,995 (13.1%)	62,379 (6.9%)
Haynesville	19,023 (8.2%)	21,367 (9.3%)	75,192 (32.6%)	58,925 (25.5%)	15,816 (6.9%)	28,313 (12.3%)	12,150 (5.3%)
Marcellus	92,789 (3%)	179,574 (5.9%)	1,174,417 (38.4%)	487,388 (15.9%)	278,894 (9.1%)	518,106 (17%)	324,718 (10.6%)

Source: EMSI 2020

Program Graduate to Industry Needs Mismatch

Several educational programs are providing the specific skills needed by the oil and gas industry, but the timing of the educational completion and the workplace needs are often not aligned. There are two main types of associate-level programs typically provided by community colleges: CIP 15.0903 Petroleum Technology/Technician and CIP 46.0504 Well Drilling/Driller. At the university level, there are CIP 14.2501 Petroleum Engineering programs. Other programs such as CIP Code 14.0802 Geotechnical Engineering supply the industry workforce needs, but also support other industries. The descriptions of these education programs are:

> CIP 15.0903 Petroleum Technology/Technician
> A program that prepares individuals to apply basic engineering principles and technical skills in support of engineers and other professionals engaged in the development and operation of oil and natural gas extraction and processing facilities. Includes instruction in principles of petroleum extraction and related geology, petroleum field mapping and site analysis, testing and sampling methods, instrument calibration, laboratory analysis,

test equipment operation and maintenance, environment and safety monitoring procedures for oil/gas fields and facilities, facility inspection procedures, and report preparation.

CIP 14.2501 Petroleum Engineering
A program that prepares individuals to apply mathematical and scientific principles to the design, development and operational evaluation of systems for locating, extracting, processing and refining crude petroleum and natural gas, including prospecting instruments and equipment, mining and drilling systems, processing and refining systems and facilities, storage facilities, transportation systems, and related environmental and safety systems.

CIP 46.0504 Well Drilling/Driller
A program that prepares individuals to apply technical knowledge and skills to set up, maintains, repair, and operate well-drilling equipment; locate, drill, construct, and develop water, gas, and oil wells; and test and monitor wells to ensure adequate flow. Includes applications to home, business, and industrial uses.

CIP Code 14.0802 Geotechnical Engineering
A program that prepares individuals to apply geotechnical engineering methods, which deal with the analysis, design, and construction of earth and earth supported structures, to the application of environmental problems, such as waste containment, waste disposal, construction of landfills, soil permeation, soil analysis, and soil improvement. Includes instruction in soil mechanics, soil dynamics, soil behavior, waste management, and containment systems, geosynthetics, geochemistry, earth structures, geo-environmental engineering, geotechnical engineering, earthquake engineering, and foundation engineering

The cyclical nature of the oil and gas industry makes it challenging for educational programs to respond. This creates a lag where there continue to be more graduates even while the industry is in decline (see Table 3). This is particularly the case with engineering programs that continue to put out graduates while the industry is shrinking.

Table 3. National Oil and Gas Industry Completions Versus Jobs

Program	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Petroleum Technology/Technician	164	256	321	390	555	676	912	1,196	1,332	1,018	898
Petroleum Technician Jobs (SOC 19-4041)	15,888	14,639	14,638	16,199	16,599	16,023	16,843	16,798	15,363	16,251	16,810
Well Drilling/Driller	8	6	8	125	91	58	54	25	18	26	11

Oil & Gas Drill Operators Jobs (SOC-5012)	28,262	23,209	21,661	23,301	26,150	27,649	27,340	22,425	16,441	16,354	18,675
Petroleum Engineering	814	1,001	1,106	1,463	1,594	1,623	1,980	2,339	2.610	2,747	2,818
Petroleum Engineering Jobs (SOC 17-2171)	24,287	28,016	31,470	34,548	40,223	38,259	37,436	37,282	35,757	37,204	37,578

Source: EMSI Education Pipeline 2019

Literature Review

If oil prices begin to recover from a recent decline and as the oil and gas industry see continued technological advancement, the Tuscaloosa Marine Shale region has the potential to develop into a prominent shale play in Southeast Louisiana and Southwest Mississippi. Fulfilling this potential requires a competent workforce comprised of individuals with the necessary training needed to meet the growing needs of the industry.

This literature review examines the research on oil and gas workforce issues. Researchers studied numerous aspects of the workforce. This report summarizes the research on eight (8) different aspects of the oil and gas workforce and each of these needs is analyzed from a national perspective in preparation for gaining a better perspective of the TMS region.

The issues include:

- Resident versus Non-Resident Worker
- Workplace Safety
- Knowledge Retention
- Education and Training
- Workplace Diversity
- Project Management and Innovation
- Competition and Collaboration
- Impact on Secondary Education

The analysis of the industry workforce needs to lead to questions about the industry – questions of the effectiveness of workforce training programs and how to prepare for the cyclical nature of the oil and gas industry. Conclusions gathered from analyses are that:

- Workers need safer conditions free of injury hazards and hazardous chemicals.
- Diversity is needed to develop the industry and the region.
- More strong oil and gas education programs are needed.
- Address the cyclical nature of employment and transferability to other industry's needs.
- Companies need systems to help retain knowledge and to develop new talent.

Residents vs. Non-Residents in Shale Regions

Many shale plays within the United States, such as the Bakken and Eagle Ford Shale Plays, have experienced population growth and job creation. However, studies indicate most of the job gains are attributable to non-resident workers who temporarily migrate to the region (Wrenn, Kelsey, et al., 2015). Some job creation is attributable to locals hires mostly through induced employment. Non-resident workers in the shale region, specifically the Bakken, account for most of the jobs in oil field development activities such as drilling, hydraulic fracturing, construction, and other specialized construction (Bangsund & Hodur, 2016). The itinerate nature of the industry creates challenges for creating lasting employment for residents.

In recent years, counties where oil and gas are extracted have tried to identify the true impact of shale gas activity on local employment. Researchers have found that data sets used to measure employment can sometimes overestimate employment impacts on residents, mainly in counties where there is high well drilling activity. A study conducted on the Marcellus Shale Play in Pennsylvania has shown that drilling activity has had only a slightly positive impact on employment. This is true for any other shale play in which 90 or more wells were drilled within a given year (Wrenn, Kesley, et al., 2015).

Louisiana and Mississippi had negative net migrations for the year 2016. Only two of the six shale regions listed in Table 4 have positive net migrations. These net migrations, however, are not indicative of the oil and gas industry alone. They consist of migrations associated with all industries in the respective regions. This suggests that there are, possibly, specific times that the non-resident oil and gas workers migrate to shale regions, and there are specific times when they leave. Their time of arrival and residence could be the reason that some shale plays like the Bakken see substantial growth. The question remains, however, when and how long is the growth and is it sustainable.

Table 4. Net Migrations of Shale Plays in 2016

Region	Total Inbound Migrations	Total Outbound Migrations	Net Migration
TMS 5-county/parish region	1,331	1,407	-76
TMS 28-parish/county region	21,817	20,728	1,089
Bakken Shale Play	1,533	2,997	-1,464
Eagle Ford Shale Play	25,401	23,749	1,652
Marcellus Shale Play	26,145	30,888	-4,743
Haynesville Shale Play	3,754	4,242	-488
Louisiana	18,199	22,986	-4,787
Mississippi	11,958	13,605	-1,647

Source: EMSI 2020

Workplace Safety

The oil and gas industry has a hazardous work environment. Workers often work in grueling conditions and with hazardous materials. Concern for workers' safety has become an increasingly present theme in oil and gas conversations, as workers are often exposed to occupational hazards (Chan, 2011) and a hazardous level of chemicals (Witter, Tenney, Clark, Newman, 2014). The oil and gas industry has shown to be one of the most hazardous industries for workers. The data in Table 5 compares the oil and gas industry with other industries within the United States, showing that its injury rate is significantly higher. The need for workplace safety has shown itself to be an occurring theme within the workforce needs of the oil and gas industry.

Hazardous Work Conditions

The oil and gas industry saw a period of exponential growth between the years 2003-2013. While this growth period produced 1.7% of the United States' GDP in 2014 (Raimi, 2019, pg. 153), it also produced hazardous work conditions for workers. During the oil and gas boom, the work-related fatality rate increased by 27.6% (Krystal, Kyla, Ryan, Jennifer, 2015).
Two-thirds of these fatalities have resulted from transportation incidents and contact with different hazardous objects and equipment (Krystal et al., 2015). Highway crashes and workers struck by objects are the most common fatal events (Witter et al., 2014). Aside from hazardous objects and equipment playing a role in work-related deaths, they also create exposure to hazardous materials that create dangerous work conditions. Workforce training can help reduce these numbers.

Table 5. Severe Injury Rates Among Different Industries in the U.S. (2015-16)

Industry	Severe Injuries	Average Annual Employment	Rate per 100,000 Workers
Support activities for oil and gas operations	349	234,403	148.9
Industrial building construction	153	114,591	133.5
Poultry processing	180	139,848	128.7
All other plastics product manufacturing	164	136,387	120.2
Power and communication line and related structures construction	117	102,974	113.6
Commercial and institutional building construction	341	333,071	102.4
Oil and gas pipeline and related structures construction	95	100,181	94.8
Highway, street and bridge construction	267	292,619	91.2

Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	87	123,461	70.5
General freight trucking, local	86	138,932	61.9

Source: Bureau of Labor Statistics 2016

Chemical Exposure

For fracking to work effectively, a variety of chemicals must be mixed with water and sand to break underground shale formations. This mixture is how oil and gas can flow through wells to the surface (Raimi, 2019, pg. 57). Along with producing oil, these wells can emit poisonous gases like hydrogen sulfide (Raimi, 2019, pg. 57) and crystalline silica (Witter et al., 2014). These gases have the possibility of causing headaches, nausea, and death (Raimi, 2019, pg. 57), creating a dangerous environment for workers. Different researchers have found that exposure to respirable crystalline silica exceeds OSHA and NIOSH exposure limits, especially with workers who are involved with drilling (Witter et al., 2014). The overall conditions that oil and gas workers are mandated to work are shown to be dangerous and could potentially affect the talent capacity of the industry.

Knowledge Retention

The oil and gas industry is currently undergoing an issue with talent management and knowledge retention. Many in the oil and gas industry are working to figure out how to retain the knowledge that is leaving with the members of an aging workforce (Bairi, Manohar, & Kundu, 2013). The oil and gas industry is a volatile one. There is a pattern of increase and decrease of oil prices with a slightly correlating rate of employment in the industry. As workers are laid off during a decreased oil price, concerns about how to retain knowledge and develop new talent begin to manifest. Handling this issue is of high importance for the continued success in the field.

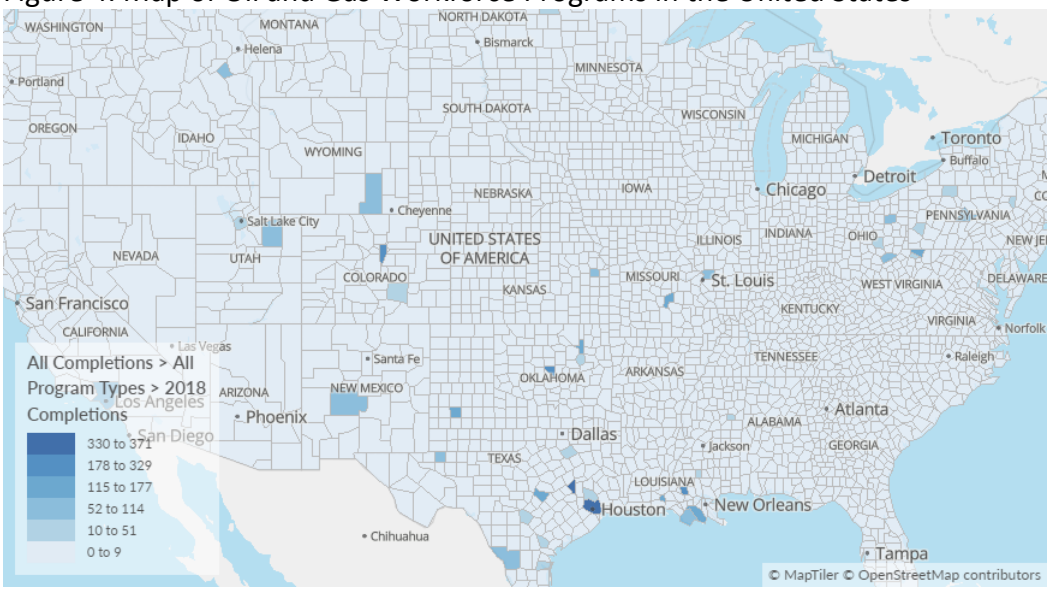
Education & Training

There is a need in the oil and gas industry for workers to be trained and educated to meet the educational requirements of the technological growth of the industry. Competencies of today's oil and gas industry are ones that require high amounts of technical training, operation training, and safety training. The education and training needed to meet the necessary skills competencies of the industry are being taught through workforce programs throughout the United States to adequately prepare workers for the advancing industry. Two of the best performing petroleum engineering programs in the nation happen to be in the Tuscaloosa Marine Shale Region, providing this region close access to some of the best-trained workers for jobs related to hydraulic fracturing.

Education

The need is a specific need of employees trained in STEM. American employers lack a high-volume pool of applicants with the necessary education needs in science, technology, engineering, and mathematics to meet the demand of positions that require this knowledge – positions like mechanists, electricians, auto technicians, and pipefitters (Cascio & Narayan, 2015). Shale gas extraction and energy production open doors to many opportunities to learn how to apply relevant solutions to technology problems. There are several workforce programs located across the United States. The blue areas on the map in Figure 4 show the concentration of these programs in certain states. There are several programs in Texas and Louisiana. The programs in the state of Louisiana lie outside of the TMS region but are proximate.

Figure 4. Map of Oil and Gas Workforce Programs in the United States



Source: EMSI 2019

Training and Competencies

Due to the retirement of a generation before the 1986 oil collapse and a need to recruit personnel with expertise in digital tools, shale operators face an impending skills shortage. To meet these shale operators' needs, workers will need a broader combination of skills than they possess today (Goydan & Webster, 2018). There are three areas of workforce competencies that apply to the oil and gas workforce: knowledge, skill, and attitude. These competencies show what areas workers must be competent to provide value to the industry through their positions. Each area of competency will cover the top five competencies ranked by level of importance from 0-100 for the O-Net Occupation of Petroleum Pump System Operators.

Knowledge

The top five areas of importance in knowledge competencies are mechanical knowledge, education and training knowledge, mathematical knowledge, engineering and technological knowledge, public safety and security knowledge (EMSI 2019). These knowledge requirements tie into the industry's need for STEM training. Workers with this type of knowledge will be in higher demand and possess the intellectual capability to perform their assigned duties.

Skills

Skills competencies for the oil and gas industry determine the need for job training. The top five skills competencies are operation monitoring, operation and control, critical thinking quality control analysis, and monitoring (EMSI 2019). These skills are ones that workforce programs could place more emphasis on when conducting training to be sure that students who complete these programs can well be prepared to do the required operational work that they are required to do.

Abilities

Among the top five ability competencies are perceptual speed, oral comprehension, problem sensitivity, inductive reasoning, and oral expression (EMSI 2019). These competencies pose a need for training in the area of personal development and soft skills. There are two main opportunities where this type of development could occur: workforce training programs and on-the-job training time. Considering that many of the workforce programs are in conjunction with community colleges, there could be greater opportunities to address these skills through academic education.

Workplace Diversity

Diversity is the concept of accepting and valuing individuals of different ages, social classes, races, ethnicities, physical and mental ability, and gender (Green, Lopez, Wysocki, & Kepner, 2008). The application of this concept lacks within the oil and gas industry. The industry is comprised of mainly one ethnic group and one gender. In a time where workplace diversity has proven to have numerous benefits, the oil and gas industry is behind on facilitating diverse work environments. Diversity can increase market opportunities, recruitment, creativity, and business image of a company (Green et al., 2008).

Table 6. Occupation Race/Ethnicity Breakdown of Oil and Gas Occupations in the United States.

Race/Ethnicity	2018 Jobs	2018 Percent
White	111,506	77.50%
Hispanic or Latino	18,269	12.70%
Black or African American	6,075	4.20%

Asian	4,865	3.40%
Two or More Races	1,610	1.10%
American Indian or Alaska Native	1,526	1.10%
Native Hawaiian or Pacific Islander	113	0.10%

Source: EMSI 2019

The racial and ethnic breakdown of the oil and gas extraction industry in the United States is in Table 7. White Americans occupy approximately 77.5% of these jobs. As the oil and gas industry continues to globalize, a more racial/ethnic workforce will be needed. During globalization, there is a potential impact on the workforce by differences in attitudes, beliefs, and culture. Diversity could even be beneficial regarding safety because it would lessen the chances of safety precautions being disregarded due to cross-cultural differences (Mearns, & Yule, 2009).

Table 7. Occupation Gender Breakdown of Oil and Gas Occupation in Louisiana and Mississippi

Gender	2018 Jobs	2018 Percent
Male	105,629	73.40%
Female	38,338	26.60%

Source: EMSI 2019

The oil and gas industry is male dominated. Almost three-quarters of the industry is male (see Table 7). Few women hold executive-level positions in the oil and gas industry. In 2013, 40% of new hires in the oil and gas industry were women, but many left their positions mid-career at major companies (Williams, Kilanski, & Muller, 2014). Studies such as Williams, Kilanski, et al., (2014) present alternative approaches for addressing gender inequality in the oil and gas industry. Workforce training programs need to include women and minorities.

Project Management and Innovation

As technology continues to advance, more opportunities for project management emerge, which is crucial to the success of the industry because it is a data-driven business. Technological advancements also create room for innovation. Whether or not companies pursue innovation in the oil and gas industry is determined by the risks that a company is willing to take. However, there has been a proven need for technological innovation as new oil reserves are found (Palma, Lessard, & Singh, 2014).

Many oil and gas companies are always looking for ways to quickly find oil, to enhance oil production, and to reduce risks. Therefore, they are looking for new technology that can help process high volumes of data than current technology (Feblowitz, 2013). Many companies have considered shifting to cloud computing. However, data being compromised is a concern of some companies, since their data would be stored outside of the company's firewall (Perrons, & Hems, 2013).

Difficult problems that these companies face brings about the question of innovation and how it could solve these problems with unheard-of methods. Many companies, however, see

innovation as costly and dangerous, but some companies think it is worth the risk (Keegan & Turner, 2002). Pushes for innovation in project management is mostly driven by the external environment. Changes in government regulation can affect a company's clientele or productivity and force a company to draw on its resources to find new ways to manage projects (Keegan et al., 2020).

Better project management could help workers in the oil and gas industry perform more efficiently and more safely. Project management continues to develop, but as the United States becomes more technologically advanced, workers need continuous, innovative project management systems to maintain their work efficiency.

Competition and Collaboration

The oil and gas industry is a competitive market as much as it is a lucrative one. Companies that hold competitive advantages tend to outperform companies that do not. Though companies compete, there is also an effort from competitors to collaborate. Collaboration is their way of discovering innovative technology.

A company's competitive advantage mainly comes from its assets. In the case of hydraulic fracturing, those assets could be land acreage, wells, and technology. However, research has proven that bundles of capabilities that solve challenges within the oil and gas industry are the ones that will most likely set a firm apart (Palma et al., 2014). Being set apart is one main reason companies strive towards innovative solutions.

Finding problems to theses solution can be challenging, which is why the Canadian oil and gas industry experimented with the idea of collaboration. Finding innovative solutions cost both time and money. Companies in the Canadian sector realized this and joined efforts to find an innovative solution to common oil and gas-related issues. They establish an industry-level organization to help with the development of innovative technologies. The innovative solutions also help them maneuver high research and development costs, long development cycles, and high technical risks. Their strategic partnering helped them lower costs in the pursuit of new technology and helps to tackle the need for innovation, ultimately helping with the project management and innovation need. Because collaboration also helps lower costs, this could potentially position companies financially to provide more resources for their workers regarding necessary training and education.

Impact on Secondary Education in Shale Communities

A line of research examines how the job opportunities from shale booms impact K-12 education in the local community. Carpenter, Anderson, et al. (2019) concluded drilling increases immigrant high school dropout rates but has insignificant overall effects, while other studies found reductions in high school attainment and enrollment (Cascio and Narayan, 2015; Rickman, Wang, et al. 2017; Zuo, Schieffer, et al. 2019). The earning opportunities appear to influence traditional education decisions, so transferable workforce training is important.

Summary of Literature Review

The totality of the analyses brings several conclusions. Workers need safer conditions that are free of injury hazards and hazardous chemicals. More emphasis on workplace safety from workforce training programs would help accomplish meet this need. Diversity, a practice that composes different types of people, is needed to develop the TMS region by offering more perspectives and insight that could advance the industry.

In analyzing the oil and gas workforce program, it is evident that stronger, more developed oil and gas education programs lie outside of the TMS region. There are, however, some in Louisiana that are nationally ranked. Utilizing these programs could help meet the need to train new talent that can be better prepared to handle the growing demands of the industry, having a domino effect to meeting the need to retain company knowledge and addressing the cyclical nature of employment and transferability to other industries.

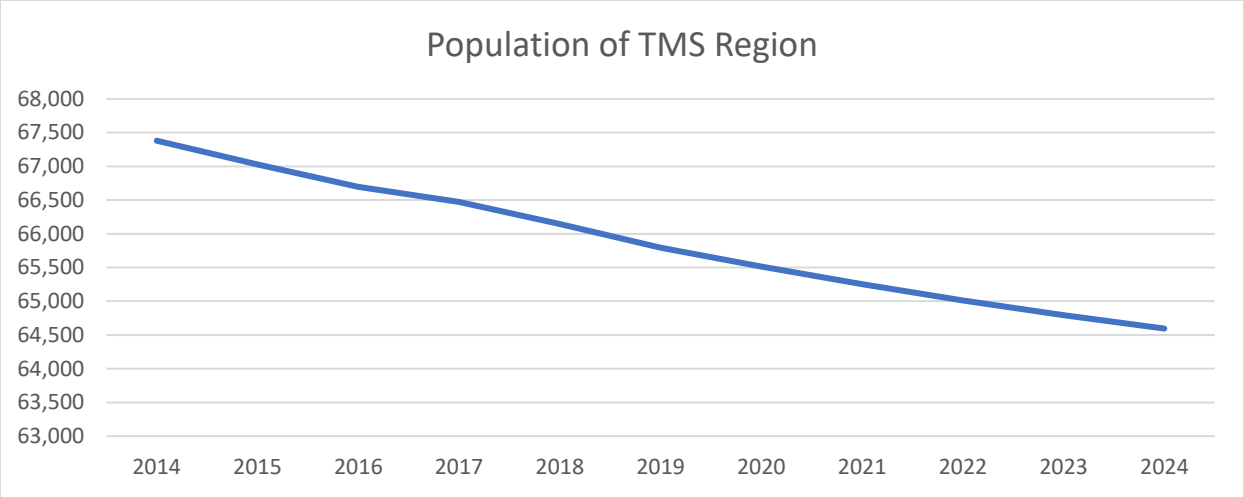
The Tuscaloosa Marine Shale region has the potential for substantial growth. The rural land acreage of TMS gives a competitive advantage, making them a valuable asset to a potential strategic partnership. Through this partnership, TMS could find innovation solutions to workplace safety and diversity without high costs of money and time. They could also find new ways to manage the data they process, which could give them another competitive advantage. In the process, they could discuss systems of talent management and knowledge retention to ensure that they sustain their growth. Addressing these explained workforce needs could help accomplish the task of meeting workforce needs in the TMS region.

TMS Workforce Overview

Decreasing Population

The population of the TMS region decreases and projected to continue to decrease (see Figure 5). The population in the five-county TMS region was 67,380 in 2014 and expected to drop to 64,595 by 2024, a 4% annual decrease. During this same period, the U.S. population expects to increase by 6% and Mississippi and Louisiana 1%. The region needs to create good jobs to stop the population hemorrhaging.

Figure 5. Overall Population Trend of TMS Region

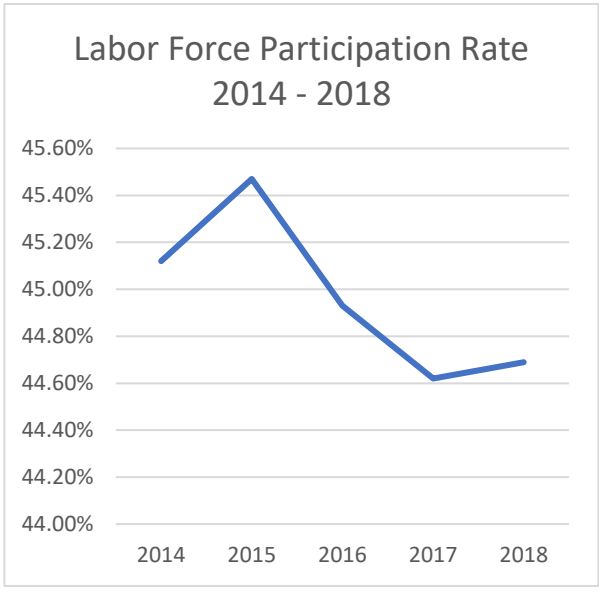


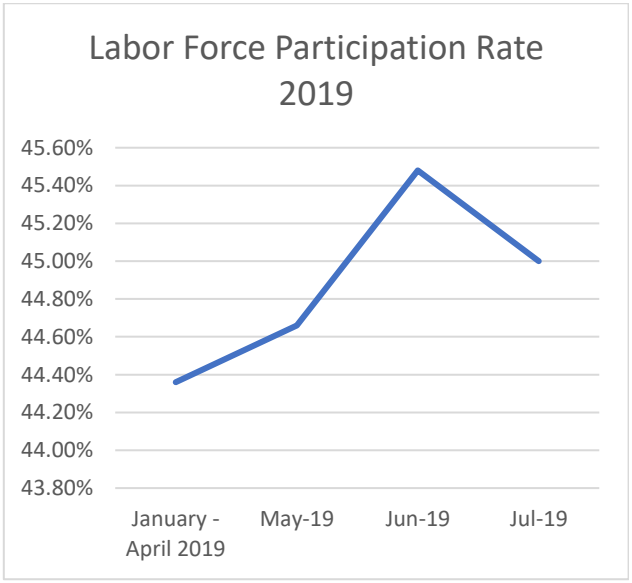
Source: EMSI 2019

Many Potential Workers Not Employed

A troubling sign for the TMS region is the low and generally decreasing labor participation rate (see Figure 6). The Bureau of Labor Statistics indicates the percentage of all people of working age who are employed or are actively seeking work. The national average is around 63%, but the TMS region is less than 45%. The low labor participation rate indicates that the region is not making full productive use of its human capital. Many potential workers either do not want to work or cannot find desirable jobs.

Figure 6. Labor Participation in the TMS





Source: EMSI 2019

Low Educational Attainment in the Region

The TMS region has low educational attainment at the collegiate level. The data in Table 8 shows that the TMS region, both the 5 and 28 county regions, has the lowest collegiate educational attainment amongst shale regions in the United States. However, the TMS region has the most oil and gas programs. The blue-collar technical jobs needed by the oil industry area good fit for the educational level of the region.

Table 8. Educational Attainment for Shale Regions

Region	Less Than 9th Grade	9th Grade to 12th Grade	High School Diploma	Some College	Associate Degree	Bachelor's Degree	Graduate Degree and Higher
5 Parish/County TMS Region	3,782 (7.8%)	7,409 (15.2%)	19,352 (39.8%)	8,913 (18.3%)	2,440 (5%)	4,544 (9.3%)	2,199 (4.5%)
28 Parish/County TMS Region	67,698 (5.9%)	114,595 (9.0%)	389,647 (33.8%)	249,927 (21.7%)	66,314 (5.8%)	173,244 (15%)	90,636 (7.9%)
Bakken	4,620 (3.6%)	6,381 (4.9%)	41,346 (31.9%)	30,720 (23.7%)	15,676 (12.1%)	23,481 (18.1%)	7,568 (5.8%)
Eagle Ford	119,063 (13.2%)	88,990 (9.9%)	269,303 (29.9%)	180,712 (20.1%)	60,958 (6.8%)	117,995 (13.1%)	62,379 (6.9%)
Haynesville	19,023 (8.2%)	21,367 (9.3%)	75,192 (32.6%)	58,925 (25.5%)	15,816 (6.9%)	28,313 (12.3%)	12,150 (5.3%)
Marcellus	92,789 (3%)	179,574 (5.9%)	1,174,417 (38.4%)	487,388 (15.9%)	278,894 (9.1%)	518,106 (17%)	324,718 (10.6%)

Source: EMSI 2020

The Regions is Poor and Economically Distressed

The region has extensive poverty and disabled population. The region's poverty rate is 19%, while the U.S. is only 10% (see Table 9). The median household income is far below the national level. Economically, the region needs the jobs and wealth that a booming shale economy can bring.

Table 9. Community Indicators of TMS Region

County Name	% Disabled Population	% Poverty Level	Median Household Income
Wilkinson County, MS	23.20%	35.20%	$23,340
St. Helena Parish, LA	22.40%	20.50%	$35,254
Amite County, MS	19.80%	20.40%	$30,129
East Feliciana Parish, LA	16.00%	13.10%	$46,964
West Feliciana Parish, LA	11.50%	7.60%	$55,647

Region Total	**18.58%**	**19.36%**	**$38,267**
U.S.	**12.50%**	**10.10%**	**$60,293**

Source: EMSI 2019

The Population is Getting Older

The population of the TMS region is old and getting older. Thirty-two percent of the TMS population is retirement age compared to 21% of the U.S. population (see Table 10). In the last 10 years, the region's younger population shrank while its older population grew. The shrinking working-age population makes it more likely that the industry will reply more on non-resident workers when production ramps back-up.

Table 10. Age Breakdown of the US Compared to the TMS Region

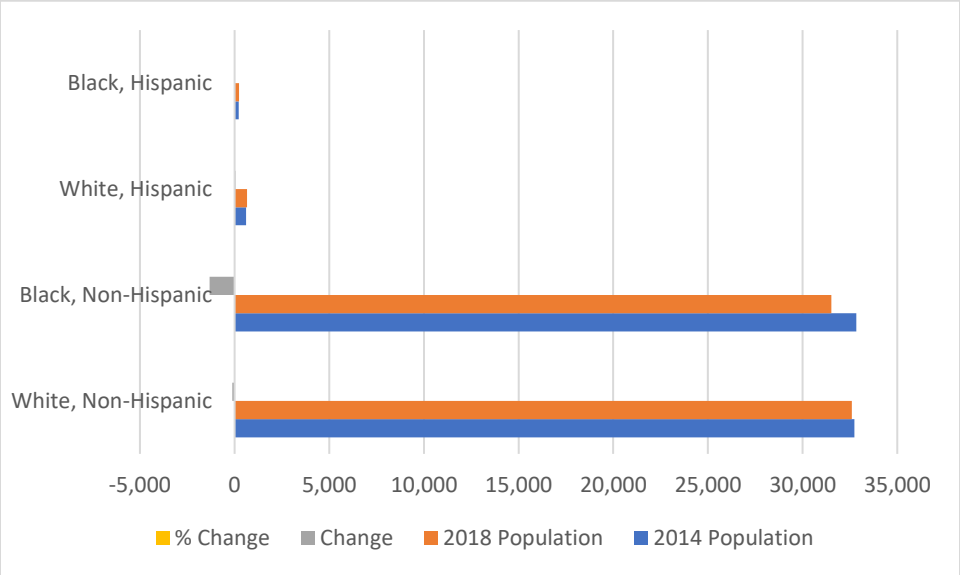
Age	U.S. Population	TMS Population	10yr TMS Change
0-19	25%	18%	-14%
20-29	14%	12%	-6%
30-39	14%	12%	-3%
40-49	13%	12%	-18%
50-59	13%	14%	-17%
60-69	12%	13%	23%
Over 70	9%	19%	26%

Source: EMSI 2019

Large Minority Population in the Region

The population of the TMS region is bi-racial (see Figure 7). The population is about 50% black, 47% white, and around 2% Hispanic. This percentage is relatively unchanged since hydraulic fracturing began in the region, with only a slight decrease in the white population replaced by Hispanics. The Mississippi counties have a slightly higher black to white population. The region with its large minority population contrasts with the overall oil and gas industry make-up of 78% white, 13% Hispanic, and 4% black.

Figure 7. Population Demographics of TMS Region by Race/Ethnicity Graph (10-year period)



Source: EMSI 2019

Lack of Available Rental Housing in the Region

The region has a high percentage of vacant housing, but a relatively low percentage of vacant rental property (see Table 11). Because of the poverty in the region, there is less homeownership and more rentals. There are also a few hotels in the region. The industry's reliance on migrant workers means when production rebounds, finding temporary accommodations will be an issue. Appendix A includes a detailed breakdown by county and parish of housing indicators.

Table 11. 2019 Housing Indicators of Shale Plays and National Region

County Name	Housing Units	Occupied Housing Units	Occupied Housing Units	Vacant Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate
East Feliciana Parish, LA	8,324	6,817	81.90%	1,507	18.10%	1.20%	3.40%
Amite County, MS	6,714	4,994	74.40%	1,720	25.60%	1.50%	4.50%
West Feliciana Parish, LA	5,363	3,947	73.60%	1,416	26.40%	2.10%	11.00%
St. Helena Parish, LA	5,244	3,990	76.10%	1,254	23.90%	1.30%	8.10%
Wilkinson County, MS	5,113	2,882	56.40%	2,231	43.60%	0.40%	3.10%
TMS Totals	**30,758**	**22,630**	**72.48%**	**8,128**	**27.52%**	**1.30%**	**6.02%**

LA & MS Totals	3,339,323	2,841,159	85%	498,164	15%	1.85%	9%
U.S. Totals	**135,393,564**	**118,825,921**	**86.75%**	**16,567,643**	**13.25%**	**1.74%**	**6.58%**
Bakkens Region	98,514	76,862	74.33%	21652	25.68%	2.48%	12.58%
Haynesville Region	147,812	123,728	80.84%	24,084	2.07%	19.16%	2.07%

Source: EMSI 2020

Inventory of Existing Workforce Training Programs in The TMS Region

There are several highly rated community college and university oil and gas industry-related programs in Mississippi and Louisiana. Petroleum Technology/Technician (15.0903) programs had 279 completions in 2018, which was up from 172 in 2013. Additionally, several new programs started, including Southwest Mississippi Community College in the TMS region. Petroleum Engineering (14.2501) completions increased from 138 in 2013 to 346 in 2018. The region has a broad range of educational programs in geographic proximity.

Industry-Specific Educational Programs Louisiana and Mississippi

Louisiana and Mississippi have a strong educational network of petroleum-related education programs (see Table 12). Louisiana is especially strong in providing educated workers to the oil and gas industry. *U.S. News and World Report* rank LSU's program with a full-time enrollment of 469 as the tenth best program in the nation. ULL's program is ranked number seventeen. Nicholls State University offers two (2) Petroleum Technology/Technician degree programs and is a top-ranked associate producing program.

Table 12. Oil and Gas Related Institutions in LA and MS

Educational Institutions	CIP	Type	Completions (2013)	Completions (2018)
Louisiana State University	14.2501	Bachelor Master Ph.D.	88	211
Nicholls State University	15.0903	Associate Bachelor	99	165
The University of Louisiana at Lafayette	14.2501	Bachelor Master Ph.D.	50	124
Fletcher Technical Community College	15.0903	Associate	16	89
Bossier Parish Community College	15.0903	Associate	21	6
South Louisiana Community College	15.0903	Associate	0	5

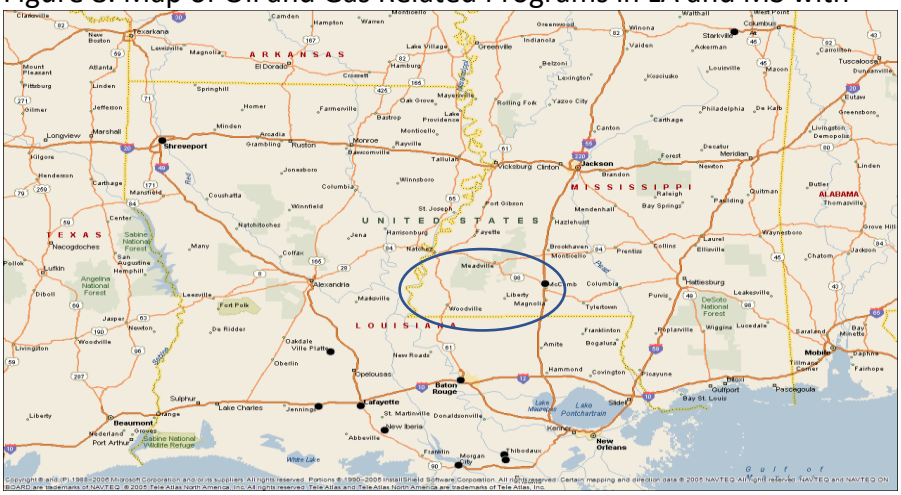
South Central Louisiana Technical College	15.0903	Associate	4	2
Southwest Mississippi Community College	15.0903 46.0504	Associate	0	12
Mississippi State University	14.2501	4 Year	0	11

Source: EMSI 2019

Industry-Specific Education Programs in the Region

The Oil & Gas Production Technology program at Southwest Mississippi Community College is the only industry-specific educational program (see Figure 8). There are no community colleges in the Louisiana portion of the TMS; Baton Rouge Community College New Roads Location and Northshore Technical Community College are the nearest. Both are at least a 45-minute drive from the heart of the play. Given the network of educational institutions, more training programs could be geared up if there was an industry need in the region.

Figure 8. Map of Oil and Gas Related Programs in LA and MS with



Educational Programs in the Region Providing Industry Needed Skills

The nearby community colleges do offer workforce programs that provide skills needed by the oil and gas industry. These skills include welding, electrician, and diesel-powered equipment technology. The EMSI posting intensity is 3-1, indicating that companies in the TMS region need these positions even without expanded oil and gas industry production, so competition might be tough when the business cycle changes.

Table 13. Related Skills Training within the TMS Region

Educational Institution	Workforce Programs	Enrollment (2017-2018)
Southwest Mississippi Community College	Electrical Technology Diesel Equipment Technology	1,779

	Welding and Cutting Computer Network Technology Well Construction Technology	
Baton Rouge Community College New Roads Location	Welding Medical Assistant Electrical	8,000 at the main campus
Northshore Technical Community College	Air Conditioning & Refrigeration Automotive Technology Building Technology Specialist Business Office Administration Diesel Powered Equipment Technology Drafting and Design Technology Electrician Electric Line Technology Information Technology Machine Tool Technology Maritime Technology Welding	9,850

Source: Institutional Websites

The educational infrastructure appears to be in place within the region and adjacent to the region to gear up programs to provide needed industry-specific and general skills. Southwest Mississippi Community College within the Mississippi portion of the region has two industry-specific regions, and numerous programs in Louisiana with a few hours' drive have programs. Within the region, community colleges are producing workers with skills needed by the region (see Table 14).

Table 14. Oil and Gas Education Programs 28 County/Parish TMS Region

Program	Completions (2014)	Completions (2015)	Completions (2016)	Completions (2017)	Completions (2018)
Direct Industry Focus					
Petroleum Technology/Technician	0	0	0	25	12
Well Drilling/Driller	11	10	6	3	4
Accompanying Skills					
Automotive Mechanics Technology/Technician	213	289	211	294	181
Mechanical Engineering	184	170	171	158	168

Drafting and Design Technology/Technician, General	65	121	156	107	110

Source: EMSI 2019

Benchmark Workforce Training Programs in other Oil and Gas Regions

When compared to other established shale regions, the TMS region's workforce infrastructure appears strong (see Table 15). The TMS region produces as many petroleum technicians as the much larger Bakken region. The Eagle Ford and Marcellus plays have more completions, but only one more program that the TMS can reach out to the five (5) proximate programs.

Table 15. CIP Codes and Program Completions in Established Shale Plays in 2018

CIP Code	Description	Programs	Completions
Bakken Shale Play			
14.2501	Petroleum Engineering	0	0
14.3901	Geological/Geophysical Engineering	0	0
15.0903	Petroleum Technology/Technician	1	12
46.0504	Well Drilling/Driller	0	0
Eagle Ford Shale Play			
14.2501	Petroleum Engineering	0	0
14.3901	Geological/Geophysical Engineering	0	0
15.0903	Petroleum Technology/Technician	2	113
46.0504	Well Drilling/Driller	0	0
Marcellus Shale Play			
14.2501	Petroleum Engineering	2	157
14.3901	Geological/Geophysical Engineering	0	0
15.0903	Petroleum Technology/Technician	5	15
46.0504	Well Drilling/Driller	2	7

Source: EMSI 2020

Hydraulic Fracturing Skills Competency Model

Top Occupations Needed for Hydraulic Fracturing

Most of the occupations employed by hydraulic fracturing companies are occupations employed in a broad array of sectors. Accountants and auditors are the third largest occupation comprising 6% of the workforce. Other industry occupations are also needed, such as general and operations managers (3.1%) and computer systems analysts (2.4%). Of the numerous occupations needed for oil and gas extraction, only a few are specific to the industry.

The top oil and gas industry-specific occupations were selected, comprising 32% of the industry workforce needs (see Table 16). Geoscientists, except hydrologists and geographers, were included in the skills competency analysis even though they are not specific to the industry. These occupations have a range of education and work experience needs.

Table 16. Top Industry-Specific Occupations for Oil and Gas Extraction (NAICS 211)

SOC	Description	Percentage of Workforce	Median Hourly Earnings	Typical Entry-Level Education	Work Experience Required
17-2171	Petroleum Engineers	6.8%	$65.97	Bachelor's degree	None
53-7073	Wellhead Pumpers	6.7%	$25.64	High school diploma or equivalent	Moderate-term on-the-job training
47-5013	Service Unit Operators, Oil, Gas, and Mining	4.7%	$23.04	No formal educational credential	Moderate-term on-the-job training
47-5071	Roustabouts, Oil, and Gas	4.0%	$18.07	No formal educational credential	Moderate-term on-the-job training
19-2042	Geoscientists	3.3%	$44.09	Bachelor's degree	None
47-1011	First-Line Supervisors of Extraction Workers	3.2%	$30.25	High school diploma or equivalent	5 years or more
51-8093	Petroleum Pump System Operators	2.9%	$34.07	High school diploma or equivalent	Moderate-term on-the-job training

Source: EMSI Staffing Patterns 2020

Top Occupational Competencies Needed for Hydraulic Fracturing

The top occupations have different important knowledge, skills, and abilities (KSAs) competencies. They present the learning objectives which the workforce system should provide and help identify the transferable skills.

- Knowledge is a body of information, usually of a factual or procedural type, that is applied directly to the successful performance of a task.

- Skills describe a present observable capability or competence to perform a job operation with precision. Performance is usually based on a learned psychomotor act and implies a standard that is required for effective performance.

- Ability describes a more general capability or competence to perform an observable behavior or a behavior that is necessary to perform a job function resulting in an observable product.

Competencies specify the "how" of performing job tasks, or what the person needs to do the job successfully. They are measurable and organizationally relevant. The specific competencies are presented in the tables below broken down by occupational education level.

Important Industry Competencies

There are three areas of workforce competencies that apply to the overall oil and gas workforce: knowledge, skill, and ability. These competencies show what areas workers must be competent to provide value to the industry through their positions. These are the competencies that workforce training programs need to address. They also provide a good foundational skillset that is easily transferable through different positions in the oil and gas industry. Each area of competency will cover the top five competencies ranked by level of importance from 0-100 (see Table 17) for the oil and gas occupation group. Appendix B has the KSAs by occupation for the industry.

Table 17. Skill Competency Model

Competency	**Level**	**Competency**	**Level**	**Competency**	**Level**
Knowledge		*Skill*		*Ability*	
Mechanical	61	Operation Monitoring	68	Perceptual Speed	57
Education and Training	50	Operation and Control	55	Oral Comprehension	55
Mathematics	46	Critical Thinking	54	Problem Sensitivity	55
Engineering and Technology	42	Quality Control Analysis	54	Inductive Reasoning	54
Public Safety and Security	42	Monitoring	54	Oral Expression	54

Source: EMSI 2020

Oil and Gas Skills Transferability

Compatible Occupations

The KSAs of the occupations can be used to show what are compatible occupations and inverse staffing patterns used to find which industries need these skills. For example, the skills required for a petroleum engineer (17-2171) align closely with the sills needed for Brownfield Redevelopment Specialists and Site Managers (11-9199). Table 18 has more of the matches,

and Appendix B is a more comprehensive list. Taken as a group, Petroleum Engineers and Geoscientists are important for Engineering Services (NAICS 541330).

Table 18. Top Compatible Occupations Oil and Gas Occupations Requiring a Bachelor's Degree

SOC	Description	Top Compatible Occupations
17-2171	Petroleum Engineers	Brownfield Redevelopment Specialists and Site Managers (11-9199.11) Water Resource Specialists (11-9121.02) Energy Engineers (17-2199.03) Wind Energy Engineers (17-2199.10)
19-2042	Geoscientists	Hydrologists (19-2043.00) Remote Sensing Scientists and Technologists (19-2099.01) Environmental Restoration Planners (19-2041.02) Environmental Scientists and Specialists, Including Health (19-2041.00)

Source: EMSI Skills Transferability 2020

Compatible Industries

The most compatible industries for the oil and gas workforce overall are in the construction fields (see Table 19). This industry is typically driven by the prosperity of the regional economy and is not generally considered an export industry. Most export industries (e.g., manufacturing) are not as compatible, which indicates that there would need to be some workforce reskilling training to transition oil and gas workers to these industries. The curriculums appear comparable (see Appendix B & C)

Table 19. Top Compatible Industries for Oil and Gas Workers

Description	Compatible Industries
Top	236220 Commercial and Institutional Building Construction 238210 Electrical Contractors and Other Wiring Installation Contractors 236118 Residential Remodelers
Manufacturing	324121 Asphalt Paving Mixture and Block Manufacturing 324122 Asphalt Shingle and Coating Materials Manufacturing 324191Petroleum Lubricating Oil and Grease Manufacturing

Source: EMSI Inverse Staffing Patterns 2020

Conclusion

The oil and gas industry is cyclical. Historical patterns indicate that oil prices rise and fall over time and has a direct effect on employment within the oil and gas industry. As oil prices rise and fall, employment rises and falls in correlation. This fluctuation poses a question as to what workers will do in the event they are laid off from their positions.

There is a need to focus on skills transferability to ensure that workers have jobs when the price of oil falls. Skill transferability pertains to skills that can be transferred across various jobs and industries. In the oil and gas industry, the top five skill sets that are the most required are operation monitoring, operation and control, critical thinking, quality control analysis, and monitoring.

Regions need to provide education conducive to honing the needed skills of the oil and gas industry to ensure workers have the necessary skills that transfer well across industries. The TMS region outperforms other developed shale regions in the United States in the area of oil and gas education. This is one advantage of the region, as it proves to be a producer of competent workers. These workers have a higher chance of finding work if the price of oil decreases, and they have to find jobs where they are still able to utilize their skill set, which they can do inside and outside of the oil and gas industry.

Ultimately, the TMS region is a region with a well-developed foundation and groundwork for equipping workers with necessary skills. Educational programs enhance workers' skills, knowledge, and abilities, and they develop experience from working onshore. Given the TMS region's proximity to the southern coast of the United States, there is also an opportunity to work offshore, should the price of oil fall, and employees are out of work. As the federal government wins bids to drill in offshore zones, the TMS region can transfer workers to offshore sites if the sites are near the region. These alternate jobs provide an array of opportunities for workers.

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Appendix A. Housing Indicators by County/Parish

TMS Housing Indicators

County Name	Housing Units	Occupied Housing Units	Occupied Housing Units	Vacant Housing Units	Vacant Housing Units	Homeowner Vacancy Rate	Rental Vacancy Rate
East Feliciana Parish, LA	8,324	6,817	81.90%	1,507	18.10%	1.20%	3.40%
Amite County, MS	6,714	4,994	74.40%	1,720	25.60%	1.50%	4.50%
West Feliciana Parish, LA	5,363	3,947	73.60%	1,416	26.40%	2.10%	11.00%
St. Helena Parish, LA	5,244	3,990	76.10%	1,254	23.90%	1.30%	8.10%
Wilkinson County, MS	5,113	2,882	56.40%	2,231	43.60%	0.40%	3.10%
Totals & Averages	**30,758**	**22,630**	**72.48%**	**8,128**	**27.52%**	**1.30%**	**6.02%**

Source: EMSI 2019

Bakkens Shale Play Housing Indicators

County Name	Housing Units	Occupied Housing Units	Occupied Housing	Vacant Housing Units	Vacant Housing	Homeowner Vacancy Rate	Rental Vacancy Rate
Ward County, ND	32,248	27,449	85.1%	4,799	14.9%	3.6%	12.6%
Williams County, ND	17,790	12,895	72.5%	4,895	27.5%	3.1%	22.7%
Stark County, ND	14,090	11,962	84.9%	2,128	15.1%	2.3%	15.4%
McLean County, ND	6,065	4,313	71.1%	1,752	28.9%	0.8%	6.7%
McKenzie County, ND	5,320	3,651	68.6%	1,669	31.4%	1.8%	17.1%
Mountrail County, ND	4,903	3,213	65.5%	1,690	34.5%	1.8%	17.1%
Bottineau County, ND	4,426	3,096	70.0%	1,330	30.0%	4.6%	6.8%
McHenry County, ND	3,155	2,663	84.4%	492	15.6%	1.4%	6.6%
Dunn County, ND	2,523	1,601	63.5%	922	36.5%	2.2%	13.7%
Bowman County, ND	1,739	1,432	82.3%	307	17.7%	1.4%	12.4%

Divide County, ND	1,531	1,053	68.8%	478	31.2%	2.4%	13.1%
Burke County, ND	1,398	950	68.0%	448	32.0%	3.2%	12.9%
Renville County, ND	1,301	1,011	77.7%	290	22.3%	5.1%	10.5%
Golden Valley County, ND	1,042	863	82.8%	179	17.2%	3.5%	8.7%
Billings County, ND	535	401	75.0%	134	25.0%	1.7%	12.5%
Slope County, ND	448	309	69.0%	139	31.0%	0.8%	12.5%
Totals & Averages	**98,514**	**76,862**	**74.3%**	**21,652**	**25.7%**	**2.5%**	**12.6%**

Source: EMSI 2019

Haynesville Shale Play Housing Indicators

County Name	Housing Units	Occupied Housing Units	Occupied Housing	Vacant Housing Units	Vacant Housing	Homeowner Vacancy Rate	Rental Vacancy Rate
Gregg County	51,560	45,615	88.5%	5,945	11.5%	2.2%	9.3%
Harrison County	28,332	23,363	82.5%	4,969	17.5%	2.0%	7.7%
Rusk County	21,472	17,982	83.7%	3,490	16.3%	1.4%	3.5%
Upshur County	16,949	14,061	83.0%	2,888	17.0%	2.5%	7.0%
Shelby County	12,084	9,218	76.3%	2,866	23.7%	2.1%	5.7%
Panola County	11,094	9,032	81.4%	2,062	18.6%	0.7%	4.4%
Marion County	6,321	4,457	70.5%	1,864	29.5%	3.6%	9.7%

Source: EMSI 2019

Appendix B. SWMCC Oil & Gas Production Technology Program Curriculum

First Semester Freshman	Semester Hours	Third Semester Sophomore	Semester Hours
OGP 1113 Safety, Health, & Environment	3	OGP 2214 Oil and Gas Production II	4
OGP 1133 Introduction to Oil & Gas Prod.	3	OGP 2313 Electronic Instrumentation	3
OGP 1213 Oil & Gas Operations I	3	OGP 2513 Oil and Gas Flow Diagrams	3
OGP 1313 Oil & Gas Equipment I	3	OGP 2913 OGP Technical Elective	3
ENG 1113 English Composition I	3	Humanities/ Fine Arts Elective	3
LLS 1311 Orientation	1	SPT 1113 Oral Communications	3
Total Hours	16	*Total Hours*	19
Second Semester	**Semester Hours**	**Fourth Semester**	**Semester Hours**
OGP 1324 Oil & Gas Equipment II	4	OGP 2113 Production Safety Systems	3
OGP 1413 Pneumatic Instrumentation	3	OGP 2223 Production Troubleshooting	3
OGP 1614 Oil & Gas Systems	4	OGP 2914 Special Project in Oil & Gas Prod.	4
Social/Behavior Science Elective	3		
Mathematics/Science Elective	3		
Total Hours	17	*Total Hours*	16

Source: Southwest Mississippi Community College

Appendix C. Benchmark Workforce Training Programs in other Oil and Gas Regions

Petroleum Programs in Shale Plays

Institution	Program Title	College of Program	Degree	Format	Total Program Hours	Sample Courses
Tuscaloosa Marine Shale Play (Bachelor's Programs)						
Louisiana State University and Agricultural & Mechanical College	Petroleum Engineering	College of Engineering	B.S.P.E., Bachelor of Science in Petroleum Engineering	Traditional	At least 91	Reserve Estimation and Reservoir Management, Unit Operations Laboratory, Drilling Engineering, Drilling Fluids Laboratory, Senior Project, Reservoir Mechanics Laboratory, Petroleum Engineering Design Courses, General Education Course: Social Sciences, General Education Courses Humanities
Nicholls State University	Petroleum Engineering	College of Science and Technology	Petroleum Engineering Technology and Safety Management	Hybrid	138	SATC 440 Environmental Technology, PSET 171 Well Drilling, PSET 241 Oil Production, PSET 121 Petroleum Computational Methods, PSET 231 Gas Production
University of Louisiana at Lafayette	Petroleum Engineering	College of Engineering	Bachelor of Science in Petroleum Engineering	Traditional	127	PETE 401 - Senior Design Project, PETE 402 - Senior Design Project II, PETE 433 - Natural Gas Engineering, PETE 423 - Improved Petroleum Recovery Processes, PETE 411G - Well Planning and Control, Economics, Risk Analysis, and Property Evaluation, PETE 431G - Petroleum

						Production Engineering
Tuscaloosa Marine Shale Play (Associates Programs)						
South Louisiana Community College	Petroleum Engineering	Integrated Production Technologies (IPT) Program	Associate of Science Degree in Industrial Technology	Traditional	63	GEOL 1020; PHYS 2070; MCIS 1005
Southwest Mississippi Community College	Petroleum Engineering	Oil & Gas Production Technology program	Associate of Applied Science	Traditional		ELT 1113 Residential Wiring; WCT 2223 Pump Theory & Installation; WCT 2423 Water Well Construction; WCT 2433 Environment and Geotechnical Drilling; Humanities/Fine Arts Elective
Eagle Ford Shale Play						
Texas A & M University-College Station	Petroleum Engineering	College of Engineering	Bachelor of Science in Petroleum Engineering	Hybrid	128	Geology of Petroleum; Petroleum Engineering Numerical Methods; Reservoir Fluids; Transport Processes in Petroleum Production
Marcellus Shale Play						
Pennsylvania State University-Main Campus	Petroleum a nd Natural Gas Enginee ring	College of Earth and Mineral Sciences	B.S. in Petroleum and Natural Gas Engineering	Traditional	129	PNG 425 - Principles of Well Testing and Evaluation; PNG 480 - Production Process Engineering; PNG 482 - Production Engineering Laboratory; PNG 492 - Petroleum Engineering Capstone Design
University of Pittsburgh-Pittsburgh Campus	Petroleum and Chemical Engineering	Swanson School of Engineering	BS in Chemical Engineering	Traditional	128	Pillars of Chemical Engineering: A Block Scheduled Curriculum

Source: EMSI 2020 & Respective Colleges' Websites

Well Drilling Programs in Shale Plays

Institution	Program Title	College of Program	Degree	Format	Total Program Hours	Sample Courses
Tuscaloosa Marine Shale Play (Bachelor's Degree)						
Louisiana State University and Agricultural & Mechanical College	Petroleum Engineering	College of Engineering	B.S.P.E., Bachelor of Science in Petroleum Engineering	Traditional	At least 91	Reserve Estimation and Reservoir Management, Unit Operations Laboratory, Drilling Engineering, Drilling Fluids Laboratory, Senior Project, Reservoir Mechanics Laboratory, Petroleum Engineering Design Courses, General Education Course: Social Sciences, General Education Courses Humanities
Nicholls State University	Petroleum Engineering	College of Science and Technology	Petroleum Engineering Technology and Safety Management	Hybrid	138	SATC 440 Environmental Technology, PSET 171 Well Drilling, PSET 241 Oil Production, PSET 121 Petroleum Computational Methods, PSET 231 Gas Production
University of Louisiana at Lafayette	Petroleum Engineering	College of Engineering	Bachelor of Science in Petroleum Engineering	Traditional	127	PETE 401 - Senior Design Project, PETE 402 - Senior Design Project II, PETE 433 - Natural Gas Engineering, PETE 423 - Improved Petroleum Recovery Processes, PETE 411G - Well Planning and Control, Economics, Risk Analysis, and

						Property Evaluation, PETE 431G - Petroleum Production Engineering
Tuscaloosa Marine Shale Play (Associates Degree)						
Bossier Parish Community College	Petroleum Engineering	Oil and Gas Production Technology, AAS	Associate of Applied Science in Oil and Gas Production Technology	Traditional	61	OGPT 131: Well Completions and Workovers; OGPT 131: Well Completions and Workovers; TEED 101: Fundamentals of Electricity and Lab I; OGPT 245: Pumps and Pump Applications; TEED 153: Hydraulics/Fluid Dynamics with Lab
South Louisiana Community College	Petroleum Engineering	Integrated Production Technologies (IPT) Program	Associate of Science Degree in Industrial Technology	Traditional	63	GEOL 1020; PHYS 2070; MCIS 1005
Southwest Mississippi Community College	Petroleum Engineering	Oil & Gas Production Technology program	Associate of Applied Science	Traditional		ELT 1113 Residential Wiring; WCT 2223 Pump Theory & Installation; WCT 2423 Water Well Construction; WCT 2433 Environment and Geotechnical Drilling; Humanities/Fine Arts Elective
Marcellus Shale Play						
Douglas Education Center	Skilled Trade Programs	Skilled Trade Programs	Commonwealth of Pennsylvania CDL Class "A"	Traditional	-	CDL Training; Heavy Equipment

Source: EMSI 2020 & Respective Colleges' Websites

Appendix D. Competencies Required by the Oil and Gas Industry

Competencies of Top Oil and Gas Occupations Requiring a Bachelor's Degree or Higher

SOC	Description	Knowledge (>70 Importance)	Skills (>70 Importance)	Abilities (>70 Importance)
17-2171	Petroleum Engineers	Engineering and Technology Mathematics Physics Computers and Electronics	Reading Comprehension Critical Thinking Complex Problem Solving Writing	Oral Expression Written Expression Written Comprehension Oral Comprehension Inductive Reasoning Problem Sensitivity
19-2042	Geoscientists	Geography Mathematics Physics Chemistry English Language	Reading Comprehension Active Listening Science Critical Thinking Complex Problem Solving	Oral Comprehension Written Comprehension Oral Expression Inductive Reasoning Written Expression Category Flexibility Deductive Reasoning

Source: EMSI Skills Transferability 2020

Competencies of Top Oil and Gas Occupations Requiring a High School Diploma or Equivalent

SOC	Description	Knowledge (>65 Importance)	Skills (>70 Importance)	Abilities (>70 Importance)
53-7073	Wellhead Pumpers	Mechanical	Operation Monitoring Operation and Control	Problem Sensitivity
47-1011	First-Line Supervisors of Extraction Workers	Customer and Personal Service Building and Construction Production and Processing Administration and Management Mechanical	Active Listening Coordination	Oral Expression Oral Comprehension Problem Sensitivity

		Public Safety and Security English Language		
51-8093	Petroleum Pump System Operators	Mechanical	Operation Monitoring	Perceptual Speed Problem Sensitivity

Source: EMSI Skills Transferability 2020

Competencies of Top Oil and Gas Occupations Requiring no Formal Education

SOC	Description	Knowledge (>50 Importance)	Skills (>50 Importance)	Abilities (>50 Importance)
47-5013	Service Unit Operators, Oil, Gas, and Mining	Mechanical Mathematics Customer and Personal Service Engineering and Technology Customer and Personal Service Education and Training Administration and Management Transportation Production and Processing Public Safety and Security Sales and Marketing English Language Chemistry	Operation Monitoring Operation and Control Monitoring Critical Thinking Equipment Maintenance Troubleshooting Repairing Quality Control Analysis Writing Speaking Complex Problem Solving Reading Comprehension Active Learning Active Listening	Control Precision Problem Sensitivity Oral Expression Multi-limb Coordination Problem Sensitivity Oral Comprehension Perceptual Speed Depth Perception Near Vision Visualization Reaction Time Auditory Attention Deductive Reasoning Inductive Reasoning Speech Recognition Hearing Sensitivity Far Vision Manual Dexterity Selective Attention Speech Clarity
47-5071	Roustabouts, Oil and Gas	Mechanical Public Safety and Security	Monitoring Troubleshooting Operation Monitoring Quality Control Analysis Judgement and Decision Making Critical Thinking	Static Strength Extent Flexibility Control Precision Trunk Strength Multi-limb Coordination Near Vision Manual Dexterity Perceptual Speed Oral Comprehension

				Depth Perception Flexibility of Closure Reaction Time Far Vision Auditory Attention Finger Dexterity Arm-Hand Steadiness Problem Sensitivity Stamina Inductive Reasoning Deductive Reasoning Speech Recognition

Source: EMSI Skills Transferability 2020

Appendix E. Compatible Occupations

Compatible Occupations Requiring at least an Associate Degree

	Median Hourly Earnings	2019 Jobs	2009-2020 Estimated Annual Openings	Compatibility Index
Petroleum Engineers				
Brownfield Redevelopment Specialists and Site Managers (11-9199.11)	$34.20	5,043	492	93
Water Resource Specialists (11-9121.02)	$41.17	146	17	93
Energy Engineers (17-2199.03)	$38.70	2,068	184	92
Wind Energy Engineers (17-2199.10)	$38.70	2,068	184	92
Electrical Engineers (17-2071.00)	$45.14	463	47	92
Architectural and Engineering Managers (11-9041.00)	$68.79	553	56	92
Mining and Geological Engineers, Including Mining Safety Engineers (17-2151.00)	$47.08	31	5	92
Biofuels/Biodiesel Technology and Product Development Managers (11-9041.01)	$68.79	553	56	92
Mechatronics Engineers (17-2199.05)	$38.70	2,068	184	92
Industrial Engineers (17-2112.00)	$45.08	468	50	91
Geoscientists, Except Hydrologists and Geographers				
Hydrologists (19-2043.00)	$23.95	111	14	96
Remote Sensing Scientists and Technologists (19-2099.01)	$40.77	88	13	94
Environmental Restoration Planners (19-2041.02)	$27.56	314	44	94
Soil and Plant Scientists (19-1013.00)	$27.49	55	9	94
Environmental Scientists and Specialists, Including Health (19-2041.00)	$27.56	314	44	94
Atmospheric and Space Scientists (19-2021.00)	$39.80	53	7	94
Biologists (19-1020.01)	$31.66	304	34	93
Environmental Compliance Inspectors (13-1041.01)	$26.03	1,594	168	93
Zoologists and Wildlife Biologists (19-1023.00)	$30.91	16	2	93
Materials Scientists (19-2032.00)	$27.43	14	2	93
Geological and Petroleum Technicians				
Chemical Technicians (19-4031.00)	$31.79	694	88	95
Non-Destructive Testing Specialists (17-3029.01)	$22.97	721	87	94
Environmental Engineering Technicians (17-3025.00)	$23.27	102	14	94
Mechanical Engineering Technicians (17-3027.00)	$29.30	86	15	94
Quality Control Analysts (19-4099.01)	$20.76	472	86	94

Nanotechnology Engineering Technicians (17-3029.12)	$22.97	721	87	94
Nuclear Monitoring Technicians (19-4051.02)	$23.43	119	18	93
Chemical Plant and System Operators (51-8091.00)	$32.87	610	102	93
Electronics Engineering Technicians (17-3023.01)	$25.73	543	65	93
Automotive Engineering Technicians (17-3027.01)	$29.30	86	15	92
Rotary Drill Operators				
Biomass Plant Technicians (51-8099.03)	$24.66	191	32	95
Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders (51-9021.00)	$19.10	102	21	95
Extruding and Forming Machine Setters, Operators, and Tenders, Synthetic and Glass Fibers (51-6091.00)	$23.84	22	5	95
Power Plant Operators (51-8013.00)	$33.55	244	45	95
Electrical Power-Line Installers and Repairers (49-9051.00)	$23.65	407	55	95
Derrick Operators, Oil and Gas (47-5011.00)	$21.82	30	15	95
Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic (51-4191.00)	$20.95	<10	3	95
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic (51-4081.00)	$14.04	178	27	95
Segmental Pavers (47-4091.00)	$21.56	1,133	173	94
Mixing and Blending Machine Setters, Operators, and Tenders (51-9023.00)	$20.13	453	74	94

Source: EMSI 2020

Compatible Occupations Requiring Less Than an Associates

	Median Hourly Earnings	2019 Jobs	2009-2020 Estimated Annual Openings	Compatibility Index
Wellhead Pumpers				
Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders (51-4122.00)	$20.96	142	45	96
Textile Cutting Machine Setters, Operators, and Tenders (51-6062.00)	$16.07	60	12	95
Grinding and Polishing Workers, Hand (51-9022.00)	$14.96	18	8	95
Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic (51-4031.00)	$16.36	202	42	95
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic (51-4034.00)	$13.02	36	11	95

Grinding, Lapping, Polishing, and Buffing Machine Tool Setters, Operators, and Tenders, Metal and Plastic (51-4033.00)	$18.87	50	15	95
Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic (51-4072.00)	$14.21	325	47	95
Agricultural Equipment Operators (45-2091.00)	$15.30	151	31	95
Pourers and Casters, Metal (51-4052.00)	$18.48	<10	3	95
Service Unit Operators				
Bus and Truck Mechanics and Diesel Engine Specialists (49-3031.00)	$19.93	1,220	144	96
Biomass Plant Technicians (51-8099.03)	$24.66	191	32	96
Septic Tank Servicers and Sewer Pipe Cleaners (47-4071.00)	$14.52	111	21	96
Control and Valve Installers and Repairers, Except Mechanical Door (49-9012.00)	$22.79	176	22	96
Pump Operators, Except Wellhead Pumpers (53-7072.00)	$23.91	93	23	95
Motorboat Mechanics and Service Technicians (49-3051.00)	$16.33	97	15	95
Hazardous Materials Removal Workers (47-4041.00)	$18.65	241	45	95
Farm Equipment Mechanics and Service Technicians (49-3041.00)	$18.56	151	31	95
Maintenance Workers, Machinery (49-9043.00)	$22.34	576	82	95
Geothermal Technicians (49-9099.01)	$22.02	1,728	227	95
Roustabouts, Oil & Gas				
Insulation Workers, Floor, Ceiling, and Wall (47-2131.00)	$20.12	618	120	97
Paving, Surfacing, and Tamping Equipment Operators (47-2071.00)	$14.72	236	59	97
Cement Masons and Concrete Finishers (47-2051.00)	$17.60	1,036	161	97
Helpers--Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters (47-3011.00)	$14.69	150	31	97
Helpers--Installation, Maintenance, and Repair Workers (49-9098.00)	$13.37	863	145	97
Pourers and Casters, Metal (51-4052.00)	$18.48	<10	3	96
Rock Splitters, Quarry (47-5051.00)	$21.79	71	18	96
Helpers--Extraction Workers (47-5081.00)	$14.40	52	19	96
Agricultural Equipment Operators (45-2091.00)	$15.30	151	31	96
Laborers and Freight, Stock, and Material Movers, Hand (53-7062.00)	$12.10	14,552	2,197	96
First-Line Supervisors of Extraction Workers				
Solar Energy Installation Managers (47-1011.03)	$29.38	5,187	683	96

First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers (37-1012.00)	$16.18	660	98	95
First-Line Supervisors of Production and Operating Workers (51-1011.00)	$33.14	2,652	323	95
Freight and Cargo Inspectors (53-6051.08)	$31.51	119	15	94
First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators (53-1031.00)	$25.03	2,258	283	93
First-Line Supervisors of Helpers, Laborers, and Material Movers, Hand (53-1021.00)	$25.03	2,258	283	93
Recycling Coordinators (53-1021.01)	$25.03	2,258	283	93
Energy Auditors (13-1199.01)	$26.68	5,965	634	93
Non-Destructive Testing Specialists (17-3029.01)	$22.97	721	87	93
First-Line Supervisors of Animal Husbandry and Animal Care Workers (45-1011.08)	$25.36	378	73	93
Petroleum Pump System Operators				
Gas Plant Operators (51-8092.00)	$33.11	104	19	96
Chemical Plant and System Operators (51-8091.00)	$32.87	610	102	96
Power Plant Operators (51-8013.00)	$33.55	245	45	96
Biomass Plant Technicians (51-8099.03)	$24.66	191	32	95
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders (51-9012.00)	$26.57	105	24	95
Crushing, Grinding, and Polishing Machine Setters, Operators, and Tenders (51-9021.00)	$19.10	104	21	94
Biofuels Processing Technicians (51-8099.01)	$24.66	191	32	94
Computer-Controlled Machine Tool Operators, Metal and Plastic (51-4011.00)	$16.05	154	28	94
Rotary Drill Operators, Oil and Gas (47-5012.00)	$25.54	144	40	94
Heat Treating Equipment Setters, Operators, and Tenders, Metal and Plastic (51-4191.00)	$20.95	<10	3	94
Helpers-Extraction Workers				
Rail-Track Laying and Maintenance Equipment Operators (47-4061.00)	$22.79	130	27	98
Paving, Surfacing, and Tamping Equipment Operators (47-2071.00)	$14.72	236	59	97
Roof Bolters, Mining (47-5061.00)	$27.32	<10	1	97
Septic Tank Servicers and Sewer Pipe Cleaners (47-4071.00)	$14.52	111	21	97
Tree Trimmers and Pruners (37-3013.00)	$13.63	312	61	97
Roustabouts, Oil and Gas (47-5071.00)	$20.49	417	103	96
Tank Car, Truck, and Ship Loaders (53-7121.00)	$14.12	129	34	96
Mine Cutting and Channeling Machine Operators (47-5042.00)	$61.58	13	5	96
Crane and Tower Operators (53-7021.00)	$23.26	808	137	96

Molding and Casting Workers (51-9195.07)	$12.76	74	14	96
Derrick Operators, Oil and Gas				
Helpers--Extraction Workers (47-5081.00)	$14.40	52	19	96
Sailors and Marine Oilers (53-5011.00)	$20.34	863	160	96
Excavating and Loading Machine and Dragline Operators (53-7032.00)	$18.83	446	77	95
Rotary Drill Operators, Oil and Gas (47-5012.00)	$25.54	144	40	95
Rail-Track Laying and Maintenance Equipment Operators (47-4061.00)	$22.79	130	27	95
Tank Car, Truck, and Ship Loaders (53-7121.00)	$14.12	129	34	95
Continuous Mining Machine Operators (47-5041.00)	$48.57	40	11	95
Roof Bolters, Mining (47-5061.00)	$27.32	<10	1	95
Crane and Tower Operators (53-7021.00)	$23.26	808	137	94
Tree Trimmers and Pruners (37-3013.00)	$13.63	312	61	94

Source: EMSI 2020

Subtask 8.4

Business Assistance and Diversification Programs

in the Tuscaloosa Marine Shale Region

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Executive Summary

This report analyzes business assistance and diversification programs in the Tuscaloosa Marine Shale (TMS) Region. First, an overview of business retention and expansion (BRE) provides context and clarity of what the report entails. Next, the report analyzes BRE programs in Mississippi and Louisiana and shows how there are many in the area but are lacking in technical assistance for oil and gas companies compared to other developed shale regions. The responses from expert interviews explain why the TMS area is lacking in oil and gas companies and well as certain business assistance programs. The Mississippi Development Authority (MDA) and Louisiana Economic Development (LED) are both examined to see what incentives they offer to oil and gas companies, as well as for these organizations' opportunities for growth in these areas.

For comparative analysis, other shale regions – Eagle Ford, Bakken, and Marcellus – are examined for their business assistance and workforce diversification programs. The services that these shale plays receive from a company by the name of Intertek are listed out for easy examination and comparison. One service, Intertek's business solutions for oil and gas, is examined in detail because it addresses three main workforce needs of the oil and gas industry.

This report ends with conclusions from the analysis and offers recommendations for practitioners who seek to address business needs in the TMS region. The conclusions stated in this report are summarized as follows:

- EDOs in the TMS region should prepare to assist businesses in the event of an increase in oil prices.
- The overlap of the TMS region and the Austin Chalk coupled with the increased extraction potential from hydraulic fracturing, the TMS region could gain a surge of business attraction in the event of increased oil prices.
- Communicating with executives of economic development organizations in established shale regions could be beneficial for the TMS, as executives in the TMS region could gain insight as to how they can best assist oil and gas companies.
- There is potential for MDA and LED in partnering with Intertek.

As it pertains to retaining the local suppliers of the oil and gas industry during cyclical periods, the TMS region is not able to do so. The current oil prices do not allow oil and gas companies to enter the market in the TMS region and make a reasonable return on their investment. Despite favorable conditions for hydraulic fracturing in the TMS region, business assistance programs will need to be developed to help businesses during both seasons of the cyclical oil and gas cycle.

Introduction

Purpose

This report analyzes business assistance and workforce diversification programs in the Tuscaloosa Marine Shale (TMS) Region. This review was completed under Task 6 of a United States Department of Energy Grant Funded research project for the Tuscaloosa Marine Shale Laboratory. The review accomplished the following subtask of Task 6:

- **Subtask 8.4** Business assistance and diversification programs will be identified to retain the local suppliers of the oil and gas extraction industry during cyclical periods. This will involve but not limited to the inventorying existing programs, benchmarking other oil & gas areas, and expert interviews as follows:
    - Inventory existing business programs in the TMS Region
    - Benchmarking other shale regions and conduct expert interviews
    - Prepare a white paper of findings.

This is done to develop a conclusion about business assistance programs and find where practitioners in the Tuscaloosa Marine Shale Laboratory can meet the needs of the regions. Recommendations are also given for assistance to develop business assistance programs in the TMS.

Background

After an examination of workforce needs in the TMS region, there was a need to identify business assistance and diversification programs to retain the local suppliers of the oil and gas extraction industry during cyclical periods. Many companies release employees during the fall of oil prices and suffer from knowledge retention issues, as well as other workforce issues that come with the repetitive nature of losing and gaining employees. This report seeks to explain the role of business assistance in lightening the blow that companies take is times when the price of oil decreases.

Scope

The primary area of observation is the 28 parish/county Tuscaloosa Marine Shale Region.

- Louisiana: Allen, Avoyelles, Beauregard, Catahoula, Concordia, East Feliciana, East Baton Rouge, Evangeline, Grant, LaSalle, Livingston, Natchitoches, Pointe Coupee, Rapides, Sabine, St. Helena, St. Landry, St. Tammany, Tangipahoa, Vernon, West Feliciana, Washington
- Mississippi: Adams, Amite, Franklin, Pike, Walthall, Wilkinson

Eagle Ford, Bakken, and Marcellus shale plays were also taken into consideration for the scope of this report.

Method of Investigation

This report is based on the analysis of secondary data using economic development organizations' and Intertek's websites. From these sites, programs and incentives were identified that were useful in the preparation of the report. All tables are accompanied by the source with which their information was received.

Business Retention & Expansion Overview

Business retention and expansion (BRE) consists of programs designed to assist an economic development plan by retaining or keeping businesses in a community and by providing assistance for businesses to expand. BRE efforts can be applied at the local, regional, or state level, and they are applicable to all businesses in a community. The retention of large businesses, like some oil and gas companies, are especially critical given the number of jobs and amount of tax revenues that could be lost. According to the International Economic Development Council's (IEDC) manual for Business Retention and Expansion (2016), assistance through BRE helps a business in the following ways:

- Increases its competitiveness in the wider marketplace
- Assists with expansions that add new jobs
- Keeps it from relocating to other areas
- Helps it survive economic difficulties
- Connects it to networks

Successful BRE programs include business recruitment efforts. When communities recruit, retain, and grow businesses in their area, they build a reputation as an area that is a good place to do business. There are specific techniques, tools, and strategies that economic development organizations will use for BRE programs. According to the IEDC manual for Business Retention and Expansion (2016), these include but are not limited to:

- Marketing (assistance with job and company promotion)
- Assistance with land and buildings
- Infrastructure (assistance with the buildings, roads, power supplies, etc.)
- Financial assistance (including linking companies with available sources of capital)
- Workforce training
- Technical assistance and assessments
- Export assistance
- Assistance in reducing energy costs and with complying with environmental laws and regulations
- Tax and non-tax incentives

Business Assistance Programs in TMS Region

The Tuscaloosa Marine Shale Region relatively lacks in business assistance programs related to oil and gas. There are no business assistance programs that cater specifically to the oil and gas production in neither Mississippi nor Louisiana. Mississippi has only been able to provide assistance to oil and gas producers through tax incentives such as Reduced Sales Tax Rate on Electricity used in Enhanced Oil

Recovery and Reduced Severance Tax Rate for Horizontally Drilled Wells. The business assistance programs that are hosted by Mississippi and Louisiana (see Appendix) are only able to cater to administrative and workforce issues within the industry.

Chandler Russ, Executive Director of Natchez, Inc. and President of the Mississippi Economic Development Council, mentioned the lack of business attraction in the TMS region in an interview at the 2020 Mississippi Economic Development Legislative Conference. Russ mentioned that the lack of business attraction in the region is an effect of the low price of oil. Even with a business severance tax, oil and gas companies would not make a reasonable return if they began drilling in the area.

Russ also mentioned, however, that the TMS region is still a prospective area because it overlaps with the Austin Chalk Play. The Austin Chalk Play is a layer above the Eagle Ford Shale Play, spanning from Southwest Texas to the entire TMS region. Given that the Austin Chalk Play is made of chalk instead of shale, it is more permeable and easier to drill through. For years the Austin Chalk Play was overlooked but has regained attention. Hydraulic fracturing has increased production rates in this area. Since the development of hydraulic fracturing, the Austin Chalk has produced approximately 54.9 million barrels of oil (Passwaters, 2018).

If the price of oil increases in the coming years, the TMS region would most likely see a resurgence in business attraction and job opportunities. According to Chandler Russ, the overlap of the Austin Chalk Play and the TMS region is attractive to well drilling companies because it provides the opportunity to produce greater amounts of oil from two different plays.

Statewide BRE programs for TMS

Among the organizations in Mississippi and Louisiana that would be able to offer business assistance programs for oil and gas companies, Mississippi Development Authority (Mississippi Development Authority, 2020) and Louisiana Economic Development (Louisiana Economic Development, 2020) would be the primary players. These two organizations are responsible for the economic development of their states.

1. Mississippi Development Authority (MDA)
   MDA is Mississippi's lead economic and community development agency. Currently, MDA recognizes the energy industry as a target industry for Mississippi. MDA has several tax incentives pertaining to the attraction of energy companies. Most of these tax incentives are centered around clean energy and manufacturing, however. There is an opportunity in MDA to develop business assistance programs in preparation for the increase of oil prices (Mississippi Development Authority, 2020).

2. Louisiana Economic Development (LED)
   LED is responsible for strengthening Louisiana's business environment and creating a more vibrant economy. Their energy incentives pertain to powering Louisiana's workforce. Most energy incentives in Louisiana pertain to assisting businesses with energy costs. The closest oil and gas extraction assistance LED boasts is The Petroleum Engineering Research & Technology Transfer Laboratory that allows petroleum engineering students at Louisiana State University to

get hands-on training in well-control at a full-scale research and training facility (Louisiana Economic Development, 2020).

Although Mississippi and Louisiana do not have programs specifically related to oil and gas extraction, there are programs within these states that oil and gas companies can take advantage of (see Table 1). The remainder of the statewide BRE programs for the TMS region is listed in the Appendix.

Table 1. Mississippi and Louisiana State Business Assistance Programs Useful to Oil & Gas Companies

Louisiana	Mississippi
LED FastStart	Mississippi's Workforce Investment Network (WIN) Job Centers
Certified Site Program	Mississippi Works
CEO Roundtables	The Mississippi Works Training Fund
Mentor-Protégé Recognition Program	

Sources: Louisiana Economic Development, Mississippi Development Authority

Louisiana State BRE Programs

LED FastStart

LED FastStart is recognized as the nation's best state workforce program, according to Business Facilities magazine. The FastStart team creates unique and specific programs to ensure workers are prepared to begin their jobs on day one. This program is praised for its innovation, flexibility, and efficiency (Louisiana Economic Development). This program can and has been used to assist oil and gas companies in Louisiana. The staff at LED often works to develop virtual workforce training modules to workers in learning how to utilize the equipment. This helps with employee and safety and saves money for the oil and gas companies long-term. Louisiana Job Connection was used by LED Fast job fairs to help skilled energy workers find new jobs in other Louisiana industries after they had been displaced by the downturn in the oil and gas industry.

Certified Sites Programs

LED Certified Sites are development-ready industrial sites. This program, conducted by a third-party engineering firm, provides certification to sites and buildings that undergo an extensive application process. The certification recognizes the site's suitability and readiness to ensure success in the site selection process (Louisiana Economic Development). There is potential to use Certified Sites in the site selection process for oil and gas companies. Intertek has used the Certified Sites Program to help locate potential office spaces in Louisiana. Now they are in a position to assist oil and gas companies within the state. These Intertek offices are outside of the TMS region, but there are many LED Certified Sites within the TMS region as well.

CEO Roundtables

LED hosts CEO Roundtables to gather groups of 15 to 18 key decision makers in Louisiana over the course of one year to collaborate and discuss business and personal issues with the guidance of

experienced facilitators. Participation in the roundtables offers peer-to-peer learning through discussion, interaction, and sharing of experiences (Louisiana Economic Development). This program caters mostly to small businesses. Oil and gas companies can participate, but they have not done so as much in the past.

Mentor-Protégé Recognition Program

The Mentor-Protégé Recognition Program connects Louisiana-based small and emerging businesses to technical and developmental assistance provided by mentor companies. The mentor is responsible for guiding the protégé into completing and taking advantage of public-private business opportunities (Louisiana Economic Development). There is potential here to assist oil and gas companies, but this program has not done so much in the past.

Manufacturing Extension Partnership (MEP)

MEP is a public-private partnership with the center in all 50 states and Puerto Rico. The primary purpose is to serve small and medium-sized manufacturers. The Manufacturing Extension Partnership of Louisiana (MEPOL) offers four specific services to Louisiana manufacturers:

- Certification & Continuous Improvement
  - This aspect focuses on putting processes and procedure in place to make measured improvements over time.
- Sustainability & Strategic Solutions
  - MEPOL helps manufacturers improve productivity and operational efficiency while meeting federal mandates and gain a competitive advantage.
- Workforce Development
  - MEPOL offers several services for attracting employees with both soft and technical skills. They also provide leadership training for managers and supervisors, help to reduce turnover, and help to create more innovative thought processes.
- Growth & Innovation
  - This aspect of MEPOL provides manufacturers with product development and commercialization assistance to help move new product opportunities into production and out into the market.

The Mississippi Manufacturers Association – Manufacturing Extension Program (MMA-MEP) is the MEP represented in Mississippi. MMA-MEP helps Mississippi manufacturers remain globally competitive. The MEP Mississippi Center is a community college and university-based, providing small and medium-sized manufacturers the tools to innovate, create and retain jobs, increase profits, and save time and money. MMA-MEP is responsible for conducting the following services:

- Client Assessment Services
- Training
- Quality Assessments
- Growth Assessments
- Sustainability Services
- Strategic Business Management and Planning
- Technological Services

- Financial Analysis
- Sales/Marketing/Business Development
- Engineering Services
- Information Technology Services

The majority of MEP's work in Louisiana and Mississippi has pertained to helping manufacturers outside of the oil and gas industry. However, some oil and gas companies benefit from the services of these metal and electricity manufacturers. Ultimately, the MEP has an indirect effect on the oil and gas industry.

Mississippi State BRE Programs

Mississippi's Workforce Investment Network (WIN) Job Centers

Mississippi's Workforce Investment Network Job Centers assist businesses in finding workers through traditional recruitment activities, online recruiting/application processes and job fairs. WIN also provides on-the-job training, which helps offset training costs. Likewise, businesses may qualify for reimbursement of up to half of a new employee's wages during training (Mississippi Development Authority). The job centers have helped oil and gas recruiters find employees. This program works closely with Steve Bishop, the president of Southwest Mississippi Community College, to help recruit oil and gas workers for companies looking for skilled workers.

Mississippi Works

Mississippi Works is Mississippi's online resource for connecting job seekers with employers. The goal of this program is to ensure that every Mississippian has a job and businesses can find quality talent, resources, and a solid infrastructure on which the business can build upon. Mississippi Works has helped thousands of Mississippians find jobs since 2014 (Mississippi Development Authority). Similar to Mississippi's Workforce Investment Network Job Centers, Mississippi Works job centers have helped oil and gas recruiters find employees through Southwest Mississippi Community College. According to Mississippi's Energy Roadmap, Mississippi Works has increased energy-based jobs in Mississippi as the state has continued to encourage exploration and extraction.

Mississippi Works Training Fund

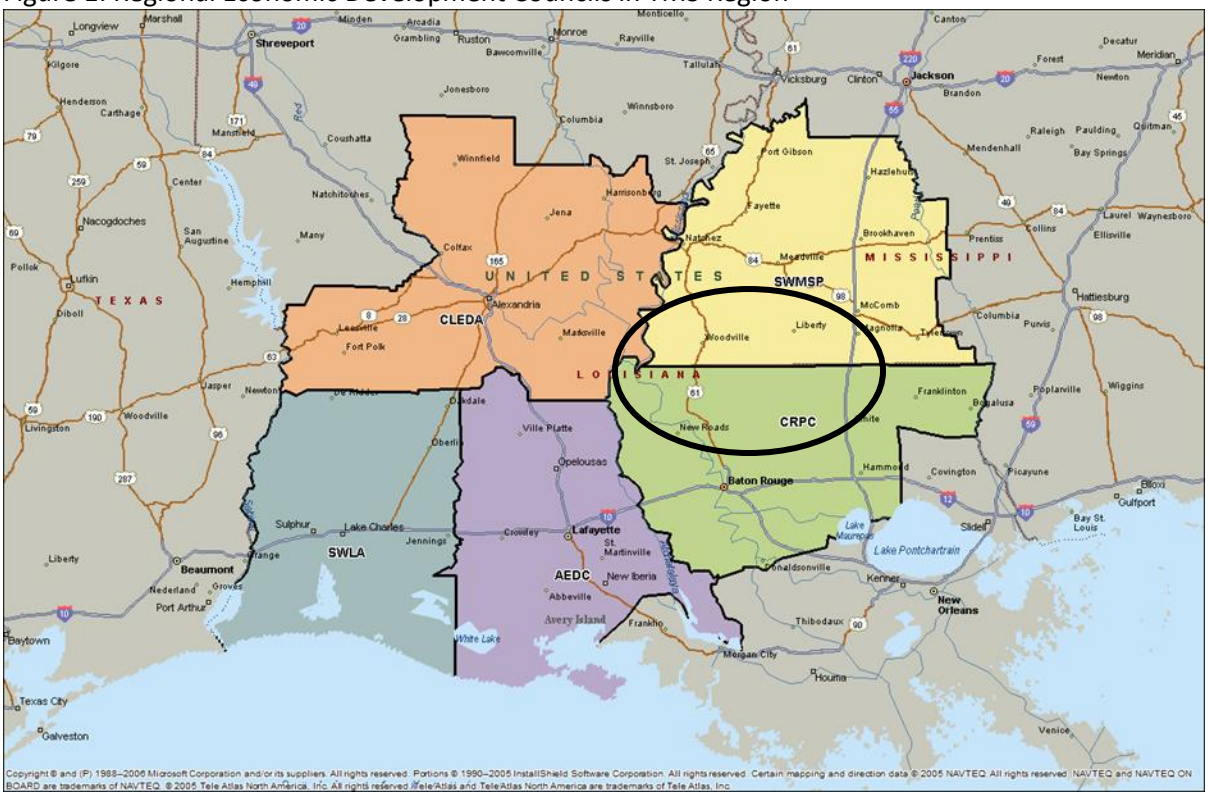
Mississippi Works Training Fund allocates money to enhance training opportunities at the state's 15 community colleges. Mississippi Development Authority directs funds as part of industry recruitment and expansion efforts. In 2016, the Mississippi Works Training Fund, allocated $50 million across the state over 10 years (Mississippi Development Authority). Some of this money has gone to Southwest Mississippi Community College who has an Oil & Gas Production program.

Regional BRE Programs for TMS

Regional economic development councils are alliances between different counties within a respective region of a state. The councils come together to achieve certain goals that will help develop the whole region. There TMS region contains five regional organizations in total. Each of these five organizations host workforce training programs as BRE efforts. These are the only differences in BRE programs from

the state level regarding the TMS region. These regions are mapped by their correlating number in the listing (see Figure 1).

Figure 1. Regional Economic Development Councils in TMS Region



Source: Google Maps

1. Central Louisiana Economic Development Alliance (CLEDA)
   CLEDA is an organization which consists of the economic development entities from the parishes of Avoyelles, Catahoula, Concordia, Grant, LaSalle, Rapides, Vernon and Winn. The mission of CLEDA is to advance the knowledge and understanding of economics and to develop economic planning and development.

2. Southwest Louisiana Economic Development Alliance
   Southwest Louisiana Economic Development Alliance is the umbrella organization of the Chamber/SWLA, the SWLA Alliance Foundation and the Southwest Louisiana Partnership for Economic Development. These regional economic development organizations, each with its own board of directors, have combined resources to strengthen the business recruiting and retention efforts for Allen, Beauregard, Calcasieu, Cameron, and Jefferson Davis Parishes.

3. Acadiana Economic Development Council (AEDC)
   AEDC is a nonprofit organization founded by local economic developers and incorporated in 2004. AEDC represents the primary economic development organizations in the Acadiana parishes of Acadia, Evangeline, Iberia, Lafayette, St. Landry, St. Martin, and Vermilion.

4. Capital Region Planning Commission (CRPC)
   CRPC is a Council of Governments serving the eleven-parish Capital Region, which includes the following Parishes: Ascension, East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, Tangipahoa, Washington, West Baton Rouge, and West Feliciana. In addition, CRPC is one of eight sub-state planning and development districts that cover all 64 parishes in Louisiana. Toward that end, CRPC provides technical assistance for economic development, comprehensive planning, and zoning to its members.

5. Southwest Mississippi Partnership (SWMSP)
   SWMSP is a regional economic development organization consisting of 11 counties in Southwest Mississippi. These Mississippi counties include Adams, Amite, Claiborne, Copiah, Franklin, Jefferson, Lawrence, Lincoln, Pike, Walthall, and Wilkinson. This partnership promotes the sharing or resources and utilization f personnel among its member counties. For years, they have facilitated economic prosperity for the region.

Local BRE Programs for TMS

Local economic development organizations in the TMS region are not very active in oil and gas business assistance now, as the market has slowed down due to low oil prices. They mostly align and work with the ones offered by the state. These BRE programs are shown in Table 2. They mostly pertain to the financial assistance part of BRE. The tax exemptions vary widely. They differ in exemptions from gas, from oil, from oil and gas, and from special severance tax rates (see Table 2).

Table 2. Local BRE Programs in the TMS Region

Gas Severance Tax Exemptions	***Gas Severance Tax Special Rates***
Injection: The gas injected maintains reservoir pressure and enhances the recovery of oil and other hydrocarbons. This gas will eventually be reproduced and sold, and at that time, the tax will be paid. This is more of a deferred payment than an exemption.	**Incapable Oil-Well Gas:** Gas produced from oil wells determined to have fifty pounds or less wellhead pressure per square inch, or producing by artificial methods, gaslift, or pumping, are eligible for a reduced tax rate of three cents per MCF.
Produced Outside the State of Louisiana: This is gas produced in another state, transported into Louisiana, and injected.	**Incapable Gas-Well Gas:** Gas produced from gas wells determined to be incapable of producing an average of 250,000 cubic feet per day is eligible for a reduced tax rate of one and three-tenths cents per MCF.
Flared or Vented: This exemption is for gas flared or vented to the atmosphere. Gas is normally flared or vented when testing, waiting on the sales line, or gas in noncommercial quantities.	**Gas with No Tax Reimbursement and Sold at a Price Less Than the Area Ceiling Rate:** Enacted in 1974, gas sold under a contract approved by the Department of Revenue and Taxation as receiving less than 50% tax reimbursement of increased taxes and at a price less than the area ceiling rate is eligible for a reduced tax rate of four cents per MCF. The contracts are in a phase-out stage, and there are few remaining.

Consumed in Field Operations: This exemption is for gas used or consumed in maintaining the operation of a field. This includes heating, separating, producing, dehydrating, compressing, and pumping of oil and gas in the field where produced.	**Gas with Less Than Fifty Percent Tax Reimbursement of Increased Taxes and at a Price Less Than the Area Ceiling Rate:** Enacted in 1974, gas sold under a contract approved by the Department of Revenue and Taxation as receiving less than 50% tax reimbursement of increased taxes and at a price less than the area ceiling rate is eligible for a reduced rate of four cents per MCF.
Consumed in the Production of Natural Resources in the State of Louisiana: This exemption benefits only one large sulfur company. Producers selling gas to this company, to be used in the production of sulfur, are allowed the exemption.	**Contract Gas at Less Than 52 Cents/MCF:** Effective July 1, 1990, when the indexing method of taxing natural gas went into effect, the tax on gas sold at a rate less than 52 cents/MCF under a written agreement in existence prior to July 1, 1970, shall not exceed seven cents per MCF.
Used in the Manufacturing of Carbon Black: This exemption affects six-carbon black companies operating in Louisiana. The producers selling gas to the carbon black plants for fuel are allowed an exemption.	
Oil Severance Tax Exemptions	***Severance Tax Exemptions Applying to Both Oil and Gas***
Tertiary Recovery: This exemption provides that no severance tax shall be due on incremental crude oil production from a qualified tertiary project approved by DNR until such a project has reached payout. Payout is determined at a public hearing held before the Assistant Secretary of Conservation.	**Discovery Well, New Field:** This exemption, enacted in 1977, provides the working-interest owner in an oil or gas well who discovers a new field is exempt from 50% of all severance taxes on oil or gas from that well for a period of twenty-four months from the date regular production begins. The exemption applies only to the first one hundred barrels of oil per day or the first two million cubic feet per day of gas during the twenty-four-month period.
Trucking, Barging, and Pipeline Fees: Oil and condensate are taxable at 12.5% of gross value or posted field price, fewer charges for trucking, barging, and pipeline fees. The deduction for oil is by statute and for condensate regulation.	**Natural Resources Owned and Served by Political Subdivisions:** This 100% exemption, enacted in 1988, applies to any political subdivision that owns and severs a natural resource for its own use.
Oil Severance Tax Special Rates	
Incapable Oil: When enacted in 1974, the purpose of this reduced rate was to provide an incentive to produce a marginal well. An oil well incapable of producing an average more than twenty-five barrels of oil per producing day and producing at least 50% salt water, and having no other capable well on the lease, is eligible for a reduced tax rate of 50% of the full rate of gross value provided that such well has been certified as incapable to the Secretary of Revenue and Taxation on or before the last day of the month following the month of production.	

Stripper Oil: In 1974, when enacted, the purpose of this reduced rate was to provide an incentive to produce a marginal well. An oil well incapable of producing an average more than ten barrels of oil per producing day is eligible for a reduced tax rate of 25% of the full rate of gross value provided that such well has been certified as a stripper well to the Secretary of Revenue and Taxation on or before the last day of the month following the month of production.
Salvage Oil: Effective July 1, 1986, a tax of 3.125% of value applies to salvage oil, which is reclaimed by salvage crude reclamation facilities which are permitted by the Office of Conservation.
Mining and Horizontal Drilling Projects: This provision became effective August 1, 1990. The working interest portion of mining and horizontal drilling projects in a stripper field approved by the Office of Conservation is taxed at one-quarter of the full rate until the cumulative value of hydrocarbon production from the project equals two and one-third times the total private investment.
Special Severance Tax Rates Applying to Both Oil and Gas
Produced Water Injection: Act 625 was enacted in 1991 and provided a 20% reduction in the severance tax that would otherwise be due on incremental production resulting from injecting produced water into an oil or gas reservoir.
Ad Valorem Tax Exemption
The Louisiana Constitution exempts the oil and gas contained in the earth from ad valorem taxes. However, producing equipment such as the well, derricks, pumps, connections, and other accessories are not exempt.

Source: Louisiana Department of Natural Resources

Intertek Louisiana -Private Sector Business Assistance

Intertek is a Total Quality Assurance provider based out of London, United Kingdom. They have several offices in Louisiana and in other parts of the United States. Intertek is a public company, gaining funding from its shareholders and investors.

A number of technical services are conducted by Intertek in Louisiana (see Table 3). There are offices in Lake Arthur, Gonzales, St. Rose, Houma, New Orleans, Morgan City, Lafayette, Sulphur, Broussard, Schriever, Nederland, Norco, Baton Rouge, West Monroe, and Shreveport. All locations are in cities outside of the TMS region. The offices are placed in a strategic location, according to Intertek.

Table 3: Intertek Services in Louisiana

Louisiana chemical, fuel and petroleum testing:	Louisiana and Mississippi River petroleum, refined product and chemical cargo inspection and metering services:
Petro-chemicals Testing	Petroleum Cargo Inspection Services
Trace Analysis	Chemical Cargo Inspection Services
Contamination Analysis	Additive Services for Petroleum and Fuels
Petroleum Testing	Crude Oil Rail Car Services
Crude Oil and Petroleum Feedstocks Tests	Metering and Calibration
Crude Oil Assay	Inspecting Bulk Commodity Cargos Since 1885
Trace Metals in Petroleum	

Petroleum Trace Analysis	
Fuel Testing	
Biofuels Testing and Inspection	
Oil and Gas Streams Composition	

Source: Intertek

Business Assistance Programs in US Shale Regions

Similar to Louisiana and Mississippi, states with established shale regions (Texas, North Dakota, and Pennsylvania) have incentives that could be helpful to the oil and gas industry, but the only specific programs are tax exemptions. There is a question whether there is a need for these states to develop business assistance programs specific to oil and gas extraction, considering that they have the help and resources of Intertek and are covered well under general business assistance programs. A quick comparison of the TMS region and the Bakken (see Table 4) shows the differences in BRE programs of two shale regions.

A comparison of two shale regions helps to see the difference in business assistance programs more clearly. The TMS region has more programs tailored towards infrastructure, while the Bakkens region has more programs tailored towards technical assistance. This is most likely due to the Bakken Shale Play being a more developed shale region and having a need for more technical assistance.

Table 4. Comparison of Business Assistance Programs

Types of BRE Programs	TMS Region	Bakkens Region
State Economic Development Organization	Mississippi Development Authority Louisiana Economic Development	North Dakota Department of Commerce Economic Development & Finance Division
Regional Economic Development	Central Louisiana Economic Development Alliance Southwest Louisiana Economic Development Alliance Acadiana Economic Development Council Capital Region Planning Commission Southwest Mississippi Planning and Development District	Tri-County Regional Souris Basin Planning Council Roosevelt-Custer Regional Council
Marketing Assistance	Mississippi Works	
Assistance with land and buildings	Certified Sites Programs	Financial packages Tax Incentives

		Research
Infrastructure	Development Infrastructure Grant Program (DIP) Job Protection Grant Program Mississippi Rail Grant Program Site Development Grant Program Capital Improvements Revolving Loan Program (CAP) Energy Infrastructure Revolving Loan Program Existing Industry Productivity Loan Program Port Revitalization Revolving Loan Program	Community Development Loan Fund (CDLF) Telecommunications Fiber Network Emerging Teleservices eBusiness Sector
Financial assistance	Mississippi Works Training Fund	Community Development Loan Fund (CDLF) Revolving Loan Fund (RLF)
Workforce training	LED FastStart CEO Roundtables Mississippi's Workforce Investment Network (WIN) Job Centers	New Jobs Training Workforce Recruitment Youth Forward
Technical assistance and assessments	Mentor-Protégé Recognition Program	InBlend Real-Time Analysis for Crude Field sampling of crude oil in storage tanks, railcars, and pipelines Hydrocarbons Field Sampling Field analysis for crude oil and other products by API Gravity and H2S by Drager Tube. Gauging of storage tanks and railcars Haz-Mat shipping of crude oil, refined fuels, other refined products, and natural gas, for laboratory analysis Local North Dakota laboratory analysis for sulfur content, density, water & sediment, RVP, and H2S.

		Crude oil vapor pressure, VPCRx, ASTM D6377. Conforms to NDIC Rule Order No. 25417. North Dakota Crude Oil and Natural Gas Tests Crude Oil Rail Car Services Shale Oil and Gas Services Crude Oil Quality Testing Shale Gas Analysis Natural Gas Testing Petroleum Refinery Services Petroleum Pipeline Services Metering and Calibration
Export assistance	Louisiana State Trade Expansion Program (STEP) Mississippi State Trade Expansion Program (STEP) International Trade Missions	Market-entry research Export education and certification Trade mission management Assistance in finding reliable international distributors
Assistance in reducing energy costs and complying with environmental laws and regulations	Energy Performance Contracting Franchise Tax Exemption for Clean Energy Businesses Mississippi Clean Energy Initiative Program	Renewable Energy Corporate Tax Credit Renewable Energy Property Tax Exemption State Facility Energy Improvement Program Business Energy Efficiency Rebates Utility Rebate Program Xcel Energy Commercial Energy Efficiency Utility Rebate Program
Tax and non-tax incentives	Gas Severance Tax Exemptions Oil Severance Tax Exemptions Severance Tax Exemptions Gas Severance Tax Special Rates Oil Severance Tax Special Rates Special Severance Tax Rates Applying to Both Oil and Gas	Oil Gross Production Tax Exemptions Gross Production Tax Exemptions Oil Extraction Tax Exemptions

	Ad Valorem Tax Exemption	

Source: Mississippi Development Authority, Louisiana Economic Development, North Dakota State Government, Intertek

State BRE Programs in Shale Regions

The Bakken, Eagle Ford, and Marcellus shale plays belong to North Dakota, Texas, and Pennsylvania respectively. There are several BRE programs in these states. However, only the ones pertaining to oil and gas are mentioned in the following text. Most involve severance tax, a financial aspect of BRE.

1. North Dakota Oil & Gas Severance Tax (North Dakota Tax Commissioner, 2020)

   The oil and gas gross production tax is imposed in lieu of property taxes on oil and gas producing properties.

   i. Oil Gross Production Tax - 5% rate is applied to the gross value at the well of all oil produced, except royalty interest in oil produced from a state, federal, or municipal holding and from an American Indian holding within the boundary of a reservation.
   ii. Gas Gross Production Tax - tax on gas is an annually adjusted flat rate per MCF of all nonexempt gas produced in the state. The annual adjustments are made according to the average producer price index for gas fuels.
   iii. Oil Extraction Tax - tax levied on the extraction of oil from the earth.

2. Texas Severance Tax Incentives – The state of Texas offers severance tax incentives for oil and gas companies. Texas recognized back in the late 1980's that incentives to increase the state's oil and gas production were extremely valuable. Economic studies have shown that for each dollar invested in the oil and gas industry and for each dollar of production, there is a positive effect on the state's economy (Texas Economic Development, 2020). The baseline Texas severance tax on oil and gas is as follows:
   - Gas severance tax = 7.5% of market value of gas produced and saved
   - Oil severance tax = 4.6% of market value of oil produced
   - Condensate tax = 4.6% of market value

3. Partnerships for Regional Economic Performance (PREP) is Pennsylvania's network of business assistance partners designed to help companies start, grow, and prosper. The PREP network consists of hundreds of trained and experienced experts who offer assistance and resources (Pennsylvania Department of Community and Economic Development, 2020). Each regional PREP team works together to coordinate the resources and services offered by local economic development service providers, including:
   - Industrial Development Organizations (IDOs)
   - Local Development Districts (LDDs)
   - Small Business Development Centers (SBDCs)
   - Industrial Resource Centers (IRCs)

- Complementary Economic Development Organizations

Regional BRE Programs in Shale Regions

There are 13 different regional economic development organizations in the Bakken, Eagle Ford, and Marcellus Shale Plays (see Table 5). These regional organizations form to develop economic development programs and initiatives for the communities that make up the region. They can be key players in developing useful oil and gas programs for the industry.

Table 5. Regional Economic Development Organizations in US Shale Regions

Bakken (North Dakota)
Tri County Regional
Souris Basin Planning Council
Roosevelt-Custer Regional Council
Eagle Ford (Texas)
Alamo Area Council of Governments
South Texas Development Council
Capital Area Economic Development District
Marcellus (Pennsylvania)
Northeastern Pennsylvania Alliance
North Central Pennsylvania Planning and Development Commission
Northern Tier Regional Planning and Development Commission
Northwest Pennsylvania Regional Planning and Development Commission
Southern Alleghenies Planning and Development Commission
SEDA-Council of Governments
Southwestern Pennsylvania Commission

Below are the BRE programs that would be applicable to oil and gas companies. Two of them provide financial assistance while one pertains to workforce training.

1. Community Development Loan Fund (CDLF)
   The Community Development Loan Fund was established by the Roosevelt-Custer Regional Council in North Dakota to provide gap financing and equity investment for projects that will create or retain jobs for low to moderate income persons (Roosevelt-Custer Regional Council, 2020). The goals of this fund are to meet the needs of job creation, value added manufacturing activities, diversification, retention and expansion of existing businesses, and use of vacant buildings and facilities. This is not used in the oil and gas sector often.
2. Revolving Loan Fund (RLF)
   Roosevelt-Custer Regional Council established a revolving loan fund to meet the economic development needs of the Region VIII counties (Roosevelt-Custer Regional Council, 2020). Companies in the oil and gas sector can take advantage of this loan to help develop a firm

foundation for gaining skillfully competent employees. The objectives of the Revolving Loan Fund include:

- Creation of permanent jobs
- Economic Diversification
- Leveraging of private and local investments
- Benefits to the county, region and state economy
- Assistance to disaster impacted businesses

3. WorkKeys
   WorkKeys, developed by ACT, measures the skills that are crucial for job success. Over 17,000 occupations have been profiled to identify the skills needed to learn and perform on the job. In Northern Tier Pennsylvania, applied mathematics, reading for information, and locating information are core components because they measure the skills valuable for any occupation and are seen by employers as crucial basic skills (Northern Tier, 2020). WorkKeys is able to identify crucial skills for the oil and gas sector and help employers better communicate the skills they are looking for.

Intertek Services (Local BRE Programs in US Shale Regions)

Intertek provides industry support for oil and gas companies in shales regions such as Bakken, Eagle Ford, and Marcellus. Intertek conducts oil and gas testing, inspection, metering, and engineering services for these shale regions as shown in Table 6. A more detailed description of provided services in each shale region is listed in Table 7. Intertek was introduced to the Bakken and Marcellus in 2013, and to Eagle Ford in 2014.

Table 6. Intertek's Oil & Gas Technical Services

Shale Oil and Gas Quality Testing	**Shale Oil and Gas Exploration and Production**
Natural Gas Testing	Gas Shale Reservoir Services
Natural Gas Composition	Condensate Composition Testing and Analysis
Shale Gas Analysis	Coalbed and Shale Natural Gas Evaluation
Natural Gas Liquids Testing	Reservoir Fluids Testing and Evaluation
Crude Oil Assay	Core Analysis Services
Crude Oil and Petroleum Feedstocks Tests	
Hydrocarbons Field Sampling	
Pipeline Transmix Testing Services	
Shale Oil and Gas Logistics and Inspection	**Shale Well Control and Other Service**
Crude Oil Rail Car Services	Well Control Training
Metering and Meter Calibration	Business Solutions for Oil & Gas
Tank Calibration Services	
Petroleum Cargo Inspection	
Petroleum Pipeline Services	

Pipeline Integrity Services	

Source: Intertek

Table 7: Intertek's Specific Services in Shale Regions

Bakken Oil and Gas Services	Eagle Ford Oil and Gas Services
InBlend Real-Time Analysis for Crude	Shale Oil and Gas Services
Field sampling of crude oil in storage tanks, railcars, and pipelines	Crude Assay Tests
Hydrocarbons Field Sampling	Shale Gas Analysis
Field analysis for crude oil and other products by API Gravity and H2S by Drager Tube	Crude Oil Rail Car Services
Gauging of storage tanks and railcars	Crude Oil by Rail DOT Classification Testing
Haz-Mat shipping of crude oil, refined fuels, other refined products, and natural gas for laboratory analysis	Natural Gas Liquids Testing (Condensates)
Local North Dakota laboratory analysis for sulfur content, density, water & sediment, RVP, and H2S	Petroleum Refining and Distribution Services
Crude oil vapor pressure, VPCRx, ASTM D6377. Conforms to NDIC Rule Order No. 25417	Petroleum Cargo Inspection
North Dakota Crude Oil and Natural Gas Tests	Metering and Calibration
Crude Oil Rail Car Services	Hydrocarbons Field Sampling
Shale Oil and Gas Services	Natural Gas Composition
Crude Oil Quality Testing	Technical Inspection Services
Shale Gas Analysis	Hazardous Locations Full Certification for North America
Natural Gas Testing	**Marcellus Oil and Gas Services**
Petroleum Refinery Services	Well-site and field technical services
Petroleum Pipeline Services	Hydrocarbons field sampling
Metering and Calibration	Load and off-load survey inspection for barges, railcars, trucks
Bismarck and Minot North Dakota locations ensure fast, reliable service	Inspection and sampling of barges, railcars, trucks
Additional testing, inspection, and metering services available for North Dakota and Bakken shale clients	Precision sampling and analysis of crude oil, gases, liquid condensates, and other hydrocarbons
	High pressure gases and liquid condensates sampling and analysis
	Crude oil and petroleum refined products testing
	Natural gas laboratory analysis
	True Vapor Pressure analysis
	Isotopic analysis for liquids and gases (IGRC/MS)

Source: Intertek

Safe Operations & Performance Consulting & Training

Intertek provides business solutions through their Safe Operations & Performance (SOP) consulting. This methodology is a form of oil and gas technical training that provides competence assurance, improved technical skills, and operational excellence. The framework of SOP is comprised of five indicators: People, Culture, Processes, Delivery, and Sustainability. Intertek's ultimate goals with SOP are to improve operational performance, reduce costs, and save lives (Intertek). Through SOP, Intertek is addressing workplace safety, education and training, and project management and innovation – all of which are common workforce needs in the oil and gas industry.

Conclusion

The TMS marine shale region has many business assistance programs, but the only one pertaining to oil and gas extraction companies specifically are tax exemptions. There is not extensive technical assistance offered in the TMS region, compared to more developed shale regions. There are several Intertek offices in the state of Louisiana, but they lie outside of the TMS region. There is opportunity for economic development organizations within the TMS to work with the offices outside of the region. EDOs in the TMS region should prepare to assist businesses in the event of an increase in oil prices. State organizations such as MDA and LED must consider the cyclical nature of oil and gas prices.

The repetitive rise and fall of oil prices throughout the past ten years give reasonable justification as to why these state organizations should develop business assistance tailored to well drilling companies. With the TMS region overlapping the Austin Chalk Play and hydraulic fracturing heightening the potential of extraction, the TMS region could gain a surge of businesses attraction in the event of increased oil prices.

Communicating with executives of economic development organizations in established shale regions could be beneficial for the TMS, as executives in the TMS region could gain insight as to how they can best assist oil and gas companies. There is also potential for MDA and LED in partnering with Intertek. Intertek has a proven record of performing well and aiding in the development of shale regions. With these conclusions gathered from the investigation of business assistance programs in the TMS region, economic development practitioners can take the necessary steps to implement solutions to meet the specific business needs of the region.

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Appendix A: Mississippi and Louisiana State Workforce and Businesses Investment Board

Program	Target Population
Louisiana Workforce Commission	
HiRE – Helping Individuals Reach Employment	Citizens looking for employment
Jump Start Program	High school students
Pre-Employment Transition Services	High school students
Ticket to Work Program	People with disabilities
Louisiana Rehabilitation Services	People with disabilities
First Episode Psychosis (FEP) Programs	People with disabilities
Blind Services	People with disabilities
Independent Living Program	People with disabilities
Vocational Rehabilitation Services	People with disabilities
Employer Services	People with disabilities
Home and Community Services	People with disabilities
Louisiana Economic Development	
LED FastStart	Citizens looking for employment
Certified Sites Programs	Business Owners
Bonding Assistance Program	Companies
CEO Roundtables	CEOs and Key Decision Makers
Economic Gardening Initiative	Small Business
Hudson Initiative	Small Business
Louisiana Contractors Accreditation Institute	Veterans
Louisiana Veterans First Business Initiative	Veterans
Mentor-Protégé Recognition Program	Companies
Small and Emerging Business Development Program	Small Business
Small Business Loan and Guaranty Program	Small Business
STEP Grant	Small Business
Veteran Initiative	Veteran-Owned Small Business
Mississippi Development Authority	
Mississippi's Workforce Investment Network (WIN) Job Centers	Mississippi businesses
Mississippi Works	Mississippi businesses
The Mississippi Works Training Fund	Mississippi businesses

Sources: Mississippi Development Authority, Louisiana Economic Development, Louisiana Workforce Commission