The Greening of Mississippi’s Economy:
the Mining, Quarrying, and Oil and Gas Extraction Sector
In 2009, Mississippi and Louisiana partnered to research economic development opportunities and workforce needs associated with the region’s green economy. Through a $2.3 million grant from the U.S. Department of Labor, a consortium of the Mississippi Department of Employment Security, Mississippi State University, Louisiana Workforce Commission, and Louisiana State University conducted an extensive study of economic activity that is beneficial to the environment. This and other research products were developed as part of that effort.

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Description of Sector

The North American Industry Classification System (NAICS) describes the activities of the Mining, Quarrying, and Oil and Gas Extraction sector, NAICS 21, as the withdrawal of naturally occurring minerals (coal and ores for example), petroleum, and gases from the ground. While these are the primary activities associated with mining, other activities such as crushing, screening, washing, and preparing a mining site are also included. Mining support operations such as exploration are included in this sector as well. In Mississippi, this sector employs 5,817 people representing 0.5 percent of total nonfarm employment. In 2009, the private entities in this sector were responsible for $1,153 billion, or 1.2 percent of Mississippi’s gross state product.

The Mississippi Green Jobs Survey was conducted during the third and fourth quarters of 2010 as part of this research effort to quantify and characterize the green economy in Mississippi. The survey provides a baseline measure of green employment. The survey results show an estimated 17,360 primary green jobs in Mississippi across all sectors, which represent 1.6 percent of Mississippi’s nonfarm employment. An estimated 32,300 support green jobs raises the total number of jobs involved in green activity categories to 49,660 jobs or 4.6 percent of nonfarm employment. The survey found that Mississippi’s Mining, Quarrying, and Oil and Gas Extraction sector accounted for 221 primary green jobs, but the number of support green jobs was not reported due to a low number of responses. These survey results reveal that 3.8 percent of jobs in the Mining, Quarrying, and Oil and Gas Extraction sector are primary green jobs.

Introduction to the Green Component of the Mining, Quarrying, and Oil and Gas Extraction Sector

Mississippi is not an “energy state” relative to others, like its neighbor Louisiana. According to the U.S. Energy Information Administration (EIA), Mississippi’s natural gas production is minimal and makes up only 1 percent of total U.S. output. Production in the state has been on the decline since 2003 despite a few new wells and volumes of non-hydrocarbon gases produced from former natural gas wells are increasing. Natural gas remains the state’s leading commodity source for electricity production, but Mississippi imports more than half of its natural gas from neighboring states and is poised to begin accepting international shipments. The EIA also reports that

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a A primary green job is defined as one where more than 50 percent of an employee’s time is devoted to one of the seven green activity categories: renewable energy; energy efficiency; greenhouse gas reduction; pollution reduction and clean-up; recycling and waste reduction; sustainable agriculture, natural resource conservation and coastal restoration; and education, compliance, public awareness and training supporting the other categories.

b Support green jobs are defined as those essential to an organization’s involvement in one of the activity categories, but not requiring more than 50 percent of an employee’s effort.
Mississippi is home to only one coal mine, in Choctaw County, that supplies lignite to a nearby clean-burning coal power plant. All other coal-burning electricity producing plants in the state import coal from Colorado, Kentucky, and Illinois. Mississippi is also home to a number of potential shale gas plays that could increase the activity of the Mining, Quarrying, and Oil and Gas Extraction sector in the state in the future.

When oil and gas refining, processing, transportation and marketing are taken into account, Mississippi can be seen as much more dependent on oil and gas activities. In a report prepared by Price Waterhouse Coopers for the American Petroleum Institute in 2009, the economic impact of the broad oil and natural gas industry in Mississippi for 2007 placed the state 11th for jobs as a percentage of total state jobs. Total impacts in the state accounted for 5.5 percent of all jobs, 6.5 percent of all labor income and 8.4 percent of the value added.

Mississippi’s Mining, Quarrying, and Oil and Gas Extraction sector will see transformative changes in the coming decades. The developed world is dependent on the oil and gas resources drilled from the Earth, and areas like the Gulf Coast are able to reap great economic benefits from that activity. However, it is widely understood that use and pursuit of these resources has hastened environmental degradation and cannot be sustained indefinitely because the resources themselves will eventually run out. Environmental risks are also possible during the exploration and extraction of these resources. The Deepwater Horizon disaster that began in April of 2010 released an estimated 4.9 million barrels of oil into the Gulf of Mexico over three months that polluted beaches and marshes, killed or harmed wildlife and its habitat, shut down commercial and recreational fishing, and reduced tourism along the Gulf Coast from Louisiana to Florida. As both a home-base for oil and gas extraction and ground zero for the human and ecological consequences that can occur when drilling goes wrong, Mississippi must perform a difficult balancing act to encourage oil and gas exploration while protecting the environment.

This report will focus on the environmentally beneficial activities of the Mining, Quarrying, and Oil and Gas Extraction sector in Mississippi in two major areas: goods and services and business practices. Discussions of this sector’s involvement in environmentally beneficial activities will be provided where significant involvement by the sector is found. As with other components of this project, green was defined based on seven green activity categories:

1. Renewable Energy
2. Energy Efficiency
3. Greenhouse Gas Reduction
4. Pollution Reduction and Clean-up
5. Recycling and Waste Reduction
6. Sustainable Agriculture, Natural Resource Conservation and Coastal Restoration
7. Education, Compliance, Public Awareness and Training Supporting the Other Categories

Each activity category includes: the research, development, production and distribution of a final good or service; the supply of unique parts or inputs to a final good or service; and production processes and business practices regardless of the final good or service produced. The table below indicates which environmentally beneficial categories will be featured in this report.

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Green Goods and Services

Although this sector provides the modern world with access to the primary fuels and feedstocks it needs to power society, many of these products come with environmental consequences. Nevertheless, the Mining, Quarrying, and Oil and Gas Extraction sector is providing important green goods and services based on their specialized experience and expertise. Extracting materials from deep within the Earth has opened doors for exploring underground renewable energy resources and provided new locations to store excess carbon dioxide that would ordinarily be released into the atmosphere. The application of new techniques for resource recovery has also made available vast new reserves of natural gas, a fossil fuel with fewer pollution and greenhouse gas consequences, which is altering the country’s energy mix.

Renewable Energy

Expertise in the exploration, drilling and extraction of oil and gas resources is being applied to the utilization of underground renewable energy. Geothermal energy can be obtained from pockets of hot water, steam and rock close to the Earth’s surface or from magma miles beneath the surface. In a process very similar to drilling for oil, renewable geothermal energy can be extracted by drilling wells to access underground water or steam that can then be used to create electricity. Oil and gas extraction industry leader Baker Hughes has provided equipment and services to 95 percent of all geothermal energy wells ever drilled. The company is also developing technology to derive energy from geologic formations that lack the hydrothermal resources typically needed to bring geothermal energy to the surface. So far, Baker Hughes is assisting with geothermal energy sites outside of Mississippi and in international locations.
Within the state, Gulf Coast Green Energy and Denbury are working together to co-produce oil and geothermal electricity from actively producing oil wells in Laurel, Mississippi. The test project will use the hot, produced water from the oil well to generate electricity that can be used on-site or sold to other end users.\(^9\)

In future, Mississippi has the opportunity to convert their network of offshore oil and gas platforms into renewable wind energy platforms once they are no longer actively producing fossil fuel resources. With the passage of the Energy Policy Act of 2005, the Bureau of Ocean Energy Management, Regulation and Enforcement (then the Minerals Management Service) assumed jurisdiction over projects utilizing existing oil and gas platforms in federal water for alternative energy uses on the Outer Continental Shelf. Oil and gas rigs are allowed to remain in place under this law after extraction activities have ceased for renewable energy projects including ocean thermal energy (exploiting temperature differences between depths of water), ocean mechanical energy (tides and waves), offshore wind and offshore solar.\(^{10}\) Offshore wind projects are currently being developed off the coast in Texas and New Jersey with other locations on the east coast also under consideration.

**Energy Efficiency**

No evidence of significant involvement for this activity category was found in the Mining, Quarrying, and Oil and Gas Extraction sector.

**Greenhouse Gas Reduction**

While the Mining, Quarrying, and Oil and Gas Extraction sector has historically been a source of significant greenhouse gas emissions, recent innovations offer a real opportunity for the sector to contribute to greenhouse gas reduction. One of the most promising technologies to mitigate carbon dioxide build up in the atmosphere is carbon sequestration also known as carbon capture and storage (CCS). During carbon capture and storage CO\(_2\) that would normally be released into the atmosphere is injected into underground geologic formations for safe storage.\(^{11}\) Estimates made by the Department of Energy in 2007 predict that depleted oil and gas fields in the U.S. could hold more than 82 billion tons of carbon.\(^{12}\)

In 2003, the United States Department of Energy’s National Energy Technology Laboratory formed several regional partnerships to investigate geologic formations adequate for carbon storage. The regional partnership to which Mississippi belongs is known as the Southeast Regional Sequestration Partnership or SECARB. SECARB found that target formations such as oil and gas reservoirs, coalbed methane reservoirs and saline aquifers identified along the Gulf Coast region could potentially be used to store 50 percent of all carbon dioxide produced in the southeast during the next 100 years. Named “the Gulf Coast Wedge,” this collection of formations has the capacity to sequester carbon dioxide for 300-1,200 years.\(^{13}\) In the Gulf Coast region, salt formations are also a
key part of carbon sequestration. In Mississippi, a carbon storage project was initiated by the electric Power Research Institute and utility provider Southern Company. This project involves testing a number of technologies and techniques for proper carbon storage including the mapping of geologic reservoirs, simulations of carbon injections, tests of storage capacity and the extended fate of the injected gas, and monitoring of the injected gas.\textsuperscript{14} At a test site in the Cranfield oil field near Natchez, Mississippi, the United States completed the first successful carbon injection and capture of more than one million metric tons.\textsuperscript{15}

In the Cranfield case, as with many others, carbon sequestration is used hand in hand with enhanced oil recovery (EOR), a 40-year old oilfield practice to increase and extend well production. During EOR, the injected carbon dioxide helps the trapped oil flow more easily out of the production well.\textsuperscript{16} As more oil fields are reaching the maturity stage, enhanced oil recovery using carbon capture and storage is becoming more and more attractive. During enhanced oil recovery, a portion of the carbon dioxide is returned with the recovered oil and recycled for reuse in other EOR projects and another portion of the gas remains trapped in the formation. Currently, this technique uses 48 million metric tons of carbon dioxide each year with 25 percent of that carbon dioxide coming from man-made sources. In 2006 EOR yielded 650,000 barrels of oil per day which is nearly 13 percent of total U.S. production.\textsuperscript{17}

Oil and gas company Baker Hughes offers carbon capture and storage services alongside its traditional drilling services in Mississippi. Technicians and engineers can assist with the assessment of sites for carbon dioxide injection and retention, well monitoring systems to evaluate CO\textsubscript{2} leaks and storage capacity, and pipeline consulting to assist with the transport of CO\textsubscript{2} from its source to the injection site.\textsuperscript{18}

\textbf{Pollution Prevention and Clean-up}

Because natural gas burns more cleanly than other fossil fuels, with lower levels of air pollutants NO\textsubscript{x}, SO\textsubscript{x} and particulates than oil or coal, oil and gas companies could be seen as assisting in pollution and greenhouse gas reducing efforts. Several Mississippi energy firms are actively promoting natural gas as an alternative transportation fuel and it is also being promoted as a clean alternative fuel by the Mississippi affiliates of the Department of Energy’s Clean Cities Program. As with other fossil fuel energy sources, however, combustion is only one part of the fuel’s environmental footprint. New techniques for retrieving natural gas are raising questions about the practice’s overall impact on local environments. These practices and risks will be discussed in the green business practices portion of this report under the heading “Sustainable Agriculture, Natural Resource Conservation and Coastal Restoration.”
Recycling and Waste Reduction

No evidence of significant involvement for this activity category was found in the Mining, Quarrying, and Oil and Gas Extraction sector.

Sustainable Agriculture, Natural Resource Conservation and Coastal Restoration

No evidence of significant involvement for this activity category was found in the Mining, Quarrying, and Oil and Gas Extraction sector.

Education, Compliance, Public Awareness and Training

No evidence of significant involvement for this activity category was found in the Mining, Quarrying, and Oil and Gas Extraction sector.

Green Business Practices

From finding ways to cogenerate more of their heat and electricity needs, to recycling drilling apparatuses for wildlife habitat and turning waste water into production process water, Mississippi’s mining, quarrying, and oil and gas extraction companies are finding ways to reduce their environmental footprint and prevent ecological damages when crises emerge.

Renewable Energy

Operational oil and gas rigs in the Gulf of Mexico are reducing their energy needs by adopting renewable energy resources on their platforms. Rather than relying solely on gas-powered generators, micro wind turbines and photovoltaic arrays are being added to rigs. According to Southwest Windpower, nearly 500 oil platforms in the Gulf of Mexico are relying on small wind turbines and solar panels to power certain aspects of their operation.¹⁹

Energy Efficiency

Like their counterparts in the refining and chemical manufacturing industries, businesses in the Mining, Quarrying, and Oil and Gas Extraction sector have the opportunity to employ cogeneration in their facilities. Rankine engines that rely on heat to produce electricity can be utilized to convert the hot brine or other produced water that accompanies oil production to co-produce heat and electricity.

Greenhouse Gas Reduction

Methane, a primary constituent of natural gas, is a greenhouse gas able to trap 20 times more heat in the atmosphere than carbon dioxide.²⁰ Producing and transmitting natural gas is a major source of methane emissions through venting, flaring, and equipment leaks. Of the methane produced by oil and gas systems as a whole, 46 percent can be linked to the production of natural gas in onshore wells and shallow water offshore platforms.²¹ In 1993, the EPA began a voluntary
partnership with the oil and gas extraction industry to encourage the adoption of cost-effective technologies and practices that would increase efficiency and reduce methane emissions. Named “Natural Gas STAR,” the program has identified a number of technologies and practices that have been implemented by the industry. Sixty percent of the natural gas industry is participating with the EPA in this effort including 18 of the top 25 producers. Since its inception, 822 billion cubic feet of methane emissions have been eliminated using 150 technologies and practices. According to Natural Gas STAR, gas producers can perform reduced emissions completions, install plunger lifts, implement aerial leak detection with laser or infrared technology, and eliminate unnecessary equipment and systems to reduce methane emissions. Oil producers can also reduce emissions by installing vapor recovery units on crude oil storage tanks and routing casinghead gas to vapor recovery units or compressors for recovery and use.

Pollution Prevention and Clean-up

The oil and gas extraction industry has been active in the state since the beginning of the 20th century. Production processes have improved greatly since the early days of oil extraction when the saltwater byproduct from the extraction process was stored in open air pits that still pose contamination problems to this day. Although concerns about safety and environmental protection are now fully incorporated into extraction processes, drilling activities are expanding into more difficult settings that are testing the limits of the industry’s technology and knowhow. The BP Oil Spill, which unfolded during the summer of 2010, showed that although the likelihood of an accident may be low, the scale of the damages caused by any incident can be extremely high. At the height of the response efforts 47,000 personnel, 7,000 vessels, and 120 aircraft were employed in the clean-up and containment effort of the estimated 4.9 billion gallons of spilled oil.

This disaster led the four largest oil and gas companies to create a new oil spill response system known as the Marine Well Containment System to help improve the abilities of the industry to stop undersea well blowouts. The primary objective of the Marine Well Containment System is to fully prevent all oil from a ruptured well from getting into the surrounding water. ExxonMobil, Chevron, ConocoPhillips, Shell, and most recently BP, have collaborated to design this system to deploy within 24 hours of a blowout and be fully operational within weeks, to be usable on a wide range of well designs and equipment on both oil and gas wells, able to adapt to different flow rates and weather conditions, useful at depths up to 10,000 feet, and to be able to contain 100,000 barrels of output per day. The system will employ undersea components to seal the well and prevent oil from escaping into the water and surface components to capture, process, store, and offload the leaked oil onto shuttle tankers.

The industry has also formed task forces to address different aspects of oil spill prevention and safety that will offer recommendations to the U.S. Department of the Interior Outer Continental
Shelf Safety Oversight Board. The Offshore Operating Procedures Task Force is reviewing drilling and completion practices and regulations to ensure greater safety, and the Offshore Equipment Task Force is studying blowout preventer designs, testing procedures, and regulations. A Subsea Well Control and Containment Joint Industry Task Force has also been formed to evaluate current abilities and to develop a plan to address future equipment, practice, or industry standards needed to enhance oil spill control and containment. A draft of industry recommendations was released in September of 2010 outlining 15 steps for immediate action and fourteen for longer-term implementation along five focus areas: well containment at the sea floor, intervention and containment within the subsea well, subsea collection and surface processing and storage, continuing research and development, and relief wells.

The federal government has also revised its standards for oil spill prevention by the industry. According to the Bureau of Ocean Energy Management, Regulation and Enforcement new regulations for offshore drilling operations require more detailed plans to respond to blowouts, drilling safety rules, and confirmation that all safety regulations are being followed at every well. Regulation NTL-06 requires detailed blowout scenarios including the highest estimated flow rate, total volume, and maximum duration of potential blowouts, the reliability of surface efforts to stop the blowout, relief well rig availability, and the time frame required to complete a relief well. Under the new drilling safety rules, cementing, casing practices, and drilling fluid use are proscribed and oversight of blowout preventers, remotely operated vehicles, shear rams and pipe rams are strengthened. Oil Spill Response Plans are also required to adequately discuss subsea containment equipment, subsea utility equipment, riser systems, remotely operated vehicles, capture vessels, support vessels, and storage facilities.

**Recycling and Waste Reduction**

Efforts to lessen the environmental impact of oil and gas mining by recycling waste water and other production fluids are gaining momentum, particularly through improvements to hydraulic fracturing practices in shale plays.

Mississippi’s foray into shale plays is still evolving; however, Mainland Resources has announced plans to drill in the state at the Buena Vista Prospect, a “future major gas field” according to Mainland Resources. According to the Gerson Lehrman Group, Devon Energy is also exploring the Tuscaloosa Marine shale play on the Mississippi/Louisiana border. These shale plays were too costly to explore until recently with rising energy costs and the use of new technologies. The Mining, Quarrying, and Oil and Gas Extraction sector is now able to exploit natural gas reserves in shale formations using horizontal drilling and hydraulic fracturing.
Horizontal drilling, in which the drill pipe gently curves until it parallels the oil zone, is allowing oil and gas extraction companies to recover more oil and gas from reservoirs by offering more extensive contact areas with the productive portion of a reservoir and avoid drawdown-related problems. Although this drilling technique can be 25 percent to 300 percent more expensive than vertical drilling, it can enhance production, and allow for the drilling of more wells, reduce environmental and land use costs, and produce at rates several times greater than vertical wells.

Hydraulic fracturing, or “fracking,” is also advancing natural gas recovery. The American Petroleum Institute explains that hydraulic fracturing involves establishing spaces in rock pores located deep underground then injecting high pressure fluids comprised of water, sand, and chemicals to crack the rock formation and release the oil or natural gas so that it can be brought to the surface. This process requires or produces fluids at three stages: drilling, completion (fracking), and production (flowback). Fresh water is used for drilling and completion processes and returned as wastewater. During production, naturally occurring salt-water solutions are extracted along with the natural gas that must also be treated and disposed of. According to Chesapeake Energy, a typical deep shale gas well requires 65,000 to 600,000 gallons of water for drilling and 4.5 million gallons per well for fracking. Fluids returning to the surface from drilling, fracking, and production are typically disposed of in “deep injection” wells where they are buried outside of the water cycle.

**Sustainable Agriculture, Natural Resources Conservation and Coastal Restoration**

Natural gas extraction through fracking presents acknowledged risks to natural resources from the potential release of wastewaters into surface-level environments. There is also a debate about the practice’s possible risk to ground water supplies due to drilling and hydraulic fracturing near or below underground aquifers. The natural gas industry reports that this process has been safely used for 60 years on more than 1 million wells. In 2004, the Environmental Protection Agency issued a report evaluating the threat of the contamination of drinking water by hydraulic fracturing fluids concluding that the injection of fracking fluids into coalbed methane production wells “poses minimal threat” to underground sources of drinking water and that additional study was not warranted at the time. After the study’s publication, EPA scientist Weston Wilson, under federal Whistleblower Protection, asserted that the EPA’s recommendations were “unsupportable” and called into question the impartiality of the EPA’s review panel. In 2010, the EPA again identified the need for a study of underground injections during hydraulic fracturing. On the EPA website, the agency, in agreement with the U.S. House of Representatives’ Appropriation Conference Committee, states “that there are serious concerns from citizens and their representatives about hydraulic fracturing’s potential impact on drinking water, human health and the environment, which demands further study.” The EPA held meetings in July, August, and September of 2010 to engage stakeholders in a conversation about the study and expects to finalize the study design in
October 2010 with results ultimately available in late 2012. As of December 2010, all nine of the country’s leading hydraulic fracturing companies had supplied the EPA with information for its study of the fracking process as well as possible impacts of fracking chemicals on human health and the environment.43

While not a primary function of businesses in this sector, oil and gas extraction companies can be directly engaged in coastal restoration activities as a result of an oil spill. In addition to their responsibility to clean up any spilled oil, companies also have a responsibility to restore the environment and compensate the public for lost use and ecosystem services during the time that the environment was injured. This process, called the Natural Resource Damage Assessment, is driven by federal legislation through the Oil Pollution Act of 1990.44

North American Coal Corporation’s Red Hills mine began operations in Ackerman, Mississippi in the fourth quarter of 2000. It supports the Red Hills power plant, an operation of the Tennessee Valley Authority. Mined lands are reclaimed for environmental purposes including pine forest, hardwood forests, streams, and small wetland areas. The mining company also constructed a 75 acre recreational fishing lake. Mining regulations dictate that companies actively manage reclaimed land for at least five years before returning it to the care of private owners.45

Education, Compliance, Public Awareness and Training

No evidence of significant involvement for this activity category was found in the Mining, Quarrying, and Oil and Gas Extraction sector.

Economic Factors

The green related activities in this sector are driven largely by two long-standing economic factors: availability or supply of natural gas and the development of alternate uses for existing technology by profit maximizing firms. Over the last few years, higher volumes of natural gas have become available due to an increase in availability from shale gas fields across the United States. This increase in supply has occurred in large part due to the development of new technologies and techniques that have lowered extraction costs. In an early release of the EIA’s 2011 Energy Outlook, new shale resources led to a doubling of natural gas production estimates through 2035 over the agency’s 2010 Energy Outlook and lower prices for natural gas as well.46 Demand for natural gas has also been bolstered by the relatively low construction costs associated with gas power plants.47

The second overarching factor that has created green opportunities for businesses in this sector is the motivation of profit maximizing firms to reduce costs. High levels of water usage during hydraulic fracturing and the associated high levels of waste water produced by the process are making natural resource conservation and water recycling efforts by the sector more attractive while also
helping to reduce the costs associated with transporting water for well production as well as managing and disposing of the waste water. The profit motive also explains the use of infrastructure or technologies developed for oil and gas extraction in alternate settings to capitalize on those investments. For example, oil and gas extraction companies can use technologies developed for their primary business function in renewable energy projects such as geothermal power generation. Similarly, the potential use of existing offshore platforms for renewable energy projects exemplifies a win-win for oil and gas companies and those seeking to develop renewable alternatives. This secondary purpose offers an additional business opportunity to the oil and gas company while bringing down the cost of developing new renewable project.

A third economic factor that also contributes to the green component of this sector is the protection or enhancement of company brand. Because some end users of the natural resources impacted by this sector value the protection of the environment, the market rewards companies that deploy green business practices. Environmental concerns can be seen as helping to drive the industry’s participation in carbon sequestration efforts. On one hand, carbon dioxide is being used for enhanced oil recovery and on the other it is a purely environmental service potentially able to mitigate increasing carbon dioxide levels in the atmosphere. These carbon concerns are also leading industry experts to assist with geothermal projects that rely on oil and gas extraction technologies to tap the carbon-free resource and to assist with the development of other renewable power sources offshore.

Public Policy

Policies in the mining sectors, other than oil and gas, are fairly mature with the impact on the industry already factored into operations. In 1977 the Coal Mining and Reclamations Act set standards and policies regulating the coal mining industry’s impact on the environment. However, variable degrees of compliance and enforcement have led to changes in the impact of those policies on activities in this sector. In 1983, the stream buffer zone rule forbade nearly all mining within 100 feet of rivers and streams and yet from 1985 to 2001, 724 river miles were buried under mining waste. In August of 2007, the stream buffer zone rule was relaxed legalizing mountaintop removal and waste disposal in streams. Coal mining establishments must also abide by the National Historic Preservation Act, the National Environmental Policy Act, the Endangered Species Act, the Resource Conservation and Recovery Act, the Clean Water Act and the Clean Air Act. State regulations generally include construction, air quality, surface water discharge and operating permits, and solid waste disposal. In Mississippi, standards and policies regulating the coal mining industry’s impact on the environment are set by the Mississippi Surface Coal Mining and Reclamations Act which is administered by the Mining and Reclamation Division of the Mississippi Department of
Environmental Quality (MDEQ). Non-coal mining activities, primarily sand and gravel, are governed by the Mississippi Surface Mining and Reclamation Act that is also administered by MDEQ. Abandoned and out of use mines are also subject to regulation due to the risks they pose. According to the federal Abandoned Mine Lands portal, environmental and health concerns associated with abandoned mines include acidic or metal contaminated waters that may affect fish or fishermen, contaminated or excessive surface runoff that can clog streams and harm ecosystems, dust in the air containing contaminants like arsenic and lead, and disturbance of threatened or endangered species.  

The picture for oil and gas-related industries is quite different. Numerous environmental agencies have regulations that affect the exploration, development, and production processes of the oil and gas extraction industry, and now in response to the BP Oil Spill, the regulatory picture is likely to evolve further. Traditionally, both federal and state agencies maintain oversight for the industry including the federal Environmental Protection Agency, the Bureau of Ocean Energy Management, Regulation and Enforcement (formerly MMS), and the Bureau of Land Management and the Mississippi Department of Environmental Quality. In addition to all of the federal and state agencies that oversee operations of oil and gas extraction firms, there is a formal legal framework at both the federal and state level that dictates how firms should respond to an oil spill. That immediate response, as well as the Natural Resource Damage Assessment process that guides the recovery and restoration of damaged resources, are driven by federal and state legislation including the Oil Pollution Act of 1990.

In May of 2010, the United States Department of the Interior issued a six month moratorium on deep water drilling as a response to the BP Oil Spill in the Gulf of Mexico so that new safety rules could be crafted for the industry. When the moratorium was lifted in October of 2010, the Secretary of the Interior warned the industry that they should expect to be, “operating under tighter rules, stronger oversight, and in a regulatory environment that will remain dynamic as we continue to build on the reforms we have already implemented.” The emerging regulations are mainly focused on safety measures, crisis response resources, and equipment like blowout preventers. But, those measures also include stronger environmental reviews for proposed lease sales including an end to “categorical exclusions” that formerly exempted operations from environmental regulation.

Regulatory agencies overseeing the oil and gas extraction industry are themselves evolving. In the wake of the BP Oil Spill, concerns arose about the close partnership between the Minerals Management Service (MMS) and the oil and gas extraction industry and potential conflicts of interest arising from the agency’s own competing interests. To address those concerns and begin applying lessons from the BP Oil Spill, the Department of Interior created the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE). Currently BOEMRE is
undergoing a re-organizational period to differentiate and reassign the different duties that formerly fell to MMS. After this restructuring BOEMRE will become three separate groups: the Bureau of Ocean Energy Management that will handle planning and leasing; the Bureau of Safety and Environmental Enforcement that will oversee inspections, investigations, penalties, decisions on suspending activities, and crisis response; and the Office of Natural Resources Revenue that will collect royalties and revenues. A new unit will also be created to coordinate with the Department of the Interior’s Office of Inspector General called the Investigations and Review Unit that will respond to allegations of ethics violations and misconduct by Bureau employees or oil and gas companies and assure quick response to crises like oil spills.

The Clean Water Act is also proving to be a significant piece of legislation for penalizing oil and gas extraction companies when environmental disasters occur. A provision of the Clean Water Act allows for fines of up to $1,100 per barrel of oil spilled or, if negligence or willful misconduct is found, fines of $4,300 per barrel. With an estimated 4.9 million barrels of spilled oil from the Deepwater Horizon blowout, BP’s fines under the Clean Water Act alone range from $5.4 billion to $21.1 billion. Normally, the Clean Water Act would divert these fines into a trust fund to pay for clean-up costs of future oil spills, but Louisiana Senator Mary Landrieu has proposed legislation that would direct at least 80 percent of these penalties back to the Gulf Coast for economic and environmental recovery.

In addition to the special concerns posed by deep water drilling, the oil and gas extraction industry is also governed by rules for water, air, and land use. The Safe Drinking Water Act regulates underground injection practices that may affect drinking water supplies. Produced water disposal and enhanced recovery fluid are also regulated. Wells are subjected to integrity tests, injection pressure, flow, and volume monitoring, as well as reporting rules. When wells are closed, certain procedures must be followed to plug the well safely. Hydraulic fracturing, however, is exempt from the Safe Drinking Water Act unless diesel fuel is used in the fracking mixture.

The onshore subcategory guidelines of the Clean Water Act ban the release of water pollutants from any oil or gas production, exploration, drilling, well completion, or well treatment sources. Wetland awareness and permitting are also an issue during exploration carrying special rules for water and solid waste, and fill disposal. Because of water availability challenges and the dependence of oil and gas operations on water resources, the Department of Energy established the Oil and Natural Gas Water Resource Program to research methods for enhancing both water resources and energy supplies. In 2001, the EPA also began using regulations to control the discharge of synthetic-based drilling fluids and other non-aqueous drilling fluids from drilling operations into United States waters by allowing discharges only at locations at least three miles offshore.
The Clean Air Act also governs conduct by the oil and gas extraction industry by setting standards for hazardous air pollutants and requiring the use of maximum achievable control technology to reduce emissions. In July of 2010, the EPA revised the Mandatory Reporting of Greenhouse Gases Rules requiring suppliers of fossil fuels and industrial gases to begin collecting and reporting on emissions in 2010 and 2011 respectively.

**Technology**

Because regulation can be so influential in the business decisions of the Mining, Quarrying, and Oil and Gas Extraction sector, and because those rules are always evolving, there is a constant pressure on the industry to develop new technologies. Concerns about emissions of air toxins and ozone causing pollutants have pushed technological improvements in emissions control devices, and the environmental costs of fugitive methane emissions has also spurred new technology. The EPA and industry’s partnership under the Natural Gas STAR program is a good example of how environmental regulation and cost-consciousness can lead to technological improvements. Without advancing any one vendor over another, EPA has promoted technological improvements through this program to assist the industry. A list of process and technology improvements that can assist with operating costs and environmental compliance along with the expected capital expense can be found on the program’s website: [http://www.epa.gov/gasstar/tools/recommended.html](http://www.epa.gov/gasstar/tools/recommended.html).

The U.S. Department of Energy also operates an oil & natural gas environmental solutions program that assists the industry with technological improvements that have helped to reduce the footprint of drilling operations for 30 years. Oil fields today are up to 80 percent smaller than they were three decades ago. New seismic and satellite technologies have increased the probability of success when drilling which has yielded fewer dry holes and fewer disturbances to local environments. The program also touts new formulations of drilling fluids that are more environmentally sensitive and better filtration systems that improve water quality. The program spurred the advent of directional drilling which allows oil and gas companies to reach multiple pockets of their commodity from a single well site reducing the number of impacts to ecosystems. According to the DOE, 22,000 fewer wells today are producing the same amount of oil and gas that was produced in 1985.

The BP Oil Spill also spurred an increase in technological developments in the area of pollution prevention, clean-up, and well containment. According to *USA Today*, BP received nearly 123,000 ideas from the public on new approaches to cleaning up the oil spill, one hundred of those ideas were eventually tested, and more than 24 deployed during the spill. New materials for absorbing oil from water, skimmers, beach sifters, and devices to clean boom were promoted and tested during the spill in addition to the new techniques developed by the industry itself to deal with well
containment in deep water. The Bureau of Ocean Energy Management, Regulation and Enforcement also maintains the Oil Spill Response and Research Program to improve oil spill response technologies in the fields of remote sensing, physical and chemical properties of crude oil, mechanical containment and recovery, chemical treating agents, in situ burning, deepwater operations, and the operation of the National Oil Spill Response Test Facility.\textsuperscript{66}

Surface mining techniques outside of the oil and gas field are quite mature and evolve more slowly. There are efforts underway, however, to enhance the ability of mining operations to re-vegetate their sites using specialized seed mixtures\textsuperscript{67} and soil amendments using poultry litter.

**Job Growth and Workforce Development**

Green employment in the Mining, Quarrying, and Oil and Gas Extraction sector is expected to grow slightly faster than the overall sector during the next 10 years, though both will be relatively flat. That growth is expected to occur slowly over the forecast horizon. At the midpoint, 2015, green employment is expected to reach 224. That gradual growth continues bringing green employment in the Mining, Quarrying, and Oil and Gas Extraction sector to 227 in 2020.\textsuperscript{6}

The long term outlook for green employment in the Mining, Quarrying, and Oil and Gas Extraction sector follows a very similar trend to the broader sector in Mississippi shown in the most recent employment projections. The similar growth trends between green and other employment in this sector reflect the large contribution of pollution prevention and clean-up related activities in this sector. As activities in this sector expand in general, so too will those in the areas of pollution prevention and clean-up.

Although Mississippi has no offshore oil wells, a significant number of workers are engaged in offshore drilling in other states. The employment projections reported above reflect long-term trends and the most relevant information available today; the future of oil and gas extraction in the gulf and the associated green jobs remains quite uncertain. The BP Oil Spill and the federal response created job growth and workforce uncertainties in the state of Mississippi. As late as February 2011, the *Wall Street Journal* reported that new drilling had not yet resumed in the Gulf even though the moratorium had technically been lifted for two months. The paper also suggested that drilling may not return to pre-oil spill levels until 2012.\textsuperscript{68}

\textsuperscript{6} The starting point for a sector’s green jobs projection is the survey estimate, which includes private and public entities in each sector. Baseline growth rates were taken from the state’s primary employment projections, which include only private sector establishments, and supplemented with additional information on future changes to the green economy collected through this research effort.
Despite the current risk to jobs due to the moratorium, there will be a continuing and increasing need for engineering and environmental professionals and support staff to handle compliance and reporting and inspections under the new safety and environmental rules.

Meanwhile, natural gas opportunities are growing. In many regions across the United States the rapid expansion of industry activities associated with shale gas plays are contributing to job growth opportunities in the associated gas extraction and related services industry. This has included professionals to assist with environmental permitting, pollution controls, emissions monitoring and reporting, and water and waste management. As shale plays are further investigated and developed in Mississippi, the state could see similar growth. Additionally, inclusion of the oil and gas extraction industry in EPA greenhouse gas reporting programs could lead to staffing needs for estimating, monitoring, and reporting of greenhouse gases.

Workforce requirements related directly to oil and gas extraction include professionals and support staff dealing mainly with environmental permitting, environmental impact assessment, pollution prevention and compliance with environmental regulations. These workers could be employed directly within the industry, with state and federal regulatory agencies charged with oversight of oil and gas extraction industry activities, or with contractors/consultants. Some examples of these activities include:

- Exploration/production permitting (e.g. coastal use, air, water, wastes)
- Environmental impact assessment (e.g. pipeline corridors)
- Environmental regulatory compliance (production and transportation – pipelines)
- Water resources management
- Pipelines inspections
- Permitting and monitoring of underground injection sites
- Permitting and monitoring of oil and gas extraction industry wastes disposal
- Disposition (e.g. well plugging, site cleanups) of orphan well sites
- Management of naturally-occurring radioactive materials (NORM) accompanying some oil and gas production activities
- Identification, planning, and cleanup of inactive and abandoned drilling sites
- Identification, location, and removal of submerged hazards left by drilling activities
- Inspection of old inactive or shut-in wells for leaks
- Decommissioning old drilling/production structures (e.g. rigs to reefs)

The Mississippi Development Authority (MDA) has a separate Energy Division. MDA, MDEQ, SERC, and existing industries are ideally suited to meet workforce training needs of the
future. Though not utilized, the current Community and Junior College System in Mississippi is also a logical entity to get involved in workforce development.

Finally, it should be noted that the anticipated employment growth of green jobs in the Mining, Quarrying, and Oil and Gas Extraction sector will be comprised of a combination of the creation of new green jobs and the gradual greening of existing jobs. While the contribution of each factor has yet to be determined, training providers should consider the unique training needs brought on by each of these changes. For some green occupations, existing workers will need training to enhance their skills. For other occupations, curricula may be needed to provide a more comprehensive training for new workers or those entering a new occupation.

**Key Players**

**Marine Well Containment Company:** [www.marinewellcontainment.com/about.php](http://www.marinewellcontainment.com/about.php)
Non-profit organization maintaining and operating the Marine Well Containment System, collaboration between ExxonMobil, Chevron, Conoco Phillips, and Shell to improve and deploy oil spill response technologies and systems.

**Mississippi Department of Environmental Quality (MDEQ):** [www.deq.state.ms.us](http://www.deq.state.ms.us)
The mission of MDEQ is to safeguard the health, safety, and welfare of present and future generations of Mississippians by conserving and improving our environment and fostering wise economic growth through focused research and responsible regulation.

**Mississippi State University Sustainable Energy Research Center (SERC):** [www.serc.msstate.edu](http://www.serc.msstate.edu)
Their mission of SERC is to develop new engineering and scientific knowledge, and serve as a catalyst to create sustainable energy industries in the Southeastern U.S.

**Southeast Regional Carbon Sequestration Partnership (SECARB):** [www.secarbon.org](http://www.secarbon.org)
Department of Energy research program regional group dedicated to the development and deployment of carbon sequestration technologies in the southeast United States.

**U.S. Department of Energy (DOE):** [www.energy.gov](http://www.energy.gov)
Federal agency dedicated to the advancement of the national, economic and energy security of the United States, the promotion of scientific and technological innovation supporting that mission. Themes of the Department of Energy intersecting the mining, quarrying, and oil and gas extraction industry are energy security and scientific discovery and innovation.
Agency responsible for overseeing safety and environmental stewardship of energy and mineral resource development on the Outer Continental Shelf. It will eventually become three entities, one each for leasing offshore projects and collecting royalties, environmental and safety enforcement, and the management of oil, gas, and renewable energy activities.

Manages public lands including federal onshore oil, gas and coal operations. Issues permits and licenses for renewable and nonrenewable energy developments and exploration on managed land.

U.S. Environmental Protection Agency (EPA): www.epa.gov
Key federal agency for the protection of the environment and public health. Oversees a variety of practices in the mining, quarrying, and oil and gas extraction industry and enforces environmental laws with a direct impact on industry operations.

U.S. EPA Natural Gas STAR Program: www.epa.gov/gasstar
Industry partnership program encouraging the adoption of cost-effective methane emission reduction processes and technologies.


52 “From Crisis to Reform: Raising The Bar for Safety and Environmental Protection on Offshore Oil and Gas Operations.” Web. 28 Feb. 2011.


