2017

ENERGY WORKS:

MISSISSIPPI'S ENERGY ROADMAP

Governor Phil Bryant

EXECUTIVE SUMMARY

MISSISSIPPI'S ENERGY LANDSCAPE

Well-Positioned for Growth

In many ways, Mississippi is advanced in energy sector development. Endowed with diverse energy resources, including oil, natural gas, coal, and biomass, the state also has a robust energy supply, significant power generation and energy distribution infrastructure, and transportation advantages. The importance of energy globally, along with Mississippi's existing strengths in this sector, suggests energy-related activities possess tremendous opportunity for job growth and economic development in Mississippi.

NEXT STEPS

A STRATEGY FOR ENERGY-BASED ECONOMIC DEVELOPMENT IN MISSISSIPPI

Energy policy and economic development policy are closely connected. When considering where to locate or expand operations, businesses take into account whether a location offers a long-term, affordable, and secure energy supply with the infrastructure capacity necessary to meet their energy needs. To ensure the success of the state's energy-related economic development efforts, effective policies and activities must be concentrated on:

- Reinforcing Mississippi's energy strengths
- Ensuring an affordable and reliable energy supply
- Encouraging energy efficiency and energy supply diversity
- Enhancing growth in technological energy-related core competencies
- Filling any identified gaps in assets, infrastructure, and resources needed to ensure future growth
- Increasing supply of skilled workforce needed in a high-tech economy

With these objectives in mind, the policy goals and opportunities outlined in this plan charge state and industry leaders with focusing on six key areas:

I. Analyzing ways Mississippi can enhance its position as a top state for oil and natural gas-related exploration and extraction to allow for the responsible development of the state's energy resources and foster an environment conducive to creating jobs and attracting energy exploration investment.

a. Proactively address known exploration and production challenges.
b. Market the state's regulatory efficiency and responsiveness.
c. Encourage increased CO_2-related investment.

II. Promoting Mississippi's competitive advantages, maximizing the use of the state's abundant energy resources, and adding value to them through manufacturing, conversion, and processing to encourage job creation and investment.

a. Leverage water resource strengths.
b. Identify and market the abundance of Mississippi's energy rich sites.
c. Target components manufacturers.

III. Expanding energy capacity by conserving energy and finding ways to use it more efficiently.

a. Coordinate state and federal efficiency programs.
b. Consider statewide residential energy building codes for new construction.
c. Lead by example.

IV. Building capacity for future economic development by ensuring the state's transportation and energy infrastructure is developed to meet the energy demands of tomorrow.

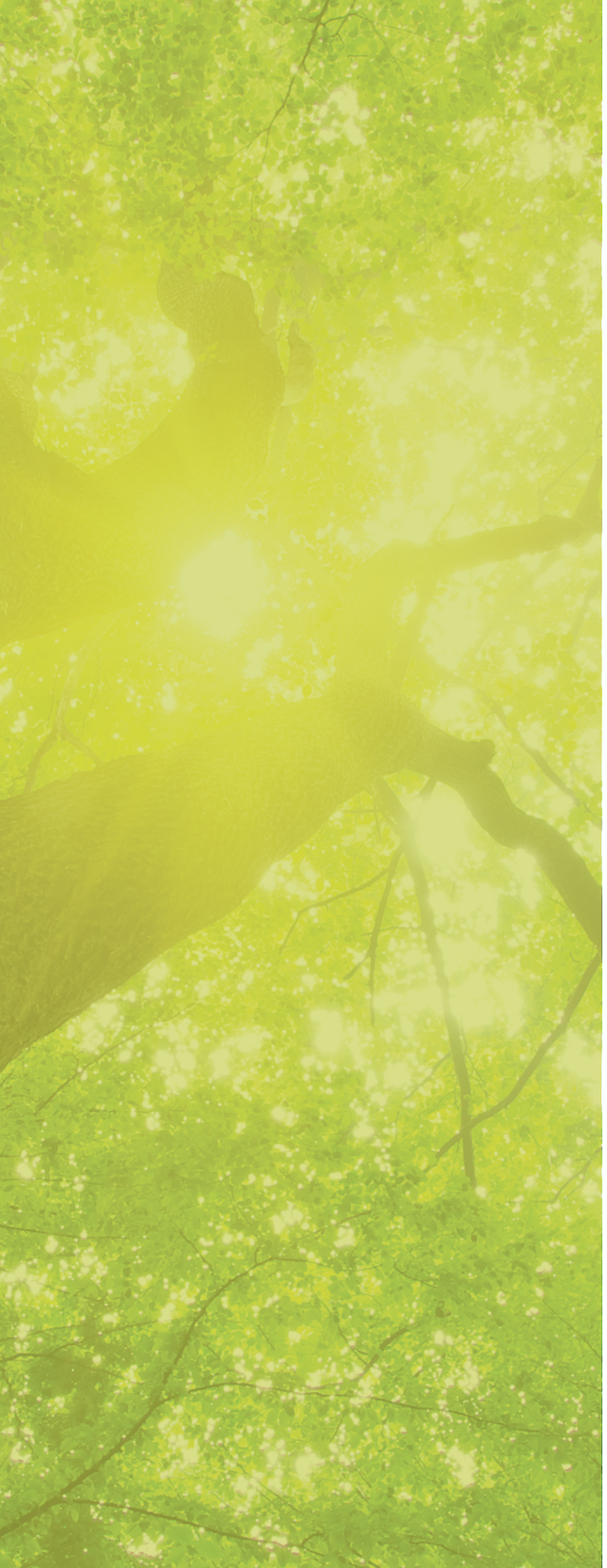
a. Position Mississippi to become the nation's transportation hub for the CO_2-enhanced oil recovery industry.
b. Expand infrastructure as a foundation for future development.
c. Position Mississippi for energy exporting opportunities.

V. Creating jobs by attracting more private research and development investment to Mississippi, encouraging public/private partnerships at Mississippi research universities, attracting leading talent in energy-related research fields, and fostering a business environment encouraging more investment in energy technology development and commercialization.

a. Consider establishing a public/private collaborative entity focused on energy technology commercialization.
b. Assess and enhance Mississippi's R&D tax credit.
c. Encourage greater interaction between the energy industry and universities.

VI. Preparing and training a 21st century workforce by understanding the long-term workforce needs of the energy sector and making Mississippi's workforce development system more responsive to these needs, increasing awareness of energy career opportunities, and increasing graduate retention rates in Mississippi's workforce.

a. Build more bridges between all educational sectors (kindergarten through post secondary) and employers.



b. Expand dual enrollment, accelerated learning programs, and apprenticeships.
c. Integrate IT-based platforms and maximize reach.

PREPARING FOR THE FUTURE

CAPITALIZING ON OPPORTUNITIES

In recent years, Mississippi has received national notice for its success in recruiting energy-related economic development projects. Energy Works: Mississippi's Energy Roadmap outlines the steps Mississippi leaders must take to build on these successes and effectively attract new energy-related investment and jobs.

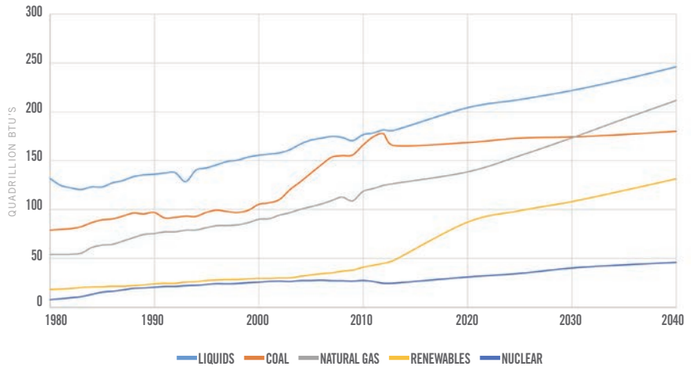
MISSISSIPPI'S ENERGY LANDSCAPE

Energy is the lifeblood of the economy. The global nature, enormous scale, and necessity of energy suggest energy-based economic development should be an area of focused opportunity in Mississippi. In many ways, Mississippi is advanced in energy sector development. Blessed with a diversity of energy resources – such as oil, natural gas, coal, and biomass – Mississippi has a robust energy supply to leverage for potential job growth and economic development. Likewise, Mississippi has significant infrastructure in power generation, including nuclear as well as fossil fuel-based power generation, and is a hub for the distribution of natural gas, carbon dioxide, and oil and refined petroleum products. Major port access on the Gulf of Mexico, in combination with the Mississippi River and Tennessee-Tombigbee Waterway, rail infrastructure, high-capacity pipelines, and other core infrastructural assets round out the suite of resources furthering opportunities for energy-based development.

Considering Mississippi's existing strengths and global demand projections, opportunity abounds. As shown in Figure 1, global and U.S. demand for energy and fuels, in all their forms, will not decline. Because of demand, more energy, in all its forms, will be needed to meet projected demand. Both developed and developing nations' economies rely on a steady stream of energy to power economic and societal activity.

FIGURE 1

GLOBAL ENERGY DEMAND BY SOURCE (QUADRILLION BTU)



Source: EIA International Energy Outlook 2013

While Mississippi has a broad range of fossil fuel reserves, abundant biomass, and a diversified value-added energy production base in terms of electricity production and refining, the state is a net importer of raw energy, including oil, natural gas, and coal.

Mississippi raw energy production amounts to 37 percent of statewide raw energy consumption.

However, when considering energy in the form used by most consumers – electricity and transportation fuels – Mississippi produces slightly more than is consumed in the state, making the state a net exporter of electricity and liquid fuels. See Table 1.

TABLE 1 - **MISSISSIPPI CONSUMPTION AND PRODUCTION**

	MISSISSIPPI CONSUMPTION	MISSISSIPPI PRODUCTION	DIFFERENCE
Total Energy (trillion Btu)	1,133	421	-712
Total Electric Power (MWHR) sales + direct use	50,539,487	64,757,864	14,218,377
Total Petroleum Products (barrels)	82,524,000	128,909,000	46,385,000

Source: EIA, 2015 data

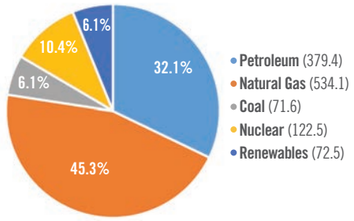
Mississippi already enjoys significant economic activity rooted in the energy sector and has the assets and resources to realize further economic growth from energy and energy-related technologies. In an analysis of energy-based development opportunities in Mississippi, Battelle Technology Partnership Practice, a technology- based economic development consulting arm of Battelle Memorial Institute, the world's largest independent nonprofit R&D organization, noted, "in some regards, Mississippi faces an 'embarrassment of riches,' having so many energy-related assets and opportunities that it is a challenge to understand them all, prioritize them based on development potentials, and formulate strategies to optimize their enhancement and growth to benefit Mississippi and Mississippians."

Understanding energy in a global context is important. To power and fuel the expansive and complex global economy today, an almost incomprehensible amount of energy is required, and currently, the vast majority of energy used in the world comes from three sources – crude oil, natural gas, and coal. **Collectively, these sources account for 83 percent of all energy consumed in the world today, according to the International Energy Agency.**

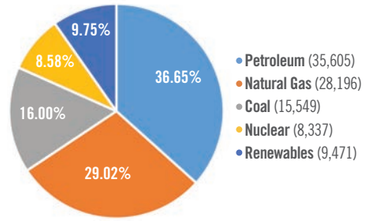
A combination of other sources – namely nuclear, hydro, wind, solar, and biomass – provide the remainder of energy used today. Figure 2 compares the overall energy mix in Mississippi, the United States and the world.

FIGURE 2

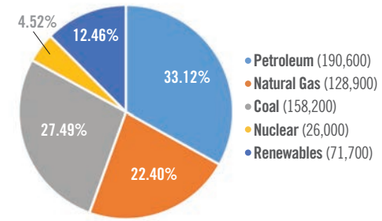
MISSISSIPPI TOTAL ENERGY USE
Usage (trillion Btu's) and percentage



U.S. TOTAL ENERGY USE
Usage (trillion Btu's) and percentage



WORLD TOTAL ENERGY USE
Usage (trillion Btu's) and percentage

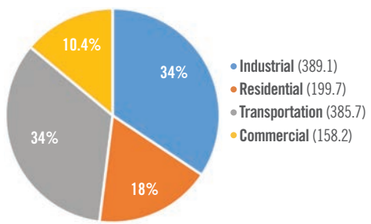


Source: EIA International Energy Outlook

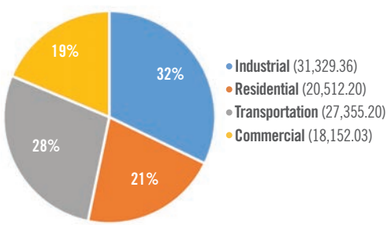
Energy is consumed in one of four economic areas – through residential, commercial, and industrial applications, with each mostly in electricity and heating, and through the use of transportation fuels. Figure 3 shows the share of each of these categories in Mississippi, the United States, and the world as a portion of total energy consumption.

FIGURE 3

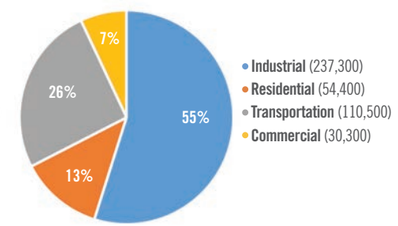
MISSISSIPPI ENERGY CONSUMPTION BY SECTOR
Usage (trillion Btu's) and percentage



U.S. ENERGY CONSUMPTION BY SECTOR
Usage (trillion Btu's) and percentage



WORLD ENERGY CONSUMPTION BY SECTOR
Usage (trillion Btu's) and percentage



Source: EIA International Energy Outlook

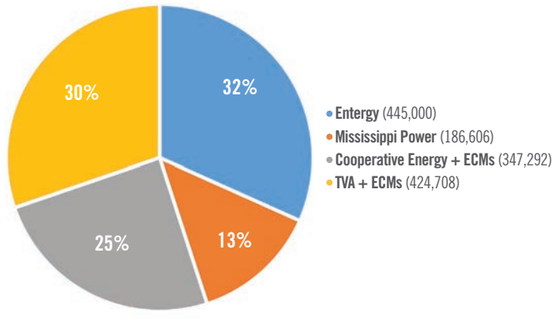
In recent years, Mississippi has received national recognition in the area of energy-based economic development. Abundant natural resources, a favorable business climate, and key infrastructure assets have combined to create opportunities for business recruitment, making Mississippi the envy of many other states. Mississippi's utility service providers are committed partners in the economic development process, offering incentives and other financial assistance, as well as participating in the proposal process. Continuing the state's string of economic development successes will require the prioritization of activities, backed by an even deeper understanding of energy assets, opportunities, and challenges both in the state and globally. Effective policies and actions need to be focused where they will do the most good – reinforcing Mississippi's strengths, ensuring a reliable supply of energy at an affordable cost, encouraging energy efficiency and supply diversity, enhancing growth in technological energy-related core competencies, and filling any identified gaps in assets, infrastructure, and resources for energy-based development across the value chain.

ELECTRIC POWER

The reliable delivery of electric power at an affordable price is fundamental to the economy. In an instant, electricity consumers ranging from small residential to large industrial users flip a switch and expect immediate power delivery in the measure demanded. Although 75 percent of the electricity generated in Mississippi is generated by investor-owned utilities, the Tennessee Valley Authority, municipal utilities, or rural electric cooperatives, 25 percent of the electricity is generated by independent power producers and by industry on site for industrial use. Electricity delivery in Mississippi occurs through a combination of providers and from a diversity of resources. Depending on locations defined by the Mississippi Public Service Commission, consumers either purchase power from regulated utilities, Entergy and Mississippi Power Company, electric power cooperatives, municipalities, or TVA. Figure 4 shows the number of total customers served by each.

FIGURE 4

CUSTOMERS BY ORGANIZATION
Usage (trillion Btu's) and percentage

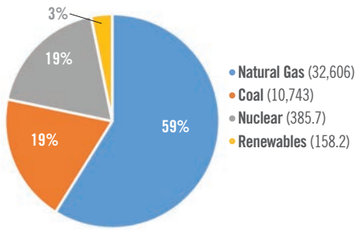


Sources: Data gathered from utility websites, 2017

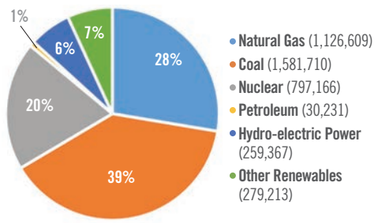
Today, nearly all of the electric power generated in Mississippi is sourced from three fuel sources – natural gas, coal, and nuclear. Similarly, these three fuels account for the vast majority of power generation in the United States and in the rest of the world. Figure 5 compares electricity sources in Mississippi, the United States, and the world.

FIGURE 5

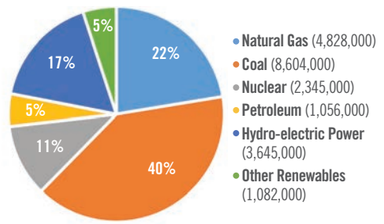
MISSISSIPPI ELECTRIC POWER GENERATION BY FUEL
Usage (trillion Btu's) and percentage



U.S. ELECTRIC POWER GENERATION BY FUEL
Usage (trillion Btu's) and percentage



WORLD ELECTRIC POWER GENERATION BY FUEL
Usage (trillion Btu's) and percentage



Source: EIA International Energy Outlook

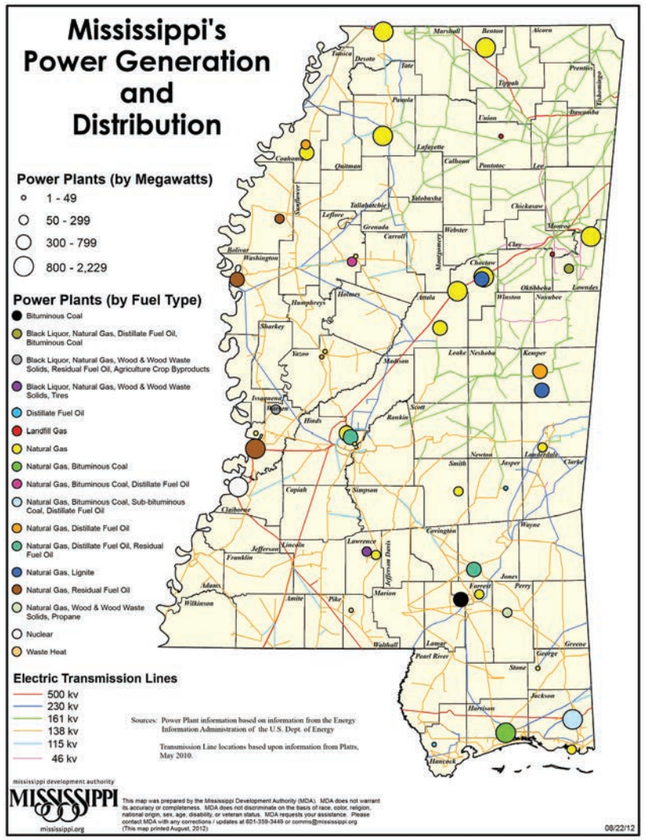
Most of the fuel used for electricity generation in Mississippi is imported from other parts of the United States. Although Mississippi is a natural gas-producing state, much more natural gas is consumed in Mississippi than is produced. However, Mississippi benefits from having high capacity natural gas interstate pipelines throughout the state.

Mississippi's only operating coal mine, located in Choctaw County and owned by North American Coal, supplies lignite coal to a 440-megawatt power plant adjacent to the mine. Lignite is a lower-grade coal with a higher moisture content than conventional coal. Mississippi's other coal-fired power plants are fueled by coal shipped primarily from Colorado, Kentucky, and Illinois.

A single large reactor at Entergy's Grand Gulf Nuclear Power Station produces nearly 20 percent of total state electricity and all of the state's nuclear power. A recently completed power upgrade project makes Grand Gulf the largest single reactor in the United States in capacity at 1,443 megawatts.

As a general rule, electric power is most efficiently used closer to the source of generation. Therefore, having adequate generation assets near all demand centers, along with a robust transmission and distribution system for delivery and interconnection with other segments of the electricity grid, is necessary to efficiently meet peak demand requirements. Figure 6 depicts fuel generation assets in Mississippi.

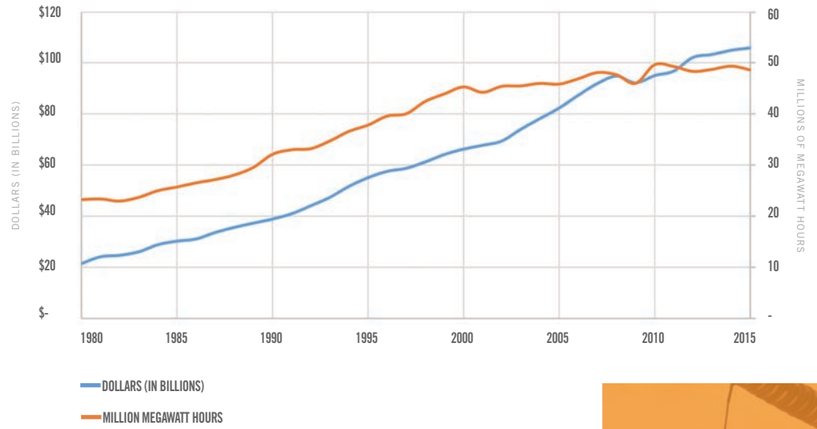
FIGURE 6



Electric power consumption, which is generally viewed as an economic growth indicator, is on the rise in Mississippi. As Figure 7 shows, as state gross domestic product rises, electricity use rises. While weather and other variables are also major factors affecting electricity demand in Mississippi, an active and growing economy is correlated with more electricity use. Additionally, Figure 7 demonstrates efficiency gains in the economy. From 1980 to 2015, state GDP grew by 496 percent in absolute terms, while electricity consumption grew by 136 percent. The average electricity usage increase required to grow state GDP by one unit from 2000-2010 was 58 percent lower than the average amount of electricity required for one unit of GDP growth in the 1980s.

FIGURE 7

STATE ANNUAL ELECTRICITY CONSUMPTION VS STATE GROSS DOMESTIC PRODUCT (1980-2015)



Source: Bureau of Economic Analysis and EIA, 2015 data

FIGURE 8

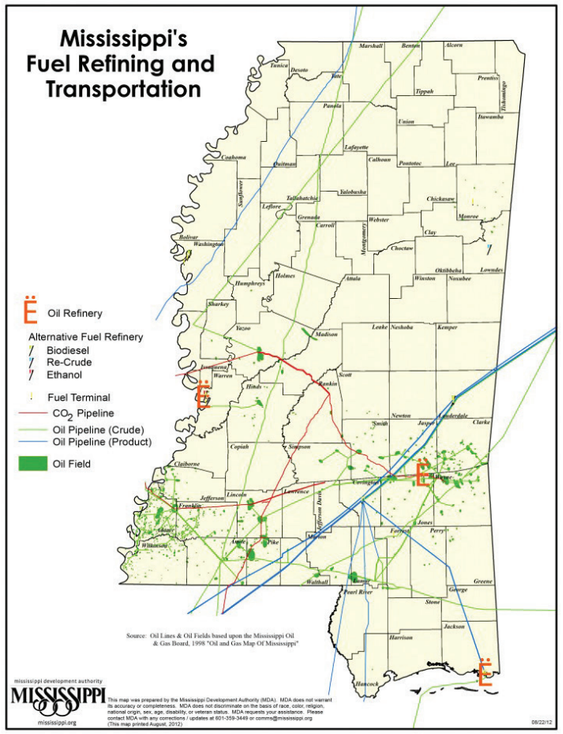
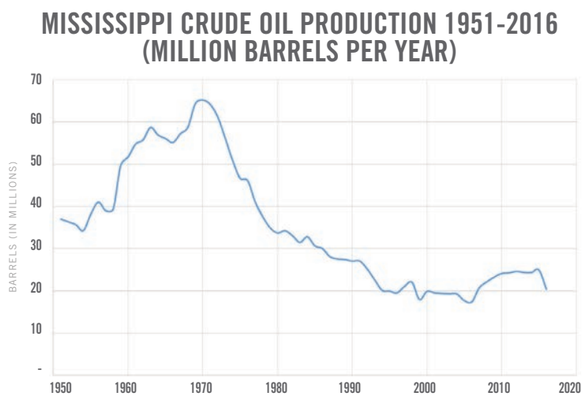


FIGURE 9



Source: EIA, 2015

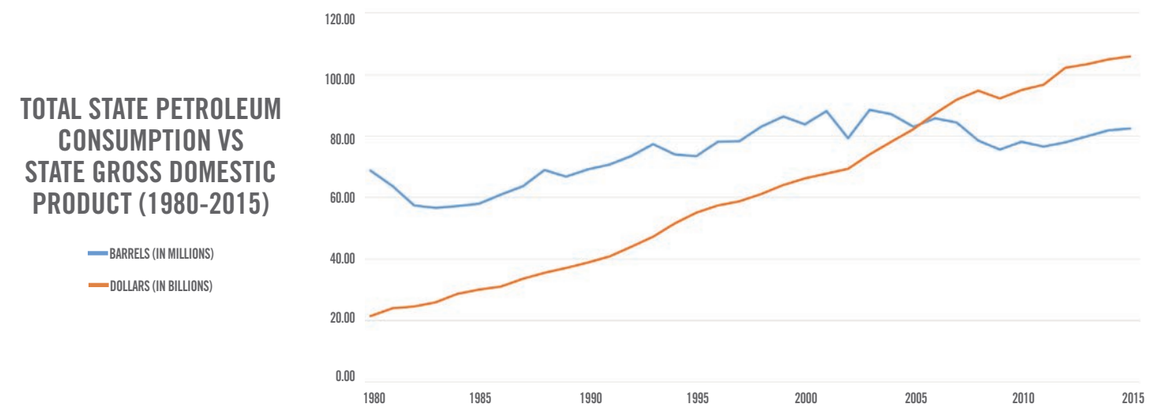
TRANSPORTATION FUELS

Energy, mostly in liquid fuels form, propels the transportation economy. As with electric power, every family and business depends on transportation fuels daily. Today, more than 5 billion gallons of fuel are used each year in the Mississippi economy. Gasoline makes up 85 percent of this total, and diesel – both on-road and off-road – makes up 14 percent. Aviation and jet fuel account for the remaining 1 percent. The supply system consists of a network of petroleum refineries, interstate pipelines, fuel terminals, distributors, and retail outlets. Figure 8 maps the major transportation fuel distribution assets in Mississippi.

Mississippi has a long history of crude oil production. Oil production on a significant scale in Mississippi began in the 1940s in the Tinsley Field in Yazoo County. Figure 9 shows crude production peaking in Mississippi in the early 1970s, followed by a gradual decline until 2005, when crude production in the state began to rise. A major reason for the recent production trend reversal was the introduction of enhanced oil recovery using carbon dioxide. The use of CO_2 allows enhanced oil recovery producers to extract significant amounts of additional oil from wells previously either shut in or had become low-volume producers through conventional production methods. Figure 9 shows annual crude oil production levels in Mississippi from 1951 through 2016.

In addition to increased crude production as a result of enhanced oil recovery, recent exploration activity in the Tuscaloosa Marine Shale in southwest Mississippi offers other high-production volume prospects for oil and natural gas production. The development of hydraulic fracturing technologies in commercial applications set off an enormous wave of oil and natural gas production-related activity in the United States since 2008. Hydraulic fracturing techniques enable extraction from tight, dense shale rock formations unable to be produced economically by conventional methods. The Tuscaloosa Marine Shale formation, sitting under much of southwest Mississippi and parts of Louisiana, is currently not in production, but the economic impact of production in this region will be significant in time. As technology and production efficiencies advance, other dense formations may also hold production potential in Mississippi.

FIGURE 10



Source: EIA 2014 data; Bureau of Economic Analysis, 2015 data

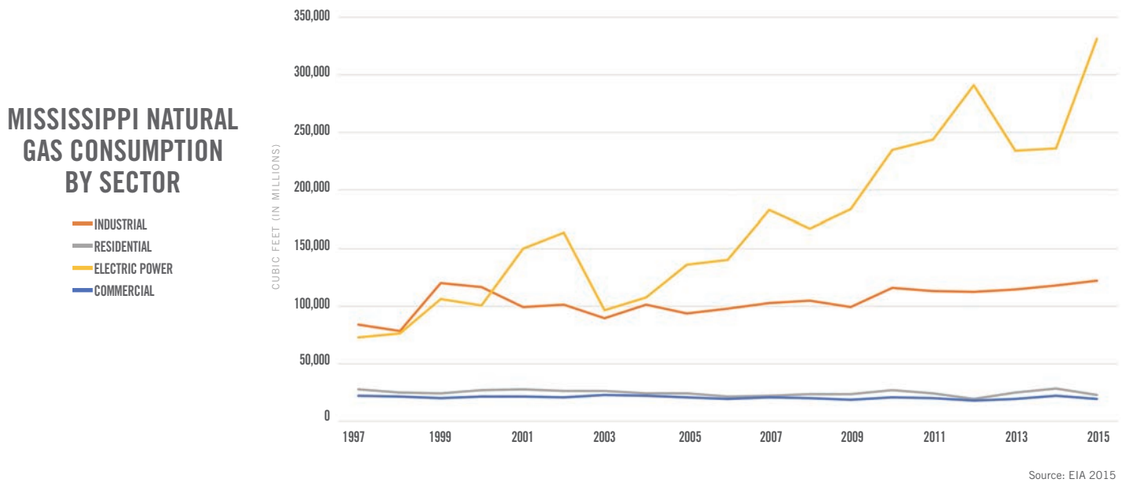
As with all forms of raw fossil energy, Mississippi consumes more oil, and its derivatives, than it produces. As Figure 10 demonstrates, Mississippi oil consumption has been around 80 million barrels per year for the past decade, while production over the last decade has risen, only peaking in the last year. Although there are other important variables such as the price of oil, as a general trend, total oil consumption increases over time as the economy grows. From 1980 to 2010, oil consumption in Mississippi increased at a much slower rate than the state's GDP. Comparing the most recent decade to the 1980s, 54 percent less oil use was required to grow GDP, on average, showing transportation fuel efficiency gains in automobiles and other efficiency gains, such as an improved roads and highway systems.

NATURAL GAS

Natural gas is a versatile fuel source used abundantly in electric power generation, industrial applications, and heating. Although the largest volume use of natural gas is in electric power generation as seen in Figure 11, natural gas is an important feedstock in industrial and manufacturing operations, such as chemical, fertilizer, plastics, pulp and paper, metal, and fabric production, as well as food processing. Additionally, much of the commercial and residential sectors in Mississippi rely on natural gas for heating and cooking. Currently, natural gas consumed in transportation in Mississippi is consumed almost entirely in the operation of the vast network of natural gas pipelines, both intrastate and interstate, within Mississippi.

Commercial natural gas production in Mississippi began in the 1920s in Monroe County. As Figure 12 shows, natural gas consumption in Mississippi has exceeded natural gas production to varying degrees over the years.

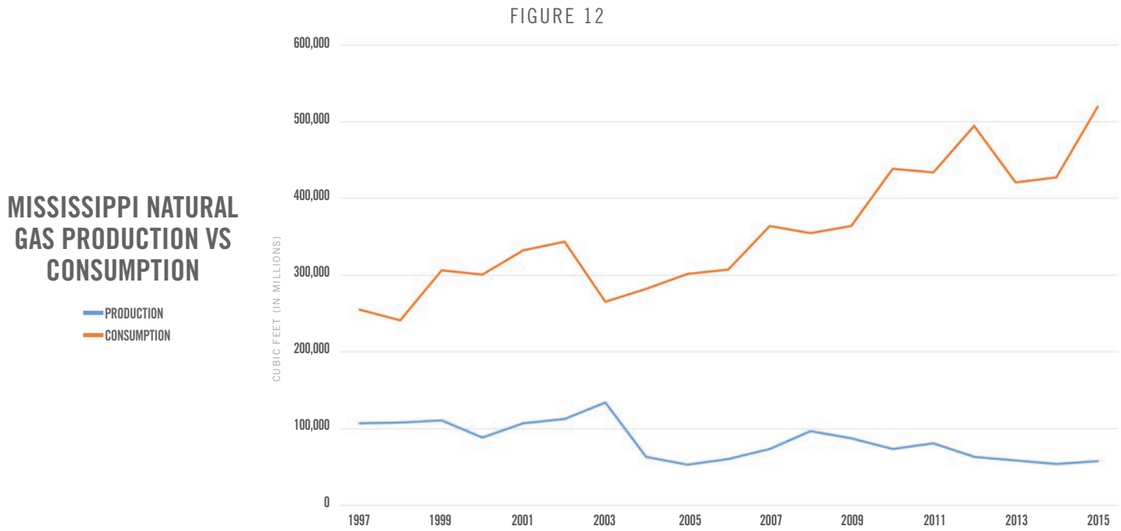
FIGURE 11



Source: EIA 2015

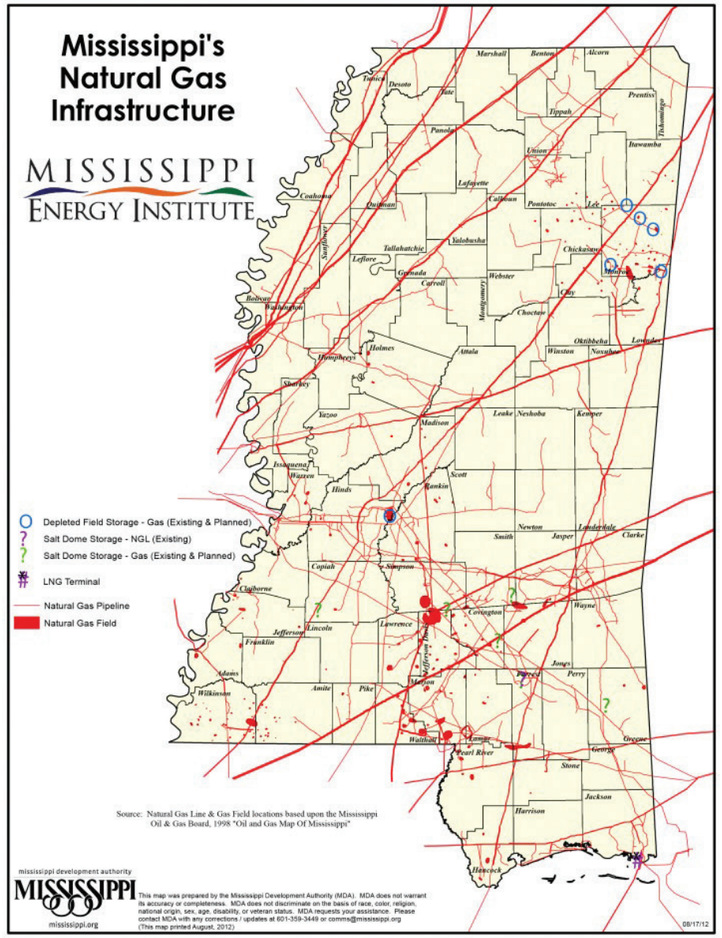
Although Mississippi consumes much more natural gas than the state produces, the presence of numerous interstate natural gas pipelines results in an enormous volume of natural gas flowing through the state. In 2011, Mississippi was recognized as having more natural gas flowing through the state than any other state, both in terms of natural gas received from other states and natural gas delivered to other states. Mississippi ranks fourth in total miles and on-shore miles of interstate natural gas pipelines in the United States, and the state's extensive natural gas infrastructure brings with it economic opportunities.

FIGURE 12



Source: EIA 2015

FIGURE 13



Additionally, Mississippi ranks third in salt dome working gas storage capacity and seventh in total working gas storage capacity. The combination of natural gas pipelines and geologic storage are additional sources of development potential. Figure 13 shows Mississippi's natural gas infrastructure.

Most Mississippi families and businesses depend on natural gas to meet their heating needs, and over the previous several decades, natural gas has been an affordable and dependable fuel. Looking at residential natural gas usage over time provides a general glimpse at efficiency improvements in construction practices and HVAC improvements. Comparing 1980 to 2015, Mississippi's population has risen by roughly 470,000, or 18 percent, with an additional 265,000 households, but total residential natural gas usage has declined by 22 percent.

Natural gas is required in many industrial and manufacturing processes. Abundant and affordable natural gas supplies not only provide stability to existing businesses but may also serve as a catalyst for industrial and manufacturing growth.

WORKFORCE

The energy sector makes up 2-3 percent of private sector jobs in Mississippi, with changing market conditions explaining the varying employment levels from year to year. Generally, the energy utility sectors, electricity and natural gas, account for the majority of energy jobs. Much of the variance in employment from year to year depends on activity in oil and gas extraction, which can employ up to 25 percent of Mississippi's energy workforce. Indirect jobs supported by the energy industry, including retail fuel stations, transportation services, construction, the array of business services, and various materials and manufacturing businesses supplying energy companies, number tens of thousands more.

As a net energy producing state, a higher percentage of Mississippi's population is employed in the energy sector than the national average. This is important because the energy sector punches above its weight, resulting in a disproportionately positive impact on Mississippi's economy. Because energy jobs pay well above average private sector wages, more wealth and output is generated from the energy sector, compared to other sectors.

As Table 2 shows, both in Mississippi and nationally, jobs in the energy sector pay twice the total private sector average or more in many cases, and while Mississippi energy sector wages lag the national average energy sector wage, the difference is consistent with the overall average wage difference between Mississippi and the United States. As Mississippi seeks growth strategies to grow the economy, the energy sector is one of the targeted sectors which can result in higher household incomes and stronger communities.

TABLE 2

AVERAGE WAGES FOR SELECTED INDUSTRIES, 2016

INDUSTRY CLUSTER	MISSISSIPPI AVERAGE WAGES (2016)	U.S. AVERAGE WAGES (2016)
Refineries	$108,698	$112,251
Power Generation	$87,417	$107,747
Pipeline Transportation	$83,576	$122,634
Management of Companies & Enterprise	$79,848	$115,105
Electric Power Transmission & Distribution	$78,249	$102,029
Mining, Quarrying & Oil and Gas Extraction	$75,208	$102,901
Paper Manufacturing	$65,103	$65,712
Ship & Boat Building	$63,176	$61,392
Transportation Equipment Manufacturing	$60,906	$72,253
Professional, Scientific & Technical Services	$59,255	$90,950
Finance & Insurance	$55,643	$101,180
Telecommunications	$55,416	$85,956
Wholesale Trade	$54,999	$73,707
Information Technology	$54,750	$105,996
Petroleum Products & Wholesale	$53,861	$77,238
Construction	$47,675	$58,643
Manufacturing	$47,191	$64,860
Transportation & Warehousing	$41,409	$50,443
Health Care & Social Assistance	$40,417	$47,955
Total Private Sector	$37,282	$53,503
Real Estate & Rental & Leasing	$34,172	$54,959
Agriculture, Forestry, Fishing & Hunting	$34,232	$33,309
Hospitality	$25,296	$30,459
Retail Trade	$24,956	$30,297
Arts, Entertainment & Recreation	$20,177	$36,727
Restaurants & Bars	$13,926	$18,290

Source: Bureau of Labor Statistics data

OPPORTUNITIES FOR ENERGY-BASED DEVELOPMENT IN MISSISSIPPI EXIST FOR ALL FUEL TYPES AND THROUGHOUT THE SUPPLY CHAIN.

MISSISSIPPI'S ENERGY FUTURE

A growing world population and an ever-developing world will dictate not only the use of more energy overall but the development of more efficient technologies. The major energy sources of today – coal, oil, natural gas, and nuclear – will continue to be the major energy sources of tomorrow, and the United States, along with the rest of the world, will demand more energy to fuel economic growth.

To meet this demand, the world economy will place greater demand on energy resources and will demand new technology solutions to supply more energy to the world in a cost-effective manner. Mississippi's rightful place in this future environment is securing an energy supply for tomorrow's family and business needs at home. Identifying job-creating opportunities where Mississippi can play a part in meeting business demands all over the world will be essential.

A STRATEGY FOR ENERGY-BASED DEVELOPMENT IN MISSISSIPPI

Energy policy and economic development policy are fully intertwined. To ensure long-term viability of investment decisions, economic development focused on job growth, improved quality of life, and community sustainability requires access to adequate energy resources throughout the life of the investment. Overall, what really matters in an economic development-based energy policy is:

- A long-term, secure energy supply with robust infrastructure to meet demand
- Affordability to assure global competitiveness
- Diversity in the fuel portfolio to protect against dramatic commodity price spikes or supply disruptions
- Supplying a trained workforce to meet highly technical demands

Opportunities for energy-based development in Mississippi exist for all fuel types and throughout the supply chain. Because of the reliable nature of demand for energy moving into the future, those nations, regions, and states having robust energy resources or the infrastructure

and know-how needed to drive the further development of energy technologies and solutions to meet global and domestic needs will be seen as energy-secure places to do business. Energy exploration, extraction, conversion, distribution, and use represent a value chain with substantial opportunities for advanced technology deployment and innovation and for traditional economic development based on industry growth. Opportunities for technology-based economic development exist for those states able to attract and grow research and development activity and innovation commercialization in energy and energy-related technologies.

To increase the share of energy-based development activity occurring in the state, Mississippi's public energy policy and initiatives may be addressed in six broad areas: encouraging exploration and extraction of natural resources; manufacturing, processing, and conversion of energy products for added value; promoting energy efficiency; building capacity through transportation and distribution infrastructure; leveraging assets for research, development, and commercialization of new energy technologies and solutions; and developing a robust energy-sector workforce.

ENCOURAGING EXPLORATION AND EXTRACTION

In today's global marketplace, raw energy resources – for example, oil, natural gas, coal, uranium, and wood – are extracted all over the globe. While some resources are used relatively close to their geologic origins, vast amounts of these resources are transported considerable distances, often overseas, for power generation or for processing or refining. End-use products are often transported considerable distances for resale.

While the efficiency of transporting bulk energy fuels has vastly improved through time, proximity to resources and infrastructure generally provides economic advantages in terms of pricing and extraction-related jobs.

As of 2016, the state of Mississippi ranks 13th in oil production among the producing states and 20th in natural gas production. These volumes of production contribute significantly to the state's economy in terms of jobs, private sector income, and local and state government revenue. As energy development is such an important part of the state's economy, commitment to future development is imperative for overall growth.

In a 2016 survey, the Fraser Institute, a Canadian public policy organization, surveyed 381 executives with oil and natural gas exploration companies to measure investment climates in 96 jurisdictions worldwide. Collectively, these jurisdictions account for 75 percent of global oil and gas production. The aggregate response from the executives, including barriers to investment, deemed Mississippi the eighth best place for oil and gas related investment worldwide.

Maximizing in-state exploration opportunities will produce high-paying exploration and production jobs, support existing and new service industry jobs, generate revenue for private landowners through leases and production royalties and increase tax revenues for local governments and the state. In recent years, oil and natural gas extraction accounts for almost 25 percent of total direct energy employment in Mississippi, ebbing and flowing depending on market conditions. With new production methods and technology developments steadily improving in hydraulic fracturing and enhanced recovery using CO_2, a prospective but very realistic opportunity exists to increase exploration and extraction-related investment and employment as markets demand more oil and/or natural gas.

The forest products industry has been a major industry in Mississippi for generations, thanks to Mississippi's abundant forest resources. The total woody biomass available on timberlands in Mississippi is estimated to be 779 million dry tons, and the availability of these resources positions Mississippi as a prime location for biomass companies. Studies show forest land comprises roughly 65 percent of Mississippi's acreage; this equates to roughly 27 million acres of forest with approximately 6.3 million dry tons of unutilized pulpwood and woody biomass residues currently available. Additionally, Mississippi is a prime candidate for the development of other biomass feedstocks, namely crop residues, poultry waste and energy grasses. Over the past several years, Mississippi's forest resources have attracted investment in several wood pellet manufacturing facilities for the manufacturing of pellets for export.

Policy Goals:

- Enhance Mississippi's position as a top state for oil and natural gas-related exploration and production.
- Allow for responsible development of all economically available energy resources in Mississippi, both onshore and offshore, to create jobs and increase local and state revenues.
- Foster an environment to create jobs and attract further exploration, investment, and related service businesses.
- Regulatory policy should encourage reasonable, predictable regulations to protect the environment and public interest.
- Legal policy should provide clarity toward proper business activity.
- Tax policy should provide for fair, competitive tax revenue assessment while encouraging new investment.
- While remaining realistic, aggressively and responsibly embrace new energy sources and production techniques, such as oil from shale formations, biomass, and other renewable products, or energy technology on the horizon.

Policy Opportunities:

- **Proactively address known exploration and production challenges.** As production efficiencies improve and markets signal for more supply, Mississippi's geology provides opportunity for growth in the upstream industry for decades to come. With unconventional production techniques like the combination of hydraulic fracturing and horizontal drilling emerging on the scene in recent years, growth has the chance to occur rapidly, creating large permitting and resource demands. For this reason, regulators and the industry should proactively identify challenging areas and seek solutions to potential challenges prior to the need. For example, while Tuscaloosa Marine Shale activity is currently halted, solutions for water supply and rapid air permitting should be investigated to prepare for production in the future.
- **Market the state's regulatory efficiency and responsiveness.** Mississippi oil and natural gas exploration regulators have a great reputation for being responsive and rational. To better market this competitive advantage, Mississippi's regulatory agencies, including the Oil and Gas Board and the Department of Environmental Quality, will continue to work with MDA to publish information regarding the number of permits issued, average time for permit review and related metrics.
- **Encourage increased CO_2-related investment.** During the past decade, the enhanced oil recovery industry has rapidly developed in Mississippi. The revitalization of old oil fields, CO_2 exploration and production and the accompanying infrastructure has resulted in billions of dollars invested in Mississippi. Policy makers are recognizing the long-term potential, and state regulatory and tax policy have been amended to foster the growth potential of the industry and encourage more investment. Mississippi policy makers should continue examining ways to further develop this industry, recognizing parallels to the manufacturing sector and factors such as the significant additional investments and energy costs associated with enhanced oil recovery. In the future, the combination of enhanced oil recovery, Mississippi's favorable geological formations and geographical location and increasing demand for beneficial environmental solutions such as associated storage of CO_2, positions this valuable commodity and the state to be the central transportation hub for an economy moving more CO_2.
- **Improve biomass supply chain knowledge.** Mississippi is a prime state for the biomass industry due to its supply. Transportation is a major cost barrier to biomass energy projects. With most of Mississippi's readily available biomass being forest products, supply chain details are not well known outside of the industry. Through effective programs like those directed by the Mississippi Institute for Forest Inventory and through cooperation with industry partners, prospects looking to invest in biomass energy projects in Mississippi can better understand feedstock availability and logistics before making significant investments. MDA has made significant progress in this area and will continue to work with partners to monitor and make available information regarding biomass feedstock availability.

ADDING VALUE AND SUSTAINING RESOURCES THROUGH MANUFACTURING, CONVERSION, AND PROCESSING

While Mississippi is rich in natural energy resources and hosts many other resources through its multitude of transportation assets, the state has comparatively few companies adding value to its raw energy resources. A targeted effort to expand the use of resources and add value through conversion or processing facilities, will result in a higher-value product mix for Mississippi energy resources and more energy-related jobs.

Leveraging Mississippi's energy strengths by continuing to add capacity and avoid scarcity must be a top priority and strategy in the state's economic development efforts. As energy demand in the United States and the world increases rapidly over the next several decades, Mississippi must prepare to both meet our internal needs and maintain the capacity to take advantage of opportunities to help the world meet its energy needs. In a global marketplace with resources and supplies constantly moving, Mississippi is well positioned to attract investment if focused on the opportunities at hand.

To accommodate value-added and energy intensive industry opportunities, ample energy resources and infrastructure capacity are required. When it comes to power generation, this means having access to plenty of generation capacity from multiple fuels to meet the highest peaks of local demand along with robust transmission and distribution systems. With regard to transportation and heating fuels, this means proximity to production and refining, and importantly, an abundance of transport and storage infrastructure to maintain adequate inventories.

Policy Goals:

- Promote Mississippi's competitive advantages – such as land availability and affordability, access to large volumes of natural gas, a fair regulatory and tax climate, competitive electricity rates, and plentiful water – to encourage job creation through energy-based manufacturing, value-added expansion, and new investment.
- Maximize the utilization of Mississippi's abundant raw energy resources and attract outside energy resources into Mississippi for value-added opportunities.
- Increase energy-based jobs and exports by manufacturing components, generating electricity, and processing or refining energy resources for use outside of Mississippi.
- Promote a diverse and abundant electric power supply, including a good mix of nuclear, coal, and natural gas generation facilities and adding renewable sources to supplement.
- Support initiatives linking energy solutions with environmental solutions, such as the use of municipal solid waste or other large waste streams for energy production.

Policy Opportunities:

- **Leverage water resource strengths for energy development marketing and consider a statewide water management strategy to accommodate industrial development.** In 2013, the Mississippi Energy Institute worked with Mississippi State University to assess Mississippi's standing in water quantity compared with other southeastern U.S. states. The report concluded: "Generally, Mississippi has a competitive water advantage in the southeast with the second highest annual rainfall in the continental U.S., well distributed groundwater, and a relatively low water consumption rates. Still, Mississippi is not immune to droughts or groundwater depletion..." For future development prospects in the state, including energy, water supply should be an area of focus.
- **Monitor regulatory agencies and communicate collectively on broad issues.** In recent years, new federal regulations seem to be proposed weekly. While regulations and standards are important to a good business environment, consistency and pragmatism also are important to investment and job creation. Businesses have unique challenges in coping with today's complex regulatory framework, but many regulatory issues are broad in nature and affect a large number of employers and the state's economy as a whole. The Mississippi Energy Institute should serve as a central entity for energy producing and consuming businesses to collaborate on key regulatory issues, working with state regulators and federal representatives to seek rational solutions.

MISSISSIPPI IS WELL POSITIONED TO ATTRACT INVESTMENT IF FOCUSED ON THE OPPORTUNITIES.

• **Identify and market the abundance of Mississippi's energy-rich sites.** With multiple interstate natural gas pipelines and access to affordable and abundant electricity, Mississippi has an array of sites suitable for industrial prospects. Mississippi will target opportunities to recruit high-volume natural gas users and identify the areas proximate to high-volume energy sources, like natural gas and electricity. The Mississippi Development Authority will collaborate with industry partners to develop a simple GIS tool to use in promoting such sites to companies.

• **Focus recruitment resources on energy-sector companies and manufacturers of energy components.** For years, Mississippi has been actively engaged in the recruitment of energy-sector industry. To continue to succeed in siting energy companies in the state, MDA will increase its participation in industry-focused trade shows and trade publications and work to bring industry leaders to Mississippi to view the state's resources and capabilities. With developing parts of the world becoming electrified and mechanized, not only will energy resources be in high demand, but electric generation and transmission components, pipeline components, and a nearly endless list of components contributing to the complex supply chain will also be in greater demand. MDA will continue to monitor activity and opportunities in energy-related manufacturing and market Mississippi as a competitive destination for high-tech energy manufacturing.

• **Identify and recruit product manufacturers using natural gas as a feedstock.** Due to the shale gas boom, the United States has an energy advantage over other parts of the world, especially in regard to natural gas supply and price. In the past, these industries sought locations overseas, but now, many industries such as the chemicals and plastics sectors are seeking locations with a plentiful long-term supply of natural gas back in the United States. Mississippi should target industries like chemicals as this sector redevelops in the United States.

• **Position Mississippi to be a leading location for nuclear power-related investment.** Nuclear power is considered by many to be the cleanest source of electric power available. Technology advancements and rapidly-growing electricity demand globally will likely result in a new wave of nuclear power-related investment. Investment opportunities could include R&D, fuel cycle management, small modular reactor development and deployment, and components manufacturing. To capitalize on nuclear power-related opportunities, constant monitoring and communication will be required with federal agencies, members of Congress and major industry participants.

• **Target major energy investment and venture capital firms.** In a $6.5 trillion global energy economy, there are many specialized participants in financial services. Often, investment firms, venture capital funds, or hedge funds are looking for safe places to invest in projects. Mississippi offers a solid business climate and stable bipartisan support for energy-related economic development projects. MDA will continue to work to target energy investment entities and to establish lines of communication into Mississippi.

• **Support use of low-value energy resources.** In addition to the abundance of natural gas, biomass, oil, and oil products due to both geologic resources and transportation assets, Mississippi has other energy-rich resources, such as lignite and waste resources. Mississippi is no different than any developed place, generating its share of waste, either municipal solid waste or wastewater. State policy should consider and encourage investments utilizing waste streams to generate electricity, manufacture fuels or utilize the waste products as a required part of industrial processes, such as the utilization of wastewater.

EXPANDING CAPACITY THROUGH ENERGY EFFICIENCY

Another way to create excess energy capacity is to effectively conserve energy and reduce waste. Therefore, greater energy efficiency is an important component of a strategy focused on expanding capacity and increasing economic development. By finding applications resulting in lower energy use, additional energy capacity is made available to be used in a growing the economy demanding more energy.

Energy efficiency has proven to be one of the most cost-effective ways to expand capacity, improve competitiveness and increase economic development. By improving the efficiency of buildings, equipment and processes, additional energy and monetary resources are made available to businesses allowing them to allocate resources elsewhere like hiring additional employees or investing in new equipment.

Over the past several years, Mississippi has made tremendous progress on the policy goals outlined in Governor Phil Bryant's Energy Works: Mississippi's Energy Roadmap released in 2012. Recent advancements in energy efficiency include:

• **Statewide Commercial Building Energy Code**
ASHRAE 90.1 2010 was adopted as the statewide commercial building energy code for the construction and renovation of both public and private facilities. Mississippi was the first state in the Southeast, and third state in the nation, to adopt this building code standard. Increased energy efficiency through building construction can reduce long-term operating costs, which in public buildings, can reduce taxpayer burdens and free up funds better spent on infrastructure, public safety, and education.

• **Lead by example**
Passage of the Mississippi Energy Sustainability and Development Act requires state agencies to develop and implement five-year energy management plans and conduct regular analysis of their energy data. This allows for consistent identification of opportunities to improve efficiency and energy management in public facilities.

• **Public Service Commission Energy Efficiency Program**
The Mississippi Public Service Commission adopted rules regarding utility energy efficiency programs intended to increase the programs and services available to all rate payers to help improve grid reliability, lower energy bills and open the door to new economic and workforce development opportunities.

Through the commitment and dedication of both public and private partners in the state, Mississippi has been using energy efficiency to create the opportunities and environment needed for businesses and communities to thrive. The policy goals and opportunities outlined in this roadmap build off of the success of previous initiatives and will continue to move the state forward in terms of economic growth and prosperity. Mississippi should continue to seek economically sound energy efficient policies and practices.

Policy Goals:

• Expand energy capacity by conserving energy and finding ways to use it more efficiently.

• Understand the long-term opportunity for cost effective, energy efficient investments in state buildings through the development of more comprehensive energy management plans.

• Understand and analyze existing program impacts to ensure maximum effectiveness.

Policy Opportunities:

• **Lead by example**. With state agency energy management plans in place, MDA should analyze agency practices and impacts to identify those common practices with the best results. MDA and other agencies should understand the progress made over the past several years and set achievable goals for the future.

• **Consider statewide energy building codes for new construction**. Improved and standardized building practices, in both commercial and residential design and construction, will not only enhance quality construction but will provide Mississippians more energy efficient households and businesses at lower costs. Rather than have an array of local standards across the state, Mississippi builders may benefit from a single energy building standard, and more efficient structures will lower costs and improve reliability in the future. Mississippi should think of efficiency as a way to grow the total energy pie. Building codes are a common and sensible way to achieve efficiency for future stores and offices. With the Legislature adopting an updated commercial energy building standard, the state should now consider a residential building standard to benefit future homeowners.

• **Coordinate State and Federal programs**. Federally funded programs like Weatherization Assistance Program and Low-Income Heating and Electricity Program seek to address energy waste in low-income households. These programs may be leveraged with other opportunities to maximize utilization and impacts. Ongoing examination by the administering agencies to seek maximum output should be a priority.

• **Monitor efficiency programs created by PSC**. The Mississippi

Public Service Commission started a program in 2014 requiring utilities to offer efficiency programs. Program costs are billed to customers, so the independent public utilities staff should carefully monitor the efficiency program to measure its success, impact on reducing energy use, and cost effectiveness.

• **Consider innovative financing**. Property Assessed Clean Energy is a popular financing tool across the U.S. allowing commercial property owners to finance energy efficiency projects through property taxes. Since PACE would need to be legislatively enabled, local governments and the Legislature may consider this option along with other innovative financing models.

BUILDING CAPACITY THROUGH INFRASTRUCTURE: TRANSPORTATION AND DISTRIBUTION

A major competitive economic advantage for Mississippi is the diversity and strength of its energy transportation assets. Starting with the natural water transportation resources like the two deepwater Gulf of Mexico ports, the five Mississippi River ports, and the six Tenn-Tom Waterway ports, Mississippi offers access to major transportation waterways in every part of the state. Specifically, in energy transportation assets, Mississippi hosts more transported natural gas than any other state, and large volumes of transportation fuel used on the east coast are stored and transported through Mississippi.

The critical components of our energy-based economy are energy production, supply and deliverability. Deliverability is where consumers interface with energy. The flip of a light switch or any electric powered device and immediate delivery of electricity is something often taken for granted in the U.S. Immediate delivery at all times for all uses requires complex planning, a robust system and good public policy. Likewise, the availability of transportation fuels or heating fuels is totally dependent upon an intricate infrastructure system adequately supplied at all times to meet the demands of the economy. Therefore, robust energy infrastructure is a requisite for development in general. Having the capacity and the capability to adapt to growing demand is necessary.

Policy Goals:

• Encourage job creation by maintaining Mississippi as a safe and welcoming environment for energy infrastructure projects.

• Ensure infrastructure development and expansion is allowed to meet tomorrow's energy demand.

• Play a leading role in areas of infrastructure growth, such as electric grid technology and CO_2 for enhanced oil recovery.

• As a coastal state, promote energy exporting opportunities.

Policy Opportunities:

• **Position Mississippi to become the nation's transportation hub for CO_2.** Mississippi is at the forefront of the enhanced oil recovery, or EOR, industry and is one of the few areas of the country where EOR using CO_2 in previously produced oil fields is happening and creating a substantial economic impact. The presence of naturally occurring CO_2, mined out of the Jackson Dome in central Mississippi and transported via pipeline to oil fields, has been the driving force behind growth in EOR in Mississippi. Other regions of the country have great potential for EOR but do not currently have access to a source of CO_2. As technology develops and allows power plants and other large industrial CO_2 producers to capture the valuable compound, EOR activity is expected to increase around the U.S. Much like transportation of other energy products, this will require large investments in pipeline transportation systems. Mississippi is committed to furthering its leadership in the area of CO_2 and tertiary oil recovery, and with the Jackson Dome and other geologic formations available for potential associated CO_2 storage along with the existing pipeline system, Mississippi is a logical location to serve as a hub for this blossoming industry. Because CO_2 is such a valuable commodity in Mississippi policy should encourage the growth of the CO_2 sector in Mississippi as a center of activity for enhanced recovery. Pipeline construction CO_2-related tax laws enacted by the Legislature during the past several decades have proven successful in the development of this industry. Mississippi is positioned to be a key player as the production, capture and transport of CO_2 becomes a greater intrastate and interstate commerce opportunity for Mississippi.

• **Embrace electric infrastructure expansion and modernization.**

As Blueprint Mississippi 2011 details, smart grids "connect and help redefine the roles of electricity providers and consumers" by "reducing the number and duration of power outages, lowering utility production and distribution costs, lowering customer prices, and lessening environmental impact." Providing more information and control of electricity use to consumers allows consumers to make more cost-effective electricity use decisions. In a rapidly changing smart grid technology world, Mississippi utilities, regulators and policymakers should continue to monitor grid improvement opportunities, and with overall ratepayer reliability benefits in mind, encourage technology improvements to enhance both demand-side and supply-side operations.

• **Position Mississippi for energy exporting opportunities.** The U.S. possesses the ability to produce massive amounts of oil and natural gas from shale formations and conventional fields both onshore and offshore. Becoming the richest energy country in the world has dynamically shifted the U.S. from a country too dependent on energy imports to a country with opportunities to supply other countries with energy. This means economic opportunities for Mississippi, as a coastal state with strong port assets. MDA and local economic developers should monitor the development of export-related assets around the U.S. and be proactive on opportunities. Any barriers to investment and development should be identified and addressed.

• **Build infrastructure as foundation for future development.** Economic development planning is prospective by nature. Communities across Mississippi desire to be competitive in vying for industrial projects to bring better jobs to its citizens. Having infrastructure in place to accommodate the basic energy needs of industrial development is a key component of a development strategy. With a long-term view in mind, the Mississippi Public Service Commission should continue to adopt policies encouraging regulated utilities to proactively work with communities and invest more capital in Mississippi, thus adding capacity for future development.

• **Maintain responsiveness to interstate and intrastate oil, oil products, CO_2, electric transmission and natural gas pipeline construction projects.** The presence of energy pipelines provides Mississippi not only with the benefit of having access to large energy volumes but also provides direct benefits in jobs and tax revenue. Long pipeline projects passing through Mississippi generate a large amount of local tax revenue for counties every year. Mississippi localities have a good reputation for being supportive of pipeline projects and understanding the local benefits and the overall necessity of energy infrastructure. Maintaining Mississippi's reputation as a safe and pleasant place to invest will result in more jobs and revenue in this area.

• **Consider alternative fuel vehicle network.** With the ever-changing technology in the automotive industry, Mississippi should continue to consider rational ways to accommodate alternative fuels and alternative fueling infrastructure throughout the state. Transportation fuel options present economic choices for consumers. The cost of fuel has a significant impact on the budgets of families, businesses and government organizations. More transportation fuel options in the future could be good for consumers. Some states have rushed to aggressive incentives in this area with poor results, so Mississippi policymakers should continue to be wise and observe the landscape as economical options emerge.

COMPETING IN TECHNOLOGY BASED ECONOMIC DEVELOPMENT: R&D AND COMMERCIALIZATION

Research and development, and the innovation it brings, represents a critically important driver of the modern U.S. economy. Technology-based economic development is seen as key to state competitiveness because the U.S. has a strong track record of investment in R&D. The investment is leveraged in providing advanced technologies and innovations launching new commercial products, new industries or providing the means to enhance productivity in existing industries.
The current R&D ecosystem in the U.S. is multi-dimensional. The core participants are the private sector, the academic sector and federal government laboratories. These entities, working individually or in collaboration, generate innovations in the U.S. leading to national and state economic growth.

Energy is increasingly a high-technology driven sector relying on advanced R&D to drive growth and efficiency. Complex instrumentation and research algorithms are used in the exploration for fuel resources; highly sophisticated drilling technologies are used in energy extraction; and the refining of resources into end products is capital intensive, high-tech and computer controlled. Generation of electric power is performed by highly refined and automated combustion – or in the case of nuclear, fission – processes and advanced technologies are used to control plant emissions. Renewable power generation is driven by technological advancements in photovoltaics, composite materials, turbines and biomass conversion technologies. Increasingly, the energy distribution grid is using advanced technology to become "smart," leveraging R&D to significantly enhance system reliability and energy use efficiency utilizing a bi-directional information flow. Likewise, in the transportation sector, advanced power and propulsion R&D is aimed at achieving increasing levels of energy efficiency. At every level in the energy value-chain, R&D is being performed and applied to keep the U.S. on the leading edge of innovation, to improve efficiency and to generate new products of value in the domestic and international marketplace.

Part of a strategy to advance Mississippi's future prospects for energy-based development must be an evaluation of the state's current R&D capabilities, assets and shortcomings. If R&D, and the innovations it brings, is an integral component of a successful energy-based economy, then Mississippi's current capacity for energy R&D is directly relevant to strategy development.

Historically, Mississippi has underperformed in energy-related R&D and technology commercialization, which prevents the state from seriously participating in technology-based economic development now and, without significant progress, going forward. Battelle Technology Partnership Practice, a technology-based economic development consulting arm of Battelle Memorial Institute, the world's largest independent nonprofit R&D organization, made the following observations in an assessment for the Mississippi Energy Institute in 2012:

> At the present time, Battelle finds Mississippi is home to a quite limited amount of energy and energy-related R&D activity. Analysis of baseline metrics for research funding, university publications volume in energy-related fields, technology transfer activity and patenting activity show Mississippi to be underperforming on the R&D front.

Patents are one measure of R&D driven innovation—indicative of a novel finding or technology. Data for 2001 through 2011, however, show Mississippi produced only 17 patents in the energy realm over the course of the recent decade, with one company, SmartSynch, accounting for seven out of the 17.

Since 2012, some progress has been made with the number of energy-related patents issued per year to Mississippi entities almost doubling relative to the period 2001-2011. Significantly contributing to this increase are Mississippi's research universities for which the number of energy-related patents issued per year has increased by more than 300 percent for the same period.

Mississippi is advancing the energy sector via significant efforts to recruit researchers who bring with them funded research projects. This not only has an economic impact through direct jobs supported by research funding but also has long-term economic impact through research outcomes spurring the creation of new businesses, bring innovations to existing businesses, and attract existing businesses to locate in Mississippi to gain access to research expertise and knowledge.

Blueprint Mississippi 2011 recommends Mississippi develop tools to stimulate private sector R&D spending and emphasizes entrepreneurship as a way to strengthen and expand the state's economy. If Mississippi is to advance in the energy sector, significant efforts must be made to increase our share of R&D, both publicly and privately-funded, and to bring successful R&D efforts further into commercialized activities.

Policy Goals:

- Create jobs by attracting more private R&D investment into Mississippi.
- Encourage public/private partnerships at Mississippi research universities utilizing private investment with public research assets.

- Attract top-class talent in energy-related research.
- Foster a business environment encouraging more investment in energy technology development and commercialization and the high-quality jobs associated with energy technology startups.

Policy Opportunities:

- **Consider establishing a public/private collaborative entity focused on energy technology commercialization.** A public/private collaboration modeled after other successful commercialization ventures, and focused on technology development opportunities in energy, stands to position Mississippi to become a center for energy technology development and commercialization. This collaboration must include cutting-edge methods of research and development, including rapid prototyping and other approaches. Critical to this effort is private sector participation, both in terms of financing and direction, in close collaboration with state economic development leaders and the four research universities. The driving force of a new, specialized entity should be economic growth. With university-based research as the core, a new entity should focus on aggressively attracting key faculty and new technology opportunities likely to have a substantial economic impact. Per Blueprint Mississippi 2011, state investment to recruit researchers who bring with them funded research projects not only has an immediate economic impact by virtue of direct jobs supported through research funding, but also has long-term economic impact through research outcomes spurring the creation of new businesses, bringing innovations to existing businesses, and attracting existing businesses to locate in Mississippi to gain access to research expertise and knowledge.
- **Assess and enhance Mississippi's R&D tax credit.** In 2013, the Legislature enacted a corporate tax rebate to encourage public/private research partnerships between public research universities and private businesses. Considering Mississippi's weakness in private R&D activity, this is good policy but needs to be better marketed and promoted to the private sector. This attractive and well-structured tax incentive should encourage private R&D investment and jobs currently going to other places. Mississippi's research universities have great capabilities and assets to be leveraged. MDA, IHL and Department of Revenue should collaborate to effectively market this incentive along with each university.
- **Encourage greater interaction between universities and the energy industry.** Building relationships between the private sector and public research universities has the potential to pay off in the development of long-term partnerships between corporations and Mississippi's research institutions. MDA has a strong track record of setting up such partnerships. The energy industry should identify issues needing research, and public research institutions should enact policies encouraging more collaboration with private sector entities looking for public research partners. Of all research done in Mississippi, 80 percent is publicly funded. More privately funded research will not only create more jobs but will result in a more sustainable, higher capacity R&D industry in Mississippi. MDA, with assistance from the Mississippi Energy Institute, should create a mechanism where the industry can outline issues needing research to allow universities to respond.

PREPARING A 21ST CENTURY ENERGY WORKFORCE

Mississippi's economic development professionals consistently report workforce capability is an essential element in locating a firm in the state. Workforce availability is often a determining factor between different potential site locations within the state. Businesses look for areas within their fields which can give their businesses a competitive advantage. In a marketplace increasingly emphasizing the use of high-tech tools adding value for suppliers and end customers, a trained and specialized workforce must be developed and valued for the enduring market advantage it can present.

To be successful in the global economy, today's industrial sector workforce must adhere to a model deeply rooted in a highly skilled workforce making extensive and intensive use of technology. The energy manufacturing sectors require specialized education, skills, and training for a large percentage of its jobs. Any efforts to scale the pipeline to assure a supply of suitably skilled energy-related workers must ideally consider "systemic" changes reaching across the full knowledge supply chain from K-12 to higher education to workforce development. Recent data show 66.3 percent of jobs in Mississippi fall within the definition of middle-skill, but only 37.1 percent of the state's workforce has the requirements to fill a middle-skill job.

The energy industry sector in Mississippi must be able to analyze and communicate its current and future workforce requirements so the larger workforce system, as represented by the educational community and public workforce agencies, can support an adequate workforce response. Companies work closely with MDA and the state workforce partners to achieve this objective when locating within the state, but making a broader base of information available with a longer-term outlook could allow for better planning and readiness to address future workforce needs. Without a greater awareness of the high-quality career opportunities, the industrial sector workforce needs will be at the mercy of general labor market dynamics and could be overshadowed by workforce demands of other sectors.

Policy Goals:

- Understand the long-range workforce needs of the energy sector and make Mississippi's workforce development system more responsive to industry.
- Increase awareness/improve perception of energy and manufacturing career opportunities.
- Improve workforce participation rates so every Mississippian will have the opportunity to find gainful employment and skilled workforce supply will increase.
- Eliminate the workforce skill gap for the increasing demand in middle-skill jobs.
- Develop results oriented measures to be tracked over time.
- Increase interaction between the workforce development system and businesses.
- Consider entrepreneurship development as component of workforce development

Policy Opportunities:

- **Build more bridges between all educational sectors (K-16) and employers.** To capitalize on state investment in education and to grow high-skill job opportunities through experiential education opportunities, additional linkages between all educational sectors (K-16) and employers are necessary. Such linkages would improve the structure and delivery of services, identifying the needs of employers and developing relevant training opportunities for job seekers. Bridges between education stakeholders and employers in local workforce areas would identify any potential gaps between the skill level of the local workforce and the needs of local employers. Strategies such as designing training programs in area high schools and community colleges to meet local workforce needs would improve workforce participation rates and reduce the middle-skill gap in the area and the state. (Source: Mississippi Workforce Innovation and Opportunity Act) Leverage currently available resources such as the National Energy Education Development Project (www.need.org) and the Center for Energy Workforce Development (www.cewd.org) to expose students to the full value chain of the energy sector.
- **Increase the number of recognized credentials.** Credentials are a vehicle to assist employers with identifying people with the training to perform the required job responsibilities. Standardized credentialing will serve as a useful tool for employers and a mechanism to increase awareness for skill demands in the workforce.
- **Expand dual enrollment, accelerated learning programs, and apprenticeships.** To offer multiple pathways into the workforce, pathways from K-12 through community colleges and universities should be seamless, more prevalent and tailored to future local workforce demands. Further, increasing the number of apprenticeships provides individuals both training and education while growing the local workforce in a meaningful way.
- **Integrate IT based platforms and maximize reach.** Mississippi Works (MississippiWorks.org) is presently managed by the Mississippi Department of Employment Security and was developed to connect Mississippi job seekers with Mississippi employers. Mississippi Works offers web and mobile applications allowing job seekers to search and apply for jobs,

build resumes, access labor market information, and perform skills-gap analysis. The technology allows employers to perform actions such as posting jobs, viewing job applicants, presenting on-the-job training information, accessing benefit and tax appeals information and retrieving work opportunity tax credit information. Get on the Grid (www.getonthegridms.com) is a sector-specific, web-based platform aimed at raising awareness of in-demand, high-quality middle-skill career options. These two resources are distinct but complementary. Under the Mississippi Works umbrella, integration of tools already available to grow the workforce pipeline should remain a key goal.

• **Deliver a unified message.** Partners in the state's workforce development system will collaborate on the development of a unified message promoting and marketing the components of the training and workforce system. This unified message is vital to helping Mississippians locate jobs and to engage employers in the workforce system. Effectively informing job seekers and employers about Mississippi's improved workforce system is necessary to move individuals through the pipeline and grow and strengthen Mississippi's workforce. (Source: MS WIOA Plan)

CONCLUSION

Mississippi sits at the edge of unprecedented energy opportunity. Current energy assets, natural resource strengths, a strong business climate, and an appetite for growth put Mississippi in a very competitive position to attract energy-related investment and jobs to the state.

With shale gas and oil technology development, the United States is in the midst of an energy revolution. Oil imports are decreasing and the nation's competitiveness is increasing due to lower natural gas prices relative to other parts of the world. Mississippi has tremendous natural resource and infrastructure assets allowing the state to capitalize on these potential growth opportunities. Mississippi can generate high-paying jobs and attract new corporate investment by building on these strengths and on the state's reputation as a prime location for energy investment, in addition to seeking economic development opportunities across the full energy value chain.

Mississippi will also provide stability to its existing employers and increase its competitiveness when it comes to business recruitment by embracing an "all of the above" strategy pursuing a diverse energy portfolio and by adopting policies ensuring access to reliable, affordable energy over the long term. Taking these steps will not only create jobs and bolster the state's position as an energy leader but will also improve quality of life and create new economic opportunities in communities throughout the state.

An ever-developing global economy will only heighten competition. As Mississippi vies to be a center for innovation and job growth, energy must remain a central area of focus. Not only are Mississippi families and businesses expecting reliable delivery of affordable energy but a 21st century economy will produce energy and demand it. Pursuing diverse opportunities for Mississippi in the energy sector and establishing the state as a leading place for investment is the right policy for Mississippi, both today and in the future.

CONTRIBUTIONS AND SOURCES

This report utilizes data and material from the following sources:

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