CENTER FOR ECONOMIC RESEARCH

REAL REPORT

REGIONAL ECONOMIC ANALYSIS OF LOUISIANA

Energy Special Edition

SPRING 2023

COLLEGE OF BUSINESS

Dean's Message

We are pleased to share with you the Spring 2023 edition of the Regional Economic Analysis of Louisiana (REAL) Report, an ongoing series designed to provide insight into recent economic developments in Louisiana. This special issue focuses on the economic impact of the energy sector on Louisiana—from renewable sources to oil and gas. Each student analyst approached their specific topic from a unique perspective, and as such, may not have reached the same general conclusions. As always, economic indicator forecasts for the state are included at the start of the report.

The REAL Report is produced by Center for Economic Research, in collaboration with faculty and students in Louisiana Tech University's College of Business, for the state of Louisiana and our region of the South. Providing an invaluable learning experience, this report is compiled by undergraduate business economics majors in partial fulfillment of their Regional Economic Analysis class.

If you are interested in reading past reports, please visit **Business.LATech.edu/RealReport**. For more information on the Center for Economic Research or the REAL Report, contact Dr. Patrick Scott at PScott@LATech.edu. Inquiries about specific sections of the report should be referred to the author of each section, while media inquiries should be directed to Waldroup@LATech.edu.

I hope the information included in this report serves as a valuable tool for your efforts.

Sincerely,

CHRISTOPHER L. MARTIN, PH.D.
Dean and Chase Endowed Professor
College of Business
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Meet the Team

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Dr. Patrick Scott is an associate professor of economics and director of the Center for Economic Research. He teaches macroeconomics, monetary theory, and research methods at Louisiana Tech University. His research interests include optimal monetary policy models, dynamic general equilibrium models, time series forecasting, and Bayesian econometrics.

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Louisiana Economic Indicator Forecasts

BY C. PATRICK SCOTT, PH.D.

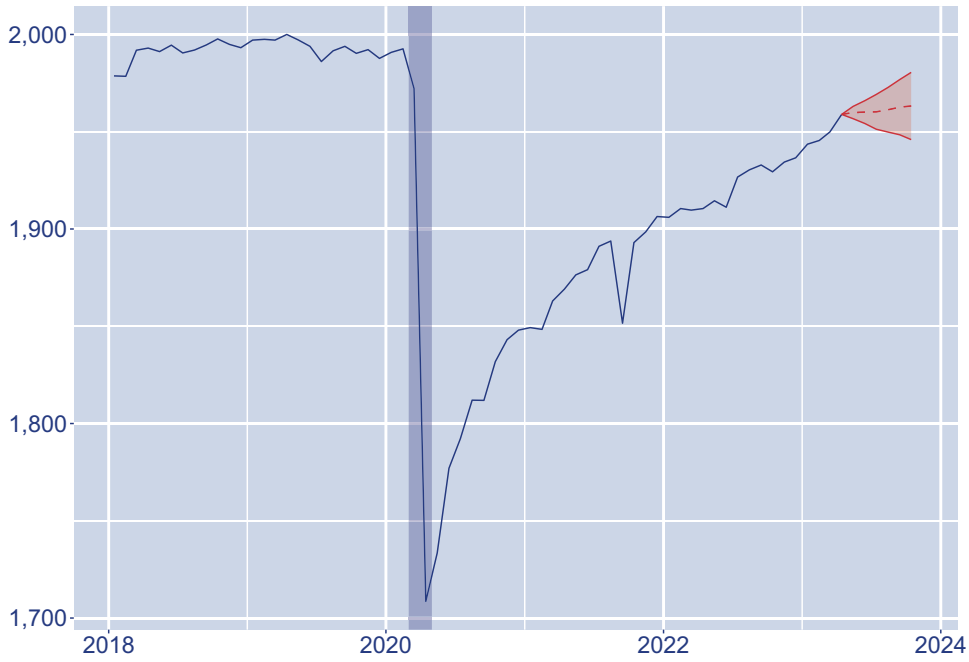
Forecasts are provided using a Bayesian model averaging approach from many statistical models. This method is utilized to capture the relative uncertainty that any one individual model is not properly specified and thus accounting for that uncertainty in our analysis.

Non-Farm Employment

Total non-farm employment bounced back with a vengeance in 2023, reclaiming 15,000 jobs over the last four months. Total employment is still down approximately 42,000 jobs from pre-COVID levels nearly three years ago. Since Louisiana has already recovered its labor force participation rate, this signals new growth in the LA economy. The most likely reason for this is persistent inflation forcing a previously disenfranchised portion of the workforce to action. Future job growth is still expected to grow at a slower rate, but most models point to growth.

Punchline: Unexpected job growth right now is a welcome sight.

Figure 1: Forecasted Non-Farm Employment (Thousands)



Unemployment Rate

The unemployment rate for Louisiana has not changed for the last three months, holding steady at 3.6%. Most models show only a modest appreciation upwards. This is likely due to continued wage bargaining and turn over in tight labor markets. Forecasts still show the rate inching its way back to 4% in the later part of this year barring any more large disruptions in the banking sector.

Punchline: The unemployment rate is holding steady into summer.

Figure 2: Forecasted Unemployment Rate (Percent)

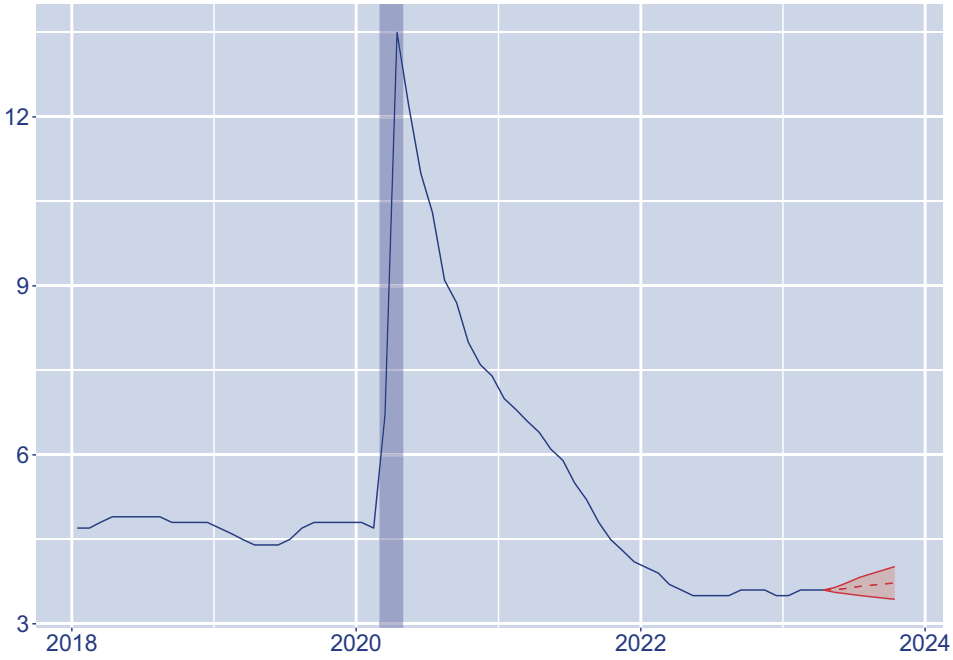
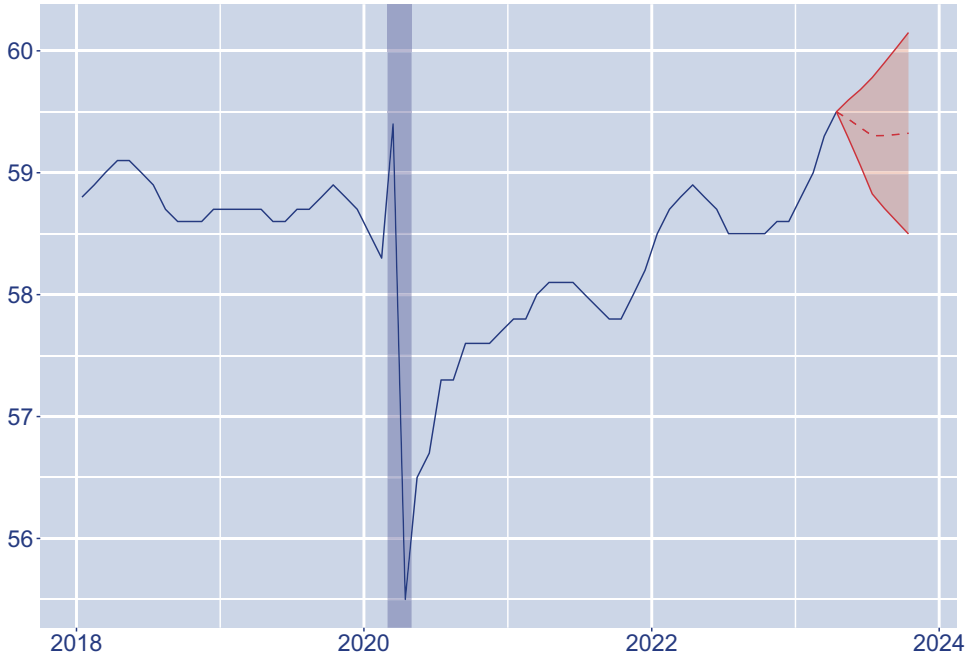


Figure 3: Forecasted Labor Force Participation Rate (Percent)

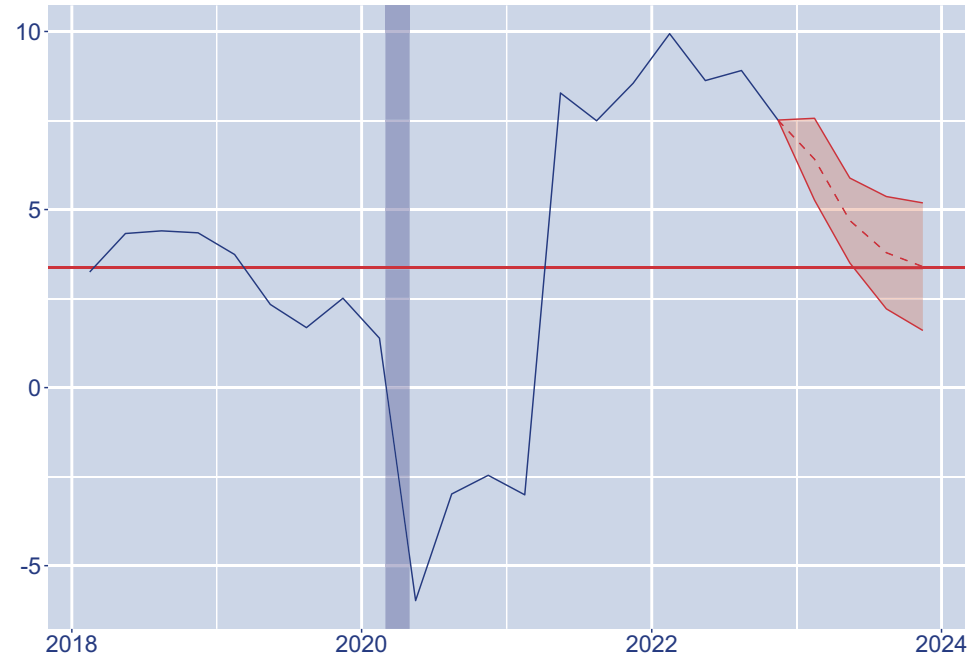


Labor Force Participation Rate

The labor force participation rate (the fraction of working age population engaging labor markets) grew sharply in the last three months to 59.5%. This is the highest we have seen since April 2016. When this number grows and employment grows, it signals new growth in labor markets. Model uncertainty is relatively high with this data, so there is still quite a bit of movement in the forecast horizon, but growth after the pandemic recovery is a reversal of the long-run trend.

Punchline: The labor force participation rate is indicating a dynamic recovery for LA.

Figure 4: Forecasted Wage Inflation (Percent)



Wage Inflation

The past few forecasting cycles for wage inflation have been relatively pessimistic. In most cases, what actually occurs is much closer to the upper bound of the forecast region of uncertainty (the pink shaded region). Wage growth has stabilized, but still high, reflecting demands from workers to account for the loss in purchasing power. Wage inflation is expected to remain positive for the rest of 2023 and above trend for most of that.

Punchline: Wage growth is above long run dynamics indicating local level inflation feedback loop.

Monthly employment, unemployment rate, and labor force participation rate data for this section extend to April 2023 and include the most current releases at the time of publication. Quarterly wage data extend through December 2022 and include the most current releases at the time of publication.

How Dependent is Louisiana on Oil and Natural Gas and Other Carbon-Based Energy Production?

BY LAUREN LASITER

According to the International Energy Agency (IEA), by 2025, renewable resources are expected to account for 35% of global power generation. This transition alters market incentives and compels states to adjust their energy sources to avoid falling behind. While Louisiana is currently a prominent producer of oil and natural gas, the state has the potential to take a leading role in the transition to clean energy within the United States. With its abundant existing natural resources, Louisiana possesses numerous opportunities to become a frontrunner in the shift toward clean energy. This would not only benefit the state's green economy but also contribute to the supply of clean energy nationwide. However, it's important to note that Louisiana's economy still relies significantly on carbon-based electricity, as well as oil and natural gas production.

Figure 5: Louisiana Crude Oil Production (Thousands of Barrels - Top) & Natural Gas Production (MMcf - Bottom)

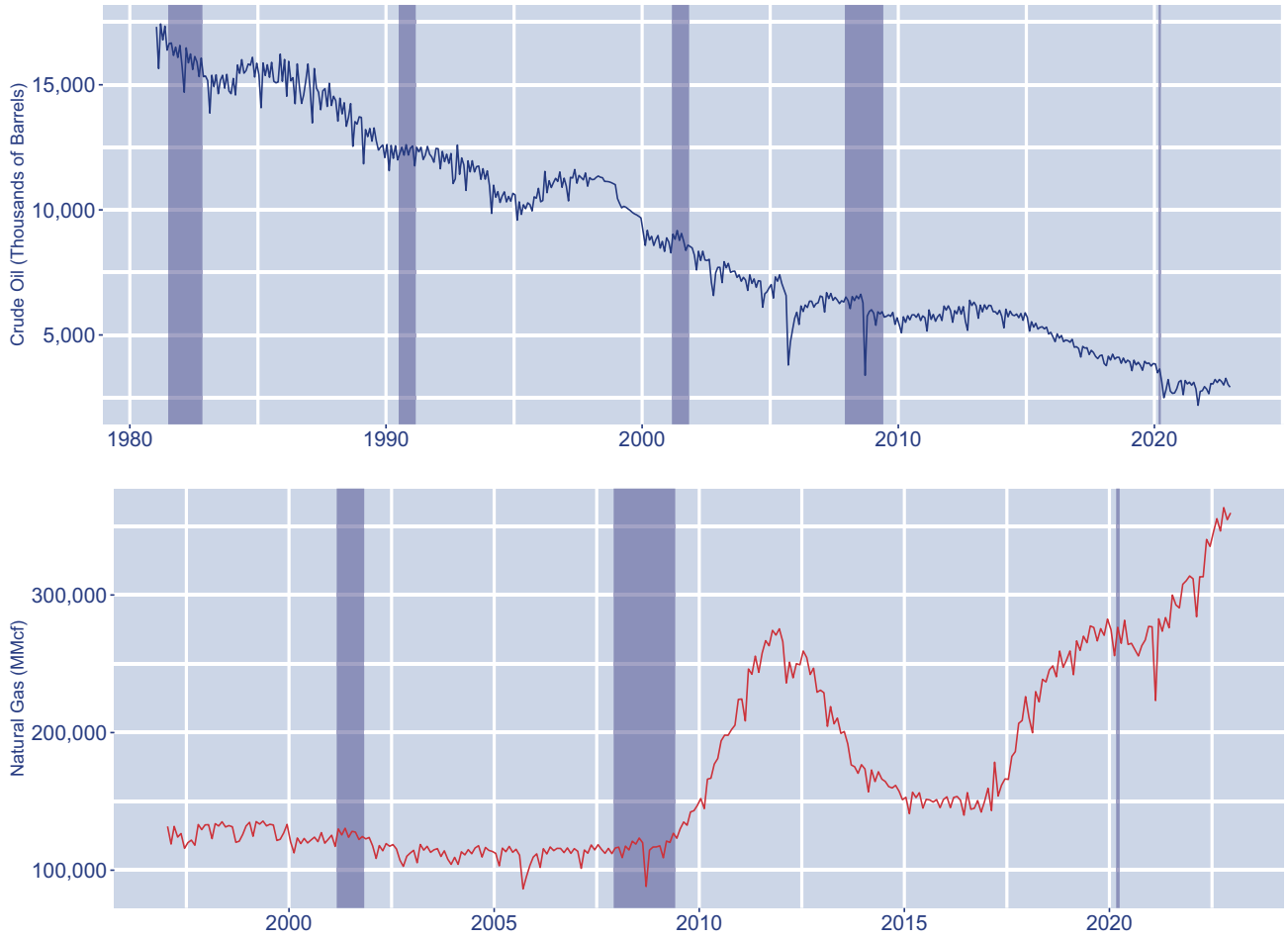


Figure 5 (top panel) depicts the downward trend of Louisiana's crude oil production over the past 43 years. Peak production is around 1982, and the overall trend of this data shows a decline in average production of nearly 80% over that time. This phenomenon can be explained by several factors. First, Figure 5 shows a fraction of the years that many of these refineries have been in business. The remaining reserves of oil are becoming increasingly difficult and costly to extract. Also, there is a rise of other oil-producing regions in the United States, including areas in Texas and North Dakota. The volatility of oil prices has also contributed to the production decline and made it more difficult for Louisiana to compete. While Louisiana remains one of the leading oil-producing states, its future competitiveness in this sector is uncertain.

Louisiana's economy also largely depends on the production of natural gas and is one of the top natural gas producing states in the United States. Figure 5 (bottom panel) also displays Louisiana's natural gas production from 1997 to present[1]. Louisiana is currently facing its highest levels of monthly natural gas production that we have on record, at approximately 360,000 million cubic feet. Louisiana also faces a direct seasonality of natural gas demand, having significantly higher demand in the winter months, likely for heating purposes. Though production levels vary from year to year, the recent general upward trend can be attributed to technological advancements in the extraction of natural gas along the Haynesville Shale, loosely the northwest region of the state. Overall, the Louisiana economy is closely tied to the production of carbon-based electricity, crude oil, and natural gas, and this will be the case until there is a significant increase in the investment of other industries. Though these industries pose challenges related to pollution, climate change, and sustainability, the carbon-based electricity, crude oil, and natural gas industries continue to provide ample jobs and revenue to the residents of Louisiana.

Figure 6: Percent of Electricity Production from Non-Renewable Energy Sources

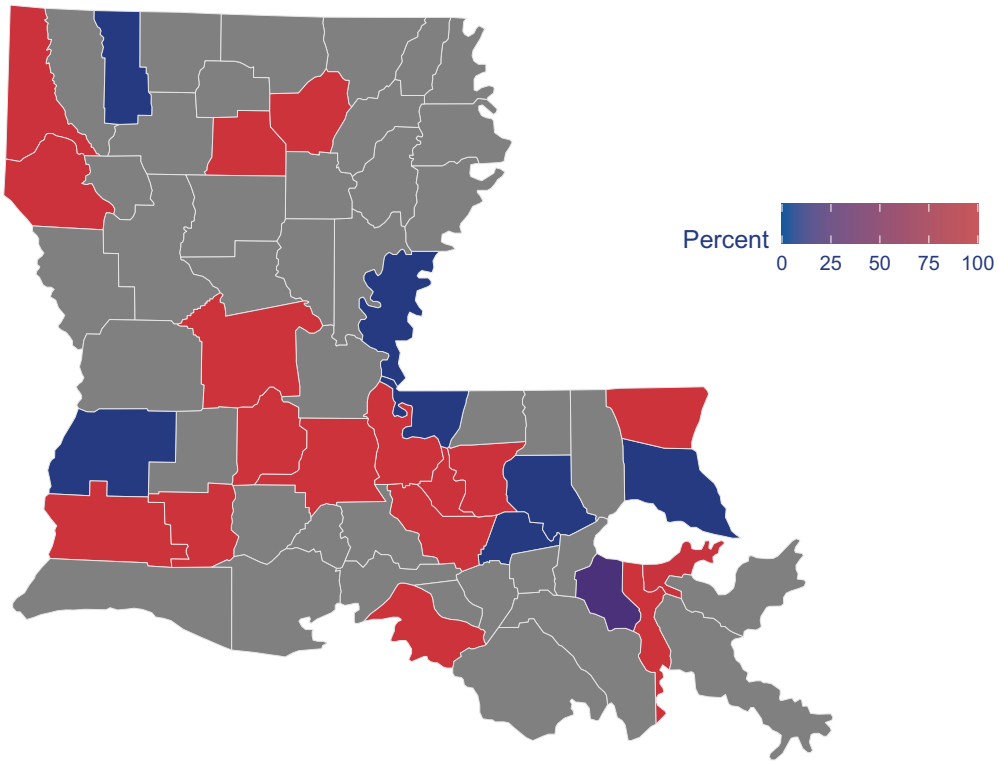


Figure 6 displays the proportion of electricity output that is generated from fossil fuel and biomass, which are not clean energy sources, to the total electricity output that is generated from all Louisiana parishes. Twenty-five parishes currently produce electricity out of 64, and of those 25, 17 parishes produce 95% or more from nonclean energy technologies. West Feliciana and St. Charles Parishes are two unique cases. They produce mostly clean energy and are among the top ten parishes for electricity production in total for the state. These two parishes represent regions that are poised to benefit the most from the transition to cleaner energy sources.

Though the transition to relatively cleaner energy output is likely to take some time, the parishes indicated by a proportionately larger output of dirty energy production outnumber the cleaner energy parishes by a factor of more than three to one. As Louisiana's electric generating industries pivot, the large number of oil and natural gas reserves will prolong the traditional economic relationships until either reserves are no longer sustainable, or until the economic incentives change.

[1] While data extends back to before 1990, starting in 1997 production in the Gulf is no longer attributed to Louisiana production aggregates.

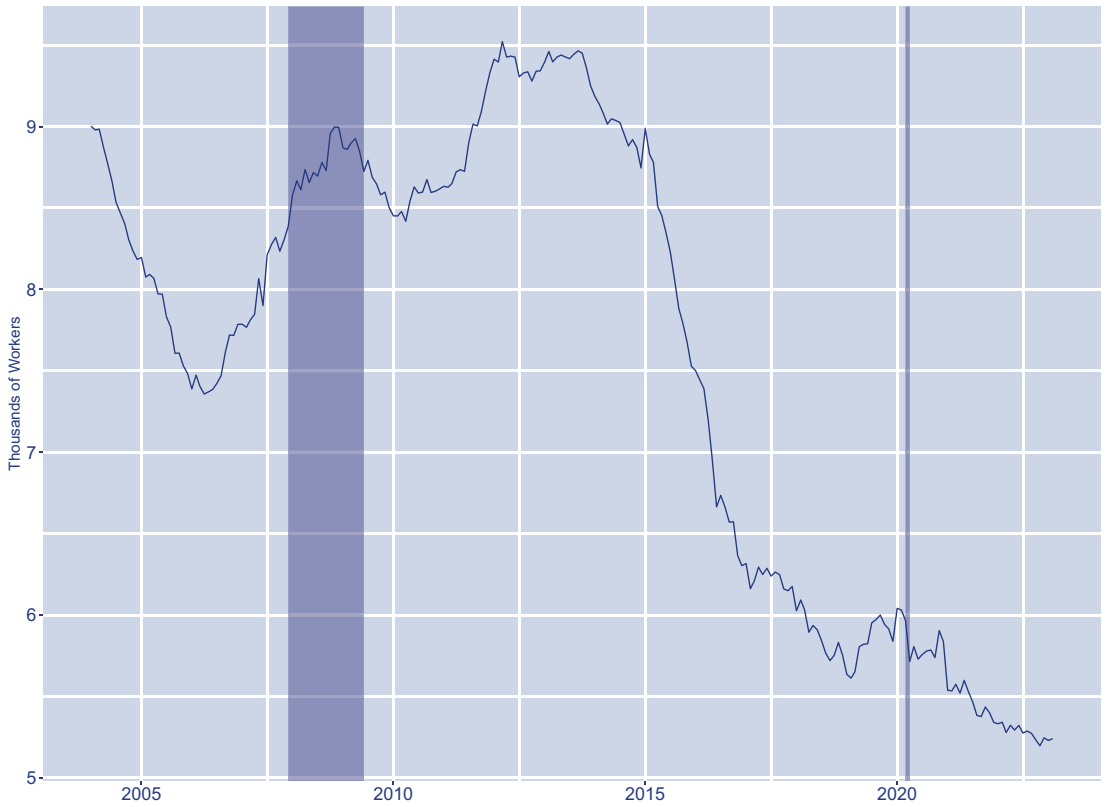
Data for this report are provided by the Bureau of Economic Analysis and Energy Information Administration. EIA data extend through March 2023. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

What about Louisiana Jobs?

BY JORDAN HATTER

The shift toward clean energy sources such as solar, wind, hydroelectric, and nuclear energy threatens Louisiana jobs across the state and in many different sectors. The most at-risk jobs are those involved in activities such as oil and gas extraction, petrochemical manufacturing, oil refining, and some types of electric power generation. There are jobs in renewable and nonrenewable energy generation and extraction across the state. The aim of this report is to identify where these jobs are and to what extent they impact total Louisiana employment. Additionally, we compare Louisiana's employment in these fields to that of the nation.

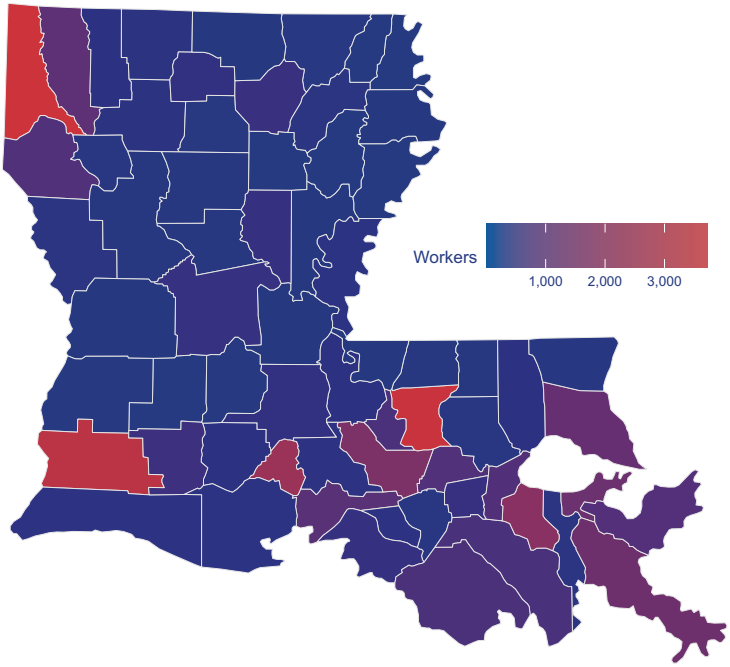
Figure 7: Oil and Natural Gas Extraction Employment (Thousands of Workers)



Overall employment trends in oil and natural gas extraction are not driven by national or global economic shocks. In February 2023, employment in this sector was just over 5,000 workers which makes up only 0.3% of all employed persons in Louisiana. As seen in Figure 7, industry employment has decreased by about 4,000 full time equivalent workers since September 2013. The industry was relatively insulated from the initial COVID-related shock, decreasing only about 320 workers from February 2020 to April 2020. Despite this, oil and natural gas extraction employment has not been able to reverse its long-run employment decline in the years following the pandemic outbreak. This threatens not only the industry's coveted position as a pillar of the Louisiana economy, but also its ability to secure political clout in Baton Rouge. The Great Recession started in December 2007 and ended in June 2009. Between these dates, there was an average increase in employment by 330 workers. The difference in impact in these two recessions—the Great Recession yielded small positive job growth and the Pandemic Recession yielded small negative job growth—emphasizes that the long-term decrease in employment of oil and natural gas extraction is not due to national or global economic fluctuations.

As people and firms pivot away from fossil fuels, such as oil and natural gas, increasing focus is shifted to the depth and breadth of electric power generating technologies. Electric power generation is a major employment hub for jobs in renewable and nonrenewable energy. Figure 8 illustrates the magnitude of direct employment of both oil and natural gas extraction as well as electric power employment for

Figure 8: Employment in Oil & Natural Gas and Electricity Production



all technology types. This figure provides a snapshot of employment that is at-risk for disruptions in the coming years at the parish-level. The three parishes with the most employment in the at-risk industries are Caddo with 3,715, East Baton Rouge with 3,592, and Calcasieu with 3,257 workers. Average annual employment location quotients (found in Table 1) are the percentage of the total Louisiana employment each sector makes up divided by the percentage of the total national workforce that the national data indicates. The second largest employment quotient is that of fossil fuel electric power generation: 0.82. Louisiana's energy production is 76.80% from fossil fuels, therefore employment in that field reflects that. Biomass electric power generation's location quotient of 0.33 is the third highest of the types listed in Table 1.

The remaining electric power generating technologies are designated as "clean energy" production. All except nuclear power are relatively under-utilized compared to national averages (location quotients less than one). There are six hydroelectric power plants in Louisiana. Two are in Concordia Parish and the rest are in Terrebonne, Catahoula, DeSoto, and Rapides Parishes.

Solar and wind power generation are the two sectors with the lowest location quotient: 0.04. Louisiana does have solar farms; however, the average employment is relatively small since most employment is contract labor from out of state. This is an important hurdle for this industry to overcome since it is relatively land intensive, but employs few people. The only wind power generation contributor in Louisiana is in Lafayette and makes up the entirety of the state's employment. Most wind turbines are located outside of the region; however, there are still many in Texas and Oklahoma. Currently, Louisiana has only exceeded a location quotient of one in the field of nuclear power. Louisiana has two nuclear power plants: River Bend in St. Francisville and Waterford 3 in Killona. Grand Gulf nuclear station is also extremely close to the Louisiana border as it is in Port Gibson, Mississippi. The employment of Louisiana residents at these three locations is why this number is so large.

While Louisiana does have lower relative levels of employment in power generation than the rest of the nation, it is not due to wages. Average wages in Louisiana exceed the national average by at least 1.38 times. Solar power wages on average are 2.71 times the national rate. Clean energy wages are higher than non-renewable energy; however, fossil fuel electric power generation does exceed hydroelectric power wages by almost $14,000 per year. Clean energy jobs in Louisiana do not have many benefits and are non-union which differs from most non-clean employment. Employment in fossil fuel and biomass power generation is closer to national proportions, but is still behind. This analysis does not account for multipliers, which are discussed more on page 12.

Table 1: Electric Power Generation Location Quotients by Industry

Type Of Power Generation	Location Quotient
Solar	0.04
Wind	0.04
Hydroelectric	0.16
Biomass	0.33
Fossil Fuel	0.82
Nuclear	2.31

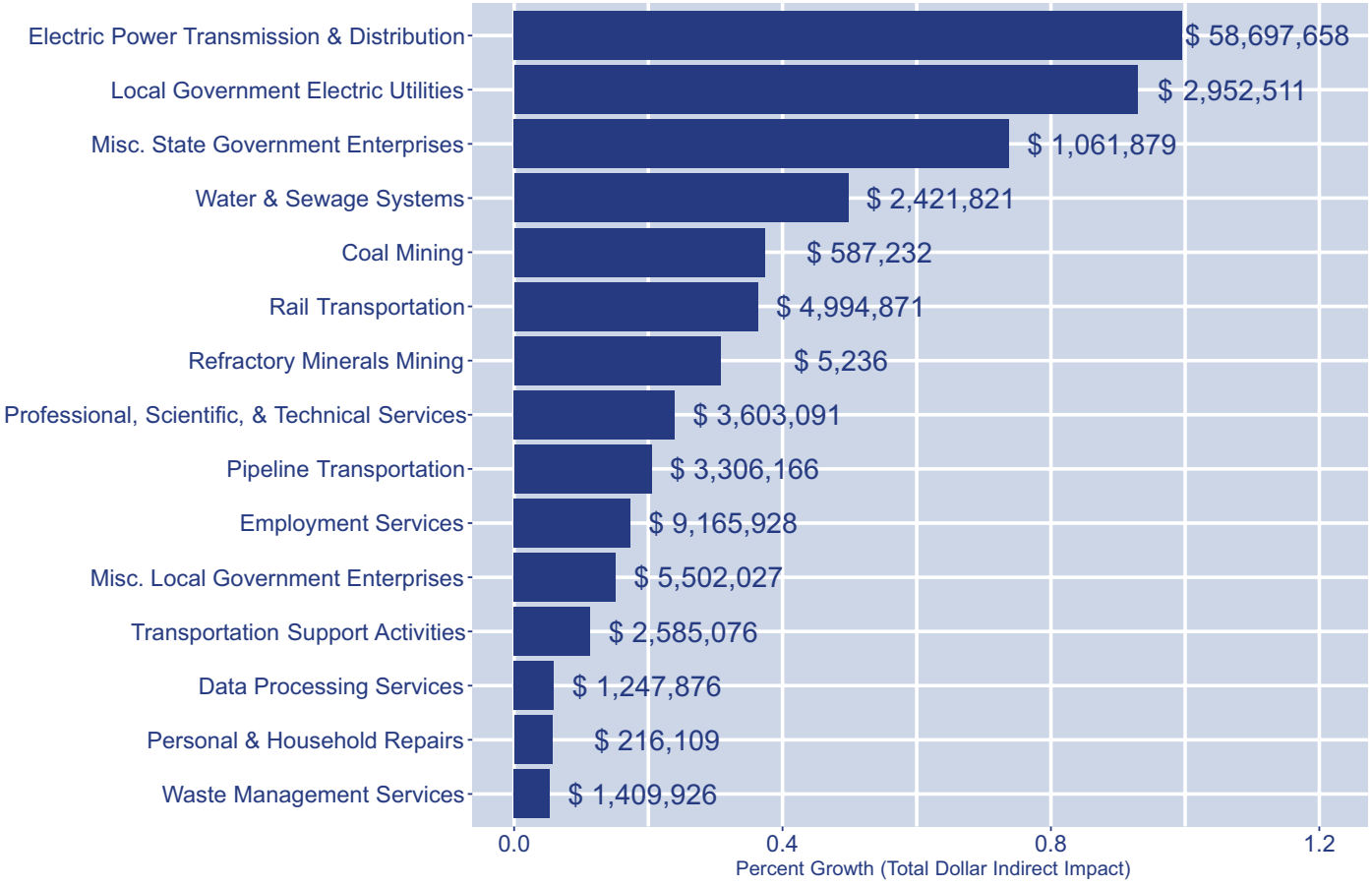
Data for this report are provided by the Bureau of Economic Analysis and Energy Information Administration. EIA data extend through March 2023. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

Supply Chain Effects Related to the Clean Energy Sector for the State of Louisiana

BY MARSHALL KEEN

According to the U.S. Energy Information Administration, the clean energy sector (encompassing wind, solar, nuclear, geothermal and hydroelectric power production) is projected to rise from 21% of electricity generation in 2020 to 42% by 2050. Louisiana Governor John Bel Edwards' Climate Action Plan (approved by his Climate Initiatives Task Force in early 2022) will enable the state to achieve a stated goal of net-zero emissions by 2050. The purpose of this study is to analyze the supply chain effects specific to these industries to better understand what incremental changes in investment patterns will do for Louisiana. To address this topic, industry contribution analyses for the five energy sectors listed above are calculated and their indirect effects are estimated via changes in business-to-business spending patterns.

Figure 9: Projected Industry Growth–Top 15 Industries–Indirect Economic Effects Only (Percent and Dollars)



An industry contribution analysis approach is used here to estimate the supply chain economic effects. Even if the nation hits the stated 42% clean energy goal, Louisiana is not likely to fully mimic the national trends in this sector. To account for this, a more conservative impact is modeled where clean energy sectors increase output by 10% and more traditional, less green sources remain unchanged. A shock of this magnitude would add more than 1,100 jobs and increase labor incomes by more than $106 million. State GDP would increase by almost $320 million and more than $23 million in state tax revenues will be generated.

Figure 9 visualizes the indirect impact on the top 15 adjacent industries given the demand changes listed above. The shaded bars show the percent growth for each industry while the corresponding dollar amounts indicate the actual level change in each industry. These top 15 industries comprise over 65% of the total indirect (supply chain) effects for the state. That said, green electricity production is a relatively far-reaching economic impact. Ninety-one percent of all industries in the state would record economic growth with advances in this sector over the coming years. The total economic effect is relatively well disbursed throughout all current industries.

In addition to examining the raw indirect effects of these various clean energy sectors within the state, this estimation allows for a contrast of these indirect effects against those of traditional power generation industries such as fossil fuels and biomass energy generation. The biomass power industry generates indirect output of approximately $9.9 million to the overall state economy, which makes up approximately 29% of the total output generated by the industry. Biomass supply chains contribute approximately $2 million to indirect labor income throughout the state and produce over $4.7 million in value added through other industries. The fossil fuel industry contributes an indirect output of $748 million, about 23% of total industry output which is approximately $3.2 billion state wide. Fossil fuel power generation produces about $156 million in indirect labor income while contributing nearly $360 million in indirect value added to other industries throughout the state. The indirect contribution of fossil fuel power generation to other industries is far greater than that of any individual clean energy sector, with the closest rival being nuclear power generation. Biomass power generation sits closely above the other individual clean energy sectors (geothermal, wind, and solar) in indirect output, though the margin is notably smaller with this industry. Though these two traditional power generation industries appear to maintain relatively high margins over their counterparts in all clean energy sectors, it is worth noting that the combined indirect impacts of the clean energy sectors approach the combined indirect impacts of fossil fuel and biomass sectors. The indirect difference between clean and non-clean energy sources is less than $100 million state-wide. As investment grows in these technologies, their total economic impact has the potential to eclipse traditional, non-clean energy sources.

In conclusion, the indirect impacts of the clean energy sector give way to notable variations. Solar energy contributes the lowest amount to total electricity output (19% of the industry's total contributions), while nuclear energy contributes the highest amount (26%). The indirect effects of clean energy power generation technologies do not quite total the indirect contributions of more traditional power generation industries such as biomass and fossil fuels, but the indirect effects are relatively similar. This indicates that as the state shifts to more cleaner energy electricity production, the economic benefits are not likely to disturb the delicate balance of policy makers' and economic development professionals' efforts to attract and retain businesses in the Pelican State.

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Economic Trade-offs of Clean Energy

BY JOSEPH CURTIN

The debate around solutions to climate change and the reduction of carbon emissions is a hot topic in our political sphere currently. One proposed solution is to make the shift away from fossil fuels and towards clean, renewable energy sources. A major question concerning alternative sources of energy is the economic benefit obtained by switching to clean energy and away from traditional fossil fuels. Even though the fossil fuel industry in Louisiana has shrunk in the last two decades, as shown in Lauren Lasiter's report on page 6, it is still a core and essential part of Louisiana's economy. This report examines the economic tradeoffs between fossil fuels and other methods of electricity production using social accounting matrix multipliers.

Displayed in Figure 10 is the direct, indirect, and induced effects of each subcategory of clean energy production as well as the effects of fossil fuel and biomass to compare the effects of each. Type SAM multipliers are calculated for each industry using an input-output table model. Utilizing the estimates of the indirect and induced portions of each multiplier, the total multiplier calculation is graphically shown in levels as well as the proportion of each component to the whole. This gives the reader a sense of how investment changes turnover within the economy as well as where additional changes in employment, labor income, and output propagate at the state level. Additionally, the plot shows these multipliers on the same scale in order to adequately communicate the relative size of each type of multiplier in the context with each other. Geothermal energy was also examined in this analysis, but since there is no geothermal energy production currently, growth estimates are loose at best and not included.

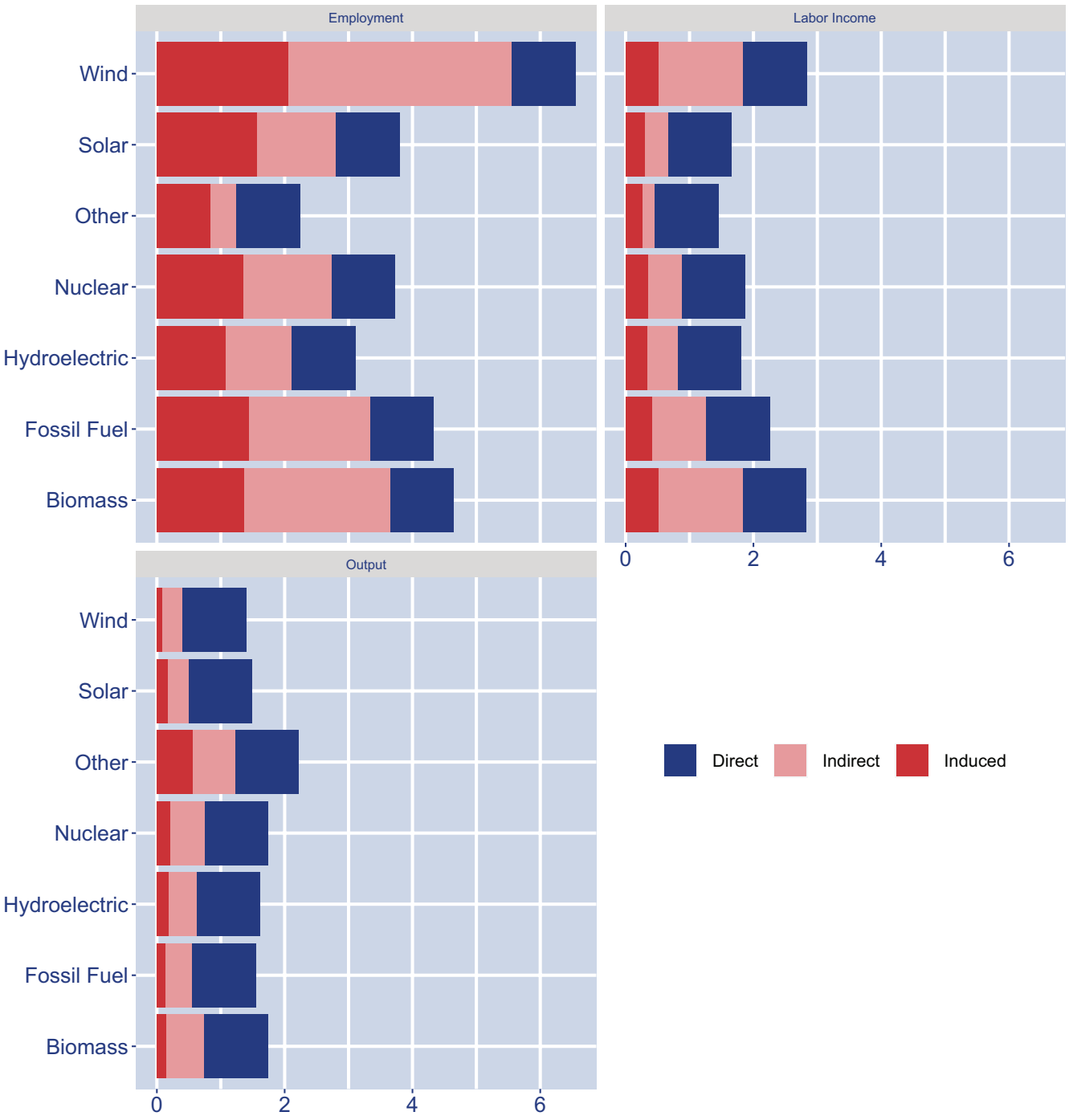
Employment multipliers are relatively large for this general industry. As a result, jobs are most affected and most at risk from shifts in investment. Wind, fossil fuel, and biomass technologies have disproportionately high indirect (supply chain) effects, as noted in Marshall Keen's report on page 10. The average total multiplier for all energy technologies is just over four, which means that every one job created in this industry supports an additional three on average. Within these calculations, the largest variation lies within the indirect effects (the pink shaded region). Current policy debates in certain corners of the state center around the allocation of land for solar energy. Estimates here indicate below average supply chain effects for that specific sub industry. This is also the case for the "Other" sub industry, which partly consists of individual solar production that is sold back to the grid.

Output multipliers are relatively low regardless of electric producing technologies. This is consistent with broader themes in past issues of this report that show the extent to which the Louisiana economy produces disproportionately more intermediate goods than final goods. For six out of seven sub industries, the sums of the indirect and induced effects don't exceed the direct effects. From an output perspective, the economic benefit of electricity investment leaks out of the state relatively quickly.

Labor income multipliers tend to mirror employment multipliers when a sector pays close to average market wages. Wind and biomass sub industries are among the highest in this study. This is intuitive since they both have more supply chain linkages in the state. Aside from wind energy, the rest of the clean energy multipliers for labor income are less than two. This is not to say that these industries are bad investment opportunities. This result reflects under investment and is more likely to change in the coming years.

Overall, it seems that based on these multipliers, it is employment and labor income that are most affected by shocks in this market, not output. This is important to note when deciding which method of energy production is best for Louisiana, since what may be a viable alternative from the employment or labor income perspectives may not actually push the state further down the road to efficiently phasing out fossil fuels. Wind, for example, has relatively high multipliers for both employment and labor income, but has relatively low multipliers for output, signaling that it may not be as efficient (probably due to sporadic energy production due to changes in wind patterns). Similarly, biomass also performs well in both employment and labor income, and actually

Figure 10: Employment, Labor Income, and Output Multipliers by Electric Generating Technologies



does relatively well in output. However, since biomass also involves burning (plant waste instead of fossil fuels), the amount of carbon released is not much better than burning traditional fossil fuels. Carbon capture technology may change this though. The industry with the most balanced multipliers is probably nuclear. While nuclear is middle of the pack for labor income and employment, it maintains that status while sacrificing relatively less output when compared to other industries. Nuclear energy production can be controversial for a few reasons (chiefly safety and waste related concerns), but from an economic standpoint this seems to be our most viable option at this time.

Data for this report are provided by the Bureau of Economic Analysis. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

Agricultural Farms Versus Solar Farms: A Comparative Static Analysis

BY HENRY MESSINGER

According to the LSU Ag Center, Louisiana is home to some of the poorest farms in the nation, with an average land value of $520,000 per farm. LA farms are valued at $380,000 (40%) below the national average. Louisiana's agriculture industry represents over $7.3 billion in output, and the largest crops include sugarcane, corn and rice, hay, soybeans, and cotton. At the time of this report, Louisiana has five proposals for solar farms being considered across the state, and all of them would come at the expense of farmland to some degree. This report analyzes the effect of contributing a hypothetical 500 acres of land to solar farm in contrast to one of the traditional farming crops listed above. This analysis will break down the direct, indirect, and induced benefits of a 500-acre farm of each type listed above to determine which of these different crop/utility industries have the strongest economic impact on Louisiana in terms of overall tax benefits, labor income, and employment all at the state and parish levels.

Figure 11 shows how the different economic multipliers from each industry are affected by creating a hypothetical 500-acre farm. The employment multiplier shows how many additional jobs are created for each new job introduced into a particular industry. Figure 11 shows that soybean and solar farms are near equivalents in terms of multiplier effects and have the highest employment multipliers of all the industries studied. Average employment multipliers across the top six crop industries are estimated to be three additional jobs for every one job created in their industry. In contrast, solar farming will support an additional four jobs to the economy for every additional job created. The labor income multiplier shows how many additional dollars of labor income are produced throughout the economy for every dollar produced in the target industry. The average labor income multiplier across the top six crop industries is $1.88 per dollar generated. This is a $.22 increase from solar farming's $1.66 generated throughout the economy. The output multiplier shows how much output each individual industry will support throughout Louisiana, affecting different industries in the economy. For all seven

Figure 11: Industry Multipliers for Louisiana

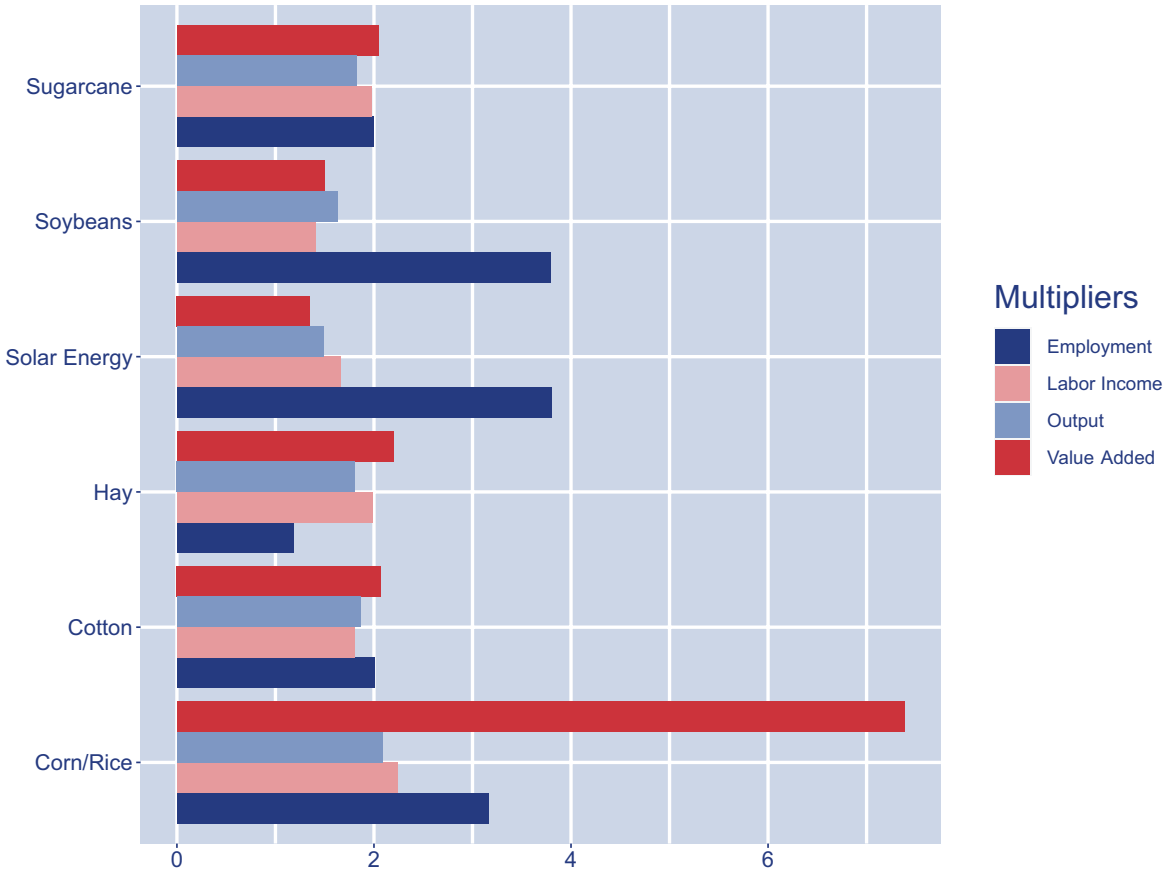
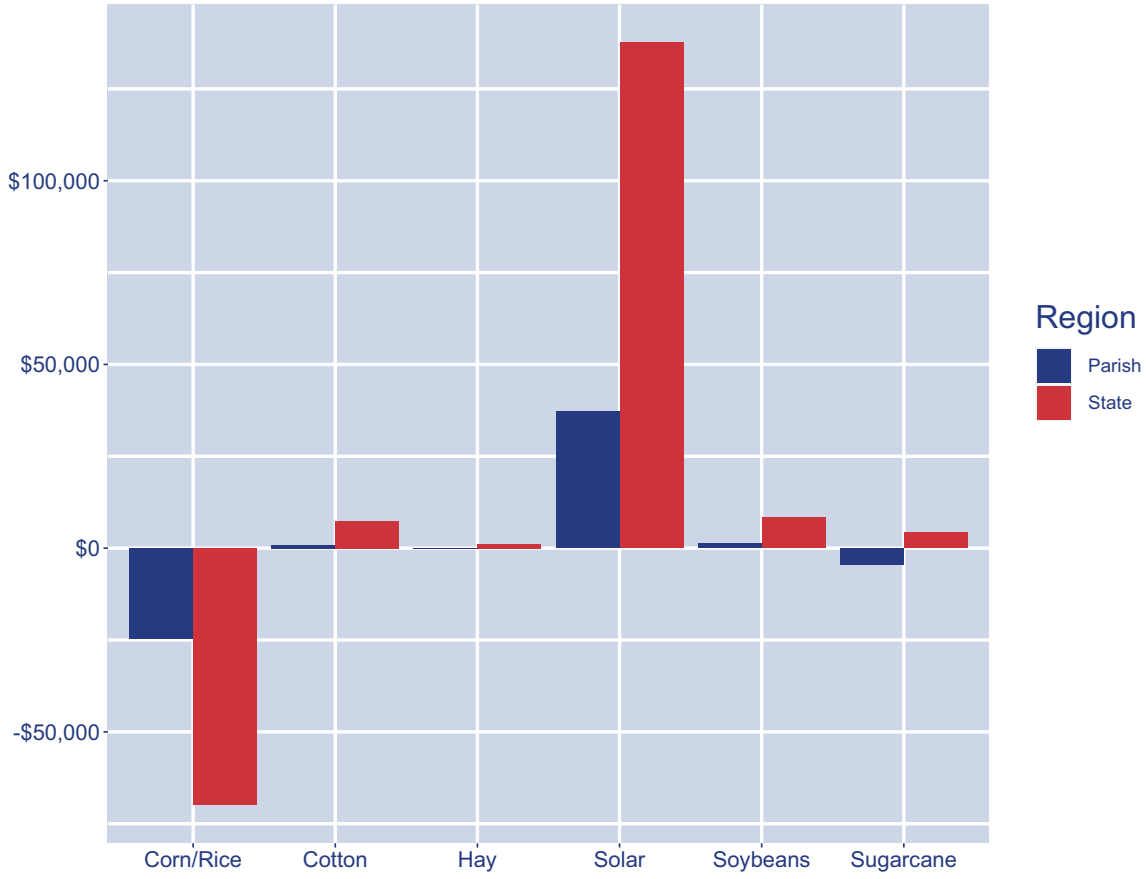


Figure 12: Parish and State Tax Revenues per 500 acre Investment (2022 Dollars)



industries and solar farming, this effect is relatively low (as indicated in Joseph Curtin's report on page 12). The value-added multiplier shows how each industry's expansion will affect final goods and services to the Louisiana economy. Of these seven industries, the highest value-added contribution to Louisiana is the production of corn and rice. Corn and rice production in Louisiana outperforms solar farming in every dimension except employment, where there is a 17% difference in favor of solar farming.

Figure 12 shows the amount of tax revenue taken in (or lost) from the hypothetical 500-acre farm. The reader must consider that crop industries are mostly unfinished goods so the taxation effect is not fully captured until the crops are used to produce final goods and services. For this reason, most of the crops initially show a tax loss (operating under subsidy). The average of the top six crop industries (excluding corn/rice) at the parish level, incurred a $655 loss, while at the state level, incurred a $5,293 gain. Solar energy generates $37,000 in tax revenue at the parish level and $137,000 in tax revenue at the state level. The scale of this result is incongruous at first glance, but once again distinctions of intermediate goods and final goods matter. Electric energy is both and can be consumed on its own by the end user. It is more likely to generate higher tax revenues. Corn and rice production tax revenues are difficult to measure due to heavy federal government subsidies as well. The reader is cautioned to take these estimates with a healthy dose of skepticism for these reasons.

Overall employment for Louisiana will benefit the greatest from a 500-acre farm in soybean, corn, or rice. This is due to solar farming needing little maintenance, once fully developed. Of the seven solar farms proposed to be built in Louisiana in 2021, on average, only four full-time equivalent jobs would be produced by each solar farm. Labor income throughout Louisiana's economy will have an 11% increased benefit by continuing to contribute farms to traditional crops over solar farms. Regarding tax benefits to Louisiana, the greatest amount and most easily tracked taxed revenue at the state and parish level will come from solar farming. A more detailed tax analysis is provided by Georgia Carroway's report on page 16.

Data for this report are provided by the Bureau of Economic Analysis and the USDA. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

Counting Coopers: Changes in State Tax Revenues from Clean Taxes

BY GEORGIA CARROWAY

The term 'clean taxes' refers to taxes or fees imposed on industries that are considered environmentally friendly or have a low impact on the environment. Louisiana has long been known for its oil and gas industry, but in recent years, the state has started to diversify its energy mix and embrace clean energy. To incentivize this transition, Louisiana has implemented a variety of clean tax policies on different industries, which aim to promote and support the growth of renewable energy sources such as solar, wind, hydroelectric, and nuclear power. These clean taxes have had a significant impact on the state's economy and have spurred the development of new industries and job opportunities. By analyzing the impact of taxes on clean energy or other environmentally friendly industries, we can identify which industries are most influenced by clean taxes.

To estimate the tax effect on the array of clean energy technologies, shocks are modeled utilizing an input-output table approach. The shocks are calculated as a 1% output change of each industry examined and the effective tax rates are calculated using 2021 tax revenue fillings. The total tax effects are then expressed both along direct, indirect, and induced economic effects as well as by state-level, parish-level, and sub-parish level revenues. All tax receipts are expressed as aggregates rather than according to tax revenue type (sales, property, excise, income, etc.). This allows this report to maintain comparability to other studies across states where the weighting of state level tax schemes may differ.

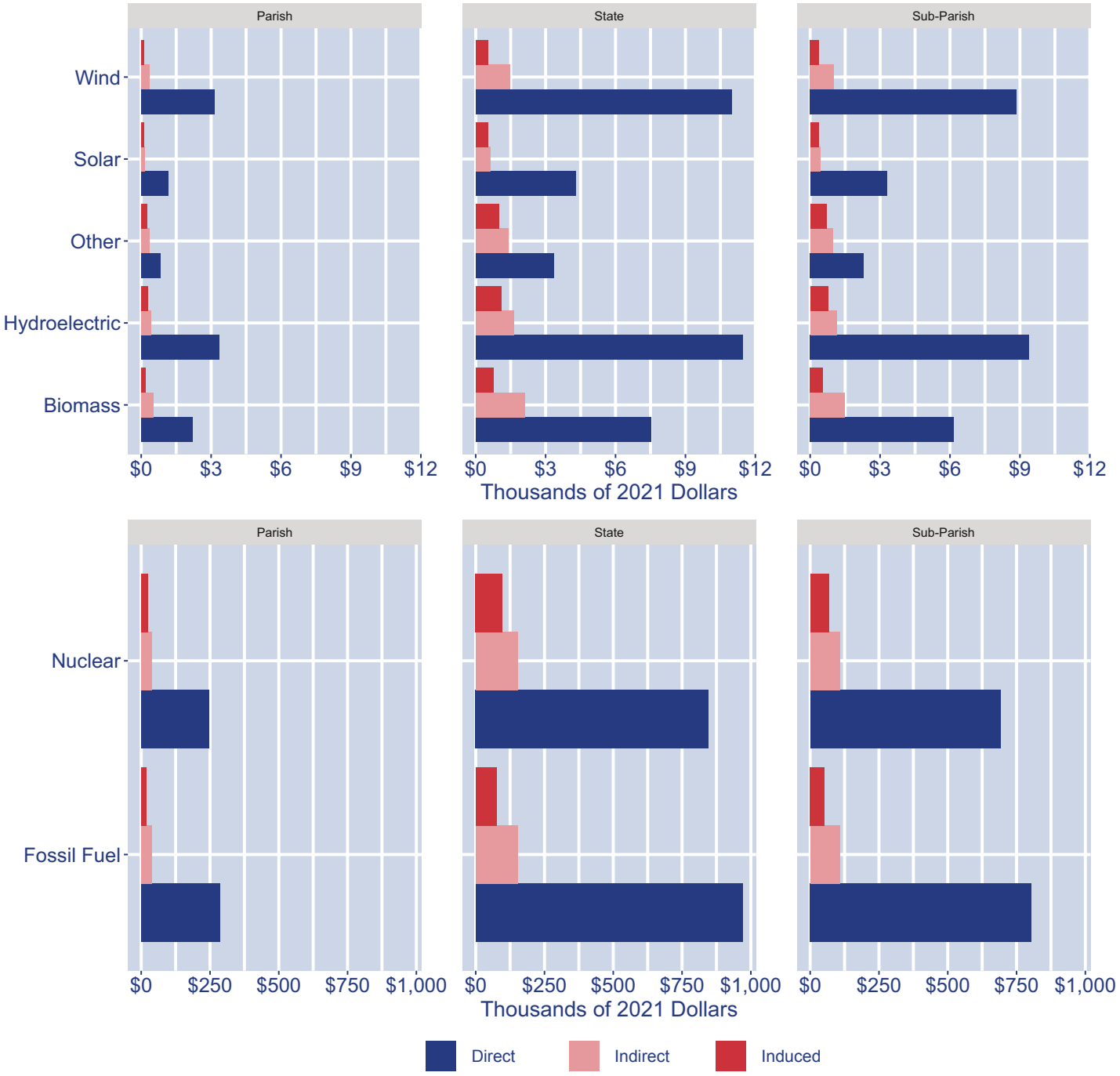
Table 2 summarizes the broad-level results per industry. A 1% output shock looks considerably different depending upon the industry. Existing nuclear and fossil fuel electric industry investment is roughly 97% of the industry. While nuclear energy is technically clean-energy since it is a low-carbon energy source, it is frequently considered to be less green since the byproduct of nuclear energy is less safe. The relatively high degree of investment in nuclear energy skews the overall numbers for green-energy investment, a phenomenon discussed in Jordan Hatter's report on page 8. One percent sub-industry shocks are relatively small for all categories beyond fossil fuel and nuclear.

Figure 13 shows tax revenues according to direct, indirect, and induced effects as well as state, parish, and sub-parish levels. The reader is cautioned to note the change in scale for the bottom portion of the figure. While tax receipts for nuclear and fossil fuel industries mirror the respective sizes of their shocks from Table 2, it is important to recognize that the proportions of the tax revenues across geographic regions and economic effects tell a nuanced story of incentives. For example, indirect and induced effects for hydroelectric energy are disproportionately higher at the state and sub-parish level. This can lead to competing economic interests among state and city-level economic development professionals in their bids to offer tax incentives for new investments. Biomass energy effects are also likely to be underestimated in this analysis given that we have three large scale biomass operations that produce the wood waste products that biomass energy uses to produce electricity. Additional investment in biomass creates an additional supply chain connection that adds more revenue.

Table 2: Industry Level Shocks and Tax Revenue Changes

Industry	1% Output	1% Employment	State Taxes	Parish	Sub-Parish
Wind	$274,176	0.06	$12,970	$3,657	$4,040
Solar	$114,604	0.08	$5,424	$2,472	$1,611
Other	$89,310	0.38	$5,714	$2,398	$1,564
Hydroelectric	$220,316	0.24	$14,163	$4,029	$4,452
Biomass	$210,101	0.14	$10,410	$2,928	$3,235
Nuclear	$17,331,763	17.02	$1,096,782	$309,994	$342,521
Fossil Fuel	$21,928,666	12.52	$1,199,192	$344,338	$380,460

Figure 13: Industry Tax Revenue Estimates per 1% Increase in Investment



The analysis of clean taxes in Louisiana highlights the significant tax contributions from the nuclear and fossil fuel industries, which are notably higher compared to other clean energy sectors. These industries have long been established and have a substantial presence in the state's economy. The high tax revenues from nuclear and fossil fuel industries can be attributed to their large-scale operations and significant production levels. These industries have historically played a dominant role in Louisiana's energy landscape, contributing to the state's overall tax revenue. As the state diversifies to cleaner energy sources, loss of tax revenue from one sub-industry will likely be replaced by others and allow the state to have multiple potential paths to future growth.

Data for this report are provided by the Bureau of Economic Analysis. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

Oil Extraction and Production: The Crumbling Pillar of the Louisiana Economy

BY ELLIS GRIFFIN

In January 1980, Louisiana produced about 17 million barrels of oil. Forty-three years later Louisiana produced about 3 million barrels over the same period. This long decline in oil production (about 82%) can be seen in Figure 5 on page 6. While the price of oil in 1980 was roughly twice what it is currently, there are numerous periods over these 43 years where prices were considerably higher than in 1980 (adjusted for inflation). Figure 7 on page 8 shows the workforce decline in both oil and natural gas extraction employment that mirrors this loss in productivity. Based on this data, will this negative trend continue, and, if it does, how much more of a loss will there be in the future for Louisiana? As U.S. auto manufacturers rush to build all-electric car inventories, what will happen to Louisiana oil?

Figure 14: Louisiana Annual Oil Production and Forecasts (Thousands of Barrels of Oil)

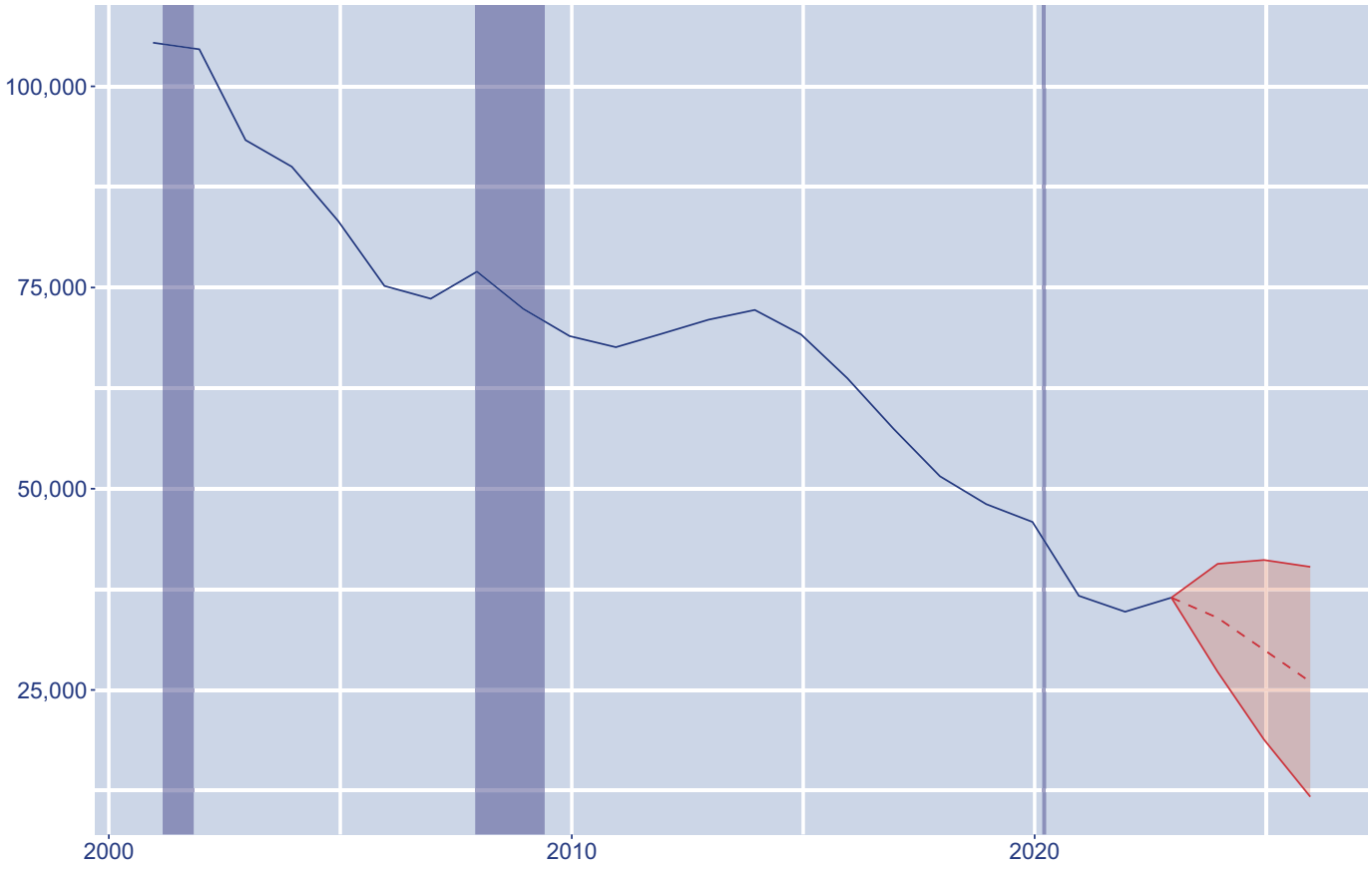


Figure 14 shows the same monthly data for Louisiana oil production (from Figure 5) annualized in blue. An autoregressive, moving average model is estimated and used to forecast annual oil production for the next three years. The results of that forecast are shown in red. In forecast simulations, 60% of outcomes are contained within the red cone of uncertainty. The top line of the cone represents optimistic forecasts for the industry, and the bottom represents a relatively more pessimistic forecast. The dashed line in the middle represents the most likely or realistic outcome given the long-term dynamics in this market.

Table 3: Oil Industry Forecasts for 2023 through 2025

	Annual Oil Production (Thousands of Barrels)			Annual Growth Rate (Percentage points)			Forecasted Employment (Change in Workers)		
Year	Pessimistic	Realistic	Optimistic	Pessimistic	Realistic	Optimistic	Pessimistic	Realistic	Optimistic
2023	27,252	33,960	40,669	-0.253	-0.069	0.115	-1,701	-476	797
2024	18,827	29,986	41,145	-0.484	-0.178	0.128	-3,129	-1,360	272
2025	11,727	26,012	40,297	-0.678	-0.287	0.105	-2,585	-1,633	-408

Total oil production has fallen substantially over the past two decades, dropping by nearly 60% since the early 2000s. The forecast is similarly grim. The optimistic upper bound projects only a mild increase over the next two years of about 1.1 million barrels in annual output. The pessimistic lower bound shows a decline of about 20,000,000 barrels over the next three years. The most likely outcome inherits the downward trend already present in the data. Point forecasts indicate an expected drop of about 10,000,000 barrels in annual output by 2025. Assuming that the most likely outcome prevails, that would mean that there will be an overall production drop of around 29% over the next three years.

To further highlight the economic effects of these forecasts, the decline in yearly output is modeled as an ongoing economic shock to the state in order to estimate the effect on total industry employment. Table 3 shows quantified data for the forecast in Figure 14 alongside the percentage change of production and the forecasted changes in employment for Louisiana oil production. Note that this table only accounts for employment specifically related to oil extraction, not ancillary industries such as transportation or refining. The annual growth rate reinforces what the forecast from Figure 14 shows—that oil production is likely to further shrink, and that even in the best case there is only a marginal increase. The predicted outcome for employment is as similarly dour as the forecast for oil production, with even the optimistic outcome beginning to lose workers by 2025.

The full scale of these losses magnifies for the overall economy when the indirect and induced effects of this industry contraction are accounted for. Total job losses at the realistic forecast level exceed 14,000, with an estimated loss in labor income of $1.56 billion. State GDP is likely to shrink an estimated $3 billion in the next three years, with total output falling over $5.7 billion during that time. The Louisiana economy is still down from pre-pandemic employment levels, a problem that the population decline since 2017 is not helping. State tax revenues are expected to shrink over $200 million between now and 2025.

This analysis serves to highlight the importance that has been placed on oil production, and by extension, the economic importance of its decline on the Louisiana economy. The state economy has a diversification problem. This is less of an issue in periods of growth. During periods of decline, lack of diversification can be devastating.

Data for this report are provided by the Bureau of Economic Analysis and Energy Information Administration. EIA data extend through March 2023. Parish level data are produced with a year-long lag. Current annual data extend to 2021. 2022 estimates are expected in December 2023.

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