

2023

OHIO ENERGY INDUSTRY CONTRIBUTION ANALYSIS REPORT



THE OHIO STATE UNIVERSITY
EXTENSION



Ohio Energy Report # OER-022023

February 2023



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Modeling Software:

IMPLAN® model, 2021 Data, using inputs provided by the user and IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

Executive Summary

Section 1: Page 3

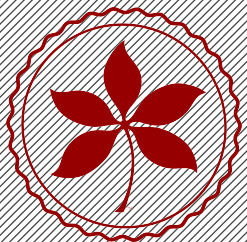


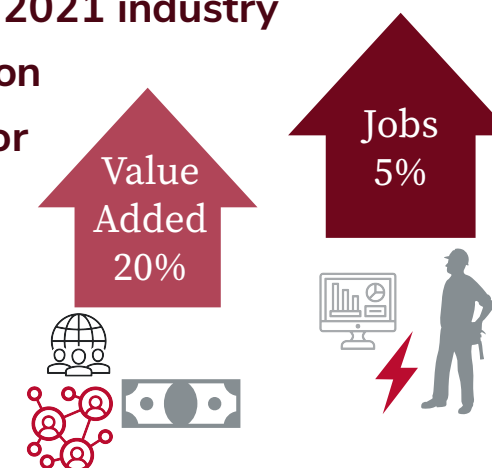
Image Source: Dennis Schroeder / NREL

Executive Summary

Ohio supports a total population of over 11.6 million residents, 5.2 million housing units, and is home to more than 251,937 business enterprises (CFAES Knowledge Exchange, 2022). Energy development in Ohio is important for the future vitality of the state as it influences both economic growth and the general quality of life of Ohioans. This industry contribution analysis estimates the portion of the Ohio economy, in terms of jobs, labor income, value added and output, that are supported by the Ohio energy sector. The analysis uses an economic input-output (I-O) modeling software program, IMPLAN, to measure the economic contribution of the energy industries based on a current level of production using 2021 data. The IMPLAN model captures indirect and induced effects of existing industries on other sectors in the state.

As illustrated in Table 1, IMPLAN presents four key measures including total estimated jobs, labor income, value added, and output. The employment reported represents the total employment, which includes direct, indirect, and induced positions supported by the energy sector. In total, the energy sector supported 104,393 jobs in the Ohio economy in 2021. Labor income is the sum of employee compensation from wages and benefits as well as proprietor income payments received by self-employed individuals and unincorporated business owners. In total, the energy sector contributed \$8.6 billion in labor income to the Ohio economy in 2021. Value added, also referred to as contribution to state gross domestic product (GDP), represents the difference between output and the cost of intermediate inputs from the energy sector throughout the Ohio economy. In 2021, the Ohio energy sector contributed over \$23.9 billion in value added to the Ohio

When comparing results of the 2020 and 2021 industry contribution analysis for the Ohio energy sector.....



economy. Value added is the best measure of the economic contribution because it estimates the added benefit to the overall Ohio economy beyond the energy sector. Output signifies the total annual production value of the Ohio energy sector, which includes all components of production value or output. In 2021, the energy sector in Ohio had a total production value of over \$46.8 billion in total output.

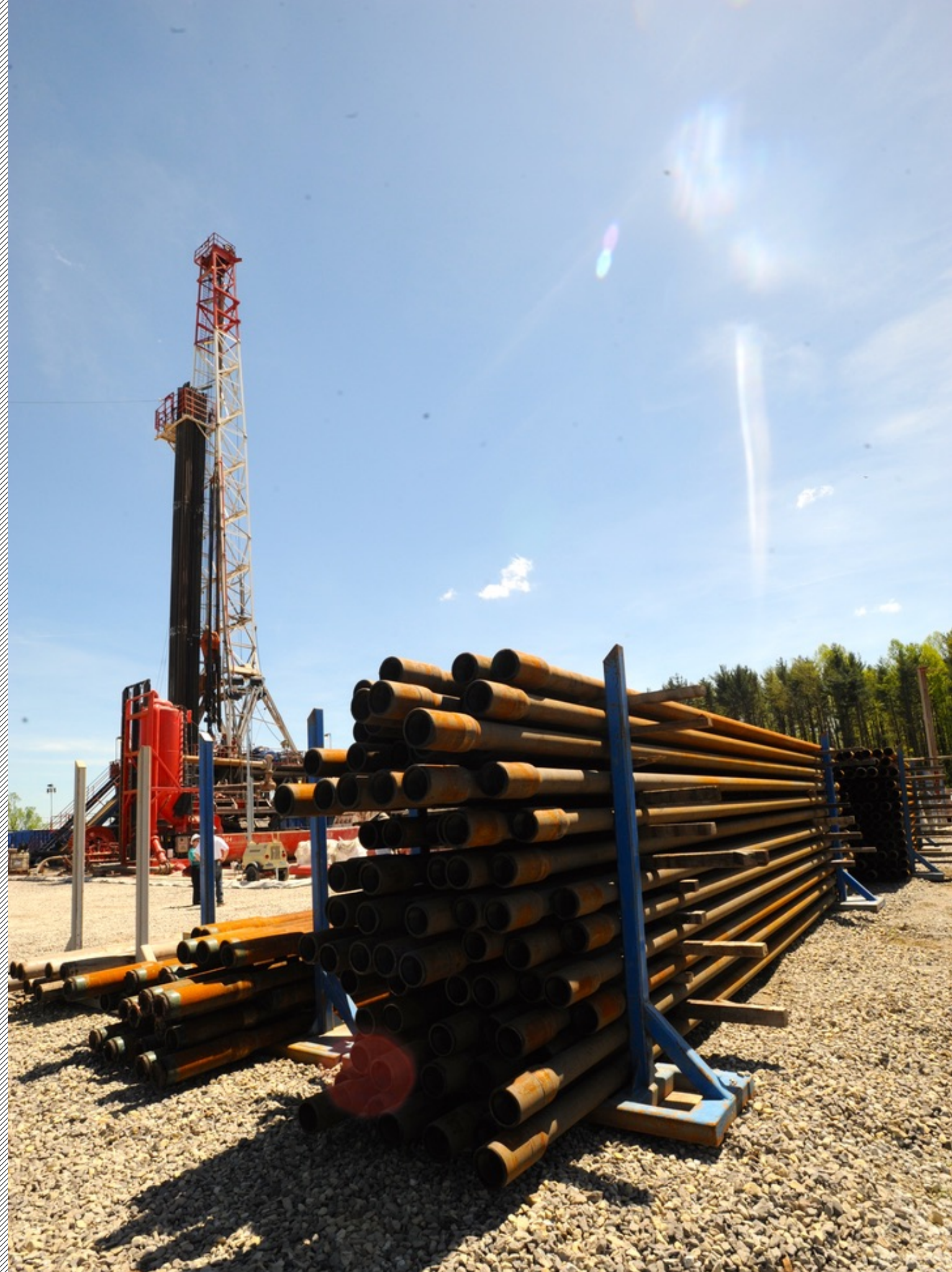
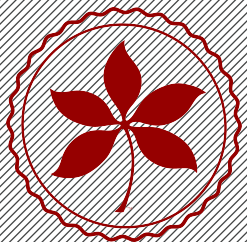
Table 1. Summary of Estimated Economic Benefits of Energy Sector Industries in Ohio (2021)

Impact	Employment	Labor Income	Value Added	Output
Energy Mining and Extraction	40,914	\$2,481,685,545	\$7,409,991,293	\$13,844,489,417
Electric Generation	16,760	\$1,666,424,530	\$4,094,261,294	\$8,178,701,833
Energy Transmission and Distribution	46,720	\$4,521,627,957	\$12,456,275,348	\$24,852,952,271
Ohio Energy Sector Total	104,393	\$8,669,738,032	\$23,960,527,935	\$46,876,143,521

Source: IMPLAN. 2021.

Methodology

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Methodology

This report measures the economic contribution of the Ohio energy sector, using IMPLAN 2021 data and software, developed by the IMPLAN Group LLC. IMPLAN utilizes an economic modeling technique called Input-Output analysis, which is a type of applied economic analysis that tracks the interdependence among various producing and consuming industries of an economy. It measures the relationship between a given set of demands for final goods and services and the inputs required to satisfy those demands. IMPLAN has data at the zip code, county, congressional district, state, and national levels. IMPLAN can be used to estimate the effect of a new economic change or contribution of an existing industry on a local or regional economy. For this report, the geographic area is the state of Ohio and unless otherwise noted, the data and dollar year is 2021.

Industry Contribution Analysis

The primary focus of this analysis is the overall contribution of the energy sector to the Ohio

economy. Using the IMPLAN Industry Contribution Analysis framework we can identify what industries and production activity is being supported by the target industry or industries in the region of study. In simple terms, the industry contribution analysis provides an understanding of how an existing industry is linked to the current economy. The Industry Contribution Analysis is a unique method that removes backward linkages or “buy backs” to the industry being analyzed and thus shows the way the energy industry is connected to the economy of the state.

Multi-Industry Contribution Analysis

By modeling the contribution of multiple industries combined within a single group, IMPLAN will treat the analysis as a multi-industry contribution analysis. In a multi-industry contribution analysis, not only are the purchases from an industry to itself restricted, but the purchases from other industries to the

modeled contributing industry are also restricted. This produces results that only include direct effects for the industries included in your multi-industry contribution analysis and all indirect and induced effects to these industries would be restricted from being generated to avoid overestimating the size of the industries being studied.

Types of Economic Effects

Using the IMPLAN multi-industry contribution analysis method, we can estimate the extent to which the contribution of the energy sector in Ohio contributes to other employment, income, and value added. The IMPLAN multi-industry contribution analysis provides estimates for direct, indirect, and induced economic effects using 2021 IMPLAN data and dollar years for Ohio. A description of each economic effect is further described below:



- **Direct effects** are the value of energy sector production, employment, and value added (which includes labor income).
- **Indirect effects** occur as Ohio businesses provide goods and services used by the energy sector and when these businesses, in turn, make additional purchases from Ohio businesses.
- **Induced effects** occur as workers or proprietors in the directly and indirectly affected industries receive income that they then use to purchase goods and services from other businesses in Ohio, in addition to subsequent rounds of labor income spending.

Key Economic Metrics

IMPLAN presents four key measures including total estimated jobs, labor income, value added, and output. For this report, we focus on two primary measures of economic activity including employment and value added.

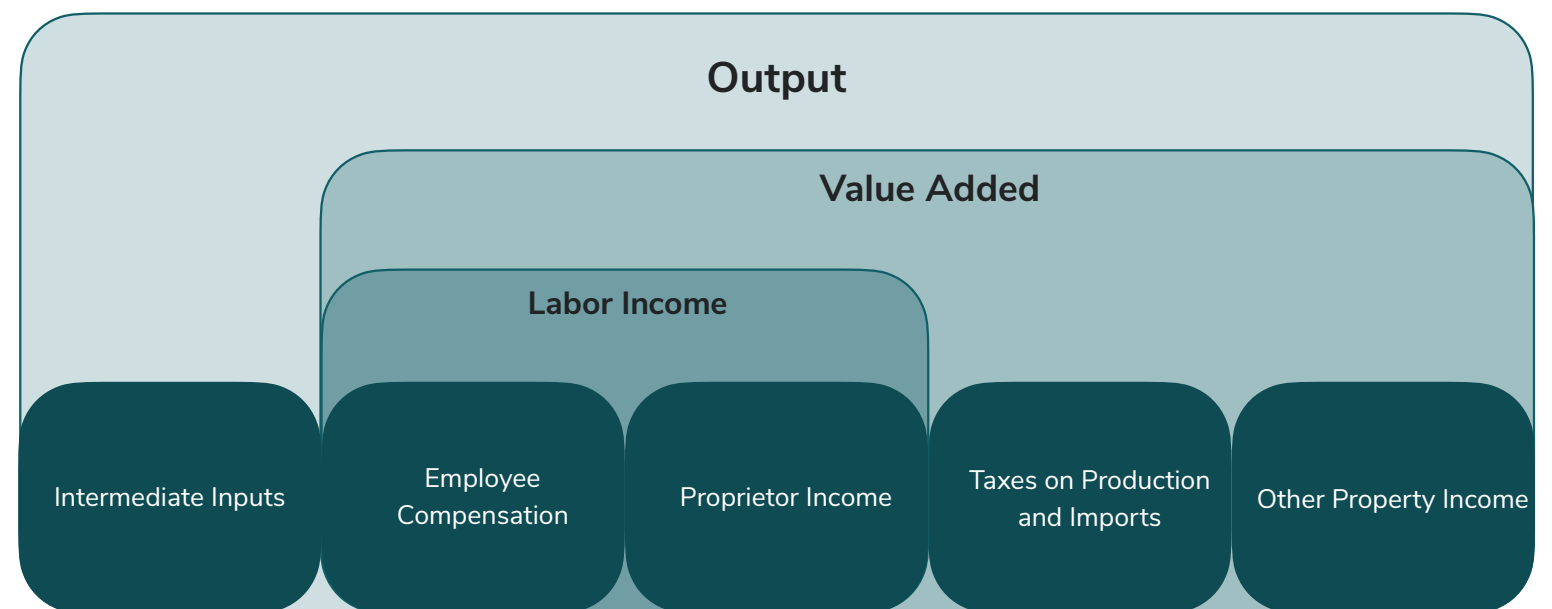
The total employment estimates reported by IMPLAN represents full and part-time annual average including the self-employed, all federal,

state, and local government employment and military employment (including overseas military). Employment in IMPLAN is an industry specific mix of full-time, part-time, and seasonal employment. It is an annual average that accounts for seasonality.

IMPLAN expresses output as an industry's annual production estimates for the year, representing the total value of production. Value added is a subset of total output and is a useful measure of wealth created by an economy. Value added is the difference between output and the cost of intermediate inputs, representing

the total annual market value of all final goods and services produced by the industry. As illustrated in Figure 1, value added is a large portion of output, as it encompasses employee compensation, proprietor income, taxes on production and imports, and other property income. In summary, value added is the wealth created by industry activity and is akin to contribution to GDP.

Figure 1: Industries in the Ohio Energy Sector



Source: IMPLAN. 2020.

Description of Energy Sector

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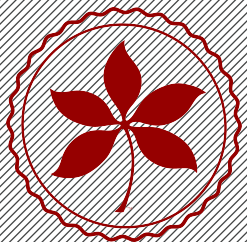


Image Source: Dennis Schroeder / NREL

Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Description of Energy Sector

The primary focus of this report is to assess the overall contribution of the energy sector to the Ohio economy. For this analysis, we reviewed a total of 546 IMPLAN industry codes to identify specific energy industries that make up the overall energy sector in Ohio. Furthermore, the individual IMPLAN energy industries were categorized into one of the three energy sub-sections. These sub-sections were designed to capture the entire energy cycle from the production of primary energy fuels extracted from nature, to the conversion of primary energy sources into electricity, to the final delivery of energy resource to the end user. The three energy sub-sectors in this analysis include: 1) energy mining and extraction, 2) electric generation, and 3) energy transmission and distribution.

The analysis of the Ohio energy sector consisted of a multi-industry economic contribution analysis. Combining multiple industries into one individual contribution

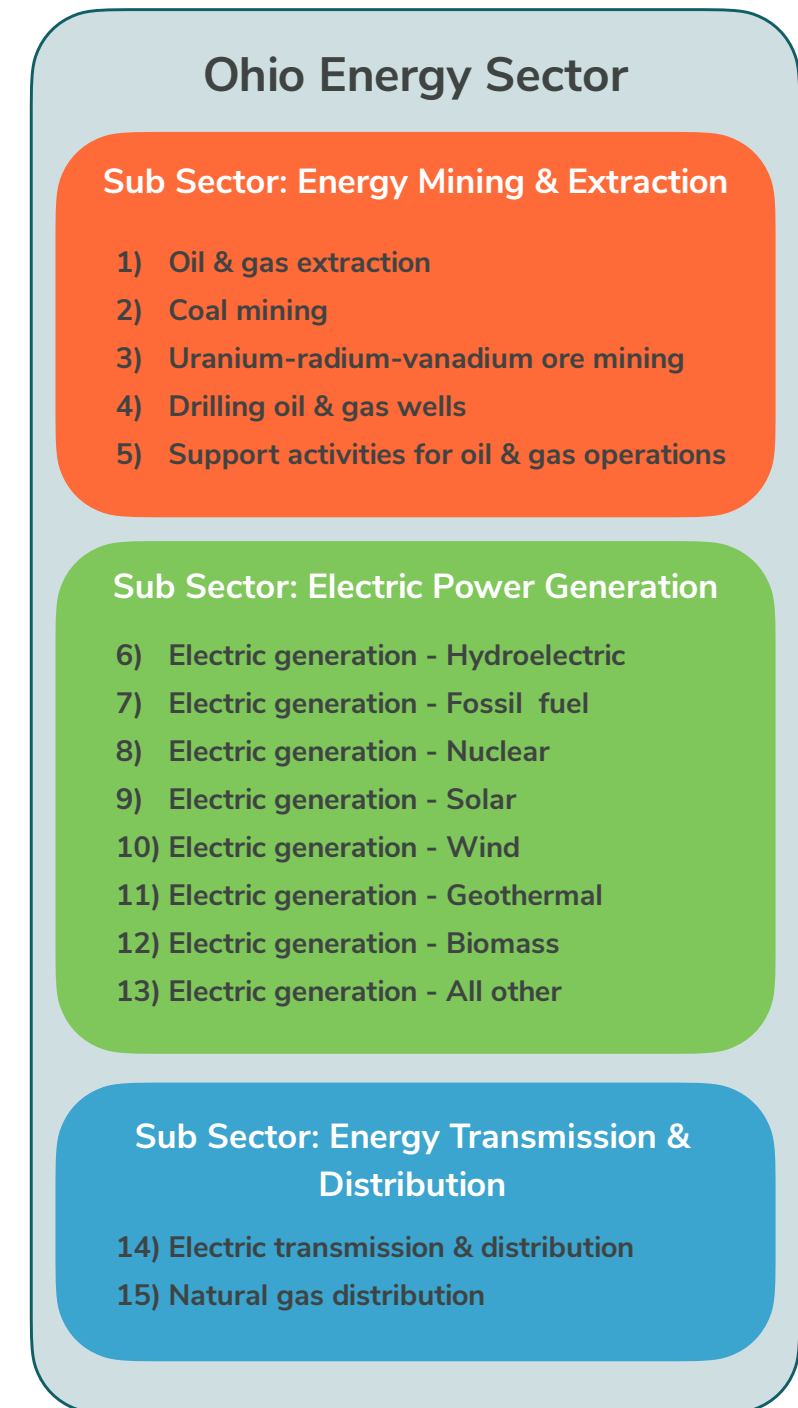
analysis allowed for detailed accounting of specific indirect and induced effects related to each industry. This ensured that the determination could be made where outputs in one industry represent inputs to another industry to avoid double-counting.

In total, there were 15 individual energy related industries included in the analysis that makeup the Ohio energy sector. Figure 2 outlines all 15 individual energy industries included in the Ohio energy sector and their corresponding energy sub-sectors. Each of the energy sub-sectors and industries are further described below.

Energy Mining & Extraction

The energy mining and extraction sub-sector focuses on industries engaged in the production of primary energy fuels which are captured or extracted from nature. In general, primary fuels are non-renewable and consist of

Figure 2: Industries in the Ohio Energy Sector



fossil fuel resources such as coal, oil, and natural gas. However, other examples of primary fuel include uranium and thorium.

The energy mining and extraction sub-sector was an aggregation of five individual industries that are further described below using definitions from the U.S. Census Bureau.

- 1) **Coal Mining:** This industry is comprised primarily of the exploration, development, extraction, and processing of coal.
- 2) **Oil and Gas Extraction:** This industry is comprised primarily of the exploration, development, and/or the production of petroleum and natural gas from wells using normal or enhanced drilling and extraction techniques.
- 3) **Drilling Oil and Gas Wells:** This industry is comprised of contractors that specialize in spudding in, drilling in, re-drilling, and directional drilling of oil and gas wells for others on a contract or fee basis.
- 4) **Support Activities for Oil and Gas Operations:** These companies are engaged in

performing support activities for oil and gas operations such as exploration, excavating slush pits, well surveying, cutting and pulling casings, cementing wells, shooting wells, acidizing and chemically treating wells, and cleaning out, bailing, and swabbing wells.

- 5) **Uranium, Radium, Vanadium Ore Mining:** This industry includes establishments primarily engaged in developing the mine site, mining, and/or preparing uranium-radium-vanadium ores.

Electric Power Generation

The electric power generation sub-sector focuses on industries engaged in the generation of electricity. In total this sub-sector includes eight individual IMPLAN industries from a mixture of renewable and non-renewable resources. It should be noted that some electric power generation resources such as coal, natural gas, and nuclear can be dispatched on demand, while other resources such as wind and solar are dependent on resource availability to generate electricity. The eight industries aggregated into the electric power generation sub-sector are further described below using definitions from the U.S. Census Bureau.

- 1) **Electric Power Generation - Hydroelectric:** This industry is engaged in operating hydroelectric power generation facilities, which use water power to drive a turbine to produce electric energy.
- 2) **Electric Power Generation - Fossil Fuel:** This industry is engaged in operating fossil fuel powered electric power generation facilities that use fossil fuels, such as coal, oil, or gas, to drive an internal combustion or combustion turbine conventional steam process to produce electric energy.
- 3) **Electric Power Generation - Nuclear:** This industry is engaged in the operation of nuclear electric power generation facilities that use nuclear power to produce electric energy.
- 4) **Electric Power Generation - Solar:** This industry is primarily engaged in operating solar electric power generation facilities that use energy from the sun to produce electric energy.

Source: U.S. Census Bureau. (2022). North American Industry Classification System (NAICS).



- 5) **Electric Power Generation - Wind:** This industry is primarily engaged in the operation of wind electric power generation facilities that use wind power to drive a turbine and produce electric energy.
- 6) **Electric Power Generation - Geothermal:** This industry is primarily engaged in operating geothermal electric power generation facilities that use heat derived from the Earth to produce electric energy.
- 7) **Electric Power Generation - Biomass:** This industry is primarily engaged in operating biomass electric power generation facilities that use wood, waste, and alcohol fuels to produce electric energy.
- 8) **Electric Power Generation - All other:** This industry is primarily engaged in operating electric power generation facilities using

other forms of energy such as tidal waves to produce electric energy.

Energy Transmission & Distribution

The Energy transmission and distribution sub-sector focuses on industries engaged in the operation of transmission and distribution systems responsible for delivering energy products from the source to the end use consumer. In total this sub-sector includes two individual industries that are further described below using definitions from the U.S. Census Bureau.

- 1) **Electric Power Transmission and Distribution:** The electric power transmission industry includes establishments that operate the electric power

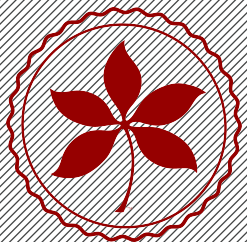
transmission systems lines and transformer stations that move electricity from generation power plants to distribution centers or other electric utilities. In addition, this industry includes electric power brokers arranging the sale of electricity through the power distribution systems operated by others.

- 2) **Natural Gas Distribution:** This industry includes establishments engaged in operating gas distribution systems, gas marketers that buy gas from the well and sell it into a distribution system, gas brokers that arrange the sale of gas over gas distribution systems operated by others, and organizations that transmit and distribute natural gas to consumers.

Source: U.S. Census Bureau. (2022). North American Industry Classification System (NAICS).

Economic Contribution: **Value Added**

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Value Added Contribution to GDP

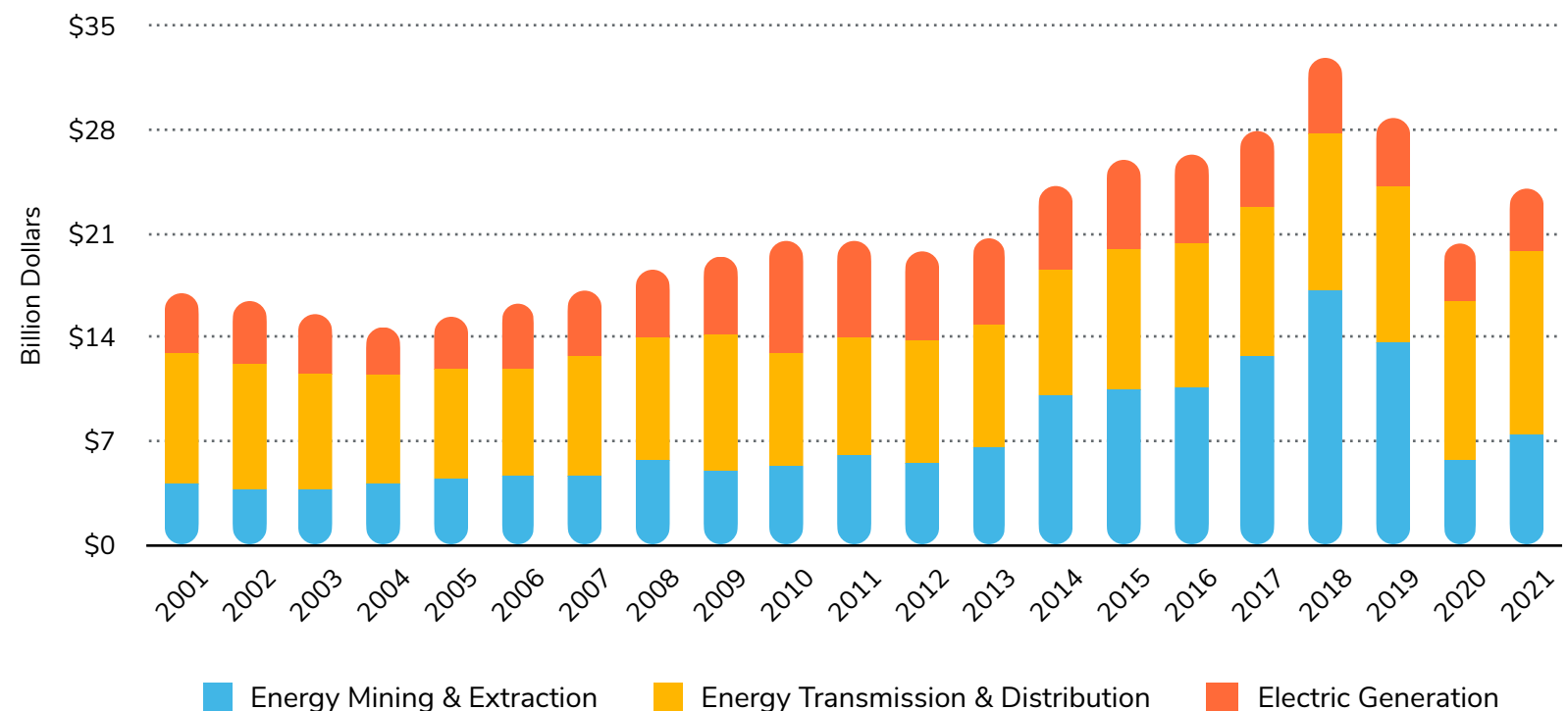
In this section we evaluate the impact of the Ohio energy sector to value added based on the industry contribution analysis. Value added is an economic metric to quantify the difference between the value of an industry's total output and the cost of its intermediate inputs. Value added includes all of the income generated at each stage of production and is equivalent to the sectors contribution to Gross Domestic Product (GDP). Because this industry contribution analysis includes all the energy industries in Ohio, the value added represents the gross state product of the energy sector for Ohio. To gain better insight into the historical trends of the energy sector's total contribution to gross state product, we consider the total value added from 2001 to 2021 which include direct, indirect, and induced contributions that were adjusted to reflect prices in 2021 real dollars (Chart 4). In 2001 the total estimated value added of the energy sector in Ohio was \$17 billion, which increased by 93% to a maximum of \$32.9 billion in 2018. Since the peak in 2018, the total value added from the energy sector in Ohio dropped

by 27% to \$23.9 billion in 2021. In 2021, the total value added of \$23.9 billion from the energy sector represented just over 3% of Ohio's total Gross State Product.

The stacked bars in Chart 4 are broken down to illustrate the value added associated with each of the three energy sub-sectors including 1) energy mining and extraction, 2) energy transmission

and distribution, and 3) electric generation. In general, the energy transmission and distribution sector is the greatest contributor to the overall value added, averaging \$8.92 billion annually between 2001 and 2020, followed by energy mining and extraction averaging \$7.19 billion annually, and finally electric generation averaging \$4.97 billion annually.

Chart 4: Value Added - (Indexed to 2021 Dollars)



Source: IMPLAN. 2021.

When comparing the overall trends of the energy sub sectors growth and/or decline of value added, electric generation was the only energy sub sector that decreased, declining by 1% from 2001 to 2021. In contrast, it appears the overall trends of the total value added from the energy sector was primarily driven by the activity in the energy mining and extraction sub-sector which increased by 320% between 2001 and 2018, before declining 57% between 2018 and 2021. The next section will specifically focus on the Ohio energy sectors contribution to value added in 2021, including a review of the multipliers of individual industries, the impact of direct, indirect, and induced effects on total value added, and the contributions of employee compensation, proprietor income, other property income, and taxes on production to the total value added from the energy sector.

Value Added Multipliers

The presence of the energy sector operating in the Ohio economy introduces additional levels of spending in the overall economy. This additional spending causes a ripple, or multiplier effect throughout the economy.

The multiplier consists of the direct, indirect, and induced effects, that combined represent the total economic contribution. The multipliers for value

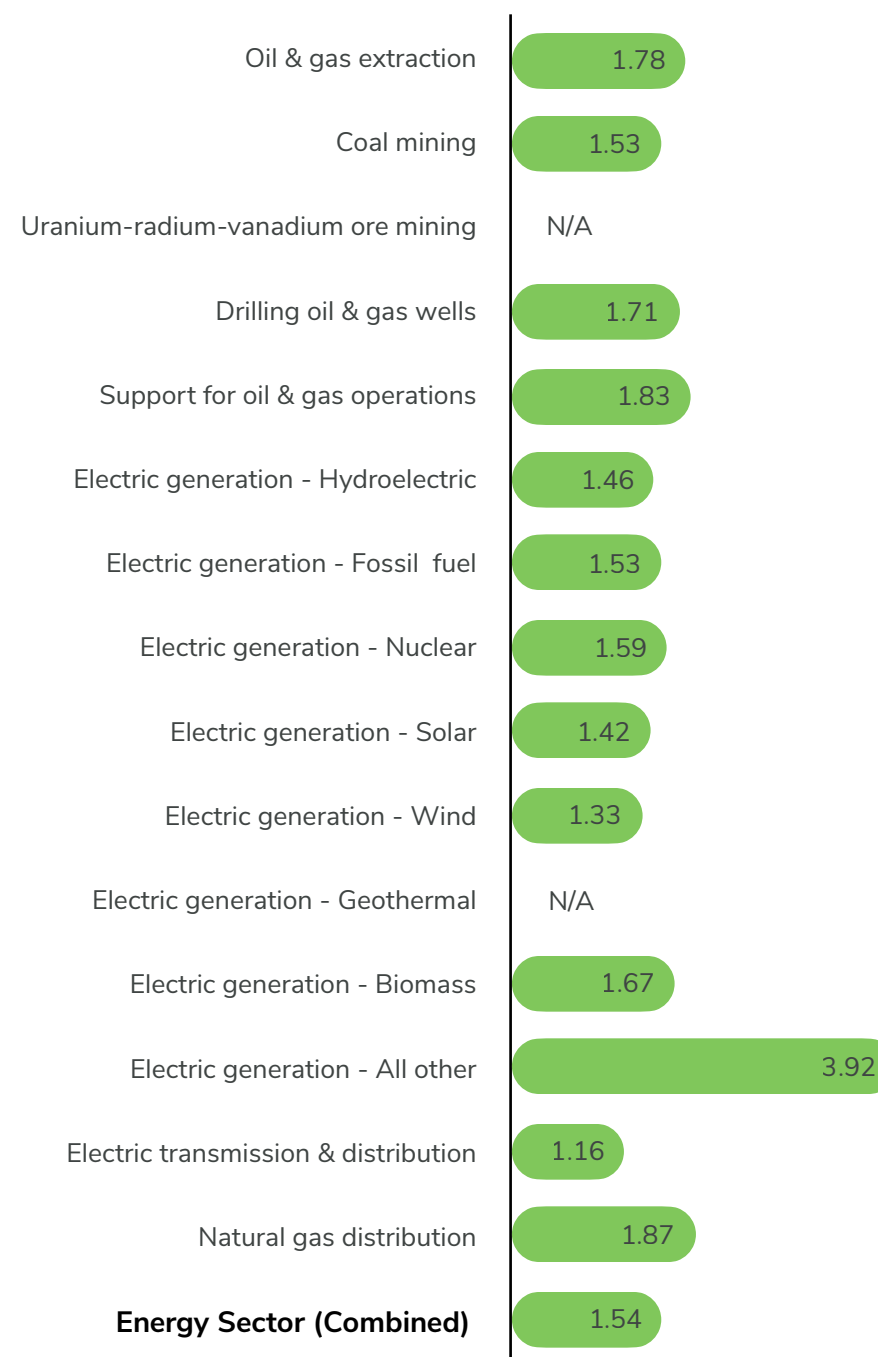
added are calculated by dividing the sum of the direct effects, indirect effects, and induced effects by the direct effects. Total value added multipliers represent the total value added supported as a result of \$1 of direct value added in the energy sector.

As shown in Chart 5, the overall value added multiplier for the energy sector combined industries in 2021 was 1.54, indicating for every \$1 of direct value added that the Ohio energy sector supports, an additional \$0.54 of value added was contributed to the state's economy. Value added multipliers for individual energy industries ranged from a high of 3.92 for the all other electric generation industry to a low of 1.16 for the electric transmission and distribution industry, while the uranium mining and geothermal electric generation industries were not active in Ohio.

Direct, Indirect, & Induced Effects of Value Added

As illustrated in Table 2, the energy sector contributed a total of \$23.96 billion

Chart 5: Energy Sector Value Added Multipliers (2021)



Source: IMPLAN. 2021.



Table 2: Ohio Energy Sector Value Added Impact by Industry (2021)

IMPLAN Energy Industry	Value Added				
	Direct	Indirect	Induced	Total	% of Total
Oil & gas extraction	\$3.17 B	\$1.8 B	\$671 M	\$5.64 B	23.5%
Coal mining	\$112.3 M	\$35.1 M	\$24.3 M	\$171.7 M	0.7%
Uranium-radium-vanadium ore mining	\$0 M	\$0 M	\$0 M	\$0 M	0.0%
Drilling oil & gas wells	\$263.2 M	\$131.5 M	\$54.6 M	\$449.3 M	1.9%
Support for oil & gas operations	\$630.7 M	\$297.2 M	\$225.3 M	\$1.15 B	4.8%
Electric generation - Hydroelectric	\$4.9 M	\$1 M	\$1.2 M	\$7.1 M	0.0%
Electric generation - Fossil fuel	\$1.87 B	\$560.2 M	\$425.7 M	\$2.86 B	11.9%
Electric generation - Nuclear	\$635.5 M	\$177 M	\$199.9 M	\$1.01 B	4.2%
Electric generation - Solar	\$74.6 M	\$14.6 M	\$16.6 M	\$105.7 M	0.4%
Electric generation - Wind	\$72.4 M	\$15.6 M	\$8.2 M	\$96.2 M	0.4%
Electric generation - Geothermal	\$0 M	\$0 M	\$0 M	\$0 M	0.0%
Electric generation - Biomass	\$4.7 M	\$1.9 M	\$1.2 M	\$7.9 M	0.0%
Electric generation - All other	\$1.5 M	\$1.6 M	\$2.9 M	\$6 M	0.0%
Electric transmission & distribution	\$5.31 B	\$75.8 M	\$754.5 M	\$6.14 B	25.6%
Natural gas distribution	\$3.39 B	\$1.9 B	\$1.02 B	\$6.31 B	26.3%
Total Ohio Value Added Impact From Energy Sector (\$Billions)	\$15.54 B	\$5.01 B	\$3.41 B	\$23.96 B	100%

Source: IMPLAN. 2021.

to the Ohio economy in 2021. Direct effects from within the energy sector represented \$15.54 billion accounting for 65% of the total value added. Through the business-to-business transactions, the energy sector contributes an additional \$5.01 billion through indirect effects, accounting for 21% of the total value added in Ohio. Finally, induced effects that result from household spending due to the economic activity generated by the energy sector represented an additional \$3.41 billion of induced effects, accounting for 14% of the total value added.

When evaluating the impact of individual industries within the energy sector, three individual industries accounted for just over 75% of the total value added in Ohio from the energy sector (Table 2). First, the natural gas distribution industry contributed 26.3% of the total value added including \$3.39 billion in direct value added impacts, \$1.9 billion of indirect value added, and an additional \$1.02 billion of induced value added contributions. The second largest contributor was the electric transmission and distribution industry, accounting for 25.6% of the total value added from the energy sector. The electric transmission and distribution industry contributed a total of \$6.14 billion in value added, including \$5.31 billion in direct value added, \$75.8 million in indirect value added, and \$754.5 million of induced value added. Finally, the third largest industry was oil and gas extraction, accounting for 23.5% of the total value added from the energy sector consisting of \$3.17 billion in direct value added, \$1.8 billion of indirect value added contributions, and \$671 million from induced value added.

Core Components of Value Added

Value added is a measure of economic activity which includes all of the income generated at each stage of production and is equivalent to the industry's contribution to Gross Domestic Product (GDP). Value added provides a lot of information in just one number, as it consists of other property income, employee compensation, taxes on production and imports, and proprietor income.

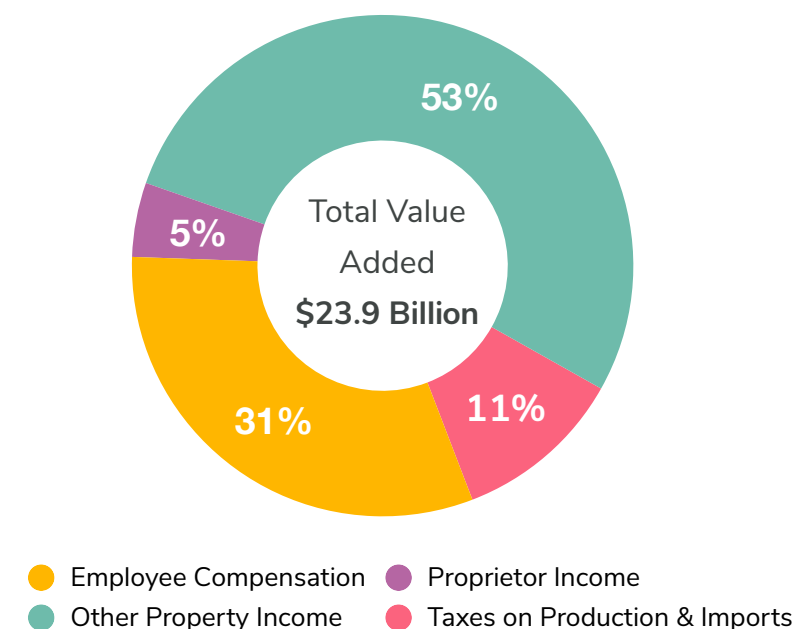
As illustrated in Chart 6, the largest component of total value added from the sector was other property income. Other property income is calculated as gross operating surplus minus proprietor income; it includes consumption of fixed capital, corporate profits, and business current transfer payments (net). Total value added from the energy sector in Ohio was driven by other property income which contributed \$12.65 billion to Ohio in 2021, representing 53% of the total value added. Next, employee compensation which includes the total payroll cost of the employee including wages and salaries, all benefits, and payroll taxes represented 31% or \$7.52 billion of the total value added contributions to Ohio in 2021. The taxes on production and imports which includes sales and excise taxes, customs duties, property taxes,

motor vehicle licenses, severance taxes, other taxes, and special assessments accounted for an estimated at \$2.64 billion or 11% of the total value added contributions from the Ohio energy sector in 2021. Finally, proprietor income which accounts for the production income of sole proprietorships, partnerships, and tax-exempt cooperatives contributed \$1.15 billion or 5% of the total value added contributions to Ohio in 2021.

Top 15 (Non-Energy) Industries

Chart 7 lists the top 15 non-energy industries by contribution to the total value added from indirect and induced affects related to the energy industry operating in Ohio. When combined, the top 15 non-energy industries contributed a total of \$4.6 billion in 2021 to the total value added from the Ohio energy sector. The non-energy industry with the highest contribution to the total energy sector value added was the monetary authorities and depository credit intermediation industry, contributing \$643.7 million of indirect value added and \$170 million of induced in total value added, yielding a total of \$813.7 million. The second largest non-energy industry contributor to total value added was the custom computer programming services industry with \$545.3 million of total value added, while the pipeline transportation industry added \$532.5

Chart 6: Ohio Energy Sector Value Added (2021)

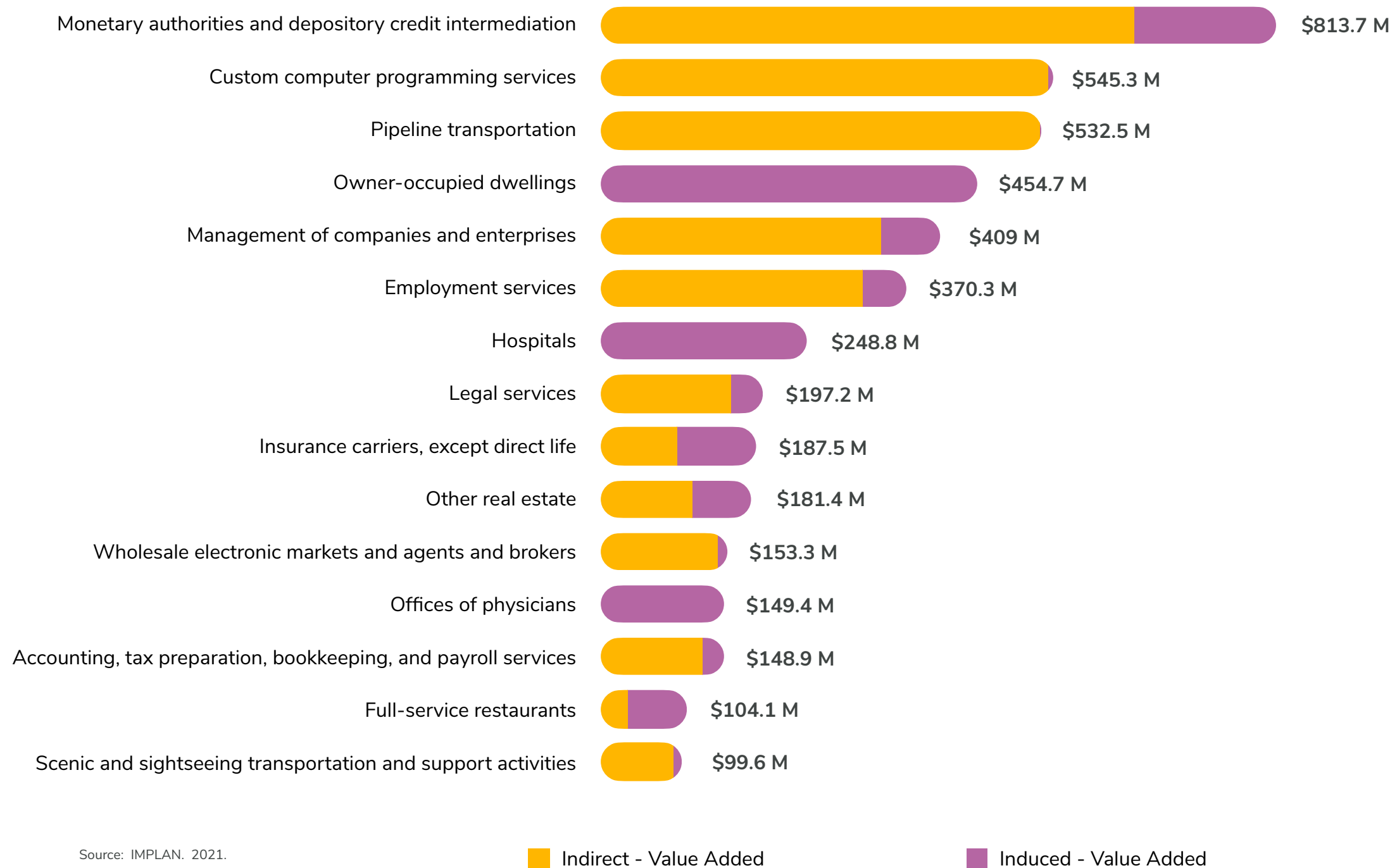


Source: IMPLAN. 2021.

million. Over 99% of the value added from the custom computer programming services and pipeline transportation industry was related to indirect value added as a result of business-to-business transactions with the energy sector. Owner-occupied dwellings was the fourth largest non-energy industry, contributing \$454.7 million of induced value added resulting from the energy sector operating in Ohio. The owner-occupied dwellings sector represents the wealth generated from home ownership. Owning and maintaining a home is also a major area of spending and the owner-occupied dwellings sector captures that economic effect.

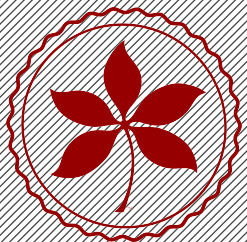


Chart 7: Top 15 (Non-Energy) Industries Contribution to Total Value Added (2021)



Economic Contribution: Employment

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Contribution to Total Employment

In this section we evaluate the impact of the Ohio energy sector on employment based on the industry contribution analysis. Similar to the Bureau of Labor Statistics Census of Employment and Wages data, IMPLAN data uses a full-time/part-time annual average to define employment. For example, one job lasting 12 months is equal to two jobs lasting 6 months each, or three jobs lasting four months each. The Total Employment estimates reported by IMPLAN represents full and part-time annual average including the self-employed, all federal, state, and local government employment and military employment.

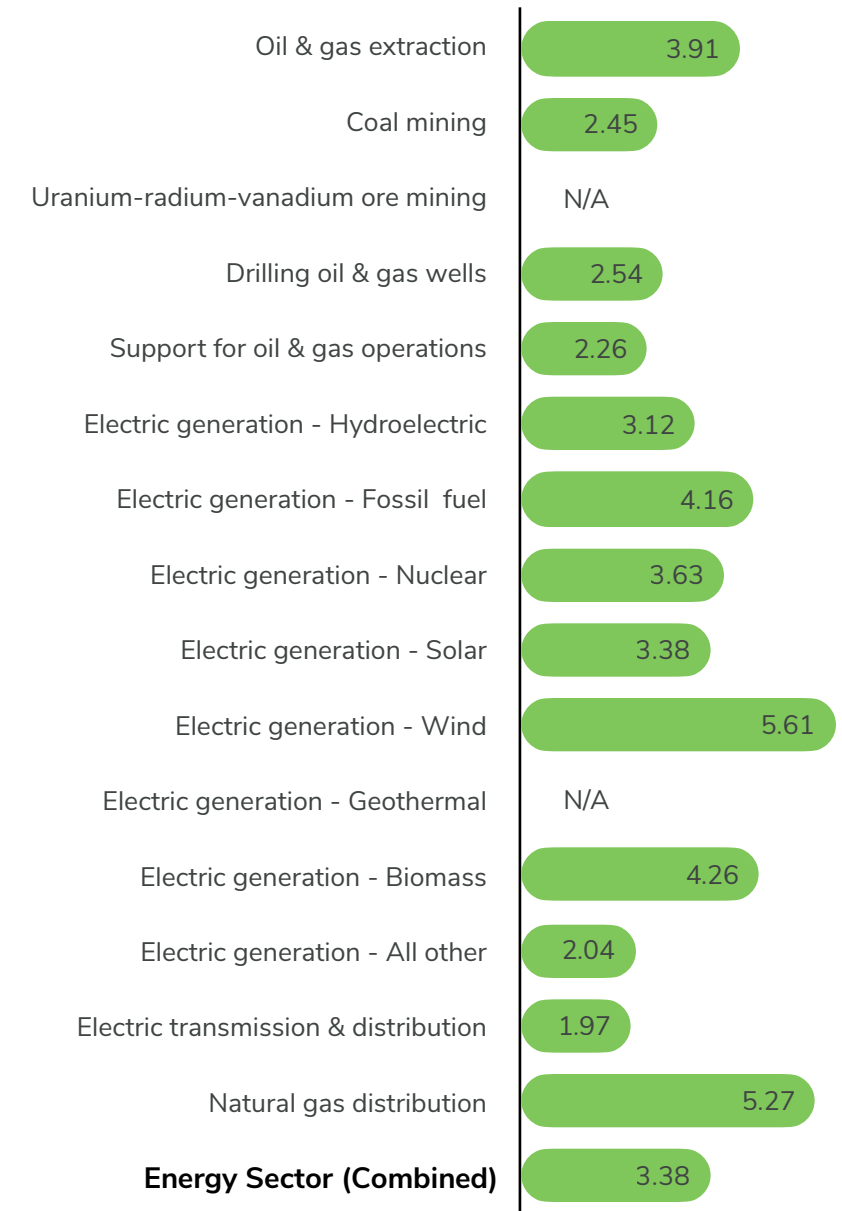
It is important to establish a clear understanding of how employment data from an industry contribution analysis is calculated and exactly what it represents when interpreting the results. The total employment impact is a sum of the direct, indirect, and induced employment as a result of the energy sector operating in Ohio. Direct employment is the direct number of jobs associated with the 15 energy industries that makeup the energy sector. Indirect employment represents the

number of jobs that are supported by the business to business transactions as a result of the economic activity generated by the energy sector operating in Ohio. Finally, induced employment represents the number of jobs supported by household spending as a result of the economic activity generated by the Ohio energy sector.

Employment Multipliers

The existence of the energy sector operating in the Ohio economy supports additional employment opportunities in the overall economy. Employment multipliers describe the total jobs generated as a result of 1 direct job in the impacted industry. The employment multipliers are calculated by dividing the sum of the direct employment, indirect employment, and induced employment by the direct employment. As illustrated in Chart 8, employment multipliers for individual energy industries ranged from a high of 5.61 for the wind electric generation industry to a low of 1.97 for the electric transmission and

Chart 8: Energy Sector Employment Multipliers (2021)



Source: IMPLAN. 2021.

distribution industry, while the uranium mining and geothermal electric generation industries were not active in Ohio. The overall employment multiplier for the combined energy sector was 3.38, indicating for every 1 direct job in the Ohio energy sector, an additional 2.38 jobs in other industries are supported by the energy sector in the Ohio economy.

Ohio Energy Sector Historical

Employment Trends

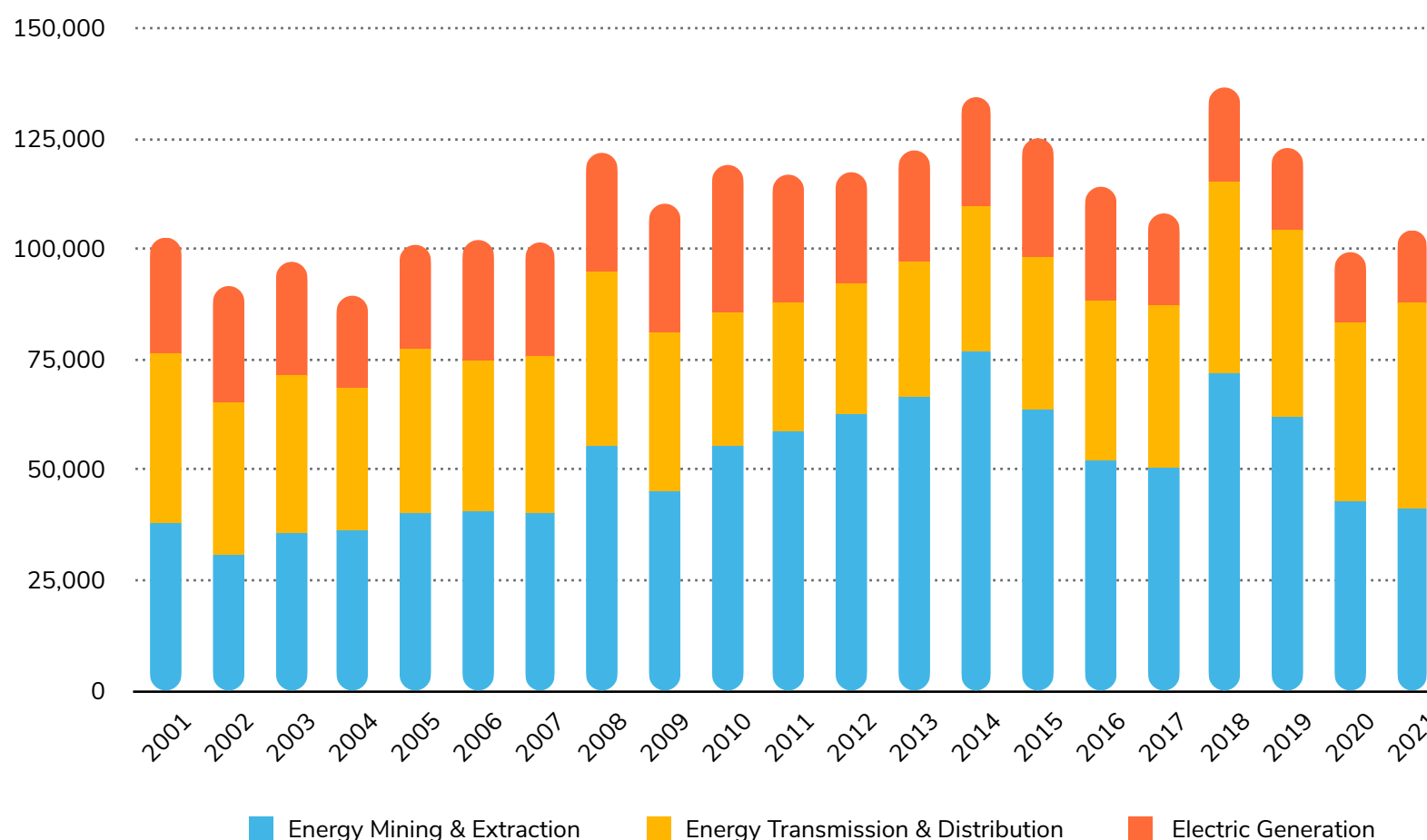
Using the three energy sub-sectors including 1) energy mining and extraction, 2) energy transmission and distribution, and 3) electric generation, Chart 9 illustrates the historical employment impacts of the energy sector operating in Ohio. The employment data in Chart 9 represents the total employment impact which includes direct, indirect, and induced employment as a result of the respective energy sub-categories operating in Ohio.

As illustrated in Chart 9, the total employment impact from all three subsections increased by 33% between 2001 and 2018 when the combined employment impact reached 136,735 jobs. However since 2018, employment in the the Ohio energy sector has decreased by 24% to

104,393 jobs in 2021. When considering the growth and/or decline of employment in the energy sub-sectors, the electric generation was the only sub-sector that experienced a decrease (-36%) in employment from 26,364 jobs in 2001 to 16,760 jobs in 2021. When evaluating the employment impacts of the energy transmission and distribution sub-sector, the employment trends have remain fairly consistent, steadily increasing from 38,538 jobs in 2001 to 40,182 in

2020. However, from 2020 to 2021, the energy transmission and distribution sub-sector experienced a 16% growth, adding 6,538 jobs. Finally, the energy mining and extraction sub-sector experienced the greatest variation increasing of 103% from 37,884 jobs in 2001 to a peak employment of 76,966 in 2014, however has since sharply declined by 46% to 40,914 jobs in 2021.

Chart 9: Historical Employment Trends by Energy Sub-Sector



Source: IMPLAN. 2020.



Ohio Energy Sector 2021 Employment Impact

In this section we explore the 2021 employment impacts from the industry contribution analysis of the energy sector operating in Ohio. Table 3 provides specific details of the total employment impact from the Ohio energy sector which includes an itemized breakdown of the employment impact by specific energy industry and employment impact type including direct, indirect, and induced employment affects. Total employment impact for the Ohio energy sector in 2021 was 104,393 total jobs which were to a certain degree evenly distributed between direct jobs (30,909) associated with the energy sector, indirect jobs (38,738) as a result of business to business transactions, and induced jobs (34,746) supported by household spending.

The top energy industry for total employment was natural gas distribution, which accounted for 30,252 total jobs, including 5,738 direct jobs, 14,070 indirect jobs, and 10,444 induced jobs, which was the highest number of induced jobs by any of the energy industries. The oil and gas extraction industry was the second largest among the energy sector supporting a total of 28,779 Ohio jobs, including the largest number of indirect jobs (14,586) related to business to business spending. Next, the electric transmission and distribution industry ranked third with a total of 16,468 jobs, including 8,367 direct jobs associated to the industry. Additional jobs related to the energy mining and extraction sub-sector include the drilling oil and gas wells industry which supported 2,559 total jobs and the coal mining industry which supported an additional 828 jobs in Ohio.

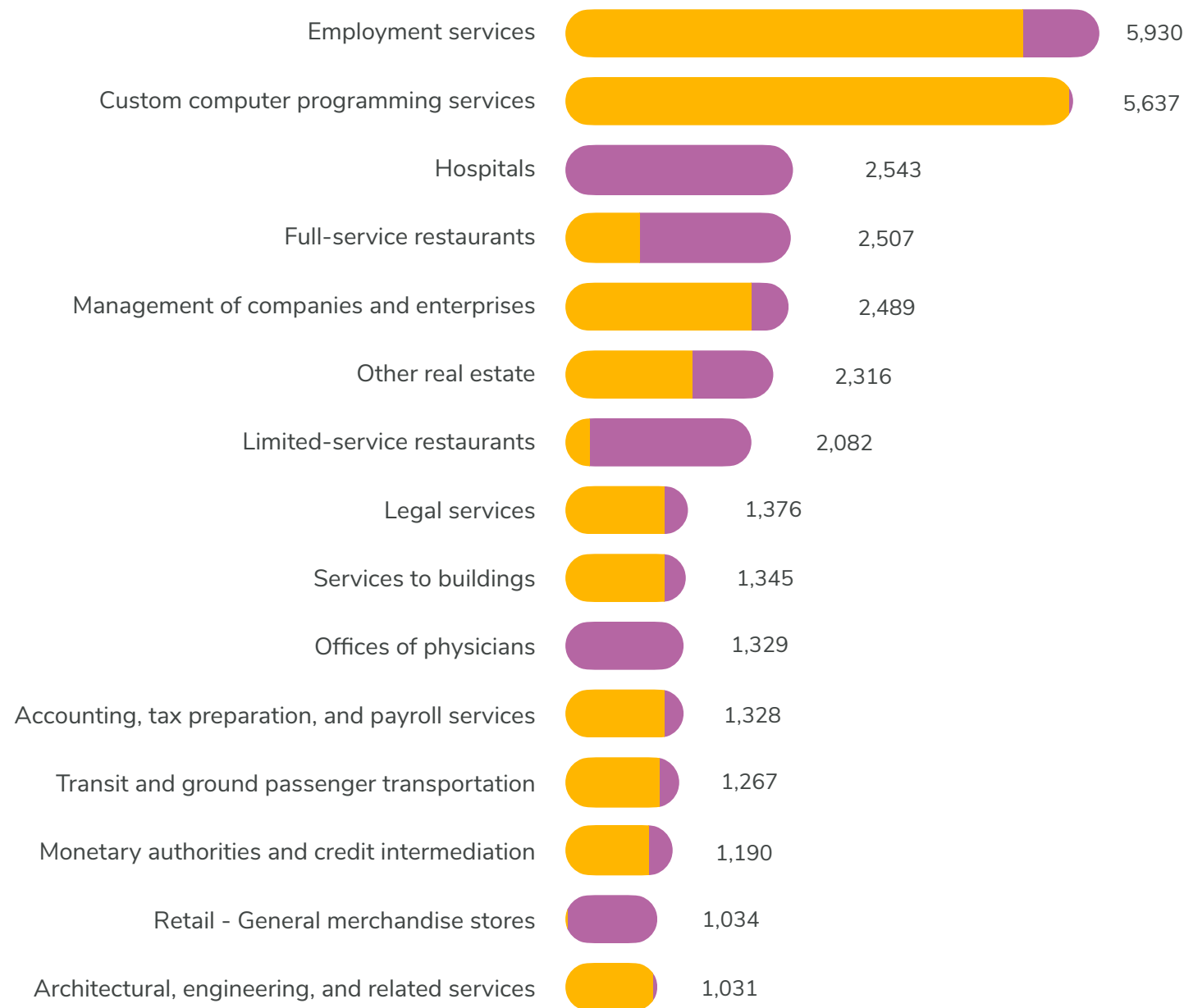
The greatest employment impact from the electric generation sub-sector was in the fossil fuel electric generation industry which supported total employment of 11,120 jobs, representing 66% of all jobs related to electric

Table 3: Ohio Energy Sector Employment Impact by Industry (2021)

IMPLAN Energy Industry	Direct	Indirect	Induced	Total Jobs	% of Total
Oil & gas extraction	7,358	14,586	6,835	28,779	27.6%
Coal mining	338	243	247	828	0.8%
Uranium-radium-vanadium ore mining	0	0	0	0	0.0%
Drilling oil & gas wells	1,009	993	556	2,559	2.5%
Support for oil & gas operations	3,873	2,580	2,295	8,748	8.4%
Electric generation - Hydroelectric	10	8	13	31	0.0%
Electric generation - Fossil fuel	2,673	4,108	4,338	11,120	10.7%
Electric generation - Nuclear	1,326	1,457	2,037	4,821	4.6%
Electric generation - Solar	121	120	169	410	0.4%
Electric generation - Wind	46	128	84	258	0.2%
Electric generation - Geothermal	0	0	0	0	0.0%
Electric generation - Biomass	9	16	12	37	0.0%
Electric generation - All other	41	13	30	84	0.1%
Electric transmission & distribution	8,367	415	7,686	16,468	15.8%
Natural gas distribution	5,738	14,070	10,444	30,252	29.0%
Total Ohio Employment Impact From Energy Sector	30,909	38,738	34,746	104,393	100%

Source: IMPLAN. 2021.

Chart 10: Top 15 (Non-Energy) Industries by Employment Impact from Energy Sector (2021)



Source: IMPLAN. 2021.

Indirect Employment Induced Employment

generation. Additional jobs from industries in the electric generation sub-sector include 4,821 total jobs related to nuclear electric generation, while solar generation supported a total of 410 jobs, and the wind generation industry accounted for a total of 258 jobs in 2021.

Top 15 (Non-Energy) Industries by

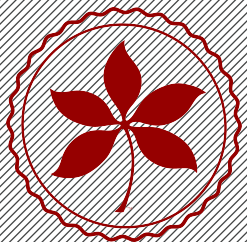
Employment Impact

Chart 10 lists the top 15 non-energy industries by indirect and induced employment related to the energy industry operating in Ohio. Combined, the top 15 non-energy industries contributed a total of 33,404 jobs representing 32% of the total 104,393 jobs in 2021 related to the Ohio energy sector. The non-energy industry with the greatest contribution to the energy sector employment was the employment services industry, supporting a total of 5,930 jobs in 2021 as a result of the energy sector operating in Ohio. Over 85% of the jobs from the employment services industry was related to indirect employment resulting from business-to-business transactions with the energy sector. The second largest non-energy industry contributor to employment was the custom computer programming services industry which supported 5,585 indirect jobs and 52 induced jobs, yielding a total of 5,637 Ohio jobs in 2021. Spending on hospitals and health care is commonly found in the top spending across all industries. Hospitals were the third largest non-energy industry, supporting 2,543 induced jobs resulting from household spending as a result of the economic activity generated by the Ohio energy sector.



Economic Contribution: Occupational Analysis

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

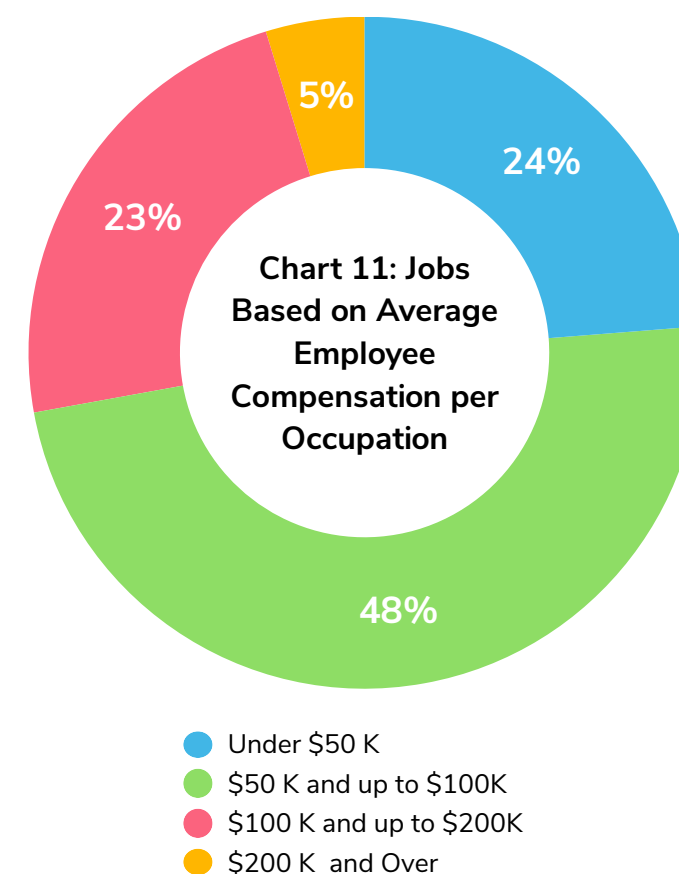
Employment Impact on Occupations

In this section we evaluate the occupational impact of the Ohio energy sector and the associated core competencies based on the industry contribution analysis. The IMPLAN occupational data can be filtered into several levels of detail, including 802 detailed occupations, 454 broad groups, 97 minor groups, and 23 major groups. For this industry contribution analysis, we have filtered the occupational data for the 2021 Ohio energy sector to the most specific 5-digit occupational detail level which includes 802 individual occupations.

The occupation impact data for the energy sector industry contribution analysis provides a combination of total employee compensation, occupational wage and salary employment, average employee compensation, and average hours worked for the impacted occupations. The employee compensation represents the total payroll cost of an employee including wages and salaries, all benefits such as health care and retirement, and payroll taxes. The wage and salary employment is simply a count of salaried and/or wage-earning employees for each

occupation that excludes proprietors. The average employee compensation per wage and salary employee is calculated as the total employee compensation divided by the count of wage and salary employment for the respective occupation. Finally, the average hours worked per year is calculated as total hours worked in a specific occupation, divided by the count of wage and salary employment.

In total there were 779 occupations supported by the energy sector operating in Ohio with the average annual employee compensation ranging from a low of \$10,335 for private household cooks to a high of \$415,449 for anesthesiologists. The average annual employee compensation among all occupations was \$86,400 per year. Chart 11, provides a summary of the percentage of jobs based on the amount average annual employee compensation for that respective occupation. As illustrated in Chart 11, 48% of the jobs supported by the Ohio energy sector are in occupations that have an average annual employee compensation between \$50,000 and \$100,000.



Source: IMPLAN. 2020.

The occupation impact data in Figure 3 outlines a summary of the top 20 occupations based on total employee compensation. In addition, the table provides the wage and salary employment, average employee compensation, and average hours worked for each of the top 20 occupations supported by the Ohio energy sector. Combined, the top 20 occupations accounted for 19,901 jobs representing over \$2.87 billion in total employee compensation for Ohio.



Figure 3: Energy Sector Top 20 Occupations by the Total Contribution to Employee Compensation

	Total Contribution to Employee Contribution	Occupational Wage and Salary Employment	Average Employee Compensation	Average Hours Worked per Year
General and Operations Managers	\$324 M	1,597	\$202,902	2,239
Electrical Power-Line Installers and Repairers	\$313.3 M	1,991	\$157,378	2,296
Software Developers, Quality Assurance, and Testers	\$218.6 M	1,550	\$141,040	2,006
Customer Service Representatives	\$179.5 M	2,540	\$70,668	1,723
Project Management Specialists and Operations	\$166.5 M	1,164	\$143,056	1,998
Supervisors of Mechanics, Installers, and Repairers	\$158.4 M	939	\$168,789	2,283
Electrical Engineers	\$154.4 M	773	\$199,720	2,122
Accountants and Auditors	\$128.1 M	1,066	\$120,119	1,992
Control and Valve Installers and Repairers	\$128 M	931	\$137,539	2,222
Computer Systems Analysts	\$115.1 M	789	\$145,904	2,064
Financial Managers	\$114.9 M	477	\$240,766	2,137
Power Plant Operators	\$109.9 M	675	\$162,770	2,419
Computer and Information Systems Managers	\$106.5 M	470	\$226,362	2,164
Management Analysts	\$105.4 M	674	\$156,314	2,060
Supervisors of Office and Administrative Support	\$101.1 M	919	\$110,021	1,971
Registered Nurses	\$98.6 M	1,132	\$87,075	1,752
Lawyers	\$90.1 M	453	\$199,170	2,146
Supervisors of Production and Operating Workers	\$90 M	523	\$172,073	2,230
Electrical Repairers, Powerhouse, and Substation	\$85.3 M	505	\$169,109	2,361
Sales Representatives, Wholesale and Manufacturing	\$84.7 M	735	\$115,191	2,065

Source: IMPLAN. 2021.

The general and operations managers occupation had the largest total employee contribution of \$324 million from 1,597 jobs in Ohio. The average employee compensation for the general and operations managers occupation was \$202,902 per worker, which consisted of an average wage and salary income of \$163,829 plus an additional \$39,073 in wage and salary supplements such as benefits and bonuses.

The second largest occupation by employee contribution was electrical power-line installers and repairers which supported 1,991 jobs and yielded \$313.3 million in total employee compensation. The average annual employee compensation for the electrical power-line installers and repairers occupation was \$157,378 per worker, which consisted of an average wage and salary income of \$109,783 plus an additional \$47,595 in wage and salary supplements such as benefits and bonuses.

Software developers and software quality assurance analysts and testers was the occupation with the third largest total employee contribution of \$218.6 million from 1,550 jobs. The average employee compensation for the software developers and software quality assurance analysts and testers occupation was \$141,040 per

worker, which included an average wage and salary income of \$122,193, plus an additional \$18,848 in wage and salary supplements such as benefits and bonuses.

Core Competencies: Knowledge, Skills, and Abilities

The core competency for occupations are broken down into the core knowledge, skills, and abilities that are essential traits for a worker to successfully complete the required task of an occupation. The core competency analysis included 33 unique knowledge elements, 35 unique skill elements, 52 unique ability elements that are assigned points that indicate the level of importance, or rank a given competency to a specific occupation.

Workers that are knowledgeable about a topic have mastered concepts, acquired facts, and information from sources such as books, journals, internet, traditional classroom-style courses and lectures, or hands on experience. Below is a list of the top five knowledge based core competencies for the occupations supported by the energy sector operating in Ohio.

- 1) **Customer and Personal Service** - Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
- 2) **English Language** - Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
- 3) **Computers and Electronics** - Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
- 4) **Mathematics** - Knowledge of arithmetic, algebra, geometry, calculus, statistics, and applications.
- 5) **Administration and Management** - Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modeling, leadership technique, production methods, and coordination of people and resources.

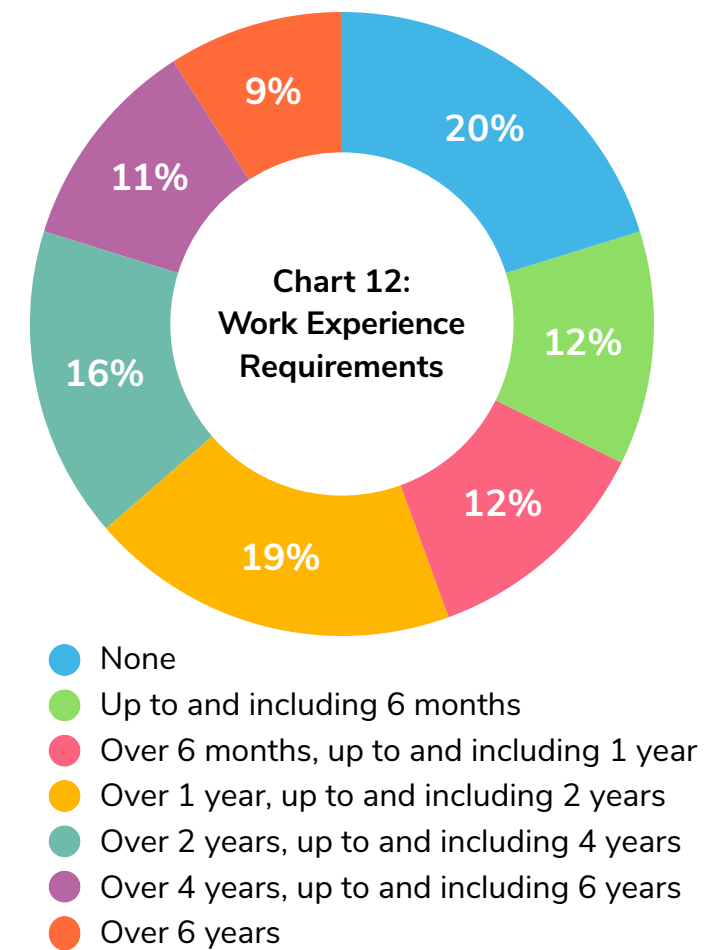


A skill is the ability to apply knowledge required to capably perform a certain task. Below is a list of the top five skills based core competencies for the occupations supported by the energy sector operating in Ohio.

- 1) **Active Listening** - Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- 2) **Speaking** - Talking to others to convey information effectively.
- 3) **Reading Comprehension** - Understanding written sentences and paragraphs in work-related documents.
- 4) **Critical Thinking** - Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.
- 5) **Monitoring** - Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action.

An ability is the possession of the methods, skills, and traits necessary to do a specific job. Below is a list of the top five abilities for workers to be successful at the occupations supported by the energy sector operating in Ohio.

- 1) **Oral Comprehension** - The ability to listen to and understand information and ideas presented through spoken words and sentences.
- 2) **Oral Expression** - The ability to communicate information and ideas in speaking so others will understand.
- 3) **Near Vision** - The ability to see details at close range (within a few feet of the observer).
- 4) **Written Comprehension** - The ability to read and understand information and ideas presented in writing.
- 5) **Problem Sensitivity** - The ability to tell when something is wrong or is likely to go wrong. It does not involve solving the problem, only recognizing that there is a problem.



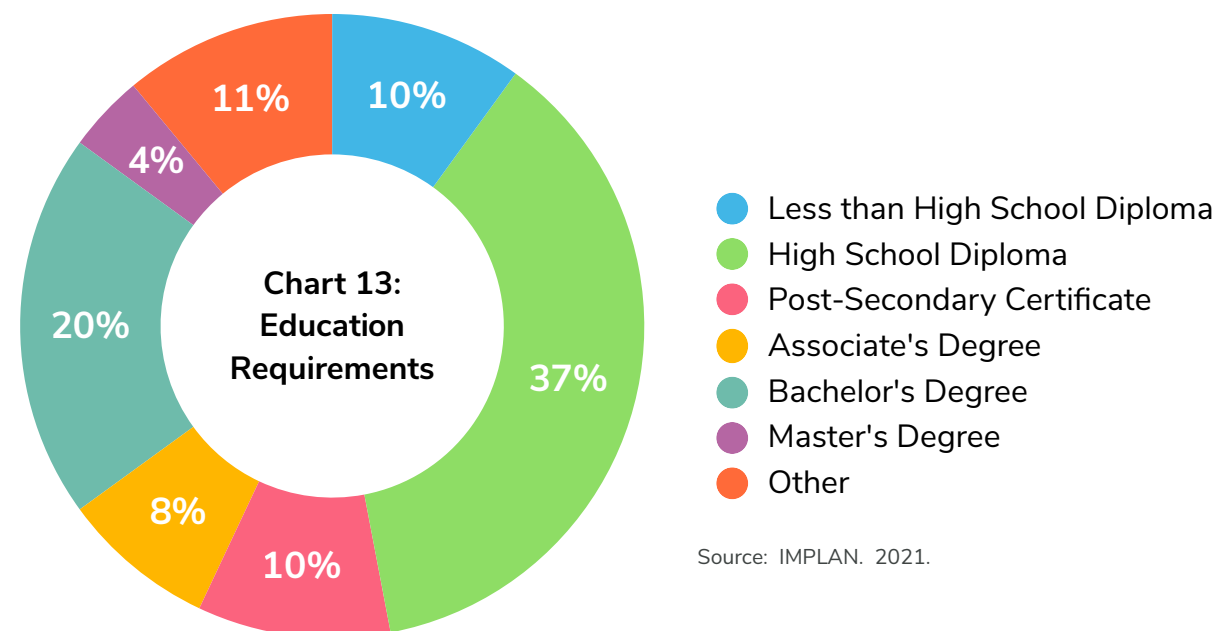
Source: IMPLAN. 2021.

Qualifications and Training

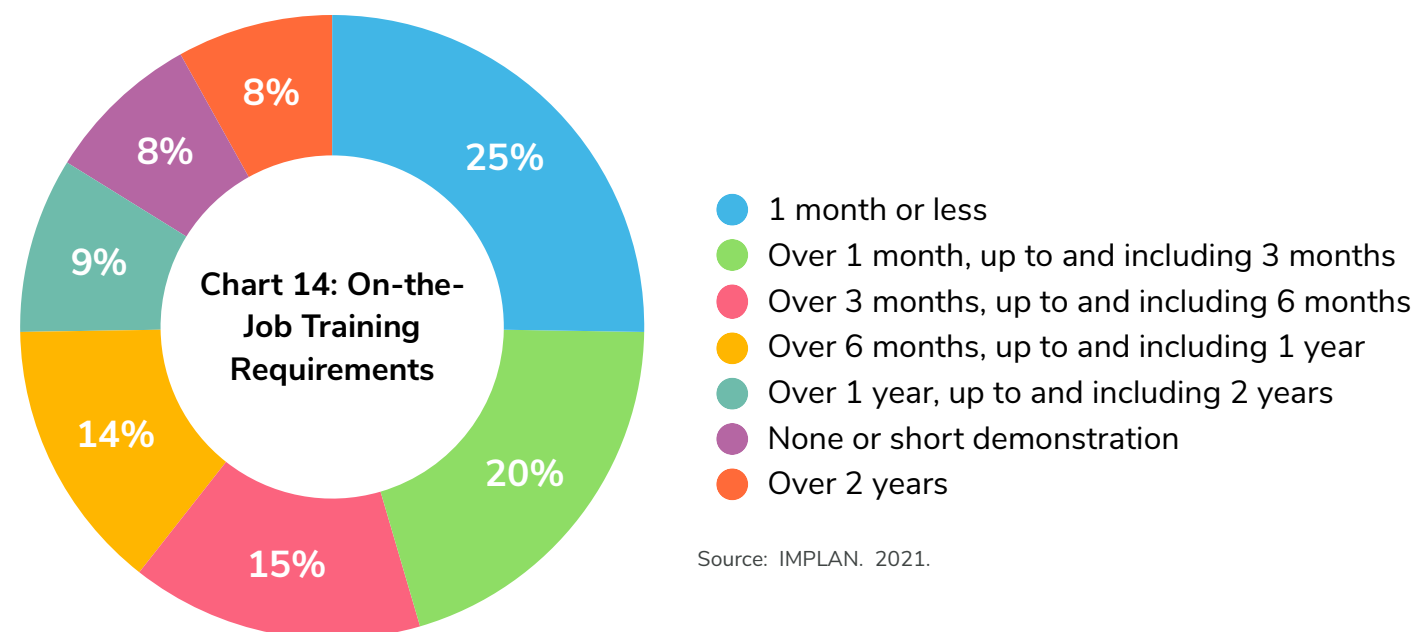
Chart 12 summarizes the amount of required work experience for the workers in occupations supported by the energy sector operating in Ohio. As illustrated in Chart 12, 20% of the positions do not require prior experience. However, 19% of the employees in occupations supported by the

energy sector were required to have between one and two years of experience. When combined, over 36% of the employees required over two years of prior work experience. Chart 13 summarizes the educational requirements for the occupations supported by the energy sector operating in Ohio. As shown in Chart 13, 10% of the jobs do not require a high school diploma. The leading form of educational requirements was high school diploma, which was required by 37% of available jobs. When combined, 32% of the employees required an Associate's (8%), Bachelor's (20%), or Master's Degree (4%), while a post-secondary certificate was required by 10% of workers. The remaining 11% of educational requirements was a combination of other categories, led by 7% of jobs that require some college courses.

There is a wide range of on the job training requirements for employees in occupations supported by the energy sector operating in Ohio. Chart 14 summarizes the length of on the job training requirements which included 25% of jobs that mandated less than one month of training, followed by 20% of positions that required up to three months of training, 15% of positions that took up to six months of training, and 14% of the employees that needed training for up to one year.



Source: IMPLAN. 2021.

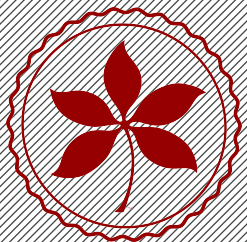


Source: IMPLAN. 2021.



Final Observations

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Final Observations

The purpose of this study was to quantify the contribution of the energy sector on the Ohio economy in 2021. The analysis found that in 2021 the Ohio energy sector contributed 4% to the overall Ohio value added and 3% to the total Ohio employment. However, the energy sector industries still support a significant number of jobs (104,393), labor income (\$8.7 Billion), and value added (\$23.9 Billion) for the state of Ohio. In addition to the direct impact in the energy industries, the sectors benefitting most from the energy sector are in industries across the financial and support services spectrum including custom computer programming services, employment services, hospitals, management of companies and enterprises, and monetary authorities and credit intermediation.

Ohio's economy competes daily on a global scale, which was historically driven by a strong manufacturing sector that included high energy-intensive industries, such as strong metals fabrication and chemical production industries. In recent years, Ohio has seen growth in more service oriented sectors such as financial services, leisure and hospitality, government, data

processing, and web hosting. Regardless of the structural mix of the economy, to remain competitive it is critical that Ohio employers have access to reliable, yet affordable sources of energy.

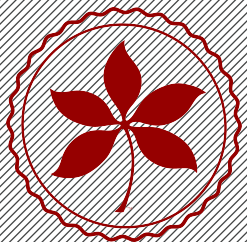
One factor that has contributed to the recent decrease in Ohio's energy consumption is the coronavirus pandemic quarantines, which induced a global economic crisis as many businesses struggled to keep operations open. According to EIA Acting Administrator Stephen Nalley, "It will take a while for the energy sector to get to its new 'normal', as the pandemic triggered a historic energy demand shock that led to decreases in energy production (USDOE/EIA, 2021)." Following the pandemic, employment in the Ohio energy sector decreased by 19% from 122,753 jobs in 2019 to 99,360 in 2020. Similarly, the total value added from the Ohio energy sector decreased by 30% from \$28.9 billion in 2019 to \$20.3 billion in 2020. However, as the coronavirus restrictions have been removed, the Ohio energy sector has rebounded quickly as the total employment from the Ohio energy sector grew by 5%, adding 5,033 new jobs in 2021, while the total Ohio Value added increased by \$3.6 billion.

Structural transitions in energy markets are typically measured in decades, not years. However, most energy transitions are not as obvious as the natural gas production boom in Ohio. For example, when comparing production trends over the past decade, natural gas production in Ohio experienced an unprecedented increase of 3,491% from 80,778 billion Btu in 2010 to over 2,901,090 billion Btu in 2019. The additional development and production of natural gas resources significantly contributed to the increase of both employment and value added to the Ohio economy. However, between 2019 to 2021, natural gas production in Ohio has decreased by 14%. Similarly, coal production in Ohio has declined by 86% between 2010 and 2020. While fossil based energy production has slowed in recent years, renewable energy production has experienced a significant increase of 28% from 125,540 billion BTU 2010 to 161,090 in 2020. Moving forward it will be interesting to evaluate how the structural changes in Ohio's energy production impact the employment and value added from the overall Ohio energy sector.



References

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

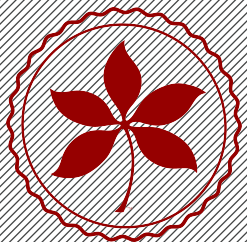
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Glossary of Key Terms

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Ohio Energy Sector IMPLAN Industry Contribution Analysis:

Glossary of Key Terms

Industry Contribution Analysis (ICA) - Industry Contribution Analysis (ICA) is a method used to estimate the wider economic contribution of an existing Industry or group of Industries in a region, at their current levels of production. ICA shifts the traditional I-O framework to see what Industries, and what level of production in these Industries, is being supported by current activity. ICA Events are distinct from Impact Events because they employ a constraint that removes feedback linkages or buy backs to the Industry being analyzed.

Multipliers - A measure of an industry's connection to the wider local economy by way of input purchases, payments of wages and taxes, and other transactions.

Sector - In the national economic accounts, the institutional units that make up the total economy: business, households and institutions, and general government.

Industry - A group of establishments engaged in the same or similar types of economic activity.

Data Year - The year of the dataset that the analysis is utilizing.

Dollar Year - The year represented by the values in the Event.

Direct Effects - The set of expenditures applied to the I-O multipliers for impact analysis. It is one or more production changes or expenditures made by producers/consumers as a result of an activity or policy. Direct effects can be positive or negative. These initial changes are determined by an analyst to be a result of this activity or policy being analyzed. Applying these initial changes to the multipliers in IMPLAN will then display how the Region will respond economically or is connected to these initial changes.

Indirect Effects - Economic Effects stemming from business to business purchases in the supply chain.

Induced Effects - Economic Effects stemming from household spending of Labor Income, after removal of taxes, savings, and commuter income.

Employment - Employment in IMPLAN is an Industry-specific mix of full-time, part-time, and seasonal employment. It is an annual average that accounts for seasonality and follows the same definition used by the BLS and BEA. IMPLAN Employment is not equal to full time equivalents. Includes wage and salary employment and proprietors.

Source: Clouse, C. 2022. IMPLAN. Glossary



Labor Income - All forms of Employment income, including Employee Compensation (wages, salaries, and benefits) and Proprietor Income.

Gross Domestic Product (GDP) - The final market value of the goods and services produced by labor and property located within the borders of the Region. Since 1991, GDP has been the featured measure of U.S. production.

Value Added - The difference between an Industry's or establishment's total Output and the cost of its Intermediate Inputs; it is a measure of the contribution to GDP. Value Added is a large portion of Output, as it encompasses Labor Income (LI), Other Property Income (OPI), and Taxes on Production and Imports (TOPI).

Output - For all Industries, output equals the value of Industry production, which is equal to sales plus net inventory change. In IMPLAN these are annual production estimates for the year of the dataset in producer prices. Note that for wholesale and retail sectors, Output is equal to gross wholesale margin or gross retail margin, respectively, not gross sales. The value of production for wholesale and retail sectors is the value of the services they provide; it does not include the value of the items sold within their establishment.

Proprietor Income - The current-production income of sole proprietorships, partnerships, and tax-exempt cooperatives. Excludes dividends, monetary interest received by non-financial business, and rental income received by persons not primarily engaged in the real estate business.

Other Property Income (OPI) - Calculated as Gross Operating Surplus minus Proprietor Income; OPI includes consumption of fixed capital (CFC), corporate profits, and business current transfer payments (net).

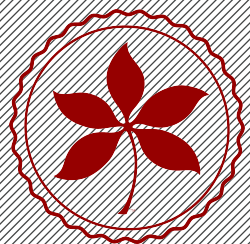
Employee Compensation - Employee Compensation in IMPLAN is the total payroll cost of the employee including wages and salaries, all benefits (e.g., health, retirement), and payroll taxes.

Taxes on Production & Imports less Subsidies (TOPI) - TOPI includes sales and excise taxes, customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments.

Appendix:

- Economic Indicators
- Employment Impacts
- Value Added Impacts
- Occupation Impact

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Appendix A: Economic Indicator Summary (Ohio / Data Year 2021 / Dollar Year 2021)

Event Name	Region	Impact	Employment	Labor Income	Value Added	Output
Electric generation - Fossil fuel	Ohio (2021)	1 - Direct	2,673	\$502,264,376	\$1,872,877,825	\$4,079,838,342
Electric generation - Solar	Ohio (2021)	1 - Direct	121	\$24,284,444	\$74,550,947	\$126,143,041
Electric generation - Wind	Ohio (2021)	1 - Direct	46	\$7,007,784	\$72,386,316	\$127,546,557
Electric generation - Hydroelectric	Ohio (2021)	1 - Direct	10	\$1,888,795	\$4,895,914	\$8,377,297
Electric generation - Nuclear	Ohio (2021)	1 - Direct	1,326	\$291,515,546	\$635,509,974	\$1,262,225,145
Electric generation - Geothermal	Ohio (2021)	1 - Direct	0	\$0	\$0	\$0
Electric generation - Biomass	Ohio (2021)	1 - Direct	9	\$1,268,247	\$4,716,257	\$11,570,368
Electric generation - All other	Ohio (2021)	1 - Direct	41	\$4,826,455	\$1,544,428	\$7,195,979
Electric transmission & distribution	Ohio (2021)	1 - Direct	8,367	\$1,457,095,630	\$5,312,463,590	\$11,801,411,074
Coal mining	Ohio (2021)	1 - Direct	338	\$28,264,639	\$112,322,226	\$193,096,202
Oil & gas extraction	Ohio (2021)	1 - Direct	7,358	-\$10,232,728	\$3,166,835,457	\$6,414,275,332
Drilling oil & gas wells	Ohio (2021)	1 - Direct	1,009	\$33,970,753	\$263,210,749	\$502,491,293
Support for oil & gas operations	Ohio (2021)	1 - Direct	3,873	\$272,911,937	\$630,695,241	\$1,196,860,029
Natural gas distribution	Ohio (2021)	1 - Direct	5,738	\$897,372,880	\$3,385,184,017	\$6,795,393,624
Uranium-radium-vanadium ore mining	Ohio (2021)	1 - Direct	0	\$0	\$0	\$0
Electric generation - Fossil fuel	Ohio (2021)	2 - Indirect	4,108	\$342,412,242	\$560,242,481	\$1,024,033,200
Electric generation - Solar	Ohio (2021)	2 - Indirect	120	\$8,680,968	\$14,574,442	\$27,154,208
Electric generation - Wind	Ohio (2021)	2 - Indirect	128	\$9,281,726	\$15,583,049	\$29,033,365
Electric generation - Hydroelectric	Ohio (2021)	2 - Indirect	8	\$585,805	\$983,505	\$1,832,405
Electric generation - Nuclear	Ohio (2021)	2 - Indirect	1,457	\$105,455,258	\$177,048,384	\$329,865,556
Electric generation - Geothermal	Ohio (2021)	2 - Indirect	0	\$0	\$0	\$0
Electric generation - Biomass	Ohio (2021)	2 - Indirect	16	\$1,153,309	\$1,936,285	\$3,607,566
Electric generation - All other	Ohio (2021)	2 - Indirect	13	\$950,976	\$1,596,590	\$2,974,667
Electric transmission & distribution	Ohio (2021)	2 - Indirect	415	\$42,461,707	\$75,816,838	\$180,082,777
Coal mining	Ohio (2021)	2 - Indirect	243	\$19,954,912	\$35,122,965	\$66,774,206
Oil & gas extraction	Ohio (2021)	2 - Indirect	14,586	\$1,344,396,232	\$1,797,921,628	\$2,975,221,222
Drilling oil & gas wells	Ohio (2021)	2 - Indirect	993	\$74,740,789	\$131,480,409	\$236,340,910
Support for oil & gas operations	Ohio (2021)	2 - Indirect	2,580	\$175,144,130	\$297,176,385	\$568,203,439
Natural gas distribution	Ohio (2021)	2 - Indirect	14,070	\$1,134,758,967	\$1,903,396,506	\$2,990,231,463
Uranium-radium-vanadium ore mining	Ohio (2021)	2 - Indirect	0	\$0	\$0	\$0
Electric generation - Fossil fuel	Ohio (2021)	3 - Induced	4,338	\$236,847,279	\$425,731,317	\$738,296,406
Electric generation - Solar	Ohio (2021)	3 - Induced	169	\$9,226,275	\$16,584,486	\$28,760,623
Electric generation - Wind	Ohio (2021)	3 - Induced	84	\$4,566,678	\$8,208,589	\$14,235,206
Electric generation - Hydroelectric	Ohio (2021)	3 - Induced	13	\$693,091	\$1,245,841	\$2,160,521
Electric generation - Nuclear	Ohio (2021)	3 - Induced	2,037	\$111,219,678	\$199,918,280	\$346,695,458
Electric generation - Geothermal	Ohio (2021)	3 - Induced	0	\$0	\$0	\$0
Electric generation - Biomass	Ohio (2021)	3 - Induced	12	\$678,656	\$1,219,886	\$2,115,508
Electric generation - All other	Ohio (2021)	3 - Induced	30	\$1,616,941	\$2,906,498	\$5,040,415
Electric transmission & distribution	Ohio (2021)	3 - Induced	7,686	\$419,764,122	\$754,536,294	\$1,308,507,772
Coal mining	Ohio (2021)	3 - Induced	247	\$13,496,896	\$24,261,033	\$42,073,196
Oil & gas extraction	Ohio (2021)	3 - Induced	6,835	\$373,300,614	\$671,021,100	\$1,163,677,402
Drilling oil & gas wells	Ohio (2021)	3 - Induced	556	\$30,386,464	\$54,621,342	\$94,723,863
Support for oil & gas operations	Ohio (2021)	3 - Induced	2,295	\$125,350,907	\$225,322,759	\$390,752,325
Natural gas distribution	Ohio (2021)	3 - Induced	10,444	\$570,174,650	\$1,024,878,104	\$1,777,325,560
Uranium-radium-vanadium ore mining	Ohio (2021)	3 - Induced	0	\$0	\$0	\$0
Source: IMPLAN. 2021.			104,393	\$8,669,738,033	\$23,960,527,935	\$46,876,143,521

Appendix B: Employment Impact Results - Top 100 (Ohio / Data Year 2021 / Dollar Year 2021)

	Industry Display	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs
1	Electric power transmission & distribution	8,367	0	0	8,367
2	Oil & gas extraction	7,358	0	0	7,358
3	Employment services	0	5,069	861	5,930
4	Natural gas distribution	5,738	0	0	5,738
5	Custom computer programming services	0	5,585	52	5,637
6	Support activities for oil & gas operations	3,873	0	0	3,873
7	Electric power generation Fossil fuel	2,673	0	0	2,673
8	Hospitals	0	0	2,543	2,543
9	Fullservice restaurants	0	828	1,679	2,507
10	Management of companies & enterprises	0	2,061	428	2,489
11	Other real estate	0	1,414	902	2,316
12	Limitedservice restaurants	0	274	1,808	2,082
13	Legal services	0	1,105	271	1,376
14	Services to buildings	0	1,112	234	1,345
15	Offices of physicians	0	0	1,329	1,329
16	Accounting, tax preparation, bookkeeping, & payroll services	0	1,106	222	1,328
17	Electric power generation Nuclear	1,326	0	0	1,326
18	Transit & ground passenger transportation	0	1,068	200	1,267
19	Monetary authorities & depository credit intermediation	0	942	249	1,190
20	Retail General merchandise stores	0	30	1,003	1,034
21	Architectural, engineering, & related services	0	974	57	1,031
22	Computer systems design services	0	944	69	1,013
23	Drilling oil & gas wells	1,009	0	0	1,009
24	Wholesale Wholesale electronic markets & agents & brokers	0	927	80	1,007
25	All other food & drinking places	0	265	716	981
26	Retail Food & beverage stores	0	12	919	930
27	Individual & family services	0	0	906	906
28	Truck transportation	0	519	353	873
29	Other financial investment activities	0	436	431	867
30	Scenic sightseeing transportation & support activities	0	751	99	850
31	Religious organizations	0	0	838	838
32	Securities & commodity contracts intermediation & brokerage	0	450	340	790
33	Automotive repair & maintenance, except car washes	0	238	530	768
34	Scientific research & development services	0	529	209	738
35	Nursing & community care facilities	0	0	715	715
36	Warehousing & storage	0	328	386	714
37	Retail Nonstore retailers	0	42	671	713
38	Business support services	0	532	174	706
39	Management consulting services	0	476	202	678
40	Pipeline transportation	0	674	3	677
41	Maintenance & repair construction of nonresidential structures	0	565	94	659
42	Landscape & horticultural services	0	471	187	658
43	Investigation & security services	0	485	158	643
44	Insurance carriers, except direct life	0	316	317	633
45	Couriers & messengers	0	285	318	603
46	Retail Miscellaneous store retailers	0	14	554	568
47	Home health care services	0	0	560	560
48	Insurance agencies, brokerages, & related activities	0	278	235	513
49	Wholesale Machinery, equipment, & supplies	0	464	38	502
50	Office administrative services	0	346	150	496

Source: IMPLAN. 2021.

	Industry Display	Direct Jobs	Indirect Jobs	Induced Jobs	Total Jobs
51	Junior colleges, colleges, universities, & professional schools	0	72	423	494
52	Retail Health & personal care stores	0	1	464	464
53	Marketing research & other professional, scientific, technical services	0	424	38	462
54	Waste management & remediation services	0	365	92	457
55	Elementary & secondary schools	0	0	449	449
56	Other local government enterprises	0	313	126	439
57	Child day care services	0	0	434	434
58	Wholesale Other durable goods merchant wholesalers	0	293	137	430
59	Commercial & industrial machinery & equipment rental & leasing	0	397	30	426
60	Nondepository credit intermediation & related activities	0	168	252	420
61	Outpatient care centers	0	0	420	420
62	Offices of dentists	0	0	390	390
63	Personal care services	0	0	376	376
64	Offices of other health practitioners	0	0	356	356
65	Retail Clothing & clothing accessories stores	0	1	346	346
66	Car washes	0	70	272	342
67	Coal mining	338	0	0	338
68	Retail Motor vehicle & parts dealers	0	29	304	333
69	Retail Gasoline stores	0	89	242	331
70	Tenantoccupied housing	0	0	331	331
71	Retail Building material & garden equipment & supplies stores	0	109	218	327
72	Postal service	0	193	123	317
73	Advertising, public relations, & related services	0	201	114	315
74	Residential retardation, mental health, & substance abuse facilities	0	0	300	300
75	Wholesale Other nondurable goods merchant wholesalers	0	102	195	297
76	Retail Sporting goods, hobby, musical instrument & book stores	0	7	278	284
77	Local government electric utilities	0	278	4	281
78	Community food, housing, relief services, rehabilitation services	0	0	263	263
79	Rail transportation	0	250	10	259
80	Other personal services	0	23	226	249
81	Other educational services	0	14	234	248
82	Commercial Sports Except Racing	0	103	143	246
83	Labor & civic organizations	0	0	245	245
84	Private households	0	0	244	244
85	Commercial industrial machinery equipment repair & maintenance	0	150	94	244
86	Other amusement & recreation industries	0	25	210	235
87	Other computer related services, including facilities management	0	200	24	224
88	Wired telecommunications carriers	0	115	103	218
89	Wholesale Professional & commercial equipment & supplies	0	68	145	214
90	Other support services	0	148	64	212
91	Retail Furniture & home furnishings stores	0	5	203	208
92	Local government passenger transit	0	170	32	202
93	Drycleaning & laundry services	0	46	148	194
94	Funds, trusts, & other financial vehicles	0	5	188	194
95	Retail Electronics & appliance stores	0	4	187	191
96	Personal & household goods repair & maintenance	0	138	52	191
97	Data processing, hosting, & related services	0	117	72	188
98	Electronic & precision equipment repair & maintenance	0	131	54	185
99	Fitness & recreational sports centers	0	21	157	178
100	Wholesale Grocery & related product wholesalers	0	11	162	174



Appendix C: Value Added Impacts Results - Top 25 Industries (Ohio / Data Year 2021 / Dollar Year 2021)

	Industry Display / Impact	Employee Compensation	Proprietor Income	Other Property Income	Taxes on Production & Imports	Value Added
1	Electric power transmission and distribution	\$1,295,050,189	\$162,045,441	\$2,981,859,370	\$873,508,591	\$5,312,463,590
2	Natural gas distribution	\$819,711,559	\$77,661,322	\$1,994,255,559	\$493,555,577	\$3,385,184,017
3	Oil and gas extraction	\$91,029,088	-\$101,261,815	\$3,029,605,651	\$147,462,533	\$3,166,835,457
4	Electric power generation - Fossil fuel	\$446,504,756	\$55,759,620	\$926,978,059	\$443,635,391	\$1,872,877,825
5	Monetary authorities and depository credit intermediation	\$110,583,242	\$2,473,988	\$691,629,691	\$9,005,412	\$813,692,332
6	Electric power generation - Nuclear	\$256,484,905	\$35,030,641	\$204,697,584	\$139,296,844	\$635,509,974
7	Support activities for oil and gas operations	\$255,426,156	\$17,485,780	\$323,300,019	\$34,483,286	\$630,695,241
8	Custom computer programming services	\$444,220,164	\$98,166,697	-\$2,951,093	\$5,841,113	\$545,276,882
9	Pipeline transportation	\$108,120,260	\$293,798,647	\$58,235,687	\$72,338,202	\$532,492,794
10	Owner-occupied dwellings	\$0	\$0	\$389,051,263	\$65,619,618	\$454,670,881
11	Management of companies and enterprises	\$347,491,004	-\$271,674	\$53,647,609	\$8,165,413	\$409,032,351
12	Employment services	\$221,184,204	\$30,340,903	\$114,747,728	\$4,010,891	\$370,283,726
13	Drilling oil and gas wells	\$38,151,180	-\$4,180,427	\$214,763,852	\$14,476,144	\$263,210,749
14	Hospitals	\$207,253,585	\$4,818,541	\$33,323,293	\$3,433,135	\$248,828,554
15	Legal services	\$94,899,129	\$23,914,567	\$81,678,167	-\$3,326,320	\$197,165,543
16	Insurance carriers, except direct life	\$59,808,745	\$1,392,415	\$116,845,136	\$9,502,892	\$187,549,188
17	Other real estate	\$31,195,407	\$19,504,536	\$119,777,959	\$10,874,286	\$181,352,189
18	Wholesale electronic markets and agents and brokers	\$112,865,519	\$7,291,131	\$31,326,069	\$1,810,632	\$153,293,350
19	Offices of physicians	\$136,162,200	\$17,646,201	-\$182,905	-\$4,182,334	\$149,443,162
20	Accounting, tax preparation, bookkeeping, and payroll services	\$85,434,568	\$21,887,711	\$42,525,141	-\$938,313	\$148,909,108
21	Coal mining	\$25,462,446	\$2,802,193	\$70,174,364	\$13,883,223	\$112,322,226
22	Full-service restaurants	\$63,272,503	\$7,455,207	\$34,496,023	-\$1,089,971	\$104,133,762
23	Scenic and sightseeing transportation and support activities	\$56,828,777	\$54,161,110	-\$12,684,419	\$1,322,169	\$99,627,637
24	Tenant-occupied housing	\$4,047,828	\$2,928,822	\$80,334,905	\$11,175,391	\$98,486,946
25	Nondepository credit intermediation and related activities	\$45,219,946	\$1,143,080	\$47,164,101	\$3,267,243	\$96,794,370

Source: IMPLAN. 2021.

Appendix D: Occupation Impact Results (Ohio / Data Year 2021 / Dollar Year 2021 / Level 5 detail)

Occ Code	Dim Occupation Occupation	Employee Compensation	Wage & Salary Income	Supplements to Wages & Salaries	Wage & Salary Employment	Hours Worked
11-1021	General & Operations Managers	\$324,030,205	\$261,631,533	\$62,398,672	1,597	3,576,038
49-9051	Electrical Power-Line Installers & Repairers	\$313,342,234	\$218,579,823	\$94,762,412	1,991	4,571,631
15-1256	Software Developers & Software Quality Assurance Analysts & Testers	\$218,605,213	\$189,392,556	\$29,212,657	1,550	3,109,872
43-4051	Customer Service Representatives	\$179,460,923	\$137,565,326	\$41,895,597	2,540	4,375,935
13-1198	Project Management Specialists & Business Operations Specialists, All Other	\$166,468,594	\$129,506,124	\$36,962,470	1,164	2,325,521
49-1011	First-Line Supervisors of Mechanics, Installers, & Repairers	\$158,440,065	\$113,969,934	\$44,470,130	939	2,142,840
17-2071	Electrical Engineers	\$154,361,499	\$109,393,195	\$44,968,304	773	1,639,862
13-2011	Accountants & Auditors	\$128,079,015	\$104,825,881	\$23,253,134	1,066	2,123,756
49-9012	Control & Valve Installers & Repairers, Except Mechanical Door	\$127,991,754	\$89,942,665	\$38,049,089	931	2,068,142
15-1211	Computer Systems Analysts	\$115,091,742	\$93,286,992	\$21,804,750	789	1,628,050
11-3031	Financial Managers	\$114,931,533	\$94,367,062	\$20,564,471	477	1,020,193
51-8013	Power Plant Operators	\$109,857,586	\$76,649,013	\$33,208,573	675	1,632,932
11-3021	Computer & Information Systems Managers	\$106,479,096	\$88,940,303	\$17,538,792	470	1,017,956
13-1111	Management Analysts	\$105,379,816	\$82,418,023	\$22,961,792	674	1,388,960
43-1011	First-Line Supervisors of Office & Administrative Support Workers	\$101,054,908	\$79,009,953	\$22,044,955	919	1,810,168
29-1141	Registered Nurses	\$98,559,625	\$80,864,322	\$17,695,303	1,132	1,983,261
23-1011	Lawyers	\$90,133,396	\$75,147,743	\$14,985,652	453	971,319
51-1011	First-Line Supervisors of Production & Operating Workers	\$89,987,256	\$65,118,967	\$24,868,289	523	1,166,187
49-2095	Electrical & Electronics Repairers, Powerhouse, Substation, & Relay	\$85,343,021	\$59,603,647	\$25,739,374	505	1,191,323
41-4012	Sales Representatives, Wholesale & Manufacturing, Except Technical & Scientific Products	\$84,655,914	\$71,151,738	\$13,504,176	735	1,517,250
53-3032	Heavy & Tractor-Trailer Truck Drivers	\$80,643,579	\$66,205,308	\$14,438,271	1,080	2,253,389
53-7062	Laborers & Freight, Stock, & Material Movers, Hand	\$80,417,886	\$66,432,667	\$13,985,219	1,814	2,953,285
43-9061	Office Clerks, General	\$79,955,903	\$64,277,045	\$15,678,858	1,547	2,470,402
41-3091	Sales Representatives of Services, Except Advertising, Insurance, Financial, & Travel	\$77,840,082	\$64,062,663	\$13,777,419	794	1,591,414
49-9041	Industrial Machinery Mechanics	\$76,845,291	\$57,528,904	\$19,316,387	629	1,337,359
11-9198	Personal Service Managers, All Other; Entertainment & Recreation Managers	\$76,778,651	\$59,803,399	\$16,975,252	353	759,660
11-9041	Architectural & Engineering Managers	\$72,219,889	\$53,737,604	\$18,482,285	261	592,969
29-1228	Physicians, All Other; & Ophthalmologists, Except Pediatric	\$71,896,925	\$59,332,429	\$12,564,496	228	502,992
11-2022	Sales Managers	\$61,033,452	\$50,785,157	\$10,248,294	267	590,990
47-1011	First-Line Supervisors of Construction Trades & Extraction Workers	\$59,358,726	\$47,505,632	\$11,853,094	450	985,266
13-1161	Market Research Analysts & Marketing Specialists	\$57,961,813	\$47,313,332	\$10,648,481	501	963,466
43-3031	Bookkeeping, Accounting, & Auditing Clerks	\$56,518,787	\$46,686,981	\$9,831,806	867	1,499,229
43-6014	Secretaries & Administrative Assistants, Except Legal, Medical, & Executive	\$55,963,933	\$45,368,351	\$10,595,582	960	1,649,241
13-2098	Investment Analysts, Financial Risk Specialists, & Financial Specialists, All Other	\$55,004,967	\$44,490,291	\$10,514,675	351	744,670
47-2111	Electricians	\$52,635,614	\$38,230,836	\$14,404,778	397	803,549
11-2021	Marketing Managers	\$50,505,095	\$41,767,540	\$8,737,555	215	436,601
49-9071	Maintenance & Repair Workers, General	\$49,656,937	\$38,503,173	\$11,153,764	639	1,254,061
13-1071	Human Resources Specialists	\$49,473,370	\$40,387,783	\$9,085,587	500	994,148
51-8092	Gas Plant Operators	\$49,074,982	\$35,727,244	\$13,347,737	356	808,852
11-3011	Administrative Services & Facilities Managers	\$49,017,872	\$37,574,990	\$11,442,882	252	514,338
15-1232	Computer User Support Specialists	\$47,150,391	\$39,659,517	\$7,490,874	610	1,174,843
15-1244	Network & Computer Systems Administrators	\$46,426,577	\$37,902,673	\$8,523,904	351	735,223
17-2161	Nuclear Engineers	\$45,690,599	\$31,971,933	\$13,718,666	173	363,629
11-1011	Chief Executives	\$43,219,994	\$34,910,750	\$8,309,244	127	292,548
51-8012	Power Distributors & Dispatchers	\$43,027,910	\$30,027,723	\$13,000,187	240	585,591
47-2152	Plumbers, Pipe fitters, & Steam fitters	\$42,918,712	\$30,941,279	\$11,977,432	359	730,689
13-1028	Buyers & Purchasing Agents	\$42,117,056	\$32,452,273	\$9,664,783	317	621,584
41-2031	Retail Salespersons	\$40,038,170	\$33,487,055	\$6,551,115	1,285	1,796,706
53-7065	Stockers & Order Fillers	\$39,460,384	\$31,780,827	\$7,679,557	953	1,420,684
15-1299	Computer Occupations, All Other	\$38,269,652	\$32,774,058	\$5,495,595	296	581,060

Source: IMPLAN. 2021.





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