THE ECONOMIC ROLE OF OKLAHOMA'S AGGREGATE INDUSTRY

STATE CHAMBER RESEARCH FOUNDATION

REGIONTRACK
Regional Economic Forecasting and Analysis

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Economic Role of the Oklahoma Aggregate Industry

The goal of this report is to aid state policymakers and the public in better understanding the structure and various economic contributions of Oklahoma's aggregate producing industry. Aggregate materials, which include primarily limestone, granite, and sand and gravel, are widely used but not highly visible to the public. The economic role played by the aggregate industry in the state economy also remains largely unknown and has received little study from an economic perspective.

In evaluating the economic role of the Oklahoma aggregate industry, the analysis in the report is structured around answering six core questions:

1. *What is the state's aggregate industry and how is it structured?*
2. *What types and quantities of aggregate materials are produced in Oklahoma?*
3. *How large is the industry, who are the key participants, and where is it located?*
4. *What are the direct economic contributions of the industry to the state and to local economies?*
5. *What spillover economic effects are generated by the operations of the industry?*
6. *What are the tax contributions produced by the aggregate industry?*

Key Findings

Key findings from the report are as follows:

1. In 2019, 341 companies reported production of aggregate material in Oklahoma.
2. The aggregate industry produced 81.5 million tons of material at 417 sites across the state.
3. Oklahoma's aggregate production is highly concentrated in just four aggregates – limestone, sand and gravel, granite, and gypsum. These four materials comprise approximately 95% of total state aggregate production.
4. The production of aggregate material in Oklahoma is up 25% the past decade (2.3% annual growth).
5. The production of aggregate material is widespread across Oklahoma, occurring in 71 of 77 counties in 2019. However, production is highly concentrated in the 20 largest producing counties. Each produced more than 1 million tons of aggregate in 2019 and jointly accounted for 81% of total state production.
6. Aggregate production in Oklahoma is highly concentrated in the non-metropolitan counties of the state. In 2019, 71% of production originated in the state's 58 non-metro counties. The remaining 29% of production occurred in the state's 19 metropolitan area counties.
7. Total state aggregate production is highly concentrated among the top 50 producers who jointly accounted for more than 90% of total state output in 2019. The top four producers accounted for nearly half of all state aggregate production in 2019. The top 25 producers accounted for more than 80% of state production.
8. The top 50 individual producing sites accounted for 76.5% of total state output in 2019, or 62.3 million tons of production.

9. Based on federal and state economic databases, 293 Oklahoma business establishments were primarily engaged in aggregate production in 2020. These establishments include 174 employers with wage and salary employees and 119 nonemployer firms.

10. The industry is comprised of a relatively small number of large producing firms and a large number of relatively small firms. Only 20 firms across the state produced more than 1 million tons of aggregate in 2019. More than half of all firms extracted less than 25,000 tons of aggregate in 2019.

11. Overall, the state's largest aggregate producers are dominant in granite, gypsum, limestone, and sand and gravel production. Mid-size producers account for most of the production of clay, dimensional stone, salt, and chat. Small producers account for most of the production of caliche, select fill, shale, and tripoli.

12. Aggregate industry revenue totaled $719 million in 2020, an increase of 84% the past decade (6.3% annual growth).

13. The industry employed nearly 2,400 workers who earned $179 million in compensation in 2020.

14. Employment in the industry increased 26% the past decade while total compensation paid to workers nearly doubled (98% gain).

15. Industry compensation of $74,675 per worker is almost 20% higher than the overall state average of $62,523. Compensation per worker in the aggregate industry increased at nearly double the pace of overall state compensation the past decade (57% vs. 29%).

16. The typical establishment in the aggregate industry remains relatively small with an average of about 14 employees, little changed since 2004. Total compensation per establishment increased 59% between 2010 and 2020, now totaling just more than $1 million.

17. Firm size as measured by revenue per establishment has risen 50% since 2010, reaching approximately $4.1 million in 2020. The rise in average revenue per establishment reflects a similar 48% increase in revenue per employee since 2010, reaching $295,520 in 2020.

18. Employment and wages in the aggregate industry are reported in 68 of the state's 77 counties in 2020.

19. A core group consisting of seven counties report more than 100 workers in the aggregate industry. Johnston County has the largest employment base with 233 workers, followed by LeFlore (230 jobs), Oklahoma (191 jobs), Murray (167 jobs), Haskell (137 jobs), Pontotoc (110 jobs), and Kiowa (106 jobs) counties. These same seven counties produced the largest amount of total employee compensation among the counties, ranging from $18.9 million in Johnston county to $8.7 million in Kiowa county in 2020.

20. As a share of total county employee compensation, the aggregate industry accounts for 14.0% of compensation in Johnston, 9.7% in Kiowa, 7.6% in Haskell, 5.2% in Murray, and 2.7% in Le Flore. In total, 12 Oklahoma counties generate more than 1% of total local employee compensation from aggregate industry jobs.

21. Average compensation at the county level ranges from a low of $34,018 to a high of $88,363. Wages in the state's metropolitan areas are only marginally higher than in the nonmetropolitan areas.

22. Relative to comparable industry sectors in Oklahoma, aggregate industry GDP of $663 million is only slightly smaller than that found in the Warehousing and storage sector ($765.8 million) and the Securities, commodities, and financial investment services sector ($751.7 million). GDP in the aggregate sector exceeds that produced in Motor vehicles, bodies and trailers, and parts

    manufacturing ($650.7 million); Performing arts, spectator sports, museums, and related activities ($645.1 million); and Computer and electronic product manufacturing ($623.7 million).

23. Estimated gross economic impacts suggest that the state's aggregate industry supported an estimated $1.3 billion in total state output, 8,450 total jobs, and $457 million in total employee compensation in 2020.

24. Each dollar of direct output within the aggregate industry supported an additional $0.84 in estimated economic output statewide. Each dollar of direct earnings by aggregate industry employees supported an additional $1.56 of household earnings statewide. Each direct job in the aggregate sector supported 2.5 additional jobs in the state economy.

25. Total expected state tax revenue generated by the gross economic contribution of the aggregate industry reached $48.9 million in 2020.

26. Based on 2019 production of 81.45 million tons of aggregate, the state's fee on aggregate production is expected to generate an estimated $1 million annually to the Oklahoma Department of Mines.

27. In 2020, the state's aggregate producers reported sales subject to state sales and use tax of $127.8 million. Aggregate producers remitted an estimated $8.79 million in sales and use tax receipts to state, city, and county governments in Oklahoma. Of the total, $5.75 million (65%) went to the state, $2.0 million (23%) to cities, and $1.0 million (12%) to counties.

28. In 2020, sales and use tax payments totaling $3.0 million were remitted to city and/or county governments in 75 of the state's 77 counties.

29. Ad valorem tax payments for the 50 largest producing sites in Oklahoma totaled an estimated $6.42 million in tax year 2020.

I. Defining Oklahoma's Aggregate Industry

This report examines the size, structure, and economic contribution of Oklahoma's aggregate-producing industry. Although the industry's activities and the minerals it produces are not highly visible to the public, its products are widely used, particularly in critical construction and transportation-related applications. This initial section of the report provides a description of the aggregate industry, its range of products, and the geology underlying the materials produced in Oklahoma.

Defining Aggregate

The term *aggregate* is used throughout the report to denote a range of inert, nonmetallic materials or minerals produced from natural sources that are used primarily in building and construction. The most common types of aggregate in Oklahoma and in most states are granite, limestone, and sand and gravel.

Aggregate material is extracted from a mine, quarry, pit, or other natural deposit. After extraction, the material is typically prepared in some manner (e.g., sorted, graded, crushed, cleaned, washed, etc....) and then measured or weighed for sale in volume and transported by truck, trailer, or train. Aggregates are then used either in raw form or as in input to other end-use products such as wet concrete and hot asphalt.

Oklahoma's Key Aggregates. The aggregates covered throughout the report include those requiring a production permit[1] from the Oklahoma Department of Mines (ODOM). ODOM regulates mine safety in the state and reports production on an ongoing basis.[2]

Coal production is excluded from the analysis along with other fuel-type natural materials such as peat.

ODOM reports production of 14 non-coal aggregate materials in Oklahoma the past decade. These materials include limestone, sand and gravel, granite, gypsum, clay, dimensional stone, select fill, shale, salt, chat, tripoli, caliche, volcanic ash, and dolomite.[3]

Both salt and dimension stone are not universally viewed as aggregate material but are permitted and tracked by ODOM and included in the report. Combined, the two materials comprise less than 2% of total state aggregate production tonnage in 2019 (dimensional stone 1.3% and salt 0.2%)

Other minerals that require a permit to mine but are no longer produced in Oklahoma include lead, zinc, copper, iron, manganese, titanium, and uranium.[4] Many of these discontinued materials are metallic ores that are produced primarily in other states or countries.

Finally, precious and semi-precious stones are not mined commercially in Oklahoma and are excluded from the analysis.

The Market for Aggregate Materials

There are several economic characteristics of the Oklahoma aggregate market that provide helpful context when reviewing the remainder of the report:

1. The goods-producing sectors of the state economy including construction, manufacturing, and agriculture are closely tied to the aggregate sector.
2. The aggregate sector plays a critical role in providing key input materials for the construction of roads, buildings, bridges, dams, flood control, septic fields, and as backfill, as well as use in other construction projects.
3. Aggregate materials are also used as a direct input to numerous other end-use products such as asphalt, bricks, countertops, construction blocks, Portland cement, roofing shingles, frac sand for the oil and gas drilling industry, and filter sand for water treatment plants.
4. The aggregate industry is tied to the physical location of the minerals and has limited ability to change the location of supply in response to changing market conditions.
5. The locally sourced nature of the industry insulates it, to a degree, from out-of-region and international competition.
6. The market for aggregate material can be highly localized in a small regional area, particularly for widely used items such as limestone and sand and gravel.
7. Aggregate materials typically have very low cost in small quantities; hence, they are sold in large quantities, frequently measured in tonnage.
8. Transportation costs are a major component of the price of aggregate and can exceed the direct cost of the aggregate when transported long distances.
9. Local truck transportation is closely intertwined with aggregate production and delivery.
10. Aggregate materials are not generally sold directly to small retail customers through traditional channels but are instead sold in quantity to construction firms, governments, landscapers, or other large users and resellers.
11. The state's concrete and asphalt producers are closely tied to aggregate production by geography, with many firms vertically integrated.

Key End-Use Products – Concrete and Asphalt. Both ready-mix concrete and hot-mix asphalt are key end-use products derived primarily from a mixture of aggregate. Many of the state's aggregate producing firms produce concrete and asphalt as value-added products.

Concrete and asphalt are key inputs to a range of construction and transportation-related projects. In Oklahoma, these activities are performed by private construction, landscaping, and engineering firms; state entities such as the Oklahoma Department of Transportation (ODOT); and counties and municipalities across the state.

Concrete is used in projects ranging from residential and nonresidential construction to roads, driveways, and numerous specialized applications. The concrete industry is highly dependent upon aggregate material, with 60-75% of the total volume of concrete comprised of aggregate material, primarily in the form of sand, crushed stone, and gravel.[5] Concrete production occurs statewide using a network of concrete plants that rely upon a steady supply of material from the state's aggregate industry. ODOT

currently uses 102 approved and inspected concrete plants located across the state.[6] About three-fourths of the plants are permanent (78) while the remainder (24) are portable and used at the jobsite.

Aggregates similarly comprise 75-80% of the volume of hot-mix asphalt, which is used to cover 90% of the nation's paved roads and highways.[7] Asphalt plants located across the state provide aggregate-based paving materials primarily for public (state, county, and municipal) and private roadway and related projects. ODOT currently contracts with 54 approved asphalt plants located in the state that hold a current inspection status.[8] Among these plants, 35 are in permanent locations while 19 are portable for on-site mixing.

Geological Formations. Oklahoma is endowed with a diverse mix of minerals for use as aggregate materials. The actual production mix reflects both the diverse supply of mineral deposits native to the state and the demand for aggregates in the state.

Four major geological formations are responsible for much of the natural aggregate material produced in Oklahoma:[9]

Arbuckle Mountains – in south central Oklahoma stretching across Pontotoc, Garvin, Murray, and Johnston counties, the mineral-rich area is home to extensive commercial deposits of limestone, granite, dolomite, silica sand, and other materials.

Ozark Uplift – in northeast Oklahoma primarily in Cherokee, Ottawa, Adair, and Delaware counties, the region has substantial limestone and unique tripoli[10] deposits.

Wichita Mountains – in southwest Oklahoma located primarily in Kiowa, Comanche, Caddo, and Greer counties, the range has significant limestone and granite deposits.

Ouachita Mountains – in the southeast Oklahoma counties of Pushmataha, Le Flore, Latimer, Atoka, and McCurtain, deposits in the region include large deposits of limestone and dimensional stone.

Beyond these four formations, sand and gravel deposits are dispersed across most areas of the state along streams and riverbeds. Broad deposits of salt, which form the state's salt plains, are found across much of northwest and southwest Oklahoma.

Significant gypsum deposits are found in west central and northwest Oklahoma. Caliche[11] is found in Ellis and Texas Counties in and near the Panhandle. Volcanic ash deposits are highly concentrated in ancient volcanic fields in the Panhandle but are found statewide.

Measuring the Economic Size of the Aggregate Industry

While the volume of aggregate material produced in Oklahoma is tracked and reported by ODOM, estimates of the economic size of the aggregate industry require the extraction of economic data from state and federal databases. This entails identifying the individual segments of the aggregate industry based on widely used NAICS codes.

Mining. The core of the aggregate industry is tied primarily to mining and quarrying activities. The NAICS classification system identifies five major groupings of mining operations in North America:

1. NAICS 2111 – Oil and gas extraction
2. NAICS 2121 – Coal mining
3. NAICS 2122 – Metal ore mining
4. NAICS 2123 – Non-metallic mineral mining and quarrying, and
5. NAICS 2131 – Support activities for mining

The report focuses on NAICS 2123 (non-metallic minerals) and the portion of NAICS 2131 (support activities) related to non-metallic minerals. Fuel-type commodities such as crude oil, natural gas, and coal (NAICS 2111 and 2121) are generally viewed as distinctly separate mining activities and their economic role has been examined in depth in Oklahoma for many years. Metal ores (NAICS 2122), or metallic minerals, were mined in the state in years past (e.g., zinc, lead, and iron ores) but are no longer produced commercially.

Within NAICS 2123 and 2131, the following nine 6-digit NAICS codes are used throughout the report to assemble economic data on the mining and quarrying activities of the industry from federal and state databases:[12]

o   NAICS 212311 - Dimension Stone Mining and Quarrying
o   NAICS 212312 - Crushed and Broken Limestone Mining and Quarrying
o   NAICS 212313 - Crushed and Broken Granite Mining and Quarrying
o   NAICS 212319 - Other Crushed and Broken Stone Mining and Quarrying
o   NAICS 212321 - Construction Sand and Gravel Mining
o   NAICS 212322 - Industrial Sand Mining
o   NAICS 212325 - Clay and Ceramic and Refractory Minerals Mining
o   NAICS 212399 - All Other Nonmetallic Mineral Mining
o   NAICS 213115 - Support Activities for Nonmetallic Minerals (except Fuels) Mining

These sectors are commonly referred to jointly as the *nonmetallic mineral mining* sector.

For brevity in presentation throughout the report, the nine sectors above are referred to using the following shortened versions of their official NAICS descriptions: *Dimension Stone, Limestone, Granite, Other Stone, Sand and Gravel, Industrial Sand, Clay and Ceramic, All Other Nonmetallic Minerals,* and *Support Activities.*

Wholesale Trade. In addition to the mining components of the industry, two additional 6-digit sectors in wholesale trade are directly related to the sale of aggregate material:

- o   NAICS 423320 - Brick, Stone, and Related Construction Material Merchant Wholesalers
- o   NAICS 423520 - Coal and Other Mineral and Ore Merchant Wholesalers

Most of the sales in the aggregate industry take place directly between producer and end-user, including physical delivery. However, wholesalers play a vital role in the distribution of aggregate material to end-users across the state.

The two wholesale trade sectors are far broader in scope than the nine narrowly defined 6-digit nonmetallic mineral sectors described above in NAICS 2123 and 2131 and include products beyond nonmetallic minerals. Because wholesale activity in these two sectors is not fully attributable to the aggregate industry, a share of the sector's activity is apportioned to nonmineral mining as follows:

NAICS 423320 – Brick, Stone, and Related Construction Material Merchant Wholesalers. NAICS 423320 includes wholesale trade activity for a range of construction materials. Along with the traditional aggregates of crushed stone, building stone, gravel, sand, and clay, NAICS 423320 includes wholesale trade in asphalt, bricks, building blocks, cement, concrete, drywall, paving mixtures plaster, clay tile, stucco, concrete septic tanks, terra cotta, and other products. Given the range of products included in NAICS 423320, our estimate is that the aggregate sector in Oklahoma is likely to comprise no more than 20-30% of total activity in the industry. Hence, we assign the midpoint of 25% of the wholesale activity in the sector to the aggregate industry.

NAICS 423520 – Coal and Other Mineral and Ore Merchant Wholesalers. NAICS 423520 includes wholesale activity only in coal-related production, metallic minerals, and nonmetallic minerals. The limited range of products included makes is far easier to apportion the share of industry activity traced to nonmetallic minerals. In Oklahoma, there is believed to be little contribution to NAICS 423520 from wholesale coal-related activity for two reasons. First, most coal activity is captured in NAICS 2121, and second, there is now relatively little coal mining activity in the state. There is also no meaningful amount of metallic mineral mining in the state. Hence, a very high percentage of the wholesale activity in NAICS 423520 is traced to nonmetallic mineral mining. Other products are believed to represent no more than 10-20% of the activity taking place in NAICS 423520. Hence, we use the midpoint and assign 85% of the wholesale activity in the sector to the aggregate industry.

The two wholesale trade sectors are referred to throughout the report using the following shortened versions of their official NAICS descriptions: *Construction Materials-Wholesale* and *Minerals-Wholesale*.

Aggregate Industry Definition. The remainder of the report examines the state's aggregate sector using the nine nonmetallic mineral mining sectors in NAICS 2123 and 2131 along with portions of the two wholesale trade sectors related to nonmetallic mineral mining. These eleven sectors are believed to capture the great majority of all relevant direct aggregate industry activity in the state.

These sectors are also believed to capture little activity not considered aggregate mining. Excluded from the measure are numerous industry sectors that are closely tied to the aggregate industry through supplier and customer channels but are not a direct component of the industry itself. These relationships are examined in a later section of the report that measures economic spillover effects resulting from direct activity in the industry.

Industry Classification Issues. When identifying the various NAICS components of a particular industry in public databases, there are common challenges faced in capturing the full presence of an industry. The most important of these are:

1) firm misclassification – activity is misclassified outside the intended industry sector. This happens for two primary reasons. First, the activity is simply reported using the wrong industry code. Second, firms are classified in another NAICS industry sectors because it is not their primary line of business; and
2) regional misclassifiction – firms are classified in the wrong region. This can occur when out-of-state firms operating in the state are not captured in Oklahoma data; or firms with operations in one Oklahoma county report the activity as being based in another county.

These two data classification issues are quite common when examining small industry sectors or small regional economies and are noted in the report where it is believed they may be influencing the reliability of the data.

II. Oklahoma Aggregate Industry Production

Aggregate Production in Oklahoma

This section of the report provides a comprehensive overview of the types, quantities, and production location of aggregate material produced in Oklahoma. Also examined are the largest aggregate producing firms operating in the state and the largest individual aggregate producing sites.

Types of Aggregate Production. **Figure 1** summarizes the annual production of aggregate materials in Oklahoma in the decade from 2009 to 2019.

In 2019, Oklahoma producers reported total production of 81.45 million tons of aggregate material. Production is highly concentrated among just four aggregates – limestone, sand and gravel, granite, and gypsum. These four materials comprise approximately 95% of total state aggregate production in 2019.

Limestone. The most produced material is limestone, totaling 42.5 million tons, or slightly more than half (52.2%) of all production in the state. Crushed limestone is commonly used as aggregate in the production of concrete.

Sand and Gravel. Sand and gravel comprise the second largest category with 19.3 million tons (23.6%) in 2019. Sand and gravel are used to make concrete and asphalt, for road construction, as construction fill, and in the production of other construction materials including concrete blocks and bricks.

Granite. Granite is the third most produced aggregate in Oklahoma with 9.6 million tons (11.8%) in 2019. It is used in numerous construction applications including asphalt, ballast for railroad tracks, landscaping, drainage, walkways, driveways, monuments, and grave markers.

Gypsum.[13] Gypsum production ranks fourth in 2019 with 5.3 million tons (6.5%). Gypsum produced in Oklahoma is used primarily for wallboard, roadbed, and in concrete production along with cement. Food-grade gypsum produced in Oklahoma is used as a calcium supplement in foods (e.g., bread and dough) and beverages (typically beer and wine).

All Other Aggregates. The remaining ten aggregates – clay, dimensional stone, select fill, shale, salt, chat, tripoli, caliche, volcanic ash, and dolomite – totaled less than 5 million tons in combined production in 2019, or 5.8% of total state production. Production of fourth-ranked gypsum exceeded the combined production of the remaining ten aggregates in 2019.

Not all tracked aggregate materials are produced each year. Dolomite was produced in the state from 2014 to 2017 but none was produced in either 2018 or 2019. Volcanic ash has been produced only periodically and in small quantities the past decade, with none produced since 2014.

Figure 1. Oklahoma Aggregate Production by Type and Share										
Aggregate	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Annual Production (tons)										
Limestone	39,159,686	41,703,789	38,619,920	31,761,092	40,950,503	46,118,855	47,420,355	48,265,197	40,580,727	41,976,859	42,544,765
Sand & Gravel	15,555,930	16,136,616	15,525,413	18,614,850	16,063,874	17,723,592	16,174,880	16,712,925	16,040,334	18,071,628	19,255,178
Granite	4,779,525	4,557,052	4,625,498	3,291,307	4,387,976	2,700,588	4,954,479	5,028,992	8,924,303	8,537,499	9,629,110
Gypsum	2,842,591	3,373,936	5,482,983	5,804,842	5,354,300	5,412,051	4,722,359	5,250,920	5,795,606	6,632,023	5,280,332
Clay	1,266,600	1,245,988	992,170	2,255,864	1,455,844	1,305,098	1,550,241	1,515,538	2,298,253	1,974,326	1,661,423
Dimensional Stone	398,329	401,738	435,430	2,052,095	519,149	913,939	730,537	664,332	1,496,232	1,347,319	1,121,896
Select Fill	228,752	685,146	463,250	1,237,479	772,590	1,376,047	1,470,280	1,551,154	1,575,876	1,028,472	1,020,763
Shale	279,427	774,473	517,593	2,090,791	443,412	539,861	565,436	939,587	558,327	547,639	566,829
Salt	155,764	95,928	130,761	195,982	133,120	159,096	167,655	131,797	150,350	132,448	166,037
Chat	264,836	286,123	315,260	220,304	301,240	365,017	321,166	241,041	178,045	109,412	142,777
Tripoli	37,661	51,520	33,973	180,766	84,052	58,065	32,781	23,000	43,097	32,177	50,269
Caliche	4,595	107,423	148,324	129,348	2,615	6,683	134,034	25,030	60,962	38,232	6,246
Volcanic Ash	240	400	800	-	730	450	-	-	-	-	-
Dolomite	-	-	-	-	-	185,667	184,318	163,511	264,522	-	-
Total	64,973,936	69,420,132	67,291,375	67,834,720	70,469,405	76,865,009	78,428,521	80,349,513	77,702,112	80,428,034	81,445,625
Share of Annual Production										
Limestone	60.3%	60.1%	57.4%	46.8%	58.1%	60.0%	60.5%	59.9%	52.0%	52.2%	52.2%
Sand & Gravel	23.9%	23.2%	23.1%	27.4%	22.8%	23.1%	20.6%	20.8%	20.6%	22.5%	23.6%
Granite	7.4%	6.6%	6.9%	4.9%	6.2%	3.5%	6.3%	6.2%	11.4%	10.6%	11.8%
Gypsum	4.4%	4.9%	8.1%	8.6%	7.6%	7.0%	6.0%	6.5%	7.4%	8.2%	6.5%
Clay	1.9%	1.8%	1.5%	3.3%	2.1%	1.7%	2.0%	1.9%	2.9%	2.5%	2.0%
Dimensional Stone	0.6%	0.6%	0.6%	3.0%	0.7%	1.2%	0.9%	0.8%	1.9%	1.7%	1.4%
Select Fill	0.4%	1.0%	0.7%	1.8%	1.1%	1.8%	1.9%	1.9%	2.0%	1.3%	1.3%
Shale	0.4%	1.1%	0.8%	3.1%	0.6%	0.7%	0.7%	1.2%	0.7%	0.7%	0.7%
Salt	0.2%	0.1%	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Chat	0.4%	0.4%	0.5%	0.3%	0.4%	0.5%	0.4%	0.3%	0.2%	0.1%	0.2%
Tripoli	0.1%	0.1%	0.1%	0.3%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%
Caliche	0.0%	0.2%	0.2%	0.2%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	0.0%
Volcanic Ash	0.0%	0.0%	0.0%	-	0.0%	0.0%	-	-	-	-	-
Dolomite	-	-	-	-	-	0.2%	0.2%	0.2%	0.3%	-	-
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes: Excludes coal and other fuel-type minerals
Source: Oklahoma Department of Mines and RegionTrack calculations

Trend in Aggregate Production. Total aggregate production measured in tonnage has remained in a steady uptrend much of the past decade, rising by a cumulative 25% (2.3% annually) in the period (**Figure 2**).

The reported 81.45 tons produced in 2019 is up 16.47 tons from 64.97 million tons produced in 2009.

The uptrend in total production was interrupted in only two years - 2011 and 2017 - the past decade. Production in both years was affected primarily by volatility in the output of limestone, the state's primary aggregate.

The 3% pullback in overall state production in 2011 is traced to a steep 7.5% pullback in limestone production that was offset in part by a simultaneous rise in both gypsum and sand and gravel output.

Weakness in total state output in 2017 was again traced to a more than 15% drop in limestone production, a reversal of record limestone production posted in 2016. A more than 75% rise in granite production softened the effect of the pullback in limestone output in 2017.

Figure 2. Oklahoma Total Aggregate Production (2009-2019)
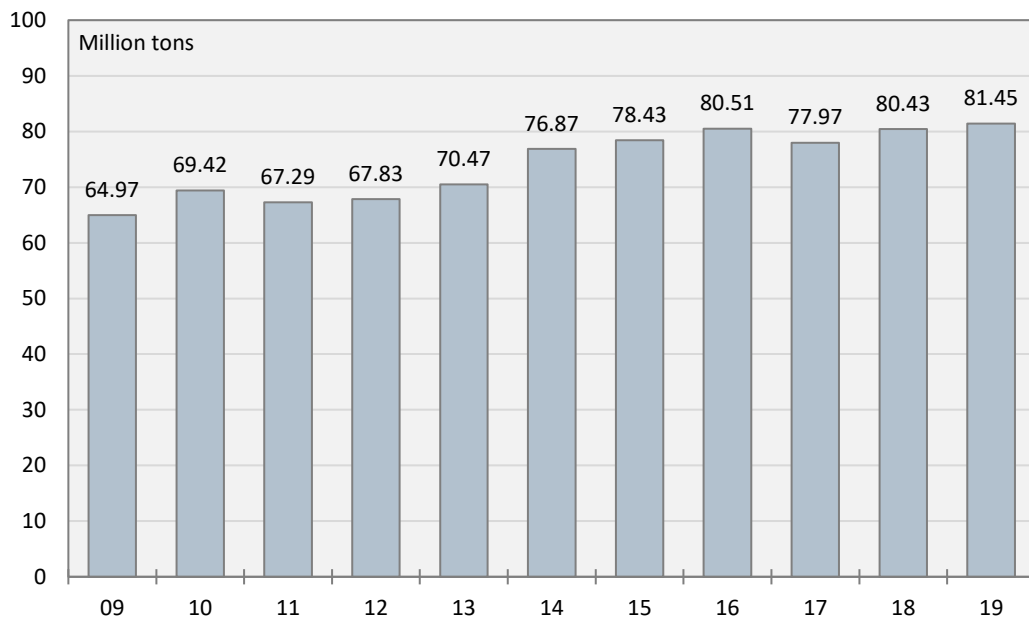
Source: Oklahoma Department of Mines

Changing Production Share. The relative shares of production among the state's aggregates continue to shift over time, reflecting changing market demand. **Figure 3** provides a summary of both production volume and share of total production over the 2009 to 2019 period for the top four aggregates and a fifth group combining the remaining ten aggregates.

Limestone has long served as the state's top aggregate but dropped from a 60% share of total production in 2016 to only 52% in 2017 and has remained at the same approximate level through 2019.

Sand and gravel continue as a distant second in production to limestone. Sand and gravel production increased sharply by volume in 2018 and 2019 to all-time highs but remains within the historical range of 20-24% of total production maintained since 2013.

Granite only recently moved ahead of gypsum as the third ranked aggregate, with granite's share of production nearly doubling in 2017 to 11.5%. Granite's share has increased slowly since 2017, reaching 11.8% in 2019. Granite production has assumed much of the former share held by limestone.

Gypsum currently has a 6.5% share of total state output, near the low end of its range the past decade.

The group of ten remaining smaller aggregates continues to comprise its historical share of approximately 5% of total state production. Large year-to-year shifts have taken place among the remaining individual aggregates, but as a group they exert little influence on total state production.

Shifts among them include a steep upward shift in select fill production beginning in 2012 and a significant downshift in chat production since 2016.

Considerable year-to-year volatility is also present in the production of clay, dimensional stone, and shale.

Salt remains highly steady over time with roughly 150,000 tons produced annually.

Tripoli, caliche, volcanic ash, and dolomite remain very small shares of total state production and have no measurable influence on overall state production.

Figure 3. Oklahoma Aggregate Production Share by Major Group
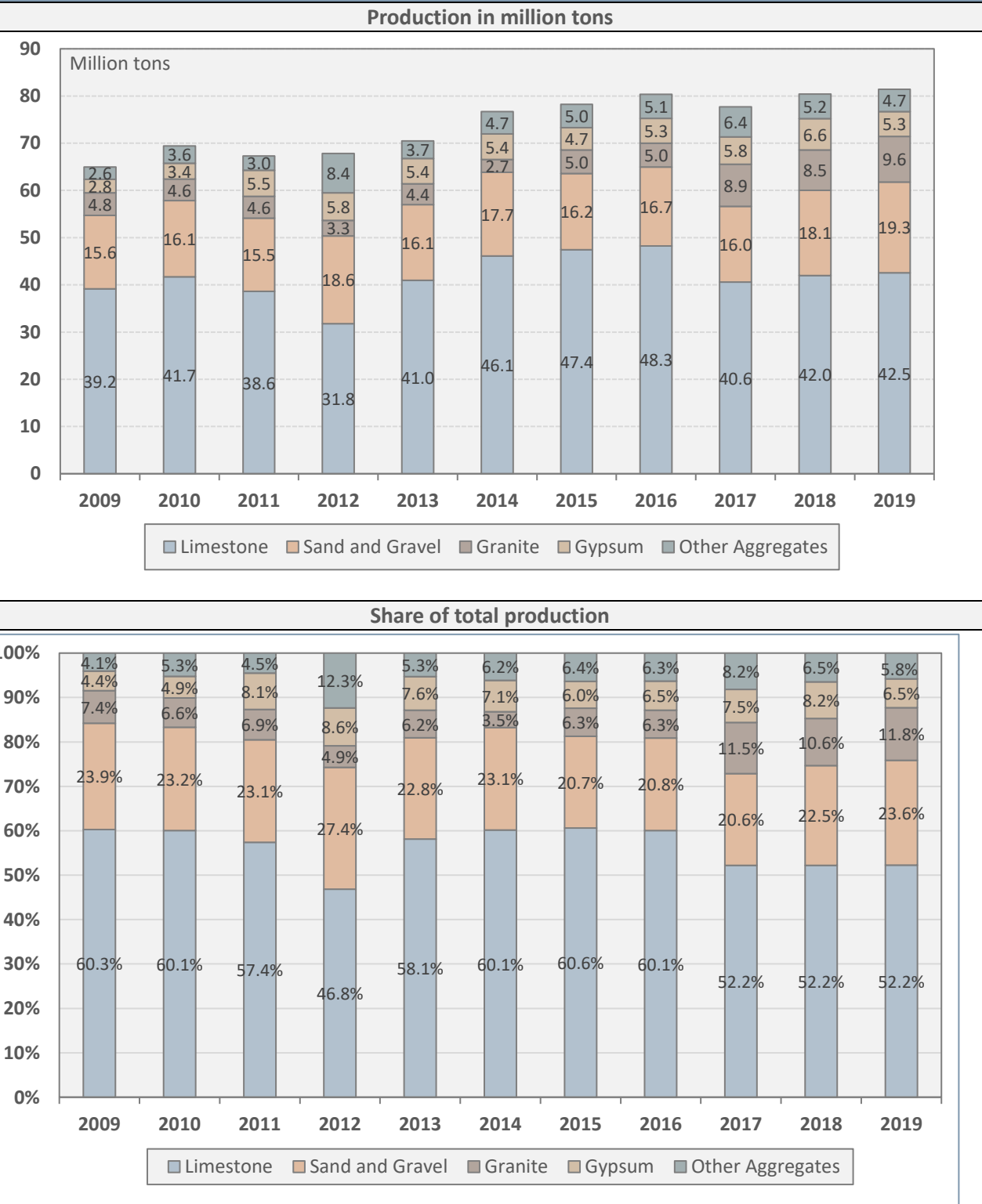
Production in million tons

Share of total production

Source: Oklahoma Department of Mines and RegionTrack calculations

Aggregate Production by Type and County. **Figure 4** provides a breakdown of aggregate production by type within each Oklahoma county in 2019.

The production of aggregate material is widespread across Oklahoma, occurring in 71 of 77 counties. However, production is highly concentrated in the 20 largest producing counties. Each produced more than 1 million tons of aggregate in 2019 and jointly accounted for 66.3 million tons of aggregate, or 81% of total state production.

Most of the major producing counties produce primarily either limestone, sand and gravel, granite, or gypsum, (or a combination of) the four major aggregates produced in Oklahoma.

Johnston (13.9 million tons) and Murray (8.1 million tons) counties are the two largest aggregate producing counties by a substantial margin. Jointly they produced more than one-fourth of total state aggregate output in 2019.

Johnston County is the state's top granite producing county, third largest limestone producer, and second largest producer of sand and gravel. Murray county is the largest limestone producing county, with limestone the only aggregate sourced in the county.

Sand and gravel are extracted in most producing counties for local and regional use, with production occurring in 52 of the state's 77 counties. Again, sand and gravel deposits are widespread across Oklahoma along streams and riverbeds.

Limestone, which comprises half of all state aggregate production, is the second most widely mined aggregate across the state with deposits and production located in 34 counties. However, a group of nine counties produced 79% of total state limestone in 2019.

Production of the remaining aggregates was far more concentrated in a small number of counties in 2019. Select fill was produced in 23 counties, clay in 22 counties, and shale in 14 counties. Dimensional stone was produced in 11 counties scattered across the state, gypsum in 4 counties in west central Oklahoma, granite in 4 counties in western Oklahoma, and caliche in Texas and Ellis counties in and near the Panhandle.

Chat was produced only in Oklahoma County, salt only in Woods County, and tripoli only in Ottawa County.

Metro vs. Non-Metro Production. Aggregate production in Oklahoma is highly concentrated in the non-metropolitan counties of the state. In 2019, 71% of production originated in the state's 58 non-metro counties. The remaining 29% of production occurred in the state's 19 metropolitan area counties.

The Tulsa area is the most significant metro market to produce aggregate materials. The seven Tulsa MSA counties accounted for 12.1 million tons of production in 2019, 15% of total state aggregate output. Limestone is the primary aggregate produced in the Tulsa metro area, with output of 9.4 million tons in 2019, or 22% of statewide limestone production. Tulsa area producers accounted for 2.12 million tons of sand and gravel, 11% of total state output, a reflection of significant construction in the region. The Tulsa region also produced more than half of all shale output statewide in 2019.

Figure 4. Oklahoma Aggregate Production by Type and County (2019)

County	Caliche	Chat	Clay	Dimen. Stone	Granite	Gypsum	Lime-stone	Salt	Sand & Gravel	Select Fill	Shale	Tripoli	Total
Adair	-	-	-	-	-	-	152,076	-	-	37,015	-	-	189,091
Alfalfa	-	-	-	-	-	-	-	-	-	-	-	-	0
Atoka	-	-	-	-	-	-	3,147,523	-	68,486	-	-	-	3,216,009
Beaver	-	-	-	-	-	-	-	-	204,043	-	-	-	204,043
Beckham	-	-	11,520	-	-	-	-	-	63,556	31,785	1,318	-	108,179
Blaine	-	-	-	-	-	2,363,263	-	-	562,275	-	110,563	-	3,036,101
Bryan	-	-	91,723	-	-	-	201,746	-	2,309,621	65,980	-	-	2,669,070
Caddo	-	-	-	-	-	1,151,543	11,365	-	-	4,944	-	-	1,167,852
Canadian	-	-	191,115	-	-	-	-	-	788,488	39,079	27,223	-	1,045,905
Carter	-	-	-	-	-	-	787,229	-	112,948	-	-	-	900,177
Cherokee	-	-	19,069	-	-	-	743,241	-	15	-	-	-	762,325
Choctaw	-	-	-	-	-	-	2,700,099	-	123,684	-	-	-	2,823,783
Cimarron	-	-	-	-	-	-	-	-	262	-	-	-	262
Cleveland	-	-	47,707	-	-	-	-	-	949,557	164,439	-	-	1,161,703
Coal	-	-	-	-	-	-	-	-	-	-	5,298	-	5,298
Comanche	-	-	-	-	-	-	4,462,798	-	195,427	3,462	-	-	4,661,687
Cotton	-	-	-	-	-	-	-	-	408,088	-	-	-	408,088
Craig	-	-	-	-	-	-	286,440	-	-	-	-	-	286,440
Creek	-	-	-	-	-	-	695,636	-	75,880	18,900	72,998	-	863,414
Custer	-	-	-	-	-	-	-	-	-	39,789	-	-	39,789
Delaware	-	-	3,194	-	-	-	-	-	-	5,580	-	-	8,774
Dewey	-	-	-	-	-	-	-	-	1,652,541	-	-	-	1,652,541
Ellis	5,764	-	-	2,292	-	-	-	-	-	-	-	-	8,056
Garfield	-	-	-	-	-	-	-	-	50,714	-	-	-	50,714
Garvin	-	-	-	-	-	-	-	-	4,950	1,953	-	-	6,903
Grady	-	-	-	-	-	-	-	-	871	-	-	-	871
Grant	-	-	-	-	-	-	-	-	-	-	-	-	0
Greer	-	-	35,232	-	448	-	-	-	-	-	-	-	35,680
Harmon	-	-	-	-	-	-	-	-	-	-	-	-	0
Harper	-	-	-	-	-	-	-	-	3,834	-	-	-	3,834
Haskell	-	-	-	181,589	-	-	182,250	-	360,982	15,995	-	-	740,816
Hughes	-	-	-	-	-	-	-	-	3,361	-	-	-	3,361
Jackson	-	-	-	-	-	663,516	-	-	118,513	-	-	-	782,029
Jefferson	-	-	-	-	-	-	-	-	34,500	-	-	-	34,500
Johnston	-	-	-	-	8,010,384	-	3,823,460	-	2,048,967	-	-	-	13,882,811
Kay	-	-	-	-	328,246	-	301,777	-	175,868	-	-	-	805,891
Kingfisher	-	-	367,613	-	-	-	-	-	1,220,004	16,113	59,966	-	1,663,696
Kiowa	-	-	-	-	1,290,031	-	1,894,806	-	-	-	-	-	3,184,837
Latimer	-	-	-	8,561	-	-	-	-	-	82,844	1,872	-	93,277
LeFlore	-	-	7,157	485,324	-	-	54,564	-	280,195	-	19,864	-	847,104
Lincoln	-	-	-	-	-	-	-	-	28,801	16,529	-	-	45,330
Logan	-	-	66,325	-	-	-	-	-	588,915	14,008	-	-	669,248
Love	-	-	351,912	-	-	-	-	-	115,379	2,317	-	-	469,608
McClain	-	-	1,250	-	-	-	-	-	82,293	39,654	-	-	123,197
McCurtain	-	-	-	-	-	-	533,881	-	93,942	-	-	-	627,823
McIntosh	-	-	-	22,270	-	-	93,005	-	41,198	-	7,931	-	164,404
Major	-	-	-	-	-	1,102,010	-	-	42,125	-	-	-	1,144,135
Marshall	-	-	-	-	-	-	1,920	-	161,242	-	-	-	163,162
Mayes	-	-	7,460	-	-	-	1,759,510	-	26,708	-	-	-	1,793,678
Murray	-	-	-	-	-	-	8,062,761	-	-	-	-	-	8,062,761
Muskogee	-	-	135,802	-	-	-	-	-	413,584	-	9,790	-	559,176

Continued

				Dimen.			Lime-		Sand &	Select			
County	**Caliche**	**Chat**	**Clay**	**Stone**	**Granite**	**Gypsum**	**stone**	**Salt**	**Gravel**	**Fill**	**Shale**	**Tripoli**	**Total**
Noble	-	-	-	-	-	-	-	-	-	-	-	-	0
Nowata	-	-	-	107,033	-	-	9,796	-	-	-	-	-	116,829
Okfuskee	-	-	-	-	-	-	-	-	11,916	-	-	-	11,916
Oklahoma	-	142,777	74,035	-	-	-	-	-	1,124,218	162,671	-	-	1,503,701
Okmulgee	-	-	-	-	-	-	-	-	14,587	-	-	-	14,587
Osage	-	-	-	-	-	-	381,624	-	-	-	-	-	381,624
Ottawa	-	-	21,378	-	-	-	451,153	-	-	-	-	50,269	522,800
Pawnee	-	-	-	-	-	-	281,443	-	-	-	-	-	281,443
Payne	-	-	23,330	-	-	-	218,791	-	36,863	-	-	-	278,984
Pittsburg	-	-	-	4,055	-	-	934,718	-	3,795	-	-	-	942,568
Pontotoc	-	-	58,681	187,506	-	-	930,090	-	1,834,146	-	960	-	3,011,383
Pottawatomi	-	-	-	19,506	-	-	-	-	508,139	-	-	-	527,645
Pushmataha	-	-	1,050	-	-	-	37,261	-	-	-	-	-	38,311
Roger Mills	-	-	-	-	-	-	-	-	-	-	-	-	0
Rogers	-	-	17,000	376	-	-	4,841,804	-	-	119,551	-	-	4,978,731
Seminole	-	-	127,342	-	-	-	147,379	-	90,500	-	-	-	365,221
Sequoyah	-	-	1,528	103,381	-	-	784,307	-	12,926	-	30,546	-	932,688
Stephens	-	-	-	-	-	-	-	-	3,930	1,134	-	-	5,064
Texas	482	-	-	-	-	-	-	-	37,666	-	-	-	38,148
Tillman	-	-	-	-	-	-	-	-	105,850	-	-	-	105,850
Tulsa	-	-	-	-	-	-	2,942,707	-	1,033,371	94,112	202,152	-	4,272,342
Wagoner	-	-	-	-	-	-	287,850	-	997,940	42,908	16,349	-	1,345,047
Washington	-	-	-	-	-	-	399,755	-	-	-	-	-	399,755
Washita	-	-	-	-	-	-	-	-	-	-	-	-	0
Woods	-	-	-	-	-	-	-	166,037	-	-	-	-	166,037
Woodward	-	-	-	-	-	-	-	-	27,513	-	-	-	27,513
Total	6,246	142,777	1,661,423	1,121,89	9,629,109	5,280,332	42,544,765	166,037	19,255,177	1,020,762	566,830	50,269	81,445,620
OKC MSA	0	142,777	380,432	0	0	0	0	0	3,563,143	436,380	27,223	0	4,549,955
Tulsa MSA	0	0	17,000	376	0	0	9,431,064	0	2,121,778	275,471	291,499	0	12,137,188
Lawton MSA	0	0	0	0	0	0	4,462,798	0	603,515	3,462	0	0	5,069,775
Small MSAs	0	0	8,685	588,705	0	0	838,871	0	343,835	0	50,410	0	1,830,506
Metro	0	142,777	406,117	589,081	0	0	14,732,733	0	6,632,271	715,313	369,132	0	23,587,424
Non-Metro	6,246	0	1,263,991	1,121,51	9,629,109	5,280,332	28,650,903	166,037	12,916,027	305,449	248,108	50,269	59,637,988

Note: The Oklahoma City MSA includes Canadian, Cleveland, Grady, Lincoln, Logan, McClain, and Oklahoma counties. The Tulsa MSA includes Creek, Okmulgee, Osage, Pawnee, Rogers, Tulsa, and Wagoner counties. The Lawton MSA includes Comanche and Cotton counties. Small metropolitan areas include the Enid, OK MSA and Le Flore and Sequoyah Counties in the Ft. Smith, AR MSA.
Source: Oklahoma Department of Mines and RegionTrack calculations

The Lawton MSA (Comanche and Cotton counties) is the second largest producing metro area market. Comanche County is the third largest limestone producing county in the state, with 4.5 million tons of production in 2019. Limestone represents nearly 90% of the Lawton region's output.

The Oklahoma City region accounted for only 5.6% of total statewide aggregate production in 2019. More than three-fourths of the metro area's production was sand and gravel which reflects general construction activity in the region. Neither limestone nor granite was produced in the Oklahoma City metro area in 2019.

The remaining small metropolitan area counties (Garfield County in the Enid, OK MSA and Le Flore and Sequoyah counties in the Ft. Smith, AR MSA) produced only 2.2% of total state output in 2019.

Concentration of Production by Aggregate. **Figure 5** highlights the largest producing county for each of the twelve aggregates produced in Oklahoma in 2019, as well as the share of total state production held by the leading producing county. The share held by the leading county lends insight into the degree of concentration in production for each aggregate.

Figure 5. Top Producing County by Aggregate Type and Share (2019)				
Aggregate	Leading Producing County	Production in Leading County (tons)	Total State Production (tons)	Share of Total State Production
Caliche	Ellis	5,764	6,246	92.3%
Chat	Oklahoma	142,777	142,777	100.0%
Clay	Kingfisher	367,613	1,661,423	22.1%
Dimensional Stone	LeFlore	485,324	1,121,896	43.3%
Granite	Johnston	8,010,384	9,629,110	83.2%
Gypsum	Blaine	2,363,263	5,280,332	44.8%
Limestone	Murray	8,062,761	42,544,765	19.0%
Salt	Woods	166,037	166,037	100.0%
Sand & Gravel	Bryan	2,309,621	19,255,178	12.0%
Select Fill	Oklahoma	162,671	1,020,763	15.9%
Shale	Tulsa	202,152	566,829	35.7%
Tripoli	Ottawa	50,269	50,269	100.0%

Source: Oklahoma Department of Mines and RegionTrack calculations

Some aggregates are confined to only a single site or relatively few producing locations (e.g., caliche, chat, granite, salt, and tripoli) while production sites for other aggregates are dispersed far more widely across multiple counties (e.g., clay, limestone, sand and gravel, and select fill).

By aggregate in **Figure 5**:

- Ellis County near the Panhandle is the hub of <u>caliche</u> production in the state, with only one other county (Texas) providing a small amount of output in 2019.
- Oklahoma County is the only producing county for <u>chat</u> in 2019.
- Kingfisher County is the largest <u>clay</u> producer but has only a 22% share of this widespread aggregate and shares it with 21 other counties.
- LeFlore County has a 43% share of <u>dimensional stone</u> production but shares the market with ten other counties.
- Johnston County has long served as the largest <u>granite</u>-producing hub in the state, with 83% of total state production. Granite was produced in only three other counties in 2019.
- Blaine County is the leading <u>gypsum</u>-producing county in the state but has only a 45% share of total state production. Three other counties share the remaining production.

- Murray is the largest producing county for <u>limestone</u>, the state's most produced aggregate. However, limestone production is widespread, with Murray accounting for only 19% of total state production and production occurring in 34 total counties.
- Woods County was the sole producing location for <u>salt</u> in 2019.
- <u>Sand and gravel</u> production has the greatest concentration in Bryan County, which has only a 12% share of state production. Sand and gravel is the most widely disbursed aggregate across the state with production occurring in 52 counties.
- <u>Select fill</u> is produced in many markets across the state, with highly populous Oklahoma County having the largest share at 16% of state output. A total of 23 counties produced select fill in 2019.
- Tulsa County has the highest share of <u>shale</u> at 36% of state output but shares the market with 13 other counties.
- Ottawa County is the sole source of <u>tripoli</u> production in 2019, a relatively rare mineral found in northeast Oklahoma.

Aggregate Production by Number of Producing Sites. County-level summary data obscure the large number of individual mining sites that comprise the aggregate industry in Oklahoma. There were 417 individual aggregate producing sites across the state reported to ODOM in 2019. Thirteen of these sites produced two aggregates, for a total of 430 unique combinations of location and aggregate type. No site produced more than two aggregates.

These 430 combinations are detailed in **Figure 6**, with total production of each aggregate categorized by seven production brackets. This breakdown provides a detailed view of the number of sites used to provide each aggregate and the relative size of the producing sites operating in each segment of the industry.

Overall, nearly one-third of all aggregate mining locations in Oklahoma produced sand and gravel (141 sites) in 2019. Dimensional stone (85 sites) production sites accounted for an additional 20% of the state total while limestone production sites (66 sites) comprised another 15%. Jointly, sand and gravel, dimensional stone, and limestone comprised slightly more than two-thirds (292 sites) of all reported mining locations in Oklahoma in 2019.

Smaller numbers of sites produced select fill (45 sites), clay (37 sites), and shale (34 sites). Gypsum was produced at only 10 sites across the state, granite at 6 sites, and caliche at 3 sites in 2019. Only a single location each produced chat, salt, and tripoli.

Aggregate sites in Oklahoma produced an average of 195,300 tons in 2019. Average annual production is highest at granite-producing sites (1.6 million tons each) followed by limestone (644,600 tons each) and gypsum (528,000 tons each). Salt (166,000 tons each), chat (142,800 tons each), and sand and gravel (136,600 tons each) sites each produced an average of more than 100,000 tons annually. All other site-types fell well below 100,000 tons per year.

Although the state has 85 dimensional stone sites, they produced an average of only 13,200 tons of material each in 2019. Three caliche sites each produced an average of only 2,080 tons of material in 2019.

Figure 6. Oklahoma Aggregate Production by Individual Site and Production

Production Range (annual tonnage)	Caliche	Chat	Clay	Dimen. Stone	Granite	Gypsum	Limestone	Salt	Sand & Gravel	Select Fill	Shale	Tripoli	Total
> 1 million tons	0	0	0	0	3	1	13	0	5	0	0	0	22
500,000 to 1,000,000 tons	0	0	0	0	0	4	8	0	6	0	0	0	18
250,000 to 500,000 tons	0	0	2	1	2	3	11	0	13	0	0	0	32
100,000 to 250,000 tons	0	1	3	4	0	1	16	1	20	2	1	0	49
50,000 to 100,000 tons	0	0	3	0	0	0	3	0	19	3	1	1	30
25,000 to 50,000 tons	0	0	4	2	0	1	3	0	16	8	5	0	39
< 25,000 tons	3	0	25	78	1	0	12	0	62	32	27	0	240
All Production Ranges	3	1	37	85	6	10	66	1	141	45	34	1	430
Share of total Production	0.7%	0.2%	8.6%	19.8%	1.4%	2.3%	15.3%	0.2%	32.8%	10.5%	7.9%	0.2%	100.0%
Average Production per Location	2,082	142,777	44,903	13,199	1,604,852	528,033	644,618	166,037	136,562	22,684	16,671	50,269	195,313

Source: Oklahoma Department of Mines and RegionTrack calculations

Aggregate Production by Individual Producers. In 2019, aggregate production was reported by 341 individual business establishments operating statewide. Many small unpermitted mines, quarries, and pits are undoubtedly operated across the state but cannot be tracked and represent only a small share of the total production of the formal aggregate industry.

Only 32 of the 341 firms produced one or more aggregate(s) at more than one site. Accounting for multiple aggregates produced at a single location, 373 unique combinations of producer and aggregate were present in Okahoma in 2019.

Figure 7 summarizes production for the 373 combinations of firms and aggregates produced statewide in 2019, with production partitioned into brackets by total annual volume for each producer.

The findings illustrate an industry that is comprised of a relatively small number of large producing firms and a large number of relatively small firms. Only 20 firms across the state produced more than 1 million tons of aggregate in 2019. More than half (11 firms) of those in the largest bracket of operators produced limestone, while 6 produced sand and gravel, 2 produced granite, and 1 produced gypsum.

An additional 15 firms produced between 500,000 tons and 1 million tons of an aggregate. These include 6 limestone producers, 5 sand and gravel producers, and 3 gypsum operations. Again, this mix of operation types closely reflects the overall composition of aggregate production in Oklahoma.

Nineteen firms produced between 250,000 and 500,000 tons in 2019, with 10 firms producing sand and gravel, 4 limestone, 3 clay, 1 gypsum, and 1 dimensional stone. These firms are all less than half the size of the top 20 firms producing more than 1 million tons of aggregate.

A reported 39 firms produced between 100,000 and 250,000 tons of aggregate in 2019. Nearly all types of aggregate were produced by these smaller producing firms. A similar mix of firm size and production type is present for both the 27 firms producing between 50,000 and 100,000 tons and the 35 firms producing between 25,000 and 50,000 tons in 2019.

By number, most aggregate producing firms are quite small. More than half (218 of 373 firms) extracted less than 25,000 tons of aggregate in 2019. And more than half of these operations were concentrated in the production of only two types of aggregate – sand and gravel (133 firms) and dimensional stone (64 firms). Relatively large numbers of small producers are also found in the production of select fill (48 firms), clay (34 firms), and shale (33 firms).

Overall, the state's largest aggregate producers are dominant in granite, gypsum, limestone, and sand and gravel. Mid-size producers account for most of the production of clay, dimensional stone, salt, and chat. Small producers account for most of the production of caliche, select fill, shale, and tripoli.

Figure 7. Oklahoma Aggregate Production by Aggregate Type and Annual Volume (2019)

(a) Number of Producing Firms

Production Range	Caliche	Chat	Clay	Dimen. Stone	Granite	Gypsum	Limestone	Salt	Sand & Gravel	Select Fill	Shale	Tripoli	Total
> 1 million tons	0	0	0	0	2	1	11	0	6	0	0	0	20
500,000 to 1,000,000 tons	0	0	0	0	1	3	6	0	5	0	0	0	15
250,000 to 500,000 tons	0	0	3	1	0	1	4	0	10	0	0	0	19
100,000 to 250,000 tons	0	1	2	4	0	0	9	1	19	2	1	0	39
50,000 to 100,000 tons	0	0	2	0	0	0	3	0	17	3	1	1	27
25,000 to 50,000 tons	0	0	3	3	0	0	2	0	15	8	4	0	35
< 25,000 tons	3	0	24	56	1	0	11	0	61	35	27	0	218
Total Firms by Aggregate	3	1	34	64	4	5	46	1	133	48	33	1	373
Share of Total Firms	0.8%	0.3%	9.1%	17.2%	1.1%	1.3%	12.3%	0.3%	35.7%	12.9%	8.8%	0.3%	100.0%

(b) Production by Tonnage

Production Range	Caliche	Chat	Clay	Dime. Stone	Granite	Gypsum	Limestone	Salt	Sand & Gravel	Select Fill	Shale	Tripoli	Total
> 1 million tons	0	0	0	0	9,026,655	2,553,967	34,782,531	0	7,888,594	0	0	0	56,449,066
500,000 to 1,000,000 tons	0	0	0	0	602,006	2,461,275	4,273,934	0	2,801,541	0	0	0	9,447,676
250,000 to 500,000 tons	0	0	1,033,887	282,230	0	265,090	1,568,461	0	3,480,089	0	0	0	5,850,395
100,000 to 250,000 tons	0	142,777	244,527	518,674	0	0	1,517,349	166,037	2,740,789	234,828	166,469	0	5,278,406
50,000 to 100,000 tons	0	0	143,049	0	0	0	255,036	0	1,269,081	228,766	55,949	50,269	1,813,536
25,000 to 50,000 tons	0	0	103,232	110,760	0	0	84,518	0	553,029	276,688	182,028	0	1,311,583
< 25,000 tons	6,246	0	136,728	210,229	448	0	62,936	0	522,054	280,480	162,384	0	1,294,958
Production by Aggregate	6,246	142,777	1,661,423	1,121,893	9,629,109	5,280,332	42,544,765	166,037	19,255,177	1,020,762	566,830	50,269	81,445,620
Share of Total Production	0.0%	0.2%	2.0%	1.4%	11.8%	6.5%	52.2%	0.2%	23.6%	1.3%	0.7%	0.1%	100.0%

(c) Share of Production by Type

Production Range	Caliche	Chat	Clay	Dime. Stone	Granite	Gypsum	Limestone	Salt	Sand & Gravel	Select Fill	Shale	Tripoli	Total
> 1 million tons	0.0%	0.0%	0.0%	0.0%	93.7%	48.4%	81.8%	0.0%	41.0%	0.0%	0.0%	0.0%	69.3%
500,000 to 1,000,000 tons	0.0%	0.0%	0.0%	0.0%	6.3%	46.6%	10.0%	0.0%	14.5%	0.0%	0.0%	0.0%	11.6%
250,000 to 500,000 tons	0.0%	0.0%	62.2%	25.2%	0.0%	5.0%	3.7%	0.0%	18.1%	0.0%	0.0%	0.0%	7.2%
100,000 to 250,000 tons	0.0%	100.0%	14.7%	46.2%	0.0%	0.0%	3.6%	100.0%	14.2%	23.0%	29.4%	0.0%	6.5%
50,000 to 100,000 tons	0.0%	0.0%	8.6%	0.0%	0.0%	0.0%	0.6%	0.0%	6.6%	22.4%	9.9%	100.0%	2.2%
25,000 to 50,000 tons	0.0%	0.0%	6.2%	9.9%	0.0%	0.0%	0.2%	0.0%	2.9%	27.1%	32.1%	0.0%	1.6%
< 25,000 tons	100.0%	0.0%	8.2%	18.7%	0.0%	0.0%	0.1%	0.0%	2.7%	27.5%	28.6%	0.0%	1.6%
Share of Aggregate Production	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Oklahoma Department of Mines and RegionTrack calculations

Largest Aggregate Producers. The 50 largest individual producers of aggregate by total tonnage in Oklahoma in 2019 are detailed in **Figure 8**. Total state aggregate production is highly concentrated among the top 50 producers who jointly accounted for more than 90% of total state output. The companies ranked among the top 50 will vary over time given changes in permit ownership and operating arrangements. It is not uncommon for one company to own the permit for a property but have a separate agreement with another company to mine the property.

The state's two largest producers in 2019 were Dolese Bros. Co. (15.9 million tons, 20.6%) and Martin Marietta (13.8 million tons, 17.0%) with a combined 38% of total state output.

The top four produces accounted for almost half (48.4%) of all state aggregate production in 2019.

Two additional firms produced more than 5% of total state output in 2019 – Sherwood Companies (4.5 million tons, 5.5%) and Vulcan Materials (4.3 million tons, 5.3%).

Other major producers with more than 2% of total state production include CRH (3.1 million tons, 3.8%), LafargeHolcim (2.7 million tons, 3.3%), ACG Arcosa (2.6 million tons, 3.1%), Anchor Stone Co. (2.3 million tons, 2.8%), Kemp Quarries (1.85 million tons, 2.3%), U.S. Silica (1.65 million tons, 2.0%), and SCS Materials (1.6 million tons, 2.0%).

The top 10 producers accounted for almost two-thirds (65.7%) of state production. The top 25 producers accounted for more than 80% (81.8%) of state production.

Number of Producing Sites Operated by Top Producers. Many aggregate producers across Oklahoma operate multiple mines, quarries, and pits. **Figure 8** also provides a count of the number of sites operated and total production for each of the 50 largest aggregate producing firms in Oklahoma in 2019 as reported by ODOM.

Dolese Bros. Co. operated the most aggregate producing sites in the state in 2019 with 16 individual locations. Other major multi-site operaters include CRH (12 sites), Martin Marietta (9 sites), and ACG Arcosa (5 sites). Two firms in the top 50 operated 4 sites, while 13 producers operated either two or three sites. The remaining 31 firms in the top 50 operated only a single site.

	Figure 8. 50 Largest Aggregate Producers in Oklahoma					
Rank	**Aggregate Producer**	**Number of Sites**	**Production (tons)**	**Share of State Total**	**Cumulative Production**	**Cumulative Share**
1	Dolese Bros.	16	16,783,759	20.6%	16,783,759	20.6%
2	Martin Marietta	9	13,857,621	17.0%	30,641,380	37.6%
3	Sherwood Companies	2	4,485,730	5.5%	35,127,110	43.1%
4	Vulcan Materials	3	4,320,953	5.3%	39,448,063	48.4%
5	CRH	12	3,085,999	3.8%	42,534,062	52.2%
6	LafargeHolcim	3	2,682,608	3.3%	45,216,670	55.5%
7	ACG Arcosa	5	2,553,967	3.1%	47,770,637	58.7%
8	Anchor Stone Co.	3	2,255,395	2.8%	50,026,032	61.4%
9	Kemp Quarries	4	1,846,448	2.3%	51,872,480	63.7%
10	U. S. Silica	1	1,653,331	2.0%	53,525,811	65.7%
11	SCS Materials, L.P.	1	1,594,503	2.0%	55,120,314	67.7%
12	Lehigh Hanson	1	1,489,585	1.8%	56,609,899	69.5%
13	Alan Ritchey Materials	1	1,165,243	1.4%	57,775,142	70.9%
14	Unimin Corp. Roff Plant	1	1,159,286	1.4%	58,934,428	72.4%
15	Foxrock Ranch, LLC	1	1,033,356	1.3%	59,967,784	73.6%
16	Hoskins Gypsum Co, LLC	1	999,800	1.2%	60,967,584	74.9%
17	Tulsa Cement, LLC	1	860,114	1.1%	61,827,698	75.9%
18	U. S. Gypsum	2	797,959	1.0%	62,625,657	76.9%
19	American Gypsum Co., LLC	1	663,516	0.8%	63,289,173	77.7%
20	Lone Star Industries	1	575,162	0.7%	63,864,335	78.4%
21	Black Mountain Sand Midcon, LLC	1	562,275	0.7%	64,426,610	79.1%
22	FML Sand, LLC	1	560,536	0.7%	64,987,146	79.8%
23	Stigler Stone	2	543,232	0.7%	65,530,378	80.5%
24	Western Aggregates, LLC	1	531,911	0.7%	66,062,289	81.1%
25	Jennings Stone Co.	1	524,771	0.6%	66,587,060	81.8%
26	General Materials (MacArthur Pit)	1	492,046	0.6%	67,079,106	82.4%
27	U. S. Lime Co.	1	481,010	0.6%	67,560,116	83.0%
28	Quality Rock, Inc.	1	385,744	0.5%	67,945,860	83.4%
29	Duit Construction Co., Inc.	1	367,613	0.5%	68,313,473	83.9%
30	J & J Land (Quarry Ranch #3)	1	355,654	0.4%	68,669,127	84.3%
31	Stewart Stone	2	346,053	0.4%	69,015,180	84.7%
32	Lightle Sand & Construction, LLC	1	333,838	0.4%	69,349,018	85.1%
33	Fittstone, Inc.	2	322,201	0.4%	69,671,219	85.5%
34	Van Eaton	1	319,952	0.4%	69,991,171	85.9%
35	Watkins Sand	1	316,911	0.4%	70,308,082	86.3%
36	Meridian Brick, LLC	2	314,362	0.4%	70,622,444	86.7%
37	Muskogee Sand	2	303,900	0.4%	70,926,344	87.1%
38	Williams Family Investments, LLC	1	293,942	0.4%	71,220,286	87.4%
39	Williams Gypsum, LLC	1	265,090	0.3%	71,485,376	87.8%
40	River Valley Materials, LLC	1	261,761	0.3%	71,747,137	88.1%
41	Souter Limestone & Minerals, LLC	1	226,653	0.3%	71,973,790	88.4%
42	Oklahoma Aztec Co., Inc.	2	226,606	0.3%	72,200,396	88.6%
43	General Materials	1	216,294	0.3%	72,416,690	88.9%
44	Mobile Crushing, Inc.	1	201,746	0.2%	72,618,436	89.2%
45	J&R Sand Co.	2	198,251	0.2%	72,816,687	89.4%
46	Mill Creek Dolomite LLC	1	192,825	0.2%	73,009,512	89.6%
47	Sober Brothers	1	175,868	0.2%	73,185,380	89.9%
48	Vickers Sand & Gravel, Inc.	4	175,275	0.2%	73,360,655	90.1%
49	FG Minerals	1	170,538	0.2%	73,531,193	90.3%
50	Excavation Resources, LLC	2	166,469	0.2%	73,697,662	90.5%

Source: Oklahoma Department of Mines and RegionTrack calculations

Aggregate Production by Producing Sites. Some of the individual producing sites across the state are quite large and account for a significant share of total state aggregate production. **Figure 9** details the 50 largest individual operating sites in Oklahoma by operator, county, type of aggregate, and amount of production.

The top 50 producing sites accounted for 76.5% of total state output in 2019, or 62.3 million tons of production. As a share of total state production of each aggregate, the 50 largest sites accounted for 94% of granite, 87% of limestone, 80% of gypsum, 60% of sand and gravel, and 22% of clay. No other aggregate materials were produced at the 50 largest sites.

The largest single producing location in Oklahoma is the Martin Marietta granite mine in Johnston County. The facility produced 5.3 million tons of granite in 2019, 55% of state granite output and 6.5% of total state aggregate output.

Twenty-one additional sites produced more than 1 million tons of aggregate in 2019. These include 13 limestone quarries, 5 sand and gravel pits, 2 additional granite mines, and a large gypsum operation.

The largest operations are not highly concentrated in any single region of the state, with the top 50 producing locations spread across 31 counties. However, several of the major producing counties are home to multiple large producing sites including Johnston (4), Blaine (3), Kiowa (3), Murray (3), Pontotoc (3), Tulsa (3), Atoka (2), Bryan (2), Choctaw (2), Dewey (2), Kingfisher (2), Mayes (2), and Rogers (2).

Rank	Producer (Location)	County	Clay	Granite	Gypsum	Limestone	Sand & Gravel	Total
	Figure 9. Top 50 Aggregate Producing Locations in Oklahoma – Annual Tonnage (2019)							
1	Martin Marietta (Mill Creek)	Johnston	-	5,309,129	-	-	-	5,309,129
2	Dolese Bros. (Richards Spur)	Comanche	-	-	-	4,462,798	-	4,462,798
3	Dolese Bros. (Davis)	Murray	-	-	-	4,186,525	-	4,186,525
4	Vulcan Construction Materials, LLC	Johnston	-	-	-	3,630,635	-	3,630,635
5	Sherwood Companies	Rogers	-	-	-	2,923,029	-	2,923,029
6	Martin Marietta (Quarry 900)	Johnston	-	2,701,255	-	-	-	2,701,255
7	Martin Marietta	Murray	-	-	-	2,386,651	-	2,386,651
8	U.S. Silica (#39)	Johnston	-	-	-	-	1,653,331	1,653,331
9	Anchor Stone Co. (Tulsa Rock Plant #2)	Rogers	-	-	-	1,614,839	-	1,614,839
10	Dolese Bros. (Coleman)	Atoka	-	-	-	1,611,657	-	1,611,657
11	SCS Materials, L.P.	Choctaw	-	-	-	1,594,503	-	1,594,503
12	Sherwood Companies	Tulsa	-	-	-	1,562,701	-	1,562,701
13	LafargeHolcim	Atoka	-	-	-	1,535,866	-	1,535,866
14	Lehigh Hanson	Murray	-	-	-	1,489,585	-	1,489,585
15	Dolese Bros. (Cooperton)	Kiowa	-	-	-	1,362,895	-	1,362,895
16	Kemp Quarries	Mayes	-	-	-	1,182,474	-	1,182,474
17	Alan Ritchey Materials	Bryan	-	-	-	-	1,165,243	1,165,243
18	Unimin Corp. Roff Plant	Pontotoc	-	-	-	-	1,159,286	1,159,286
19	ACG Arcosa	Major	-	-	1,102,010	-	-	1,102,010
20	Martin Marietta (Wade Sand)	Bryan	-	-	-	-	1,100,526	1,100,526
21	Foxrock Ranch, LLC	Dewey	-	-	-	-	1,033,356	1,033,356
22	Martin Marietta (Snyder)	Kiowa	-	1,016,271	-	-	-	1,016,271
23	Hoskins Gypsum Co, LLC	Blaine	-	-	999,800	-	-	999,800
24	Dolese Bros. (Hartshorne)	Pittsburg	-	-	-	924,655	-	924,655
25	Tulsa Cement, LLC	Tulsa	-	-	-	860,114	-	860,114
26	Martin Marietta (Sawyer-Apple)	Choctaw	-	-	-	803,090	-	803,090
27	LafargeHolcim	Pontotoc	-	-	-	794,830	-	794,830
28	Dolese Bros. (Ardmore)	Carter	-	-	-	787,229	-	787,229
29	ACG Arcosa (#5)	Caddo	-	-	763,278	-	-	763,278
30	Dolese Bros. (Badger Pit)	Creek	-	-	-	695,636	-	695,636
31	U.S. Gypsum	Blaine	-	-	682,890	-	-	682,890
32	American Gypsum Co., LLC	Jackson	-	-	663,516	-	-	663,516
33	Lone Star Industries	Mayes	-	-	-	575,162	-	575,162
34	Dolese Bros. (Guthrie)	Logan	-	-	-	-	570,760	570,760
35	Dolese Bros. (East Sand Plant)	Oklahoma	-	-	-	-	569,709	569,709
36	Black Mountain Sand Midcon, LLC	Blaine	-	-	-	-	562,275	562,275
37	FML Sand, LLC	Dewey	-	-	-	-	560,536	560,536
38	Western Aggregates, LLC	Kiowa	-	-	-	531,911	-	531,911
39	Jennings Stone Co. (Pontotoc Sands Co., LLC)	Pontotoc	-	-	-	-	524,771	524,771
40	Dolese Bros. (Dover)	Kingfisher	-	-	-	-	519,248	519,248
41	General Materials (MacArthur Pit)	Cleveland	-	-	-	-	492,046	492,046
42	U.S. Lime Co.	Sequoyah	-	-	-	481,010	-	481,010
43	CRH (Wagoner Plant #17)	Wagoner	-	-	-	-	425,027	425,027
44	CRH (Roberts Quarry)	Cherokee	-	-	-	412,041	-	412,041
45	Vulcan Materials (Waurika Plant)	Cotton	-	-	-	-	408,088	408,088
46	CRH (East Quarry Main)	Tulsa	-	-	-	393,158	-	393,158
47	CRH (Muskogee Sand)	Muskogee	-	-	-	-	388,669	388,669
48	Quality Rock, Inc.	McCurtain	-	-	-	385,744	-	385,744
49	Duit Construction Co., Inc. (Young Sand)	Kingfisher	367,613	-	-	-	-	367,613
50	Stigler Stone (Tiger)	Haskell	-	-	-	-	360,982	360,982
	Total - Top 50 Producing Locations		367,613	9,026,655	4,211,494	37,188,738	11,493,853	62,288,353
	State Total		1,661,423	9,629,109	5,280,332	42,544,765	19,255,177	81,445,620
	Top 50 Share of State Total		22.1%	93.7%	79.8%	87.4%	59.7%	76.5%

Notes: The top 50 aggregate producing locations in Oklahoma produce no tonnage of caliche, chat, dimensional stone, salt, select fill, shale, or
Source: Oklahoma Department of Mines

III. Economic Contribution of the Oklahoma Aggregate Industry

This section of the report evaluates the direct economic contribution of the Oklahoma aggregate industry. A range of federal economic databases are used to prepare an economic profile of the industry in 2020. Historical data on industry trends in the 2001 to 2020 period are evaluated as well. Economic measures include industry revenue, number of business establishments, employment, and employee compensation. The contributions of both employer and nonemployer firms operating in the industry are discussed.

Measuring the Industry's Economic Contribution

An economic profile of the aggregate industry is prepared at the state and local levels. Economic data is collected from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) survey, the Census Bureau's County Business Patterns database, Census Bureau's Economic Census, and the Department of Labor's Mine Safety and Health Administration databases. Estimates are made for some county-level data in federal databases when undisclosed for confidentiality purposes.[14]

Geography. The economic role of the aggregate industry is first examined from a statewide perspective to capture the full extent of the industry. County-level data is then used to capture a local perspective more consistent with the dispersed structure of the industry across the state. Activity is also partitioned to reflect activity in the state's metropolitan and nonmetropolitan areas.

NAICS Sectors. The economic measures of aggregate industry activity are prepared using the nine NAICS industry sectors reflecting mining activity and two sectors capturing wholesale trade activity discussed earlier in the report. Again, these sectors are believed to capture the great majority of aggregate industry activity without including excess business activity not directly related to the industry.

Employers and Nonemployers. The data further capture the influence of both traditional employers and the large number of nonemployers operating in the industry.[15] Employers are traditional business establishments that have wage and salary employees beyond the owners of the firm. In contrast, nonemployers are business entities that have no regular wage and salary employees but produce and distribute income to the owner(s). They are most often sole proprietorships operated by a self-employed individual, but a portion are partnerships and corporations where the owner is not an employee and has no other employees.

Nonemployers constitute nearly three-quarters of all businesses in the U.S., but they contribute less than four percent of overall sales and receipts. For nonemployers, each distinct business income tax return filed is counted as an establishment. There are typically a high number of nonemployers in the mining-related sectors in most states.

Detailed data at the 6-digit level are not available for nonemployers. Estimates for the aggregate industry must be formed using data at the 4-digit level. Nonemployer estimates are produced using NAICS 2123 (Nonmetallic Mineral Mining and Quarrying) which captures eight of the nine NAICS codes used to define the mining-related portion of the industry. Because detailed data at the 6-digit level for the wholesale

trade sectors are not available, they are excluded. While this understates the full amount of nonemployer activity in the aggregate sector, the estimate is believed to capture at least 80% of the total.

Economic Summary of the Oklahoma Aggregate Industry

Figure 10 provides a summary profile of the overall size of Oklahoma's aggregate industry in 2020. Estimates suggest that the industry was comprised of 293 total business establishments, including 174 employers with wage and salary employees and 119 nonemployer firms.

The 293 establishments produced an estimated $719 million in total output, or receipts. Employer firms produced more than 98% of total industry receipts. The average employer establishment generated $4.1 million in annual receipts, far larger than the $98,970 generated by nonemployer firms on average.

The aggregate industry employed nearly 2,400 wage and salary workers earning a total of $179 million in compensation in 2020. Average compensation for wage and salary workers reached $74,675 in 2020, about 20% above statewide average compensation of $62,523 across all industries.

Figure 10. Oklahoma Aggregate Industry Economic Summary (2020)	
Industry Output (Receipts)	
Employers	**$706.9 million**
Nonemployers	**$11.8 million**
Total Output (Receipts)	**$718.7 million**
Business Establishments	
Employers	174
Nonemployers	119
Total Business Establishments	293
Wage and Salary Employment	2,392
Total Employee Compensation	$178.6 million
Average Compensation per Wage & Salary Worker	$74,675
Output (Receipts) per Wage & Salary Worker	$295,520
Output (Receipts) per Nonemployer	$98,970
Output (Receipts) per Employer Establishment	$4,060,129

Note: The aggregate industry is defined using NAICS sectors 212311, 212312, 212313, 212319, 212321, 212322, 212325, 212399, 213115, 423320 (25%), 423520 (85%).
Source: Bureau of Labor Statistics – Quarterly Census of Employment and Wages (QCEW), Census Bureau – County Business Patterns, and U.S. Department of Labor – Mine Safety and Health Administration, and RegionTrack estimates.

The 119 nonemployers operating in the industry comprised 43% of all aggregate industry establishments but contributed only about 1.6% of total output by the industry. These firms reflect the large number of very small aggregate producers across the state operating small mines and quarries.

Capturing the Full Industry. It is important to note that the 293 business establishments identified in federal economic databases using the eleven NAICS sectors is less than the 341 firms reported by ODOM as producing aggregate material in Oklahoma in 2019. The difference is largely attributable to both industry and regional misclassification as discussed earlier in the report. These factors are believed to be especially prevalent among the large number of relatively small aggregate producers in the state. There are approximately 150 firms in the state that produced less than 10,000 tons of aggregate in 2019. Many of these very small producers engage in other business lines as their primary activity. They are frequently classified in federal databases as operating in the construction, landscape, architectural, building materials, and other sectors related to aggregate production and use.

Because of these known classification issues, our estimates likely understate the full amount of economic activity tied to aggregate production and provide more of a lower bound for the size of the industry in Oklahoma. The estimates in **Figure 10** are best viewed as describing those firms that are *primarily* engaged in the business activities captured by the eleven NAICS sectors used throughout the report.

Economic Profile by NAICS Sector. **Figure 11** provides a detailed overview of the economic size of the aggregate industy by NAICS sector. Because detailed data at the 6-digit level are not available for nonemployers, the estimates in this section include only traditional employer firms operating in the industry.

By number of firms, more than 80% of all aggregate-producing establishments are classified in one of four NAICS sectors: sand and gravel (45 establishments), limestone (33 establishments), other stone (29 establishments), and dimension stone (23 establishments).

Only one small firm is reported as operating primarily in the granite mining sector. However, four firms reported granite production to ODOM in 2019, including large granite operations in Johnston County. This suggests important misclassification of the granite mining operations in Johnston County in federal economic databases.

Employment and compensation are similar concentrated in the same four NAICS sectors, with 1,811 (76%) of the 2,392 jobs and $130.9 million (73%) of $178.6 million in total compensation paid across all sectors in 2020.

Output produced per worker in the industry averaged approximatley $293,000 in 2020 but varies greatly across the nine sectors. The highest output per worker is found in industrial sand mining ($376,163), limestone ($337,623), minerals-wholesale ($333,223), other nonmetallic mining ($332,351), and construction sand and gravel ($296,046). Far lower average output levels are reported in granite ($101,798), clay and ceramic minerals ($122,480), and dimension stone ($180,307).

Average compensation by sector closely tracks output per worker. Higher than industry average compensation is found in minerals-wholesale ($107,839), support activities ($88,143), industrial sand mining ($86,474), other nonmetallic mining ($82,265), and limestone ($81,749). Far lower compensation is found in granite ($37,703), clay and ceramic minerals ($42,089), and dimension stone ($52,263). The earlier note on the misclassifiction of granite operations in Johnston county likely underlies the low average compensation reported in the granite sector.

Figure 11. Economic Profile of the Oklahoma Aggregate Industry by Sector							
Aggregate Industry - NAICS Sector	Establish-ments	Employ-ment	Total Employee Compen-sation	Industry Output (Revenue)	Average Compen-sation per Worker	Average Output per Worker	Output per Establish-ment
212311 - Dimension Stone Mining and Quarrying	23	294	$15,365,252	$54,700,297	$52,263	$180,307	2,378,274
212312 - Crushed and Broken Limestone Mining and Quarrying	33	751	61,393,430	253,554,867	81,749	337,623	7,683,481
212313 - Crushed and Broken Granite Mining and Quarrying	1	10	377,029	1,017,979	37,703	101,798	1,017,979
212319 - Other Crushed and Broken Stone Mining and Quarrying	29	253	16,787,627	63,289,354	66,354	250,156	2,182,392
212321 - Construction Sand and Gravel Mining	45	513	37,406,804	151,871,626	72,918	296,046	3,374,925
212322 - Industrial Sand Mining	8	154	13,317,022	57,929,045	86,474	376,163	7,241,131
212325 - Clay and Ceramic and Refractory Minerals Mining	2	5	210,446	629,233	42,089	122,480	314,617
212399 - All Other Nonmetallic Mineral Mining	9	188	15,465,845	62,482,013	82,265	332,351	6,942,446
213115 - Support Activities for Nonmetallic Minerals (except Fuels) Mining	8	123	10,841,630	36,438,718	88,143	273,244	4,554,840
423320 - Brick, Stone, and Related Construction Material Merchant Wholesalers	11	91	6,354,371	21,414,231	70,021	209,362	1,946,748
423520 - Coal and Other Mineral and Ore Merchant Wholesalers	5	10	1,099,958	3,541,864	107,839	333,223	694,483
All Aggregate Industry Sectors	**174**	**2,392**	**$178,619,415**	**$706,869,228**	**$74,675**	**$292,554**	**$4,060,133**

Note: Only 25% of NAICS 423320 and 85% of NAICS 423530 are included as components of the aggregate industry.
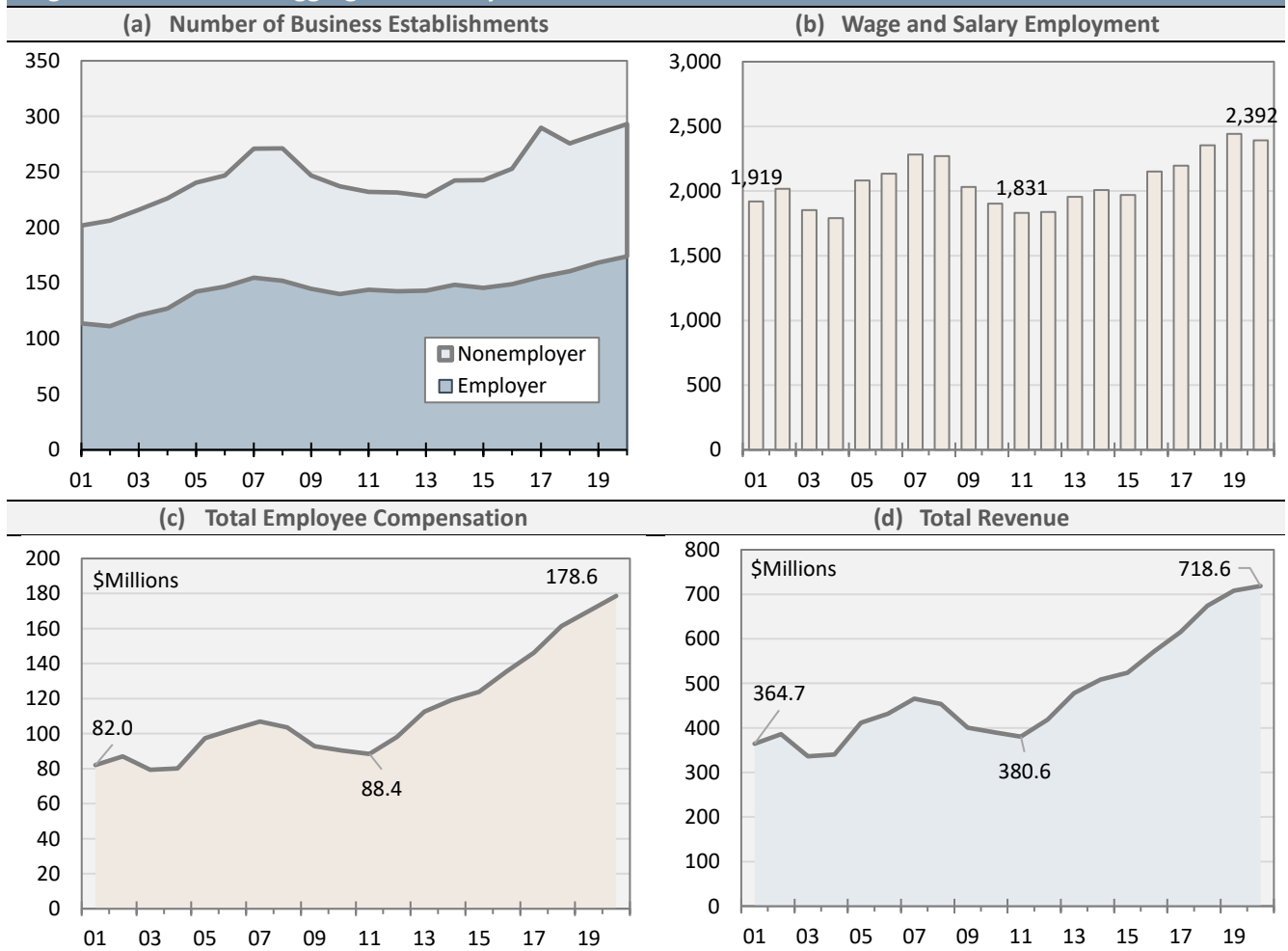Source: Bureau of Labor Statistics – Quarterly Census of Employment and Wages (QCEW), Census Bureau – County Business Patterns, and U.S. Department of Labor – Mine Safety and Health Administration.

Economic Trends in the Oklahoma Aggregate Industry

Figure 12 provides an overview of historical trends in business establishments, employment, compensation, and revenue for the aggregate industry in the 2001 to 2020 period. These measures reflect only employer firms operating within the industry.

Major Industry Trends. The industry posted significant growth in each of the past two decades, but with significant volatility in both periods. From 2001 to 2010, the industry experienced net growth over the full period but was hampered by the national recession during the 2008-10 Great Recession period. Strong growth through 2007 was followed by sharp contraction from 2008 to 2010. Across the 2010 to 2020 period, the industry again posted solid net growth on most measures despite some volatility. Industry weakness surfaced in 2015 as the state underwent an oil and gas-driven state-level recession and again in 2020 during the recent national recession and Covid 19 pandemic.

Figure 12. Oklahoma Aggregate Industry – Economic Profile

Source: Bureau of Labor Statistics – Quarterly Census of Employment and Wages (QCEW), Census Bureau – County Business Patterns, and U.S. Department of Labor – Mine Safety and Health Administration.

Business Establishments and Revenue. Business formation was steady across the most recent decade from 2010 and 2020 (**Figure 12a**). The aggregate industry added 34 employer establishments (24% increase) and 22 nonemployer establishments (23% increase). Employer businesses were added in nine of the eleven NAICS sectors comprising the industry. The weakest performance measured by establishment growth was a small reduction in the number of both granite mining and construction materials-wholesale companies.

Total revenue from aggregate production reached an estimated $718.6 million in 2020, 84% above 2010 revenue (**Figure 12d**). Annual revenue growth averaged 6.3% over the decade and was especially strong from 2012 to 2019, posting an 8% average gain. Industry revenue was down slightly in 2020, reflecting both the state economic slowdown from Covid 19 and ongoing retrenchment in the oil and gas industry.

Employment and Compensation. Employment in the aggregate industry has closely tracked the rising number of business establishments the past decade (**Figure 12b**). The industry added 490 new workers the past decade, a 26% increase.

Total employee compensation increased at a far faster pace than employment the past decade (**Figure 12c**), almost doubling (98% increase) in the period. The sharp acceleration in compensation growth the past decade pushed average compensation per worker up by 57% (from $47,487 to $74,675) between 2010 and 2020. This gain was roughly double the 29% gain (from $48,515 to $62,523) in overall state wages in the period.

Aggregate Industry vs. State Average Compensation. Compensation per worker in the aggregate industry has historically exceeded the state average (**Figure 13**). However, the sharp slowdown in the aggregate industry in the 2008 to 2010 recessionary period weighed heavily on aggregate industry compensation and opened up a slight wage gap relative to the state. Compensation in the aggregate sector has since returned to well above statewide average compensation since 2012, with the gap widening to almost 20% in 2020 ($74,675 vs. $62,523).

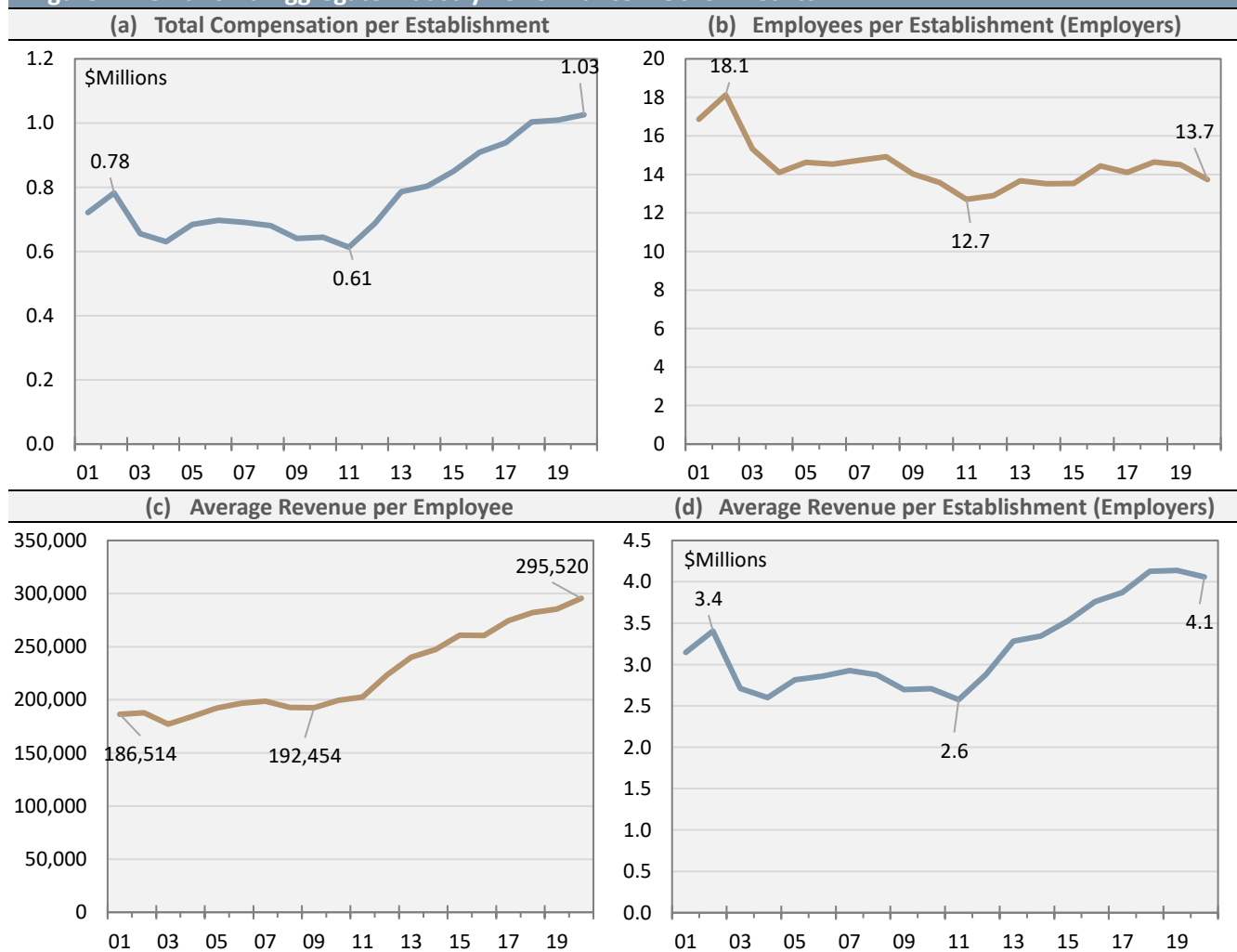**Figure 13. Average Compensation per Worker – Aggregate Industry vs. State**
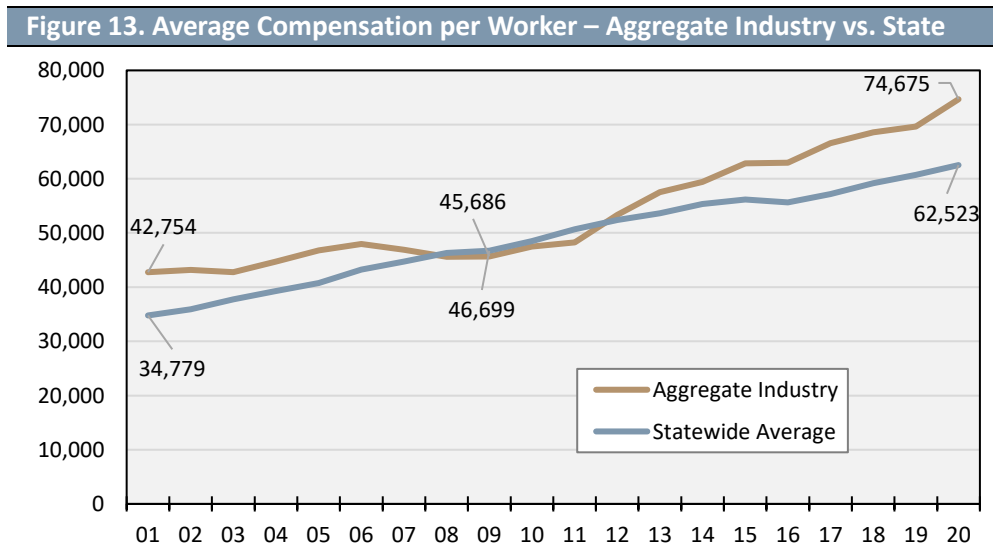
Source: Bureau of Labor Statistics – Quarterly Census of Employment and Wages (QCEW) and Census Bureau – County Business Patterns.

Other Industry Metrics. **Figure 14** provides a range of additional metrics evaluating the economic size and performance of the Oklahoma aggregate industry.

Establishments in the aggregate industry remain relatively small with an average of about 14 employees, little changed since 2004 (**Figure 14b**). Total compensation per establishment increased 59% between 2010 and 2020, with compensation paid by the average employer now totaling just more than $1 million.

Firm size measured by revenue per establishment has risen 50% since 2010, reaching approximately $4.1 million in 2020 (**Figure 14d**). The rise in average revenue per establishment reflects a similar 48% increase in revenue per employee since 2010, reaching $295,520 in 2020 (**Figure 14c**). This suggests strong productivity gains per worker in the industry the past decade.

**Figure 14. Oklahoma Aggregate Industry Performance – Other Metrics**

Source: Bureau of Labor Statistics – Quarterly Census of Employment and Wages (QCEW), Census Bureau – County Business Patterns, and U.S. Department of Labor – Mine Safety and Health Administration.

Nonemployer Trends. The 119 nonemployers operating in the Oklahoma aggregate industry in 2020 have experienced more volatility than employers the past two decades. **Figure 15** captures long-run trends for the number of nonemployers, total annual receipts, and receipts per nonemployer.

The current number of nonemployers operating in the aggregate sector is down from a recent high of 134 reported in 2017 (**Figure 15a**). However, the nonemployer count is still above the average of 102 the past two decades. Nonemployers suffered a more extended decline than employer establishments beginning in 2008 during the Great Recession period, with declining counts through 2013.

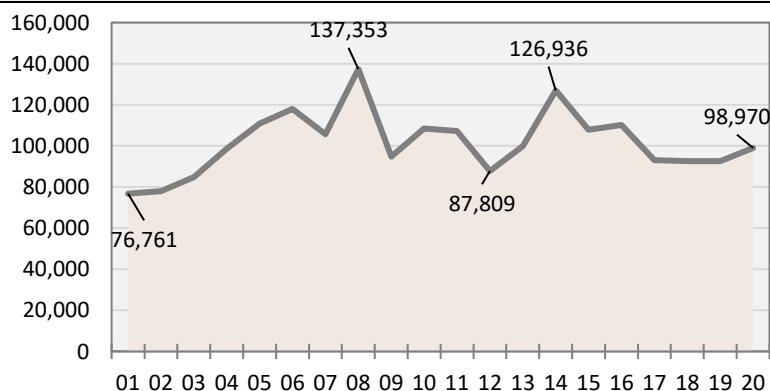**Figure 15. Oklahoma Aggregate Industry Non-Employers Trends**

(a) Number of Non-Employer Establishments
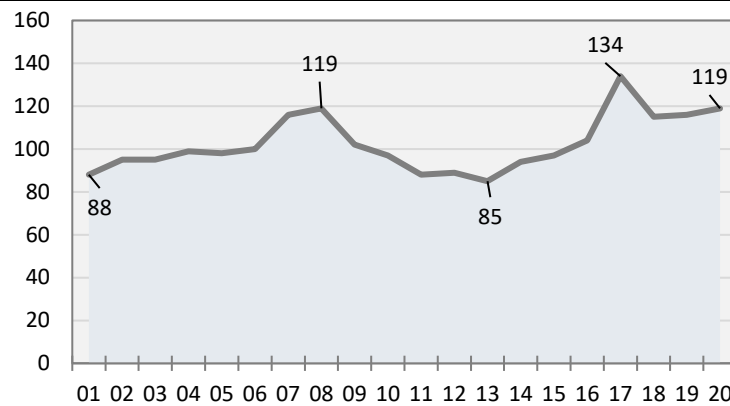
(b) Non-Employer Total Annual Receipts

(c) Non-Employer Annual Receipts per Establishment

Source: Census Bureau – Nonemployer Statistics

Total receipts of nonemployers experienced a similar prolonged decline that began in 2008 and extended into 2012 (**Figure 15b**). Nonemployer receipts have since rebounded to near $12 million annually, well above the recent 2012 low of $7.8 million but well below the peak level of $16.3 million reached in 2008. Despite the volatility in the number of nonemployer establishments and receipts the past two decades, average annual receipts across all nonemployers continues to fluctuate around $100,000 annually (**Figure 15c**).

County-Level Aggregate Industry Activity

Aggregate production is reported in 71 of Oklahoma's 77 counties and is a significant contributor to economic activity at the local level in many counties. **Figure 16** highlights county-level aggregate production along with key economic measures including establishments, wage and salary employment, total compensation, and average compensation per worker.[16] Aggregate industry compensation as a share of total county compensation is provided as a measure of the local share of total economic activity tied to the industry within each county.

Aggregate production amounts reflect 2019 tonnage while the remaining economic measures reflect 2020 conditions. The estimates capture only the activity of employer firms.

Establishments. Only five counties are home to seven or more aggregate producing firms. These include Oklahoma (15 establishments), Tulsa (12 establishments), LeFlore (10 establishments), Johnston (8 establishments), and Haskell (7 establishments) counties. All remaining counties have five or fewer aggregate producing establishments.

An additional 18 counties have between three and five aggregate producing establishments, including Canadian (5), Sequoyah (4), Choctaw (4) Kingfisher (4), Kiowa (4), Payne (4), Atoka (3), Blaine (3), Bryan(3), Creek (3), Kay (3), Love (3), McClain (3), McIntosh (3), Murray (3), Pittsburg (3), and Pontotoc (3). Four additional establishments operate statewide and have no single county classification.

Nine counties report no aggregate producing firms – Alfalfa, Cimarron, Coal, Delaware, Ellis, Grant, Harmon, Noble, and Roger Mills. Four of the nine counties – Cimarron, Coal, Delaware, and Ellis – report a small amount of aggregate production but no producing firms located within the county.[17]

Employment and Compensation. Only nine counties report no employment and compensation paid within the aggregate industry. County-level employment and compensation in the aggregate industry generally reflect the level of aggregate production volume in each county.

A core group consisting of seven counties report more than 100 workers in the aggregate industry. Johnston County has the largest employment base with 233 workers, followed by LeFlore (230 jobs), Oklahoma (191 jobs), Murray (167 jobs), Haskell (137 jobs), Pontotoc (110 jobs), and Kiowa (106 jobs) counties. These counties are located primarily in central, south-central, and southeast Oklahoma. These same seven counties produced the largest amount of total employee compensation among the counties, ranging from $18.9 million in Johnston county to $8.7 million in Kiowa county in 2020. Jointly the seven largest producing counties employ 1,174 workers, or approximately half the state total of aggregate industry employment.

Figure 16. Oklahoma Aggregate Industry – County Profile

County	Aggregate Industry					All County Industries	
	Production (Tons)	Establish-ments	Employ-ment	Total Annual Compensation	Average Compensation	Total County Compensation	Aggregate Share of Total County Compensation
Adair	189,091	1	2	$141,999	$70,999	197,479,707	0.1%
Alfalfa	0	0	0	0	0	76,882,353	0.0%
Atoka	3,216,009	3	34	2,410,119	70,886	138,777,680	1.7%
Beaver	204,043	1	7	368,030	52,576	70,264,117	0.5%
Beckham	108,179	1	2	124,252	62,126	502,186,075	0.0%
Blaine	3,036,101	3	27	1,921,770	71,177	157,072,037	1.2%
Bryan	2,669,070	3	22	1,745,824	79,356	1,076,411,190	0.2%
Caddo	1,167,852	2	17	1,127,697	66,335	403,216,485	0.3%
Canadian	1,045,905	5	73	5,574,674	76,365	1,829,777,143	0.3%
Carter	900,177	2	14	919,389	65,671	1,278,461,114	0.1%
Cherokee	762,325	2	29	1,933,187	66,662	830,258,611	0.2%
Choctaw	2,823,783	4	39	2,713,862	69,586	181,209,809	1.5%
Cimarron	262	0	0	0	0	34,919,953	0.0%
Cleveland	1,161,703	1	19	1,189,388	62,599	4,686,820,855	0.0%
Coal	5,298	0	0	0	0	52,348,519	0.0%
Comanche	4,661,687	1	57	4,374,694	76,749	2,207,653,954	0.2%
Cotton	408,088	1	4	198,477	49,619	67,630,969	0.3%
Craig	286,440	1	9	475,076	52,786	244,896,535	0.2%
Creek	863,414	3	14	961,868	68,705	1,084,251,292	0.1%
Custer	39,789	1	3	171,429	57,143	701,977,212	0.0%
Delaware	8,774	0	0	0	0	399,675,954	0.0%
Dewey	1,652,541	2	19	1,206,836	63,518	103,083,363	1.2%
Ellis	8,056	0	0	0	0	58,855,343	0.0%
Garfield	50,714	1	5	317,589	63,518	1,300,609,597	0.0%
Garvin	6,903	1	3	192,214	64,071	594,863,107	0.0%
Grady	871	1	1	57,143	57,143	637,536,451	0.0%
Grant	0	0	0	0	0	88,321,470	0.0%
Greer	35,680	1	1	34,018	34,018	39,581,602	0.1%
Harmon	0	0	0	0	0	30,823,928	0.0%
Harper	3,834	1	2	147,112	73,556	53,287,420	0.3%
Haskell	740,816	7	137	10,292,547	75,128	135,634,669	7.6%
Hughes	3,361	1	1	45,162	45,162	125,155,317	0.0%
Jackson	782,029	1	21	1,493,826	71,135	523,684,695	0.3%
Jefferson	34,500	1	2	147,112	73,556	49,394,240	0.3%
Johnston	13,882,811	8	233	18,866,711	80,973	134,562,670	14.0%
Kay	805,891	3	28	1,856,669	66,310	985,933,000	0.2%
Kingfisher	1,663,696	4	34	2,327,119	68,445	409,836,127	0.6%
Kiowa	3,184,837	4	106	8,661,985	81,717	89,107,801	9.7%
Latimer	93,277	1	5	367,781	73,556	118,244,370	0.3%
LeFlore	847,104	10	230	16,143,546	70,189	603,289,460	2.7%
Lincoln	45,330	1	3	171,429	57,143	364,031,825	0.0%
Logan	669,248	2	8	588,449	73,556	367,852,185	0.2%
Love	469,608	3	28	2,107,261	75,259	310,134,217	0.7%
McClain	123,197	3	12	1,060,356	88,363	499,603,137	0.2%
McCurtain	627,823	2	45	3,032,488	67,389	555,989,174	0.5%
McIntosh	164,404	3	51	3,584,412	70,283	164,641,906	2.2%
Major	1,144,135	1	42	2,928,138	69,718	110,624,076	2.6%
Marshall	163,162	2	6	342,859	57,143	221,752,387	0.2%
Mayes	1,793,678	1	13	832,926	64,071	770,982,610	0.1%
Murray	8,062,761	3	167	13,529,395	81,014	258,276,978	5.2%
Muskogee	559,176	2	21	1,345,496	64,071	1,664,605,742	0.1%

Continued

Figure 16. (Continued) Oklahoma Aggregate Industry – County Profile

County	Aggregate Industry					All County Industries	
	Production (Tons)	Establish-ments	Employ-ment	Total Annual Compensation	Average Compensation	Total County Compensation	Aggregate Share of Total County Compensation
Noble	0	0	0	0	0	275,252,157	0.0%
Nowata	116,829	1	8	512,570	64,071	95,806,887	0.5%
Okfuskee	11,916	1	1	35,143	35,143	100,776,333	0.0%
Oklahoma	1,503,701	15	191	14,916,006	78,094	32,469,889,623	0.0%
Okmulgee	14,587	1	1	52,659	52,659	503,039,529	0.0%
Osage	381,624	1	21	1,345,496	64,071	326,046,962	0.4%
Ottawa	522,800	2	27	2,035,652	75,395	554,087,029	0.4%
Pawnee	281,443	2	19	1,217,353	64,071	169,166,623	0.7%
Payne	278,984	4	42	3,165,086	75,359	1,809,439,771	0.2%
Pittsburg	942,568	3	30	1,922,137	64,071	873,198,138	0.2%
Pontotoc	3,011,383	3	110	8,955,889	81,417	1,136,850,671	0.8%
Pottawatomie	527,645	1	9	576,641	64,071	1,088,648,178	0.1%
Pushmataha	38,311	1	1	57,143	57,143	115,357,449	0.0%
Roger Mills	0	0	0	0	0	45,249,018	0.0%
Rogers	4,978,731	1	87	6,954,570	79,938	1,598,394,333	0.4%
Seminole	365,221	2	18	1,462,225	81,235	352,005,857	0.4%
Sequoyah	932,688	4	68	5,262,919	77,396	378,285,236	1.4%
Stephens	5,064	1	1	51,091	51,091	802,399,389	0.0%
Texas	38,148	1	3	168,460	56,153	528,126,508	0.0%
Tillman	105,850	1	4	256,285	64,071	77,491,358	0.3%
Tulsa	4,272,342	12	91	7,282,417	80,027	24,285,686,708	0.0%
Wagoner	1,345,047	2	33	2,492,775	75,539	538,851,760	0.5%
Washington	399,755	1	7	448,499	64,071	1,296,924,401	0.0%
Washita	0	1	4	228,572	57,143	95,658,529	0.2%
Woods	166,037	2	7	419,536	59,934	180,880,875	0.2%
Woodward	27,513	2	4	228,572	57,143	495,134,317	0.0%
Unclassified	-	4	9	539,404	59,934	201,442,852	0.3%
All Counties	**81,445,620**	**174**	**2,392**	**$178,619,415**	**$74,675**	**$97,986,560,919**	**0.2%**
OKC MSA	4,549,955	28	307	23,557,445	76,734	40,855,511,219	0.1%
Tulsa MSA	12,137,188	22	266	20,307,138	76,343	28,505,437,207	0.1%
Lawton MSA	5,069,775	2	61	4,573,171	74,970	2,275,284,923	0.2%
Small MSAs	1,830,506	15	303	21,724,053	71,697	2,282,184,293	1.0%
Total MSA	**23,587,424**	**67**	**937**	**$70,161,808**	**$74,879**	**$73,918,417,642**	**0.1%**
Nonmetro	**57,858,196**	**107**	**1,455**	**$108,457,607**	**$74,541**	**$24,068,143,277**	**0.5%**

Notes: Production data is for 2019. All economic measures are for 2020.

Source: Oklahoma Department of Mines, Census Bureau - County Business Patterns, U.S. Department of Labor, Mine Safety and Health Administration, and Bureau of Labor Statistics - Quarterly Census of Employment and Wages (QCEW)

Aggregate production is a major contributor to the local economy in all of these counties except far larger Oklahoma county. As a share of total county employee compensation, the aggregate industry accounts for 14.0% of compensation in Johnston, 9.7% in Kiowa, 7.6% in Haskell, 5.2% in Murray, and 2.7% in Le Flore. Aggregate industry activity produces just less than 1% of total county wages in Pontotoc County and only a negligible share of Oklahoma County compensation. Seven additional counties have more than 1% of total county employee compensation derived from aggregate industry hiring, including Major (2.6%), McIntosh (2.2%), Atoka (1.7%), Choctaw (1.5%), Sequoyah (1.4%%), Blaine (1.2%), and Dewey (1.2%). In total, 12 Oklahoma counties generate more than 1% of total local employee compensation from aggregate industry hiring.

An additional 6 counties report having 50 to 100 aggregate industry employees, 12 counties report 25 to 50 aggregate industry employees, and 43 counties report less than 25 aggregate industry employees. Similarly, an additional 24 counties report more than $1 million in employee compensation from aggregate producing firms. Thirty-seven more counties report employee compensation of less than $1 million.

The six Oklahoma counties with no aggregate production in 2019 include Alfalfa, Grant, Harmon, Noble, Roger Mills, and Washita. Among these six, Washita county reports no aggregate production but has one firm with four employees located in the county.

Average Compensation per Worker. Average compensation reached $74,675 for workers in Oklahoma's aggregate industry in 2019, but varies considerably across the producing counties. The highest average compensation is found in McClain County ($88,363) and lowest in Greer County ($34,018). Unlike overall wages across the state, wages in the state's metropolitan areas are only marginally higher than in the nonmetropolitan areas.

The largest producing counties tend to have the highest average compensation, with only 18 counties having above industry average wages. As a result, the median annual wage of approximately $66,500 is well below the average for the 68 counties with aggregate industry employment.

Thirty-two additional producing counties have wages below the overall industry average of $74,674 but above the state average wage of $62,523. Nearly all other counties report average compensation per worker in the aggregate sector above $50,000. Only four counties (Cotton, Hughes, Okfuskee, and Greer) report average annual compensation in the aggregate industry below $50,000. Among the four, all have only one establishment located in the county and three of the four have only a single employee. These very small businesses are unlikely to represent the owner-operator's sole source of income.

Comparable Industries

Placing the size of the aggregate industry alongside other sectors of the state economy of similar size provides useful context for evaluating the absolute size of the sector. A common approach in making this type of comparison is to use gross domestic product (GDP), or value added, produced in the industry as a benchmark. The use of value added eliminates any differences in the underlying meaning of receipts or output across industry sectors, especially when comparing industries to retail or manufacturing operations. GDP is lower than output, or receipts, and does not include spending by aggregate producers on intermediate goods used in production.

Oklahoma aggregate industry receipts are first converted to GDP using the ratio of value added to receipts for the industry from the 2017 Economic Census administered by the Census Bureau. The Economic Census provides detailed data on the structure of industry receipts and value added at five-year intervals, with the most recent estimate produced in 2017. The ratio of value added to receipts is 93.7% across the eleven aggregate industry sectors in 2017. The ratio is generally highly stable in most states over intermediate time periods.

GDP, or value added, for the aggregate industry in 2019 is subsequently estimated at $663.1 million (i.e., $707.65 million x .937). **Figure 17** compares GDP produced in the aggregate industry relative to multiple industry sectors as reported by the Bureau of Economic Analysis for 2019, the most recent year of detailed state GDP data available. To enhance comparability, the sectors used for comparison in **Figure 17** are primarily 4-digit NAICS sectors. This is consistent with the aggregation level of NAICS 2123 which comprises the bulk of the aggregate sector.

The size of the aggregate sector by GDP falls within a range of several well-known goods-producing and service-providing industries that play an important role in the state economy.

Relative to other larger well known industries, the aggregate industry is roughly three-fourths the size of the state's chemical manufacturing industry ($895 million) and two-thirds the size of the size of the state's paper manufacturing industry, both nearly $1 billion sectors that are established components of the state economy.

Aggregate industry GDP is only slightly smaller than the critical Warehousing and storage sector ($765.8 million) and the Securities, commodities, and financial investment services sector ($751.7 million).

Relative to smaller industries, GDP produced in the aggregate sector exceeds that produced in Motor vehicles, bodies and trailers, and parts manufacturing ($650.7 million), Performing arts, spectator sports, museums, and related activities ($645.1 million), and Computer and electronic product manufacturing ($623.7 million).

GDP in the aggregate sector far exceeds that produced in Waste management and remediation services ($439.0 million), Electrical equipment, appliance, and component manufacturing ($410.8 million), Primary metal manufacturing ($329.3 million), and Wood product manufacturing ($240.4 million)

Relative to other smaller but key service-providing sectors, the aggregate industry is more than double the size of the Forestry, fishing, and related activities sector ($265.2 million), triple the size of the Funds,

trusts, and other financial vehicles sector ($233.8 million), more than four times the size of the Printing sector ($158.5 million), and more than six times the size of the state's Motion picture and sound recording sector ($108.5 million).

Figure 17. Gross Domestic Product in Comparable Oklahoma Industries		
Industry (BEA Designation)	**2019 GDP ($mil.)**	**Share of State GDP**
Paper manufacturing	$955.7	0.5%
Chemical manufacturing	894.7	0.4%
Securities, commodity contracts, & other finan. invest. activities	765.8	0.4%
Warehousing and storage	751.7	0.4%
Aggregate (noncoal nonmetallic mining)	**663.1**	**0.3%**
Motor vehicles, bodies and trailers, and parts manufacturing	650.7	0.3%
Performing arts, spectator sports, museums, and related activities	645.1	0.3%
Computer and electronic product manufacturing	623.7	0.3%
Waste management and remediation services	439.0	0.2%
Electrical equipment, appliance, and component manufacturing	410.8	0.2%
Primary metal manufacturing	329.3	0.2%
Forestry, fishing, and related activities	265.2	0.1%
Wood product manufacturing	240.4	0.1%
Funds, trusts, and other financial vehicles	233.8	0.1%
Printing and related support activities	158.5	0.1%
Furniture and related product manufacturing	132.6	0.1%
Motion picture and sound recording industries	108.5	0.1%
All industry total	$202,036.1	100.0%

Source: Census Bureau – 2017 Economic Census and Bureau of Economic Analysis

IV. Gross Economic Contribution – Oklahoma Aggregate Industry

The activity taking place within the state's aggregate industry produces a substantial direct economic contribution to the state economy. In 2020, the industry's employer firms produced $707 million in output and employed nearly 2,400 wage and salary workers earning $179 million in compensation.

Like all industry sectors, the state's aggregate industry has a strong degree of economic interdependence with many other sectors of the state economy. These linkages create spillover economic activity in other industry sectors as the aggregate industry expands over time. In this section, we use the direct activity in the aggregate industry to estimate the resulting economic spillover activity and the gross economic contribution of the industry to the overall state economy.

Modeling Regional Economic Linkages

Direct production within the state's aggregate industry creates measurable spillover activity that can be tracked in the form of output, employment, and employee compensation created in other sectors of the economy. Estimates of the economic spillover effects from the industry are formed using RIMS II input-output multipliers for the state of Oklahoma produced by the U.S. Bureau of Economic Analysis (BEA).[18]

The multipliers provide model-based estimates of the impact that a local final demand shock has on total output, employee compensation, and employment in a region. The multipliers can also be used to form estimates of an industry's total, or gross, economic contribution to the state economy.[19]

The approach uses the direct activity of firms operating within the aggregate industry along with a model of the flow of expenditures between businesses, households, and the government sector within the state.[20] The indirect, or spillover, activity occurs as aggregate producers purchase goods and services from firms in other sectors of the economy. In other words, the multipliers provide a convenient method for estimating the spillover effects that a change in output, employment, or employee compensation within the aggregate industry may have on broader state economic activity.

To accommodate the various activities taking place within the aggregate industry, data for each component of the industry are matched by NAICS sector to the RIMS II industry structure.[21] The individual effects of each sector of the industry are estimated and then aggregated to determine the overall industry effect.[22]

Gross Economic Contribution of the Aggregate Industry[23]

Gross economic spillover impacts resulting from the operation of the state's aggregate industry in 2020 are detailed in **Figure 18**. Included are estimates of the amount of statewide output, employment, and employee compensation supported by employer firms in the aggregate industry, both directly and through spillover effects.

Gross Economic Impact. The estimates suggest that the direct operations of the aggregate industry along with its spillover effects make a sizeable gross contribution to the broader state economy. In total, the

Figure 18. Gross Economic Contribution - Oklahoma Aggregate Industry (2020)									
	Direct Effects			Indirect and Induced Effects			Total Effects		
NAICS Industry Description	Output ($mil.)	Employee Compen-sation ($mil)	Employ-ment	Output ($mil)	Employee Compen-sation ($mil)	Employ-ment	Output ($mil)	Employee Compen-sation ($mil)	Employ-ment
212311 Dimension Stone	54.7	15.4	294	46.1	25.5	785	100.8	40.8	1,079
212312 Crushed and Broken Limestone	253.6	61.4	751	213.8	101.8	2,005	467.4	163.2	2,756
212313 Crushed and Broken Granite	1.0	0.4	10	0.9	0.6	27	1.9	1.0	37
212319 Other Crushed and Broken Stone	63.3	16.8	253	53.4	27.8	675	116.7	44.6	928
212321 Construction Sand and Gravel	151.9	37.4	513	128.1	62.0	1,370	280.0	99.4	1,883
212322 Industrial Sand	57.9	13.3	154	48.9	22.1	411	106.8	35.4	565
212325 Clay and Ceramic Minerals	0.6	0.2	5	0.5	0.3	13	1.2	0.6	18
212399 All Other Nonmetallic Minerals	62.5	15.5	188	52.5	20.5	410	115.0	36.0	598
213115 Support Activities	36.4	10.8	123	30.7	10.3	208	67.1	21.1	331
423320 Construction Material-Wholesale	21.4	6.4	91	15.2	6.2	141	36.6	12.5	231
423520 Minerals-Wholesale	3.5	1.1	10	2.5	1.1	16	6.1	2.2	26
Total Aggregate Industry	**$706.9**	**$178.6**	**2,392**	**$592.6**	**$278.3**	**6,060**	**$1,299.5**	**$456.9**	**8,452**

Source: Bureau of Economic Analysis: RIMS II and RegionTrack calculations

state's aggregate industry supported an estimated $1.3 billion in state output, 8,450 jobs, and $457 million in employee compensation in 2020.

Output. The estimated $1.3 billion in total state output is the broadest measure of the total economic contribution of the aggregate industry and can be partitioned into direct, indirect, and induced effects.[24]

The *indirect* effect is the economic output generated in the state resulting from spending by firms in the aggregate industry on goods and services to fund production or capital expenditures. The *induced* effect reflects the economic output generated in other sectors of the state economy resulting from new household spending in the state out of household earnings received as part of the direct and indirect effects.

The *direct* effect includes $707 million in output generated directly by aggregate producing establishments in the state. The direct output of the industry in turn supported an estimated $593 million in indirect and induced output in other industries statewide. In other words, each dollar of new direct output within the aggregate industry supported an additional $0.84 in estimated economic output statewide.

Employee Compensation. The total impact of $457 million in gross employee compensation supported by the aggregate industry's activities and expenditures can also be partitioned into direct, indirect, and induced effects. The *direct* effect is the $179 million in compensation paid directly to employees in the aggregate industry. The direct earnings supported an incremental $278 million in added indirect and induced earnings for workers in other industries statewide. Each dollar of direct earnings by aggregate industry employees supported an additional $1.56 of household earnings statewide.

The *indirect* effect is the earnings paid in the state resulting from expenditures on goods and services by the aggregate industry. The *induced* effect reflects the earnings paid in other sectors of the state economy resulting from new household spending in the region out of earnings received as part of the direct and indirect effects.

Employment. Measured by direct employment, 2,392 employees worked as wage and salary workers in the Oklahoma aggregate industry in 2020. This direct employment supported an additional 6,060 jobs statewide through estimated indirect and induced effects. The *indirect* effect is the employment generated across the state because of spending by the aggregate industry on goods and services. The *induced* effect reflects the employment generated in other sectors of the economy resulting from new household spending in the state out of household earnings received as part of the direct and indirect effects.

In total, the operations of the aggregate industry directly and indirectly supported an estimated 8,452 jobs statewide in 2020. Each job in the aggregate sector supported 2.5 additional jobs in the state economy. The high employment multiplier is typical of most mining sectors and other production sectors with high output per worker.

V. Tax Contributions of the Aggregate Industry

Oklahoma's aggregate industry and its employees make significant tax payments to state and local governments. Common taxes paid to the state include sales and use tax, motor vehicle tax, corporate income tax, and others. Employees of aggregate producers pay personal income tax on employee compensation. Firms in the aggregate industry also pay significant ad valorem tax and sales and use tax to city and county governments across Oklahoma. In addition, the spillover economic activity discussed in the prior section of the report generates added tax revenue. These tax contributions are estimated and reviewed throughout this section of the report.

State Tax Contribution

The contribution of the aggregate industry to total state taxes can be estimated as a share of the direct economic contribution of the industry. The estimates are derived using an average tax rate derived from state taxes as a share of state employee compensation.[25] Specifically, the average tax rate is calculated as the ratio of total state taxes as defined by the Census Bureau[26] (minus corporate taxes and taxes not elsewhere classified (which include oil and gas severance taxes)) to total state employee compensation and equals 10.7% over the 2017 to 2019 period.[27] State tax shares are generally stable over intermediate time periods.

Figure 19. Estimated State Tax Effects from Aggregate Industry Operations (2020)				
Estimated Effect	**Output ($mil.)**	**Employee Compensation ($mil.)**	**Employment**	**State Tax Revenue ($mil.)**
Direct	$706.9	$178.6	2,392	$19.1
Indirect/Induced	592.6	278.3	6,060	$29.8
Total	**$1,299.5**	**$456.9**	**8,452**	**$48.9**

Notes: Tax estimates assume an average tax rate of 10.7% of employee compensation based on state historical average tax shares reported by Census.
Source: Census Bureau-Annual Survey of State Government Finances and RegionTrack estimates.

The estimated direct state tax revenue in 2020 from annual aggregate industry activity is $19.1 million, or a 10.7% share of $178.6 million in employee compensation (**Figure 19**). Again, the tax estimates include income, sales, use, motor vehicle, and other taxes paid by aggregate producing firms to the state of Oklahoma. Estimates also include individual income tax payments made by employees of aggregate firms.

Including economic spillover effects, estimated tax payments based on the same tax share include an additional $29.8 million paid to the state. In total, expected state tax revenue from the gross economic contribution of the aggregate industry reached $48.9 million in 2020.

Oklahoma Non-Coal Production Fee. Some of the revenue received by the state of Oklahoma from the aggregate industry is in the form of fee income. The state of Oklahoma assesses all operators of non-coal mining operations a fee of one and one-fourth cents ($0.0125) per ton of mineral produced.[28]

Fee Coverage and Use. In assessing the fee, "mineral" means asphalt, clay, copper, granite, gravel, gypsum, lead, marble, salt, sand, shale, stone, tripoli, volcanic ash, and zinc, or any other substance commonly recognized as a mineral, and includes ores or rock containing any such substances, but excludes oil, gas and any other mineral found naturally in a liquid or gaseous state. The production fee was raised from one cent per ton in November 2017.[29]

Fee Revenue. Based on 2019 production of 81.45 million tons of aggregate, the fee is expected to generate an estimated $1 million annually. **Figure 20** provides estimates of total fees due in the 2009 to 2019 period. Mining operations are required to file quarterly production and fee reports with ODOM.

Figure 20. Estimated Non-Coal Mineral Production Fees
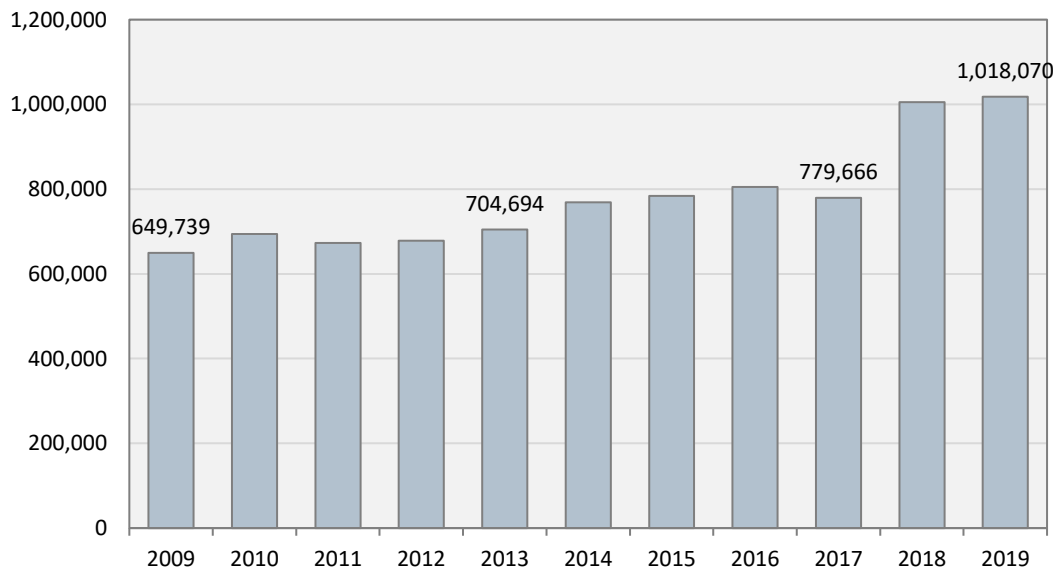
Note: The production fee rate increased from $0.01 per ton to $0.0125 per ton in November 2017.
Source: Oklahoma Department of Mines and RegionTrack calculations

Fee Revenue Use. All fees on mineral production are deposited with the State Treasurer, who credits one-tenth of one cent ($0.001) per ton of fees collected to the Oklahoma Miner Training Institute Revolving Fund, with the balance of the fees deposited in the ODOM Revolving Fund. Expenditures from the ODOM Revolving Fund can be made for any lawful purpose of the department.

Funds accruing to the Oklahoma Miner Training Institute[30] Revolving Fund are fully appropriated and may be budgeted and expended by the Oklahoma Mining Commission.[31] The Commission maintains a contract with the Board of Regents of Eastern Oklahoma State College for operation of the Oklahoma Miner Training Institute.

Sales and Use Tax Payments – State and Local

Estimates of the amount of sales and use tax paid by the aggregate industry to state and local governments can be estimated using Oklahoma Tax Commission records. A portion of the sales made by firms in the aggregate industry are taxable and generate significant sales and use tax payments to state and local governments.

Sales and use taxes paid by the aggregate industry are tabulated annually in the 2016 to 2020 period, the most recent five years for which NAICS sector based tax reporting is available. The data captures the eleven NAICS codes comprising the industry used throughout the report. The same fractional shares used earlier in the report are used for NAICS wholesale trade sectors 423320 and 423520.

Specifically, the data measures the taxes collected on sales by the industry and then remitted to the Oklahoma Tax Commission. The estimates do not include sales and use taxes paid on purchases by aggregate producers, which cannot be extracted from publicly available data.

Taxable Sales. **Figure 21** summarizes both the amount of taxable sales and the resulting sales and use taxes collected and remitted to the state and Oklahoma cities and counties by the aggregate industry.

In 2020, the state's aggregate producers reported sales subject to state sales and use tax of $127.8 million. Of this amount, $53.3 million was taxable at the city level and $54.5 million taxable at the county level. Approximately 18.1% of total sales of $706.7 million in the industry in 2020 was subject to state sales and use tax.

It is important to note that a substantial share of the sales of the aggregate industry are made to the same government entities who receive sales and use tax payments from the industry. These sales are typically for public construction projects and are exempt from sales and use taxes under state statute.

Figure 21. Sales and Use Tax Base and Remittances – Aggregate Industry						
State	**2016**	**2017**	**2018**	**2019**	**2020**	**2016-20**
Sales/Use Taxable Sales	57,115,576	95,739,740	185,978,354	128,385,915	127,815,764	595,035,349
Sales/Use Tax Collections	2,570,201	4,308,288	8,369,026	5,777,366	5,751,709	26,776,590
Cities	**2016**	**2017**	**2018**	**2019**	**2020**	**2016-20**
Sales/Use Taxable Sales	31,998,686	54,533,207	104,563,858	69,199,432	53,321,929	313,617,112
Sales/Use Tax Collections	1,125,734	2,130,813	4,155,845	2,649,491	2,044,402	12,106,285
Counties	**2016**	**2017**	**2018**	**2019**	**2020**	**2016-20**
Sales/Use Taxable Sales	53,338,205	85,219,607	165,912,559	186,535,688	54,546,856	545,552,915
Sales/Use Tax Collections	629,854	750,173	1,482,342	1,397,561	996,672	5,256,602
State/Cities/Counties	**2016**	**2017**	**2018**	**2019**	**2020**	**2016-20**
Sales/Use Tax Collections	4,325,790	7,189,275	14,007,214	9,824,418	8,792,783	44,139,480

Source: Oklahoma Tax Commission and RegionTrack calculations

Tax Remittances. The state's aggregate producers subsequently remitted $8.79 million in sales and use tax receipts to state, city, and county governments in Oklahoma in 2020. Of the total, $5.75 million (65%) went to the state, $2.04 million (23%) to cities, and $1 million (12%) to counties. The $5.75 million in sales and use taxes paid to the state represents approximately 30% of the estimated $19.1 million in total direct taxes paid by the industry to the state in 2020 (**Figure 19**).

The trend in sales and use tax collections from aggregate industry activity is highly volatile over time. The recent peak in sales tax remittances by the industry was $14.0 million in 2018, nearly double the more recent 2020 level. The volatility reflects year-to-year changes in both aggregate production and the share of total aggregate sales that are tax exempt.

From 2016 to 2020, Oklahoma aggregate producers remitted a cumulative $44.1 million ($8.8 million annually) in sales and use taxes to state, city, and county governments. Total remittances include $26.8 million in sales and use tax to the state, $12.1 million to cities, and $5.3 million to counties.

City- and County-Level Sales and Use Tax Payments

Figure 22 provides a breakdown of city and county sales and use taxes paid by the aggregate industy by the county in which taxable sales occurred. Payments are again provided for years 2016 to 2020 and totaled across the five-year period for each county.

It is important to note that local area sales tax estimates are far more volatile on a year-to-year basis than statewide tax payments. Again, this reflects large year-to-year changes in total sales at the local level and changes in the share of total sales that are taxable. Some large one-time tax payments at the county level are traced to large construction projects.

In 2020, sales and use tax payments totaling $3.0 million were remitted to city and/or county governments in 75 of the state's 77 counties. Over the full period from 2016 to 2020, Oklahoma's aggregate producers remitted a total of $17.4 million in sales and use tax payments, an average of $3.47 million annually.

The aggregate industry in Oklahoma and Tulsa counties generated the most sales and use tax revenue among cities and counties in 2020. Tulsa County received the largest tax remittances with $572,300, followed by Oklahoma County with $482,200. This reflects the high concentration of end use in the state's two largest counties despite significant production of the materials in other counties.

Five additional counties received more than $100,000 in sales and use tax revenue in 2020 including Muskogee ($271,024), Murray ($122,332), Wagoner ($114,939), Sequoyah ($109,311), and Rogers ($100,143). Counties where city and county sales and use tax payments ranged from $50,000 to $100,000 in 2020 include Canadian, Cherokee, Cleveland, Ellis, Kingfisher, Okmulgee, and Wagoner.

Over the full five-year period, Tulsa County's city and county governments received the largest total remittances at $4.6 million, followed by Garfield County with $2.5 million and Oklahoma County with $2.1 million. No other county received more than $1 million in the period.

County	2016	2017	2018	2019	2020	2016-20
Figure 22. City and County Sales/Use Tax Payments – Oklahoma Aggregate Industry						
Adair	14,292	4,912	13,186	23,032	20,368	75,791
Alfalfa	370	200	429	1,749	384	3,132
Atoka	683	4,491	8,477	10,658	6,212	30,521
Beaver	599	143	989	192	112	2,034
Beckham	-24,189	125,938	65,931	86,383	6,240	260,303
Blaine	1,322	95,817	82,918	7,457	1,157	188,671
Bryan	21,559	6,113	5,622	7,828	24,583	65,705
Caddo	1,864	1,639	5,574	444	308	9,828
Canadian	36,471	40,342	110,545	85,218	68,829	341,404
Carter	11,169	1,380	6,871	11,143	11,496	42,058
Cherokee	1,084	1,134	86,400	58,902	86,687	234,207
Choctaw	4,920	-854	1,911	1,915	918	8,811
Cimarron	0	58	41	0	0	99
Cleveland	118,364	74,980	45,115	56,826	81,206	376,491
Coal	18,150	841	2,305	-1,319	64	20,042
Comanche	2,390	941	1,364	2,067	2,336	9,098
Cotton	4	56	1,347	264	5	1,676
Craig	296	241	88,974	46,663	38,583	174,757
Creek	29,150	49,285	191,333	58,517	28,941	357,227
Custer	1,104	36,785	44,845	15,633	1,311	99,679
Delaware	5,277	4,140	9,108	11,703	8,888	39,115
Dewey	5,571	18,096	13,790	27,736	44,427	109,619
Ellis	3,111	19,460	536,978	219,033	93,282	871,863
Garfield	1,351	548,651	1,668,867	255,698	29,672	2,504,239
Garvin	2,474	2,975	2,050	2,459	5,276	15,234
Grady	6,431	6,763	25,730	5,324	9,275	53,522
Grant	173	30	33	125	386	747
Greer	83	17	307	137	306	851
Harmon	3	2,791	10	0	0	2,804
Harper	2,033	968	806	490	805	5,103
Haskell	19,493	21,008	31,836	39,596	23,949	135,881
Hughes	1,186	3,473	4,110	3,255	-93	11,931
Jackson	264	657	263	195	1,533	2,911
Jefferson	3,178	2,096	-41	2,428	5,451	13,112
Johnston	54,239	49,566	-87,707	27,167	29,274	72,539
Kay	1,149	6,418	1,728	1,287	21,330	31,912
Kingfisher	14,913	30,601	34,987	73,390	95,979	249,870
Kiowa	7,164	10,599	13,190	9,272	6,807	47,033
Latimer	1,192	236	185	434	59	2,105
Le Flore	4,214	9,216	18,194	24,743	23,886	80,254
Lincoln	11,123	10,766	9,918	13,443	21,029	66,279
Logan	7,756	5,700	6,807	5,245	30,210	55,718
Love	1,189	7,515	6,510	3,666	617	19,498
McClain	8,819	10,724	19,135	17,786	31,949	88,413
McCurtain	4,745	403	4,657	2,364	876	13,045
McIntosh	286	362	8,452	156	1,594	10,850
Major	293	1,430	2,520	5,024	102	9,369
Marshall	16,452	6,760	11,045	15,105	11,637	60,998
Mayes	1,482	5,833	17,189	8,979	47,795	81,278
Murray	45,823	54,119	69,883	88,176	122,332	380,333
Muskogee	2,750	5,908	97,961	148,226	271,024	525,869

Continued

Figure 22. (Continued) City and County Sales/Use Tax Payments – OK Aggregate Industry						
County	2016	2017	2018	2019	2020	2016-20
Noble	286	82	158	331	13	870
Nowata	2,381	4,618	5,205	4,641	14,770	31,616
Okfuskee	3,127	3,788	21,334	7,549	27,506	63,304
Oklahoma	386,373	426,420	442,673	361,258	482,201	2,098,925
Okmulgee	11,974	10,973	6,573	31,581	54,851	115,953
Osage	9,969	18,613	35,487	30,283	32,532	126,884
Ottawa	847	765	1,308	1,880	1,678	6,479
Pawnee	1,012	961	1,661	2,128	4,083	9,846
Payne	3,472	7,941	11,880	5,663	7,394	36,349
Pittsburg	1,201	1,125	3,764	21,355	49,727	77,171
Pontotoc	41,225	98,695	85,952	108,855	40,921	375,648
Pottawatomie	28,571	30,663	28,580	33,374	44,303	165,490
Pushmataha	0	384	411	583	255	1,632
Roger Mills	195	858	2,587	258	1,463	5,361
Rogers	161,731	169,518	170,025	181,837	100,143	783,252
Seminole	6,771	57,272	23,019	32,542	17,236	136,841
Sequoyah	22,086	16,055	84,448	83,579	109,311	315,479
Stephens	1,128	3,519	3,202	3,411	6,366	17,626
Texas	1,865	208	61	377	66	2,576
Tillman	550	7,184	213	208	4,377	12,532
Tulsa	523,169	642,223	1,301,755	1,568,414	572,257	4,607,818
Wagoner	43,590	53,646	80,201	57,474	114,939	349,850
Washington	13,896	24,580	22,219	15,268	20,702	96,665
Washita	1,965	1,330	567	2,040	920	6,822
Woods	1,823	-56	979	101	3,736	6,583
Woodward	12,564	7,899	11,246	5,848	9,927	47,484
State Total	1,755,589	2,880,987	5,638,188	4,047,051	3,041,074	17,362,889

Source: Oklahoma Tax Commission and RegionTrack calculations

Counties with little aggregate production generally receive very little annual sales and use tax revenue from the industry, while some counties receive it only in occassional years. However, across the full 2016 to 2020 period, city and/or county governments in all 77 Oklahoma counties received some sales and use tax revenue from aggregate production.

Local Ad Valorem Tax Revenue

Ad valorem, or property, tax payments at the local level are an additional source of tax revenue paid by the aggregate industry. Aggregate producing firms in Oklahoma typically have significant holdings of real and personal property that are subject to county ad valorem taxation.

Much like oil and gas taxation in the state, the value of minerals in the ground are not taxed. However, the land where mining occurs is taxable along with equipment used in production.

The amount of 2020 ad valorem tax payments were collected for the 50 largest aggregate producing sites across Oklahoma. Only 50 sites were surveyed due to both the costly nature of a manual search and the finding that the 50 largest producing sites are believed responsible for the great majority of total ad valorem tax paid by the industry statewide.

Ad valorem tax payments were collected directly from county assessor websites and other property record providers. Included property includes real property primarily in the form of mines, quaries, and pits used in the aggregate mining process plus any related personal property. Property unrelated to active aggregate mining such as undeveloped land, concrete plants, residential property, and corporate property, are excluded from the totals.

Figure 23 details total estimated ad valorem tax payments for 2020 associated with the 50 largest aggregate producing sites in the state by the county in which each site is located. Tax payments for the 50 sites totaled $6.42 million for the 2020 tax year.

Figure 23. Ad Valorem Tax Payments – 50 Largest Producing Sites	
County	**Ad Valorem Tax (2020)**
Atoka	$259,842
Blaine	151,505
Bryan	74,470
Caddo	59,475
Carter	69,849
Cherokee	46,129
Choctaw	175,646
Cleveland	30,930
Comanche	347,533
Cotton	25,500
Creek	102,676
Dewey	540,700
Haskell	20,095
Jackson	336,818
Johnston	797,384
Kingfisher	103,946
Kiowa	111,521
Logan	33,228
Major	51,541
Mayes	419,772
McCurtain	16,001
Murray	552,373
Muskogee	130,416
Oklahoma	90,642
Pittsburg	114,920
Pontotoc	1,238,553
Rogers	131,177
Sequoyah	284,331
Tulsa	81,762
Wagoner	20,293
50 Largest Producing Sites	**$6,419,028**

Note: Includes only real and personal property engaged directly in mining activities.
Source: Property records from county assessor websites, okcountytreasurers.com, oktaxrolls.com. okcountyrecords.com.

Based on the rapid falloff in tax payments beyond the 50 largest sites, the $6.42 million total is believed to represent at least 90% of the total ad valorem taxes associated with all 417 operating sites across the state. For example, the ten largest sites averaged annual taxes of $406,500 each while the sites ranked 41-50 in production averaged only $7,600 each in annual taxes. A sample of smaller firms suggests that the 200 smallest sites paid $1,000 or less annually in ad valorem taxes.

The 50 largest sites are spread across 30 counties and are located in all regions of the state. There is also a significant share of total ad valorem tax revenue received by counties in rural areas of the state. Comanche County is the only metropolitan area county ranked among the top ten in ad valorem tax payments.

The largest tax payments were made to Pontotoc County and totaled $1.24 million. Three additional counties received more than $500,000 in ad valorem tax from the aggregate industry – Johnston ($797,384), Murray ($552,373), and Dewey ($540,700).

Five additional counties received between $250,000 and $500,000 in ad valorem payments from the industry – Mayes ($419,772), Comanche ($347,533), Jackson ($336,818), Sequoyah ($284,331), and Atoka ($259,842).

Thirteen counties received less than $100,000 in ad valorem taxes. These sites generally have either far less production than the largest sites or the county is home to only one top 50 site.

VII. Endnotes

1 Mining rules and regulations in Oklahoma are available online at: https://mines.ok.gov/regulations

2 Recent production reports from the Oklahoma Department of mines are available online at: https://mines.ok.gov/oklahoma-mining-production

3 The most recently available data on aggregate production extends through 2019.

4 See the Oklahoma Historical Society's report on mining and minerals in Oklahoma: https://www.okhistory.org/publications/enc/entry.php?entry=MI041

5 For more details, see: https://www.cement.org/cement-concrete/concrete-materials/aggregates#:~:text=Aggregates%20are%20inert%20granular%20materials,an%20essential%20ingredie nt%20in%20concrete.&text=Fine%20aggregates%20generally%20consist%20of,3%2F8%2Dinch%2Dsieve. A more technical guide to the use of aggregates in concrete is available from the American Concrete Institute at: https://www.concrete.org/Portals/0/Files/PDF/E1_07.PDF

6 The concrete plant count is as of September 20, 2021. An additional 119 concrete plants did not have current inspection status. A current list of approved concrete plants is available online from ODOT: https://www.odot.org/materials/htm-smap/11067cp.pdf

7 For more details, see: https://www.apai.net/Files/content/DesignGuide/Chapter_2B.pdf

8 The asphalt plant count is as of September 20, 2021. An additional four asphalt plants did not have current inspection or scale certification status. A current list of approved asphalt plants is available online from ODOT: https://www.odot.org/materials/htm-smap/11067ap.pdf

9 For more detailed maps of Oklahoma's major mineral deposits, see: http://www.ogs.ou.edu/pubsscanned/EP9p10_11minoilgas.pdf and https://www.researchgate.net/publication/307575678_Mineral_map_of_Oklahoma_exclusive_of_oil_and_gas_fields

10 For context on tripoli deposits in Oklahoma, see: http://ogs.ou.edu/docs/bulletins/B28.pdf and https://americantripoli.com/about/

11 For discussion of caliche deposits in Oklahoma, see: https://ojs.library.okstate.edu/osu/index.php/OAS/article/view/2329/2030

12 For more detailed descriptions of the activities associated with these nine 6-digit NAICS codes, see: https://www.naics.com/six-digit-naics/?code=21

13 See: https://www.ou.edu/ogs/research/minerals/gypsum

14 Data describing the industry are the state level are fully disclosed in these datasets. However, some estimates are formed at the 6-digit level for counties with suppressions using iterative proportional fitting techniques. The initial starting value, or prior, is formed using an average of the industry ratio at the state level and the industry average at the national level for each missing data point. All estimates are then iteratively adjusted to sum to known state totals.

15 Census defines nonemployers as: "A nonemployer business is one that has no paid employees, has annual business receipts of $1,000 or more ($1 or more in the construction industries), and is subject to federal income taxes. Nonemployer businesses are generally small, such as real estate agents and independent contractors." For additional context, see: https://www.census.gov/quickfacts/fact/note/US/NES010218#:~:text=A%20nonemployer%20business%20is%2 0one,estate%20agents%20and%20independent%20contractors.

16 Establishments, employment, and total compensation are derived from the Bureau of Labor Statistics Quarterly Census of Employment and Wages using the same eleven NAICS code comprising the aggregate industry.Some county estimates are not disclosed due to confidentiality concerns and are estimated using data

from the County Business Patterns database. Iterative proportional fitting techniques are used to control the county-level estimates to known state totals.

17 This implies that firms based outside the county perform some extraction within the county.

18 RIMS (Regional Input-Output Modeling System) II multipliers are discussed in detail at: https://apps.bea.gov/regional/rims/. Multipliers used in the report are based on the 2019 regional update of the 2012 U.S. input-output model underlying the RIMS II estimates.

19 Caution must always be used when using input-output multipliers to assess the total 'contribution' or total economic activity 'supported' by an existing industry or firm. Input-output multipliers are designed to predict the gross changes in a regional economy resulting from a small, incremental change in its current structure. More specifically, the estimates provided for the aggregate industry reflect predictions from the RIMS II input-output model of the incremental impact that would result if industry activity expanded incrementally. The actual realized impact is determined by the unique adjustment process that would take place in the state as aggregate industry activity changed. For an accessible discussion of how multiplier-based estimates of spillover effects are frequently misused and often overstate resulting spillover effects, see Hughes, David W. (2003) "Policy Uses of Economic Multiplier and Impact Analysis." Choices. 2nd Quarter. https://extension.tennessee.edu/publications/Documents/W644.pdf and Olfert, M.R. and J. C. Stabler (1994) "Community Level Multipliers for Rural Development Initiatives." Growth and Change, 25: pp. 467–486.https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-2257.1994.tb00155.x.

20 While the input-output approach provides a useful way to measure the extent of the economic interlinkages within a regional economy, the approach is not without shortcomings. The primary criticisms of the approach are misapplication of the models and the failure of the largely static approach to account for changes in other areas of the economy such as prices, wages, and traded activity. Despite these criticisms, careful application of the models can provide useful estimates of the total gross economic activity attributable to an individual industry, firm, or institution within a region. Input-output analysis is most appropriate when the policy change or stimulus does not alter production patterns, product prices, input prices, wage rates, or cost of capital. It is generally most useful when there are no capital or labor constraints.

21 All sectors in NAICS 21231 and 21232 are modeled using RIMS sector 212310. NAICS 212399 is modeled using RIMS sector 2123A0. NAICS 213115 is modeled using RIMS sector 21311A. NAICS sectors 423320 and 423520 are modeled using RIMS sector 420000.

22 The three-step process of matching the components of the aggregate industry to RIMS sectors, modeling the individual effects, and then aggregating the individual contributions of the components is often termed analysis-by-parts. It is technically equivalent to modeling the activity as a single entity, but the process can produce more appropriate impact estimates when the activities being modeled do not fit precisely within a single RIMS II industry sector.

23 We do not attempt to formulate a comprehensive net cost-benefit analysis of the state's aggregate industry. There are many relevant components to a net analysis that extend well beyond the direct economic role of the industry. These include social costs and benefits, alternative uses of state and local funding, alternative options for providing aggregate material in the state, and the deadweight economic loss that can occur in the private sector because of taxpayer funding of services.

24 We do not construct a counterfactual scenario that represents an alternative comparative view of the state economy that removes the aggregate industry and its various interrelationships from the structure of the model. Devising a sound counterfactual analysis that represents a reasonable alternative use to products from the aggregate industry presents a considerable modeling challenge. It is not at all clear what the proper counterfactual should be in assessing the economic role of aggregate production.

25 This approach to estimating the tax contribution of the industry reflects the lack of administrative data on the incidence of state and local taxation by industry in most states, including Oklahoma. An average tax rate assumes the aggregate industry pays taxes, across the full range of taxes, at the same rate as all industry sectors. The estimates can be adjusted upward or downward based on the degree to which the industry is believed to pay more or less tax on average. Payments also differ substantially by industry across the various types of tax paid.

26 See: Urban Land Institute, 2020. "State and Local Finance Data." https://state-local-finance-data.taxpolicycenter.org/pages.cfm

27 The removal of taxes paid on oil and gas production before calculating the average tax rate removes the potential inflation of the rate by severance tax payments on oil and gas.

28 See Oklahoma's Mines and Mining statutes at: https://oksenate.gov/sites/default/files/2019-12/os45.pdf

29 See: https://mines.ok.gov/mineralnon-coal

30 See: https://mines.ok.gov/oklahoma-miners-training-institute-omti

31 See: https://mines.ok.gov/oklahoma-mining-commission

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