
Economic Impact of the Arizona Rock Products Industry

**Arizona Rock Products Association
916 W. Adams Street
Phoenix, Arizona 85007**



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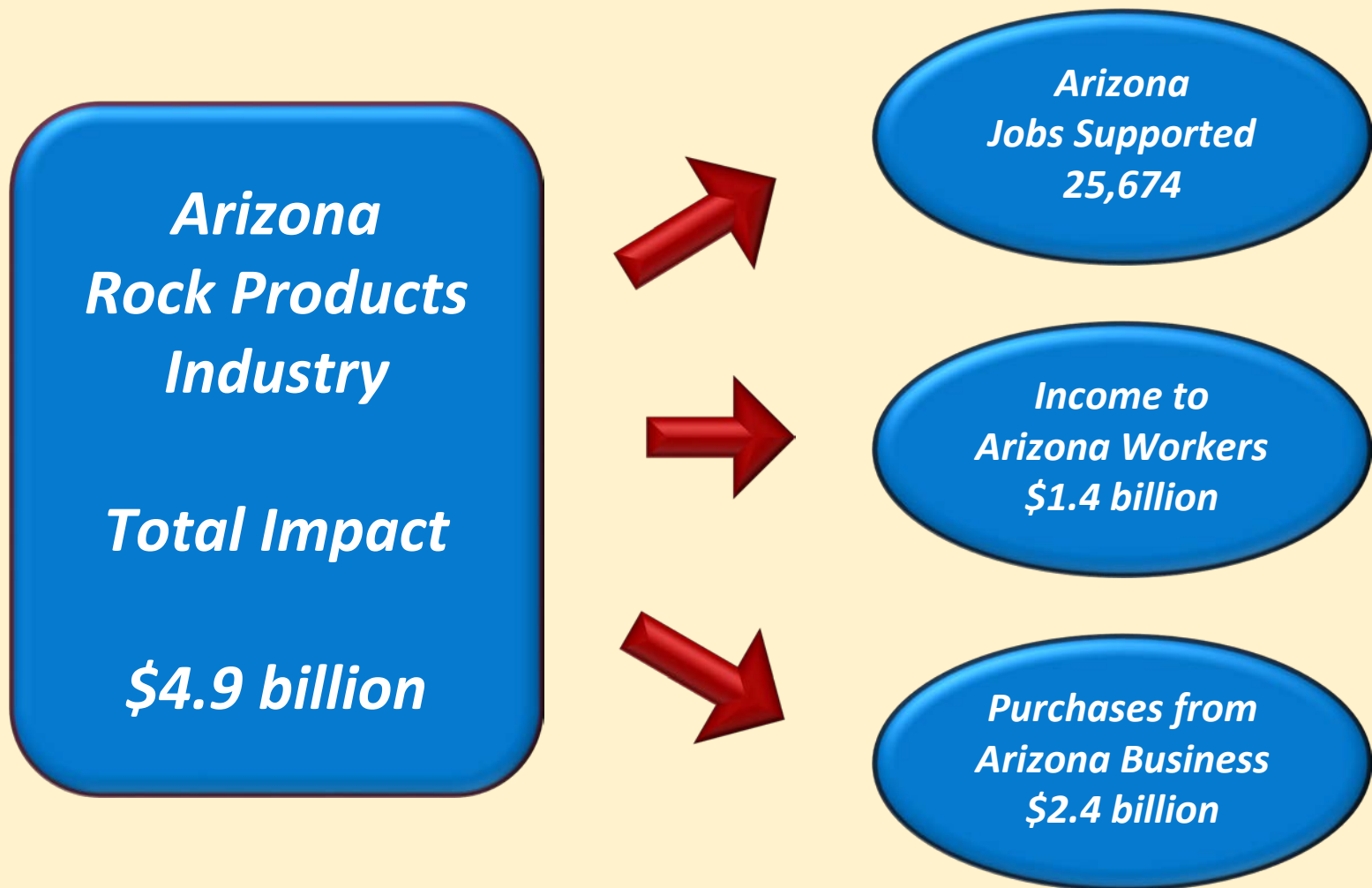
Executive Summary: Economic Impact 2017

The Arizona Rock Products industry includes sand and gravel mining firms, crushed stone producers, ready-mix concrete and asphalt suppliers, manufacturers of concrete and stone products, and producers of cement, gypsum, and lime.

Arizona Rock Products firms employed 7,745 Arizona workers in 2017 producing direct output valued at \$2.5 billion. As spending cycled back into the economy, these dollars created a total economic impact of \$4.9 billion and 25,674 total Arizona jobs. As a result of economic activity of the Arizona Rock Products industry, its workers and its suppliers:

- Personal income created for Arizona workers was \$1.4 billion
- Purchases from Arizona businesses created \$2.4 billion in new sales
- Tax revenue to Arizona state and local governments was \$236.9 million
- Each of the 7,745 workers in the Rock Products industry supported an additional 2.3 jobs per worker, distributed across all other industries of the economy
- The 7,745 workers in the Rock Products industry supported 145,500 workers in construction (a ratio of 19/1), Arizona's fastest growing sector in 2017

The Rock Products Industry Supports Arizona Workers and Businesses



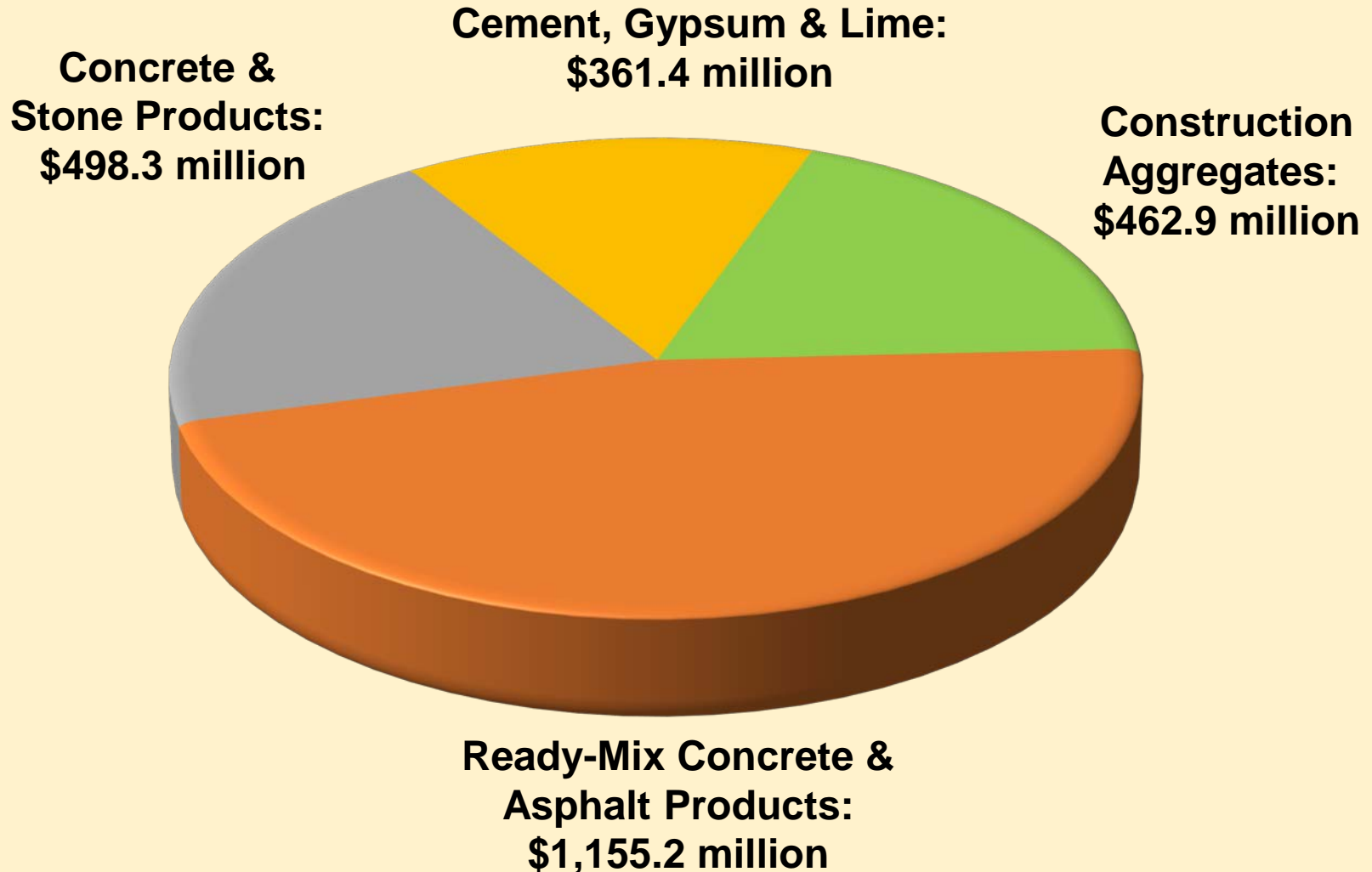
The Arizona Rock Products Industry

Within the river beds and flood plains of Arizona and located close to growing metropolitan areas are some of the finest sources of sand and gravel in the world. These deposits must be counted among the most important natural resources in the Arizona economy. Along with sand, gravel and stone providers, the Arizona Rock Products industry includes ready-mix concrete and asphalt suppliers, manufacturers of concrete products such as pipe and blocks, and producers of cement, gypsum and lime.

These products are vital to Arizona's economic development and especially for construction of residential and office structures, schools, roadways, hospitals, airports and other private and public facilities. Rock products are truly the foundation of growth.

The value of Arizona Rock Products industry output in 2017 was \$2,477.8 million. Ready-mix concrete and asphalt made up the largest single component, at \$1,155.2 million followed by aggregates output (sand, gravel and crushed stone) of \$462.9 million. Output of concrete and stone products was \$498.3 million. Cement, gypsum and lime output was valued at \$361.4 million.

Arizona Rock Products Direct Output: \$2.5 billion



Arizona was the Second Leading State for Non-Fuel Mineral Resource Production in 2017

| State | Rank | Value | Percent of U.S. Total |
|------------|------|---------------|-----------------------|
| Nevada | 1 | \$8.7 billion | 11.5% |
| Arizona | 2 | \$6.6 billion | 8.8% |
| Texas | 3 | \$5.2 billion | 6.9% |
| Alaska | 4 | \$3.5 billion | 4.7% |
| California | 5 | \$3.5 billion | 4.7% |

According to the U. S. Geological Survey, Arizona ranked second in the nation in the value of non-fuel mineral production (including copper, molybdenum, sand and gravel, cement, and crushed stone) in 2017.

For that same year, the USGA reports that the value of Arizona's sand and gravel produced (\$381 million) was third greatest of all states, ranking behind only California and Texas. The value of Arizona sand and gravel produced in 2017 was 8.2 per higher than the prior year.

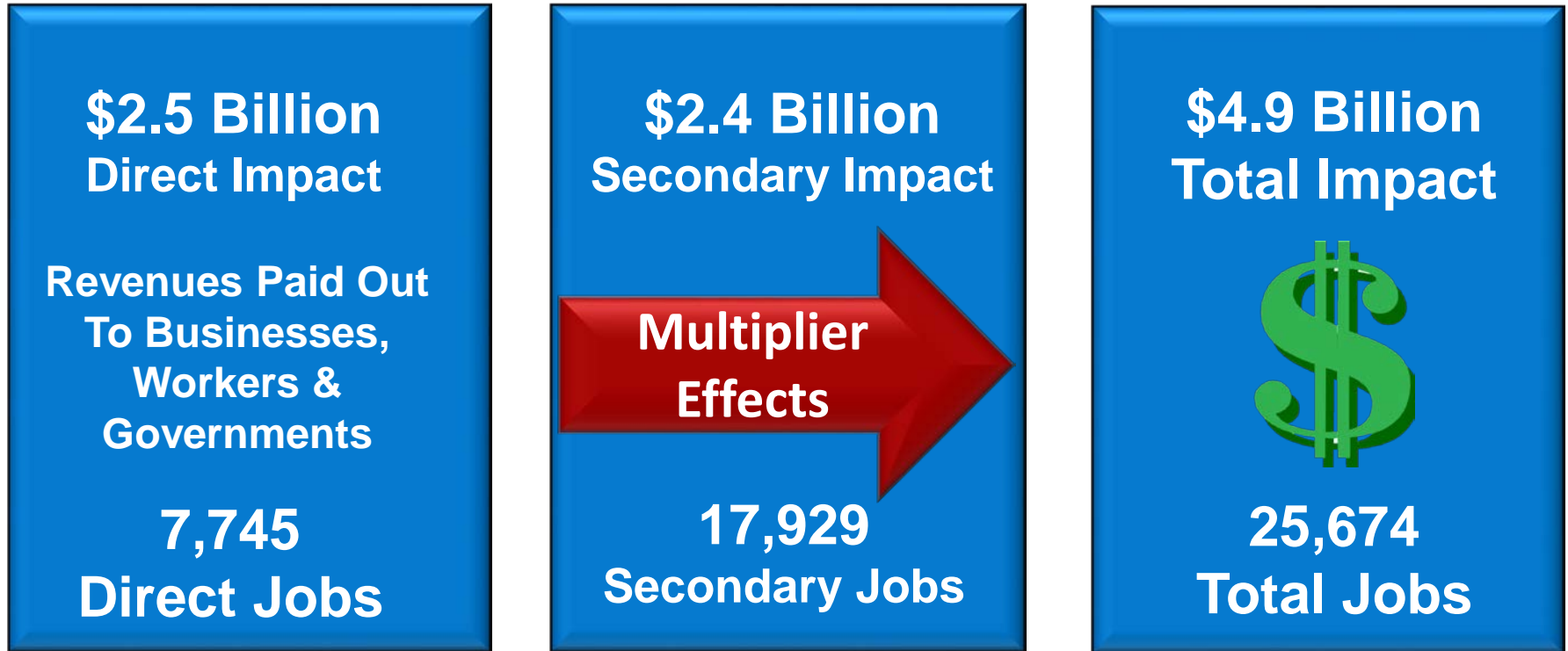
Economic Impact of The Rock Products Industry

This economic impact study was conducted to analyze the contribution of the Arizona Rock Products industry to the state's economy. Four indicators were used to measure impacts: employment, personal income, output, and value added. The data sources for these indicators are explained below.

The economic impact process involves four types of impacts: direct, indirect, induced, and total impact. The direct impact of an industry equals the value of its output and employment, as well as personal and business incomes created, and taxes and fees paid to governments. Measured by market value of output (sales), the Arizona Rock Products industry direct impact was \$2.5 billion in 2014. Industry employment was 7,745 workers taking home income of \$913.6 million.

When workers spend their income on consumer goods, the effects are known as induced impacts. When firms make supply chain purchases, these are indirect impacts. In this study, the induced and indirect impacts are *combined* as secondary impacts. Secondary impacts were \$2.4 billion in 2017. The total economic impact of the Arizona Rock Products industry is the sum of the direct and secondary impacts, measured as \$4.9 billion in 2017.

Economic Impact of The Rock Products Industry



Secondary impacts are due to the multiplier effects embedded within an input-output model. The total impact is the sum of direct and secondary impacts as the initial direct impact recirculates within the economy. Every \$1 billion of direct Rock Products industry output stimulated an additional \$960 million in total Arizona output and each Rock Product industry worker supported an additional 2.3 jobs in the overall economy in 2017.

Direct Impact of The Rock Products Industry

| Direct Impact by Source | Output (\$ millions) | Value Added (\$ millions) | Personal Income (\$ millions) | Employment |
|---------------------------------|-------------------------|---------------------------------|-------------------------------------|--------------|
| Construction Aggregates | \$462.9 | \$271.0 | \$108.4 | 2,231 |
| Ready-Mix Concrete & Asphalt | 1,155.2 | 330.5 | 197.0 | 2,689 |
| Concrete & Stone Products | 498.3 | 196.6 | 120.4 | 2,141 |
| Cement, Gypsum & Lime | 361.4 | 115.5 | 44.2 | 584 |
| <i>Direct Impact</i> | <i>\$2,477.8</i> | <i>\$913.6</i> | <i>\$470.0</i> | <i>7,745</i> |

The direct impact of the Rock Products industry was \$2,477.8 million of output and creation of 7,745 Rock Products jobs with income to workers of \$470 million. The industry value added contributed \$913.6 million to Arizona's Gross Domestic Product (GDP) in 2017. Value added is smaller than output because it is calculated as output minus the cost of intermediate inputs, supplies and materials in production.

Secondary Impact of The Rock Products Industry

| Secondary Impacts | Output (\$ millions) | Value Added (\$ millions) | Personal Income (\$ millions) | Employment |
|--------------------------|-------------------------|---------------------------------|-------------------------------------|---------------|
| Purchases from Suppliers | \$924.2 | \$493.1 | \$317.8 | 5,451 |
| Purchases by Workers | 1,021.1 | 590.8 | 331.2 | 7,448 |
| Purchases by Government | 478.9 | 381.9 | 289.8 | 5,030 |
| <i>Indirect Impacts</i> | <i>\$2,423.2</i> | <i>\$1,465.8</i> | <i>\$938.8</i> | <i>17,929</i> |

Secondary impacts occur after Rock Products firms pay their workers and purchase materials and services from Arizona suppliers, who in turn purchase from their own suppliers and make payments to their employees. Taxes paid by firms and workers provide revenues for government spending, estimated as a separate impact in this study. This spending recycled through multiplier effects to create secondary impacts of 17,929 additional Arizona jobs and further output of \$2,423.2 million, with income to workers of \$938.8 million. Secondary impacts contributed \$1,465.8 million in value added to Arizona GDP.

Secondary Impacts Benefit All Arizona Industries

| Secondary Impacts by Industry | Output (\$ millions) | Personal Income (\$ millions) | Employment |
|-------------------------------------|-------------------------|-------------------------------------|---------------|
| Banking, Insurance & Real Estate | \$560.0 | \$93.7 | 1,972 |
| Environmental & Business Services | 351.7 | 176.4 | 3,414 |
| Government & Non-Profit | 278.3 | 233.0 | 3,722 |
| Transportation & Warehousing | 188.7 | 60.5 | 1,046 |
| Health Care Services | 177.8 | 99.1 | 1,676 |
| Wholesale Trade | 173.4 | 60.7 | 737 |
| Retail Trade | 130.9 | 52.4 | 1,474 |
| Agriculture & Mining | 127.3 | 25.3 | 279 |
| Telecommunication & Data Processing | 125.8 | 22.7 | 278 |
| Accommodations & Food Services | 88.9 | 32.3 | 1,393 |
| Manufacturing | 68.9 | 12.7 | 192 |
| All Other Arizona Industries | 151.5 | 70.0 | 1,745 |
| <i>Secondary Impacts</i> | \$2,423.2 | \$938.8 | 17,929 |

As Arizona Rock Products direct spending recycled in the economy, secondary impacts benefited all Arizona industries with additional sales, jobs, and worker incomes.

Total Impact of The Rock Products Industry

| Economic Impacts | Output (\$ millions) | Value Added (\$ millions) | Personal Income (\$ millions) | Employment |
|-------------------------------------|---------------------------------|--|--|----------------------|
| Direct Impact | \$2,477.8 | \$913.6 | \$470.0 | 7,745 |
| Secondary Impacts | 2,423.2 | 1,465.9 | 938.8 | 17,929 |
| <i>Total Economic Impact</i> | <i>\$4,901.0</i> | <i>\$2,379.5</i> | <i>\$1,408.8</i> | <i>25,674</i> |

The total economic impact of the Arizona Rock Products industry is the sum of direct and secondary impacts (\$4,901.0 million in 2017). Rock Products industry operations ultimately created 25,674 jobs in the Arizona economy with personal income to workers of \$1,408.8 million. The value added to state GDP was \$2,379.5 million. Value added is smaller than output by the cost of intermediate inputs, but not all are purchased from Arizona firms. It is the spending for inputs and consumer goods purchased only from Arizona suppliers (\$2,423.2 million) that recycled as secondary impacts. Therefore, all values in the table represent impacts on the Arizona economy, measured by jobs, incomes, value added, and output.

Tax Impact of The Rock Products Industry

| Taxes Paid | State & Local (\$ millions) | Federal (\$ millions) | Total (\$ millions) |
|------------------------------|--|----------------------------------|--------------------------------|
| Rock Products Firms | \$23.1 | \$58.5 | \$81.6 |
| Rock Products Workers | 50.8 | 54.2 | 105.0 |
| Supplier Firms | 85.6 | 77.8 | 163.4 |
| Supplier Workers | 77.5 | 88.7 | 166.2 |
| <i>Tax Impacts</i> | <i>\$237.0</i> | <i>\$279.2</i> | <i>\$516.2</i> |

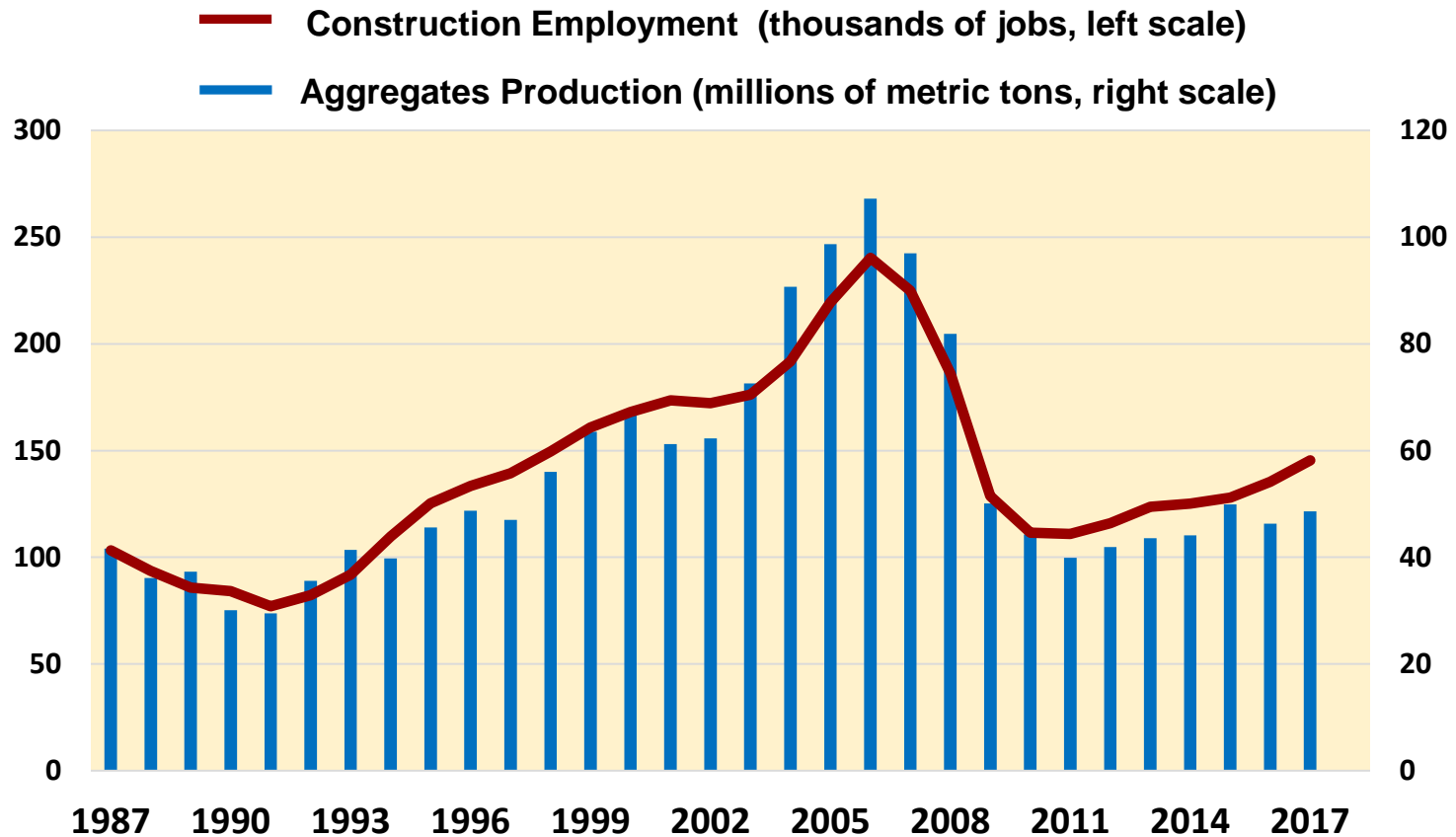
Businesses and workers pay income taxes on earnings, sales taxes on purchases, property taxes, motor vehicle taxes, and various fees. Total state and local tax revenues associated with Rock Products economic activity, based on combined direct and secondary impacts, summed to \$237.0 million in 2017. Federal taxes were \$279.2 million and total taxes were \$516.2 million. Rock Products firms paid state, local and federal taxes of \$81.6 million and their workers paid taxes at all levels of \$105.0 million.

Arizona Construction Relies on Rock Products

Arizona is traditionally recognized as a leading growth state. According to official statistics, Arizona ranked 4th among all states in growth of Gross State Product in 2017, ranked 5th in both personal income and employment gains, and ranked 6th in the rate of population growth. The construction industry provides the state's critical infrastructure expansion to accommodate this growth, with the support of the Rock Products industry. Sand, gravel, stone, concrete, cement, and other Rock Products are used by workers in all types of construction, including commercial and public structures, street and highway construction, and multi-family and single family residential buildings. For example, about 400 tons of aggregates are needed to build the average Arizona home. In 2017, the 7,745 workers in the Arizona Rock Products industry supported 145,500 construction workers (a ratio of 19 to 1).

Construction and the Rock Products industry tend to move together over the business cycle. After peaking in 2006, both industries saw severe declines in employment and output until reaching a cycle trough in 2011. Arizona construction employment and aggregates production are now increasing. From 2011 to 2017, construction employment increased by 31.1 percent and Arizona aggregates tonnage rose by 21.8 percent. The 2017 aggregates output was 48.6 million metric tons (U.S Geological Survey).

Arizona Aggregates and Construction Move Together Over the Business Cycle



Construction employment fell by more than half during the Great Recession, but was Arizona's fastest growing industry in 2017 (up 7.4%). Aggregates production similarly declined by 40 percent from peak 2006 output, but is now on the rise.

The Rock Products Industry Supports 145,500 Arizona Construction Workers

28,800 Workers
*Construction of
Buildings*

16,800 Workers
*Heavy
Construction*

99,900 Workers
Special Trades

*Each Rock Products Worker Supports
19 Arizona Construction Jobs*

7,745 Workers
Rock Products Industry

Rock Products Impact in Arizona Counties

Every Arizona county requires materials from the Arizona Rock Products industry to support growth, development, infrastructure, commercial centers and residential units. Larger counties with greater construction activity tend to account for a higher level of demand and as a result, tend to have more locally based production facilities.

“Direct” output and employment in the accompanying table measure production and jobs within Rock Product firms in each county. “Total” output and employment include all multiplier effects of secondary spending and employment supported by the presence of Rock Product activity and sales in that county.

The greatest levels of Rock Products output and employment are found in Maricopa County, which accounts for 61 percent of the state’s population and 64 percent of direct Rock Products output. Pima County has 14 percent of Arizona population and accounts for 11 percent of Rock Products direct output. Yavapai County has the third most Rock Products activity, followed by Pinal county, now part of the greater Phoenix Metropolitan Statistical area. These four counties all have more than 1,000 total jobs due to direct and secondary economic activity related to the Rock Products industry.

Rock Products Impact in Arizona Counties

| County | Direct Output (\$ millions) | Direct Employment | Total Output (\$ millions) | Total Employment |
|----------------------|--------------------------------|----------------------|-------------------------------|---------------------|
| Apache | \$28.8 | 94 | \$56.9 | 313 |
| Cochise | 27.9 | 82 | 55.1 | 273 |
| Coconino | 29.2 | 100 | 57.8 | 331 |
| Gila | 52.8 | 151 | 104.4 | 500 |
| Graham | 20.4 | 74 | 40.4 | 244 |
| Greenlee | 0.8 | 3 | 1.6 | 11 |
| La Paz | 2.7 | 13 | 5.3 | 43 |
| Maricopa | 1,585.5 | 4,866 | 3,136.0 | 16,130 |
| Mohave | 60.8 | 291 | 120.3 | 963 |
| Navajo | 46.0 | 159 | 91.0 | 528 |
| Pima | 285.0 | 748 | 563.8 | 2,480 |
| Pinal | 129.9 | 427 | 257.0 | 1,416 |
| Santa Cruz | 7.5 | 25 | 14.9 | 83 |
| Yavapai | 160.3 | 534 | 317.2 | 1,769 |
| Yuma | 40.1 | 178 | 79.4 | 590 |
| Total Impacts | \$2,477.8 | 7,745 | \$4,901.0 | 25,674 |

Economic Impact Study Methodology

The purpose of this study is to analyze and measure the economic impact of the Arizona Rock Products industry on the state's economy. The impact methodology involved application of an IMPLAN model based on Arizona data. IMPLAN is an input-output model regularly used in regional economic research for impact analysis. The model estimates secondary or multiplier effects from direct impacts and also has state-specific values for other useful variables such as output per worker, compensation, and the proportion of inputs each producer purchases locally. Four indicators of economic impact were used: employment, personal income, output, and value added.

Figures on 2017 employment for each Rock Products sector in Arizona counties and the state were obtained from the Quarterly Census of Employment and Wages, as reported by the U.S. Bureau of Labor Statistics. Jobs for sand and gravel and stone mining operations were checked against county figures from the Mine Safety and Health Administration. Following the U.S. BLS procedures, the tally of jobs reported here includes full and part time workers, as well as those who are self-employed.

Personal income consists of two components, worker compensation and proprietor (self employed) income. Compensation for each producer in the Rock Products industry

Economic Impact Study Methodology *Continued*

includes earnings of the self-employed and wages received by workers as well as employer paid social security, health insurance and other benefits as derived from the U.S. Bureau of Economic Analysis and incorporated in the data for the IMPLAN model.

Output is synonymous with the value of sales or shipments for each of the component sectors of the Rock Products industry. Output for sand and gravel mining and stone production (aggregates) was based on U.S. Geological Survey reports for 2017. Output estimates for other producers (such as ready-mix concrete) were derived through Arizona output coefficients in the IMPLAN model.

Value added is a measure of the change in value at each stage of production, calculated as the value of output from that production stage minus the cost of intermediate inputs from suppliers. The basic components of value added are compensation paid out to workers and retained business income before taxes. Conceptually, firms at each stage of production “add value” when they buy inputs and then process these inputs for sale to the next stage of production at a new higher price sufficient to cover the costs of the initial inputs plus compensation to workers plus a return to the business enterprise.

Economic Impact Study Methodology *Continued*

The sale price of products to final users such as consumers will incorporate the combined valued added at each previous stage of production. At the national level, Gross Domestic Product (GDP) is defined as the sum of value added across industries, net of the cost of intermediate inputs. Similarly, the value added by the Arizona Rock Products industry (\$2,379.5 million) is its addition to Arizona Gross State Product.

The economic activity of an industry can be measured by employment, personal income, output or value added. Each of these measures appears in the tables in this report, but the emphasis is placed on output, the broadest measure of impact, following industry studies by the U. S. Bureau of Economic Analysis. However, It should be noted that the Rock Products industry in Arizona includes firms involved in various stages of production, and some output from one stage (such as mining of sand and gravel) is used as an intermediate input for a later stage (such as ready-mix concrete).

Adjustments were made in the IMPLAN input-output model used in this analysis to eliminate overstating the impacts of sales of intermediate goods to producers, through application of an IMPLAN feature known as “contribution analysis.”

Economic Impact Study Methodology *Continued*

Contribution analysis adjusts the IMPLAN coefficients so that all Rock Products industry output is captured as direct impacts. Inter-industry Rock Products sales as secondary intermediate goods are effectively “zeroed out.” This step provides a more accurate measure of the industry’s basic share of employment, personal income, value added and output in the state.

A second customization of standard IMPLAN model methodology was used to estimate state and local taxes and the effect of government expenditures based on these revenues. Total state and local taxes paid were estimated as \$237.0 million. Estimates for state and local taxes paid by workers were derived from U. S. Census Bureau figures, resulting in revenue to state and local governments of \$128.3 million. Rock Products firms paid state and local business taxes estimated as \$23.1 million and supplier firms paid \$85.6 million. Next, the state and local government sector was removed from the input-output analysis based on Rock products activity and re-introduced to the model as a separate source of impact from government spending of the \$237.0 million tax revenues generated through the economic activity of the Rock Products industry. This resulted in an addition to output of \$478.9 million and 5,030 jobs created throughout the economy, included as a secondary impact in this study.

Economic Impact Data Sources

The following data sources were used in this study:

1. Arizona Department of Revenue, Phoenix, Arizona
2. Arizona Rock Products Association, Phoenix, Arizona
3. IMPLAN Group and IMPLAN System, Huntersville, N.C.
4. National Stone, Sand and Gravel Association, Alexandria, VA
5. U. S. Bureau of Labor Statistics, Washington, D. C.
6. U.S Census Bureau, Washington, D.C.
7. U. S. Geological Survey, Washington, D.C.
8. U.S. Mine Safety and Health Administration, Denver, CO

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**Arizona Rock Products Association
916 W. Adams Street
Phoenix, Arizona 85007**

**Prepared by
L. William Seidman Research Institute
W. P. Carey School of Business
Arizona State University**

