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# ECOSYSTEM GAP ANALYSIS

OKLAHOMA OFFICE OF WORKFORCE DEVELOPMENT



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## Key Findings

This study examines selected occupations employed in Oklahoma’s five key demand industry sectors, or economic systems, known as “ecosystems.” Ecosystems provide Oklahoma with a competitive advantage in a global economy. They exhibit significant potential for employment growth and provide wealth generating employment opportunities. The five key ecosystems’ demand industries produce or provide similar goods and services and therefore have similar needs in workforce, infrastructure, and economic development policy. These ecosystems include Aerospace and Defense, Agriculture and Biosciences, Energy, Information and Finance, and Transportation and Distribution. The analyses focused on identifying and quantifying 1) the gap between the educational attainment of the current workforce and the educational attainment needs of a projected 2025 workforce; 2) stress in the educational pipeline intended to provide graduates to fill newly created jobs in the top 10 growth occupations for each ecosystem; and, 3) any additional factors found to impact the ability to meet industry needs in filling high growth occupations.

These analyses resulted in the following findings.

### Ecosystem Comparisons

- **No two ecosystems exhibit the same characteristics and face the same economic challenges regarding the projected needs of a 2025 workforce.** The strengths and challenges identified, within the scope of this study, for the industries within each ecosystem are unique and varied.
- Anticipated workforce skills gaps within an ecosystem range from 7% to 35%. **The skills gap is greatest in those ecosystems employing a large percentage of highly technical workers – Aerospace and Defense, and Information and Finance.** The skills gap is smallest in the Transportation and Distribution Ecosystem, an ecosystem that continues to rely upon a large number of occupations which value the ability to perform physical labor over the attainment of higher education.
- The top 10 growth occupations identified for each ecosystem account for 40.4% (17,748) of all new ecosystem jobs projected to be created by 2025.
- **Most job classifications are utilized by a variety of employers; therefore, industries within the five ecosystems must compete for qualified workers, not only among themselves, but with other employers outside of the five ecosystems.**
- **Industrial Machinery Mechanics** job classification appears on the top 10 growth lists for four of the five key ecosystems. Other growth occupations across ecosystems include *General and Operations Managers; Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products;* and a variety of computer-related occupations such as computer support specialists, software developers and analysts.

- Occupations in two of the five ecosystems – Aerospace and Defense, and Agriculture and Biosciences – experience signs of potential educational pipeline stress. Educational pipeline stress is characterized by an insufficient supply of appropriately trained workers available to fill expected job openings.

#### Aerospace and Defense

- Total employment in industries within the Aerospace and Defense Ecosystem is projected to increase 6.1% by 2025, creating nearly 8,000 new jobs.
- **For newly created jobs in Aerospace and Defense, 89% will require a postsecondary degree or credential above a high school diploma or its equivalency.** Over 52% will require a Bachelor’s Degree or more. Without intervention, Oklahoma faces a 35% skills gap in meeting the educational attainment needs of Aerospace and Defense Ecosystem industries in less than 10 years.
- Three of the top 10 growth occupations in the Aerospace and Defense Ecosystem exhibit characteristics of educational pipeline stress.

#### Agriculture and Biosciences

- The Agriculture and Biosciences Ecosystem is the only ecosystem projected to decline in employment between 2016 and 2025. Overall, the ecosystem is anticipated to experience a net loss of nearly 1,000 jobs.
- The educational requirements for occupations in the Agriculture and Biosciences Ecosystem are centered predominantly in the classifications of high school diploma plus experience, Career and Technology (CareerTech) Certificate, or Associate Degree. These qualifications are sufficient for 44% of all newly created jobs by 2025.
- **Despite the comparatively lower educational requirements to meet the needs of new jobs in the Agriculture and Biosciences Ecosystem, Oklahoma will face a 23% skills gap in those industries by 2025 if no intervention occurs.**
- Four of the top 10 growth occupations in the Agriculture and Biosciences Ecosystem show symptoms of educational pipeline stress.

#### Energy

- **Despite a softening in the Oklahoma energy industry within the recent year, employment in the Energy Ecosystem is predicted to grow 16% by 2025, the largest anticipated growth of any ecosystem. This growth will add nearly 16,000 new positions.**
- The Energy Ecosystem is trending toward increased requirements for higher levels of education. Currently, however, occupations in Energy Ecosystem industries are centered predominantly on the possession of either a CareerTech Certificate or an Associate Degree. This education level is sufficient to meet the minimum education requirements for 62% of all newly created jobs. Twenty percent of those new jobs require a Bachelor’s Degree.

- Without intervention, Oklahoma is projected to face a 26% skills gap in meeting the educational attainment needs of Energy Ecosystem industries by 2025.
- **The Energy Ecosystem, more so than any of the other ecosystems, is experiencing stress due to an aging workforce. In five of the top 10 growth occupations, the percentage of the workforce over the age of 55 is 23% or higher. At the same time, new participants entering the workforce only account for between 2.5% and 7.8% in these same occupations.**

#### Information and Finance

- Information and Finance Ecosystem industries employ 5.9% of Oklahoma's workforce in 2016 and is projected to grow 5.9% by 2025. More than 7,700 new jobs will be created.
- The entry level education requirements for jobs within the Information and Finance Ecosystem are expected to significantly shift toward the need for college degrees within the next nine years. **By 2025, 46% of all jobs and 71% of all newly created jobs will require a Bachelor's Degree or higher.**
- Without intervention, Oklahoma is projected to face a 31% skills gap in meeting the educational attainment needs of industries in the Information and Finance Ecosystem.
- Based upon the data analyzed, the greatest threat to the ability to fill the top 10 growth jobs in the Information and Finance Ecosystem is competition from surrounding states, which report median hourly wages up to 60% higher than those found in Oklahoma.

#### Transportation and Distribution

- The Transportation and Distribution Ecosystem employs 6.7% of Oklahoma's total workforce and is projected to grow 4.8% by the year 2025. Nearly 7,600 new jobs will be created, 29% of which will be centered in the top 10 growth jobs for the industry.
- **Within the Transportation and Distribution Ecosystem, there is a shift toward a greater need for CareerTech Certifications or Associate Degrees. By 2025, 47% of all jobs and 37% of newly created jobs in the ecosystem will require these credentials.**
- Many positions within the Transportation and Distribution Ecosystem require physical labor. This results in the attainment of a high school diploma or less still qualifying job seekers for 46% of newly created jobs.
- Overall, without intervention, Transportation and Distribution Ecosystem industries will face a 7% skills gap in meeting educational attainment needs by 2025.
- The top 10 growth occupations in the Transportation and Distribution Ecosystem will account for 49% (3,755) of anticipated new job creation. Included on the list of top 10 growth occupations are positions critical to the success of the ecosystem, yet still maintain low educational requirements and relatively low median hourly earnings.

- **Wage disparities pose a challenge for the top 10 growth occupations in the Transportation and Distribution Ecosystem. Median hourly earnings for these positions are reported to be as much as 73% higher in surrounding states compared with Oklahoma.**

## Purpose

Oklahoma has identified five key, in demand, industry sectors known as “ecosystems” which provide the state with a competitive advantage in a global economy. The ecosystems exhibit significant potential for employment growth and provide wealth generating employment opportunities in the state. These five ecosystems include Aerospace & Defense; Agriculture and Biosciences; Energy; Information and Financial Services; and, Transportation and Distribution. Four additional regional or complementary ecosystems including Health, Education, Construction and Manufacturing have been identified within the state; however, only the five key ecosystems have been included in this study.

The purpose of this study is to identify and quantify 1) the gap between the educational attainment of the current workforce and the educational attainment needs of a projected 2025 workforce; 2) stress in the educational pipeline intended to provide graduates to fill newly created jobs in the top 10 growth occupations for each ecosystem; and 3) any additional factors found to impact the ability to meet industry needs in filling high growth occupations. To accomplish these goals, two unique but complementary methodologies were applied to data for each ecosystem: a skills gap analysis and an educational pipeline analysis.

## Methodology, Data Limitations, and Sources

- 1) **Skills Gap Analysis.** Initially, data representing the current educational attainment levels of Oklahoma’s working-age population – those individuals who are between the ages of 18 and 64, was examined. Educational attainment classifications are standardized by the U.S. Census Bureau and can range from “Less than 9<sup>th</sup> Grade” completion up to the achievement of a “Graduate Degree or Higher.” These data were then compared to the expected entry level of education required for job projections in each ecosystem in 2025 to identify skills gaps. Skills gaps are characterized as a disparity between the two data sets at one or more educational attainment levels.

One significant data limitation poses a hurdle to the accomplishment of this analysis. Specifically, the U.S. Census Bureau does not collect data regarding the number of individuals who have completed a Career and Technology Center Certification or achieved a professional license without a college degree. The only intermediary classification between the attainment of a high school diploma and the achievement of an Associate Degree is termed by the Bureau as “Some College.” Conversely, for occupational projections, many jobs require significant levels of training or work experience beyond the completion of a high school diploma, but less than an Associate Degree or no college coursework at all, assigning the requirements of these occupations to a unique category non-existent in Census Bureau data.

In order to overcome these classification issues, a three-step methodology was employed. First, occupational projections mandating substantial training above the achievement of a

high school diploma but below a Bachelor's Degree were isolated and determined, in best practice, to require the completion of a certificate or other appropriate non-degree industry-validated credential such as a professional license. This group was temporarily designated as requiring "Certification/Credential" attainment. Next, to achieve a comparable level of education based on the Census Bureau classifications, the categories of "Some College" and "Associate Degree" were combined. Finally, these two categories were aggregated under the nomenclature of "Associate/Certificate/Credential." This unique educational attainment category was utilized for all applicable analyses.

- 2) **Educational Pipeline Analysis.** This second analysis attempted to answer the question of, "Do regional education institutions produce sufficient graduates to meet the need of the growing demand for skilled workers in this occupation?" To accomplish this analysis, the top 10 growth occupations in each ecosystem as measured by new job creation between 2016 and 2025 were identified. An examination was then made of the educational "pipeline" – educational program graduates – qualified and available to fill those positions. This methodology results in the identification of possible pipeline "stress" or bottlenecks. Educational pipeline stress is characterized by an insufficient supply of appropriately trained workers available to fill expected job openings. The topic of Oklahoma's education and training facility "capacity," or the ability to produce greater numbers of graduates, fell outside the scope of this analysis and is not addressed.

Two data limitations include:

- Data regarding the estimated annual number of job openings as well as education completions are available only at the occupational level, not narrowed by ecosystem. Estimates for these two variables must be extrapolated from the statewide data. This presents a conflict for occupations critical to more than one ecosystem. For example, of the 2,576 Civil Engineers employed statewide in 2016, 899 (35%) are employed in the Aerospace and Defense Ecosystem while 861 (33%) are employed in the Agriculture and Biosciences Ecosystem; the remainder are employed in other ecosystems or non-ecosystem industries. It is not possible to predict in which industry a new civil engineering graduate will find employment. As a result, for the purposes of this analysis, the assumption is made that each ecosystem will mirror the state employment model as a whole. That is, the Aerospace and Defense Ecosystem, with 35% of civil engineers employed, will then attract and hire 35% of graduates. Likewise, Agriculture and Biosciences, with 33% of civil engineers employed, will attract and hire 33% of graduates, etc.
- The model utilized fails to address the issue of migration. With the exception of certain occupations that require licensure within the state of Oklahoma, the ability to quantify the permanent relocation of workers into and out of the state for the purpose of employment, based upon existing readily-available datasets, is limited. As a result, the analysis model represents a "closed system," assuming most

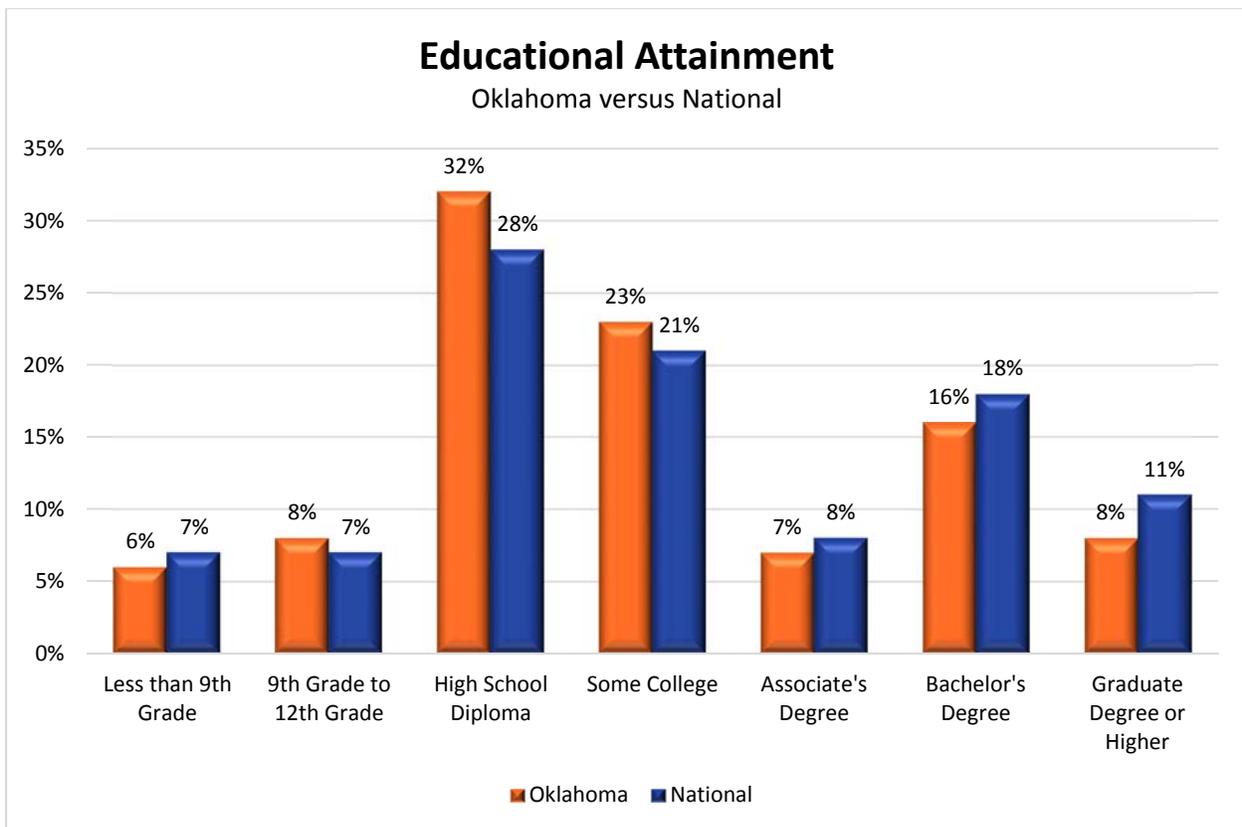
graduates of state programs will remain in Oklahoma and few graduates from outside the state will migrate into the state for employment.

- 3) **Labor Market Data Limitations.** Labor market analyses rely upon a large amount of data gathered from a variety of federal and state government, as well as private, sources. Based upon staggered reporting cycles, there are often delays in obtaining and synthesizing this data. The data provided for this analysis are the most recent available and the only basis upon which to model projections for the future.
- 4) **Data Sources.** Except when otherwise cited, the data utilized for these analyses are extracted from the Economic Modeling Specialist International (EMSI) database software. EMSI aggregates data from over 90 publicly-available or proprietary data sources including a variety of data from the U.S. Census Bureau, the Bureau of Labor Statistics, the Bureau of Economic Analysis and the National Center for Education Statistics (NCES), among others. Examples of datasets incorporated into the EMSI software include:
  - Quarterly Workforce Indicators (QWI);
  - Local Area Personal Income (LAPI);
  - Current Employment Statistics (CES);
  - Non-Employer Statistics (NES);
  - Quarterly Census of Employment and Wages (QCEW);
  - Occupational Employment Statistics (OES);
  - National Industry-Occupation Employment Matrix (NIOEM);
  - Occupational Information Network (O\*Net); and,
  - Integrated Postsecondary Education Data System (IPEDS).

The methodologies summarized here and the associated data are intended to provide a general overview of the educational gap in the state of Oklahoma as applied to ecosystem industries. A broad range of variables affect the labor market, thus, additional research is recommended for further understanding.

## Educational Attainment of Oklahomans Versus the Nation

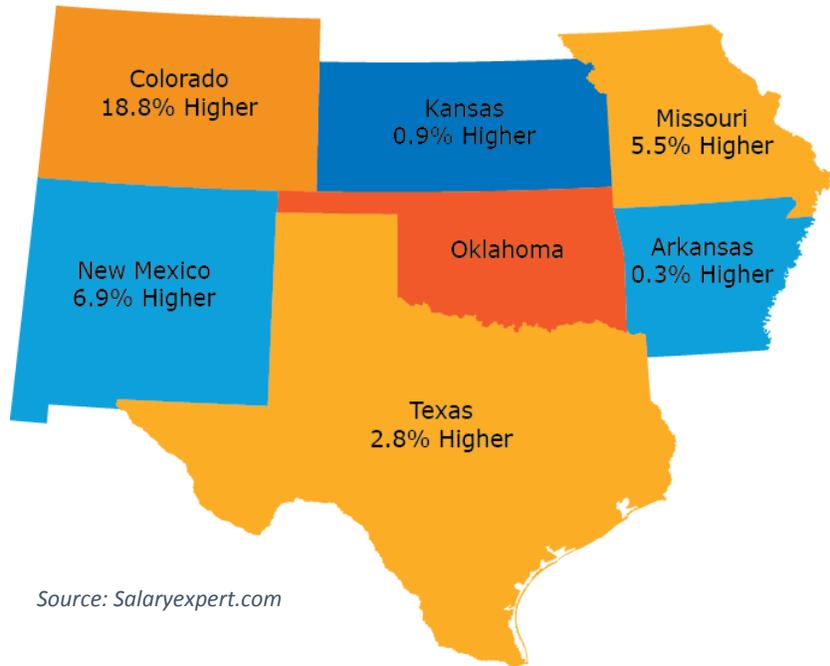
The American Community Survey (ACS), conducted by the U.S. Census Bureau, provides annual estimates of a variety of demographics for the total population of the United States. These data are used to establish the baseline for the educational gap analysis. As of 2016, 46% of Oklahoma residents have earned a high school diploma or less, compared with 42% nationally. There is a six percentage point differential between Oklahoma residents and the nation with regard to individuals who have attained an Associate Degree or higher – 31% in Oklahoma compared with 37% nationally. At the highest level of education, “Graduate Degree or Higher,” only 8% of Oklahomans are represented compared to 11% nationally.



Source: EMSI 2017.1

## Cost of Living Comparison – Six States Contiguous to Oklahoma

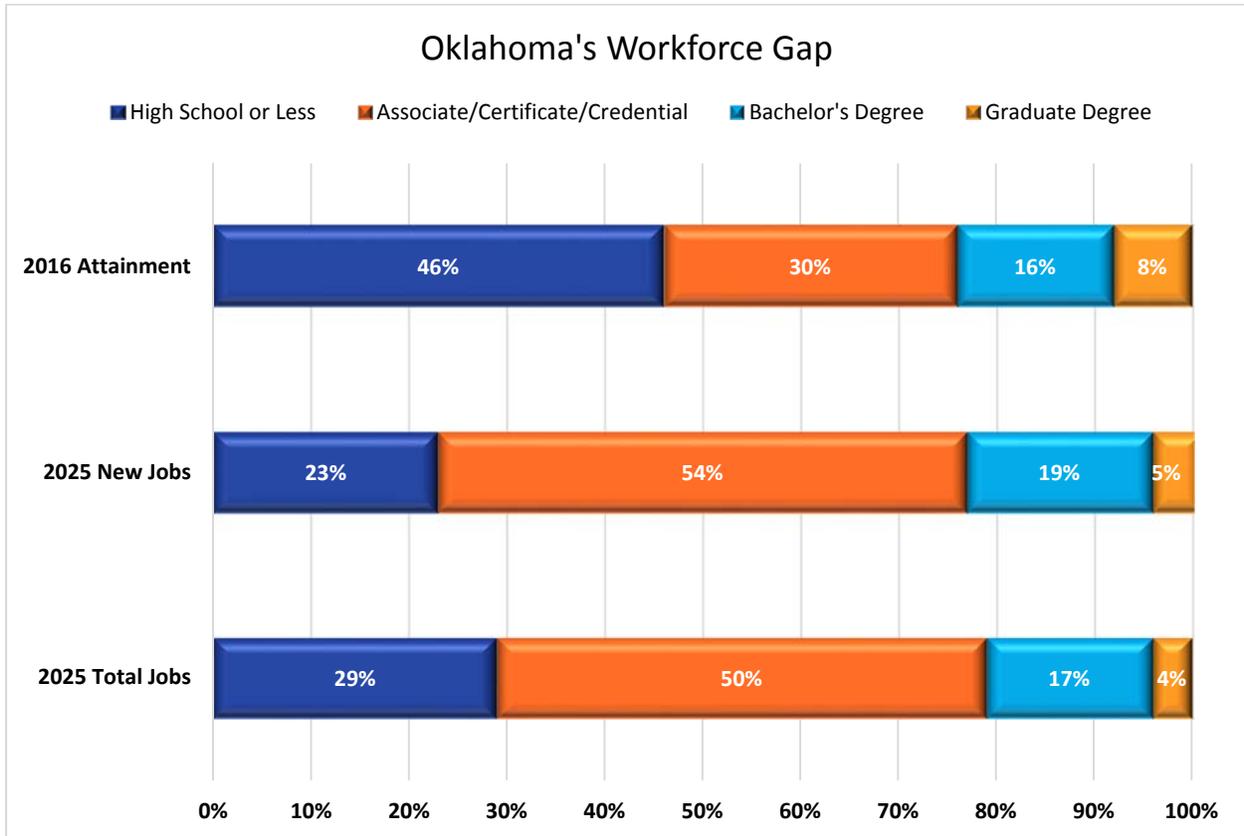
The educational pipeline analysis methodology evaluates the supply and demand for workers in a particular occupational classification within each of the five key ecosystems. However, it is not only possible, but likely, that many Oklahoma graduates will be enticed to leave the state for employment. One of the primary factors driving this migration of graduates is the possible wage differentials in Oklahoma versus the surrounding states. Although salaries may be higher in contiguous states, the cost of living in those locales must be weighed against the salary increase. The cost of living comparison for the six states contiguous to Oklahoma are provided in the map.



*Note: Cost of Living statistics are averages for the state cited. Individual cities may experience a higher or lower cost of living differential than provided.*

## Oklahoma Statewide Skills Gap

In 2016, employers reported 1,797,132 jobs in nearly 800 job classifications. By 2025, this figure is expected to grow to over 1,931,000; a growth rate of 7% resulting in the creation of nearly 134,000 new jobs. While 46% of Oklahomans possess a high school diploma or less, it is projected this education level will only be sufficient to meet the educational requirements of 23% of newly created jobs by 2025. Without intervention, Oklahoma faces a 23% skills gap in meeting the needs of employers statewide by 2025.



Source: EMSI 2015.2

## AEROSPACE AND DEFENSE ECOSYSTEM

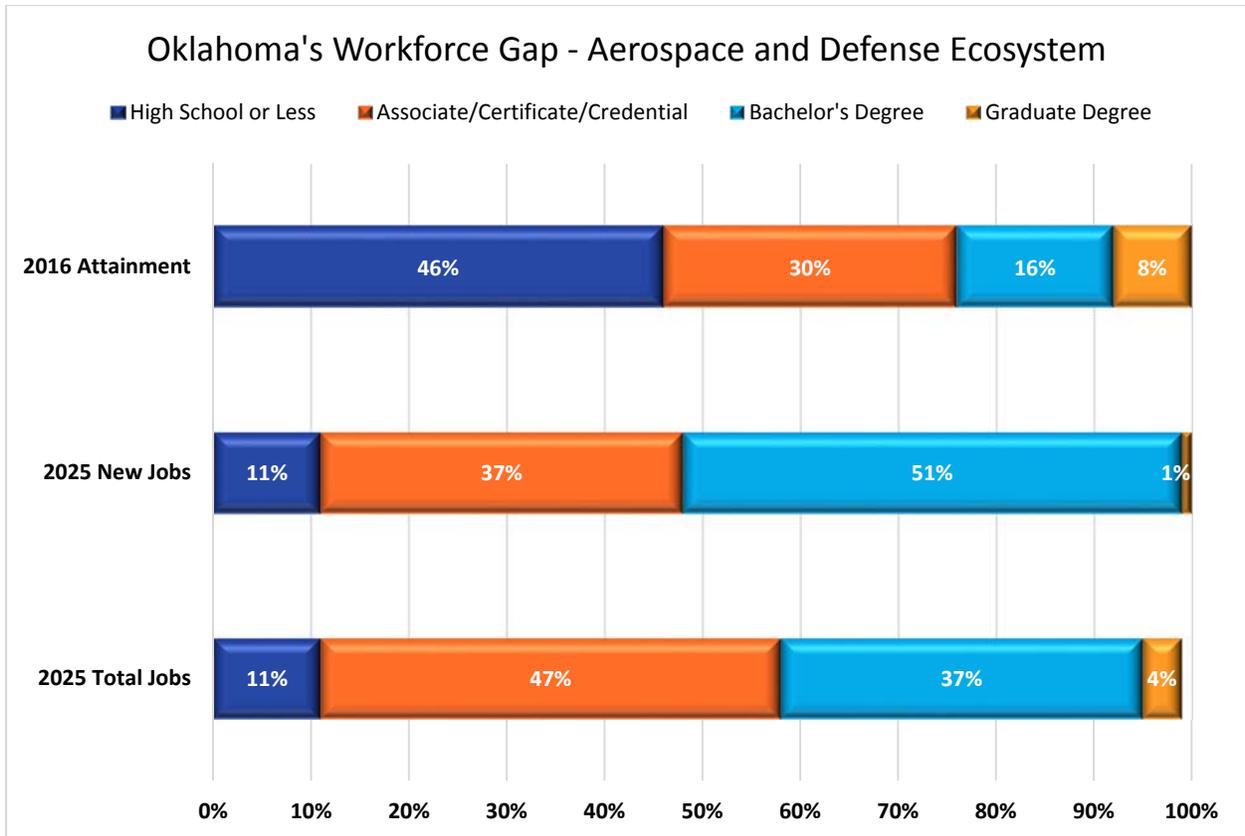
### *Gap Analysis*

In 2016, over 107,200 jobs, approximately 6% of Oklahoma's total workforce, were associated with industries in the Aerospace and Defense Ecosystem. By 2025, total employment is expected to increase 6.1% to nearly 114,000.

As industry needs evolve, several occupations within the ecosystem will experience a decline in demand, resulting in an associated loss of jobs. By 2025, it is anticipated 52 job classifications will experience the loss of between one and 422 positions each, resulting in an estimated overall total loss of 1,478 jobs. However, at the same time, growth in other occupations is expected to rise, with some jobs experiencing as much as a 45% increase. Overall, it is anticipated that nearly 8,000 new jobs will be created between 2016 and 2025.

As the occupational needs of the ecosystem's industries change, so too do the educational requirements of the individuals employed. Industries within the Aerospace and Defense Ecosystem require employees with advanced technical skills. By 2025, it is anticipated that over 40% of all jobs in these industries will require a Bachelor's Degree or higher. At the same time, a high school diploma or less will only provide the necessary skill set for 11% of jobs.

Of the 8,000 new jobs created in the next decade, 89% will require some type of credential above a high school diploma. Over 52% will require a Bachelor's Degree or higher. These projections indicate that without intervention, Oklahoma will face a 35% skills gap in meeting the needs of Aerospace and Defense Ecosystem industries in less than a decade.



Source: EMSI 2017.1

### *Educational Pipeline Analysis*

The top 10 growth occupations in the Aerospace and Defense Ecosystem are predicted to generate 2,757 new jobs by 2025 – approximately 35% of the anticipated new job growth among the ecosystem industries. They account for over 12% of the total jobs in the ecosystem industries and boast high median hourly earnings, between \$18 and \$38 per hour. The top 10 growth occupations and several key demographics of those positions are presented in Table 1.

**Table 1: Top 10 Growth Occupations in the Aerospace and Defense Ecosystem**

Description	Number of Jobs 2016	Projected Number of Jobs 2025	New Jobs Created 2016-2025	Percent of Occupation Currently Employed Statewide by this Ecosystem	Statewide Annual Job Openings (2015) <sup>1</sup>	Estimated Annual Job Openings <sup>2</sup>	Oklahoma Median Hourly Earnings	National Median Hourly Earnings	Typical Entry Level Education	Annual Educational Completions <sup>3</sup>	
										Total Completions	Estimated Completions Available for This Ecosystem
Software Developers, Applications	1,755	2,209	454	41.19%	141	58	\$36.21	\$47.68	Bachelor's Degree	591	243
Machinists	2,148	2,477	329	40.97%	266	109	\$18.72	\$19.63	High school diploma or Equivalent with Long-term On-The-Job Training	208	85
Computer Systems Analysts	959	1,270	311	29.18%	124	36	\$34.50	\$41.41	Bachelor's Degree	970	283
Computer User Support Specialists	1,283	1,580	297	16.36%	183	30	\$19.95	\$23.80	Some college, no degree	800	131
General and Operations Managers	1,850	2,112	262	6.93%	1,006	70	\$38.35	\$48.04	Bachelor's Degree plus 5 year's work experience	4,254	295
Management Analysts	1,910	2,171	261	32.47%	152	49	\$30.82	\$38.10	Bachelor's Degree with Less than 5 year's work experience	4,016	1,304
Software Developers, Systems Software	1,079	1,333	254	50.39%	67	34	\$33.96	\$51.08	Bachelor's Degree	619	312
Industrial Machinery Mechanics	798	1,003	205	19.13%	235	45	\$22.95	\$24.11	High school diploma or Equivalent with Long-term On-The-Job Training	0	0
Web Developers	504	698	194	38.15%	60	23	\$22.80	\$29.68	Associate Degree	1,563	596
Computer-Controlled Machine Tool Operators, Metal and Plastic	831	1,021	190	40.64%	125	51	\$18.00	\$18.08	High school diploma or Equivalent with Moderate On-The-Job Training	127	52

Source: EMSI 2017.1

- 1 "Annual Job Openings" is defined as all positions in this category that become vacant. This includes both newly created jobs as well as positions left vacant through turnover.
- 2 Estimated Annual Job Openings: Calculated as "Statewide Annual Job Openings (2015)" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."
- 3 Annual Education Completions: "Total Completions" represent the number of graduates of all state educational programs providing training applicable to the occupation. Estimated Completions Available for This Ecosystem" represents the estimated number of graduates that *may seek employment specifically in Aerospace and Defense Ecosystem industries*. Assuming that graduates are equally distributed among all industries that utilize a particular occupation, "Completions Available for This Ecosystem" is calculated as "Total Completions" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."

As indicated previously, educational pipeline stress is characterized by an insufficient number of graduates available to fill job openings. Three of the top 10 growth occupations in the Aerospace and Defense Ecosystem exhibit characteristics of educational pipeline stress. While each of these positions only require a high school diploma, they also require significant on-the-job training (OJT), elevating them into a category best addressed by the completion of a certificate in the field. These three occupations, accounting for 724 newly created jobs by 2025, are:

- *Machinists*: There are 109 anticipated job openings in this ecosystem annually with only an estimated 85 graduates available to fill them. Two programs, both available exclusively at Career and Technology Centers, exist to provide graduates for this occupation:
  - Machine Tool Technology Machinist program, offered by 19 centers; and,
  - Machine Shop Technology Assistant program, offered by 13 centers.
- *Industrial Machinery Mechanics*: There are 45 anticipated annual job openings for this position in the ecosystem of Aerospace and Defense, while no program graduates were available to fill those positions in the latest year reported. Only one program is available to train students for this occupation:
  - Industrial Mechanics and Maintenance Technology program, offered by six Career and Technology Centers statewide.
- *Computer-Controlled Machine Tool Operators, Metal and Plastic*: An estimated 51 job openings occur annually within the ecosystem. At the same time, 52 completions are available to fill those openings. Two programs, both available exclusively at Career and Technology Centers, are available to provide graduates for this occupation:
  - Machine Shop Technology Assistant program, offered by 13 centers; and,
  - Computer Numerically Controlled (CNC) Machinist Technology/CNC Machinist program offered by four centers.

It should be noted that the position of *Industrial Machinery Mechanics* appears on the top 10 growth occupations lists as well as the educational pipeline stress lists for four of the five key ecosystems including Aerospace and Defense, Agriculture and Biosciences, Energy, and Transportation and Distribution. Employers within these four ecosystems are all competing for a limited number of individuals in the labor market with these specialized skills. As a result, employers must develop creative strategies to entice these skilled workers to select their job opportunities over those of their competitors. Further discussion of this position will be included with each ecosystem section of this report, citing the appropriate data and circumstances specific to that ecosystem as appropriate.

Additional observations regarding the educational pipelines for the top ten growth occupations in the Aerospace and Defense Ecosystem:

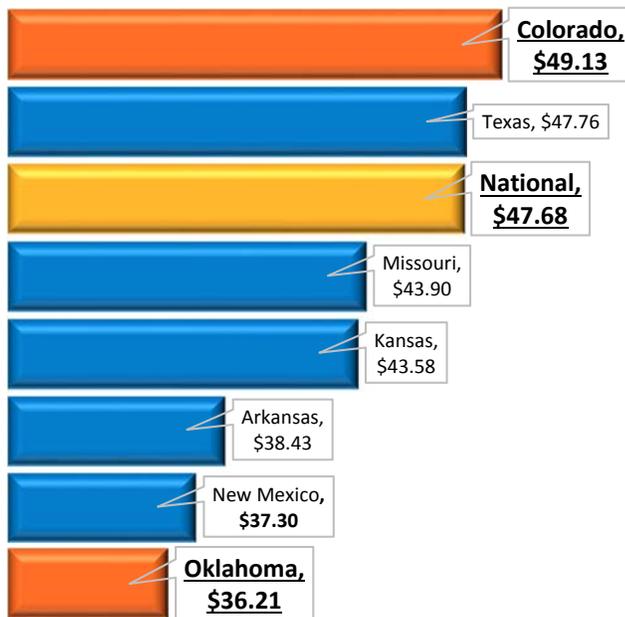
- An additional factor indirectly impacting the pipeline for two of the three classifications experiencing educational pipeline stress – *Machinists* and *Industrial Machinery Mechanics* – is the age distribution of those individuals in Oklahoma currently employed in these

positions. Over 25% of the workforce in these two occupations are currently 55 years of age or over, and are within a decade of traditional retirement age.

In comparison, for the job classification of *Machinist*, new workers under the age of 25 comprise only 6.5% of the workforce, while only 5.2% of *Industrial Machinery Mechanics* fall into this age category. In the long-term, as the workforce for these two occupations ages out, a greater number of staff must be educated or trained to step into those roles.

- The occupation of *Management Analyst* experiences an even higher percentage of an aging workforce, with 29.6% of those age 55 or older. Since this occupation requires the completion of a Bachelor’s Degree, individuals entering the workforce will be at a slightly higher age. Examining the next higher occupational age category, consisting of those employed who are under the age of 34, reveals that only 24% of the workforce are represented.
- While the position of *Software Developers, Applications* was not identified as experiencing pipeline stress with 243 available completions to fill 58 annual job openings, the occupation is at risk of losing many of those graduates to migration. All six surrounding

**Software Developers, Applications**  
Median Hourly Earnings Comparison



states – Arkansas, Colorado, Kansas, Missouri, New Mexico, and Texas – offer higher wages than Oklahoma, possibly enticing Oklahoma graduates to relocate. Median hourly earnings for this position in Oklahoma are \$36.21. Median hourly earnings across the six competing states range from a high of \$49.13 in Colorado to a low of \$37.30 in New Mexico. For Colorado, this salary differential equates to a 35.7% increase over Oklahoma. With the cost of living in Colorado only 18.8% higher, job openings in that state may very well attract applicants from Oklahoma’s graduate pool.

- The position of *Web Developers*, while experiencing a 38% growth in demand within the Aerospace and Defense Ecosystem, is over-saturated. Statewide, programs graduate 1,563 *Web Developers* annually; 596 positions are estimated to be available for placement in this

ecosystem alone. Unfortunately, only 23 positions are open annually for this occupation in Aerospace and Defense.

- For three of the top ten growth positions, Oklahoma is outclassed by five of six surrounding states with regard to median hourly earnings. Again, this provides incentive for Oklahoma graduates to leave the state in favor of better wages. Only Arkansas offers lower wages for *Computer User Support Specialists* (\$25.49/hour in Colorado), *General and Operations Managers* (\$50.46/hour in Texas), and *Software Developers, Systems Software* (\$52.06/hour in Colorado).

## AGRICULTURE AND BIOSCIENCES ECOSYSTEM

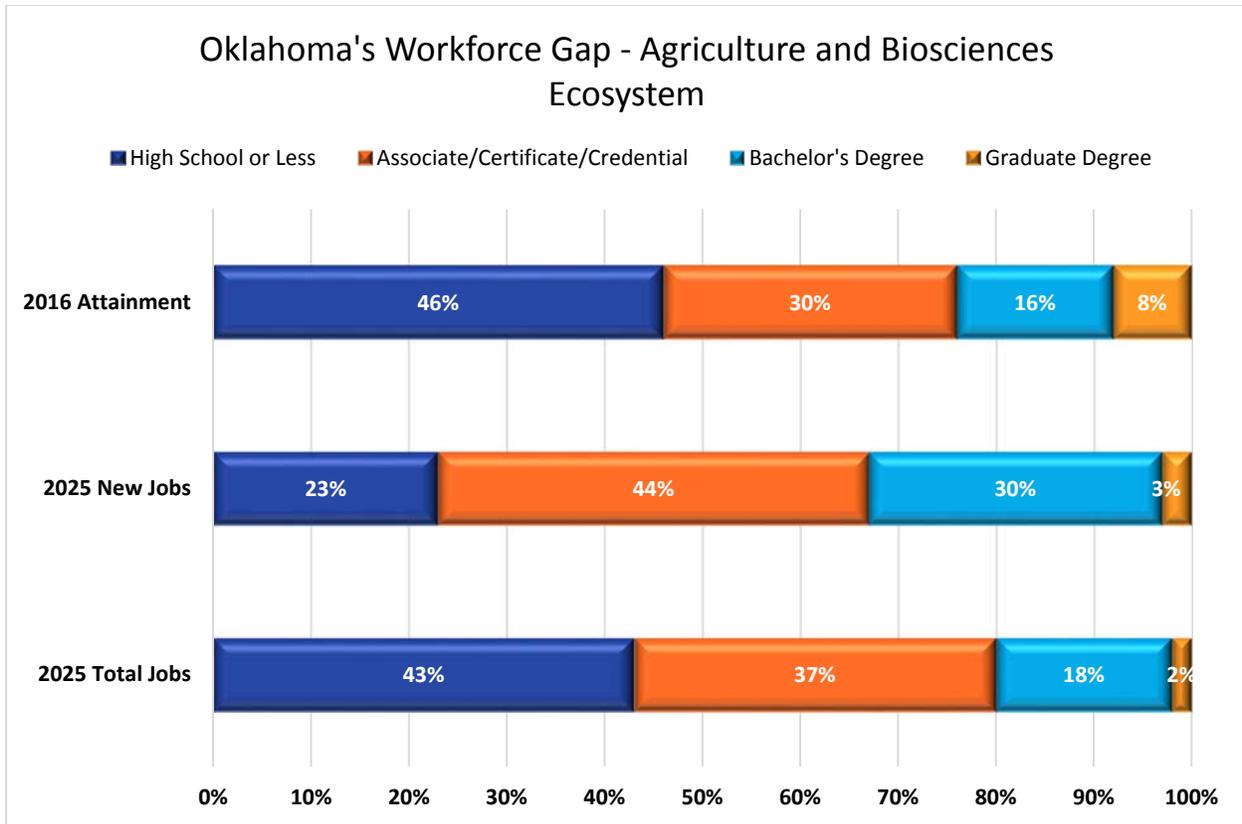
### *Gap Analysis*

Over 84,300 jobs were associated with industries in the Agriculture and Biosciences Ecosystem in 2016. This figure represents 4.7% of Oklahoma's total workforce. By 2025, the total employment in this ecosystem is expected to decrease to 83,400. Agriculture and Biosciences is the only ecosystem projected to experience a loss in total employment.

While 4,700 new jobs will be created in 231 occupation classifications, over 5,600 will be lost, predominantly in the job classification of *Farmers, Ranchers, and Other Agricultural Managers* which is expected to experience a 49% decreased demand. *Slaughterers and Meat Packers* (-19%); *Helpers – Production Workers* (-11%); and, *Farmworkers, Farm, Ranch, and Aquacultural Animals* (-10%) will also contribute to decreased demand resulting in significant job loss.

As the occupational needs of the ecosystem's industries change, so too do the educational requirements of the individuals employed. The educational requirements for Agriculture and Biosciences Ecosystem industries is anticipated to slowly move toward requiring higher credentials, but is still centered predominantly on either a(n) 1) high school diploma plus experience, 2) Career and Technology Center Certificate, or 3) Associate Degree. These qualifications are sufficient for 37% of all jobs and 44% of all newly created jobs by 2025. At the same time, approximately 33% of all jobs in Agriculture and Biosciences Ecosystem industries will require a Bachelor's Degree or higher while a high school diploma or less will only provide the necessary skill set for 23% of the jobs.

These projections indicate that, without intervention, Oklahoma will face a 23% skills gap in meeting the needs of Agriculture and Biosciences Ecosystem industries in less than a decade.



Source: EMSI 2017.1

### *Educational Pipeline Analysis*

The top 10 growth occupations in the Agriculture and Biosciences Ecosystem are predicted to generate 1,405 new jobs by 2025 – approximately 30% of the anticipated new job growth among the ecosystem’s industries. In 2016, these occupations accounted for just over 8% of the total number of ecosystem jobs and boasted moderate to high median hourly earnings, between \$14 and \$35 per hour. The top 10 growth occupations and several key demographics of those positions are presented in Table 2.

**Table 2: Top 10 Growth Occupations in the Agriculture and Biosciences Ecosystem**

Description	Number of Jobs 2016	Projected Number of Jobs 2025	New Jobs Created 2016-2025	Percent of Occupation Currently Employed Statewide by this Ecosystem	Statewide Annual Job Openings (2015) <sup>1</sup>	Estimated Annual Job Openings <sup>2</sup>	Oklahoma Median Hourly Earnings	National Median Hourly Earnings	Typical Entry Level Education	Annual Educational Completions <sup>3</sup>	
										Total Completions	Estimated Completions Available for This Ecosystem
Veterinary Technologists and Technicians	835	1,070	235	93.66%	37	35	\$15.90	\$15.77	Associate Degree	373	349
Veterinary Assistants and Laboratory Animal Caretakers	1,193	1,366	173	88.09%	52	46	\$11.07	\$12.14	High school diploma or Equivalent with Short-term On-The-Job Training	373	329
Sales Representative, Wholesale and Manufacturing, Except Technical and Scientific Products	1,651	1,816	165	15.40%	395	61	\$23.99	\$26.60	High school diploma or Equivalent with Moderate-term On-The-Job Training	141	22
Civil Engineers	861	1,011	150	33.44%	120	40	\$35.54	\$39.95	Bachelor's Degree	108	36
Phlebotomists	346	485	139	27.51%	72	20	\$14.18	\$15.39	Postsecondary Non-degree Award	16	4
Medical and Clinical Laboratory Technicians	423	545	122	18.64%	103	19	\$15.01	\$19.07	Associate Degree	390	73
Medical and Clinical Laboratory Technologists	342	457	115	16.62%	89	15	\$26.81	\$29.69	Bachelor's Degree	298	50
Industrial Machinery Mechanics	519	624	105	12.44%	235	29	\$22.95	\$24.11	High school diploma or Equivalent with Long-term On-The-Job Training	0	0
Market Research Analysts and Marketing Specialists	343	444	101	10.81%	120	13	\$25.02	\$30.50	Bachelor's Degree	599	65
Photographers	307	407	100	26.36%	37	10	\$14.01	\$15.36	High school diploma or Equivalent with Long-term On-The-Job Training	245	65

Source: EMSI 2017.1

- 1 "Annual Job Openings" is defined as all positions in this category that become vacant. This includes both newly created jobs as well as positions left vacant through turnover.
- 2 Estimated Annual Job Openings: Calculated as "Statewide Annual Job Openings (2015)" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."
- 3 Annual Education Completions: "Total Completions" represent the number of graduates of all state educational programs providing training applicable to the occupation. Estimated Completions Available for This Ecosystem" represents the estimated number of graduates that *may seek employment specifically in Agriculture and Biosciences Ecosystem industries*. Assuming that graduates are equally distributed among all industries that utilize a particular occupation, "Completions Available for This Ecosystem" is calculated as "Total Completions" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."

Four of the top 10 growth occupations in this ecosystem exhibit characteristics of educational pipeline stress. These include:

- *Sales Representative, Wholesale and Manufacturing, Except Technical and Scientific Products*, with 22 completions and 61 annual job openings;
- *Civil Engineers*, with 36 completions and 40 annual job openings;
- *Phlebotomists*, with 4 completions and 20 annual job openings; and,
- *Industrial Machinery Mechanics*, with 0 completions and 29 annual job openings in this ecosystem.

Overall, these four occupations account for 559 newly created positions over the next decade. Two of the four occupations require a high school diploma or equivalent in conjunction with some level of on-the-job-training (OJT). One occupation requires a Postsecondary Non-degree Award (Certificate or License). The remaining occupation – *Civil Engineer* – requires a Bachelor’s Degree. The programs available to train potential job seekers for these occupations include:

- *Sales Representative, Wholesale and Manufacturing, Except Technical and Scientific Products*, requires a high school diploma or equivalent with moderate-term OJT. There are four general sales-oriented programs available state-wide to train students at the skill-level necessary for entry into this occupation.
  - Business, Management, Marketing and Related Support Services, Other; offered by four Career and Technology Centers;
  - Special Products Marketing Operations; offered by one Career and Technology Center;
  - General Merchandising, Sales and Related Marketing Operations, Other; offered by four Career and Technology Centers and one regional university; and,
  - Sales, Distribution, and Marketing Operations General; offered by three Career and Technology Centers.
- *Civil Engineer*: One program is offered – Civil Engineering, General – at two major universities in the state. While not required at the entry level for this occupation, these two universities offer not only a Bachelor’s Degree in this field, but also degrees at the Master’s and Doctoral levels;
- *Phlebotomist* requires a Postsecondary Non-degree Award; one program is offered – Phlebotomy Technician/Phlebotomist – at four Career and Technology Centers and one regional university; and,
- *Industrial Machinery Mechanics*: high school/equivalent with Long-term OJT; one program is available – Industrial Mechanics and Maintenance Technology – which is offered by six Career and Technology Centers.

Additional observations regarding the educational pipelines for the top ten growth occupations in the Agriculture and Biosciences Ecosystem:

- An additional factor indirectly impacting the pipeline for three of these positions – *Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products; Civil Engineers; and Industrial Machinery Mechanics* – is the age distribution of those individuals in Oklahoma currently employed in these positions. Over 25% of the workforce in these three occupations are currently 55 years of age or over; within a decade of traditional retirement. The occupational classification of *Civil Engineers* ranks highest among the top 10 growth occupations with the greatest percentage of age 55 and over at 29.5%. *Sales Representatives* rank second at 26.9% while *Industrial Machinery Mechanics* are third at 25.6%. As this workforce ages out, a greater number of staff must be prepared to step into those positions. *Phlebotomists*, although considered an educational pipeline stressed occupation, exhibits one of the lowest percentages of over-55 workers at 13.0% compared with 43.7% under the age of 34.
- Agriculture and Biosciences Ecosystem industries employ 94% and 88% respectively of individuals in the occupations of *Veterinary Technologists and Technicians; and Veterinary Assistants and Laboratory Animal Caretakers*. This means there are few opportunities for employment in these job classifications outside the ecosystem. Programs providing training for these classifications are producing graduates at a rate of 10:1 for Technology/Technician positions and 7:1 for Assistants/Animal Caretakers. In addition to this over-saturation in the field, salary ranges for these positions are relatively low. Median hourly salaries for Assistants/Animal Caretakers range from \$10 to \$12 per hour. Salaries for Technologists/Technicians are marginally higher, ranging from \$12 to \$17 per hour.
- For one position on the top 10 growth list, *Market Research Analysts and Marketing Specialists*, the completions-to-openings ratio is nearly 5:1, indicating no educational pipeline stress. However, competing salaries in the region may increase the chance that Oklahoma graduates will migrate out of state for higher wages. Five of the six states contiguous to Oklahoma offer up to 28% higher median hourly earnings for this job classification.
- Only 26% of *Photographers* work in the Agriculture and Biosciences Ecosystem. Given that there are an estimated 65 annual graduates to fill 10 anticipated annual job openings, there is no sign of pipeline stress within this occupation. However, it is important to note that many photographers are self-employed or employed in other industries focused on specialties such as portrait or wedding photography. Employers of photographers in Agriculture and Bioscience industries must ensure they develop strategies to attract sufficient graduates to meet their needs.

## ENERGY ECOSYSTEM

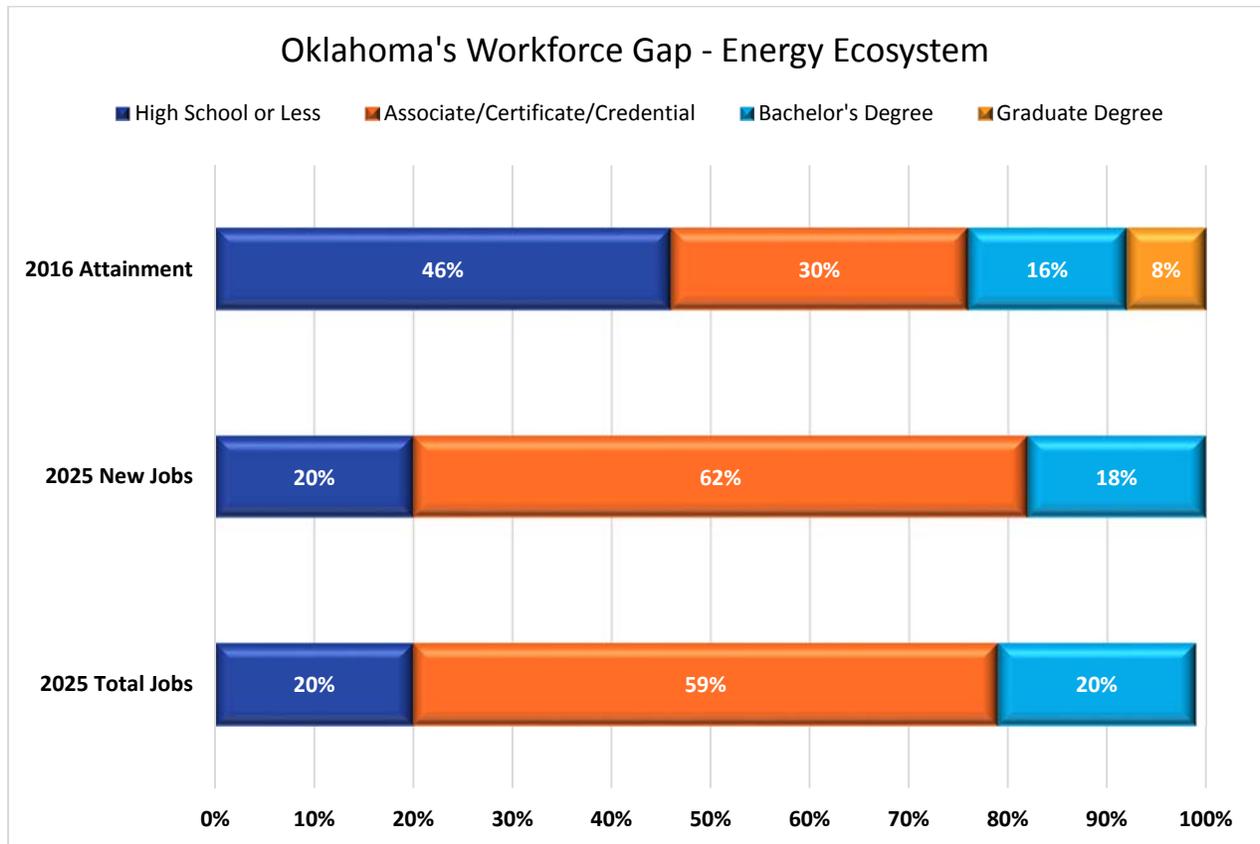
### *Gap Analysis*

As Oklahoma citizens are aware, the energy industry has experienced a softening in recent years, resulting in job loss and business closures, predominantly in oil- and gas-producing organizations. Approximately 16,000 jobs were lost in the last year alone; however, oil price gains from the fourth quarter of 2016 as well as a steady increase in active oil rig counts may be signaling an upward trend.

In 2016, over 97,900 jobs were associated with industries in the Energy Ecosystem. This figure represents 5.4% of Oklahoma's total workforce. Based upon data currently available, this figure is predicted to grow by 15,900 jobs in the next nine years, reflecting a 16% growth rate, the highest of any of the five key ecosystems. Only 27 occupational classifications are expected to decrease in the number of jobs – a total loss of only 163 positions. The position of *Managers, All Other* accounts for 54 of those lost positions, a decline of 11% in the employment in that occupational code. *Power Plant Operators* ranks second with an overall estimated job loss of 18, a decline of 6% in that occupational code. In contrast, the highest ranking job growth position is that of *Welders, Cutters, Solderers and Brazers*, an occupational classification that is expected to grow 23% by 2025, adding 832 jobs to the industries represented in the Energy Ecosystem.

As the occupational needs of the ecosystem's industries change, so too do the educational requirements of the individuals employed. The educational requirements for Energy Ecosystem industries is anticipated to slowly move toward requiring higher credentials, but is still centered predominantly on either 1) a Career and Technology Center Certificate, or 2) an Associate Degree. These qualifications are sufficient for 59% of all jobs and 62% of all newly created jobs by 2025. At the same time, approximately 20% of all jobs in Energy Ecosystem industries will require a Bachelor's Degree or higher while a high school diploma or less will only provide the necessary skill set for 20% of the jobs. Interestingly within this ecosystem in 2025, of more than 113,700 total jobs, only 316 (0.28%) maintain entry level educational requirements at the graduate degree or higher level. Only the Transportation and Distribution Ecosystem experiences a comparable graduate degree requirement rate of less than one percent.

Overall, these projections indicate that, without intervention, Oklahoma will face a 26% skills gap in meeting the needs of Energy Ecosystem industries in less than a decade.



Source: EMSI 2017.1

### *Educational Pipeline Analysis*

The top 10 growth occupations in the Energy Ecosystem are predicted to generate 5,509 new jobs by 2025 – approximately 35% of the anticipated new job growth among the ecosystem’s industries. In 2016, these occupations accounted for over 26% of the total number of ecosystem jobs and provided a wide range of median hourly earnings, between \$13 and \$56 per hour. The top 10 growth occupations and several key demographics of those positions are presented in Table 3.

**Table 3: Top 10 Growth Occupations in the Energy Ecosystem**

Description	Number of Jobs 2016	Projected Number of Jobs 2025	New Jobs Created 2016-2025	Percent of Occupation Currently Employed Statewide by this Ecosystem	Statewide Annual Job Openings (2015) <sup>1</sup>	Estimated Annual Job Openings <sup>2</sup>	Oklahoma Median Hourly Earnings	National Median Hourly Earnings	Typical Entry Level Education	Annual Educational Completions <sup>3</sup>	
										Total Completions	Estimated Completions Available for This Ecosystem
Welders, Cutters, Solderers, and Brazers	3,623	4,455	832	37.18%	444	165	\$18.17	\$18.68	High school diploma or Equivalent with Moderate-term On-The-Job Training	1,474	548
Construction Laborers	2,116	2,858	742	10.98%	724	79	\$13.41	\$15.56	No Formal Educational Credential with Short-term On-The-Job Training	11	1
Roustabouts, Oil and Gas	4,411	5,169	758	94.70%	214	203	\$17.62	\$17.93	No Formal Educational Credential with Moderate-term On-The-Job Training	0	0
First-Line Supervisors of Construction Trades and Extraction Workers	2,428	2,930	502	23.85%	238	57	\$26.09	\$28.31	High school diploma or Equivalent with 5 years or more experience	678	162
Heavy and Tractor-Trailer Truck Drivers	2,569	3,074	505	9.63%	708	68	\$18.91	\$19.32	Postsecondary Non-degree Award with Short-term On-The-Job Training	237	23
Rotary Drill Operators, Oil and Gas	2,151	2,616	465	99.16%	151	150	\$25.13	\$26.26	No Formal Educational Credential with Moderate-term On-The-Job Training	0	0
Operating Engineers and Other Construction Equipment Operators	1,427	1,877	450	21.84%	225	49	\$17.79	\$22.60	High school diploma or Equivalent with Moderate-term On-The-Job Training	51	11
Service Unit Operators, Oil, Gas, and Mining	3,200	3,647	447	96.92%	194	188	\$20.70	\$22.04	No Formal Educational Credential with Moderate-term On-The-Job Training	0	0
Petroleum Engineers	2,644	3,056	412	86.81%	152	132	\$56.67	\$63.94	Bachelor's Degree	252	219
Industrial Machinery Mechanics	1,359	1,755	396	32.58%	235	77	\$22.95	\$24.11	High school diploma or Equivalent with Long-term On-The-Job Training	0	0

Source: EMSI 2017.1

- 1 "Annual Job Openings" is defined as all positions in this category that become vacant. This includes both newly created jobs as well as positions left vacant through turnover.
- 2 Estimated Annual Job Openings: Calculated as "Statewide Annual Job Openings (2015)" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."
- 3 Annual Education Completions: "Total Completions" represent the number of graduates of all state educational programs providing training applicable to the occupation. Estimated Completions Available for This Ecosystem" represents the estimated number of graduates that *may seek employment specifically in Energy Ecosystem industries*. Assuming that graduates are equally distributed among all industries that utilize a particular occupation, "Completions Available for This Ecosystem" is calculated as "Total Completions" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."

Three occupations in the top 10 growth list for the Energy Ecosystem meet the criteria for experiencing educational pipeline stress. These include:

- *Heavy and Tractor-Trailer Truck Drivers*. This occupation requires a Postsecondary Degree Award as well as short-term on-the-job training. Only 9.6% of truck drivers in this category are employed within the Energy Ecosystem; most program graduates will be employed in industries within another key ecosystem or in an industry outside of the defined ecosystems. Approximately 23 of the 237 statewide graduates would be anticipated to choose to work in energy-related industries. Conversely, an estimated 68 of the 700 annual openings statewide would provide employment for those graduates. This results in a ratio of graduates to job openings of nearly 1:3.
- *Operating Engineers and Other Construction Equipment Operators*. Two training programs are available to meet the training needs for this profession: 1) Construction/Heavy Equipment/Earthmoving Equipment Operation, and 2) Construction Trades, General. These two programs are offered at nine different state Career and Technology Centers. It is anticipated that there would be approximately 49 openings for this career in the Energy Ecosystem annually while only 11 completions should be available to fill those jobs.
- *Industrial Machinery Mechanics*. As indicated previously, this job classification is found on the top 10 growth list as well as the educational pipeline stress list in four of the five key ecosystems. There is one program available to train for this position, but no graduates were reported in the last year. Seventy-seven annual openings are expected for this job classification within the Energy Ecosystem.

The application of the educational pipeline stress analysis methodology has revealed one unique characteristic of the Energy Ecosystem. Four of the 10 growth occupations – representing 2,412 positions and 43.8% of all newly created jobs – require no formal educational credential. These include *Roustabouts, Oil and Gas; Rotary Drill Operators, Oil and Gas; Construction Laborers; and Service Unit Operators, Oil, Gas, and Mining*. The demand for each of these occupations is expected to grow between 14% and 35% by 2025.

For three of these four job classifications, no training programs are available to enhance the skill levels of workers and better prepare them for their career. Only the classification of *Construction Laborers* has an applicable program – titled “Construction Trades, Other” available at ten Career and Technology Centers and one regional university branch – to train prospective employees in this field. In 2015, the latest year for which data is available, eleven graduates were reported from 2 Career and Technology Centers; one of those graduates would be anticipated to join the workforce in the Energy Ecosystem. It must also be noted that, while the training delivered by this program may provide graduates with an advantage in the hiring process for this position, the achievement of certification is not required to qualify for employment.

Additional observations regarding the educational pipelines for the top 10 growth occupations in the Energy Ecosystem:

- Four of the 10 are experiencing some level of stress due to an aging workforce. For example, the classification of *Heavy and Tractor-Trailer Truck Drivers* has 30.1% of the

workforce over the age of 55 and 57.9% of the workforce over the age of 45. At the same time, those individuals entering the workforce in this position (age 19-24) only constitute 3.9% of the workforce. The job classifications of *First Line Supervisors of Construction Trades and Extraction Workers; Operating Engineers and Other Construction Equipment Operators; and Industrial Machinery Mechanics* are all experiencing similar aging workforce dynamics.

The retirement/entry age breakdown for these occupations is available in Table 4. Since these positions do not require extended periods of time to complete advanced education, the comparison is made to individuals in the 19-24 age range.

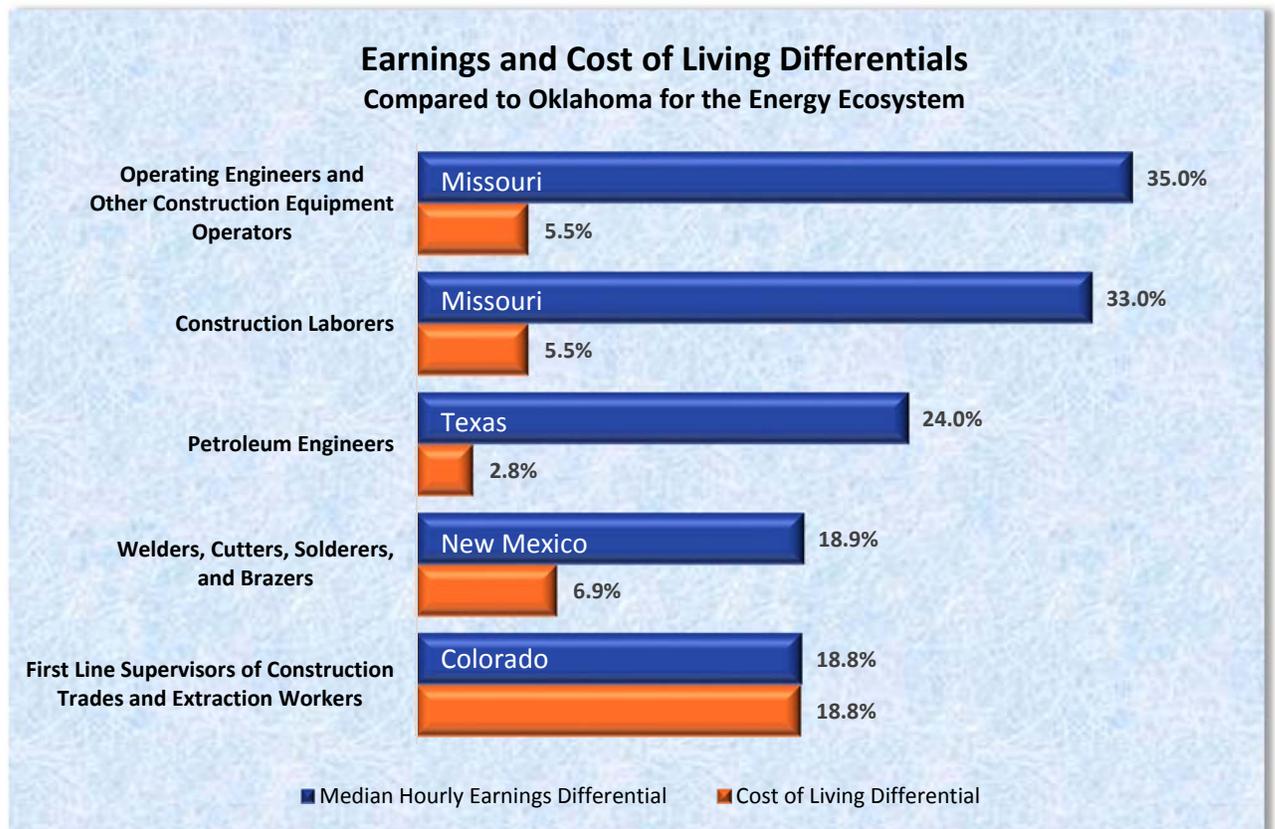
**Table 4: Aging Workforce Stress on the Energy Ecosystem**

Job Classification	Percentage of workforce that is 55 years of age or older	Percentage of workforce that is 45 years of age or older	Percentage of workforce age 19-24 entering the occupation
Heavy and Tractor-Trailer Truck Drivers	30.1%	57.9%	3.9%
First-Line Supervisors of Construction Trades and Extraction Workers	26.7%	54.4%	2.5%
Operating Engineers and Other Construction Equipment Operators	25.8%	53.0%	6.1%
Industrial Machinery Mechanics	25.6%	53.8%	4.9%

Source: EMSI 2017.1

- For the top 10 growth occupations in the Energy Ecosystem, there remains competition for Oklahoma graduates based upon salary. Colorado median wages are higher for all 10 of the growth occupations; Texas wages are higher than Oklahoma’s on 7 out of 10. Five of the 10 occupations experience salary differentials in excess of 15%. For each of these occupations, the increase in wage exceeds the cost of living differential for the applicable state:
  - *Operating Engineers and Other Construction Equipment Operators* – 35% increase in salary in the state of Missouri when compared with Oklahoma. The increased cost of living in Missouri is only projected statewide at 5.5% making relocation to Missouri attractive to qualified job applicants.

- *Construction Laborers* – 33% increase in median wages in Missouri at \$17.93 per hour.
- *Petroleum Engineers* – 24% increase in salary in Texas, with median wages of \$70.26 per hour.
- *Welders, Cutters, Solderers, and Brazers* – 18.9% increase in salary in New Mexico, with median wages of \$21.60.
- *First-Line Supervisors of Construction trades and Extraction Workers* – 18.8% increase in salary in Colorado.

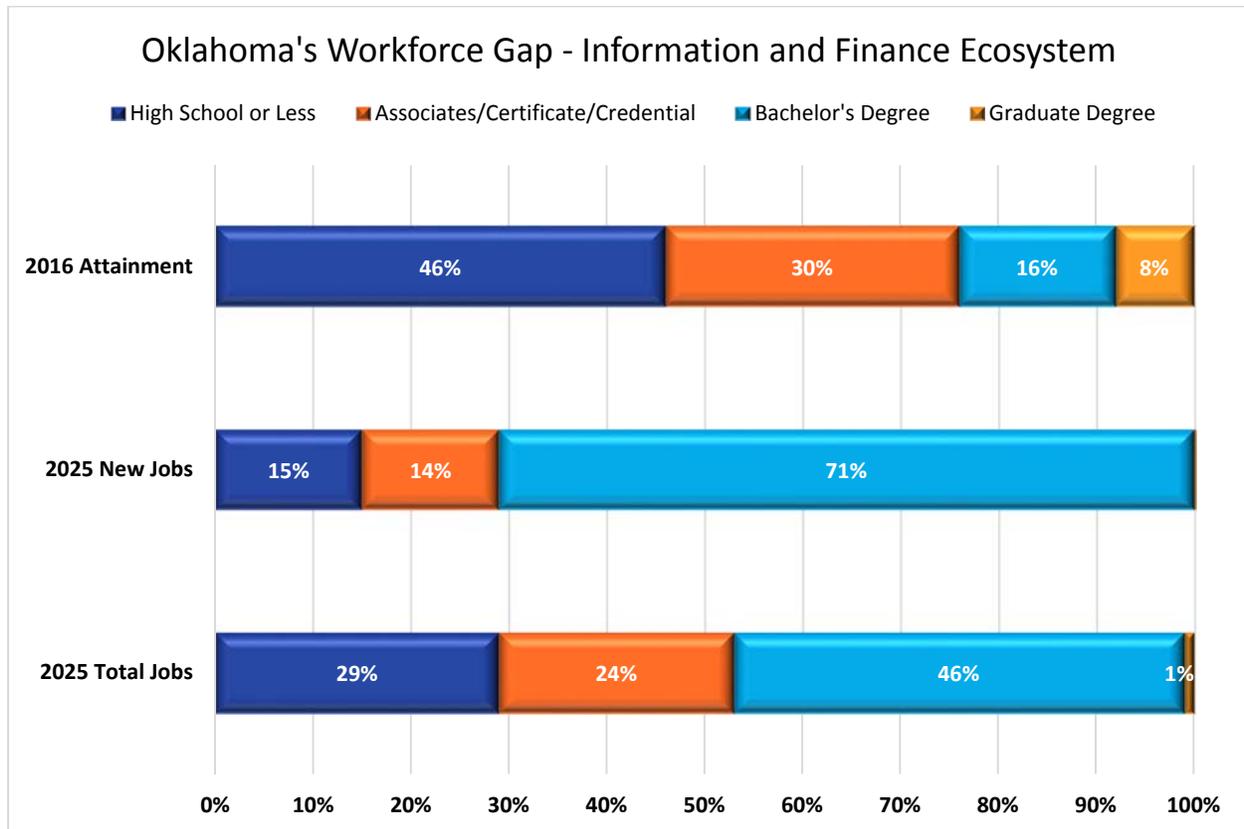


## INFORMATION AND FINANCE ECOSYSTEM

### *Gap Analysis*

Over 105,200 jobs were associated with industries in the Information and Finance Ecosystem in 2016. This figure represents 5.9% of Oklahoma's total workforce. By 2025, this figure is expected to grow by a net 6,200 jobs to 111,484, reflecting a 5.9% growth rate. More than 7,700 new jobs will be created. Thirty-seven occupational classifications will experience a decrease in the number of jobs available – a total loss of 1,485 positions. The position of *Claims Adjusters, Examiners, and Investigators* accounts for 268 of those lost positions, a decline of 17% in the employment in that occupational code within the ecosystem. Likewise, the number of *Electronics Engineers* positions is projected to diminish by 29%, a loss of 141 jobs overall. In contrast, the highest ranking job growth position is that of *Accountants and Auditors*, an occupational classification that is expected to grow 19% by 2025, adding 1,527 jobs to the industries represented in the Information and Finance Ecosystem.

As the occupational needs of the ecosystem's industries change, so too do the educational requirements of the individuals employed. The minimum educational requirements for jobs within Information and Finance Ecosystem industries are anticipated to shift drastically toward the need for college degrees over the next nine years. By 2025, 46% of all jobs and 71% of all newly created jobs within the ecosystem will require a Bachelor's Degree. A high school diploma will only qualify an applicant for 15% of newly created jobs and an Associate Degree or Career and Technology Certificate will only meet the minimum qualifications for 14% of the same job pool. For all jobs in 2025, 71% will require some level of certification or degree above a high school diploma. These projections indicate that, without intervention, Oklahoma will face a 31% skills gap in meeting the needs of Information and Finance Ecosystem industries in less than a decade.



Source: EMSI 2017.1

### Educational Pipeline Analysis

Four of the top 10 growth occupations in the Information and Finance Ecosystem specialize in financial functions: 1) *Accountants and Auditors*; 2) *Loan Officers*; 3) *Loan Interviewers and Clerks*; and, 4) *Financial Managers*. The remaining six job classifications are computer-oriented, including a variety of software developers, information systems managers, and computer support specialists.

These top 10 growth occupations are predicted to generate 4,322 new jobs by 2025 – 56% of the anticipated new job growth among the ecosystem’s industries. In 2016, these occupations accounted for nearly 26% of the total number of individuals employed within the ecosystem. Overall, salaries for this set of occupations are high. Only two occupations – *Loan Interviewers and Clerks*, and *Computer User Support Specialists* – exhibit salaries below \$20 per hour median earnings. Incumbents in five of the ten occupations earn a median hourly wage of over \$30 per hour and up to \$46 per hour. The Information and Finance Ecosystem list of top 10 growth occupations and several key demographics of those positions are presented in the following Table 5.

**Table 5: Top 10 Growth Occupations in the Information and Finance Ecosystem**

Description	Number of Jobs 2016	Projected Number of Jobs 2025	New Jobs Created 2016-2025	Percent of Occupation Currently Employed Statewide by this Ecosystem	Statewide Annual Job Openings (2015) <sup>1</sup>	Estimated Annual Job Openings <sup>2</sup>	Oklahoma Median Hourly Earnings	National Median Hourly Earnings	Typical Entry Level Education	Annual Educational Completions <sup>3</sup>	
										Total Completions	Estimated Completions Available for This Ecosystem
Accountants and Auditors	7,852	9,379	1,527	47.35%	742	351	\$27.43	\$32.40	Bachelor's Degree	857	406
Software Developers, Applications	2,447	2,940	493	57.43%	141	81	\$36.44	\$47.68	Bachelor's Degree	591	339
Loan Officers	3,918	4,386	468	89.37%	136	122	\$27.55	\$31.32	Bachelor's Degree with Moderate On-The-Job Training	574	513
Loan Interviewers and Clerks	3,236	3,613	377	89.96%	105	94	\$14.85	\$18.48	High school diploma or Equivalent with Short-term On-The-Job Training	3	3
Computer Systems Analysts	1,441	1,791	350	43.85%	124	54	\$34.50	\$41.41	Bachelor's Degree	970	425
Web Developers	650	893	243	49.14%	60	29	\$22.80	\$29.68	Associate Degree	1,563	768
Computer User Support Specialists	2,361	2,602	241	30.10%	183	55	\$19.95	\$23.80	Some College, No Degree	800	241
Computer and Information Systems Manager	1,227	1,444	217	40.03%	81	32	\$46.02	\$63.28	Bachelor's Degree with 5 years or more experience	873	349
Financial Managers	2,921	3,127	206	45.55%	226	103	\$41.06	\$57.13	Bachelor's Degree with 5 years or more experience	621	283
Software Developers, Systems Software	1,138	1,338	200	53.13%	67	36	\$33.96	\$51.08	Bachelor's Degree	619	329

Source: EMSI 2017.1

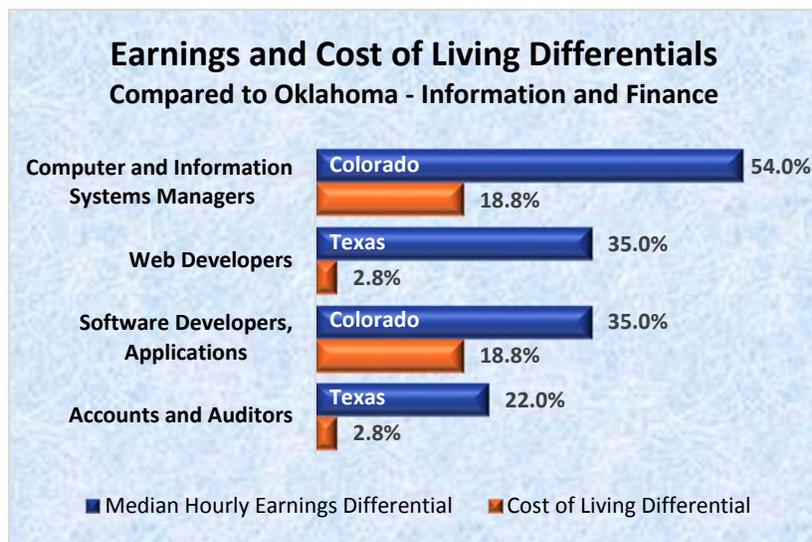
- 1 "Annual Job Openings" is defined as all positions in this category that become vacant. This includes both newly created jobs as well as positions left vacant through turnover.
- 2 Estimated Annual Job Openings: Calculated as "Statewide Annual Job Openings (2015)" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."
- 3 Annual Education Completions: "Total Completions" represent the number of graduates of all state educational programs providing training applicable to the occupation. Estimated Completions Available for This Ecosystem" represents the estimated number of graduates that *may seek employment specifically in Information and Finance Ecosystem industries*. Assuming that graduates are equally distributed among all industries that utilize a particular occupation, "Completions Available for This Ecosystem" is calculated as "Total Completions" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."

There are no occupations in the Information and Finance Ecosystem that clearly meet the criteria to be considered as stressed with regard to the educational pipeline. One occupation, *Loan Interviewers and Clerks*, is noted as offering an estimated 94 job openings with only 3 program graduates. That said, however, the minimum entry level education for *Loan Interviewers and Clerks* is the possession of a high school diploma or the equivalent and subsequent short-term on-the-job training. As a result, postsecondary education is not mandatory to obtain the job. While the program offered by several Career and Technology Centers in Oklahoma – called “Banking and Financial Support Services” – may provide additional advantage to graduates as they are considered for hire, the higher educational level is not required and therefore cannot be considered an educational pipeline stress point.

Based solely upon the data examined for this analysis, the greatest threat to the ability to fill most of the top 10 growth jobs in Information and Finance Ecosystem industries is rooted in wage disparity. According to the Bureau of Labor Statistics:

- Oklahoma offers the lowest wage for four of the top 10 growth occupations in the region.
  - *Accountants and Auditors*: Oklahoma median hourly salary is \$27.43. Texas offers the highest median hourly salary at \$33.38 per hour, an increase of 22%. The cost of living increase in Texas as compared with Oklahoma is only 2.8%.
  - *Software Developers, Applications*: Oklahoma median hourly salary for this position is \$36.44. Of the six comparison states, Colorado offers the highest median hourly wage at \$49.13 per hour, an increase of 35%. The cost of living increase in Colorado as compared with Oklahoma is 18.8%.
  - *Web Developers*: Oklahoma median hourly wage is \$23.39. The highest median

hourly wage in the region is paid in Texas at \$31.65 per hour. This is an increase of 35%. While there is a tremendous disparity in wages for this position between Oklahoma and



Texas, possibly enticing Oklahoma graduates to move out of state, the job classification of *Web Developers* is oversaturated with 1,563 graduates available to fill 60 positions annually statewide. For the Information and Finance Ecosystem, there are estimated to be 768 graduates available to fill 29 positions annually; a ratio of over 26 graduates for each job opening.

- *Computer and Information Systems Managers*: The Oklahoma median hourly salary is \$45.79. The highest median hourly wage offered for this position in the region is available in Colorado at \$70.42 per hour. This is an increase of 54%.
- For five of the remaining occupational classifications, only one state offers lower median hourly wages than Oklahoma. The Oklahoma wage for the final occupation in the list of top 10 growth jobs is lower than four of the six contiguous states.

With regard to the age distribution of individuals in occupations identified as the top 10 growth jobs in the Information and Finance Ecosystem, none exhibit inordinately high levels of anticipated retirements. Two occupations, *Accountants and Auditors*, and *Financial Managers*, average over 20% in the “Over 55 Years of Age” group at 28.7% and 24.1% respectively. At the same time, however, a relatively equal percentage of individuals in these two job classifications are under the age of 34, providing assurances that successors to the potential retirees are already in the pipeline.

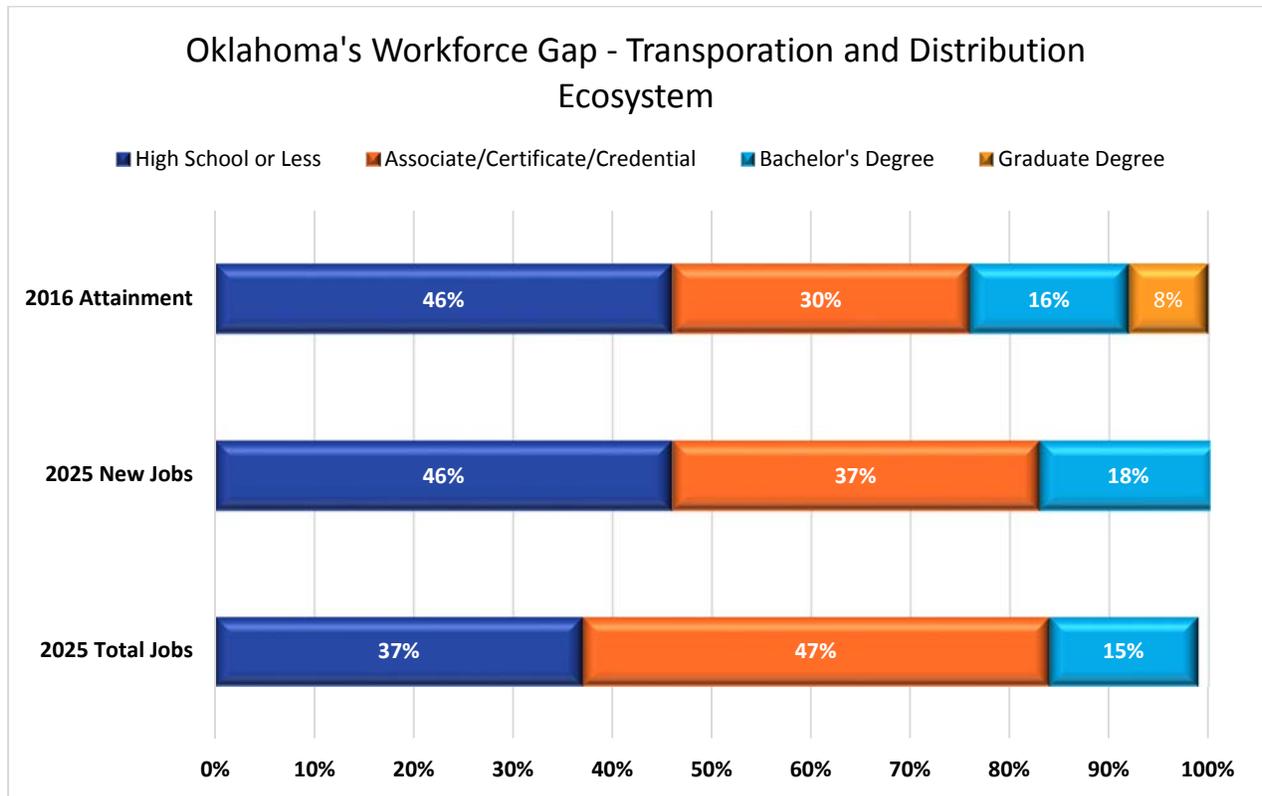
## TRANSPORTATION AND DISTRIBUTION ECOSYSTEM

### *Gap Analysis*

In 2016, industries included in the Transportation and Distribution Ecosystem reported 121,258 jobs; more than any other ecosystem. This figure represents 6.7% of Oklahoma's total workforce. By 2025, this figure is expected to grow by a net 5,778 jobs to 127,036, reflecting a 4.8% growth rate. Nearly 7,600 new jobs will be created. Seventy-one occupational classifications will experience a decrease in the number of jobs available – a total loss of 1,817 positions. For the most part, these job losses will occur in occupations that are not critical to the continuation of the industry. As an example, the classification of *Engine and Other Machine Assemblers* is expected to experience a decrease of 13% -- a loss of 19 jobs overall – but that classification only represents 0.1% of all jobs in the ecosystem. Likewise, the classification of *Fiberglass Laminators and Fabricators* will lose 18% (7 jobs overall) but represents 0.0% of all jobs. Conversely, *Laborers and Freight, Stock, and Material Movers, Hand*, a position representing 7.4% of all jobs in the ecosystem, will increase by 10%, adding 865 newly created positions by 2025.

As the occupational needs of the ecosystem's industries change, so too do the educational requirements of the individuals employed. The minimum educational requirements for jobs within Transportation and Distribution Ecosystem industries are anticipated to shift toward a greater need for CareerTech Certifications and/or Associate Degrees. By 2025, 47% of all jobs and 37% of all newly created jobs within the ecosystem will require these credentials. Since many of the positions within this ecosystem remain physical-labor oriented, a high school diploma will still qualify an applicant for 46% of newly created jobs. For all jobs in 2025, 63% will require some level of certification or degree above a high school diploma. The requirement for a graduate degree or higher is only required for 109 of the 127,036 projected jobs in 2025 – the least of any of the ecosystems.

These projections indicate that, without intervention, Oklahoma will face a 7% skills gap in meeting the needs of Transportation and Distribution Ecosystem industries in less than a decade.



Source: EMSI 2017.1

### Educational Pipeline Analysis

The top 10 growth occupations in this ecosystem are predicted to generate 3,755 new jobs by 2025 – 49% of the anticipated new job growth among the ecosystem’s industries. In 2016, these occupations accounted for over 29% of the total number of individuals employed within the ecosystem. Unfortunately, while these job classifications are often critical to the industry, they also require low levels of education/training and earn lower median wages. The position of *Laborers and Freight, Stock, and Material Movers, Hand* is such an example. The classification composes 7.4% of all jobs in the industry, but requires no formal educational credential with some short-term on-the-job training and earns a median hourly wage of \$12.47. Six of the 10 occupations earn median wages of \$15 per hour or less. Only two of the 10 require a Bachelor’s Degree. Three job classifications require high school diplomas while four can be obtained with no formal educational credential. These figures emphasize the human physical-labor orientation of many of the occupations within the Transportation and Distribution Ecosystem.

**Table 6: Top 10 Growth Occupations in the Transportation and Distribution Ecosystem**

Description	Number of Jobs 2016	Projected Number of Jobs 2025	New Jobs Created 2016-2025	Percent of Occupation Currently Employed Statewide by this Ecosystem	Statewide Annual Job Openings (2015) <sup>1</sup>	Estimated Annual Job Openings <sup>2</sup>	Oklahoma Median Hourly Earnings	National Median Hourly Earnings	Typical Entry Level Education	Annual Educational Completions <sup>3</sup>	
										Total Completions	Estimated Completions Available for This Ecosystem
Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products	7,382	8,431	1,049	68.85%	395	272	\$23.99	\$26.60	High school diploma or Equivalent with Moderate-term On-The-Job Training	141	97
Laborers and Freight, Stock, and Material Movers, Hand	9,017	9,882	865	33.34%	1,042	347	\$12.47	\$12.41	No Formal Educational Credential with Short-term On-The-Job Training	0	0
Industrial Truck and Tractor Operators	2,782	3,074	292	44.91%	222	100	\$15.17	\$15.74	No Formal Educational Credential with Short-term On-The-Job Training	0	0
General and Operations Managers	3,112	3,384	272	11.66%	1,006	117	\$38.35	\$48.04	Bachelor's Degree plus 5 Years or More Work Experience	4,254	496
Stock Clerks and Order Fillers	2,482	2,734	252	12.79%	815	104	\$10.94	\$11.44	No Formal Educational Credential with Short-term On-The-Job Training	10	1
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	3,718	3,960	242	64.55%	171	110	\$27.01	\$36.77	Bachelor's Degree with Moderate-term On-The-Job Training	60	39
Customer Service Representatives	2,668	2,895	227	9.44%	1,053	99	\$14.02	\$15.56	High school diploma or Equivalent with Short-term On-The-Job Training	12	1
Packers and Packers, Hand	884	1,088	204	22.09%	160	35	\$10.38	\$10.59	No Formal Educational Credential with Short-term On-The-Job Training	0	0
Industrial Machinery Mechanics	764	942	178	18.30%	235	43	\$22.95	\$24.11	High school diploma or Equivalent with Long-term On-The-Job Training	0	0
Officer Clerks, General	2,888	3,062	174	7.50%	1,131	85	\$12.62	\$14.54	High school diploma or Equivalent with Short-term On-The-Job Training	30	2

Source: EMSI 2017.1

- 1 "Annual Job Openings" is defined as all positions in this category that become vacant. This includes both newly created jobs as well as positions left vacant through turnover.
- 2 Estimated Annual Job Openings: Calculated as "Statewide Annual Job Openings (2015)" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."
- 3 Annual Education Completions: "Total Completions" represent the number of graduates of all state educational programs providing training applicable to the occupation. Estimated Completions Available for This Ecosystem" represents the estimated number of graduates that *may seek employment specifically in Transportation and Distribution Ecosystem industries*. Assuming that graduates are equally distributed among all industries that utilize a particular occupation, "Completions Available for This Ecosystem" is calculated as "Total Completions" multiplied by "Percent of Occupation Statewide Employed by this Ecosystem."

Four of the top 10 growth jobs in the Transportation and Distribution Ecosystem require no formal educational credential, relying on on-the-job training to prepare employees to perform their duties. These include: 1) *Laborers and Freight, Stock, and Material Movers, Hand*; 2) *Industrial Truck and Tractor Operators*; 3) *Stock Clerks and Order Fillers*; and 4) *Packers and Packers, Hand*. As a result of these low entry-level requirements, only one of the four (*Stock Clerks and Order Fillers*) has an associated post-secondary program in the state of Oklahoma producing 10 graduates per year. Since these positions can be filled from the general population with little to no educational background, there is no applicable educational pipeline.

Two positions, those of *Customer Service Representative and Office Clerks, General*, require a high school diploma, though both rely upon short-term on-the-job training for developing staff to fulfill their duties. There is one educational program for each of these job classifications that can produce graduates more highly skilled than the entry level expectation. For the customer service position, this program is called Customer Service Support/Call Center/Teleservice Operation and is offered only at Francis Tuttle Technology Center located in Oklahoma City. The educational program applicable to the office clerk position is called General Office Occupations and Clerical Services. This program is available at four Career and Technology Centers and three regional colleges statewide. While these programs, in combination, produce fewer graduates than necessary to fill anticipated job openings, the educational level they provide is not required to meet minimum requirements for jobs in these two classifications. As a result, there is no stress on the educational pipeline.

Three of the top 10 growth jobs do show characteristics of educational pipeline stress. These include the following:

- *Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products*;
- *Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products*; and,
- *Industrial Machinery Mechanics*.

Sales representatives, both those who market technical or scientific products and those who market non-technical/scientific products, earn relatively high median hourly wages. For those marketing non-technical items, the median wage in Oklahoma is \$23.99 per hour. If an individual markets technical products, the median wage rises to \$27.01. This increase in wage reflects the higher educational requirement of a Bachelor's Degree for the marketing of technical products versus a high school diploma for the marketing of non-technical items.

Six programs are available to train individuals who wish to be a sales representative of non-technical products in this ecosystem:

- Business Management, Marketing, and Related Support Services, Other;
- Apparel and Accessories Marketing Operations;
- Fashion Merchandising;
- Special Products Marketing Operations;

- General Merchandising, Sales, and Related Marketing Operations; and,
- Sales, Distribution, and Marketing Operations, General.

These six programs, available at Career and Technology Centers and regional universities state-wide, produce an estimated 97 graduates annually available to fill 272 job openings in this job classification in the Transportation and Distribution Ecosystem.

Only two programs are available to train individuals for the position of sales representatives marketing technical or scientific products. These include 1) Business, Management, Marketing, and Related Support Services, Other, and 2) Selling Skills and Sales Operations. Since the entry level educational requirements for this position are possession of a Bachelor’s Degree, only six institutions provide this training state-wide. A lower level of training in these two subjects is available at numerous Career and Technology Centers as well as regional universities in Oklahoma offering either Certification or an Associate Degree, but it is presumed that the graduates from these courses would not be qualified for this particular position. As a result, only 39 graduates are produced annually to fill an expected 110 job vacancies.

The position of *Industrial Machinery Mechanic* has been addressed in this report in relation to three other ecosystems which employ individuals in this same job classification. Over 18% of all *Industrial Machine Mechanics* are employed in the Transportation and Distribution Ecosystem. There is one program available to contribute graduates to filling this job – Industrial Mechanics and Maintenance Technology, offered by six Career and Technology Centers statewide – but the program produced no graduates in the last year reported (2015) and only one graduate in 2014. With an anticipated 43 annual job openings, this occupation is experiencing educational pipeline stress.

Additional observations regarding the positions on the top 10 growth jobs in the Transportation and Distribution Ecosystem:

- *Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products*, in addition to experiencing educational pipeline stress, is further challenged by comparatively low wages in Oklahoma versus the region. The median hourly earnings for this position range from \$27.01 in Oklahoma to \$46.82 per hour in Colorado. While the cost of living in Colorado is 18.8% higher than in Oklahoma, the wage disparity is over 73%, making it attractive for these individuals to relocate to that state. Of the six contiguous states utilized for wage comparison in this study, the increase in wage over that earned in Oklahoma, is sufficient to overcome the difference in cost of living for all states except New Mexico.
- Only Arkansas and New Mexico consistently offer lower wages for the top 10 growth positions in the ecosystem as compared with Oklahoma. Colorado, Kansas and Missouri offer higher median hourly wages for nine out of the 10 positions. Texas offers higher wages for seven of the 10.
- In five of the 10 positions, approximately 25% of the workforce is age 55 or over. These positions include Sales Representatives (both for technical/scientific products and non-technical/scientific products); *General and Operations Managers*; *Industrial Machinery*

*Mechanics; and Office Clerks, General.* These figures would normally be examined as indicators of an aging workforce; however, to counter this concern, the age distributions for occupations in this ecosystem appear relatively level. For example, for sales representatives (non-technical/scientific), the percentage of individuals 55 years of age or over is 26.9%. However, 20.9% are between 25 and 34 years of age; 23.3% are between the ages of 35 and 44; and 24.5% are between 45 and 54 years old. This consistency mitigates concern regarding vacancies left by an aging workforce anticipated to retire within the next decade.

## Conclusion

The state of Oklahoma has identified five key, in demand, industry sectors, called “ecosystems” which provide the state with a competitive advantage in a global economy. The ecosystems are characterized by a potential for employment growth and the ability to provide wealth generating employment opportunities. These five key ecosystems include Aerospace & Defense; Agriculture and Biosciences; Energy; Information and Financial Services; and Transportation and Distribution.

This analysis sought to examine the occupations central to each of these ecosystems and to quantify any identified gaps that may develop between the current 2016 and the anticipated 2025 workforces. To accomplish this analysis, two unique but complementary methodologies were applied to data for each ecosystem: a skills gap analysis and an educational pipeline analysis. Additional analyses regarding wages and workforce age distribution were applied as needed.

Within the narrow scope of this study, a number of varied and unique challenges have been identified for the industries within each ecosystem. The Aerospace and Defense Ecosystem and the Information and Finance Ecosystem both face significant gaps, at 35% and 31% respectively, in meeting the educational attainment requirements necessary for new jobs in 2025. Total employment in the Agriculture and Biosciences Ecosystem is expected to decline by nearly 1,000 jobs during the same period. The workforce associated with the Energy Ecosystem is rapidly aging, with more than 50% of workers in critical positions over the age of 45. And while the Transportation and Distribution Ecosystem faces little challenge in obtaining qualified workers, the competition for wages from other states has significant potential to impact the ability to fill positions in those industries. Further consideration of these challenges, and additional studies to identify new concerns, may lead to strategic solutions, enhancing Oklahoma’s success in building wealth generating employment opportunities for all of its citizens.

This analysis was developed by the Oklahoma Office of Workforce Development Labor Market Analyst. For questions regarding the analysis or for additional information, please contact Sandi Wright, 405-945-9198 or [sandi.wright@okstate.edu](mailto:sandi.wright@okstate.edu).