



Program of Study Justifications for Transportation

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Automotive Collision Repair

2019-20 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Collision Repair	Introduction to Collision Repair (C20H20)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14) -or- Dual Enrollment Automotive & Collision Repair (C20H02)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14) -or- Collision Repair: Damage Analysis, Estimating, & Customer Service (C20H19) -or- Dual Enrollment Automotive & Collision Repair (C20H02)
			<p>Industry Certification for C20H13: I-CAR Refinish Technician ProLevel 1 or I-CAR Non-Structural Technician ProLevel 1 or Automotive Service Excellence Student Certification: Nonstructural Analysis/Repair</p> <p>Industry Certification for C20H14: Automotive Service Excellence Student Certification: Painting and Refinishing</p>	

Description

The Automotive Collision Repair program of study prepares students for entry into careers as automotive body repairers. Automotive body repairers restore, refinish, and replace vehicle bodies and frames. Content emphasizes customer service skills, proper use of tools and equipment, safety, shop operations, engine fundamentals, damage analysis, cost estimation, painting and refinishing, and structural and non-structural repair in a hands-on environment. Upon completion of this program of study, students will be eligible to earn certifications from Automotive Student Excellence (ASE) or the Inter-Industry Conference on Auto Collision Repair (I-CAR).

Job Outlook

Job opportunities are projected to be good for automotive body repairers. According to the U.S. Bureau of Labor Statistics, the overall national employment of automotive maintenance technicians and collision repair related workers is projected to grow from 2016 to 2026. Employment growth will be driven by increased demand for automotive work, but will vary by specialty. Those without formal training or experience will face fierce competition in the industry. Employment of automotive body and glass repairers is projected to grow by eight percent.¹

The Tennessee Department of Labor and Workforce Development projected 3905 automotive body and related repairers being employed statewide in 2016. That will grow to 4315 in 2026. This reflects a 10.60 % change in the occupation group in Tennessee for the period 2016 to 2026.² Students in Automotive Collision Repair may also pursue related careers as automotive specialty technicians where there are a large number of annual average openings anticipated or automotive glass installers and repairers where there are a smaller number of annual average openings anticipated.

In the past 20 years, the business layout of the automotive collision repair industry has shifted to fewer small shops and more large shops. A 2016 survey indicated that large shops (those with annual sales over \$1 million) have increased to a share of 68.1% of all shops in 2016 whereas the share was 15.3% in 1995.³

Related occupations requiring associates or bachelor's degrees include mechanical engineers and mechanical engineering technicians. The Tennessee Department of Labor and Workforce

¹ Bureau of Labor Statistics, U.S. Department of Labor. *Occupational Outlook Handbook, 2017-18 Edition*. <http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-body-and-glass-repairers.htm>

² Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

³ Collision Repair Education Foundation, ICAR. *2016 Snapshot of the Collision Repair Industry*. Retrieved from <https://www.collisioeducationfoundation.org/2013/11/2013-snapshot-of-the-collision-industry/>.

Development projects a growth in employment of 16.70 % for mechanical engineers and 10.70 % growth for mechanical engineering technicians. ⁴

Figure 1. Tennessee employment projections for occupation openings related to Automotive Body and Related Repairers 2016-2026.⁵

Occupation	2016 Estimated Employment	2026 Projected Employment	Total 2016 - 2026 Employment Change	Total Percent Change 2016-2026	Median Salary
Automotive Body and Related Repairers	3,905	4,315	415	10.60%	\$37,580
Automotive Service Technicians and Mechanics	15,440	16,575	1,135	7.40%	\$38,180
Tire Repairers and Changers	3,700	3,770	70	1.90%	\$34,510
Bus and Truck Mechanics and Diesel Engine Specialists	7,720	8,425	705	9.10%	\$43,450
Automotive Glass Installers and Repairers	495	525	30	6.50%	\$32,230

⁴ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

⁵ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>

Figure 2. National trends for occupations related to automotive body and related repairers 2016-26.⁶

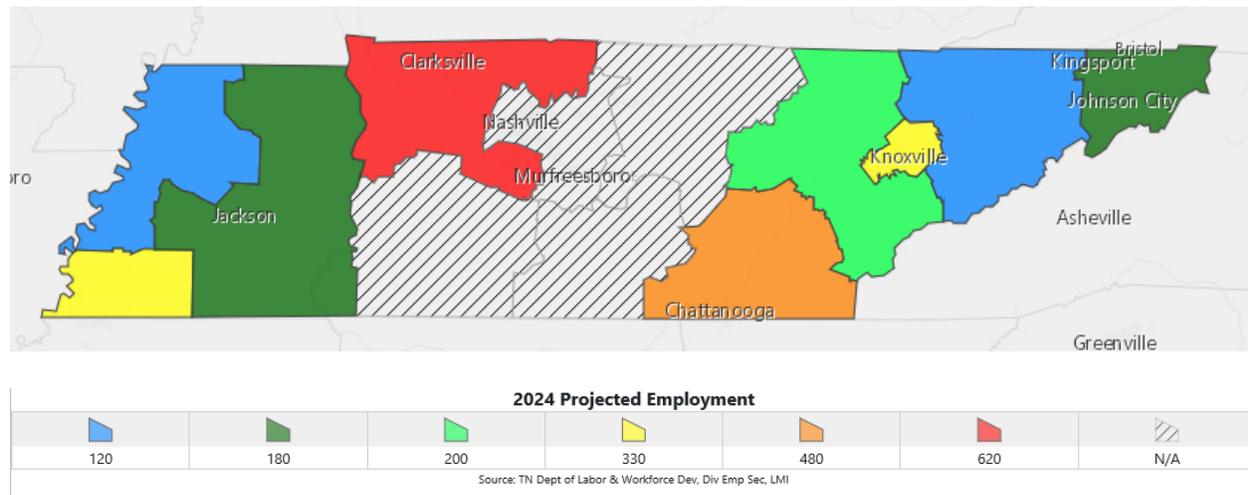
United States	Employment			Projected Annual Job Openings
	2016	2026	Percent Change	
Automotive Body and Related Repairers	160,400	174,100	+ 9 %	17,100
Automotive Service Technicians and Mechanics	749,900	795,800	+ 6 %	75,600
Tire Repairers and Changers	111,700	112,500	+ 1 %	13,800
Automotive Glass Installers and Repairers	19,600	20,900	+ 7 %	2,100

Openings for automotive body and related repairers are concentrated in the urban areas of the state with the greatest concentration in the Nashville area. While the demand is high, the outlook for automotive body and related repairers statewide is still competitive. Additional training and education is valuable for automotive body and related repairers. More training and certifications lead to more job opportunities.⁷

⁶ Career One Stop. (2018). *Occupation Profile, State and National Trends*. Retrieved from <https://www.onetonline.org/link/summary/49-3021.00>

⁷ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

Figure 3. The map below shows the 2024 Projected Employment Automotive Body and Related Repairers in Tennessee by workforce development regions. ⁸



Postsecondary Opportunities

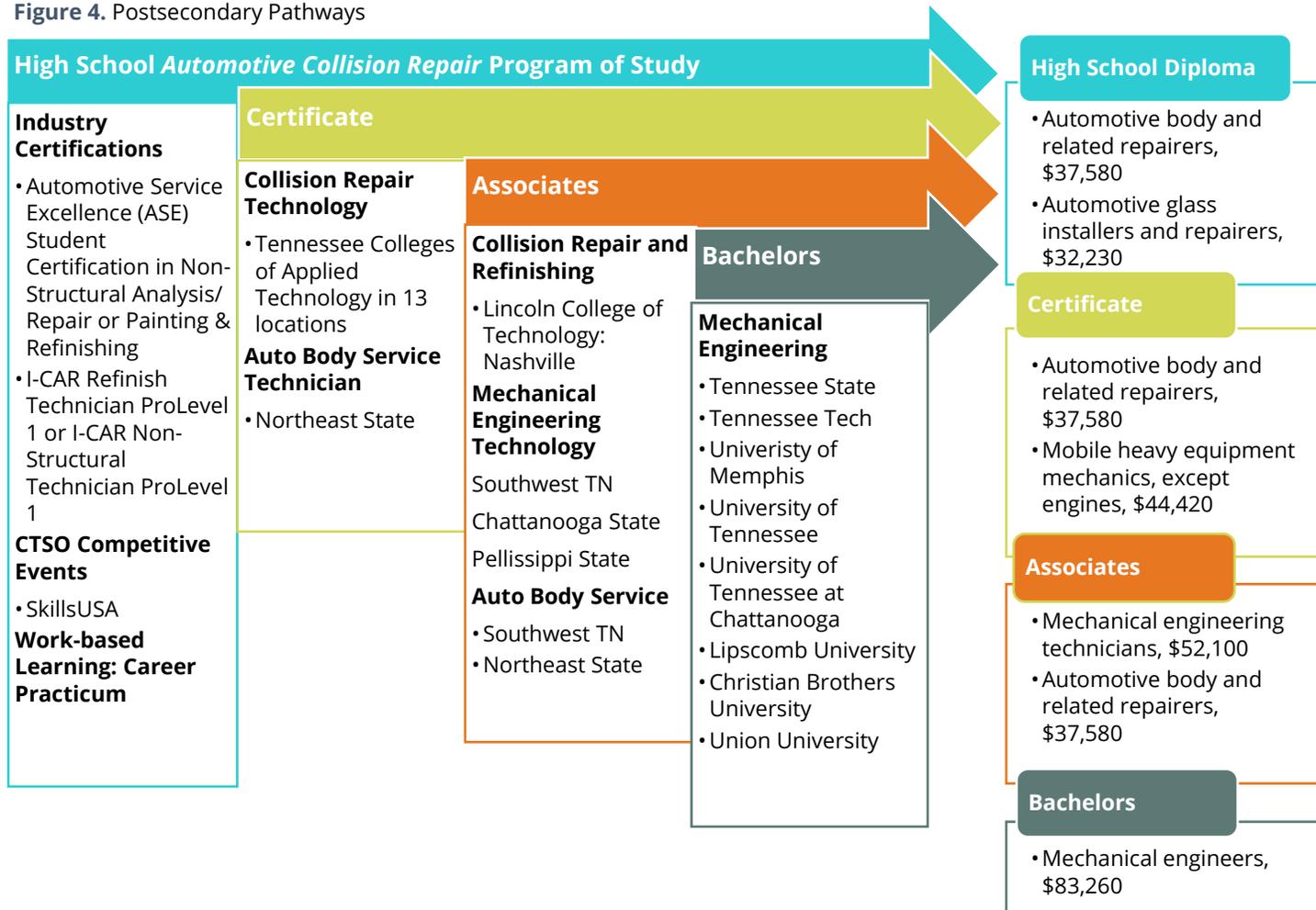
Upon completion of this program of study, students will be prepared to enter the workforce or to further their training at postsecondary institutions such as a Tennessee College of Applied Technology (TCAT) or a community college or university. Certifications may be obtained any time during the third or fourth level course. Students who obtain the ASE student certification may be able to articulate hours at TCAT. Students may gain job experience while still in high school through local and CTSO competitions and work-based learning.

The chart below outlines the related career opportunities and the training necessary for each. While a high school diploma is typically the minimum requirement for an automotive collision repair technician, employers prefer technicians with certifications or training from a postsecondary institution.⁹ Long term on-the-job training is essential for an individual to become fully qualified in the occupation. Students who are interested in pursuing related study in a four year university may seek bachelor's degrees in mechanical engineering.

⁸ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

⁹ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2017-18 Edition*, Retrieved from <https://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-body-and-glass-repairers.htm>

Figure 4. Postsecondary Pathways



Current Secondary Landscape

In the 2017-18 School Year, 2,649 students were enrolled in an Automotive Collision Repair course. This continues the growth in this program. It is a nine percent increase over the 2471 enrolled in the 2016-17 school year. Between 2014 and 2018, the number of students enrolled in a collision repair course grew by about 987 students. In 2017-18, the Automotive Collision Repair program of study was offered in 57 schools, a sharp increase. In 2018-19 it is projected to return to the more consistent level of 48 schools offering an Automotive Collision Repair course.¹⁰

¹⁰ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

Figure 5. Open Enrollment Analysis, Schools offering Automotive Collision Repair POS.¹¹

SY	Automotive Collision Repair
2014-15	46
2015-16	44
2016-17	48
2017-18	57
2018-19	48

Figure 6. Student Enrollment in Automotive Collision Repair Program of Study Courses.¹²

SY	Introduction to Collision Repair	Collision Repair: Non-Structural	Collision Repair: Painting & Refinishing	Collision Repair: Damage Analysis, Estimating, & Customer Service	Dual Enrollment Automotive Collision Repair
2014-15	0	1038	605	19	0
2015-16	621	994	614	43	34
2016-17	927	880	577	35	52
2017-18	1091	777	588	40	153

Figure 7. Automotive Collision Repair Concentrators.¹³

SY	Automotive Collision Repair Concentrators
2013-14	0
2014-15	358
2015-16	449
2016-17	284
2017-18	312 (projected)

¹¹ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

¹² Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

¹³ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.



Recommendation

No changes are recommended at this time.

2020-21 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Collision Repair	Introduction to Collision Repair (C20H20)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14) -or- Dual Enrollment Automotive & Collision Repair (C20H02)	Collision Repair: Non-Structural (C20H13) -or- Collision Repair: Painting & Refinishing (C20H14) -or- Collision Repair: Damage Analysis, Estimating, & Customer Service (C20H19) -or- Dual Enrollment Automotive & Collision Repair (C20H02)
			<p>Industry Certification for C20H13: I-CAR Refinish Technician ProLevel 1 or I-CAR Non-Structural Technician ProLevel 1 or Automotive Service Excellence Student Certification: Nonstructural Analysis/Repair</p> <p>Industry Certification for C20H14: Automotive Service Excellence Student Certification: Painting and Refinishing</p>	

References

Bureau of Labor Statistics, United States Department of Labor, *Occupational Outlook Handbook, 2017-18 Edition*. Retrieved from <https://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-body-and-glass-repairers.htm>.

Career One Stop. (2018). *Occupation Profile, State and National Trends*. Retrieved from <https://www.onetonline.org/link/summary/49-3021.00>

Collision Repair Education Foundation (ICAR) <https://www.collisioeducationfoundation.org/>

Collision Repair Education Foundation (ICAR). *2016 Snapshot of the Collision Repair Industry*. Retrieved from <https://www.collisioeducationfoundation.org/2013/11/2013-snapshot-of-the-collision-industry/>

Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

Tennessee Department of Labor & Workforce Development, Jobs4TN Online. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>



Automotive Maintenance & Light Repair

2019-20 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Maintenance and Light Repair	Maintenance and Light Repair I (C20H09)	Maintenance and Light Repair II (C20H10)	Maintenance and Light Repair III (C20H11) -or- Dual Enrollment Automotive Maintenance & Light Repair (C20H01)	Maintenance and Light Repair IV (C20H12) -or- Dual Enrollment Automotive Maintenance & Light Repair (C20H01)
			Industry Certification: Precision Measurement Instruments Certification (all subtests)	Industry Certification: Automotive Service Excellence Student Certification: Maintenance & Light Repair

Description

The Automotive Maintenance and Light Repair (MLR) program prepares students for entry into the automotive service industry. Automobile service technicians apply technical knowledge and skills to repair, service, and maintain all types of automobiles. Includes instruction in brake systems, electrical systems, engine performance, engine repair, suspension and steering, automatic and manual transmissions and drive trains, and heating and air condition systems.

The National Institute of Automotive Service Excellence (ASE) sets the nationwide standards for automotive maintenance and repair education and training. The ASE Education Foundation supports programs through instructor training, accrediting programs, and building relationships between employers and instructors. ¹⁴

¹⁴ Certifications through ASE Education Foundation were formerly awarded by National Automotive Technicians Education Foundation (NATEF). The name changed on January 1, 2018. Retrieved from <http://www.aseeducation.org/> and <http://www.ase.com/News-Events/Press-Releases/NATEF-and-AYES-Formed-New-Organization-ASE-Educati.aspx>



Job Outlook

According to the U.S Bureau of Labor Statistics, the overall national employment of automotive maintenance technicians and collision repair related workers is projected to grow from 2016 to 2026. Employment growth will be driven by increased demand for automotive work, but will vary by specialty. Employment of automotive service technicians and mechanics is projected to grow six percent.¹⁵

Chief among the reasons for this continuing job growth is the large and growing fleet of vehicles and their high average age. There are now more cars than ever in need of maintenance and repair. Based on U.S. Department of Transportation data, between 1997 and 2007, the U.S. auto fleet increased by 25% to over 240 million registered vehicles. In 2015 the average age of registered vehicles was 11.5 years old and has been increasing steadily since the 2008. Though the growth has slowed with improving economic conditions this average is still increasing and was expected to reach 11.7 years by 2017.¹⁶

The Tennessee Department of Labor and Workforce Development projected 15,440 automotive service technicians being employed statewide in 2016. That will grow to 16,575 in 2026.¹⁷ This reflects a 7.40 % change in the occupation group in Tennessee for the period 2016 to 2026. Students in Automotive Maintenance and Light Repair may also pursue related careers such as bus and truck mechanics or farm equipment mechanics where there are a large number of annual average openings anticipated. While positions are available for technicians with a high school diploma and an ASE certification, larger employers and dealerships expect most technicians to have a two year degree in automotive repair.¹⁸

¹⁵ Bureau of Labor Statistics. U.S. Department of Labor, *Occupational Outlook Handbook, 2017-18 Edition*. Retrieved from <https://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-service-technicians-and-mechanics.htm>

¹⁶ Franchise Help. *Automotive Industry Analysis 2018 – Costs & Trends* <https://www.franchisehelp.com/industry-reports/automotive-industry-analysis-2018-cost-trends/>

¹⁷ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

¹⁸ Myers, Kelly, June 29, 2018, *Education Requirements for Auto Mechanics*, Chron <https://work.chron.com/education-requirements-auto-mechanics-14930.html>.



Figure 1. Tennessee employment projections for automotive maintenance and light repair related occupations with positive openings projected 2016-2026.¹⁹

Occupation	2016 Estimated Employment	2026 Projected Employment	Total 2016 - 2026 Employment Change	Total Percent Change 2016-2026	Median Salary
Automotive Service Technicians and Mechanics	15,440	16,575	1,135	7.40%	\$38,180
Bus and Truck Mechanics and Diesel Engine Specialists	7,720	8,425	705	9.10%	\$43,450
Automotive Body and Related Repairers	3,905	4,315	415	10.60%	\$37,580
Motorcycle Mechanics	345	355	10	2.60%	\$37,450
Farm Equipment Mechanics and Service Technicians	695	800	105	15.10%	\$35,230

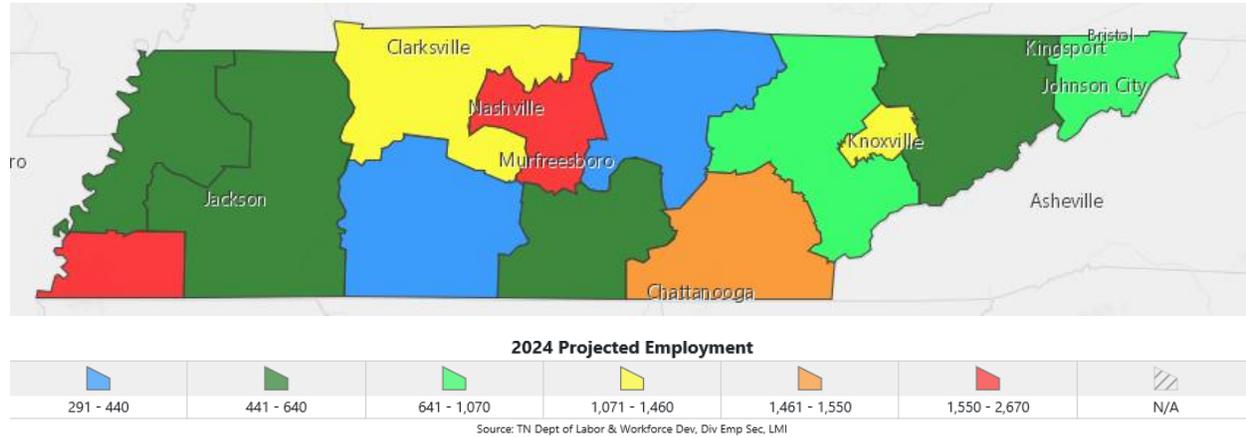
¹⁹Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

Figure 2. National trends for occupations related to Automotive Service Technicians and Mechanics 2016-26.²⁰

United States	Employment			Projected Annual Job Openings
	2016	2026	Percent Change	
Automotive Service Technicians and Mechanics	749,900	795,800	+ 6 %	75,600
Automotive Body and Related Repairers	160,400	174,100	+ 9 %	17,100
Bus and Truck Mechanics and Diesel Engine Specialists	278,800	304,600	+ 9 %	28,200
Farm Equipment Mechanics and service Technicians	42,500	45,700	+ 8 %	4,500

²⁰ Career One Stop. (2018). *Occupation Profile, State and National Trends*. Retrieved from <https://www.onetonline.org/link/summary/49-3023.00>

Figure 3. The map below shows the 2024 Projected Employment for Automotive Service Technicians and Mechanics in Tennessee by workforce development regions.²¹



Openings for automotive service technicians are available across the state with greater concentrations in urban and surrounding areas. (See Figure 3). While the demand is high, the outlook for automotive service technicians and tire repairers and changers statewide is still competitive. More training and certifications lead to more job opportunities.²²

Related occupations requiring associates or bachelor's degrees include mechanical and electrical engineers and technicians. These engineers and technicians may find opportunity in the large automotive manufacturing industry in Tennessee. A study by the Brookings Institution found that Tennessee has more than 900 automotive-related manufacturers. In fact, most Tennessee counties have at least one automotive-related manufacturer (80 out of 95).²³ Figure 4 illustrates the widespread presence of automotive manufacturing in Tennessee.

²¹ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

²² Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

²³ Muro, M., Andes, S., Fikri, K., Ross, M., Lee, J., Ruiz, N., and Marchio, N., (4 Oct. 2013). *Drive! Moving Tennessee's Automotive Sector UP the Value Chain*. Retrieved from <https://www.brookings.edu/research/drive-moving-tennessees-automotive-sector-up-the-value-chain/>

Figure 4. Location of industries and businesses in Tennessee devoted to auto manufacturing or supply. 80 out of 95 counties have at least one automotive business or industry.²⁴



Postsecondary Opportunities

Upon completion of this program of study, students will be prepared to enter the workforce or to further their training at postsecondary institutions.²⁵ While a high school diploma is typically the minimum requirement for an automotive service technician, many employers prefer, and some require, mechanics with ASE certifications and/or training from a postsecondary institution. Automotive Technology programs are available at technical and community colleges across Tennessee. Long term on-the-job training is essential for an individual to become fully qualified in the occupation.

ASE Entry Level Certifications, formerly called Student Certifications, may be obtained any time during the third or fourth level course. No work requirements are necessary to sit for the exam. Additionally, students completing the MLR program of study through an ASE-accredited program may work in a repair shop and receive work experience to count toward the requirements for ASE Certification at the professional level. Students may gain job experience while still in high school through local and CTSO competitions and work-based learning. Dual credit/dual enrollments opportunities may be established with local postsecondary institutions.

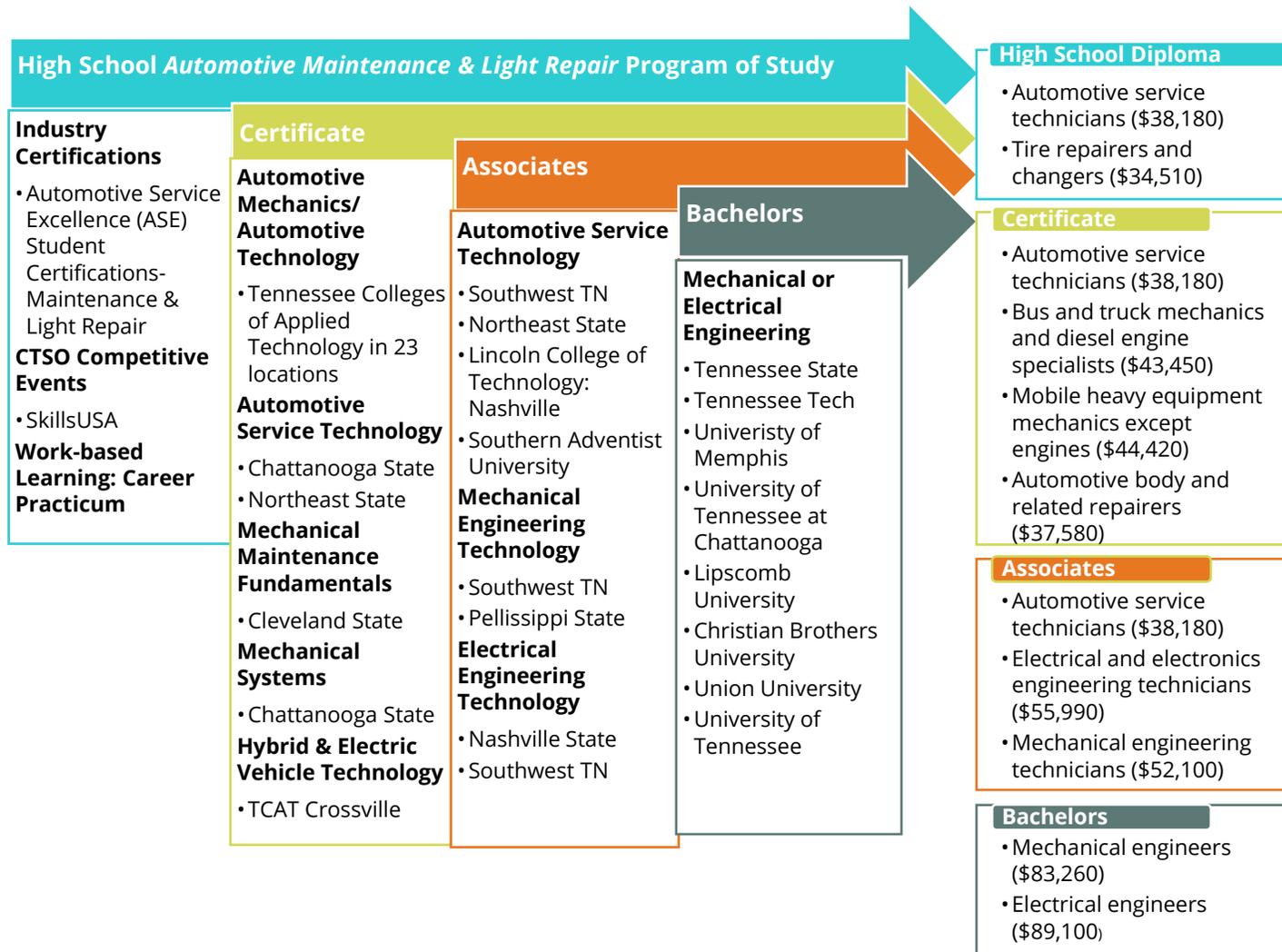
The chart below outlines the related career opportunities and the training necessary for each. Students who are interested in pursuing related study in a four year university may seek bachelor's degrees in mechanical or electrical engineering. In response to the large automotive manufacturing

²⁴ Map produced by Tennessee Department of Economic and Community Development. Retrieved from http://tntoday.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

²⁵ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2017-18 Edition*, Retrieved from <https://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-service-technicians-and-mechanics.htm>

presence in Tennessee, the University of Tennessee at Knoxville has a graduate concentration in Automotive Manufacturing and Technology.²⁶

Figure 5. Postsecondary Pathways



Current Secondary Landscape

In the 2017-18 School Year, 11,466 students were enrolled in an Automotive Maintenance and Light Repair course. This is 92 more students than during the 2016-17 when 11,374 students enrolled in

²⁶ University of Tennessee at Knoxville. (11 Jan 2016) *UT Announces Plans to Begin Automotive Engineering Concentration*. Retrieved at https://news.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

an Automotive Maintenance and Light Repair course. This is a six percent increase over enrollment in 2014-15.

After past growth in the number of programs offered, the current year has seen a reduction in the number of schools offering the Automotive Maintenance and Light Repair program of study. The program was offered in 134 schools in 2016-17 which grew to 142 in 2017-18 and has fallen to 130 for the 2018-19 school year.

Figure 6. Open Enrollment Analysis, Schools offering Automotive Maintenance and Light Repair POS.²⁷

SY	Automotive Maintenance and Light Repair
2014-15	118
2015-16	118
2016-17	134
2017-18	142
2018-19	130

Figure 7. Student Enrollment for Automotive Maintenance and Light Repair POS Courses.²⁸

SY	Maintenance and Light Repair I	Maintenance and Light Repair II	Maintenance and Light Repair III	Maintenance and Light Repair IV	Dual Enrollment Automotive Maintenance & Light Repair
2014-15	5253	3068	1855	617	0
2015-16	5090	2979	1900	655	160
2016-17	5446	2835	2083	710	300
2017-18	5515	2873	2038	704	336

²⁷ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

²⁸ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

Figure 8. Automotive Maintenance and Light Repair Concentrators. ²⁹

Automotive Maintenance and Light Repair Concentrators	
SY	
2014-15	1265
2015-16	1441
2016-17	1449
2017-18	1441 (projected)

Recommendation

No changes as this time.

2020-21 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Maintenance and Light Repair	Maintenance and Light Repair I (C20H09)	Maintenance and Light Repair II (C20H10)	Maintenance and Light Repair III (C20H11) -or- Dual Enrollment Automotive Maintenance & Light Repair (C20H01)	Maintenance and Light Repair IV (C20H12) -or- Dual Enrollment Automotive Maintenance & Light Repair (C20H01)
			Industry Certification: Precision Measurement Instruments Certification (all subtests)	Industry Certification: Automotive Service Excellence Student Certification: Maintenance & Light Repair

²⁹ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

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<https://www.onetonline.org/link/summary/49-3021.00>

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Muro, M., Andes, S., Fikri, K., Ross, M., Lee, J., Ruiz, N., and Marchio, N. (4 Oct. 2013). *Drive! Moving Tennessee's Automotive Sector UP the Value Chain*. Retrieved from

<https://www.brookings.edu/research/drive-moving-tennessees-automotive-sector-up-the-value-chain/>

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https://news.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

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Tennessee Department of Labor & Workforce Development, Jobs4TN Online. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>

University of Tennessee at Knoxville. (11 Jan 2016). *UT Announces Plans to Begin Automotive Engineering Concentration*. Retrieved from https://news.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6



Aviation Flight

2019-20 Program of Study	Level 1	Level 2	Level 3	Level 4
Aviation Flight	Introduction to Aerospace (C20H15)	Aviation I: Principles of Flight (C20H16)	Aviation II: Advanced Flight (C20H18) -or- Dual Enrollment Aviation Flight (C20H03)	Work-Based Learning: Career Practicum (C20H17) -or- Dual Enrollment Aviation Flight (C20H03)

Description

Aviation Flight is a pathway intended to prepare students to be successful in a range of aviation careers, such as pilots, aircraft engineers, air traffic control specialists, aircraft mechanics, or airline statisticians. Course content covers the knowledge and skills of all aspects of flight needed to pass the Federal Aviation Administration (FAA) Private Pilot written exam, including aircraft structures, flight environment, procedures and regulations, aerodynamics of flight, judgment training, navigation, communications, and more. Upon completion of this program of study, students will be prepared to take the FAA Private Pilot written exam and will be able to advance more quickly through the training hours typically required to solo in an aircraft after graduating. Students may gain related job experience while still in high school through work-based learning and local and CTSO competitions. Dual credit/dual enrollment opportunities may be established with local postsecondary institutions.

Job Outlook

Air Transportation Workers

Amongst the air transportation workers occupation groups projected to grow in Tennessee between 2016 and 2026 are commercial pilots at 29.40%, aerospace engineering at 15.30%, and aircraft mechanics and service technicians at 4.5%. Avionics technicians are a smaller group that is not expected to have employment growth. All of the above mentioned occupation groups range in average salary from \$56,300 to \$86,440. Other occupation groups include air traffic controllers, airline pilots, copilots, flight engineers, and first-line supervisors of mechanics, installers and

repairers. Yearly review of the air transportation work force is vital as the marketplace for job openings appears to be dynamic and volatile.³⁰

Aerospace Engineering

Students enrolled in the Aviation Flight program of study may also use their training to pursue careers as aerospace engineers. A significant increase in aerospace engineer employment is expected from 2016-2026. The strongest demand for aerospace engineers is in the Memphis area.³¹

Unmanned Aerial Systems

Although the Bureau of Labor Statistics has not yet categorized unmanned aerial system (UAS) operators outside of military specific occupations, the increased commercial use of this technology is significant. The demand for jobs in the UAS industry, commonly referred to as drones, is going to increase. A study by the Association for Unmanned Vehicle Systems International (AUVSI), projects more than 100,000 new jobs would be created in the UAS field by 2025. In 2015, an employment of 99 was reported in the UAS field in Tennessee. The report indicated that the number will triple to 297 by 2017 and grow to 439 in 2025.³² While salaries for UAS pilots vary widely, salaries up to \$100,000 have been reported.³³ A recent report that focused only on large businesses stated that drone adoption by large companies is expected to double.³⁴ An example of the expected job demand increase is the fact that an increasing number of companies need a UAS program manager.

According to one study the UAS industry was anticipated to generate \$1.1 billion in spending in 2015, growing to \$2.3 billion in 2016, and to \$5.1 billion in 2025. In 2015, employment was expected to be 11,400, growing to 22,800 in 2016, and to 50,529 in 2025. Over the 10-year period 2015-2025, drones were anticipated to generate 100,000 jobs and \$82 billion in direct and induced economic activity. The study indicated that agriculture and public safety sectors are expected to make the highest use of drones.³⁵

³⁰ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

³¹ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

³² Jenkins, Darryl, & Vasigh, Bijan. (March 2013). *The Economic Impact of Unmanned Aircraft Systems Integration in the United States*. Retrieved from <http://www.auvsi.org/auvsiresources/economicreport>.

³³ Lindzon, Jared. (25 October 2017). *I want to be a Commercial Drone Pilot*. Retrieved from <https://www.theglobeandmail.com/report-on-business/careers/career-advice/i-want-to-be-a-commercial-drone-pilot-what-will-my-salary-be/article36687404/>

³⁴ Skyward. 2018 Industry Report. *State of Drones in Big Business*. Retrieved from <http://go.skyward.io/rs/902-SIU-382/images/2018%20State%20of%20Drones.pdf>

³⁵ Federal Aviation Administration, (Nov 2016), *The Economic Impact of Civil Aviation on the U. S. Economy*, Retrieved from https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf



A license, Part 107 of the Federal Aviation Regulations, is now mandatory for commercial UAS pilots.³⁶ Knowledge and skills needed for those working in the UAS field include a strong understanding of aerodynamics, operation skills, and engineering skills. Career opportunities for students with drone training include military drone pilot, firefighter, disaster relief, search and rescue, law enforcement, oil and gas operations, seismic study, border patrol, traffic reporting, storm chasing, agriculture, package delivery, forestry, engineering, computer science, commercial contractors, mapping, film, construction, real estate, and other industries.

Figure 1. Tennessee employment projections for Aerospace related occupations with positive openings projected 2016-2026.³⁷

Occupation	2016 Estimated Employment	2026 Projected Employment	Total 2016 - 2026 Employment Change	Total Percent Change	Median Salary
Airline Pilots, Copilots, and Flight Engineers	215	235	20	8.80%	\$83,760
Commercial Pilots	445	575	130	29.40%	\$70,080
Air Traffic Controllers	615	635	20	3.20%	\$130,190
Aerospace Engineers	315	360	50	15.30%	\$86,440
Aircraft Mechanics and Service Technicians	1,365	1,425	60	4.50%	\$56,300
Avionics Technicians	175	175	0	0.0%	\$56,910
First-Line Supervisors of Mechanics, Installers, and Repairers	10,910	12,295	1380	12.70%	\$62,030

³⁶ Federal Aviation Administration, (June 2016). *Fact Sheet – Small Unmanned Aircraft Regulations (Part 107)*, Retrieved from https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20516

³⁷ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

Figure 2. National trends for occupations related to Automotive Service Technicians and Mechanics 2016-26.³⁸

United States	Employment		Percent Change	Projected Annual Job Openings
	2016	2026		
Commercial Pilots	40,800	42,300	+ 4 %	4,000
Airline Pilots, Copilots, and Flight Engineers	84,000	86,900	+ 3 %	8,100
Aerospace Engineers	69,600	73,800	+ 6 %	4,600
Aircraft Mechanics and Service Technicians	132,000	138,500	+ 5 %	10,900

The map below (figure 3) shows the Nashville area with the highest concentration of projected employment of commercial pilots in 2024.

The Greater Memphis Chamber named Memphis as America’s Aerotropolis because of its large airport and surrounding transportation linkages from distribution centers and manufacturing facilities to its roadways, waterways, and railways. Despite the decline in air passenger service, the Memphis-Shelby County International Airport is the busiest cargo airport in America and handles hundreds of cargo flights, mostly through FedEx.³⁹

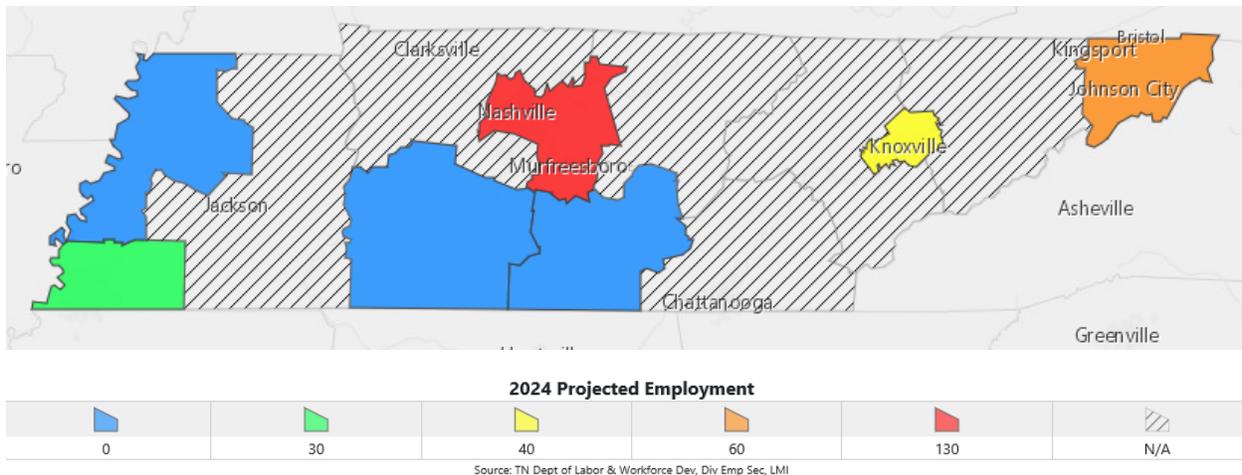
The Tri-Cities area also has an aviation industry presence. Tri-Cities Airport is in Blountville, Tennessee and serves the Tri-Cities area of Northeast Tennessee and Southwest Virginia. Bell Helicopter has teamed up with Northeast State to provide aviation maintenance training. An aviation

³⁸ Career One Stop. (2018). *Occupation Profile, State and National Trends*. Retrieved from <https://www.onetonline.org/link/summary/53-2012.00>

³⁹ Hurley, Amanda. City Lab. (28 August 2014) *The Memphis Airport is on a Mission to Become Its Own City*. Retrieved from <https://www.citylab.com/design/2014/08/the-memphis-airport-is-on-a-mission-to-become-its-own-city/379227/>

park has been designed for aerospace industry to move into the area.⁴⁰ As the industry grows, the need for pilots and air traffic controllers in this area may increase as well.

Figure 3. The map below shows the 2024 projected employment for Commercial Pilots in Tennessee by the workforce development regions.⁴¹



Postsecondary Opportunities

Upon completion of this program of study, students will be prepared to pass the FAA Private Pilot written exam. Students may enter the workforce as commercial pilots or other aerospace employees. Students will be ready to further their training at technical schools and universities in various areas of aerospace such as air traffic control. Students may pursue bachelor’s degrees with majors in aerospace engineering, aerospace technology, professional pilot, and more. Training and educational opportunities are available through the United States Air Force or other military branches.

Training and education available in Tennessee includes the MTSU Aerospace Program which awards bachelor’s degrees in the following concentrations: aerospace technology, flight dispatch, professional pilot, maintenance management, aviation administration, and UAS operations. A Master’s degree in Aviation Administration is also available. In addition to this program, students may complete the Air Traffic Control program at MTSU and be prepared to attend the FAA Training

⁴⁰ Lowery, Lurah, (5 Sept. 2014). *Northeast State will offer 2-year aviation program*. Bristol Herald Courier. Retrieved from https://www.heraldcourier.com/news/article_6dd96efe-356c-11e4-b6e0-001a4bcf6878.html.

⁴¹ Tennessee Department of Labor and Workforce Development. (2018). *Occupational Projections (Long-term)*. Retrieved from <https://www.jobs4tn.gov>.

Academy in Oklahoma City and become an air traffic controller.⁴² The University of Tennessee of Knoxville offers a bachelor's degree in Aerospace Engineering. Tennessee State University offers a bachelor's degrees in Aviation Flight Training and Aviation Management in which the first two years may be taken at Columbia State Community College.

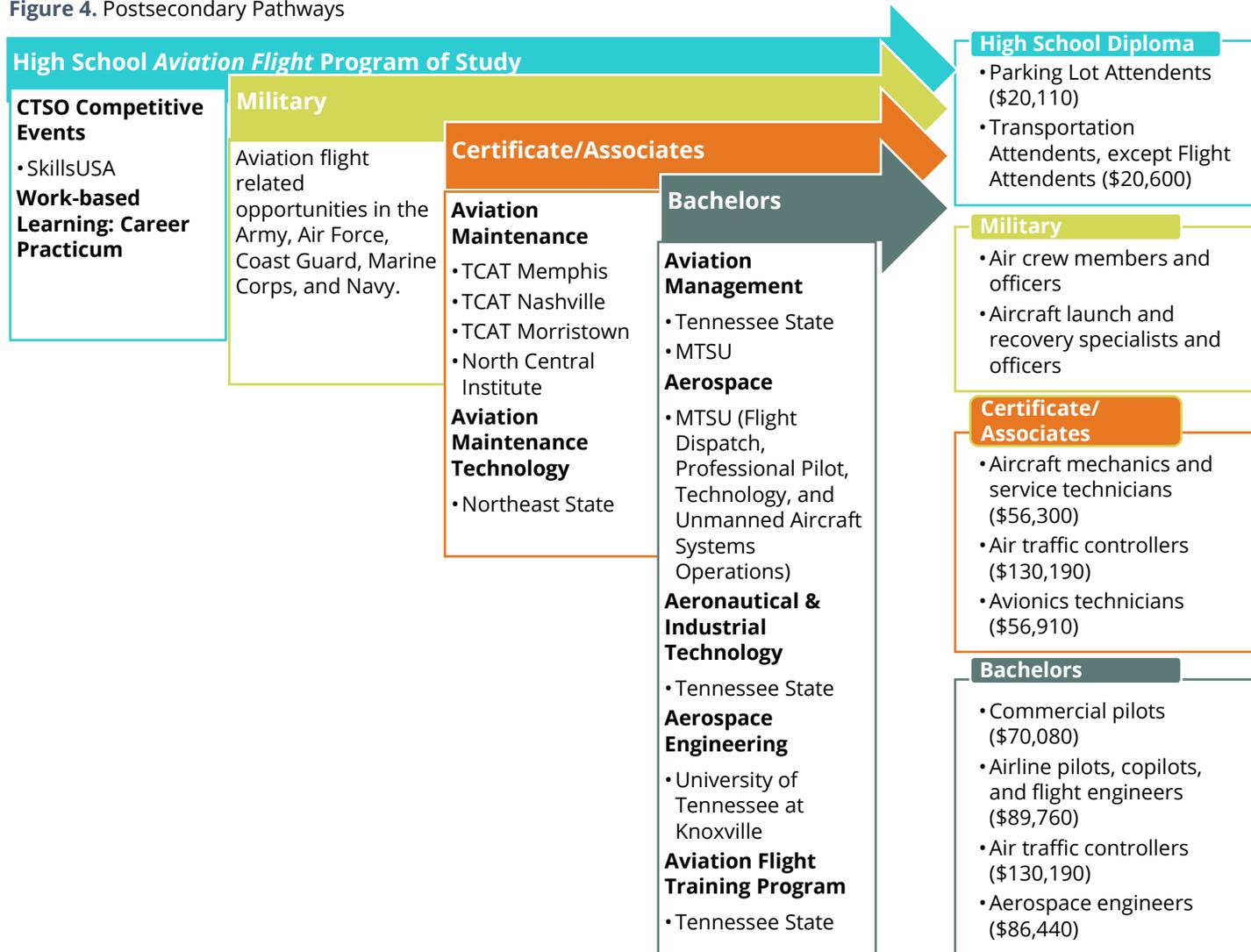
Some Tennessee College of Applied Technology (TCAT) offer aviation related programs. TCAT Nashville, TCAT Morristown and TCAT Memphis offer an Aviation Maintenance Technology diploma for Aviation Airframe and Power plant Maintenance Mechanics. Northeast State Community College offers an Associate of Applied Science in Aviation Technology. TCAT Morristown and Northeast State have signed an articulation agreement to make it easier for students to transfer their aviation credits.⁴³

A clear pathway is developing for students concentrating on UAS. Other states already have a statewide UAS program and curricula built for high schools. The study of unmanned aerial systems is emerging within postsecondary programs across the country and worldwide. At least 50 accredited colleges worldwide offer bachelor's degrees in UAS, including Embry-Riddle Aeronautical University who also offers a Master of Science in Unmanned Systems. Middle Tennessee State University (MTSU) added a concentration in UAS operations within the B.S. in Aerospace degree in the Fall of 2015. The mission of the MTSU program is to prepare students for a prosperous career in the newly forming UAS marketplace, in professions such as UAS operator, consultant, or manager for UAS programs. The aligned coursework for the UAS operations concentration requires students to build and fly UAS in addition to preparing for the private pilot license for manned vehicles and studying in many interdisciplinary areas including electricity, computer science, GIS, agriculture, and business.

⁴² Middle Tennessee State University Department of Aerospace. Retrieved from <https://www.mtsu.edu/aerospace/>.

⁴³ Citizen Tribune (12 December 2017) *TCAT signs articulation agreement with Northeast State for Aviation Technology program*. Retrieved from https://www.citizentribune.com/newsnow/tcat-signs-articulation-agreement-with-northeast-state-for-aviation-technology/article_a66ff186-df62-11e7-969c-bf23fe0e41d7.html

Figure 4. Postsecondary Pathways



Current Secondary Landscape

In the 2016-17 school year, 254 students were enrolled in *Introduction to Aerospace* and 148 were enrolled in *Aviation I: Principles of Flight* while 89 were enrolled in *Aviation II: Advanced Flight*.

Enrollment numbers grew in 2017-18 to 307 students enrolled in *Introduction to Aerospace* and 137 enrolled in *Aviation I: Principles of Flight* and 108 enrolled in *Aviation II: Advanced Flight*.

The number of Aviation Flight programs has increased. In 2014-15, 7 schools offered the Aviation Flight program of study. The number increased to 15 in 2017-18 and in 2018-19 there are 14 schools offering the program. In 2018-19 two high schools offered a special program of study for Unmanned Aerial Systems.

Figure 5. Open Enrollment Analysis, Schools offering Aviation POS.⁴⁴

SY	Aviation Flight
2014-15	7
2015-16	7
2016-17	9
2017-18	15
2018-19	14

Figure 6. Student Enrollment Data for Aviation Flight POS Courses.⁴⁵

SY	Introduction to Aerospace	Aviation I: Principles of Flight	Aviation II: Advanced Flight	Dual Enrollment Aviation Flight
2014-15	317	96	77	0
2015-16	451	131	70	0
2016-17	254	148	89	0
2017-18	307	137	108	2

Figure 7. Aviation Flight Concentrators.⁴⁶

SY	Aviation Flight
2014-15	42
2015-16	53
2016-17	64
2017-18	65 (projected)

Recommendations

The successful completion of the FAA Private Pilot Written Exam should be a promoted certification aligned to the Aviation Flight II course. Flight II already lists the FAA Private Pilot Written Exam as a certification for the course.

⁴⁴ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

⁴⁵ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

⁴⁶ Tennessee Department of Education. (2018). Student Enrollment Data. Retrieved from TN DOE calculation of student enrollment data.

Unmanned Aerial Systems

Due to the increasing demand for pilots in the commercial use of Unmanned Aerial Systems (UAS), an UAS course should be added to the curriculum. A clear industry certification links to this new course since the FAA has specified the requirement, Part 107 of the Federal Aviation Regulations, for a commercial drone pilot. UAS is an emerging area and relevant to many different industry applications. Because the industry is so new, regional and local labor data is not readily available. But nationwide data, provided earlier in this document, for industry growth is very strong and shows the demand for such a course.

The Program Manager has spoken with Aviation teachers, including the teachers in the special UAS programs, to get feedback on UAS courses. Since Part 107 requires a person to be 16 years old, any course leading to the Part 107 license should be at Level 3 or 4. Teachers confirm it is possible to have a course focused only being a drone pilot.

The new course, Unmanned Aircraft Systems Pilot, should be in the Aviation program as an option at level 4. The course would focus on the operation of UAS. At the end of the course students would be able to test for their Remote Pilot Certification (FAA Part 107). This can be done in a one credit course. Teachers would need to have completed their Part 107 to be qualified to teach the course.

The successful completion of the Remote Pilot Certification (FAA Part 107) should be a promoted certification aligned to the new Unmanned Aerial Vehicle Systems courses.

Job data and industry news should be carefully monitored in the coming years to determine if a critical mass of demand warrants the addition of other UAS courses. One possibility is to develop courses that would be included in other CTE programs. The Agriculture programs are adding an UAS course this coming year. These classes would provide students Remote Pilot Certification (FAA Part 107) in context with program content.

2020-21 Program of Study	Level 1	Level 2	Level 3	Level 4
Aviation Flight	Introduction to Aerospace (C20H15)	Aviation I: Principles of Flight (C20H16)	Aviation II: Advanced Flight (C20H18) -or- Dual Enrollment Aviation Flight (C20H03)	Work-Based Learning: Career Practicum (C20H17) -or- Dual Enrollment Aviation Flight (C20H03) -or- Unmanned Aircraft Systems Pilot
			Industry Certification for C20H18: FAA Private Pilot Written Exam	Industry Certification for new course: Remote Pilot Certification (FAA Part 107)

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