Advanced Manufacturing

Comprehensive Career Cluster Review (C3R)

Postsecondary, Workforce, CTE, and Military Readiness | Spring 2025

TN Department of Education

Comprehensive Career Cluster Review (C3R)

The comprehensive career cluster review (C3R) is the intentional review of career and technical education (CTE) programs and the course standards within each program to ensure students have up-to-date course standards aligned to postsecondary and career needs. Each career cluster is reviewed annually with input from the state-wide advisory councils comprising postsecondary partners, industry partners, and secondary CTE teachers. Advisory council meetings allow the stakeholders to engage in dialogue and discuss current needs, emerging trends, and necessary course revisions to course standards. Advisory council input could potentially lead to new or retired programs of study, new courses or retired courses, or revised course standards within existing courses, if necessary. The collaborative engagement ensures students receive instruction on the most up-to-date and relevant course standards, so they are prepared for postsecondary and the workforce.

Advanced Manufacturing

Advanced Manufacturing integrates innovative technologies and time-saving processes to enhance productivity, efficiency, and quality in manufacturing. This includes techniques such as automation, robotics, and additive manufacturing to streamline production processes and create more customized products. Advanced Manufacturing is a critical sector of Tennessee's economy. After several consecutive years of positive employment growth, the demand for skilled manufacturing workers shows no sign of slowing. This career cluster contains seven programs of study (POS): Advanced Science, Technology, Engineering, and Mathematics (STEM) Applications, Engineering, Industrial Maintenance Technology, Machining Technology, Mechatronics, Robotics & Technology, and Welding. Advanced STEM Applications, Engineering, and Robotics & Technology will be added to the Advanced Manufacturing Cluster beginning the 2025-26 school year. According to the 2025 Supply and Demand Report, there are 51 in-demand occupations in Advanced Manufacturing and 47 aligned academic programs across the State of Tennessee. Engineering and Other STEM Programs are reported as having 14 in-demand occupations and 71 aligned academic programs across Tennessee. These numbers include secondary and post-secondary institutions.

Advanced STEM Applications

Advanced STEM Applications			
Year 1	Year 2	Year 3	Year 4
STEM I: Foundations [1] (C21H15)	STEM II: Applications [1] (C21H16)	STEM III: STEM in Context [1] (C21H17)	STEM IV: STEM Practicum [2] (C21H18) -or- **WBL** Advanced STEM Applications Career Practicum [3] (C21H45)

Dual Enrollment Advanced STEM Applications [4]				
DE I (C21H32)	DE II (C21H33)	DE III (C21H35)	DE IV (C21H36)	DE V (C21H49)
DE VI (C21H50)	DE VII (C21H51)	DE VIII (C21H52)	DE IX (C21H53)	DE X (C21H54)

Available courses for elective credit in this cluster:

- ***Introduction to Geographical Information Systems (GIS)*** (C18H39) is a supplemental course that can be offered in addition to courses within the STEM Applications program of study but does not count toward concentrator status.
- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] Satisfies the third lab science credit required for graduation.

[2] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[3] May be taught for 1, 2, or 3 credits.

[4] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

The *Advanced STEM Applications* POS is designed for students interested in the exciting careers available in the high-demand fields of science, technology, engineering, and mathematics. This POS is uniquely structured to offer students an overview of STEM fields, occupations, and applications in the first year, followed by a more specialized study of the scientific inquiry or engineering design process in subsequent years, culminating in a portfolio and internship experience. Upon completion of these POS, students will be prepared to pursue engineering studies or an advanced study in the STEM field of their choice at a variety of postsecondary institutions.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS is aligned with SkillsUSA and Technology Student Association (TSA) Career and Technical Student Organizations (CTSOs).

Job Outlook

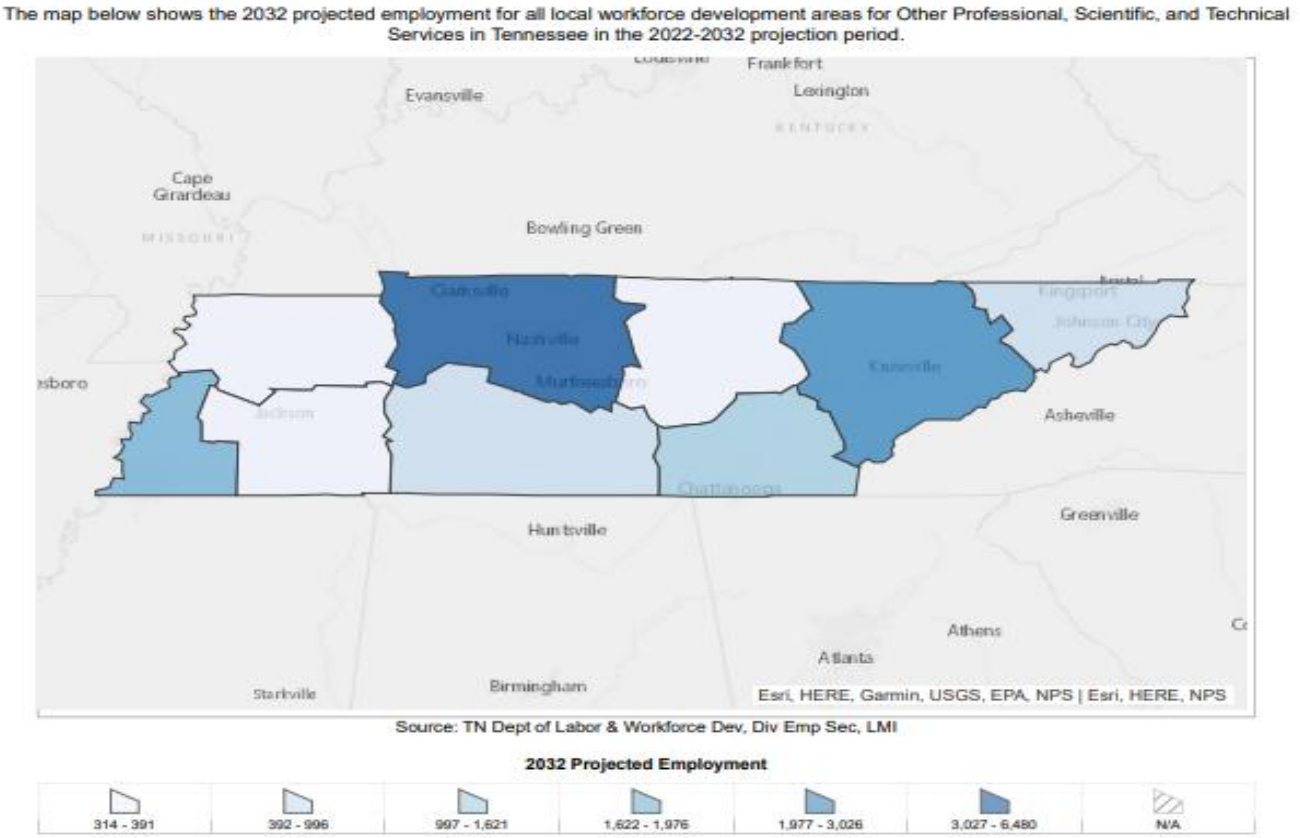
As the global demand for STEM professionals continues to grow, there is an increasing need for skilled workers in various industries, such as healthcare, information technology, and renewable energy. STEM education prepares students for high-paying jobs by providing them with the knowledge and skills required to excel in these competitive fields. According to the Bureau of Labor Statistics, the overall employment of computer systems analysts is strong statewide and nationally. Nationally, computer systems analysts are projected to grow ten percent or more from 2022 to 2032, much faster than the average for all occupations[1]. In Tennessee, the highest in-demand occupations in this cluster are electrical and electronic engineering technologists and technicians (eight regions), industrial engineering technologists and technicians (eight regions), mechanical engineers (seven regions), industrial engineers (five regions), and

[1] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 17, 2025, from https://www.onetonline.org/link/summary/15-1211.00

electrical engineers (four regions). Industrial engineering technologists and technicians typically require associate degrees, while engineers require a bachelor's degree[2].

There are about 37,300 openings for computer systems analysts each year, on average, over the decade[3]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force through retirement.

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Other Professional, Scientific, and Technical Services in Tennessee in the 2022-2032 projection period.[4]



[2] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 17, 2025, from https://www.onetonline.org/link/summary/17-3026.00

[3] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 17, 2025, from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx, https://www.onetonline.org/link/summary/15-1211.00

[4] Jobs4Tn.gov. *Occupation Profile*. Retrieved March 20, 2025, from JOBS4TN.GOV - Industry Profile

Figure 2. Tennessee employment projections for Advanced STEM Applications related occupations with positive job openings projected from 2022 to 2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
Computer and Information Systems Managers	11-3021	9,369	12,699	36%	1,037
Industrial Engineers	17-2112	6,511	8,112	25%	560
Computer Systems Analyst	15-1211	7,754	9,615	24%	693

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

[5] Tennessee Higher Education Commission, Supply and Demand Report, Retrieved March 20, 2025, from https://www.tn.gov/content/dam/tn/thec/bureau/research/other-research/supply-demand/2025/2025%20Supply%20and%20Demand%20Report.pdf

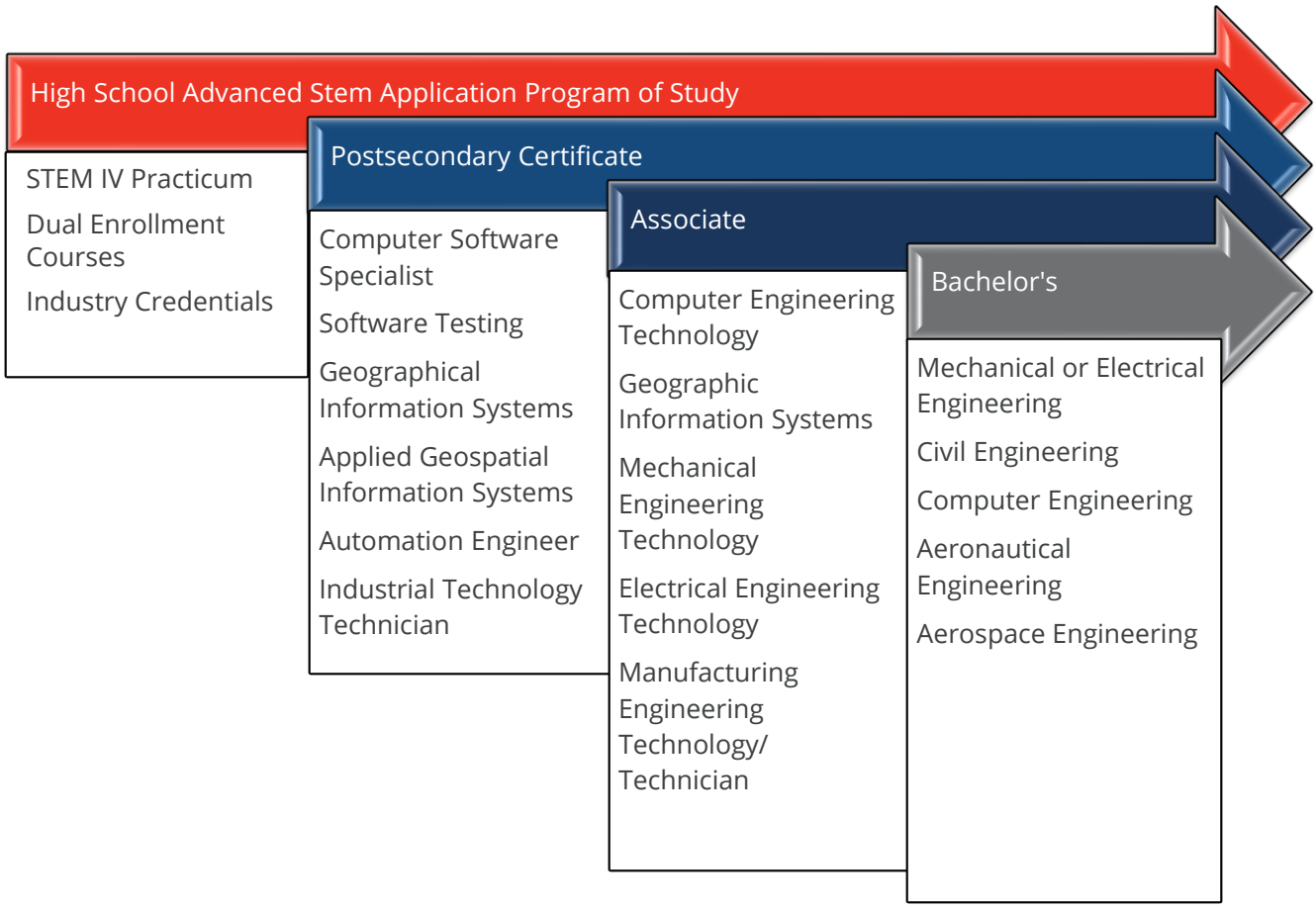
Postsecondary Pathways

Tennessee offers extensive post-secondary opportunities for students aspiring to specialize in advanced STEM applications. Many trade schools, colleges, and universities play a pivotal role, offering specialized programs in advanced manufacturing, robotics, and automation, providing students with hands-on training and certifications essential for careers in innovative industries. These institutions provide opportunities for advanced research, interdisciplinary collaboration, and industry partnerships, preparing graduates to tackle complex challenges and drive innovation in fields such as space exploration, renewable energy, and biomedical engineering. With a diverse range of educational pathways tailored to different interests and career aspirations, Tennessee ensures that aspiring professionals in advanced STEM applications have the resources and support needed to excel in these dynamic and high-impact fields.

These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in STEM applications. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Advanced STEM Applications program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the Tennessee Department of Labor and Workforce Dashboard.

High School Diploma	Certificate	Associate	Bachelor's
• N/A	• Computer User Support Specialist **($51,128)**	• Electrical and Electronics Engineering Technologists and Technicians **($72,800)** • Geographic Information Systems Technologists **($104,920)** • Civil Engineering Technologists and Technicians **($60,700)**	• Software Quality Assurance Engineer **($101,800)** • Software Developer **($132,270)** • Mechanical Engineer **($99,510)** • Electrical Engineer **($106,950)** • Civil Engineers **($95,890)**

Current Secondary Landscape

Over the past three years, the number of schools offering Advanced STEM Applications has increased from 40 to 68. In the 2023-24 school year, 7,953 students were enrolled in Advanced STEM Applications, an increase from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2021-22 to the 2023-24 school year, as well as the enrollment in the Advanced STEM Applications POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Advanced STEM Applications
2021-22	40
2022-23	52
2023-24	68

Figure 6. Student Enrollment by Course

School Year	STEM I: Foundations	STEM II: Applications	STEM III: STEM in Context	STEM Practicum
2021-22	3,487	1,710	1,039	339
2022-23	3,777	1,682	1,233	481
2023-24	4,337	2,018	1,098	403

Engineering

Engineering			
Year 1	Year 2	Year 3	Year 4
Principles of Engineering & Technology (C21H04)	Engineering Design I [1] (C21H05)	Engineering Design II [1] (C21H06)	Engineering Practicum [2] (C21H14) -or- **WBL** Engineering Career Practicum [3] (C21H47)

Dual Enrollment Engineering [4]				
DE I (C21H00)	DE II (C21H11)	DE III (C21H41)	DE IV (C21H42)	DE V (C21H61)
DE VI (C21H62)	DE VII (C21H63)	DE VIII (C21H64)	DE IX (C21H65)	DE X (C21H66)

Available courses for elective credit in this cluster:

- ***Introduction to Geographical Information Systems (GIS)*** (C18H39) is a supplemental course that can be offered in addition to courses within the Engineering program of study but does not count toward concentrator status.
- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, & Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] Satisfies the third lab science credit required for graduation.

[2] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[3] May be taught for 1, 2, or 3 credits.

[4] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

Engineering is a POS designed for students interested in the various disciplines of engineering and engineering technology. Course content is arranged around four sequenced, progressive courses that provide students with the opportunity to develop critical thinking skills and an understanding of engineering concepts. Students then apply these skills with the multi-step engineering design processes to solve real-world problems. The capstone Engineering Practicum course places students with industry partners to complete a design project, report the results, and present their project before an audience.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

Engineers play a significant role in pushing the boundaries of applied science and solving technical problems that enable construction, manufacturing, medicine, and numerous other areas to reach new heights. The field is often at the leading edge of innovation and plays a significant role in shaping society and its future. According to the Bureau of Labor Statistics, overall employment of industrial engineers is strong both statewide and nationally. Nationally, industrial engineers are projected to grow 12 percent from 2022 to 2032, much faster than the average for all occupations[6]. Tennessee is expecting a 14 percent projected growth in employment of industrial engineering technologists and technicians[7]. There are 25,200 openings for industrial engineers each year, on average, over the decade[8]. Electrical engineers are expected

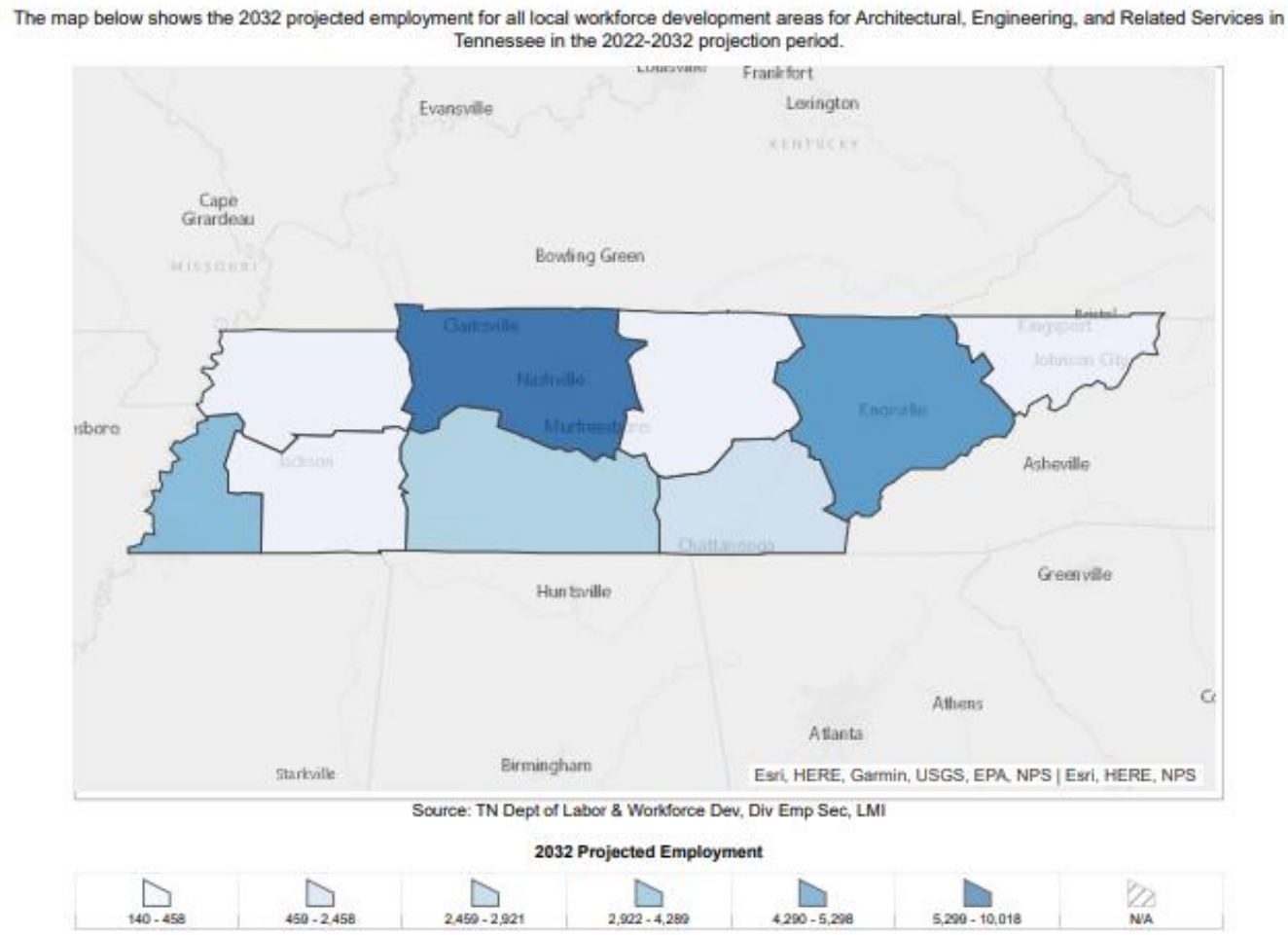
[6] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/47-2031.00

[7] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/17-3026.00

[8] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/17-2112.00

to continue growing at over 9 percent from 2022 to 2032[9]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force through retirement.

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Architectural, Engineering, and Related Services in Tennessee in the 2022-2032 projection period [4].



[9] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025 from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx

Figure 2. Tennessee employment projections for Engineering-related occupations with positive job openings projected for 2022 to 2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
Industrial Engineers	17-2112	6,511	8,112	25%	560
Computer and Information Systems Managers	11-3021	9,369	12,699	36%	1,037
Computer Systems Analysts	15-1211	7,754	9,615	24%	693

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
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2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

Postsecondary Pathways

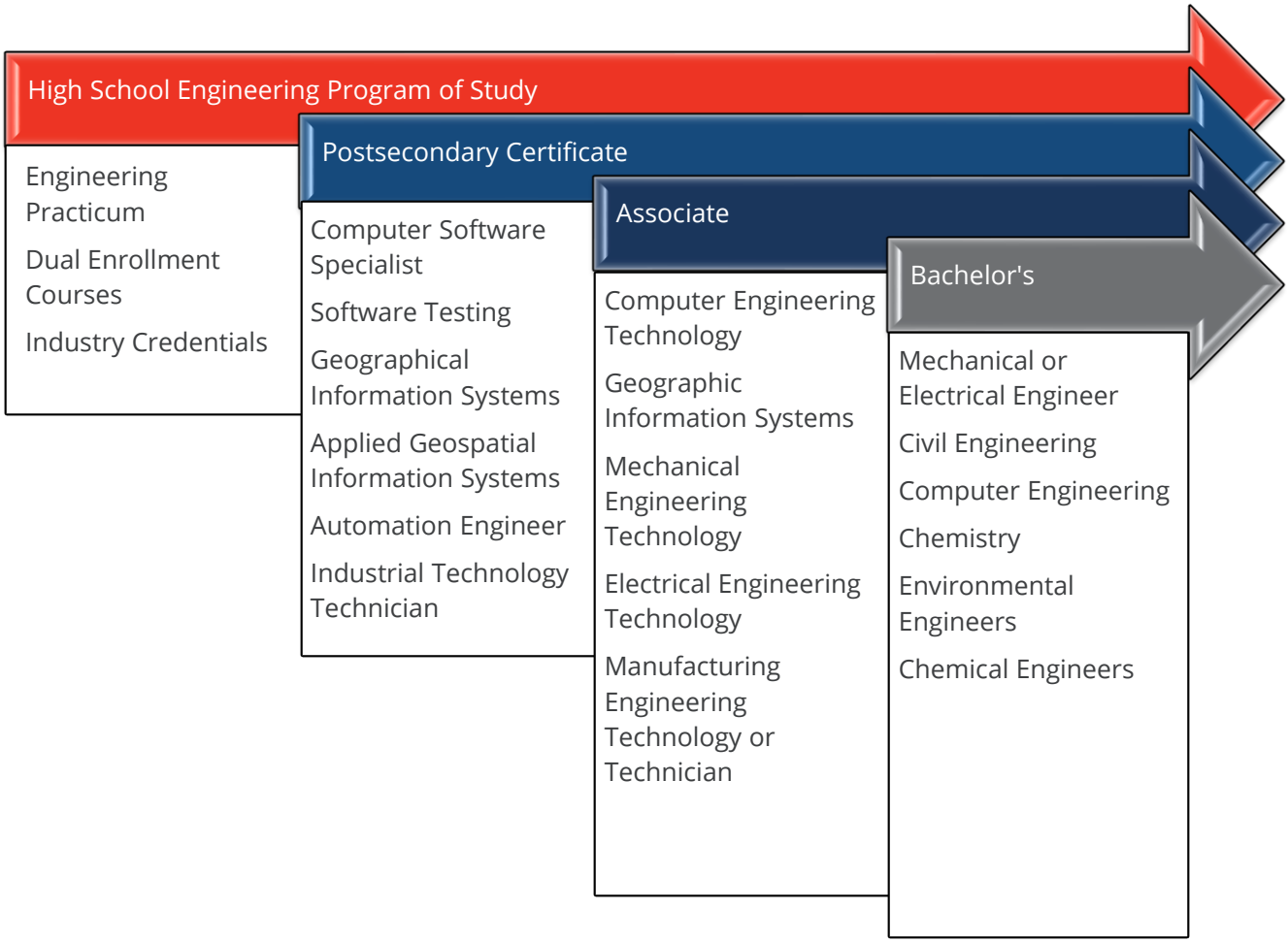
In Tennessee, students aspiring to pursue engineering as a profession are presented with several post-secondary opportunities. Many of the trade schools, colleges, and universities offer specialized programs in engineering technology. These programs provide hands-on training in areas such as mechanical, electrical, and civil engineering, equipping students with the practical skills necessary for entry-level positions in various engineering fields.

These institutions boast state-of-the-art facilities and renowned faculty members, positioning graduates for success in industries ranging from automotive and aerospace to energy and environmental engineering. With a diverse range of educational pathways tailored to different interests and career aspirations, Tennessee ensures that aspiring engineers have the resources and support they need to thrive in this dynamic and impactful profession.

These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Engineering. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Engineering program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



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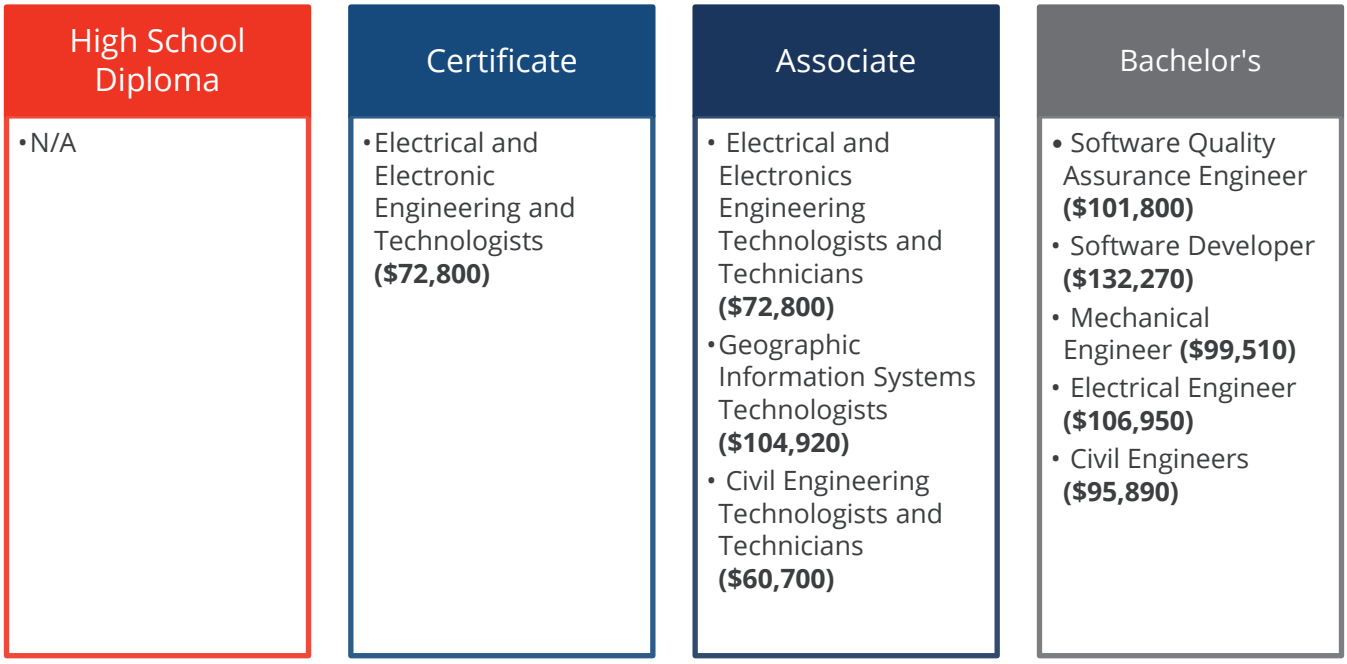


Current Secondary Landscape

Over the past three years, the number of schools offering Engineering has increased from 63 to 89. In the 2023-24 school year, 8,598 students were enrolled in Engineering, an increase from the previous year. The figures below show the open enrollment analysis for 2021-22 through the 2023-24 school year and the enrollment in the Engineering POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Engineering
2021-22	63
2022-23	59
2023-24	89

Figure 6. Student Enrollment by Course

School Year	Principles of Engineering and Technology	Engineering Design I	Engineering Design II	Engineering Practicum
2021-22	4,795	1,929	1,026	470
2022-23	4,727	1,777	1,062	396
2023-24	4,650	1,865	1,213	193

Industrial Maintenance Technology

Industrial Maintenance Technology			
Year 1	Year 2	Year 3	Year 4
Principles of Manufacturing (C13H05)	Introduction to Industrial Maintenance (C13H28)	Advanced Industrial Maintenance (C13H29)	Manufacturing Practicum [1] (C13H08) -or- **WBL** Industrial Maintenance Technology Career Practicum [2] (C13H40)

Dual Enrollment Industrial Maintenance Technology [3]				
DE I (C13H30)	DE II (C13H31)	DE III (C13H32)	DE IV (C13H33)	DE V (C13H50)
DE VI (C13H51)	DE VII (C13H52)	DE VIII (C13H53)	DE IX (C13H54)	DE X (C13H55)

Available courses for elective credit in this cluster:

- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[2] May be taught for 1, 2, or 3 credits.

[3] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

Industrial Maintenance Technology is a wide-ranging field that includes maintaining and repairing mechanical systems, electrical systems, computer systems, and electronic circuits. Technicians install, repair, and troubleshoot mechanical, electrical, electronic, and computer-controlled systems. Professionals in this field must be able to problem-solve and troubleshoot by applying mathematics, design, and systems thinking while documenting highly technical processes in a manner others can replicate. Engineers plan and design the infrastructure within the manufacturing facilities.

The Industrial Maintenance Technology POS is designed to provide students with the knowledge and skills to effectively perform basic industrial maintenance procedures in an advanced manufacturing facility. This POS is designed for students interested in becoming general maintenance and repair workers, industrial machinery mechanics, master mechanics, electromechanical technicians, mechanical engineers, or electromechanical engineers. Course content focuses on the electromechanical domains, including fundamental safety practices in electromechanical technology, shielded metal arc welding (SMAW), basic metal inert gas (MIG) welding, electrical systems, AC and DC motors, calibrating instruments, drive systems, pipe fabrication, hydraulic systems, pumps, digital electronics, programmable logic controllers (PLC), and troubleshooting procedures. Upon completing this POS, proficient students will be prepared to pursue postsecondary industrial maintenance technology programs and entry-level industrial maintenance technology careers in the advanced manufacturing industry.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

Job demand for industrial maintenance technicians is strong. Industrial Maintenance Technology provides these critical employees with the knowledge and skills needed at every manufacturing facility. There are many opportunities for career advancement. Tennessee is home to a strong base of manufacturers

representing many diverse industries, led by the state's automotive sector, which has become a regional and national powerhouse. The continual growth of manufacturing and the number of workers retiring ensure that industrial maintenance technicians remain a high-demand occupation.

As seen in Figure 1, the demand for all occupations related to industrial maintenance continues to grow. According to the Bureau of Labor Statistics, jobs for industrial machinery mechanics in Tennessee are projected to grow 10 percent from 2022 to 2032, much faster than the average for all occupations.[10]. The Supply and Demand Report lists maintenance and repair workers as an occupation that is projected to grow 14 percent from 2022 to 2032[11]. Over 2,000 openings for first-line supervisors in industrial maintenance areas are projected each year through 2032 in Tennessee[12]. Career One Stop designates industrial machinery mechanics as one of the fastest-growing occupations in the United States[13]. Demand for maintenance and repair workers is projected to grow 17 percent from 2022 to 2032[14]. Over 3,000 openings for first-line supervisors in industrial maintenance areas are projected each year through 2032[15]. Many of these openings are expected due to the need to replace workers who retire from the workforce.

[10] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/49-9041.00

[11] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/49-9071.00

[12] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-1011.00

[13] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025 from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx

[14] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/49-9071.00

[15] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-1011.00

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Commercial and Industrial Machinery and Equipment, except Automotive and Electronic Repair and Maintenance in Tennessee in the 2022-2032 projection period[4].

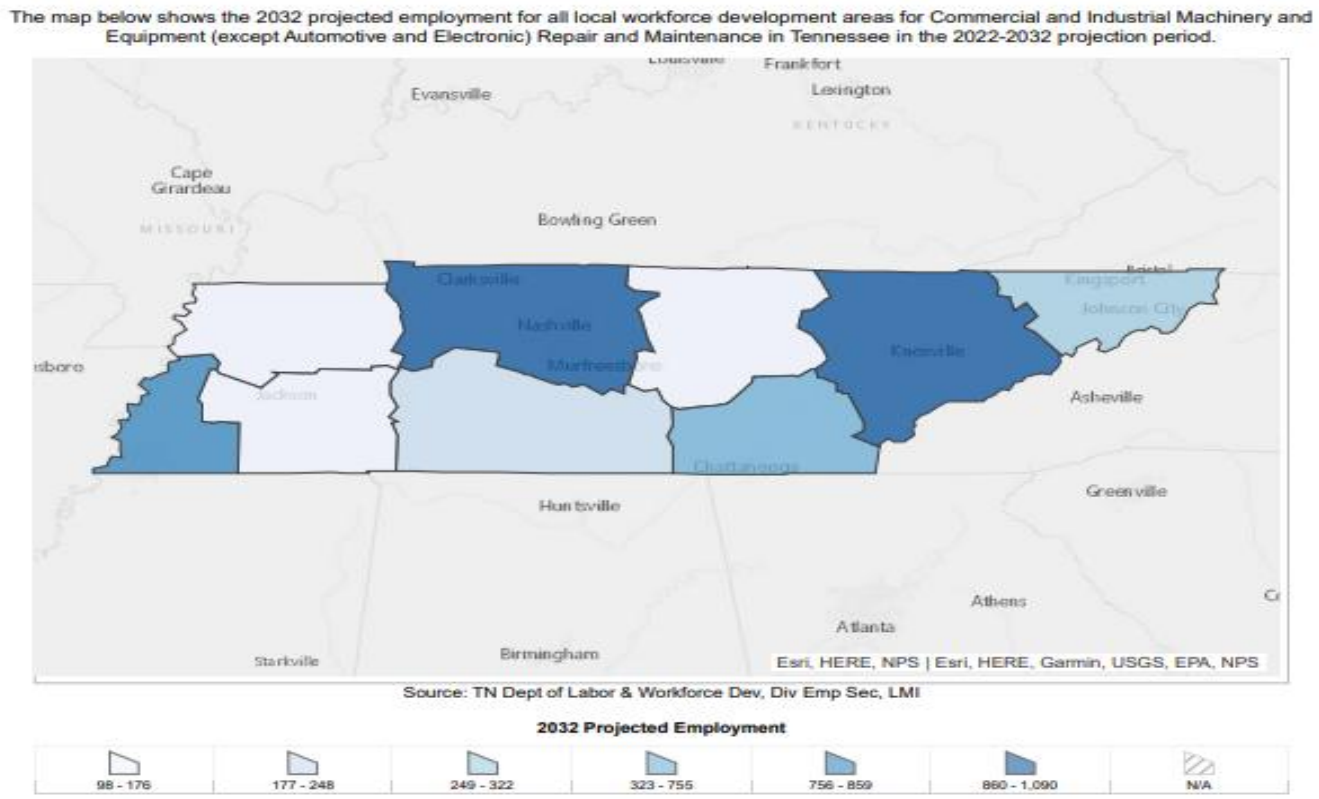


Figure 2. Tennessee employment projections for Engineering-related occupations with positive job openings projected for 2022 to 2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
Industrial Machinery Mechanics	49-9041	8,995	11,532	28%	1,044
First-Line Supervisors of Mechanics	49-1011	11,772	14,053	19%	1,286
General and Operations Managers	11-1021	66,201	78,396	18%	6,903

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

Industrial Maintenance Technology Program: Level 3

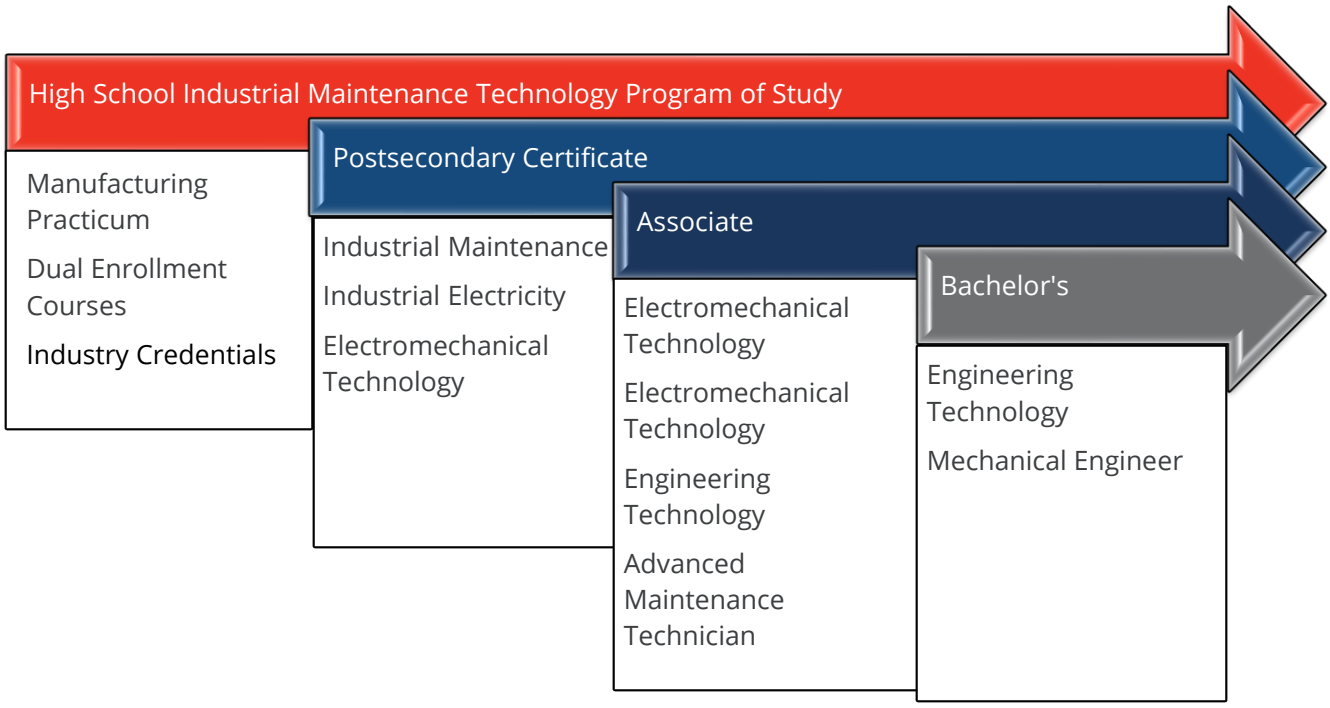
Postsecondary Pathways

The Industrial Maintenance Technology pathway offers opportunities to funnel students into careers at various education levels. Industry credentials earned in high school and work experience through practicum courses can lead to employment immediately after high school. There are early Postsecondary Pathways at the high school level that lead to certificate programs at the state's network of trade schools, colleges, and universities. Community colleges in Tennessee offer various associate-level degrees that continue to increase wage-earning potential. Advanced training at the bachelor's level increases opportunities for students, as it provides better prospects for higher-wage engineering and production management occupations.

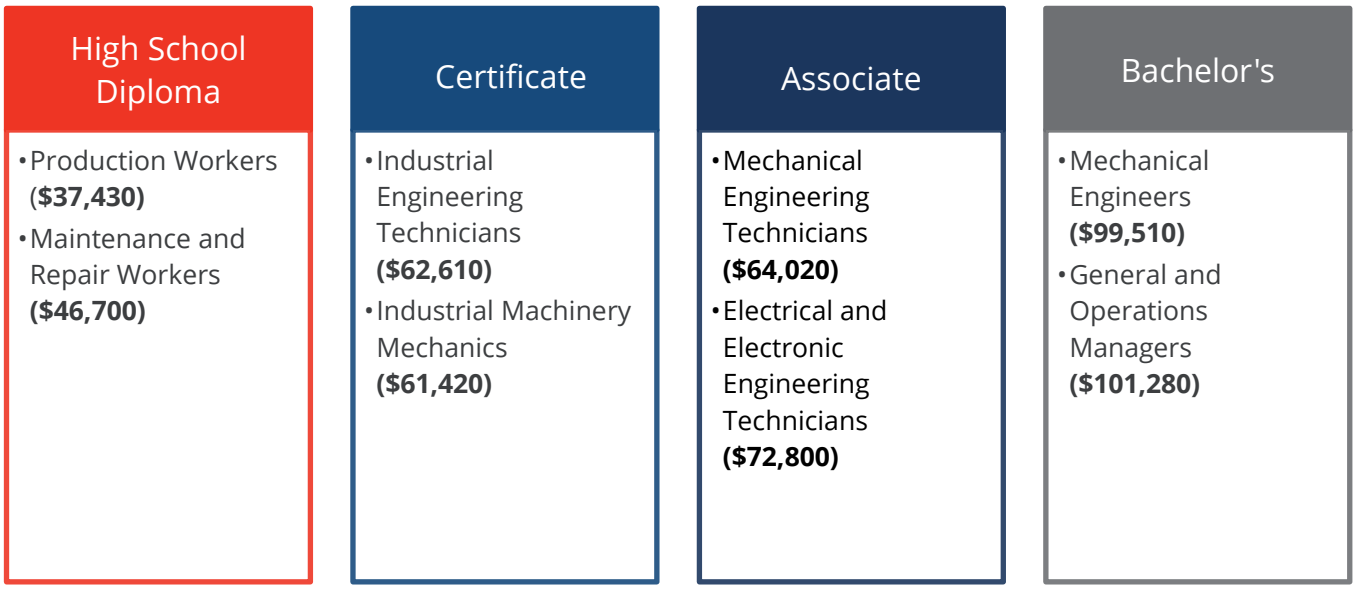
These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Industrial Maintenance Technology. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Industrial Maintenance Technology program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the Tennessee Department of Labor and Workforce Dashboard.



Current Secondary Landscape

Over the past three years, the number of schools offering Industrial Maintenance Technology has increased from 26 to 62. In 2023-24, 6,906 students were enrolled in Industrial Maintenance Technology courses, an increase from previous years. This program may not be appropriate for schools that do not have supporting labor market data. The figures below show the open enrollment analysis for the 2021-22 through the 2023-24 school year and the course enrollment in the Industrial Maintenance Technology POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Industrial Maintenance Technology
2021-22	26
2022-23	28
2023-24	62

Figure 6. Student Enrollment by Course

School Year	Principles of Manufacturing	Introduction to Industrial Maintenance	Advanced Industrial Maintenance	Manufacturing Practicum	Dual Enrollment Courses
2021-22	5,104	199	77	241	490
2022-23	5,377	245	100	316	511
2023-24	5,557	316	132	261	600

Machining Technology

Machining Technology			
Year 1	Year 2	Year 3	Year 4
Principles of Manufacturing (C13H05)	Principles of Machining I (C13H09)	Principles of Machining II (C13H06)	Manufacturing Practicum [1] (C13H08) -or- **WBL** Machining Technology Career Practicum [2] (C13H41)

Dual Enrollment Machining Technology [3]				
DE I (C13H01)	DE II (C13H20)	DE III (C13H34)	DE IV (C13H35)	DE V (C13H56)
DE VI (C13H57)	DE VII (C13H58)	DE VIII (C13H59)	DE IX (C13H60)	DE X (C13H61)

Available courses for elective credit in this cluster:

- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[2] May be taught for 1, 2, or 3 credits.

[3] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

Machining Technology is the heart of manufacturing things. machinists, computer numerical controlled (CNC) machine tool operators and programmers, and manufacturing production technicians set up and operate a variety of machine tools to produce precision parts and instruments. Technicians may also fabricate and modify parts to make or repair machine tools or maintain machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures. Mechanical engineers plan and design the tools and equipment used in machining.

The Machining Technology POS is designed for students interested in becoming a CNC tool operator, a CNC machining tool programmer, or a machinist. Course content focuses on safety practices concerning machining technology; proper measurement and layout techniques; reading and interpreting specification drawings and blueprints; production design processes; quality control procedures; machine parts to specifications using both manual and computer-controlled machine tools; and measuring, examining, and testing completed products to check for defects and conformance to specifications. Upon completion of this POS, proficient students will be prepared to pursue industry certification at a technology college or more advanced coursework at a two-year or four-year postsecondary institution.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

Job demand for machinists is strong. Machining technology, using lathes, milling machines, and grinders, is a critical occupation in every manufacturing facility, ensuring many opportunities for career advancement in manufacturing industries. Tennessee is home to a strong base of manufacturers representing many diverse industries, led by the state's automotive sector, which has become a regional and national powerhouse. The continual growth of manufacturing combined with the number of workers retiring ensures that machinists remain a high-demand occupation in Tennessee.

As seen in Figure 1, the demand for all occupations related to Machining Technology continues to grow. According to the Bureau of Labor Statistics, jobs for Machinists in Tennessee are projected to grow 17 percent from 2022 to 2032, much faster than the average for all occupations[16]. The Supply and Demand Report lists Production Workers as an occupation in demand in eight of the state's regions[17]. Career One Stop designates industrial machinery mechanics as one of the fastest-growing occupations in the United States[18]. Demand for production workers is projected to grow 18 percent from 2022 to 2032[19]. Over 1,900 openings for first-line supervisors in the machining areas are projected each year through 2032[20]. Many of these openings are expected because of the need to replace workers who retire from the workforce.

[16] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-4041.00

[17] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025 from https://www.onetonline.org/link/summary/51-9199.00, Supply and Demand Report

[18] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025, from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx, https://www.onetonline.org/link/summary/49-9041.00

[19] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-9199.00

[20] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-1011.00

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Fabricated Metal Product Manufacturing in Tennessee in the 2022-2032 projection period[4].

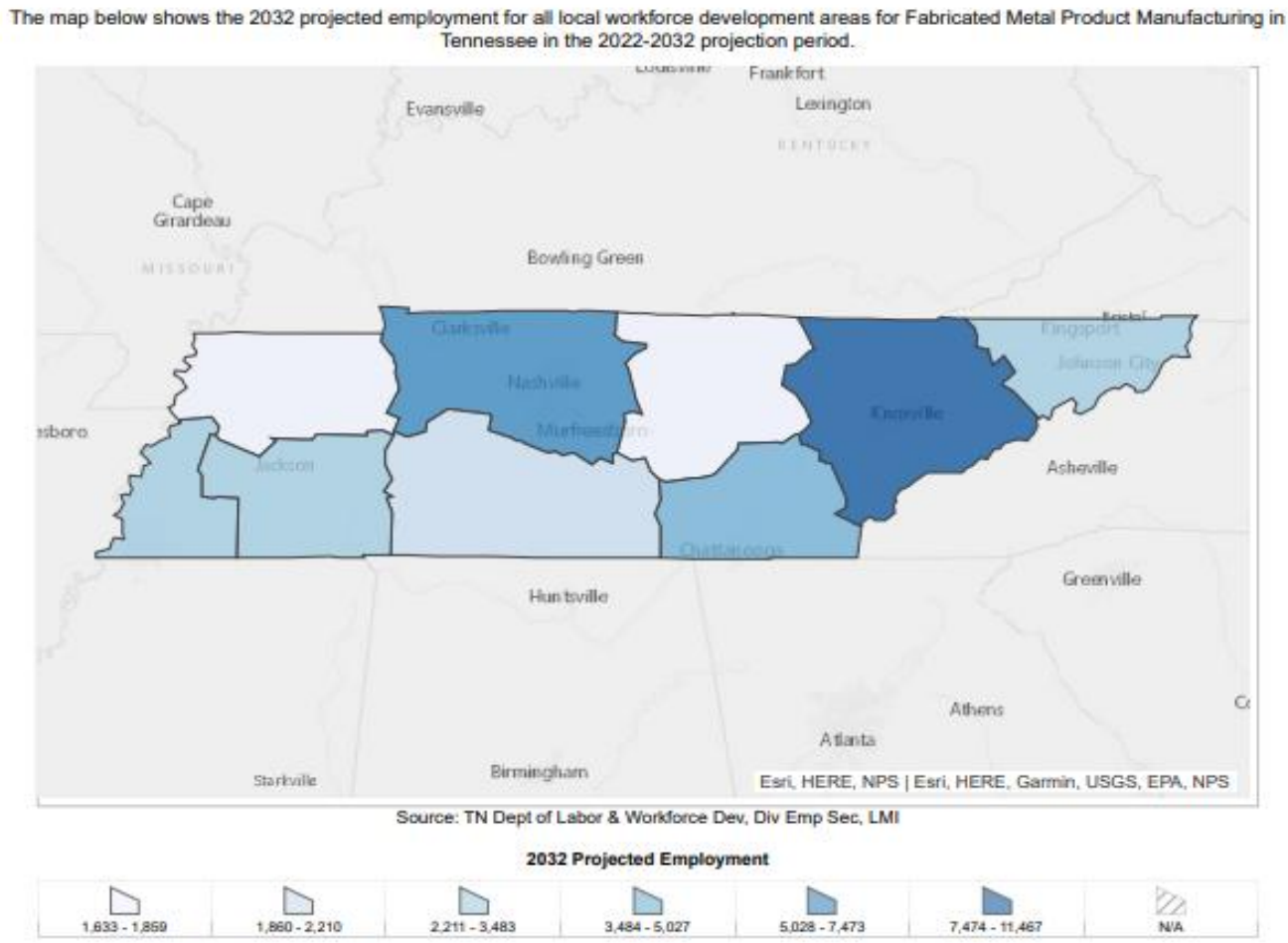


Figure 2. Tennessee employment projections for Machining Technology-related occupations with positive job openings projected for 2022 to 2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
General and Operations Managers	11-1021	66,201	78,396	18%	6,903
First-Line Supervisors of Mechanics, Installers, and Repairers	49-1011	11,772	14,053	19%	12,861
First-Line Supervisors of Production and Operating Workers	51-1011	18,398	19,905	8%	1,922

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

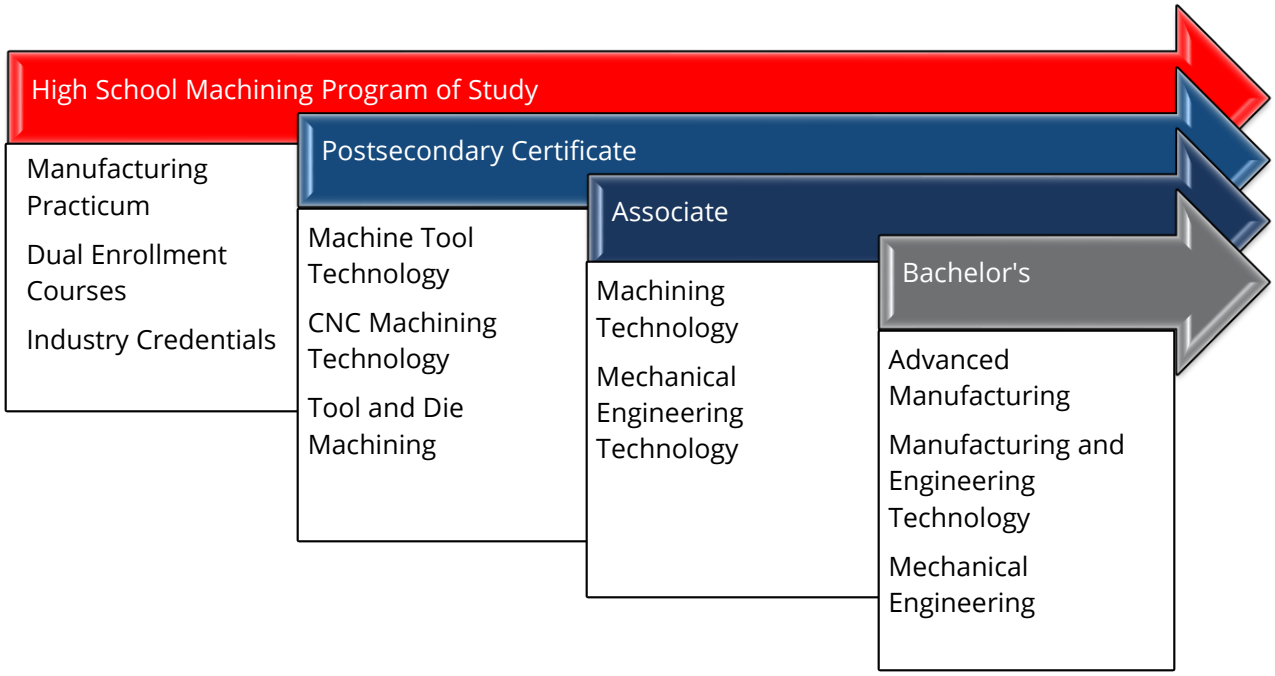
Postsecondary Pathways

The Machining Technology pathway offers opportunities to funnel students into careers at a variety of education levels. Industry credentials earned in high school and work experience, through practicum courses, can lead to employment immediately after high school. There are early Postsecondary Pathways at the high school level that lead to certificate programs at the state's network of Tennessee Colleges for Advanced Technology (TCATs). As shown in the table below, the wage level increases significantly with a certificate from a TCAT. Community colleges in Tennessee offer a variety of associate-level degrees that continue to increase wage-earning potential. Advanced training at the bachelor's level increases opportunities for students, as better prospects for higher-wage engineering and production management occupations.

These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Machining Technology. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Machining Technology program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the [Tennessee Department of Labor and Workforce Dashboard]

High School Diploma	Certificate	Associate	Bachelor's
• Production Workers **($37,340)**	• Industrial Engineering Technicians **($62,610)**	• Mechnical Engineering Technicians **($64,020)**	• Mechanical Engineers **($99,510)**
• Maintenance and Repair Workers **($46,700)**	• Industrial Machinery Mechanics **($61,420)**	• Millwrights **($62,980)**	• General and Operations Manager **($101,280)**

Current Secondary Landscape

Over the past three years, the number of schools offering Machining Technology has increased from 51 to 80. In 2023-24, 8,196 students were enrolled in Machining Technology courses, an increase from previous years. This program may not be appropriate for schools that do not have supporting labor market data. The figures below show the open enrollment analysis for the 2021-22 through the 2023-24 school year and the course enrollment in the Machining Technology POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Machining Technology
2021-22	51
2022-23	57
2023-24	80

Figure 6. Student Enrollment by Course

School Year	Principles of Manufacturing	Principles of Machining I	Principles of Machining II	Manufacturing Practicum	Dual Enrollment Courses
2021-22	5,104	811	394	241	762
2022-23	5,377	702	402	316	982
2023-24	5,557	743	324	261	1,229

Mechatronics

Mechatronics			
Year 1	Year 2	Year 3	Year 4
Principles of Manufacturing (C13H05)	Digital Electronics (C13H07)	Mechatronics I (C13H16) -or- Robotics & Automated Systems (C13H15)	Mechatronics II (C13H17) -or- Manufacturing Practicum [1] (C13H08) -or- **WBL** Mechatronics Career Practicum [2] (C13H42)

Dual Enrollment Mechatronics [3]				
DE I (C13H04)	DE II (C13H21)	DE III (C13H36)	DE IV (C13H37)	DE V (C13H62)
DE VI (C13H63)	DE VII (C13H64)	DE VIII (C13H65)	DE IX (C13H66)	DE X (C13H67)

Available courses for elective credit in this cluster:

- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[2] May be taught for 1, 2, or 3 credits.

[3] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

Mechatronics is an interdisciplinary field that includes manufacturing production technicians, industrial engineering technicians, robot technicians, mechanical engineering technicians, and mechatronics engineers. Technicians work wherever mechanical systems are used, including the integration of digital electronics, robotics, human-machine interfaces, and information processing. Troubleshooting is a particularly important skill. Mechatronics systems combine mechanical, electrical, computer, and control systems into a unified process to optimize results and minimize defects.

Mechatronics POS is designed for students interested in becoming mechatronics technicians, electrical technicians, mechanical engineering technicians, robotics technicians, or mechatronics engineers. Course content focuses on the components of manufacturing systems, the collection and analysis of quality data, electronics, mechanics, fluid power systems, computers, and control systems, and technical documentation and troubleshooting. Upon completion of this POS, proficient students will be prepared to pursue industry certifications at a technology college or more advanced coursework at a two-year or four-year postsecondary institution.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

Job demand for mechatronics technicians and engineers is strong. Mechatronics, with its emphasis on ensuring machines and processes work well, offers many opportunities for career advancement in advanced manufacturing industries. Tennessee is home to a strong base of manufacturers representing many diverse industries, led by the state's automotive sector, which has become a regional and national powerhouse. The continual growth of manufacturing, combined with the number of workers retiring, ensures that mechatronics is a high-demand occupation in Tennessee.

As seen in Figure 1, the demand for all occupations related to Mechatronics continues to grow. According to the Bureau of Labor Statistics, jobs for multiple machine tool setters, operators, and tenders in Tennessee are projected to grow by 13,100 jobs from 2022 to 2032[21]. The Supply and Demand Report lists maintenance and repair workers as an occupation in demand in eight of the state's regions[22]. Career One Stop designates industrial machinery mechanics as one of the fastest-growing occupations in the United States[23]. Demand for industrial engineering technicians is projected to grow 14 percent from 2022 to 2032[24]. Over 2,200 openings for first-line supervisors in mechatronics areas are projected each year through 2032[25]. Many of these openings are expected because of the need to replace workers who retire from the workforce.

[21] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-4081.00

[22] Tennessee Higher Education Commission, Supply and Demand Report, O*Net Online, Retrieved March 20, 2025, from https://www.tn.gov/content/dam/tn/thec/bureau/research/other-research/supply-demand/2025/2025%20Supply%20and%20Demand%20Report.pdf, https://www.onetonline.org/link/summary/49-9071.00

[23] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025, from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx, https://www.onetonline.org/link/summary/49-9041.00

[24] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/17-3026.00

[25] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-1011.00

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Other Professional, Scientific, and Technical Services in Tennessee in the 2022-2032 projection period[4].

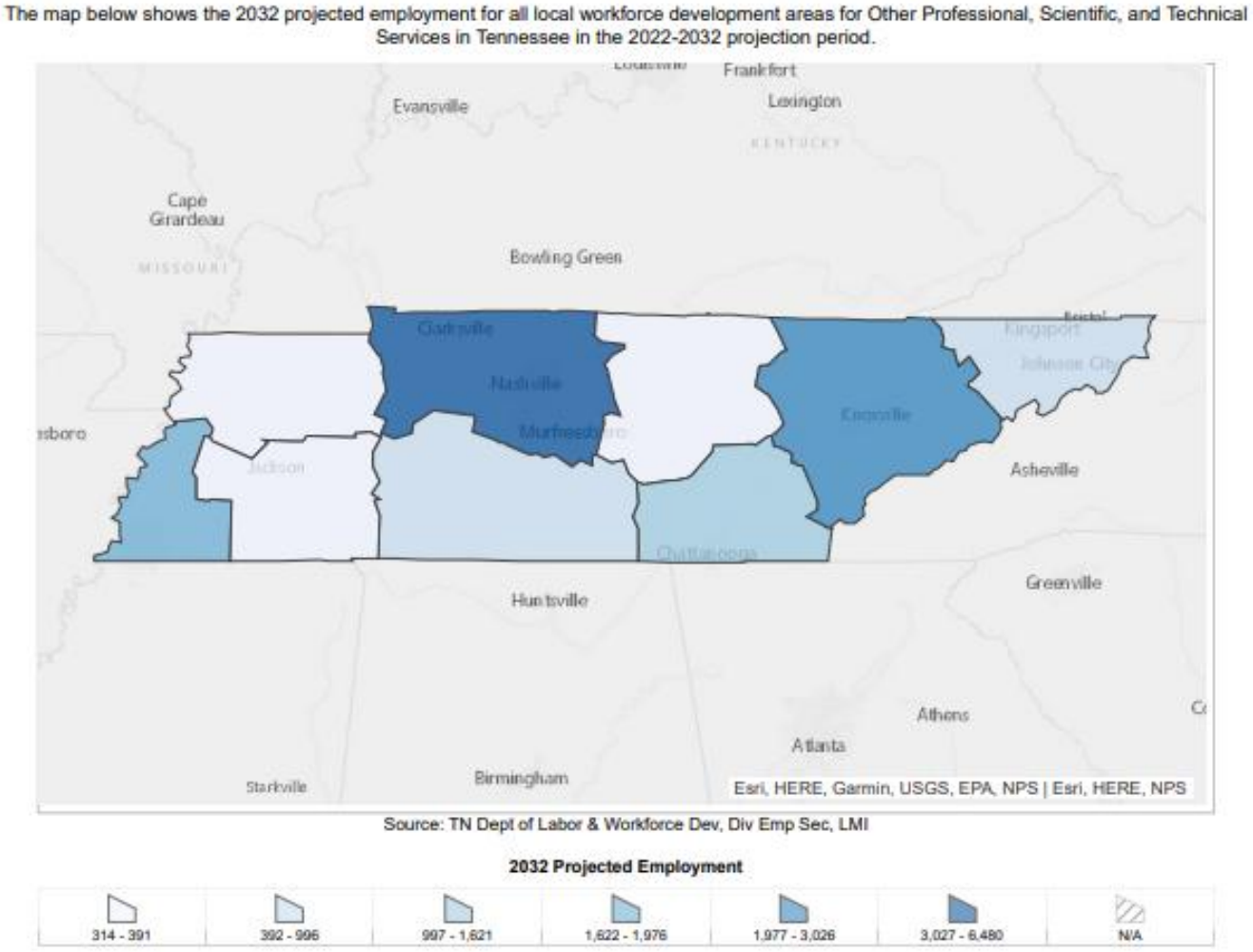


Figure 2. Tennessee employment projections for Mechatronics-related occupations with positive job openings projected for 2022-2032 according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
Industrial Machinery Mechanics	49-9041	8,995	11,532	28%	1,044
Industrial Engineers	17-2112	6,511	8,112	25%	560
First-Line Supervisors of Mechanics, Installers, and Repairers	49-1011	11,772	14,053	19%	1,286

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

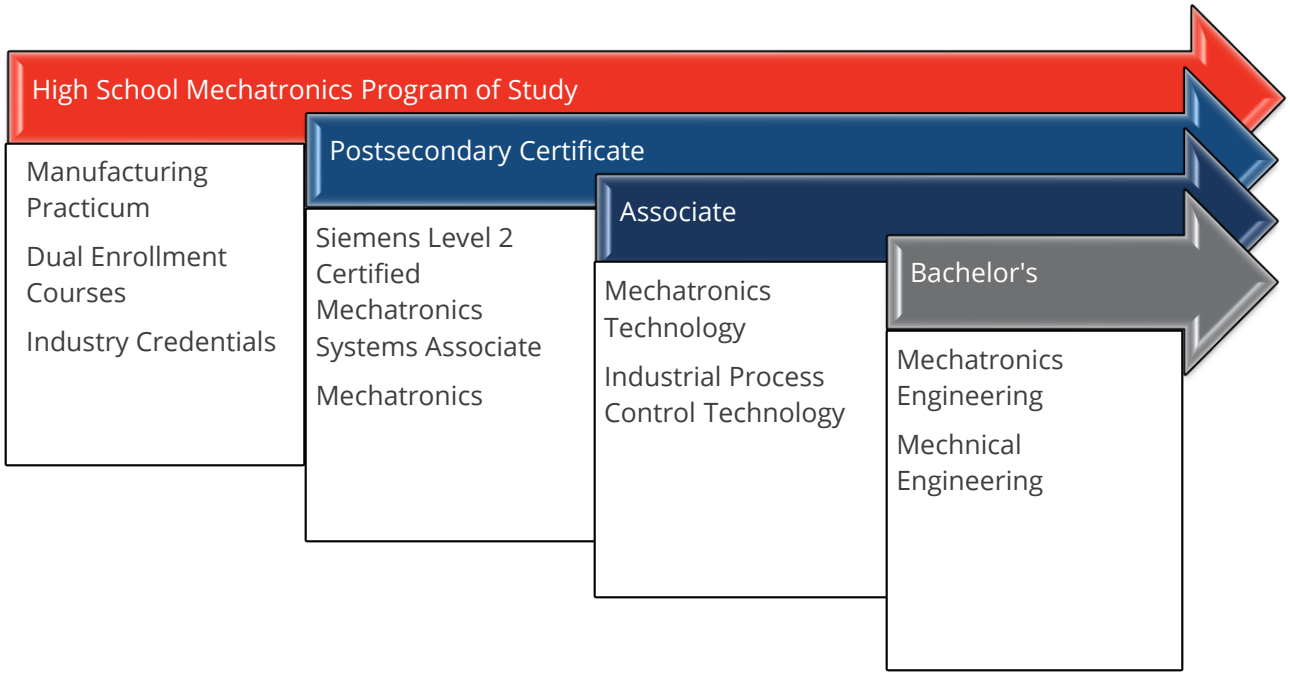
Postsecondary Pathways

The Mechatronics pathway offers opportunities to funnel students into careers at a variety of education levels. Industry credentials earned in high school and work experience through practicum courses can lead to employment immediately after high school. There are early Postsecondary Pathways at the high school level that lead to certificate programs at the state's network of Tennessee Colleges for Advanced Technology (TCATs). As shown in the table below, the wage level increases with a certificate from a TCAT. Community colleges in Tennessee offer a variety of associate-level degrees that continue to increase wage-earning potential. Advanced training at the bachelor's level opens even more doors for students, offering better prospects in higher-wage engineering and production management occupations.

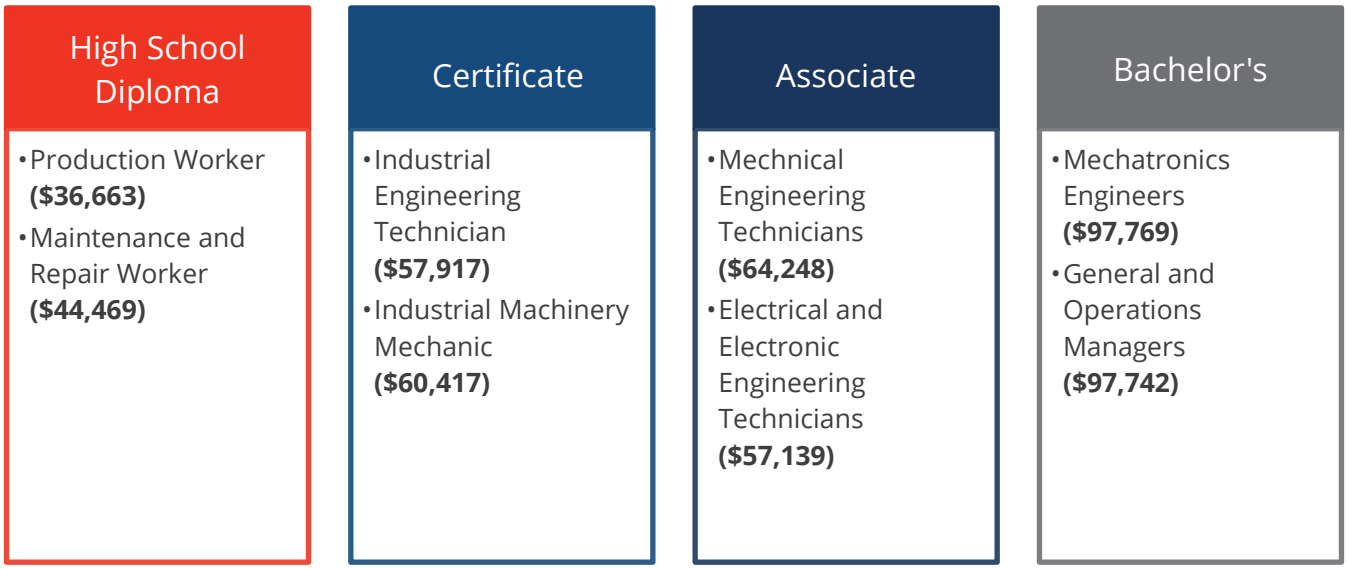
These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Mechatronics. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Mechatronics program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the Tennessee Department of Labor and Workforce Dashboard.



Current Secondary Landscape

Over the past three years, the number of schools offering Mechatronics has increased from 44 to 66. In 2023-24, 8,560 students were enrolled in Mechatronics courses, which was a slight decrease from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2021-22 through the 2023-24 school year and the course enrollment in the Mechatronics POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Mechatronics
2021-22	44
2022-23	59
2023-24	66

Figure 6. Student Enrollment by Course

School Year	Principles of Manufacturing	Digital Electronics	Mechatronics I	Robotics & Automated Systems	Mechatronics II	Dual Enrollment Courses
2021-22	5,104	807	360	923	159	1,075
2022-23	5,377	755	369	1,062	160	1,042
2023-24	5,557	950	243	927	127	1,383

Robotics & Technology

Robotics & Technology			
Year 1	Year 2	Year 3	Year 4
Principles of Engineering & Technology (C21H04)	Digital Electronics (C13H07)	Robotics & Automated Systems (C13H15)	Engineering Practicum [1] (C21H14) -or- **WBL** Robotics & Technology Career Practicum [2] (C21H48)

Dual Enrollment Robotics & Technology [3]				
DE I (C21H01)	DE II (C21H12)	DE III (C21H43)	DE IV (C21H44)	DE V (C21H67)
DE VI (C21H68)	DE VII (C21H69)	DE VIII (C21H70)	DE IX (C21H71)	DE X (C21H72)

Available courses for elective credit in this cluster:

- ***Introduction to Geographical Information Systems (GIS)*** (C18H39) is a supplemental course that can be offered in addition to courses within the Robotics & Technology program of study but does not count toward concentrator status.
- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[2] May be taught for 1, 2, or 3 credits.

[3] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

The *Robotics & Technology POS* is for students who wish to pursue careers in robotics, electronics, and related engineering and technology fields. The course content introduces students to the principles of engineering and the engineering design process and progresses to applying these skills in the context of robotics, electronics, and automated systems. Upon completion of this POS, students will have gained valuable training in an Engineering Practicum and will be prepared for advanced study in a variety of STEM fields at the postsecondary level.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

There is continuous work and progress in technology as it offers significant benefits, and these benefits have an enormous impact on our day-to-day lives and the operations of countless industries, such as healthcare, automobile, communication, manufacturing, and business, among others[26]. According to the Bureau of Labor Statistics, the overall employment of industrial machinery mechanics, machinery maintenance workers, and millwrights is strong both statewide and nationally[27]. Nationally, industrial machinery mechanics are projected to grow 17 percent from 2022 to 2032, much faster than the average for

[26] Tennessee Higher Education Commission, Supply and Demand Report, O*Net Online, Retrieved March 20, 2025, from https://www.tn.gov/content/dam/tn/thec/bureau/research/other-research/supply-demand/2025/2025%20Supply%20and%20Demand%20Report.pdf, https://www.onetonline.org/link/summary/49-9071.00

[27] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/49-9041.00

all occupations[28]. Tennessee is expecting a 38 percent projected growth in the employment of industrial machinery mechanics[29]. There are about 19,200 openings for industrial machinery mechanics each year, on average, over the decade[30]. Many of these openings are expected to result from the need to replace workers who transfer to different occupations or exit the labor force through retirement.

[28] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025, from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx, https://www.onetonline.org/link/summary/49-9041.00

[29] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/49-9041.00

[30] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved, March 20, 2025, from https://www.onetonline.org/link/summary/49-9041.00

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Electrical Equipment, Appliance, and Component Manufacturing in Tennessee in the 2022-2032 projection period[4].

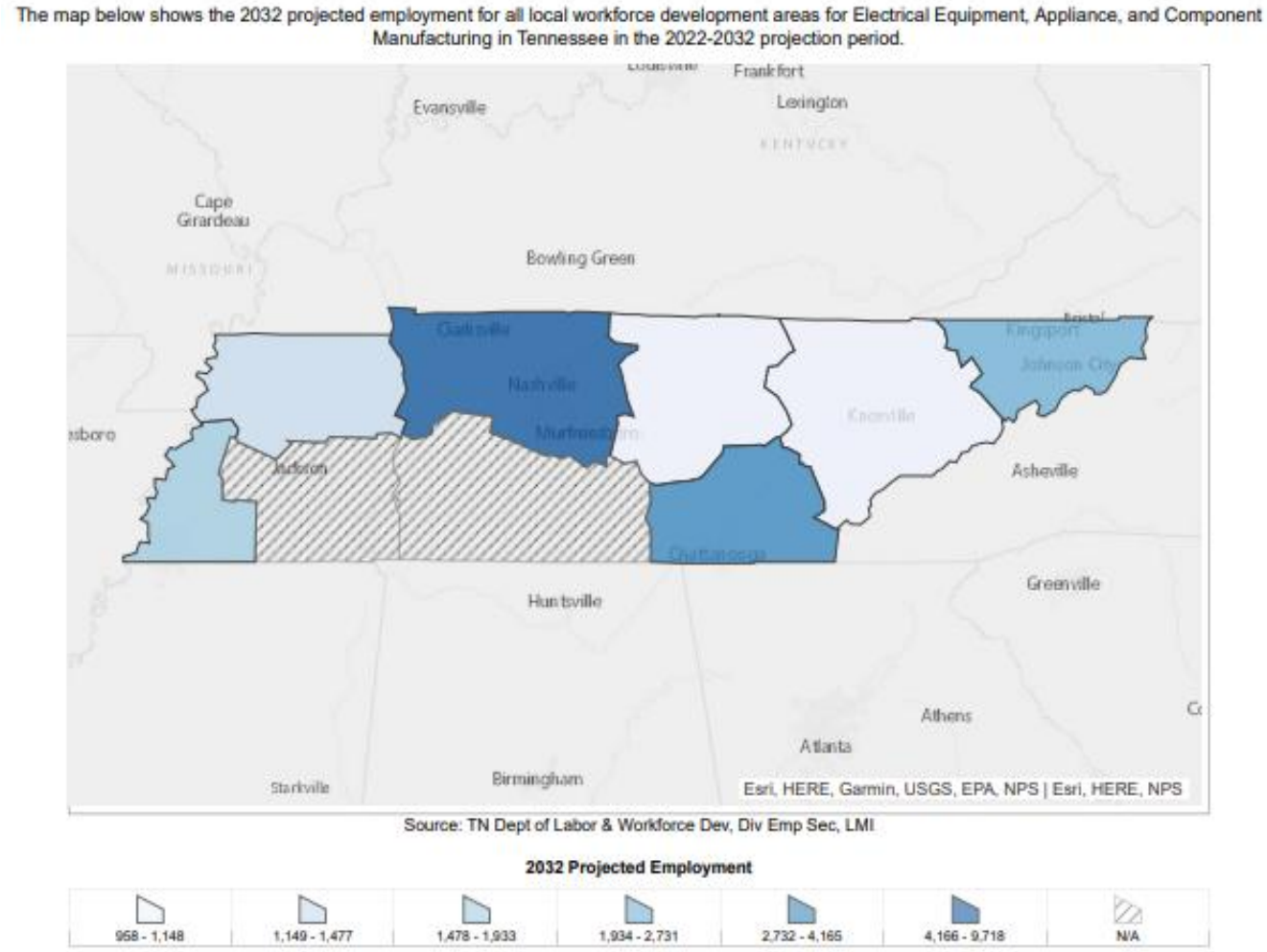


Figure 2. Tennessee employment projections for Technology-related occupations with positive job openings projected for 2022 to 2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022 to 2032)	Projected Annual Job Openings (2022 to 2032)
Computer and Information Systems Managers	11-3021	9,369	12,699	36%	1,037
Management Analysts	13-1111	10,199	12,732	25%	1,176
Computer Occupations, All Other	15-1299	11,648	14,727	26%	1,123

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

Postsecondary Pathways

Tennessee offers a wide range of postsecondary opportunities for students interested in robotics and STEM-related careers, including robotics engineering, robotics programming, and automation technologies. Across the state, trade schools, community colleges, and universities provide specialized programs that combine engineering principles, computer science, and hands-on training to prepare students for the growing demand in robotics-driven industries.

Many technical and community colleges offer associate degree programs in robotics engineering and programming, as well as STEM-related fields like mechatronics, computer technology, and engineering systems. These programs emphasize real-world applications through lab-based learning, simulations, and certifications, giving students practical skills needed for entry-level roles in automated manufacturing, robotics maintenance, and systems integration.

Tennessee's universities build on this foundation with bachelor's and graduate programs in robotics-focused disciplines, including electrical engineering, computer engineering, mechanical systems, and artificial intelligence. These programs often feature interdisciplinary coursework that bridges robotics with other STEM areas such as biomedical engineering, data science, and cybersecurity, while offering students opportunities to engage in research projects, robotics competitions, and industry partnerships.

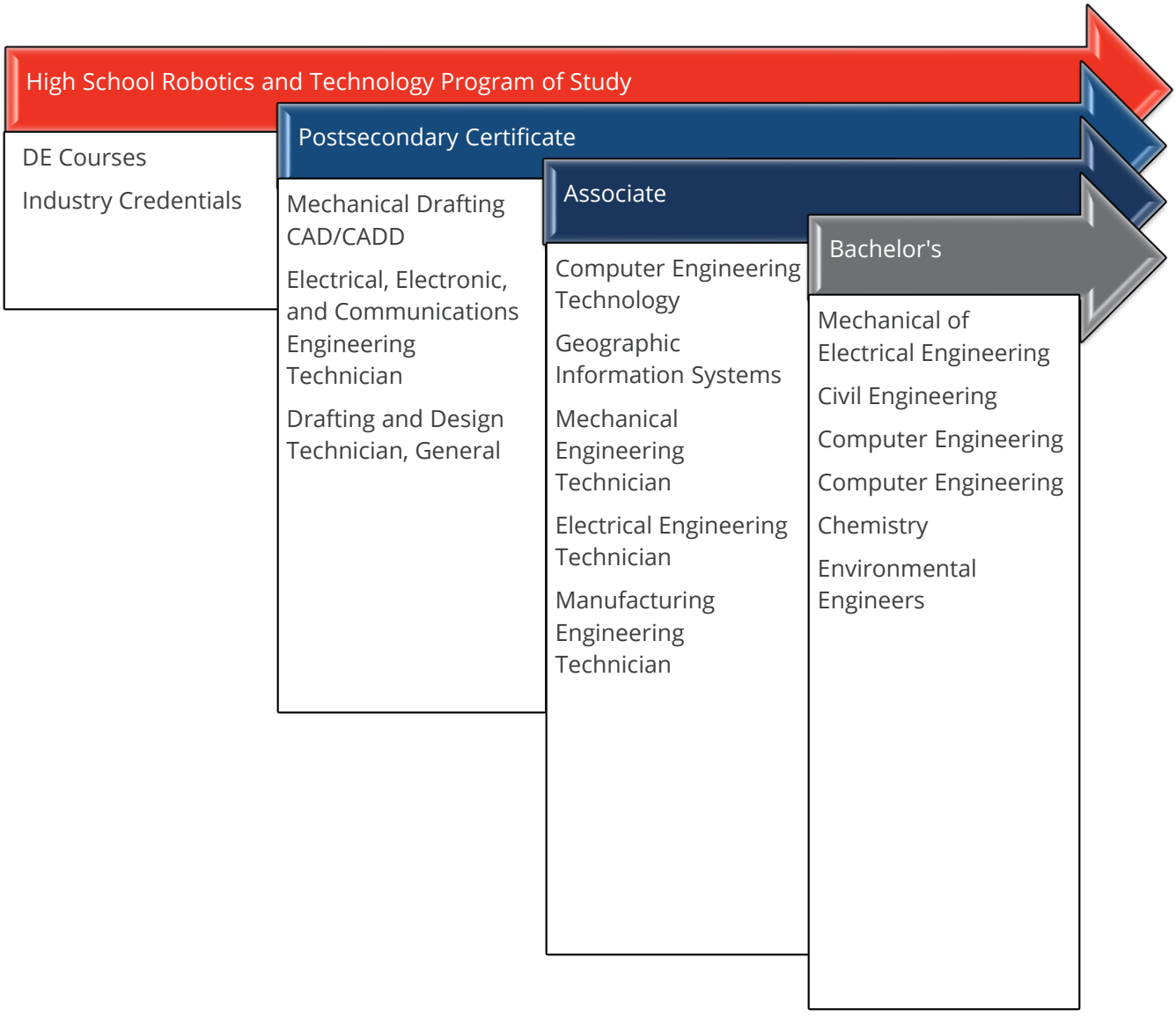
The state also supports STEM innovation through initiatives that promote K-12 robotics education, dual-enrollment pathways, and collaboration between education and industry. These efforts help students explore robotics careers early, understand how robots are used across sectors—from manufacturing and healthcare to aerospace and logistics—and build a seamless path from high school to high-demand careers.

With a strong emphasis on hands-on learning, technical skill development, and problem-solving, Tennessee's educational landscape ensures that students interested in robotics and STEM fields are equipped with the tools they need to succeed. Whether entering the workforce after technical training or advancing through university-level research and design, Tennessee students have access to a robust and flexible set of pathways into one of today's most exciting and rapidly evolving industries.

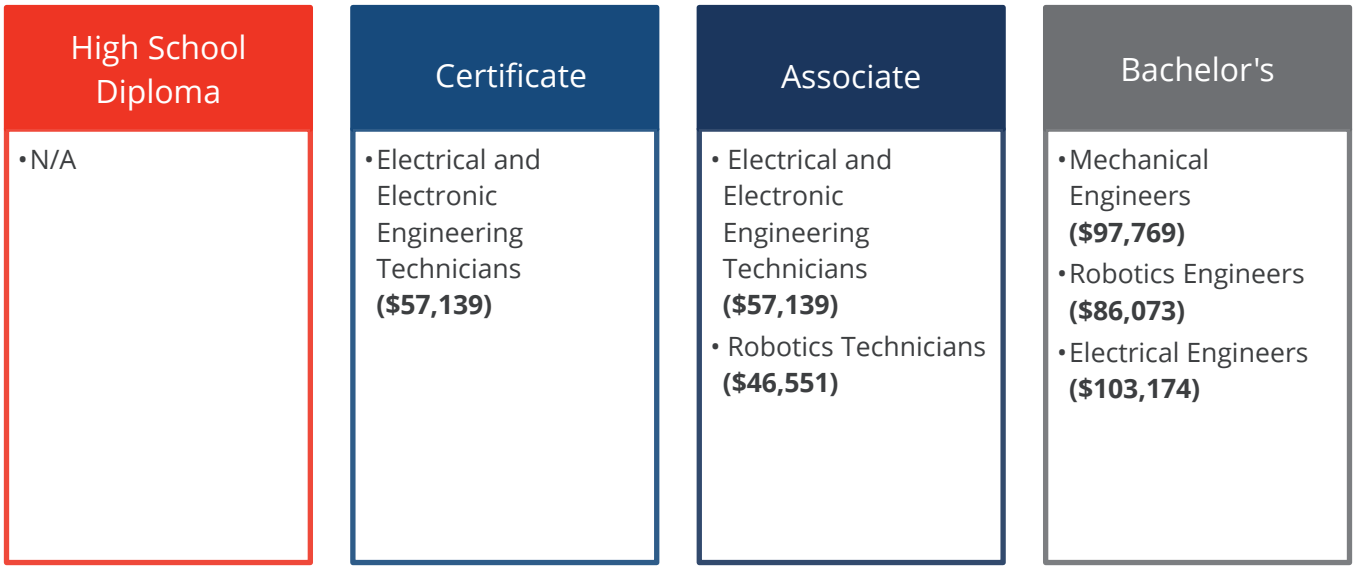
These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Robotics and Technology. Whether students choose to enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Robotics and Technology program in high school. It outlines some of the related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the Tennessee Department of Labor and Workforce Dashboard.



Current Secondary Landscape

Over the past three years, the number of schools offering Robotics &Technology has increased to 40. In the 2023-24 school year, 7,496 students were enrolled in Robotics & Technology. The figures below show the open enrollment analysis for the 2021-22 through the 2023-24 school year, as well as the enrollment and student concentration in the Robotics & Technology POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Robotics & Technology
2021-22	39
2022-23	36
2023-24	40

Figure 6. Student Enrollment by Course

School Year	Principles of Engineering and Technology	Digital Electronics	Robotics & Automated Systems	Engineering Practicum
2021-22	4,796	807	923	470
2022-23	4,727	755	1062	396
2023-24	4,650	950	927	516

Welding

Welding			
Year 1	Year 2	Year 3	Year 4
Principles of Manufacturing (C13H05)	Welding I (C13H12)	Welding II (C13H10)	Manufacturing Practicum [1] (C13H08) -or- **WBL** Welding Career Practicum [2] (C13H43)

Dual Enrollment Welding [3]				
DE I (C13H03)	DE II (C13H18)	DE III (C13H38)	DE IV (C13H39)	DE V (C13H44)
DE VI (C13H45)	DE VII (C13H46)	DE VIII (C13H47)	DE IX (C13H48)	DE X (C13H49)

Available courses for elective credit in this cluster:

- ***JAG TN Course I*** (C25H20), ***JAG TN Course II*** (C25H21), ***JAG TN Course III*** (C25H22), and ***JAG TN Course IV*** (C25H09) are supplemental courses that can be offered in addition to courses within the programs of study but do not count toward concentrator status.
- ***Preparing for the ACT, Postsecondary, and Career*** (G25H00) is a supplemental course that can be offered in addition to courses within the programs of study but does not count toward concentrator status.

Footnotes

[1] A student pursuing an Industry 4.0 diploma distinction may substitute their 4th credit of math with this work-based learning course.

[2] May be taught for 1, 2, or 3 credits.

[3] Dual Enrollment (DE) courses can be taken in Year 1, Year 2, Year 3, or Year 4.

Description

Welding careers are an integral part of advanced manufacturing. Welders, cutters, solderers, and brazers use hand-held or remotely controlled equipment to join, repair, or cut metal parts and products. They may work outdoors, often in inclement weather, or indoors, sometimes in a confined area. They may work on a scaffold, high off the ground, and they occasionally must lift heavy objects and work in awkward positions. Some welders go on to earn their bachelor's degrees as material engineers.

The Welding POS is designed to prepare and certify students as entry-level welders. Students will learn safe practices, career exploration, leadership development, and basic arc welding and thermal cutting skills. Basic welding and thermal cutting skills are developed over two welding courses, which will prepare students for an American Welding Society certification.

Dual credit and dual enrollment opportunities may be established with local postsecondary institutions. Dual credit and dual enrollment opportunities allow high school students to earn college credits while still in high school by partnering with local postsecondary institutions. Upon successful completion of the course, students earn both high school and college credit. In addition to taking college-level courses, students may also have the option to take exams, such as Advanced Placement (AP) exams, which can also count toward college credit if they meet the required score thresholds. Through dual enrollment, students can have the opportunity to accelerate their education, reduce future college costs, and gain a head start on earning a postsecondary degree or certification. Moreover, students who participate in dual credit programs often have a smoother transition to college, as they are already familiar with the demands of higher education.

This POS aligns with SkillsUSA and Technology Student Association (TSA) CTSOs.

Job Outlook

Job demand for welders is strong in both construction and manufacturing. Welders are needed in manufacturing because of welding's importance and versatility. The nation's aging infrastructure will require the expertise of welders, cutters, solderers, and brazers to help rebuild bridges, highways, and buildings. There are many job openings to replace retiring workers. The basic welding skills are similar across multiple industries, so welders can easily shift from one industry to another, depending on where they are needed most.

As seen in Figure 1, the demand for all occupations related to Welding continues to grow. According to the Bureau of Labor Statistics, jobs for materials engineers in Tennessee are projected to grow 22 percent from

2022 to 2032, much faster than the average for all occupations[31]. Demand for production workers is projected to grow 22 percent from 2022 to 2032[32]. Demand for machinists is projected to grow 15 percent from 2022 to 2032[33]. Over 2,200 openings for first-line supervisors in the welding area are projected annually through 2032[34]. Many of these openings are expected because of the need to replace workers who retire from the workforce.

[31] Career One Stop, U.S. Department of Labor, Fastest-Growing Careers, O*NET Online, Retrieved March 20, 2025, from https://www.careeronestop.org/Toolkit/Careers/fastest-growing-careers.aspx, https://www.onetonline.org/link/summary/51-4041.00

[32] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-9199.00

[33] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-4041.00

[34] Bureau of Labor Statistics, U.S. Department of Labor, O*NET Online, Retrieved March 20, 2025, from https://www.onetonline.org/link/summary/51-1011.00

Figure 1. This section shows the distribution of 2032 projected employment by local workforce development areas for Transportation Equipment Manufacturing in Tennessee in the 2022-2032 projection period[4].

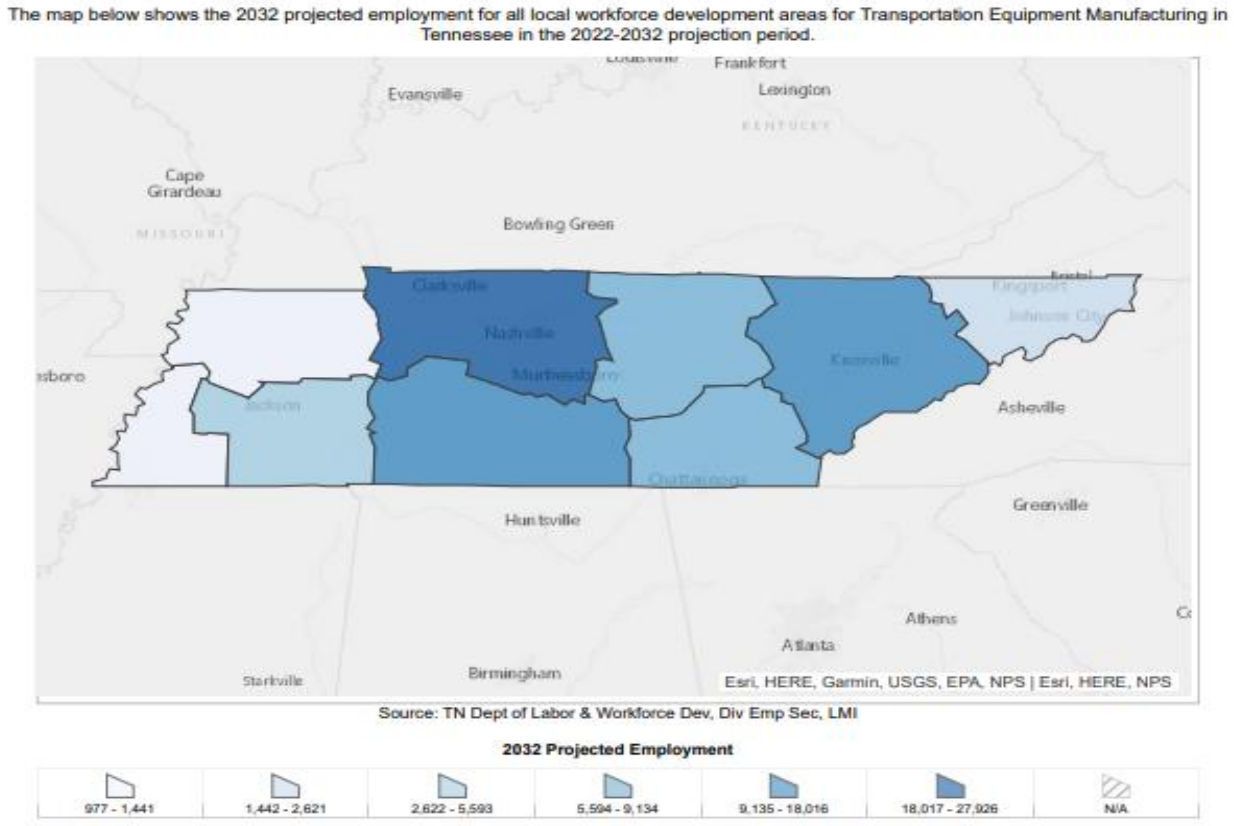


Figure 2. Tennessee employment projections for welding-related occupations with positive job openings projected for 2022-2032, according to the Tennessee Higher Education Commission, Supply and Demand Report[5].

Occupation	SOC Code	Employment (2022)	Projected Employment (2032)	Projected Growth (2022-2032)	Projected Annual Job Openings (2022-2032)
Industrial Machinery Mechanics	49-9041	8,995	11,532	28%	1,044
First-Line Supervisors of Production and Operating Workers	51-1011	18,398	19,905	8%	1,922
Welders, Cutters, Solderers, and Brazers	51-4121	13,935	15,712	13%	1,609

Program of Study Level

Tennessee Investment in Student Achievement (TISA) provides direct funding for student participation in CTE programs to drive college and career readiness outcomes. Pursuant to T.C.A. § 49-3-105(c)(2), a direct allocation amount will be generated for each student membership in a CTE program based on the rule:

1. The level of the program
    - Programs shall be designated into one (1) of three (3) levels.
    - Programs will be classified into three (3) levels based on alignment to wage-earning potential indicators and additional resources required to support the program if aligned to wage-earning potential occupational pathways.
2. The student's progression in coursework through the program

CTE funding is tiered based on POS level and progression year through the program. The proposed state budget differentiates CTE funding, with the lowest tier funded at $5,000 per CTE ADM for the 2025-26 school year (based on 2024-25 data). See the CTE TISA Programs of Study Leveling Guide 2025-26 for the current POS levels. For more information on CTE TISA funding, please see the CTE Quick Guide.

Welding Program: Level 2

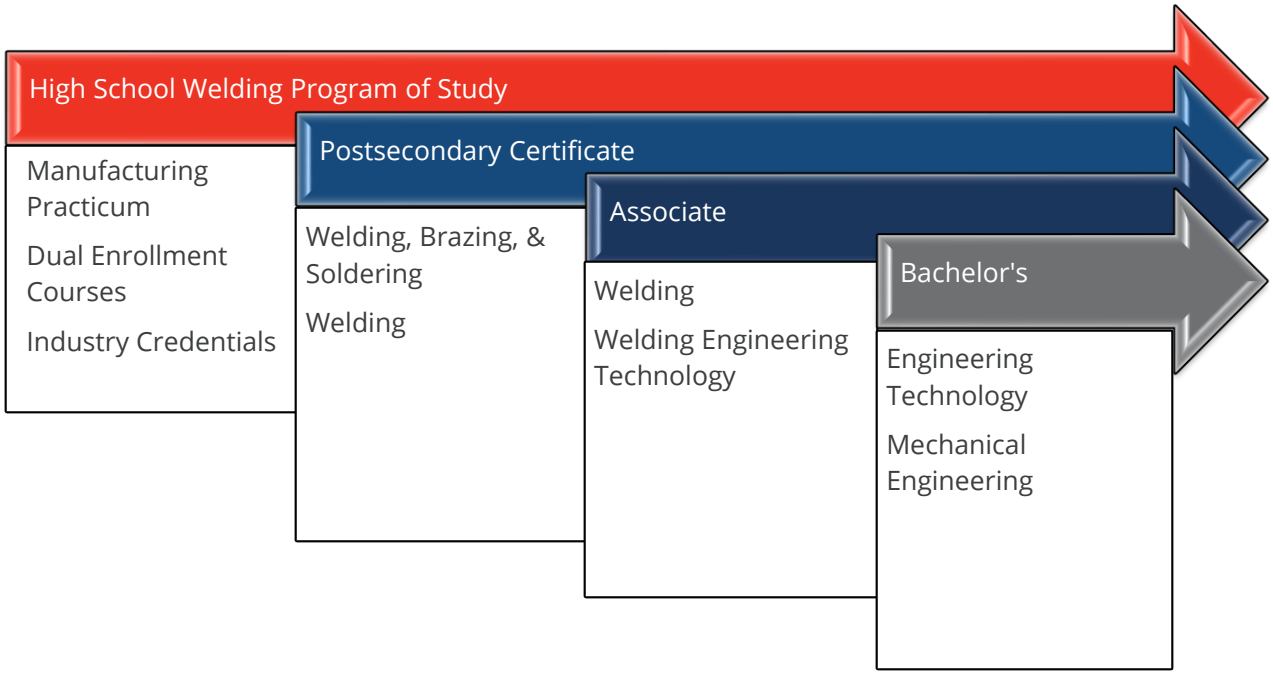
Postsecondary Pathways

The Welding pathway offers opportunities to funnel students into careers at various education levels. Industry credentials earned in high school and work experience through practicum courses can lead to employment immediately after high school. There are early Postsecondary Pathways at the high school level that lead to certificate programs at the state's network of Tennessee Colleges for Advanced Technology (TCATs). As shown in the table below, the wage level increases significantly with a certificate from a TCAT. Private and community colleges in Tennessee offer a variety of associate-level degrees that continue to increase wage-earning potential. Advanced training at the bachelor's level opens even more doors for students, offering better prospects in higher-wage engineering and production management occupations.

These postsecondary pathways enable students to develop the expertise, critical thinking, and analytical skills needed for successful careers in Welding. Whether students enter the workforce immediately or pursue advanced degrees, Tennessee's robust education system ensures they have the resources and training necessary to thrive in an evolving financial landscape. Specific information on post-secondary programs and their anticipated costs can be found on College for TN, a site developed to help students explore additional educational opportunities.

Figure 3 illustrates which opportunities are available for a student graduating from a Tennessee Welding program in high school. It outlines some related postsecondary certificates and degrees, career opportunities, and salaries available to students in the pathway. Students may acquire hours transferable to a postsecondary institution to complete certificates and degrees.

Figure 3. Outlines the related career opportunities and training necessary for each POS. Students may acquire hours transferable to a postsecondary institution for the completion of a degree.



Additional opportunities are offered at multiple postsecondary institutions, as indicated in the Tennessee Department of Labor and Workforce Dashboard.

Current Secondary Landscape

Over the past three years, the number of schools offering Welding has increased from 104 to 153. In 2023-24, 14,577 students were enrolled in Welding courses, a significant increase from previous years. This program may not be appropriate for schools that do not have the supporting labor market data. The figures below show the open enrollment analysis for the 2021-22 through the 2023-24 school year and the course enrollment in the Welding POS.

Concentrators (the number of CTE participating students who earn credit in at least two sequenced courses in a single, approved CTE POS) continue to increase in the Advanced Manufacturing career cluster, as indicated below.

Figure 4. Concentrators

School Year	Advanced Manufacturing Concentrators
2021-22	10,613 (includes STEM Concentrators)
2022-23	12,673 (includes STEM Concentrators)
2023-24	14,665 (Includes STEM Concentrators)

Figure 5. Open Enrollment Analysis

School Year	Schools Offering Welding
2021-22	104
2022-23	113
2023-24	153

Figure 6. Student Enrollment by Course

School Year	Principles of Manufacturing	Welding I	Welding II	Manufacturing Practicum	Dual Enrollment Courses
2021-22	5,104	2,286	1,045	241	2,999
2022-23	5,377	2,027	917	316	4,304
2023-24	5,557	1,920	928	261	5,535

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Recommendations

There are currently no recommendations for the 2025-2026 school year.