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Manufacturing in rural America: A plan for K–12–industry partnerships

A seismic threefold increase in advanced-manufacturing investment could transform rural America by driving economic growth, creating high-quality jobs, and revitalizing communities.

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The US economy has begun to undergo a seismic shift. The COVID-19 pandemic, geopolitical developments,[1] and a global AI tech race have led executives to increase their focus on reshoring and resilience. Over the past five years, hundreds of billions of dollars in capital investments have flowed into US advanced manufacturing, with leading global companies making huge commitments.[2]

Two features of this trend have so far gone overlooked. The first is its potential benefits for rural America. Indeed, a McKinsey analysis found that 63 percent of $1 trillion in announced advanced-manufacturing projects is anticipated to go to facilities within 15 miles of rural communities.[3]

Such business investment could substantially increase demand for qualified manufacturing workers in the United States, potentially resulting in a 2.1 million-worker shortfall by 2030. This gap highlights the second overlooked feature: the central role K–12 schools can play to ensure business and governments succeed in supporting the push to reshore. In particular, rural K–12 schools will be vital in preparing students for future-oriented, tech-enabled careers in advanced manufacturing.

Industry and K–12 schools have a once-in-a-generation opportunity to join forces and usher in a brighter future for rural America's businesses, communities, and students. The benefits of such a collaboration could be enormous: about $20 billion from improved productivity and employee retention and $34 billion in additional wages a year for rural American workers, according to McKinsey analysis.

These transformative gains are by no means guaranteed. They depend on a sufficient supply of qualified workers, which in turn will require K–12 schools and industry to collaborate closely to develop and implement programs on a historic scale. These stakeholders can pursue two major actions to usher in a new era for rural America: First, renew their focus on providing students with core literacy, math, and critical thinking skills; and, second, implement quality, evidence-based career-connected learning that bridges high school, postsecondary education, and the workplace.

Sizing the opportunity

America's push for resilience and self-reliance has been underway for some time. According to a 2025 McKinsey Global Institute (MGI) report,[4] US companies have diversified their sources of trade in recent years. The United States' import concentration, which measures a country's reliance on a small number of trading partners, declined by 18 percent from 2017 to 2024, reducing its trade risk. Over that same time span, MGI finds, US trade flows shifted by 9 percent to more geopolitically aligned nations, signaling an increased emphasis on supply chain resilience.[5] Recent tariff announcements may result in additional shifts. Together, these trends could lead US companies to increase their focus on self-reliance.

In addition to changing trade flows, rising investments in advanced-manufacturing facilities and related infrastructure reinforce the United States' growing focus on reshoring. Since 2020, US and foreign manufacturers and suppliers have dramatically increased their investments in the country. For instance, from January 2020 to January 2024, annual construction spending on manufacturing facilities grew by more than $150 billion, on average—a threefold jump (Exhibit 1).[6] Similarly, greenfield foreign direct investment in the United States rose roughly fourfold from 2016 to 2024, reaching $231 billion.[7]

[1] Matt Watters, Shubham Singhal, and Zoe Fox, "How American business can prosper in the new geopolitical era," McKinsey, April 23, 2025.
[2] "Fact sheet: The Biden-Harris Administration record," The American Presidency Project, January 15, 2025.
[3] For more on how we define rural communities, please see: JP Julien, Nora Gardner, Sarah Tucker-Ray, and Shelley Stewart III, "Who is Rural America?," McKinsey Institute for Economic Mobility, March 20, 2025, and our forthcoming article on the rural archetypes.
[4] "Geopolitics and the geometry of global trade: 2025 update," McKinsey Global Institute, January 27, 2025.
[5] "Geopolitics and the geometry of global trade," McKinsey Global Institute, January 17, 2024.
[6] "Total construction spending: Manufacturing in the United States," US Census Bureau, retrieved from FRED, Federal Reserve Bank of St. Louis, updated June 2, 2025.
[7] Derek Brahney, "Will Trump's tariffs turbocharge foreign investment in America?," *Economist*, March 17, 2025.

Exhibit 1

Construction spending on manufacturing facilities in the United States increased threefold from January 2020 to January 2024.

Average annual construction spending on manufacturing facilities, US, $ billion

Source: "Total construction spending: Manufacturing in the United States," US Census Bureau, retrieved from FRED, Federal Reserve Bank of St. Louis, June 26, 2025

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Rural communities could be well positioned to benefit from these advanced-manufacturing investments. Research from McKinsey's Institute for Economic Mobility examined rural America and identified six archetypes based on economic and demographic factors (see sidebar "Rural America archetypes"). We found that rural communities categorized as "manufacturing workshops" and "middle America" stand to gain the most from these investments.

We analyzed $1 trillion in announced advanced-manufacturing investments in strategic sectors—such as clean technology, semiconductors and electronics, and biomanufacturing—and found that approximately 63 percent of that investment will be within commuting distance of rural America (Exhibit 2).[8] (For comparison, 30 percent of existing manufacturing jobs are located in proximity to rural communities.) More than half of the investments are concentrated in 20 heartland states.[9] Among rural community archetypes, 35 percent of the investments are set to go to projects in or near middle-America communities, with 26 percent in or near manufacturing workshops.

[8] Joseph Parilla and Glencora Haskins, "The Bidenomics investment boom in red America," Brookings Institution, December 11, 2024; *Investing in America report: Today's investments, tomorrow's future*, The White House Archives, January 2025; McKinsey analysis of Lightcast industry employment data. Commuting distance is defined as being within about 15 miles of a rural area, which is the average commute for an American according to AAA: "American driving survey: 2022," AAA Foundation for Traffic Safety, September 2023. While these investments were announced prior to February 2025, trends in domestic manufacturing investments have continued; see, for example: David Shepardson and Steve Holland, "Trump and TSMC announce $100 billion plan to build five new US factories," Reuters, March 4, 2025; Zachary Hansen, "Clean tech jobs are booming. Here's how many Georgians work in the sector," *Atlanta Journal-Constitution*, March 18, 2025; Derek Brahney, "Will Trump's tariffs turbocharge foreign investment in America?," *Economist*, March 17, 2025.

[9] We use Heartland Forward's 20-state definition of the heartland: Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Texas, and Wisconsin. For more, see Richard Florida and Karen King, *America's evolving geography of innovation: How the heartland region can lead the way on industry transforming technology*, Heartland Forward, November 28, 2023.

Rural America archetypes

The McKinsey Institute for Economic Mobility conducted research on rural America and identified six community archetypes:

- *Agricultural powerhouses* are small- to moderate-growth communities where agriculture accounts for 20 percent or more of GDP.
- *Manufacturing workshops* are medium-size, growing communities where manufacturing accounts for 30 percent or more of GDP.
- *Middle America* encompasses medium-size to large communities, often with diverse industries and self-sustaining economies.
- *Migration magnets* are medium-size to large communities where net in-migration is greater than 1 percent, or food and accommodations generate more than 5 percent of GDP.
- *Remote regions* are small to medium-size communities where net out-migration is at least 4 percent, labor force participation is below 52 percent, and GDP is relatively low compared with other rural communities.
- *Resource-rich regions* are small communities where resource extraction—defined as mining, quarrying, and oil and gas extraction—accounts for 25 percent or more of GDP.

This article focuses on advanced manufacturing and the associated implications for a subset of rural archetypes, schools, and industry partners, but other industries hold promise for the other archetypes. As rural K–12 schools and industry think about how to prepare the students of today for the jobs of tomorrow, they can take stock of the economic and industry characteristics of their communities.

Beyond manufacturing, the following industries could offer career-connected learning opportunities for rural communities:

- *Construction in manufacturing workshops, resource-rich regions, and migration magnets.* In rural communities with manufacturing and energy companies and growing populations, the construction industry appears set to benefit from investment trends.
- *Hospitality and entrepreneurship in migration magnets.* In rural communities with large tourism economies, the hospitality sector appears poised for continued growth.

How companies could benefit

Manufacturing companies that hire local, better-prepared workers could reduce workforce attrition and increase productivity. According to available data, annual turnover for manufacturing workers in rural communities exceeds 50 percent. Industry experts estimate that the most effective workforce development and retention efforts decrease attrition rates by 40 to 70 percent.[10]

Based on our analysis of the $1 trillion in announced investments, we estimate that advanced manufacturers could save as much as $20,000 to $30,000 a year per retained employee. The improved retention and productivity associated with local, well-prepared workers could be worth $20 billion annually.

A potential windfall for rural workers and communities

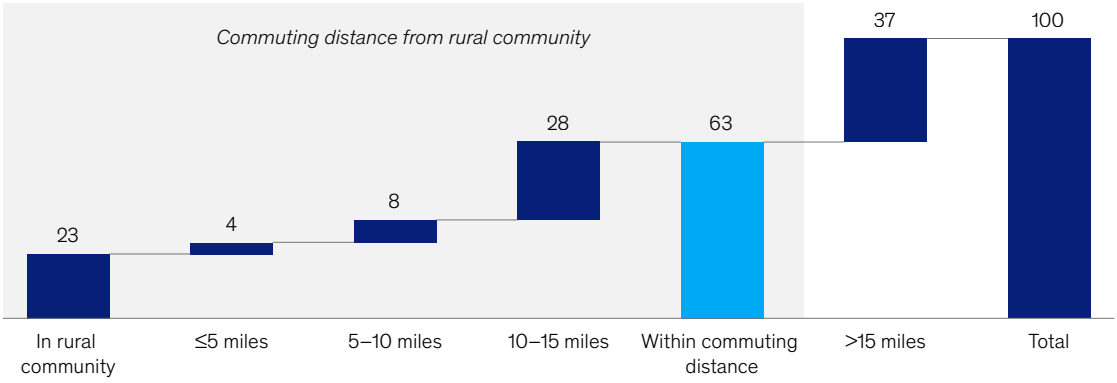
Rural students, communities, and economies could see about $34 billion a year in wage increases across jobs created directly and indirectly from the influx of investment and expanded job opportunities—roughly 10 percent of rural America's manufacturing GDP. Those annual net new wages would go to

[10] McKinsey analysis of Lightcast data.

Exhibit 2

Nearly two-thirds of the $1 trillion in announced advanced-manufacturing investments will support facilities within commuting distance of rural America.

Share of strategic-sector manufacturing investment[1] announcements by geography, 2021–24, % of total



[1]Inclusive of new facility construction, facility expansion, and facility modernization. The Brookings Institution defines strategic manufacturing sectors as clean technology, semiconductors and electronics, biomanufacturing, and other advanced industries (eg, heavy industry, chemicals and materials, steel, aluminum).
Source: AAA Foundation; Brookings Institution; US Census Bureau; White House; McKinsey analysis

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three groups of workers. First, local K–12 graduates hired to fill incoming advanced-manufacturing jobs could earn an additional 40 percent in incremental income, equivalent to a collective $3.8 billion.[11] Second, these manufacturing investments could spur an additional $9.7 billion in indirect and induced wages in rural areas.[12] Third, existing manufacturing workers who stay in their jobs could collectively see $20 billion in wage benefits, with retention further strengthened by equipping these workers with advanced skills and a deeper understanding of their roles, making them less likely to leave for lower-paying jobs.

The impact on future rural K–12 graduates could be life-changing. However, according to interviews with industry experts, students are not aware of that wage potential. As one employer stated, "There is a gap in student perception and reality. We just hired someone with an associate's degree making $100,000."

[11] Our calculated wage impact is based on analysis of $1 trillion of geolocated American manufacturing announcements made following the COVID-19 pandemic. Using the longitude and latitude of those investments, we identified the rural counties that could benefit from incoming manufacturing jobs. Across those counties, the average nonmanufacturing wage is about $58,000 annually, compared with $80,000 annually for the average manufacturing wage. If these jobs went to rural residents, we estimate that their incomes could grow by 40 percent, equal to $3.8 billion in new wages each year across affected rural communities.

[12] Indirect and induced wages represent associated supply chain wages and broader economic multipliers resulting from direct investments in advanced manufacturing.

Advanced-manufacturing investments could produce jobs that require different education levels, from a high school diploma to a bachelor's degree or higher (Exhibit 3). Critically, many jobs that do not require a four-year degree have clear career pathways. For example, welders develop skills on the job that make first-line production supervisor a natural next role. In turn, supervisors build skills that open up an even broader range of occupations, leading to expanded career options and earning potential.[13]

These career paths have benefits beyond higher wages. Recent research from the Brookings Institution finds that communities with a high share of manufacturing jobs across the American

[13] "Job Progression Tool," McKinsey and Rework America Alliance, accessed June 26, 2025.

Exhibit 3

Advanced-manufacturing investments could produce jobs that require a range of education levels.

Highest-employing 5 manufacturing jobs that pay >$45,000 and require no work experience, by degree type

Degree required	Occupation	% of US manufacturing jobs (number of jobs, thousand)	Median annual wage	Job-related prep required[1]
High school diploma	Inspectors, testers, sorters, samplers, and weighers	3.0 (~380)	$45,843	Moderate
	Welders, cutters, solderers, and brazers	2.2 (~280)	$48,942	Moderate
	Machinists	**10.8%** — 1.9 (~240)	$50,835	Long-term
	Sales reps, wholesale and manufacturing, except technical and scientific products	1.9 (~240)	$65,645	Moderate
	Industrial machinery mechanics	1.8 (~230)	$61,422	Long-term
Associate's	Industrial engineering technologists and technicians	0.4 (~50)	$62,608	None
	Electrical and electronic engineering technologists and technicians	**3.0%** — 0.3 (~40)	$72,800	None
	Chemical technicians	0.2 (~25)	$56,763	Moderate
	Mechanical drafters	0.2 (~25)	$64,064	None
	Mechanical engineering technologists and technicians	0.1 (~13)	$64,022	None
Bachelor's	Industrial engineers	1.8 (~230)	$99,382	None
	Software developers	1.2 (~150)	$132,267	None
	Mechanical engineers	**5.6%** — 1.0 (~130)	$99,507	None
	Buyers and purchasing agents	0.9 (~115)	$71,947	Moderate
	Accountants and auditors	0.7 (~90)	$79,893	None

[1] "None" defined as no job-related prep required beyond formal education; "moderate" defined as the equivalent of 1 month to 1 year of on-the-job training; "long term" defined as the equivalent of 1 year of on-the-job training.
Source: Lightcast

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heartland are more likely to have a higher volume of middle-income occupations and greater upward mobility.[14]

The impact could be particularly outsize for rural Americans, who have faced the greatest challenges in recent years. For instance, health and life outcomes for rural males have lagged far behind those of urban males since the 1990s.[15] New advanced-manufacturing jobs may disproportionately benefit rural males, who are about three times as likely as rural females to work in manufacturing.[16]

Closing a gap in the talent pipeline

The projected investment and demand for qualified workers could create a shortage of 2.1 million manufacturing workers in the United States by 2030.[17] The semiconductor subsector alone could have 67,000 unfilled jobs (58 percent of its total jobs created).[18]

In interviews and surveys, industry experts and manufacturing companies emphasize that students need to develop multiple types of skills for today's advanced-manufacturing careers. These include foundational K–12 skills (such as reading, writing, and math), technical skills for advanced-manufacturing jobs, and durable skills (for example, resilience) that enable employees to thrive in any workplace.

One employer noted, "Basic math and problem-solving are fundamental skills that will always be transferable and no-regrets skills to invest in." Another stated that students will need to understand "robotics and complex problems" to thrive in advanced-manufacturing roles. Further, surveys reveal that advanced-manufacturing employers believe higher-level cognitive skills, including tech and digital literacy, creative thinking, and analytical thinking, will have increased importance for their workforces (Exhibit 4; see sidebar "What do today's advanced-manufacturing jobs look like?").[19]

[14] Ben Armstrong and Elisabeth Reynolds, "Growing from the middle out: An economic model of good jobs for the heartland, by the heartland," Brookings Institution, April 21, 2025.
[15] "Growing divide: Rural men are living shorter, less healthy lives than their urban counterparts," USC Leonard D. Schaeffer Institute for Public Policy & Government Service, September 25, 2024.
[16] McKinsey analysis of Lightcast data.
[17] "2.1 million manufacturing jobs could go unfilled by 2030," Manufacturing Institute, May 4, 2021.
[18] *Semiconductor workforce development: A policy blueprint*, Semiconductor Industry Association, April 2024.
[19] *Future of jobs report 2025*, World Economic Forum, January 2025.

What do today's advanced-manufacturing jobs look like?

Previous McKinsey research found increased automation and technology in manufacturing could lead to changes in skill requirements for manufacturing workers.[1] Demand for technological skills, both basic digital skills and advanced IT skills, is likely to grow. Demand for higher-level cognitive skills could also rise as a result of greater creativity and complex information processing. This shift in skills reflects changes in the daily job experience of manufacturing workers.

Take a semiconductor fab as an example. Today's production workers and technicians spend a significant amount of time problem-solving with colleagues and optimizing the performance of manufacturing equipment and materials. They often start their day on a computer and in meetings, learning about the prior shift's production and any challenges that need to be addressed. They then don a clean-room suit and work in the factory's production clean-room, monitoring factory performance and addressing complex problems in automated manufacturing equipment. They use precision manual techniques and computer skills to calibrate equipment performance.

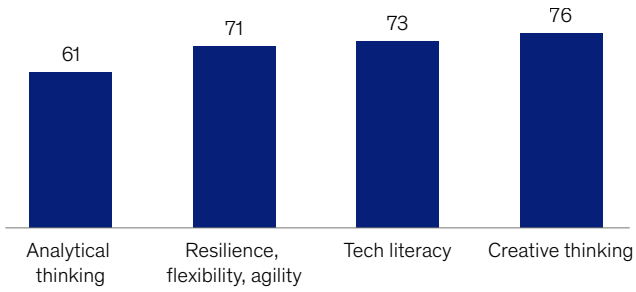
In some ways, their work more closely resembles that of a scientist in a high-tech lab. Such work requires creativity, collaboration with colleagues, social and emotional intelligence, and digital, mathematical, and technological savvy.[2]

[1] "Skill shift: Automation and the future of the workforce," McKinsey Global Institute, May 23, 2018.
[2] "Day in the life: Manufacturing production specialist," Texas Instruments, March 14, 2023, and "Day in the Life: Technician," Texas Instruments, June 15, 2023.

Exhibit 4

Advanced manufacturers believe higher-level cognitive skills (such as digital literacy and analytical thinking) will be increasingly important in the future.

Growth in skill importance in advanced manufacturing, % of employers indicating the skill has growing importance for their workers



Source: Gallup; World Economic Forum; McKinsey Global Institute

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However, according to employers and industry groups, such skill sets appear to be in short supply across America's manufacturing labor pool. In the National Association of Manufacturers' quarterly industry survey, "attracting and retaining a quality workforce" has consistently ranked toward the top of manufacturer challenges.[20] According to our research and engagement with industry leaders, one cause of this skill shortage is the failure of industry and K–12 schools to effectively collaborate with each other. One industry expert with experience in K–12 schools commented that industry and school systems are often "like ships passing in the night." Each wants to reap benefits from the other—industry seeks well-prepared, eager future workers, and K–12 schools want to help their students learn about career opportunities—but neither knows how to effectively engage the other.

Despite the challenges with engagement between industry and schools, K–12 schools can play an effective role in preparing students for manufacturing careers. Research has found a link between career and technical education (CTE) and performance. High school students who take CTE courses have higher graduation rates and greater employability, especially students from low-income backgrounds, than those who do not.[21] Further, an analysis of earnings outcomes reveals that students who concentrate on CTE curriculums earn more than $6,000 more a year, on average, than their non-CTE counterparts by their seventh year in the workforce.[22] These findings underscore the potential of CTE programs to enhance economic outcomes.

Developing the rural American workforce of the future

Industry and schools would need to collaborate more closely to produce the workforce of the future. Our research and analysis identified two sets of actions stakeholders could pursue to align worker supply and demand.

1. Ensure students gain foundational skills from their K–12 education

To prepare students for future jobs, rural schools—and all schools—must ensure that students graduate from high school with skills in literacy, math, and critical thinking. These ingredients are

[20] Victoria Bloom and Mary Frances Holland, "NAM manufacturers' outlook survey: First quarter 2025," National Association of Manufacturers, March 6, 2025.
[21] Hannah C. Kistler and Shaun M. Dougherty, "Career and technical education is a hidden weak spot in many high schools' teacher workforces," Brookings Institution, April 9, 2024.
[22] "Positive outcomes for high school CTE concentrators," CTE Policy Watch, February 4, 2022.

crucial to prepare students for the workforce more broadly and for advanced-manufacturing jobs specifically. Unfortunately, as has been widely reported, results on the National Assessment of Educational Progress have declined in reading and math over the past decade, with disproportionately large declines among the nation's lowest-performing students[23] —demonstrating that America's students may be backsliding on such core skills. These areas should be a top priority for rural America's K–12 schools, and industry can help reinforce their importance.

How can schools help students attain these skills? As McKinsey's *Spark & Sustain* report highlights, excellence in K–12 requires a focus across three levels: classrooms, schools, and system support.[24] Among the most vital elements for student preparation is getting high-quality, standards-aligned curriculum materials into the hands of teachers—and ensuring those teachers are well supported in using them.

2. Implement revamped, evidence-based career-connected learning

Industry and rural schools can work together to provide K–12 students with the necessary education and technical skills for future careers. This approach consists of three elements that have achieved proven results in school districts across the country: deploying evidence-based models, forging strong partnerships between industry and K–12 schools, and aligning career-connected skill development programs with local industry needs. These elements move well beyond infrequent or one-off efforts (such as career days) to build awareness and double down on proven interventions to expand opportunities for young people.

Evidence-based models. Schools and industry can collaborate to reimagine career-connected learning and adopt evidence-based models to design more-effective programs. These models include the following categories:

— CTE courses provide students with applicable skills for a defined set of careers. As with all career-connected learning, when done well, these courses center on skills in demand among local employers. In rural communities with growing manufacturing investments, schools could offer CTE courses that equip students with technical and other STEM-based skills for careers in advanced manufacturing.

State legislatures could provide incentives for CTE programming through state-level policies and funding. Encouragingly, states are already providing such incentives: Interest has surged in CTE courses in recent years; in 2024 alone, 40 states collectively approved more than 150 policies focused on boosting CTE programming.[25]

Such policies are most effective when anchored on helping students build career-aligned skills for occupations that promise employment, career pathways, and good pay. In addition to government, companies can play a role by engaging with local school systems to help educators understand the skills needed in local industry. School systems can then tailor their curriculums to better prepare students.

— Dual-enrollment programs allow students to take high school and postsecondary courses simultaneously, earning credits that count toward both a high school diploma and an associate's or bachelor's degree. For advanced-manufacturing roles, such programs could include enrolling students in technical or STEM courses at a community college or four-year institution. State policymakers may need to alter state education rules to enable dual-enrollment tracks.

— Youth apprenticeships give students real-world experience with specific trades and occupations. Students can engage deeply with workplace opportunities that prepare them for full-time

[23] Sarah Mervosh, "The pandemic is not the only reason U.S. students are losing ground," *New York Times*, April 7, 2025.
[24] "Spark & Sustain: How all of the world's school systems can improve learning at scale," McKinsey, February 12, 2024.
[25] "State policies impacting CTE: 2024 year in review," CTE Policy Watch, February 24, 2025.

Case study: A youth apprenticeship program facilitated by a local economic development organization

EmployIndy's Modern Apprenticeship Program (MAP) is a three-year initiative preparing central-Indiana high school students for in-demand careers through paid, hands-on work experience starting in their junior year. Students earn an average of $13 an hour, gain more than two years of job experience, and receive college credits or certifications in industries such as IT, healthcare, and advanced manufacturing. Local employers partnering with MAP include the Indianapolis Airport Authority and OneAmerica.[1]

Open to all students on track to graduate, MAP aligns students' work with their academic schedules and provides up to $6,000 in education support.[2] With 91 percent of apprentices retaining employment after the program, MAP is developing career-ready talent and strengthening central Indiana's workforce.[3]

[1] "Modern Apprenticeship," EmployIndy, accessed June 27, 2025; "Indianapolis employers look to apprenticeships as solution to workforce gaps," EmployIndy, October 15, 2024.
[2] "Students & parents," Indy Modern Apprenticeship, accessed June 27, 2025.
[3] "Employers," Indy Modern Apprenticeship, accessed June 27, 2025.

careers while earning their high school diploma. For youth apprenticeships to thrive, local employers must offer opportunities for students and partner with the K–12 school system—for example, creating recruitment and hiring pipelines in K–12 schools.

— Career academies combine many features of the approaches detailed above to integrate career-based skill development and workplace learning opportunities (for example, youth apprenticeships) related to a single career path (such as advanced manufacturing).For instance, they often include both CTE coursework and apprenticeship opportunities. The key differentiator of career academies is that they combine these approaches under a single

Case study: A manufacturing academy in Ohio

In Ohio, the Greene County Career Center (GCCC) offers specialized manufacturing programs in advanced engineering systems and industrial robotics alongside programming at seven Greene County high schools.[1] This approach provides high school students with the opportunity to earn industry-recognized credentials and credits that count toward an associate of applied science degree in manufacturing engineering. The GCCC also runs summer camps for middle schoolers to build early interest in manufacturing and recruit future students.

GCCC has seen particular success in increasing student access to associate's degrees. More than 90 percent of GCCC students earn a Tech Prep Scholarship each year, and 99 percent of the class of 2023 graduated from high school within five years. As of 2024, 93 percent of 2022 graduates were employed, enrolled in college or an apprenticeship, or in the military. GCCC also provides direct opportunities for industry engagement through work-based learning: High school seniors have the opportunity to engage directly with employers through on-the-job placements, and GCCC students have collectively worked nearly 59,000 hours in the local economy.

[1] *Building the workforce! 2024–2025*, Greene County Career Center, October 2023.

career path, allowing students to engage deeply with a career field during high school.

— Pathways in Technology Early College High School (P-TECH) intentionally blurs the lines between high school and postsecondary education more than any other model detailed in this article. Schools using the P-TECH approach set up students to earn postsecondary credits and secure an associate's degree for high-demand industries while in high school or soon after graduation. The model incorporates workplace-based learning through local industry partnerships with a focus on STEM-related education and fields. Industry has played a central role in developing and promoting P-TECH; for instance, IBM created the P-TECH school model and continues to partner with schools to prepare students for careers.[26]

Strong partnerships between K–12 schools and industry. Industry partnerships are essential for each of the aforementioned models to work. Employers and industry associations can collaborate with schools to provide apprenticeships and other workplace learning opportunities. They can also support the development of industry-relevant curriculums to ensure that students learn high-demand skills. Companies stand to gain from such collaboration by securing a pipeline of workers who are prepared for jobs at those employers. As advanced manufacturers expand their footprints in and around rural America, they have a role to play by forming partnerships with nearby school

[26] Rosabeth Moss Kanter and Ai-Ling Jamila Malone, "IBM and the reinvention of high school (A): Proving the P-TECH concept," Harvard Business School Case 314-049, September 2013 (revised June 2017).

Case study: A rural P-TECH program in a single school

Situated in rural Texas, Roscoe Collegiate High School's Early College/STEM Academy features a Pathways in Technology Early College High School (P-TECH) model to help students secure industry-relevant certifications and associate's degrees in high school. The program seeks to have students earn college credits or degrees during their high school education or within two years after graduation. This approach allows the program to draw on public K–12 funding to support students' postsecondary education, reducing the need for students to take on debt. Students can also access directed research and work-based learning later in high school.[1]

The school has formal partnerships with nearby universities and community colleges,[2] as well as collaborations with businesses that provide on-the-job learning opportunities for students.

Collegiate Edu-Nation (CEN), the nonprofit that runs this program, has sought to build on Roscoe's success by bringing this rural-based P-TECH model to schools across Texas and potentially the rest of the United States.[3] CEN has achieved significant success, with 22 percent of students earning an associate's degree and 44 percent obtaining a high-wage, in-demand certificate prior to finishing high school.[4]

[1] "P-TECH," Roscoe Collegiate Independent School District, accessed June 27, 2025.
[2] "P-TECH," Roscoe Collegiate Independent School District, accessed June 27, 2025.
[3] See the Collegiate Edu-Nation website.
[4] "A year in review 2024," Collegiate Edu-Nation, March 13, 2025.

Case study: A semiconductor-focused CTE pathway

Arizona's Chandler Unified School District is launching a semiconductor-focused career and technical education (CTE) high school program. Its partners include the University of Arizona and various industry partners, such as Advantest, ARM, Cactus Materials, Cirrus Logic, Edwards Vacuum, Intel, KLA, Lawrence Semiconductor, Leonardo Electronics US, MCP Inc., Microchip, Mortenson, NXP, Sunlit, and Teradyne. The two-year CTE program, which welcomes its inaugural class in the 2025–26 school year, will engage students through a weeklong "semiconductor camp" and ongoing hands-on education pathways drawing on industry partners' expertise. The initiative is expected to significantly boost the local workforce pipeline, preparing students for high-wage careers in the semiconductor industry.[1]

[1] "Semiconductors," Chandler Unified School District, accessed July 2, 2025. This program has not yet been launched, so it does not have any outcomes or impact metrics to date.

systems. And school systems can work with local government, economic development organizations, and workforce institutions (such as community colleges) to build connections with employers.

Advanced manufacturers, industry, and K–12 schools could keep the following principles in mind:

— Frequency: Regular interaction with students. Industry could create touchpoints with students throughout the K–12 experience, particularly during high school. Scheduled at regular intervals, these touchpoints could reinforce consistent messages about the promise of careers throughout a student's K–12 journey. Without such repetition and continual engagement, students could forget about opportunities in advanced manufacturing. Such outreach can also extend to families to build community-wide awareness of the promise of these careers.

— Intensity: Increased engagement as students progress in school. Building on prior engagement, industry could increase the intensity of its offerings for students. For instance, early in a student's education, companies may visit schools to teach students about their industry. At this stage, business leaders can also work directly with schools to integrate relevant skills into basic curriculums or create personalized, project-based learning opportunities. In later high school grades, industry could offer students apprenticeships, summer jobs, and scholarships for postsecondary degrees.

Skill development programs that align with local industry needs. Today, career-connected learning often falls short of student and industry needs. For instance, a Walton Family Foundation report on career learning opportunities in northwest Arkansas highlights "significant misalignment between workforce needs and CTE pathway completions by students."[27] Close collaboration with industry and other stakeholders could ensure that career-connected learning aligns with local needs.

What could such collaboration look like? K–12 school systems can meet with state policymakers, regional intermediaries (such as local economic development organizations), and anchor employers in their region to understand the skills and credentials that employers demand. One output from their collaboration could be a codified skill continuum. An example of such a deliverable is the Ohio MFG Competency Model, which offers a detailed, standardized framework to help employers, training programs, and schools

[27] "CTE and career readiness in Northwest Arkansas," Walton Family Foundation, January 24, 2024.

identify and communicate the skill sets needed for manufacturing jobs.[28] Government can play a central role in promoting or requiring the development of such frameworks. With this foundation, K–12 schools and industry can partner to design career-connected learning in a way that provides students with the relevant, agreed-upon skills.

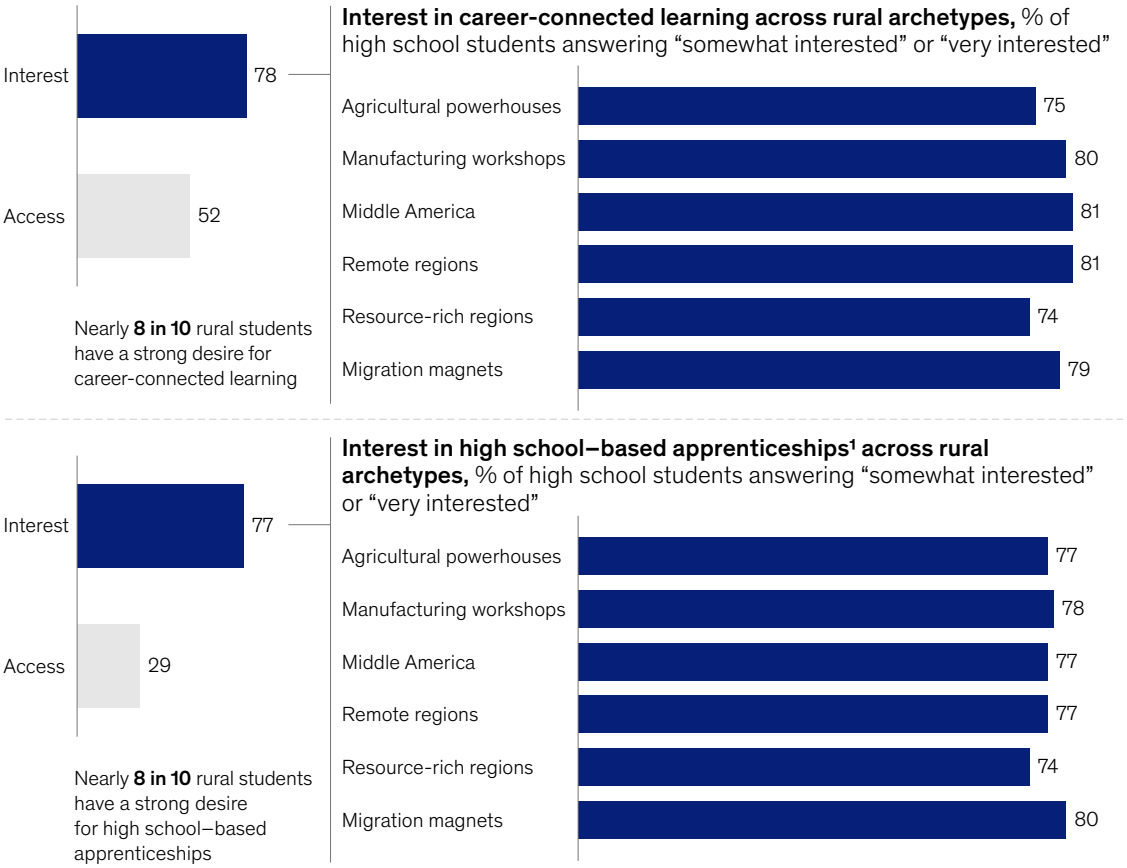
Providing rural America's students with the education they want

Beyond preparing rural students for higher-paying, future-oriented jobs, career-connected learning also presents an immediate benefit for rural high schoolers: It gives them the type of learning they say they want (Exhibit 5).

[28] "The Ohio Manufacturing Competency Model," Ohio Manufacturers' Association, accessed June 27, 2025.

Exhibit 5

Rural students are interested in career-connected learning and high school–based apprenticeships but say they lack access.



[1] Specifically, apprenticeships with local employers, facilitated by their high school.
Source: McKinsey Rural K–12 Student Survey, 2025, n = ~2,000 students

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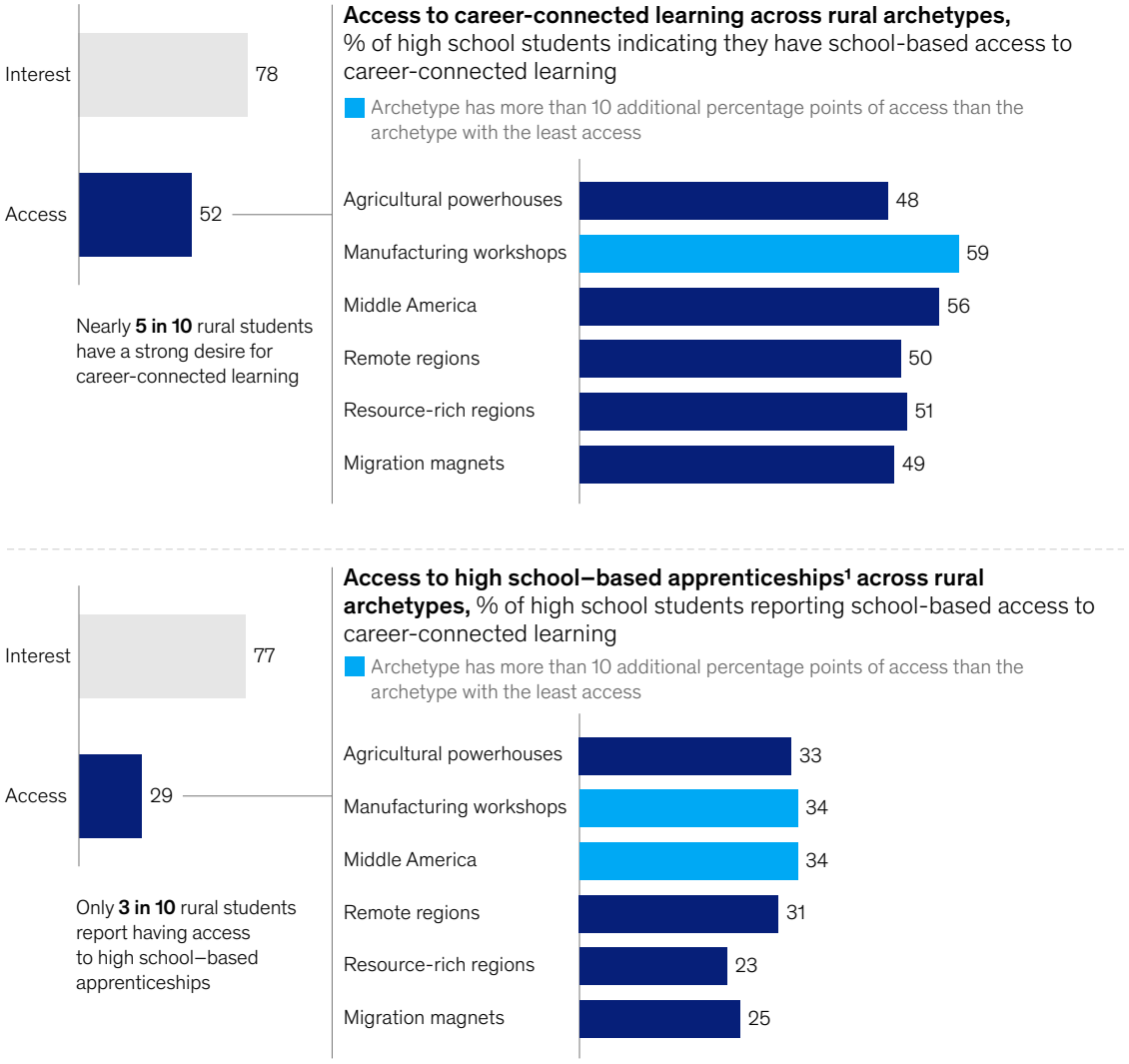
Exhibit 5 (continued)

Rural students are interested in career-connected learning and high school–based apprenticeships but say they lack access.



[1]Specifically, apprenticeships with local employers, facilitated by their high school.
Source: McKinsey Rural K–12 Student Survey, 2025, n = ~2,000 students

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We surveyed nearly 1,500 rural high schoolers and recent graduates across the six rural archetypes as well as nonrural high schoolers. Three findings stand out:

1. Eight in ten rural students have a strong desire for career-connected learning and apprenticeship opportunities.
2. Just five in ten rural students report having access to career-connected learning in high school, and only three in ten to apprenticeships.
3. While rural students in manufacturing workshops and middle America report greater access to career-connected learning and

apprenticeships than students in other rural geographies do, they still have less access than they want.

With the US economy increasingly focused on resilience and reshoring, rural communities could see a massive influx of new jobs in advanced manufacturing. This moment presents a generational opportunity for industry, K–12 schools, and governments to partner to create a brighter future for youth and employers. Broader changes in the skills required for work in advanced-manufacturing roles also present an opportunity to improve career-connected learning.

Public and private sector stakeholders could seize this opportunity to ensure that students, communities, and employers across rural America can thrive. The impact could be felt in every facet of rural life: Enhanced career advancement, greater social mobility, and more-dynamic school curriculums could create a new world of expanded possibility.

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