America's Semiconductor Boom Faces a Challenge: Not Enough Workers

Strengthened by billions of federal dollars, semiconductor companies plan to create thousands of jobs. But officials say there might not be enough people to fill them.

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A Taiwan Semiconductor Manufacturing Company plant under construction in Phoenix. America is on the cusp of a semiconductor manufacturing boom. T.J. Kirkpatrick for The New York Times

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Reporting from Washington

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Maxon Wille, an 18-year-old in Surprise, Ariz., was driving toward Interstate 17 last year when he noticed a massive construction site: Taiwan Semiconductor Manufacturing Company at work on its new factory in Phoenix.

A few weeks later, as he was watching YouTube, an advertisement popped up for a local community college's 10-day program that trains people to become semiconductor technicians. He graduated from the course this month and now hopes to work at the plant once it opens.

"I can see this being the next big thing," Mr. Wille said.

Semiconductor manufacturers say they will need to attract more workers like Mr. Wille to staff the plants that are being built across the United States. America is on the cusp of a semiconductor manufacturing boom, strengthened by billions of dollars that the federal government is funneling into the sector. President Biden had said the funding will create thousands of well-paying jobs, but one question looms large: Will there be enough workers to fill them?

"My biggest fear is investing in all this infrastructure and not having the people to work there," said Shari Liss, the executive director of the SEMI Foundation, a nonprofit arm of SEMI, an association that represents electronics manufacturing companies. "The impact could be really substantial if we don't figure out how to create excitement and interest in this industry."

Lawmakers passed the 2022 CHIPS Act with lofty ambitions to remake the United States into a semiconductor powerhouse, in part to reduce America's reliance on foreign nations for the tiny chips that power everything from dishwashers to computers to cars. The law included $39 billion to fund the construction of new and expanded semiconductor facilities, and manufacturers that want a slice of the subsidies have already announced expansions across the country.

More than 50 new facility projects have been announced since the CHIPS Act was introduced, and private companies have pledged more than $210 billion in investments, according to the Semiconductor Industry Association.

But that investment has run headfirst into the tightest labor market in years, with employers across the country struggling to find workers. Semiconductor manufacturers have long found it difficult to hire workers because of a lack of awareness of the industry and too few students entering relevant academic fields. Company officials say they expect it to become even more difficult to hire for a range of critical positions, including the construction workers building the plants, the technicians operating equipment and engineers designing chips.

The U.S. semiconductor industry could face a shortage of about 70,000 to 90,000 workers over the next few years, according to a Deloitte report. McKinsey has also projected a shortfall of about 300,000 engineers and 90,000 skilled technicians in the United States by 2030.

Semiconductor manufacturers have struggled to hire more employees, in part because, officials say, there are not enough skilled workers and they have to compete with big technology firms for engineers. Many students who graduate with advanced engineering degrees in the United States were born abroad, and immigration rules make it challenging to obtain visas to work in the country.

Ronnie Chatterji, the White House's CHIPS implementation coordinator, said that filling the new jobs would be a big challenge, but that he felt confident Americans would want them as they became more aware of the industry's domestic expansion.

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"While it hasn't been the sexiest job opportunity for folks compared to some of the other things that they're graduating with, it also hasn't been on the radar," Mr. Chatterji said. He added that America would be less "prosperous" if companies could increase output but lacked the employees to do so.

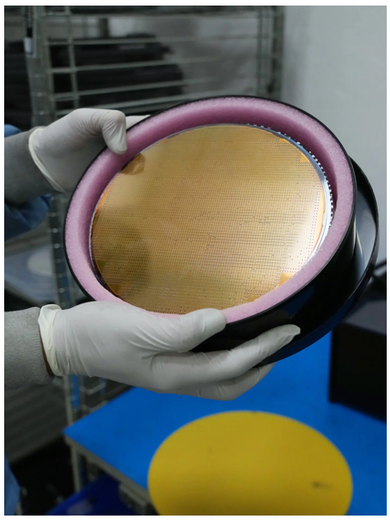
In an effort to meet the labor demand, the Biden administration said this month that it would create five initial "work force hubs" in cities like Phoenix and Columbus, Ohio, to help train more women, people of color and other underrepresented workers in industries like semiconductor manufacturing.

Administration and company officials have also pushed for changes to better retain foreign-born STEM graduates, but immigration remains a controversial topic in Washington, and few are optimistic about reforms.

Some industry leaders are looking to technology as an antidote, since automation and artificial intelligence can amplify the output of a single engineer, but companies are mostly putting their faith into training programs. Federal officials have backed that effort and pointed out that funding in the CHIPS Act could be used for work force development.

Intel, which announced plans to spend $20 billion on two new chip factories in Arizona and more than $20 billion on a new chip manufacturing complex in Ohio, has invested millions in partnerships with community colleges and universities to train technicians and expand relevant curriculum.

Gabriela Cruz Thompson, the director of university research collaboration at Intel Labs, said the company anticipated creating 6,700 jobs over the next five to 10 years. About 70 percent would be for technicians who typically have a two-year degree or certificate.



A silicon wafer, a thin material essential for manufacturing semiconductors, at a chip-packaging facility in Santa Clara, Calif. Jim Wilson/The New York Times

She said that the industry had faced staffing challenges for years, and that she was concerned about the number of "available and talented skilled workers" who could fill all of the new Intel positions.

"I am confident," she said. "But am I fully certain, 100 percent? No."

Micron, which pledged as much as $100 billion over the next two decades or more to build a huge chip factory complex in New York, has also deployed new work force programs, including ones that train veterans and teach middle and high school students about STEM careers through “chip camps.”

Bo Machayo, the director of U.S. federal affairs at Micron, said the company anticipated needing roughly 9,000 employees after its full build-out in the region.

“We understand that it’s a challenge, but we also look at it as an opportunity,” he said.

To be considered for the federal subsidies, manufacturers must submit applications to the Commerce Department that include detailed plans about how they will recruit and retain workers. Firms requesting more than $150 million are expected to provide affordable, high-quality child care.

“We don’t think that a company can just post a bunch of jobs online and hope that the right work force shows up,” said Kevin Gallagher, a senior adviser to the commerce secretary.

The lack of interest in the industry has been evident at academic institutions. Karl Hirschman, the director of microelectronic engineering at the Rochester Institute of Technology, said the university was “nowhere close” to the maximum enrollment for its microelectronic engineering degree program, which sets up students for semiconductor-related careers. Enrollment averages about 20 new undergraduates each year, compared with more than 200 for the university’s mechanical engineering program.

Although students graduating with more popular engineering degrees could work in the semiconductor industry, Mr. Hirschman said, many of them are more aware of and attracted to tech firms like Google and Facebook.

“We do not have enough students to fill the need,” he said. “It’s only going to get more challenging.”

Community colleges, universities and school districts are creating or expanding programs to attract more students to the industry.

In Maricopa County, Ariz., three community colleges have teamed up with Intel to offer a “quick start” program to prepare students to become entry-level technicians in just 10 days. During the four-hour classes, students learn the basics of how chips are made, practice using hand tools and try on the head-to-toe gowns that technicians wear.

More than 680 students have enrolled in the program since it began in July, said Leah Palmer, the executive director of the Arizona Advanced Manufacturing Institute at Mesa Community College. The program is free for in-state students who complete it and pass a certification test.

In Oregon last year, the Hillsboro School District started a two-year advanced manufacturing apprenticeship program that allows 16- to 18-year-old students to earn high school credit and be paid to work on the manufacturing floors of companies in the semiconductor industry. Five students are participating, and officials hope to add at least three more to the next cohort, said Claudia Rizo, the district's youth apprenticeship project manager.

"Our hope is that students would have a job offer with the companies if they decide to stay full time, but also be open to the possibility of pursuing postsecondary education through college or university," Ms. Rizo said.

Universities are also expanding undergraduate and graduate engineering programs. Purdue started a semiconductor degree program last year, and Syracuse, which has worked with Micron and 20 other institutions to enhance related curriculum, plans to increase its engineering enrollment 50 percent over the next three to five years.

Students participated in an event hosted by Micron at Onondaga Community College in Syracuse, N.Y. Benjamin Cleeton for The New York Times

At Onondaga Community College, near Micron's build-out in New York, officials will offer a new two-year degree and one-year certificate in electromechanical technology starting this fall. The programs were already underway before Micron's announcement to build the chip factory complex but would help students gain the qualifications needed to work there, said Timothy Stedman, the college's dean of natural and applied sciences.

Although he felt optimistic, he said interest could be lower than officials hoped. Enrollment in the college's electrical and mechanical technology programs has noticeably declined from two decades ago because more students have started to view four-year college degrees as the default path.

"We're starting to see the pendulum swing a little bit as people have realized that these are well-paying jobs," Mr. Stedman said. "But I think there still needs to be a fair amount of work done."

Ana Swanson contributed reporting.

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