# Semiconductor Industrial Policy and the Fifth District

**Will the recently enacted CHIPS Act bring major growth to the region's semiconductor industry?**

BY MATTHEW WELLS

Chip maker Wolfspeed recently announced that it would bring the largest semiconductor materials facility in the world to Chatham County, N.C.

IMAGE: COURTESY OF WOLFSPEED

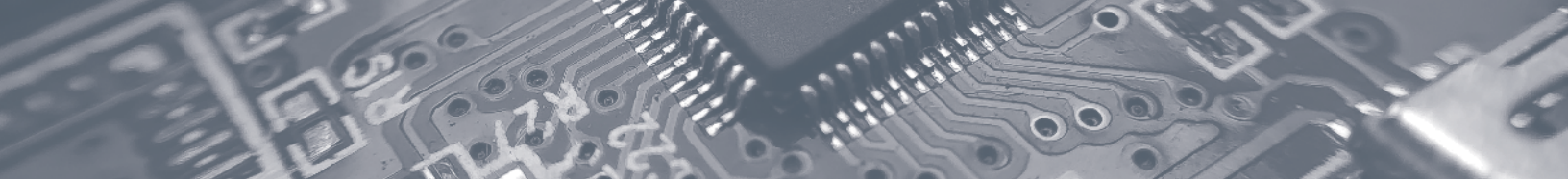
Chatham County, N.C., is a long way from Silicon Valley. Around 76,000 residents live here among the rolling hills of the Piedmont region, nestled between the Atlantic Plain and the Appalachian Mountains. Farming and mining have been the primary industries for generations. The county is about 2,700 miles away from Silicon Valley, the Bay Area region widely acknowledged as the world's semiconductor innovation hub for over half a century. But despite these differences in geography and reputation, in September 2022, Wolfspeed, a firm originally founded in North Carolina in 1987 as a developer and maker of LEDs, announced that Chatham County would be the home of a new $5 billion semiconductor materials facility — the largest in the world and one that would bring 1,800 high-tech jobs by the end of the decade on top of the 3,000 the company already has at its existing facility in Durham, about 50 miles away.

Almost all modern technologies, from smartphones and washing machines to the electrical grid and defense systems, depend on semiconductors to function. As recently as the 1990s, the United States was the dominant producer of semiconductors, accounting for 37 percent of the global market. That number has shrunk to only 12 percent, and China now leads with 24 percent of the market. Tension between the two countries, however, has raised concerns among policymakers that in a geopolitical crisis, the United States may not have access to these crucial products, kneecapping its high-tech manufacturing ability. Further, Taiwan, which China regards as a renegade province, has another 21 percent of the global market, and should China attempt to reassert control there, access to that source might also be in jeopardy.

The COVID-19 pandemic also made clear that international supply chains can rupture for extended periods, contributing to economic instability. To hedge against these potential threats to the nation's security and prosperity, federal policymakers have adopted an industrial policy to reestablish a domestic semiconductor manufacturing base. The centerpiece of this targeted intervention, the bipartisan CHIPS and Science Act, was passed by Congress and signed into law by President Joe Biden last summer. With $52.7 billion for semiconductor research and development, manufacturing, and workforce development (including $39 billion in subsidies for computer chip makers and a 25 percent investment tax credit for the establishment of chip plants), and $200 billion for research and manufacturing in technologies such as artificial intelligence, robotics, and quantum computing, it represents an unparalleled federal initiative to expand the nation's semiconductor industry.

## THE CHIPS ACT AS "PLACE-BASED" INDUSTRIAL POLICY

The original semiconductor industry that emerged in Silicon Valley in the 1960s wasn't the product of industrial policy. Many of the firms were spinoffs, or spinoffs of spinoffs, of Fairchild Semiconductor, which was founded by a group of scientists who previously worked for William Shockley,



the leader of the Bell Labs group that invented the transistor. Local talent also was abundant in the area, as Stanford University's electrical engineering department had already attracted and encouraged the development of high-tech manufacturing, particularly in the areas of vacuum tubes and microwave electronics. To be sure, many of these firms benefitted from government contracts, but the industry's overall development and growth was not the result of any "place-based" policy, that is, a government intervention targeted to aid a region's or community's economy.

That was then. Today, private manufacturing firms are applying for the billions of dollars in federal funding and tax breaks to subsidize their operations under the CHIPS Act. Also, while the legislation is intended to boost the broader economy and secure the country's semiconductor supply lines, it also includes a crucial "place-based" element: the "Regional Technology and Innovation Hubs" grant program, or Tech Hubs. Instead of markets allocating capital and financing to sectors and places, this $10 billion program will use a competitive grant process to direct federal dollars to at least 20 selected regions across the country where the relevant industries are located or plan to be located. According to the U.S. Department of Commerce's Economic Development Administration, which runs the program, Tech Hubs "aims to invest in regions with the assets, resources, capacity, and potential to become globally competitive, within approximately ten years, in the technologies and industries of the future." A 2022 report by the Brookings Institution notes that while "such programs may aim to boost the broader economy, they do it by directly helping local economies thrive — engaging with the local needs of individuals and industries and leveraging the 'bottom-up' energy of local talent, networks, clusters, institutions, and ecosystems." In other words, the CHIPS Act treats local and regional economic development as a key part in the rebuilding of a domestic semiconductor industry.

## IN NORTH CAROLINA, A LEGACY EVOLVES

Realizing the value of tech-based economic development, the North Carolina legislature created and funded the nonprofit Microelectronics Center of North Carolina (MCNC) in the early 1980s to support the work coming out of universities such as North Carolina State University in Raleigh, Duke University in Durham, the University of North Carolina at Chapel Hill, North Carolina A&T State University in Greensboro, and the University of North Carolina at Charlotte. Also, MCNC utilized the National Cooperative Research Act established by Congress to provide antitrust protection for corporations that wished to collaborate with other semiconductor leaders to develop next generation design and fabrication technology. MCNC served as a network where researchers from across these universities could collaborate on innovations that would make North Carolina a key location for the American semiconductor industry. Holt Anderson was the founding secretary/treasurer and director of administration of MCNC from 1981 to 1995. He says that it was a "center point for developing a policy foundation and standards for collaboration, which became very important as we moved forward with bringing in industry."

The effort paid dividends at the time, as Mitsubishi Electric Semiconductor chose northern Durham County as its American headquarters and wafer fab soon afterward. ("Fab" is short for fabrication plant, where raw silicon wafers are turned into integrated circuits.) General Electric Semiconductor soon followed, and then Silicon Valley firm Sanmina Corp., rounding out this initial industry presence in the state.

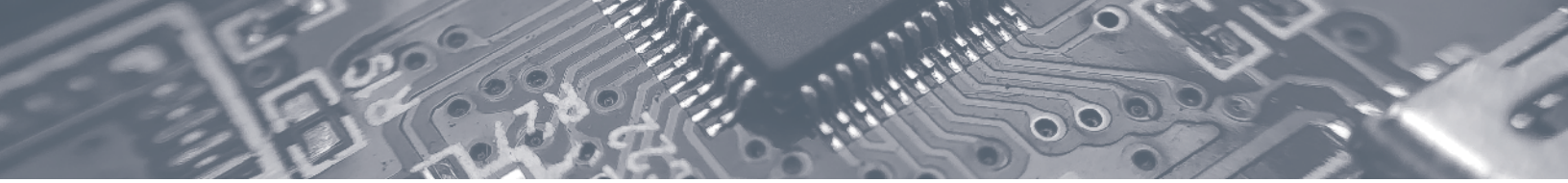
As with many industries, however, it experienced ebbs and flows over the years. In the 2000s, life sciences and biopharmaceuticals became the focus of research and development investment in North Carolina, while the semiconductor sector declined as the industry migrated overseas. But during that time, the state's universities still played an important role in maintaining a professional infrastructure that has been crucial to the region's semiconductor resurgence, as they have continued to produce engineers and conduct basic research that has led to ongoing technological innovations by Wolfspeed, which was originally a spinoff from North Carolina State University, and the other semiconductor firms spread across the state, including Qorvo Inc. in Greensboro and Triad Semiconductor in Winston-Salem.

Since 2002, for example, Duke University has run the Shared Materials Instrumentation Facility, which promotes collaboration in semiconductor development and manufacturing across universities, government laboratories, and industry. Much of its recent focus has been on identifying and testing new, more efficient materials and blending them with existing semiconductor architecture and technology.

North Carolina State University also has identified a need to integrate emerging technologies with what is currently in use. Along with Purdue University in Indiana, it has received funding from the National Science Foundation to develop a proposal for the Center for Interface Science for Emerging Devices & Systems, which would focus on research aimed at ensuring cutting-edge materials are able to work well with each other, as well as with existing parts of semiconductor devices used in the fields of energy, communications, and medicine.

State and local governments have also been active participants in attracting firms to the region, as they see significant upside in this form of economic development — specifically, good, high-paying jobs — when they bring tech firms into their communities. Attracting those firms isn't cheap, however. For example, when deciding between Chatham County and Marcy, N.Y. (where it has a second production facility) for its new manufacturing location, Wolfspeed received state and local tax incentives that totaled about $1 billion, including over $159 million from the state and $615 million from Chatham County.

Additionally, the state is building five advanced manufacturing megasites that it anticipates will host companies producing semiconductors or their component parts, as well as firms that will use semiconductors in



the products they make. This effort is managed by the Economic Development Partnership of North Carolina, a nonprofit public-private partnership under contract with the state's Department of Commerce. Two such locations are in Chatham County: Triangle Innovation Point (TIP) and Chatham-Siler City Advanced Manufacturing Site, which will host the new Wolfspeed facility. Officials have stated that while their names are confidential for now, there are about a dozen firms considering locating in these campuses.

Three companies that are potential purchasers of those semiconductors have already announced that they will be moving into the state. Toyota is investing $3.4 billion in an electric battery plant at the state's Greensboro-Randolph megasite, creating 2,100 jobs. Vietnamese car company VinFast will also be establishing the state's first automobile assembly plant, a $4 billion investment, at TIP, adding approximately another 7,500 jobs. As demand for electric vehicles increases, manufacturers like VinFast are looking for the most powerful and efficient semiconductors, and Wolfspeed builds chips from silicon carbide, which, according to the firm's internal studies, produces a 13-1 energy savings in an electric vehicle's semiconductors, compared to traditional semiconductors made from silicon. And Boom Supersonic, which builds supersonic airliners for commercial service, broke ground in 2022 on a manufacturing facility in Greensboro.

## CHALLENGES TO BUILDING A HIGH-TECH WORKFORCE

When reflecting on why North Carolina's semiconductor industry has enjoyed such tremendous growth in recent years, Tom White, the director of the Economic Development Partnership at North Carolina State University, says, "With the onshoring and reshoring of semiconductors, we've been there, done that. We have that nucleus of higher education. We know how to train the workforce for these skill sets."

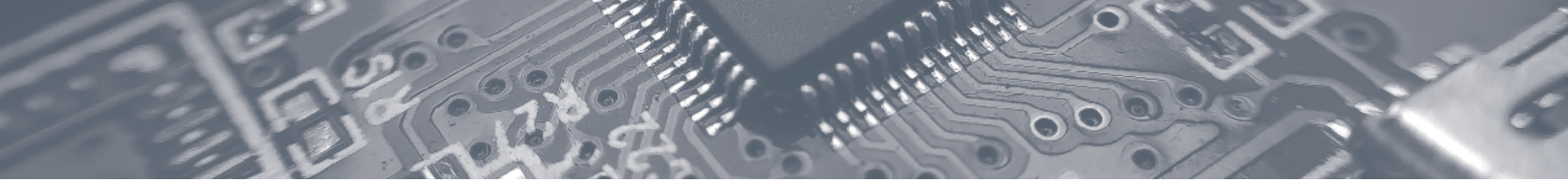
North Carolina may be an outlier when it comes to the presence of a skilled semiconductor workforce as there is a nationwide dearth of both the engineers to design the semiconductors and the technicians to build them. Due to intense competition from tech giants like Google and Meta (formerly Facebook) for STEM graduates and a lack of training programs for technicians, McKinsey and Co. has estimated that the country may be short 300,000 engineers and 90,000 skilled semiconductor technicians by 2030. Further complicating the situation is that the industry cannot necessarily rely on the immigration of overseas talent to make up for the lack of a homegrown workforce, as those policy discussions are subsumed by a thorny political debate over the country's broader immigration system.

With these difficulties in mind, many of the initiatives for bringing in new firms prioritize workforce development. Like North Carolina, Virginia also has a semiconductor manufacturing legacy that it is seeking to energize. Richmond was the North American base of operations for German firm Qimonda, which manufactured semiconductors for computer memory and data storage technology. At its height, Qimonda's Richmond factory employed 2,500 workers. Much of its production became obsolete, however, and it closed its doors in 2009. More recently, Micron Technology has invested heavily in a Manassas, Va.-based plant.

To build its production capability, the state recently established the Virginia Alliance for Semiconductor Technology (VAST), which is led by Virginia Tech and its top-ranked computer engineering program. VAST also incorporates several of Virginia's other universities, including the University of Virginia, Virginia Commonwealth University, Norfolk State University, and George Mason University, and partners with community colleges across the state. A key element of that collaborative effort is the development of a new curriculum for undergraduate STEM degrees; the state expects to graduate 5,000 students from those programs over the next three years. As a part of that effort, Virginia Tech is building a $1 billion, 1 million-square-foot Innovation Campus in Alexandria that will focus on quantum information sciences, intelligent interfaces, artificial intelligence, and machine learning. Its Chip-Scale Integration program, one of 14 majors within the umbrellas of electrical and computer engineering at the school, was the result of a Revolutionizing Engineering Departments grant from the National Science Foundation.

In their efforts to recruit semiconductor firms to set up shop, North Carolina and Virginia tout their colleges and universities as both key components of talent pipelines that they can tap and sources of research and development that will drive future innovations in the industry. But it isn't just the high-profile research universities that are taking part. VAST also is working with community colleges on creating an adult learning program aimed at veterans and traditionally underserved communities: Fast Track to Semiconductor Careers. It will offer three 10-week certificate programs on different elements of semiconductor manufacturing that plan to train a total of 600 learners, award 550 certificates, and create as many as 100 internships over two years. Similarly, in North Carolina, Nash Community College in the city of Rocky Mount recently launched a 96-hour certification course geared to students without a traditional four-year degree who are seeking a career in chip manufacturing.

Wolfspeed CEO Gregg Lowe said that the presence of North Carolina A&T State University in Greensboro also "gave a little bit of a tipping edge" to the state over New York when deciding to build its new facility in Chatham County. Wolfspeed is in the midst of a five-year commitment it made in 2020 to donate $4 million to the historically Black university for the creation of the Wolfspeed Endowed Scholars Program, and now the company and the university are collaborating on the development of undergraduate and graduate training and credential programs, as well as professional development programs for workers already working in semiconductor manufacturing.



## IS THE CHIPS ACT WORTH THE PRICE?

Semiconductor chip fabs are sprouting all over the country. Large firms such as Intel, GlobalFoundries, TSMC, and Samsung Foundry are planning to spend over $70 billion by 2025 building new chip fabs in Arizona, Texas, New York, and elsewhere, and private investments over the next decade may reach as high as $200 billion. Clearly, a lot is also happening in the Fifth District when it comes to the semiconductor ecosystem in terms of firm activity and workforce development. All this raises an important question: If the market seems to believe that a domestic semiconductor industry is worth building, what is the need for the CHIPS Act?

But for proponents of the law, even though the CHIPS Act's primary goal is the rebuilding of a domestic industry, the process of getting to that goal includes other objectives that are geared to regional economic development. To be sure, areas of North Carolina and Virginia have experienced tremendous growth, both in their semiconductor industries and in other sectors of their economies. But plenty of areas have not — and supporters contend that the programs will bring opportunity to those communities.

"We had a recession in North Carolina before the Great Recession, where we lost tens of thousands of jobs in textiles, furniture, and tobacco," says Tom White of North Carolina State University. "If you can encourage capital investment and job creation in more rural and micropolitan markets, I think it would help those markets recover. We've got capacity, and we thankfully are indeed starting to see that capital investment and job generation."

John Hardin is the executive director of the North Carolina Department of Commerce's Office of Science, Technology, and Innovation, which provides support to the communities across the state considering applying for Tech Hubs designation. He echoes this sentiment. "There are a lot of communities out there that have a lot of pieces in place, but it takes a lot of time and a lot of money to reorient their economies," he notes when describing the purpose of the Tech Hubs component of the CHIPS Act. "It's helping communities that are on the cusp actually achieve their potential."

Determining whether these investments bring about the types of change that drive them can be tricky, however. In particular, identifying what really happened is not straightforward, according to Richmond Fed senior economist Santiago Pinto. Pinto offers the example of a community receiving significant investment in one year that results in some measurable change, perhaps an overall reduction in the amount of people living in poverty. That reduction, he suggests, could come from an actual increase in wages for those living there, or it could be that those investments attracted new, better paid workers who drove out the existing poorer population. To accurately determine what is happening in these communities that receive CHIPS funding, "we need to have good policy evaluation and a clear understanding of what the policy should accomplish," he says.

The programs in the CHIPS Act that provide subsidies to firms for the construction of new production facilities have requirements that the firms make investments in the people and communities where they are located. To be competitive, applying firms must, among other things, explain how they plan to hire, train, or retain workers; provide transportation and housing assistance as well as child care for facility workers and builders; and consult and coordinate with a range of partners when it comes to establishing pay and benefit structures.

These provisions are problematic, according to opponents of the policy. Scott Lincicome of the libertarian CATO Institute, for example, has argued that such regulations are counterproductive and "impose additional costs on subsidy recipients, potentially diverting finite resources — money, time, labor, etc. — away from producing more chips onshore and toward these other requirements." Goldman Sachs has suggested that the CHIPS Act will only boost U.S. global market share by less than 1 percent because it "costs 44% more to build and run a new fab in the U.S. than in Taiwan."

Lincicome has argued that, in general, industrial policies in the United States have rarely achieved their stated goals — even when motivated by national security concerns — because of the increased costs associated with domestic production. "Just doing something does not necessarily mean that you're going to be in a stronger position than if you had a little more faith in markets and did what we would call horizontal policies," he contended in an American Enterprise Institute podcast. "In other words, improving the tax environment, immigration, basic research, etc., instead of cherry-picking specific industries because of these perceived threats."

For proponents of the law, semiconductors are a valuable enough cherry to justify billions in federal aid and a higher level of federal involvement. What is clear is that the CHIPS Act is as ambitious as it is controversial, both in terms of its desired end of a strong domestically based semiconductor industry and the broad economic development it is meant to create along the way. **EF**

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