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‘Mind-boggling’ machines are headed for Micron’s Clay fabs, and so are the world’s top chip suppliers

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- Christopher Borst, an associate vice president at the nonprofit that runs the Albany NanoTech Complex, looks at an extreme ultraviolet lithography machine, which is made by just one company in the world, ASML, of the Netherlands. Micron Technology plans to use similar machines at its chip-making complex in Clay. Yellow filters on the lights of the cleanroom keep protect the silicon wafers from exposure. Glenn Coin | gcoin@syracuse.com Glenn Coin | gcoin@syracuse.com

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Syracuse, N.Y. – When [Micron Technology](#)’s massive semiconductor plant opens in Clay a few years from now, it will be anchored by some of the most advanced and complex technology ever invented.

The centerpiece of the plant would be tractor-trailer-sized machines called EUVs, which cost in the neighborhood of \$200 million to \$500 million each. The machines lay the critical foundation for the 1,200 steps a silicon wafer goes through to become a computer chip, or semiconductor.

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The sole maker of this highest-tech tool in the highest-tech industry is a Netherlands-based firm called ASML. The company has cornered the market on EUVs, which create the microscopic patterns that produce faster, more information-laden chips at a lower cost than any other similar machine on the planet.

Those machines are so complex that ASML would follow them to Clay, too, to keep them running 24 hours a day. That may mean ASML would deploy dozens of high-paid engineers and warehouse workers to a site near Micron's Clay fabrication plants, or fabs.

ASML would be just the tip of a technology and supply chain iceberg that would crystallize around the four fabs Micron plans to build over the next 20 years. Dozens of the world's best-known semiconductor companies are expected to converge in Micron's back yard, all to support the astonishingly precise production process that transforms sand into the electronic underpinnings of modern life.

“I think Micron will demand it from their suppliers,” said Kevin Younis, a Syracuse native who helped land Micron as executive deputy commissioner of the state’s economic development agency. “I think that’ll be part of when they say, ‘Hey, you want to bid this contract? We need to know you’re not driving (parts) in from Texas, you’re not flying them in from Asia. You’re down the street.’”

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That would be the beginning of the 40,000 spinoff jobs Micron says will be created when the four fabs are completed 20 years from now. About 6,000 of those jobs would be at companies directly serving the Micron plant in Central New York, according to the economic impact report commissioned last year by New York state. Micron says it will eventually have 9,000 of its own employees in the fabs.

Micron’s massive complex would house some of the most leading-edge technology ever invented. Consider how astounding EUV technology is: Light waves need to be shortened to create lines one-tenth the width of a virus. To do that, an EUV shoots light beams at drops of molten tin falling through a vacuum chamber 50,000 times a second. That light is projected through a “mask” — essentially a stencil — onto silicon wafers to lay the pattern for billions of transistors on a chip the size of your pinkie fingernail.

“It’s mind-boggling. It really is,” said Dave Anderson, a 30-year veteran of the semiconductor industry who is president of the nonprofit that oversees the Albany NanoTech Complex, the only publicly owned research-and-development facility in North America that has the latest EUV model. “It’s probably the most complex piece of machinery ever built by mankind.”

An EUV machine — short for “extreme ultraviolet lithography” — has about 100,000 parts. It takes months to install one in a fab, and even requires a specially made crane to set it gently into a cleanroom. After installation, the machines require round-the-clock monitoring. That means ASML is likely to open up shop in Central New York, as it has done in Micron’s U.S. fabs in Idaho and Virginia.

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“We’re there all the time,” said Clayton Patch, ASML’s head of U.S. field operations. “We’ll have warehouses that we set up, we’ll have parts logistics that are coming and going nonstop into the region.”

Patch declined to say how many employees ASML would bring to Central New York. He said there are about 100 employees now in New York, including some at Albany Nanotech and GlobalFoundries, a chip maker in Malta, near Saratoga Springs.



A worker walks through the Albany NanoTech Complex clean room. In the background is an extreme ultraviolet lithography (EUV) machine made by ASML, a Dutch company that is the sole manufacturer of EUVs. Micron Technology plans to use EUVs in its semiconductor fabrication plants in Clay.

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One of many companies needed

Borst said that while ASML's technology is essential, their machines are far from the only ones needed to make chips.

“ASML is great because they make the most expensive and most critical piece of equipment in the factory,” said Christopher Borst, an associate vice president at the nonprofit that runs Albany NanoTech who oversees the chip-making research plant there. “But if I said that our factory here has 200 individual unique systems that all perform different functions, six of those are from ASML.”

The rest of those machines perform some of the 1,200 steps that transform a blank disk of silicon into the chips that let you text your kids or operate your car. The machines – they’re called “tools” in the industry – apply chemicals, and wash and etch and polish the wafers.

Machines are the essential guts of a chip fab. Humans don’t produce chips; humans make and monitor the machines that produce chips. No person ever touches a wafer or the tiny chips that are ultimately cut from them like pieces of a jigsaw puzzle. The silicon wafers — about the size, thickness and color of a vinyl album — are tucked inside containers or machines to prevent even a speck of dust from landing on their surface.

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“A very small piece of dust is a boulder on a semiconductor wafer surface,” said Joe Stockunas, who succeeded Anderson as president of the trade group SEMI Americas.

All of those machines need to be maintained. Fittings and joints for the thousands of miles of tubing need adjusting or replacing. Chemicals that wash and coat the chips need to be restocked; vacuum pumps need servicing. Filters need changing on the high-purity air-handling systems that make fab cleanrooms orders of magnitude cleaner than an operating room. The wafers, less than a millimeter thick, need to be delivered and stored; at full capacity, Micron said it could process 200,000 wafers a month in Clay.

That's where support industries like ASML come in.

"I think you're going to see 30 to 40 companies that will make investments in the locale," Stockunas said.

Other marquee names in the semiconductor industry are likely to open in Clay. They, like ASML, also have locations near Micron's existing fabs. Among them are Japan-based Tokyo Electron, which makes machines that etch the patterns created by EUVs; and Lam Research Corp., based in California, whose machines remove residue from wafers and apply thin films of protective metals. Tokyo Electron had sales of \$14 billion last year; Lam's were \$17 billion.

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Neither company responded to requests for information from syracuse.com.

Bob Petrovich, executive director of the Onondaga County Industrial Development Agency, said firms like ASML, Tokyo Electron and Lam Research are known as “Tier 1” supply chain companies.

“They’re companies that manufacture the tools that Micron uses to manufacture chips,” Petrovich said. “By the nature of what they do, (they’ll make) a more substantial investment and have greater numbers of people near Micron in support of what they manufacture or what Micron uses.”

Petrovich said those companies could each have several hundred employees near Micron.

OCIDA has bought more than 100 acres for suppliers across Route 31 from the White Pine Commerce Park, where Micron plans to build the four fabs. Each fab would be as tall as the JMA Wireless Dome and have a footprint seven times bigger.

Not all of the suppliers would locate in Central New York. Edwards Vacuum, a major supplier of pumps to the semiconductor industry, announced in November it would build a manufacturing plant in Genesee County that will employ 600 people. That site allows the company to serve Micron’s fabs in Clay and Intel’s planned fabs in Ohio, Anderson said.

Micron said construction on the first Clay fab will begin in late 2024, and it would open in 2026. Construction will continue for 20 years until the fourth and final fab is done, Micron said.



- Extreme ultraviolet lithography machines, similar to what Micron Technology plans to use at its chip-making plant in Clay, can cost up to \$500 million and are made by only one company, ASML, based in the Netherlands. Special to Syracuse.com Special to Syracuse.com

Dutch company is ‘heartbeat’ of the industry

Micron and ASML have similarly intriguing origin stories. Micron was founded in an Idaho dentist’s basement in the late 1970s and was saved from near-collapse by a billionaire potato farmer. ASML was launched in a leaky shed in 1984 in the Netherlands city of Eindhoven, and the company was rescued from a near financial collapse by electronics giant and fellow Dutch firm Philips.

ASML, also like Micron, grew over the decades by gobbling up competitors and incessantly innovating. ASML developed the first EUV process in the early 2000s.

Since then, ASML revenues and stock have soared. Revenues last year were about 10 times higher than in 2002. If you had bought a share of ASML stock 10 years ago for \$50, you could sell it today for about \$600 – a return on your investment of more than 1,000%.

This year, ASML expects to ship 60 EUVs — a little more than one a week. The company also plans to ship 375 of its less expensive deep ultraviolet machines, or DUVs, the workhorses of the world's \$500 billion semiconductor industry. The lead time for an EUV is about 18 months, Patch said. Only the biggest semiconductor manufacturers in the world — Micron, Samsung, S.K. Hynix, Intel and Taiwan Semiconductor Manufacturing Corp. — use EUVs.

And they all bought them from ASML.

“We’re kind of the heartbeat of the semiconductor industry,” Patch said.

The sticker price for an EUV starts at \$200 million, and the final bill could be more than double that depending on the size and features. And that’s not the whole cost of an EUV, said Scott Gatzemeier, Micron’s corporate vice president in charge of U.S. expansion plans.

“You buy the scanner from ASML, but then you need a photo track, you need inspection tools, you need support equipment, you have to install the tool,” Gatzemeier said. “There’s a lot of other costs that go into it besides just the sticker price that we negotiate with ASML.”

Manufacturers like Micron are willing to shell out that kind of money because EUVs can pack more transistors onto a single chip and cut the number of steps needed in chip-making. To compete against other industry giants, Micron needs to make the leading-edge chips only made possible with EUVs.

Memory chips like the ones Micron makes are commodities, interchangeable goods produced by multiple suppliers. Just like you can buy the same gasoline at Citgo if Mobil raises its price, chip buyers can switch to Samsung if they get a better deal.

EUVs at the Albany NanoTech Complex

Albany NanoTech received one of ASML's first EUVs, in the mid-2000s. The facility has had two other EUVs over the past two decades, and now has the latest version, which was delivered in 2019. That's the only one still in use there. Several companies, including IBM and Tokyo Electron, use the machine to research newer and faster ways to make chips.

Micron says it will spend \$100 billion over the next 20 years to build and outfit four fabs in Clay. Of that, an estimated \$70 billion of that would be for machines.

Gatzemeier said Micron uses EUV at its research and development center Boise, and has two of the machines at its main fabs in Taiwan. The EUVs in Clay would be the next generation machines, capable of producing ever smaller and ever faster chips.

Micron is building the fabs in Clay because the federal government is handing out billions of dollars to semiconductor manufacturers to make chips in the U.S. Most of the world's chips are made overseas, especially in Taiwan. Congress, rattled by chip supply chain shortages during the Covid-19 pandemic shutdowns and by China's antagonism toward Taiwan, passed the CHIPS and Science Act to bring chip manufacturing back to America. There's \$39 billion to subsidize the construction of fabs in the U.S.

Micron has applied for CHIPS Act money, although it doesn't say how much.

Money is also available for suppliers that would keep those new fabs operating. Nobody wants to see a repeat of the pandemic supply chain disruptions, Younis said.

"Micron, I think uniquely, is pushing their suppliers to be proximate so that they don't have real supply chain hiccups again," he said.



- A worker at the Albany NanoTech Complex monitors a semiconductor-making machine known as extreme ultraviolet (EUV), lithography, considered the most advanced manufacturing machine ever created. Micron Technology plans to use EUVs in its fabrication plants, or fabs, in Clay. Albany NanoTech Complex | Special to syracuse.com Albany NanoTech Complex | Specia

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