

Insight: As chip plants get pricey, U.S. risks losing edge

Noel Randewich, Reuters

(Reuters) - It goes by the anodyne moniker Fab 42, but the new Intel Corp factory being built in the Arizona desert is hardly a run-of-the-mill production facility.

At \$5 billion, it will be the most advanced chip factory ever constructed, producing microchips with transistors so tiny that over 100 million of them could fit on the head of a pin.

And it represents a giant bet by the world's largest semiconductor company that the United States can still be a good place to build things. If manufacturing is critical to jobs and long-term economic health, as many government and industry officials believe, then Fab 42 is an encouraging symbol of what could be.

Yet many technology executives worry that Intel's new factory is less a sign of things to come than the last gasp of an advanced manufacturing sector that could readily go the way of its lower-tech predecessors -- to Asia.

Those kinds of concerns have stoked an election-year debate on an old policy question: is there anything the U.S. can or should do to support manufacturing and the benefits that go with it?

"There are a lot of companies that are moving operational resources out of the U.S. and I have a tough time getting my arms around that being a good thing for us long-term," said Mark Adams, president of Micron Inc, the last remaining U.S. memory chip manufacturer and historically a champion of government cooperation with the industry.

The loss of chip plants in the U.S. is not because labor is cheaper abroad -- as in previous waves of manufacturing migration -- but rather due to lower tax rates, complex international supply chains and abundant skilled workers.

U.S. President Barack Obama has made "insourcing" manufacturing jobs a key economic policy goal, and proposed incentives aimed at supporting advanced manufacturing.

His framework for business tax reform, unveiled in February, would cut the top corporate tax on manufacturing to 25 percent, and even lower for advanced manufacturers. He would also make permanent a temporary research and development credit, a change that has been popular among both political parties and could cost \$99 billion over 10 years. His budget also calls for \$2.2 billion to support advanced manufacturing R&D, a 19 percent increase.

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The President's Council of Advisors on Science and Technology, which counts Google Inc Chairman Eric Schmidt among its members, has gone further, calling for the launch of an "Advanced Manufacturing Initiative."

Invoking Sematech, an industry consortium which the U.S. government supported in the 1980s to aid chip industry manufacturing, the council urged the government to "invest to overcome market failures, to ensure that new technologies and design methodologies are developed here."

But Obama's push to involve the government in rebuilding U.S. manufacturing is controversial, with critics saying that most jobs attracted back to the United States would be low-paid and that U.S. companies are better off focusing on design and invention. They point to Apple Inc, arguably one of the world's most innovative companies, and one that does no manufacturing.

Chip industry executives stress that advanced manufacturing is less about jobs created directly, which are relatively few but well-paid, than maintaining the know-how that's critical for long-term success.

Intel's efforts provide ammunition for both sides. The company has kept three-quarters of its manufacturing in the U.S. Yet Intel also says it's cheaper to build overseas, and it could readily move more production offshore if it became more advantageous.

Chip manufacturers with intricate supply chains look at a range of factors when they decide where to add new facilities, but with corporate tax rates as high as 39 percent, the United States is at a disadvantage compared with countries like [Ireland](#) [1], with a 12.5 percent tax rate, and Israel, at 24 percent, according to the Organization for Economic Cooperation and Development.

Taiwan, Singapore, Israel and other countries keen to woo foreign investors have offered a range of tax breaks and R&D tax credits that go beyond the perks available to manufacturers in the United States.

Unlike simpler manufacturing industries like apparel, semiconductor factories employ relatively few people, making labor costs only a minor factor. They do need access to highly skilled local labor, but that's becoming increasingly abundant as emerging economies like [China](#) [2] become more sophisticated.

MEGA-FABS

The cost of building semiconductor "fabs," or fabrication facilities, has been soaring for years, with each new generation of technology requiring more expensive and sophisticated production processes.

That trend long ago prompted many U.S. chip companies to focus on design, and rely on contract manufacturers to build the products. That became more attractive as Asian companies like Taiwan's TSMC invested heavily in huge new factories, often with government support.

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U.S. companies accounted for half of the global chip industry's sales of about \$300 billion last year, with U.S. plants producing some of the world's most advanced and valuable semiconductors. But just 16 percent of the world's chip manufacturing capacity is located in the United States, steady for the past three years but down from 23 percent a decade ago, according to SEMI, an industry association.

U.S. semiconductor exports, inevitably, reflect the trend, dropping by \$3 billion last year to \$44 billion, according to U.S. trade data. That's down more than a quarter from a 2001 peak of \$60 billion.

Most semiconductor R&D still takes place in the United States, but it's also declining in proportion to Europe, Israel, Singapore and other countries, according to a study commissioned by the Semiconductor Industry Association. Unsurprisingly, the U.S. R&D decline is sharpest in the area specific to manufacturing chips.

The challenge of competing in chip manufacturing is growing even more daunting as the industry approaches a major hurdle that is so formidable -- but offers a huge advantage -- that rivals have begun working together.

Today, most fabs etch integrated circuits row after row onto silicon wafers measuring 300 millimeters across, which are then diced into individual chips. But the bigger the wafer, the cheaper each individual chip, so every few years, as technology improves, the industry moves to larger wafers.

Upgrading to the new 450 mm wafer size -- bigger than a large pizza -- is harder than it sounds. Only a handful of players with deep pockets will be able to play, experts say.

"There are something like 35 companies out there today that have 300 mm processing capability. There aren't that many companies that will be able to jump to 450 mm fabs. We think that number's probably five, maybe six," said Mark Thirsk, a manufacturing expert at Linx Consulting.

PERSONAL CONTACT

One of those companies will certainly be Intel. The company is sharply increasing its capital spending this year to \$12.5 billion from about \$10.8 billion in 2011.

With fabs in Arizona, Oregon, New Mexico and Massachusetts, Intel makes about three quarters of its chips in the United States -- and there are good reasons for it to keep favoring those locations.

Adding a new fab onto an existing site is much cheaper than starting from scratch at a new location, and speeds up completion by as much as a year. Fab 42, which will be upgradable to accommodate larger wafer sizes, is adjacent to a facility opened in 2007.

Intel's top manufacturing experts, responsible for keeping its technology years

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ahead of rivals, are mostly at U.S. facilities, including a research center in Hillsboro, Oregon. As new manufacturing technologies are launched, Intel circulates engineers from its production fabs through Hillsboro to train and interact with experts there.

That personal contact, where experience is shared between researchers and the engineers who run Intel's fabs day-to-day, is invaluable to the innovative process, executives say.

But Intel's loyalty to the United States is not absolute. It has fabs in Ireland, Israel and even one in Dalian, China, launched in 2010. Intel may invest billions of dollars to expand or upgrade those sites in the future instead of in the United States if the benefits add up.

"You look at the whole world. In Ireland, we've done some investment to prepare that for next-generation technology when the demand is such that I need to add it. They essentially would be a site that might get the next generation technology. Similarly, Israel," said Josh Walden, Intel's general manager in charge of building and operating its fabs.

Intel has said it can cost \$1 billion less to build a fab abroad thanks to tax incentives and other perks. Walden weighs those cost advantages against the benefit of building fabs close to the chipmaker's R&D staff and extensive U.S. infrastructure.

Intel and other chipmakers want a lower corporate tax rate in the United States and a quicker process for approving the building of new facilities.

Tech companies also want U.S. colleges to turn out more engineers to help fill hiring gaps, and to allow more foreigners graduating from U.S. universities to stay and work.

Just 4 percent of U.S. undergraduate degrees awarded in 2008 were for engineering, compared to 19 percent in Asia, according to a recent report from the National Science Board.

HISTORY OF SUPPORT

Washington's current climate of spending cuts may not be ideal for discussing more support for industries showing no signs of imminent crisis. But the federal government in the past has pitched in to help the chip industry stay sharp.

In the 1980s, when stiff competition from [Japan](#) [3] had the U.S. memory chip industry against the ropes, the U.S. government spent \$500 million to help Sematech improve equipment used across the industry, seen as key to national security and competitiveness.

Now, California Congressman Mike Honda, whose constituency includes Silicon Valley, wants the Obama administration to put up money to make sure the 450 mm transition stays firmly rooted in the United States.

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"The government has always had a major role in everything from Kennedy saying we're going to go to the moon to the development of the Internet," Honda said.

"If we don't get in line and get in sync and be agile in this, we're going to be left behind globally," Honda said.

Some government entities are already stepping up. New York State Governor Mario Cuomo has championed a plan to spend \$400 million on an engineering college in Albany as part of a wider deal for a consortium of Intel, TSMC, Samsung, IBM and GlobalFoundries to invest \$4.4 billion there over five years, some of which will go toward the 450 mm leap.

They will cooperate to set new standards, build and test prototypes, and help equipment makers redesign tools.

"We're trying to do it all together, fund it all together, share all the data and then say at any point you as a company can take that information, step away and take it home and start your own development," Intel's Chief Operating Officer Brian Krzanich told Reuters.

Keen to attract more chip manufacturing to Europe, Belgian research institute IMEC and others are pushing for a government-funded coalition there to help tackle the move to 450 mm wafers.

Rather than attracting jobs, executives say the best reason to make sure cutting-edge chip fabs keep getting built in the United States is because the very act of manufacturing leads to invention and new ideas that reverberate beyond the industry.

"There are a lot of folks who take the view that everything will be fine for the U.S. as long as we keep innovation and high-level design functions here and we ship all the manufacturing overseas. I disagree with that," said Ted Tewksbury, CEO of Integrated Device Technology, which has one of its facilities in Malaysia because of generous tax breaks.

"If you're totally removed from the way things are made, it is going to have an impact on your ability to innovate. That's a very dangerous direction this country is going in."

(Editing by Jonathan Weber, [Edwin Chan](#) [4] and Phil Berlowitz)

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