

Semiconductor Industry Speaker Series Webinar

U.S.-China Trade War: The Tariff Effects on the Global OSAT Market

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Founder, President & CEO**

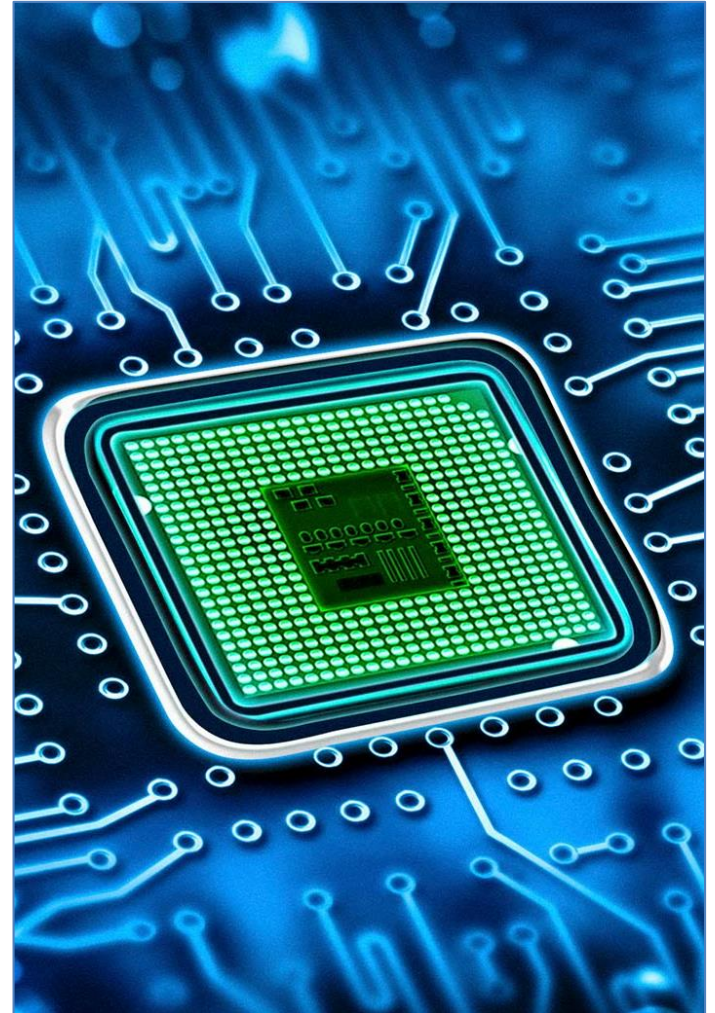


July 1, 2020

Knowledge. Relationships. Results.

Today's Agenda

- Meet ATREG
- Global Fabs Deals: Few & Far Between ...
- Spotlight: China Semiconductor Market
- Global OSAT Market Overview
- U.S.-China Trade War Timeline Recap
- U.S.-China Tariff Impacts
- Key Takeaways
- Q&A



Meet ATREG

- A global focus
- Specializing exclusively in the acquisitions and dispositions of front-end and back-end wafer fabs
- 100+ wafer manufacturing fab transactions over 20+ years
- Long-standing relationships with key industry executives
- We drive increased demand, creating pricing tension among buyers, and deliver the fastest, most optimal outcome (one year on market on vs. up to 4.5)
- By completing disposition engagements in a more rapid timeframe, ATREG saves its clients millions of dollars in associated carrying costs



ATREG Representative Transactions Over Last 10 Years

<p>September 2019</p>  <p>200mm SIC Greenfield fab and incentive package</p>  <p>Utica, USA</p>	<p>April 2019</p>  <p>Acquisition of operational 300mm fab from</p>  <p>Fishkill, USA</p>	<p>February 2019</p>  <p>Disposition of operational 200/150mm fab to</p>  <p>Greenock, UK</p>	<p>January 2019</p>  <p>Acquisition of operational 200mm fab from</p>  <p>Singapore</p>	<p>December 2018</p>  <p>Disposition of 200 and 300mm tool line to</p>  <p>SGP, TWN, DEU, USA</p>	<p>August 2017</p>  <p>Disposition of operational backend facility to</p>  <p>Akita, Japan</p>	<p>March 2017</p>  <p>Disposition of operational 200mm fab to</p>  <p>Bloomington, USA</p>	<p>October 2016</p>  <p>Disposition of display manufacturing facility to</p>  <p>San Jose, USA</p>
<p>February 2016</p>  <p>Disposition of operational 200mm fab to</p>  <p>Shiga, Japan</p>	<p>December 2015</p>  <p>maxim integrated.</p> <p>Disposition of 200mm fab to</p>  <p>San Jose, USA</p>	<p>April 2015</p>  <p>Disposition of display facility to</p>  <p>Longtan, Taiwan</p>	<p>December 2014</p>  <p>Disposition of cleanroom facility to</p>  <p>Phoenix, USA</p>	<p>October 2014</p>  <p>Disposition of 200mm tool line to</p>  <p>Kofu, Japan</p>	<p>July 2014</p>  <p>Disposition of operational 200mmfab to</p>  <p>Aizu, Japan</p>	<p>March 2014</p>  <p>Disposition of operational 300mm fab to</p>  <p>Yamagata, Japan</p>	<p>December 2013</p>  <p>Licensing of intellectual property to</p>  <p>Roseville, USA</p>
<p>June 2013</p>  <p>Disposition of 300mm tools to</p>  <p>Hsinchu, Taiwan</p>	<p>May 2013</p>  <p>Disposition of operational 200mm fab to</p>  <p>Avezanno, Italy</p>	<p>February 2013</p>  <p>maxim integrated.</p> <p>Disposition of 200mm facility to</p>  <p>Irving, USA</p>	<p>July 2012</p>  <p>Disposition of assembly and test facility to</p>  <p>Cavite, Philippines</p>	<p>January 2012</p>  <p>Disposition of operational 200mm fab to</p>  <p>Hillsboro, USA</p>	<p>August 2011</p>  <p>Disposition of 150mm Facility to</p>  <p>East Kilbride, Scotland</p>	<p>May 2011</p>  <p>Disposition of 300mm fab and tools to</p>  <p>Dresden, Germany</p>	<p>May 2011</p>  <p>Disposition of operational 200mm fab to</p>  <p>Roseville, USA</p>
<p>January 2011</p>  <p>Disposition of production tools to</p>  <p>Cincinnati, USA</p>	<p>October 2010</p>  <p>Disposition of 200mm facility</p>  <p>Dunfermline, UK</p>	<p>June 2010</p>  <p>Disposition of operational 200mm fab to</p>  <p>Rousset, France</p>	<p>March 2010</p>  <p>Disposition of 200mm and 300mm facilities to</p>  <p>Richmond, USA</p>	<p>January 2010</p>  <p>Disposition of 200mm facility to</p>  <p>Bobligen, Germany</p>	<p>September 2009</p>  <p>Disposition of 300mm tool line to</p>  <p>Richmond, USA</p>	<p>May 2009</p>  <p>Disposition of 150mm fab and business unit to</p>  <p>Caen, France</p>	<p>April 2009</p>  <p>Disposition of business unit to</p> <p>Confidential Chinese Entity</p> <p>Fenghua, China</p>

Notable Current ATREG Offerings

ON Semiconductor Belgium Fab – 150mm Acquisition Opportunity



- ATREG is working with ON Semiconductor who is considering strategic alternatives for their well-regarded 150 mm fab in Belgium
- Includes fully integrated line of 150mm, 200mm-convertible manufacturing tools capable of manufacturing 4,400 wafers per week down to 350nm
- Stable and cost-effective manufacturing region with a strong semiconductor ecosystem and secure IP environment
- Highly efficient workforce with 30+ years of automotive product experience



Allegro Thailand Back-end Cleanroom Opportunity



- Allegro MicroSystems has engaged ATREG to assist in the sale of its state-of-the-art back-end cleanroom facility in Saraburi, Thailand
- Facility includes 30,000 ft² of built cleanroom, with the ability to expand cleanroom by an additional 70,000 ft²
- Facility contains nearly 16,000 ft² of existing office space with 50,000 ft² of available expansion area within the building
- Built on a nearly 20-acre site that includes 7.5 acres of land that could be used for future expansion



Notable Current ATREG Offerings *(cont'd)*

New York State – 300mm / 200mm Investment / Expansion Opportunity



- ATREG is assisting New York State in promoting a semiconductor greenfield investment opportunity in New York's silicon carbide and power electronics corridor
- The 428-acre Marcy Nanocenter site is considered one of the world's top tech centers for semiconductor manufacturing
- Globally competitive financial incentives are available to companies wishing to establish new manufacturing facilities at the site:
 - Cash grant (for fab design, construction, and tooling)
 - Tax incentives
 - Utility discounts




300mm Fab Shell (Former Qimonda) – Lease Opportunity



- ATREG is representing the owner of an advanced 300mm manufacturing fab shell in Virginia, USA, who would consider leasing all or a portion of their facility to a company or companies interested in resuming 300mm operations
- The entire 100,000-sq. ft. cleanroom (ballroom configuration) is available for lease, or alternatively, the facility could be leased in independently operated 25,000-sq. ft. increments



Most Recent ATREG Transactions

CLIENT	TYPE	LOCATION	DESCRIPTION
 CREE	200mm SiC greenfield fab investment	Utica, USA	Advised Mohawk Valley Edge in the marketing of their greenfield Marcy Nanocenter site in NY offering \$500M in incentives from NY State. Definitive agreement signed with Cree Wolfspeed in Sept. 2019
 ON ON Semiconductor	300mm operational fab acquisition	East Fishkill, USA	Accelerates transition from 200mm to 300mm. Fab acquired from GF for \$430 million (over 3 years). Supply agreement till end 2022
 TEXAS INSTRUMENTS	200mm operational fab disposition	Greenock, UK	Advised TI in the sale of its operational 200mm Scottish fab to Diodes. Definitive agreement signed in Feb. 2019
 VIS	200mm operational fab disposition	Tampines, Singapore	Advised VIS in the purchase of GF's operational 200mm Fab 3E in SG for \$236 million. Definitive agreement signed in Jan. 2019
 GLOBAL FOUNDRIES	Tool sale	Singapore, Taiwan, Germany, USA	Advised GF in their worldwide tool sale to companies including TI, Micron, and UMC
 Micron	Operational back-end facility disposition	Akita, Japan	Advised Micron in the sale of its Akita facility to PTI. Definitive agreement signed in Jan. 2017 and transaction closed in Aug. 2017
 CYPRESS EMBEDDED IN TOMORROW	200mm operational fab disposition	Bloomington, USA	Advised Cypress in the sale of its Minn. fab to SkyWater. Definitive agreement signed in Nov. 2016 and transaction closed in March 2017
 QUALCOMM	150mm cleanroom facility disposition	San Jose, USA	Advised Qualcomm MEMS Technologies in its display fab sale. Definitive agreement signed in July 2016 and transaction closed in Oct. 2016
 RENESAS	200mm operational fab disposition	Shiga, Japan	Advised Renesas on the sale of its Shiga fab to ROHM. Definitive agreement signed in April 2015 and transaction closed in Feb. 2016
 maxim integrated.	200mm fab disposition	San Jose, USA	Advised Maxim on the sale of its 200mm San Jose fab to Apple. Definitive agreement signed and transaction closed in Dec. 2015
 QUALCOMM	Cleanroom facility disposition	Longtan, Taiwan	Advised Qualcomm MEMS Technologies on this sale to TSMC for advanced packaging production. Transaction closed in April 2015

What Underlies The U.S.-China Trade War?

The Coming Chip Wars

Posted on June 18, 2020 by Steve Blank

“Controlling advanced chip manufacturing in the 21st century may well prove to be like controlling the oil supply in the 20th. The country that controls this manufacturing can throttle the military and economic power of others.”

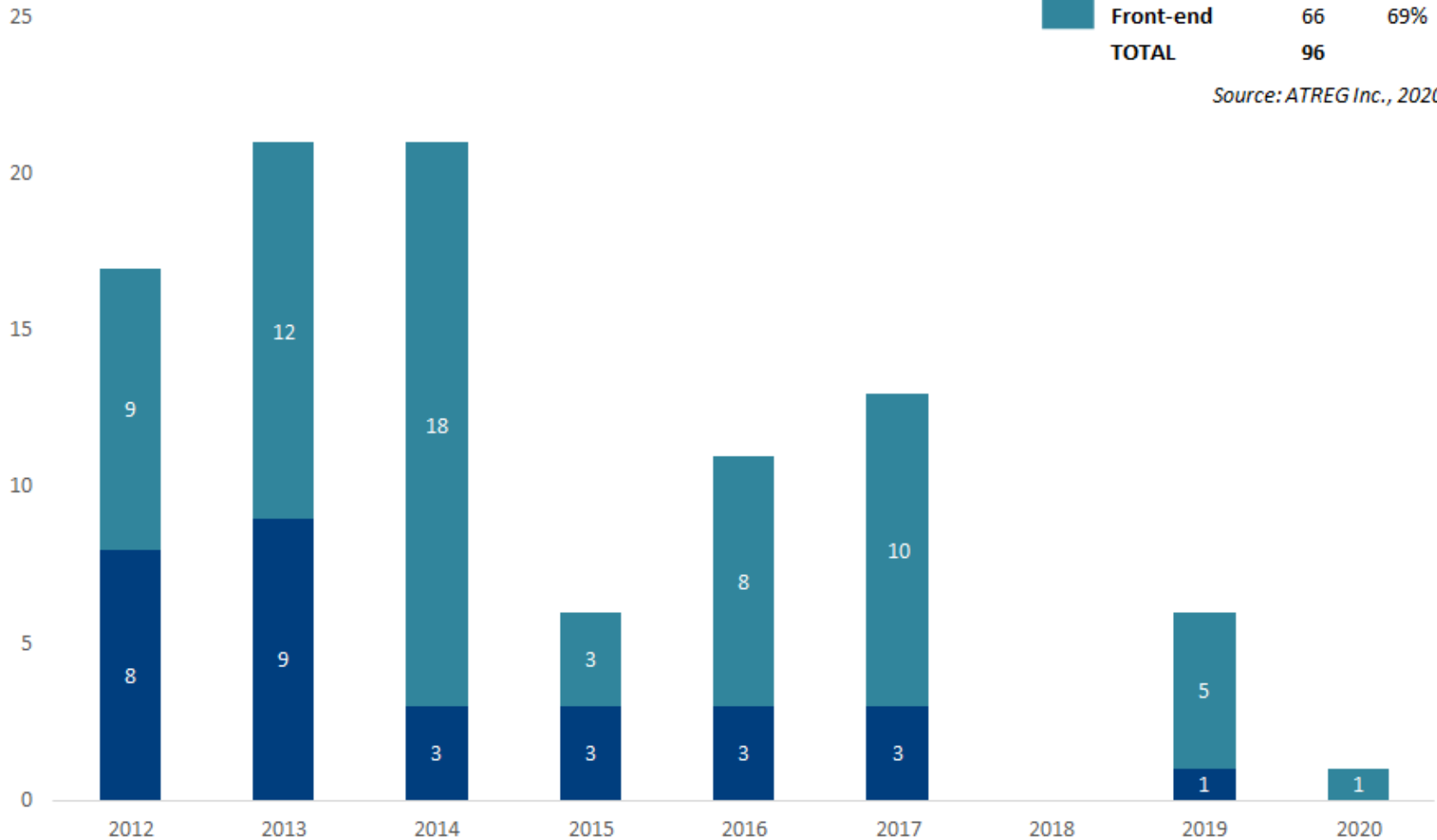
China looks to control Taiwan.

“Short of war, there would be no obvious way to get those foundries back. Without them, the U.S. defense and consumer electronics industries will be set back at least five years — and because China has its own advanced chip foundries, it could become the world leader in technology for the next decade or more...”

The World just got a lot more dangerous!

Global Fab Deals: Few And Far Between ...

BY FACILITY TYPE



WAFER SIZE	#	%
Back-end	30	31%
Front-end	66	69%
TOTAL	96	

Source: ATREG Inc., 2020

Global Fab Deals: SE Asia Dominates

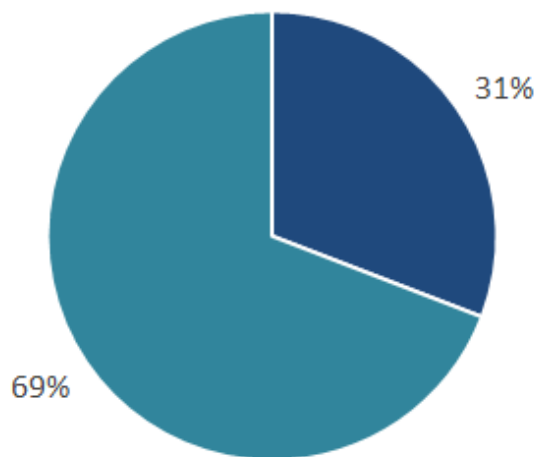
WAFER SIZE	#	%
Back-end	30	31%
Front-end	66	69%
TOTAL	96	

Source: ATREG Inc., 2020

REGION	#	%
Asia-Pacific	10	31%
China	7	24%
Japan	9	31%
North America	1	3%
Taiwan	3	10%
TOTAL	30	

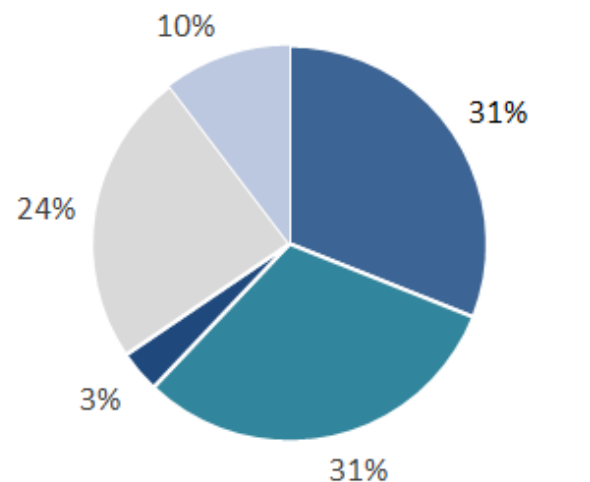
Source: ATREG Inc., 2020

By Facility Type



■ Backend ■ Front End

Back-End Transactions By Region



■ APAC ■ Japan ■ NA ■ China ■ Taiwan

Spotlight: China Semi Market Imported \$310B Last Year

- China's uses 61% of the world's chips in products for domestic and export markets
- IC back-end industry declined in 1H19 due to the U.S.-China trade war / tariffs
- Top 3 Chinese companies - JCET, Tianshui Huatian Technology, and Tongfu - accounted for 16.2% of domestic OSAT revenue
- U.S. restrictions on Chinese telecom companies such as Huawei reduces OSAT order volume; Reemergence of U.S.-China trade tensions will likely drive OSAT production down further
- More than \$21.5 billion accumulated by the National IC Fund has spurred rapid gains throughout the region's IC supply chain



Spotlight: China Semiconductor Market *(cont'd)*

- China struggling to complete fab builds (8/30 incomplete)
- New trend: Advanced technology companies resisting China expansion
- Apple exploring moving 15 to 30% of its hardware production out of China



China Falling Far Short Of “Made In China 2025” IC Goal

- Domestic content percentage forecast to be about one-third of its 70% 2025 target
- IC production in China represented 15.7% of its \$125 billion IC market in 2019, up only slightly from 15.1% in 2014. Forecasts that this share will increase by 5% to 20.7% in 2024

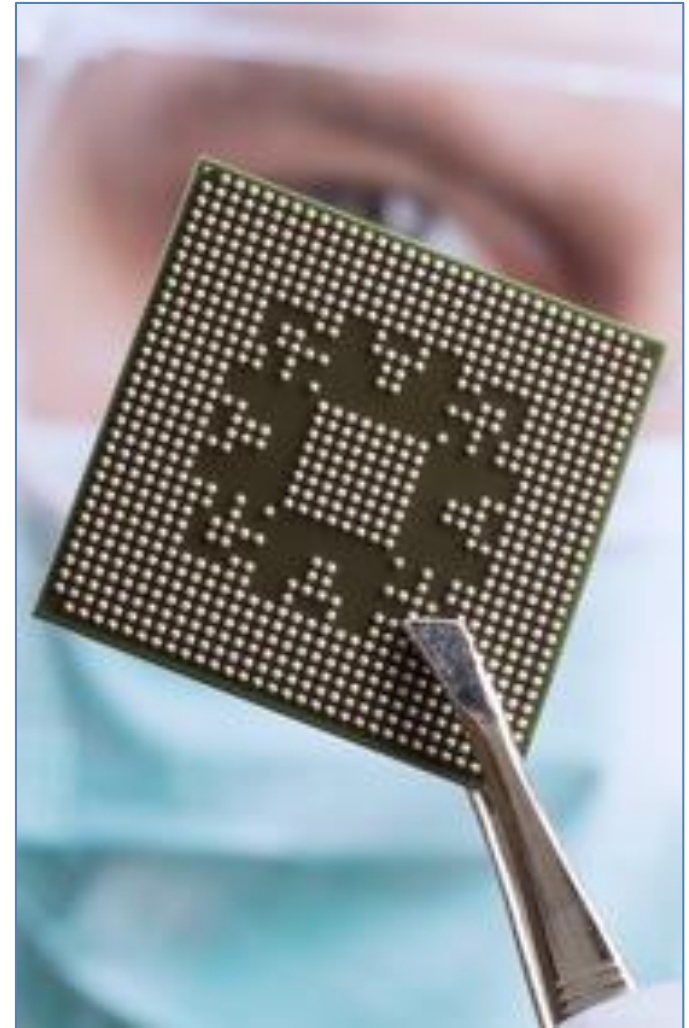
China IC Market vs. China IC Production Trends



Source: IC Insights

Global OSAT Market Overview

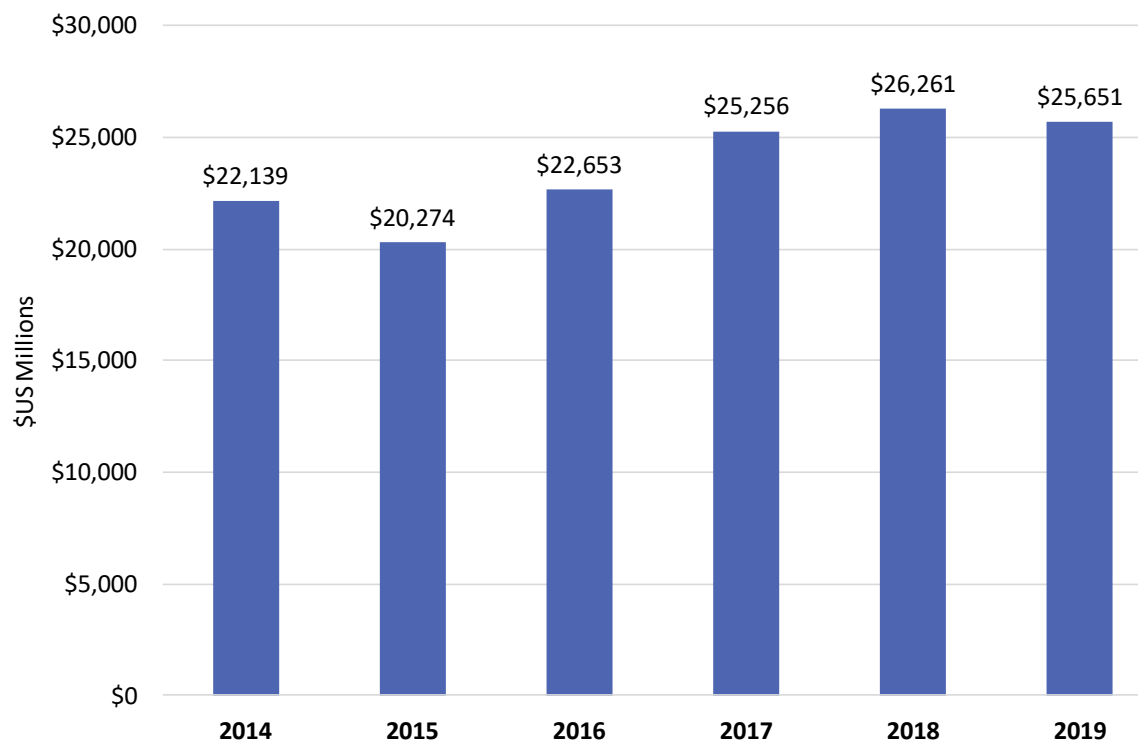
- A \$28.7 billion OSAT market in 2019 with approx. 100 companies
 - 97% + of revenue generated by 40 publicly traded companies
 - Top 20 OSATs account for 90% of market
 - 1Q20, the top 5 OSAT companies = 80.6% market share (ASE, Amkor, JCET, SPIL, and Powertech)
- In 1Q20, the global top 10 OSAT companies experienced an overall revenue increase of 25.3% YoY



Source: Trendforce, 2020

Global OSAT Market Overview *(cont'd)*

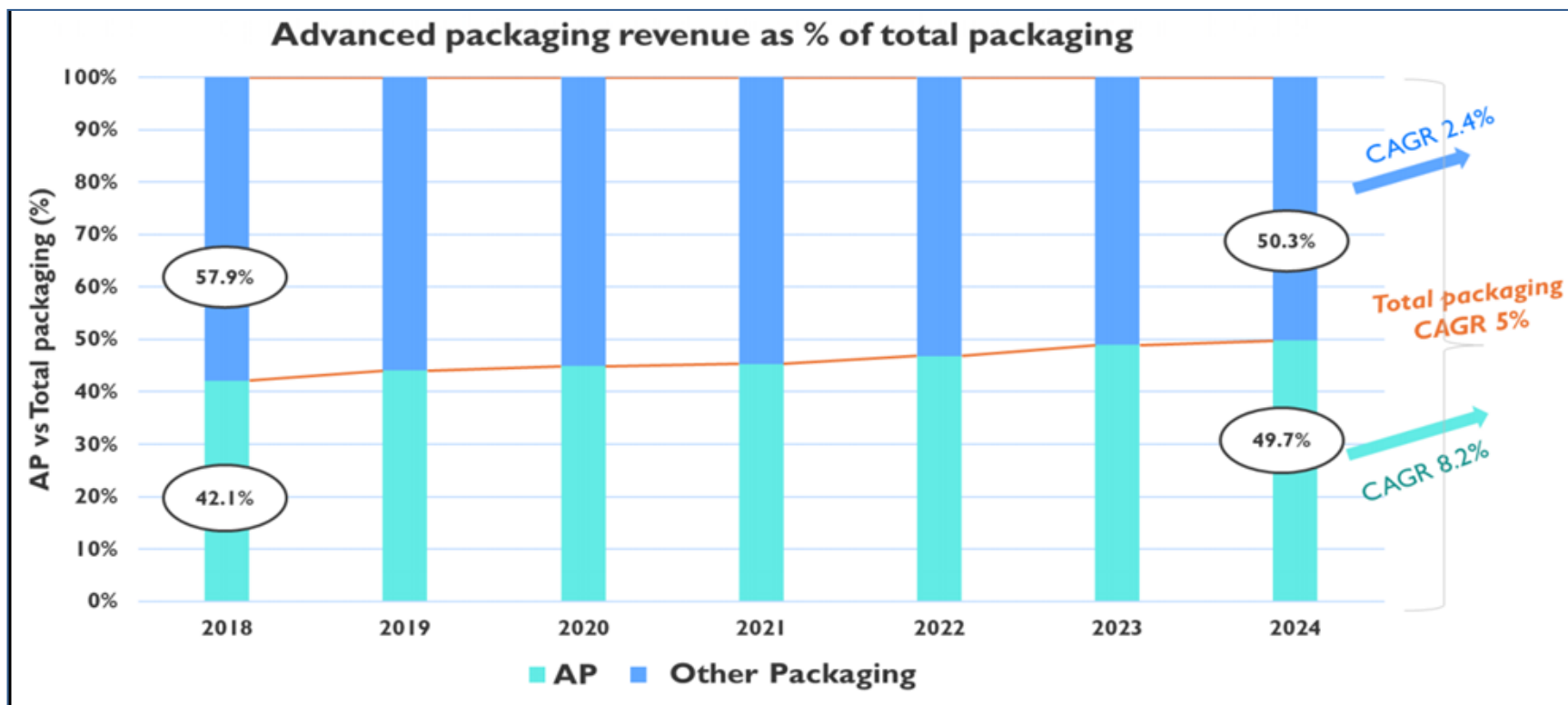
- Negative Fitch Rating
 - COVID -19
 - Production disruption
 - Trade uncertainty
- OSAT revenue for 2020 may decline by 6% in 2020



**Revenue of the Top 20 publicly traded OSATs
based on quarter average fluctuating exchange rates**

Source: 

Global Semi Market Overview – Advanced Packaging

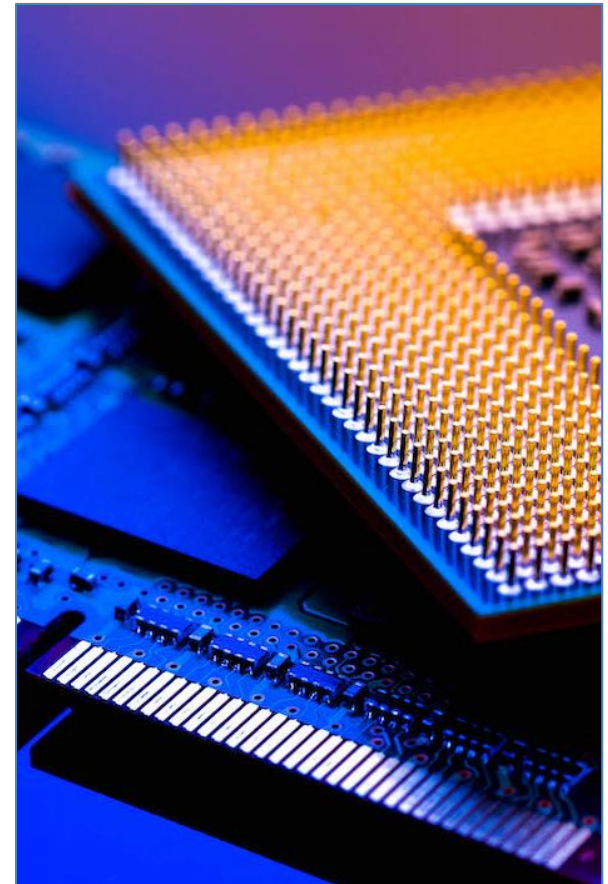


Source: Yole Développement, 2019

- Advanced packaging will account for effectively half of total packaging by 2024
- CAGR for advanced packaging is three times higher than other packaging
- Advanced packaging revenue is expected to increase by 43% by 2024

Global OSAT Market Challenges

- The OSAT industry is expected to decline further in 2H20
 - **Temporary closure of factories due to Covid-19 in Q1**
 - Stay-at-home orders = decline in consumer spending on smartphones and consumer electronics
 - COVID-19 relapse cases could delay supply chain restart
 - **As tensions continue between the U.S. and China, companies with direct exposure to Chinese production will be directly affected**

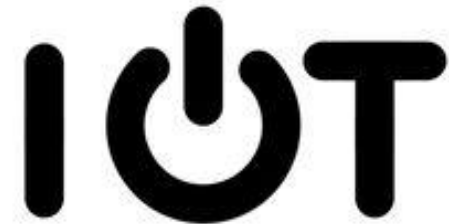


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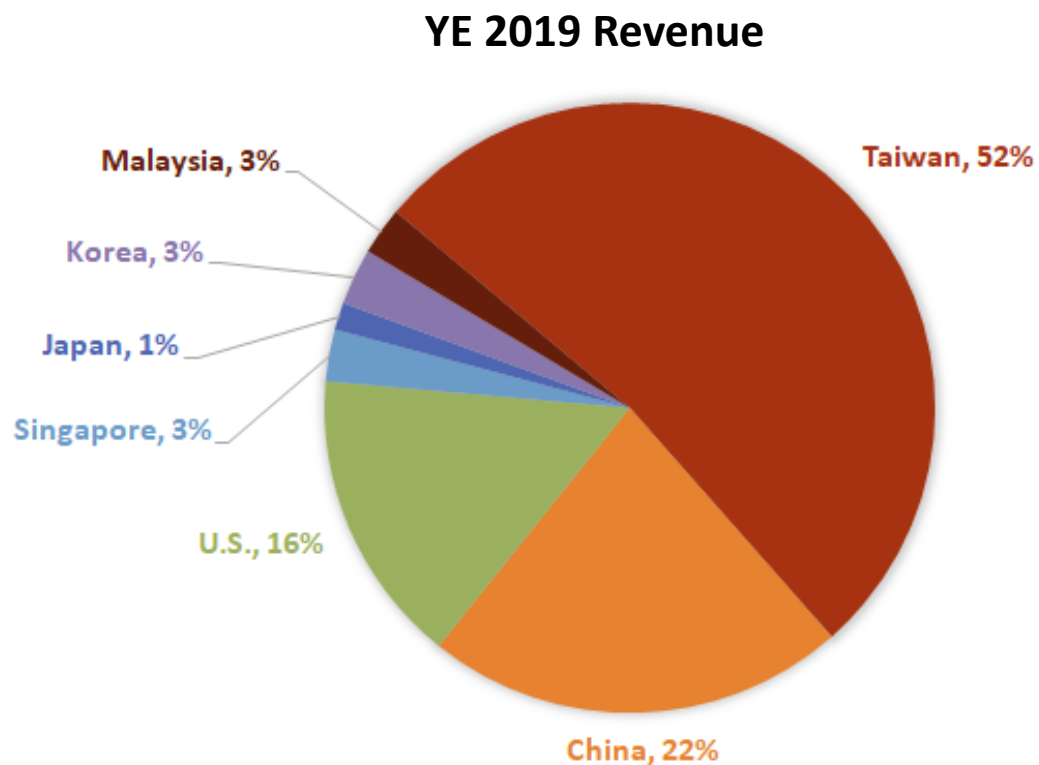
Global OSAT Future Growth Drivers

- Increased demand from automotive sub-systems and connected devices (OSAT's forecast CAGR of 6% for 2020-2025)
- Smartphones market is saturated and declining
- Widespread implementation of IoT devices, 5G and AI
 - Newer chips are being developed by smaller players in the market who lack testing and packaging infrastructure
- Chip providers are forced to introduce new products with a short lifecycle duration



Who Controls The OSAT Market?

- No change from 2018 to 2019
- Revenue increases in Taiwanese OSATs YoY attributed to COF, memory demand, and growth in assembly and test for advanced packaging solutions, notably SiP

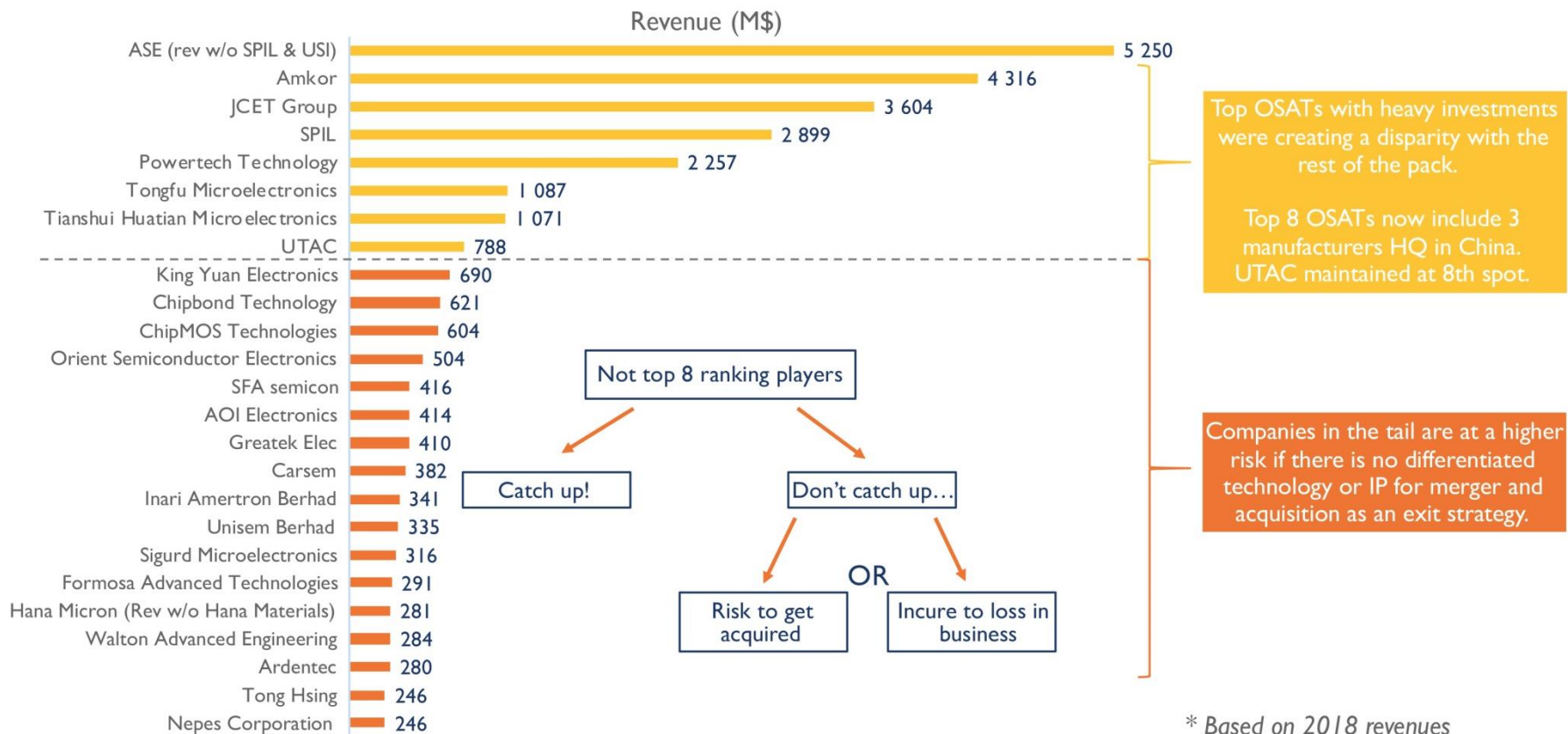


Market profile by region of Top 20 publicly traded OSATs based on quarter average fluctuating exchange

Who Controls The OSAT Market? *(cont'd)*

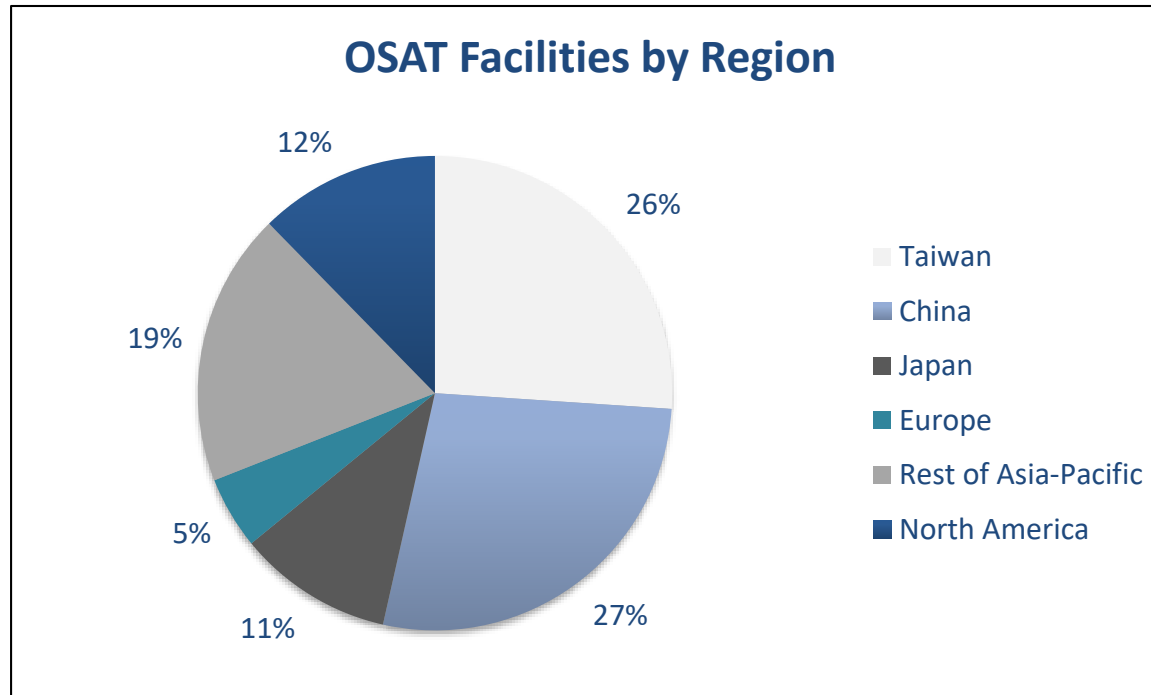
Top 25 OSAT companies* (in M\$)

(Source: Status of the Advanced Packaging Industry 2019 report, Yole Développement, 2019)



* Based on 2018 revenues

Where Are All The OSAT Fabs?



Source: SEMI Worldwide OSAT Manufacturing Database, Oct. 2017

- More than 80% of OSAT facilities are located in Asia
- More than 50% of OSAT facilities are located in either China or Taiwan
- The remainder of the Asia-Pacific region makes up a significant portion of OSAT facilities

Source: The Conference Board, 2016

U.S.-China Trade War Timeline Recap

- **May 15, 2019:** The U.S. effectively bans Huawei with a national security order
- **May 20, 2019:** The U.S. imposes 25% tariffs on \$200 billion worth of Chinese imports
- **June 1, 2019:** China brings into effect its 10% to 25% tariff on \$60 billion worth of U.S. imports
- **August 1, 2019:** The U.S. declares it will impose 10% tariffs on \$300 billion additional Chinese goods
- **August 13, 2019:** U.S. Administration delays tariff implementation, stock prices improved dramatically
- **January 15, 2020:** U.S. and China sign Phase 1 trade deal, cutting U.S. tariffs and increasing Chinese purchase of U.S. goods (tariffs left on US\$250 billion of Chinese products)
- **May 15, 2020:** U.S. Administration announces ban on Huawei from using U.S. software and hardware in certain strategic semiconductor processes; extends export ban until 2021



U.S.-China Tariff Impacts On Global OSAT Market

The chips that TSMC makes are found in everything – smartphones (i.e. Apple iPhones), computing platforms, PCs, tablets, servers, base stations, and almost every weapon system built in the 21st century.

- **May 15:** TSMC announces intention to build advanced semiconductor fab in AZ
 - 60% of the chips TSMC makes are for American companies
 - Wafer fabrication will use 5-nanometer technology / 20,000 wpm capacity
 - Total spending: Approx. \$1B (2021- 2029) (including capital expenditure). Not a Giga fab?
 - Creation of over 1,600 direct high-tech professional jobs and 1000s indirect ones
 - Construction to start in 2021; production in 2024



U.S.-China Tariff Impacts On Global OSAT Market

“Made in the USA” OSAT manufacturing could become the new standard.

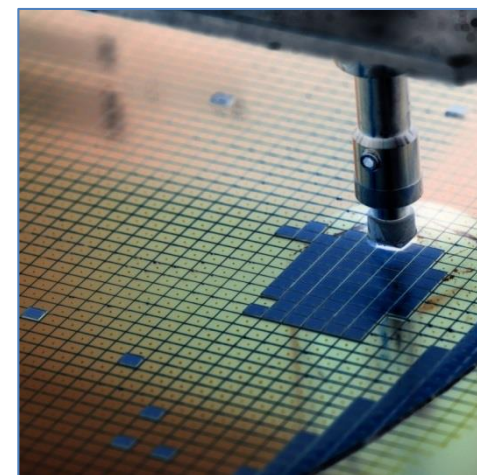
- **May 31:** SIA lobbying for \$37B in federal funding
 - \$5B for new semiconductor factory financed and operated in cooperation with the private sector (Intel CEO Bob Swan had proposed in April that the company work with the Pentagon to build and operate such a facility)
 - \$15B would go to states as block grants to provide incentives for new chip manufacturing facilities
 - \$17B would go to federal research funds
 - Under SIA proposal, funding would go to build facilities in the U.S., but would be available to U.S. and non-U.S.-based companies (excluding China)



U.S.-China Tariff Impacts On Global OSAT Market

“Made in the USA” OSAT manufacturing could become the new standard.

- **June 10:** U.S. lawmakers propose two bills to provide aid to semi industry
 - A bipartisan group of U.S. lawmakers introduced the “CHIPS BILL” to provide more than \$22.8 billion in aid for semi manufacturers
 - The “AMERICAN FOUNDRIES ACT” of 2020 proposes \$25 billion in aid for commercial and defense related microelectronics projects
 - While some U.S. firms (Intel / Micron) still make chips in the U.S., the industry’s center of gravity has shifted to Asia
- **Companies moving manufacturing out of China**
 - Cree, Texas Instruments, ON Semiconductor, GLOBALFOUNDRIES, Micron all focusing on expansions in the U.S.



U.S.-China Tariff Impacts On Global OSAT Market

“Made in the USA” OSAT manufacturing could become the new standard.

- The recent U.S.-China trade war turmoil has made western semiconductor manufacturers come to the realization that they should keep their fabs closer to home.
- U.S. companies with back-end facilities located in Asia are getting increasingly concerned because of the risk of overly centralizing production in just one location.
- As a result, sell-side activity has been increasing in Southeast Asia alone over the past few months with several assembly and test facilities currently on the market.



U.S.-China Tariff Impacts On Global OSAT Market

China will reduce its heavy reliance on U.S. semiconductor suppliers.

- China is slowly, but surely developing its very own domestic semiconductor supply chain
 - “Made in China 2025” plan objective threaten to reduce U.S. semiconductor market share to as low as 43% from 48%.
 - Further decoupling because of additional U.S. trade restrictions could lead U.S. market share to fall as low as 30% of global sales.
 - For China’s semiconductor industry to get off the ground, it also needs more local design and engineering talent, but more restrictions have been put on that transfer of knowledge due to continuous technology IP infringement.



U.S.-China Tariff Impacts On Global OSAT Market

China will reduce its heavy reliance on U.S. semiconductor suppliers.

- Broad unilateral restrictions on Chinese access to U.S. technology could significantly deepen and accelerate the share erosion for U.S. companies.
- Established alternative non-U.S. suppliers apparently exist already for over 70% of Chinese semiconductor demand.
- China claims it can now make 5G base stations, a crucial piece of equipment to deploy the superfast cellular networks, entirely without U.S.-made parts.
- If implemented, the regulations could cost U.S. chip makers about \$36 billion in revenue.

HOW RESTRICTIONS
TO TRADE WITH CHINA
COULD END US LEADERSHIP
IN SEMICONDUCTORS



BCG

U.S.-China Tariff Impacts On Global OSAT Market

“Industry consolidation” will continue as new technologies drive competitive edge.

- New innovative applications drive current market demand and accelerated time-to-market dictates shorter development cycles.
- In 2019, 44 semiconductor transactions were completed altogether, representing an amount of \$27,828 million.
- OSAT sector’s forecast CAGR of 6% between 2020 and 2025.



Key Takeaways

The U.S.-China trade war goes beyond the usual “re-shoring, bring manufacturing back to the U.S.” policy.

- It is about maintaining U.S. investments in technology innovation and stating how countries can leverage their expertise to neutralize China's supposed cost advantages.
- An entire industry of research, procurement, manufacturing, and logistics expertise has developed over the last 10 to 15 years.
- Will the CHIP ACT be enough to do just that – support companies either relocating facilities overseas or seeking ways to blunt the edge rivals from moving to China.



Key Takeaways *(cont'd)*

The U.S.-China trade war goes beyond the usual “re-shoring, bring manufacturing back to the U.S.” policy.

- The SIA / BCG report predicts that dramatic drops in U.S. semiconductor revenue would inevitably lead to severe cuts in R&D and capital expenditures as well as the loss of 15,000 to 40,000 highly skilled direct jobs in the U.S. semiconductor industry.
- If things comes to the worst, a complete severing of technological ties with China would eventually enable South Korea to overtake the U.S. as world semiconductor leader in just a few years, with China likely attaining leadership in the long term.





Thank you for your attention!

Q&A

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