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Defense Industrial Base Division, Office of Technology Evaluation
Bureau of Industry and Security
U.S. Department of Commerce

Re: SEMI comments on Risks in the Semiconductor Supply Chain Request for Information; 86 FR 53031; 0694-XC08; Docket Number BIS-2021-0036

Introduction

Thank you for your leadership to strengthen semiconductor supply chains in the United States. As the global association for the semiconductor supply chain, SEMI supports the Administration's policy to strengthen the resilience of U.S. supply chains for semiconductors and the Administration's efforts to address the chip shortage and stands ready to assist in this effort. SEMI is pleased to provide the following comments in response to the "Notice of Request for Public Comments on Risks in the Semiconductor Supply Chain**"** issued by the Department of Commerce's Bureau of Industry and Security (BIS).

Established in 1970, SEMI is the leading industry association working to advance the technology and business of the global electronics manufacturing supply chain. SEMI has more than 2,400 members worldwide, including over 400 members in the United States, and represents the full range of U.S. semiconductor companies, including design automation and semiconductor IP suppliers, device manufacturers, equipment makers, materials producers, software designers and subcomponent suppliers. While SEMI's membership includes many large companies, more than 85 percent of SEMI members are considered small businesses, and half of U.S. members earn revenues of $25 million or less. SEMI member companies are the foundation of the $2 trillion electronics industry and this vital supply chain supports 350,000 high-skill and high-wage jobs across the United States. Semiconductors are a significant U.S. export, the United States consistently enjoys a surplus in semiconductor trade, and roughly 90 percent of semiconductor equipment and materials sales are made to facilities outside the United States.

FRN question 2(d): What are the primary disruptions or bottlenecks that have affected your ability to provide products to customers in the last year?

The current supply and demand imbalance in the semiconductor industry has been unprecedented and it is largely a consequence of the global COVID-19 pandemic. As world economies went into lockdown, demand for electronics to power remote learning, working, and

healthcare surged to record levels. In the subsequent period, industry has taken strong actions to meet the increase in demand. Industry worked around the globe to classify its manufacturing and production as essential so it could continue operations and run above the preferred utilization rate of over 90 percent. Currently, the majority of fabs are running at full capacity with some leading-edge foundries reporting greater than 100 percent utilization. However, industry has not been insulated from the broader supply chain constraints. Transportation disruptions, workforce shortages, and export control policies which led to stockpiling all have contributed to the shortage. SEMI appreciates our continued collaboration and appreciates the opportunity to provide these comments.

I. Semiconductor manufacturing equipment depend on low volumes of chips, but unavailability of those chips may limit production of a wide swathe of end products that incorporate semiconductors

FRN question 2(b): What are the general applications for the semiconductor products and integrated circuits that your purchase?

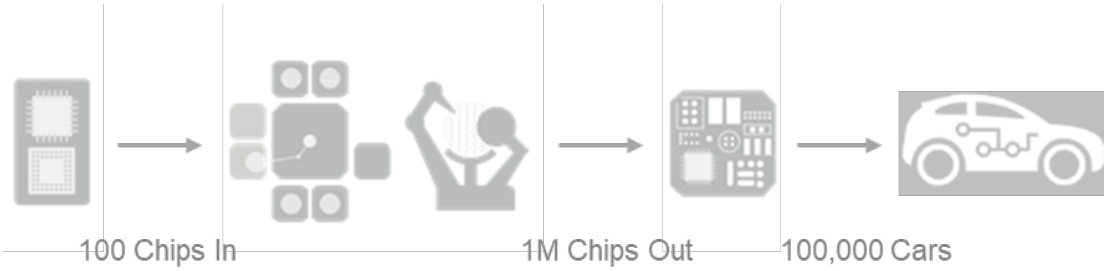
The semiconductor industry is a circular ecosystem – the equipment needed to manufacture semiconductors are also powered by semiconductors, as are the machinery that produce semiconductor manufacturing equipment (SME) and materials. Although semiconductors for SME are a small fraction of the global chip market, supply chain capacity balance is critical to ensure an adequate supply of semiconductors used in the equipment needed to manufacture them. However, since SME producers predominantly purchase sub-assemblies – manufactured and assembled components that are incorporated into a complete SME tool – rather than purchasing semiconductors from producers or distributors, SME producers' visibility into the semiconductor shortage is reduced.

Equipment suppliers' lack of access to the semiconductor parts used to manufacture chipmaking tools reduces their ability to shorten tool lead-times to help chipmakers accelerate delivery of chips to end users. The relatively small number of semiconductor devices required by equipment makers to manufacture these tools have a large multiplier effect that produces a very large number of semiconductors for downstream end users. For example, a typical field-programmable gate array (FPGA) tester requires approximately 80 FPGAs. However, that tester can then test about 320,000 FPGAs per year, leading to a multiplier effect of ~4,000X.

Chipmaking process tools require about 100 FPGAs to build each tool, which can then typically process 120 or more wafers per hour. Wafers make many passes through each tool during the manufacturing flow but the share of most tools' contribution to overall production equates to at

least 2 million devices per year, a ~20,000X multiplier. Similarly, there are roughly 100 high-performance computing (HPC) server chips required to manufacture an optical wafer inspection tool. In full volume production, a fab may sample just 10% of production lots for measurement at 2 wafers per lot. Even with large die size, the multiplier effect can be ~30,000X, and much higher if the sampling rate is larger.

In an even more compelling case, a typical microcontroller unit (MCU) tester needs approximately 100 FPGAs to be manufactured, but that tool can then test nearly 10 million MCUs in a year, providing a Multiplier Effect of ~100,000X.



To take this example across the full supply chain, with the tester/year output of 100,000X and assuming the number of MCUs required for auto manufacturing is ~100 per car, then every tool/tester enables enough MCUs to build 100,000 cars.

A small number of semiconductor parts allocated to equipment and material suppliers enables the production of a very large number of devices for end users. A significant part of the delay in capacity expansion could be resolved by ensuring the availability of devices for manufacturing of the very tools that make these chips.

II. More time for responses and clarity on how information already provided, and to be provided under this RFI, will be used would improve responsiveness.

The Commerce Department has requested detailed and highly confidential information on business operations spanning several years. Compiling accurate and complete data requires companies, many of which are multinational with global footprints, to work across several business units. A longer comment period would help industry be responsive to the Commerce Department's request. We understand the urgency and note that historically the response time is typically 90 days for industrial base surveys.

The semiconductor industry has been the recent focus of federal government information requests and is likely to continue to receive requests in the years to come. The 2019 survey on the U.S. Integrated Circuit Design and Manufacturing Industry Assessment by the Office of

Technology Evaluation was comprehensive. While industry understands there have been significant global changes over the last two years, no information or assessment regarding how the government has used the data already collected, or how that data has informed the government on supply chain issues, has been made public. Additionally, the Fiscal Year 2021 National Defense Authorization Act requires a Commerce Department report on microelectronics technologies in the U.S. industrial base. As industry continues to receive requests for sensitive business information and data, transparency regarding how the information will be used is important for future collaboration.

SEMI and its members are pleased to continue working with the Department of Commerce and other policymakers to increase familiarity and understanding of these extremely complex, global supply chains. Analytics to derive root causes of the wave and ripple nature of the current global chip shortage like the bullwhip effect (the amplification of demand fluctuation along the supply chain to the semiconductor manufacturer) may facilitate policy decisions that will be positive for the semiconductor industry, and industries incorporating semiconductors into their products, over the long term.

III. Concerns regarding repetitive or additional requests from multiple governments

SEMI members also share concerns that other governments may request similar data to that in this RFI and/or information additional to the data requested in this RFI. Responding to multiple RFIs in multiple jurisdictions, potentially without adequate safeguards for the protection of the information provided, would, in aggregate, become burdensome. This would pose risks to companies with operations and sales in most jurisdictions with a local semiconductor industry or industries dependent on semiconductors for their products.

IV. Summary of SEMI data offerings

SEMI is the unparalleled leader in semiconductor supply chain data. SEMI market data primarily relates to the supply side of the semiconductor shortage – from fab capacity and investments to the items supplied to fabs that are essential to semiconductor production, including equipment, materials, packaging, and electronic design software.

SEMI provides reports such as the World Fab Forecast that include a list of fabs – existing, under construction, being equipped, planned – which illustrate the supply/capacity side of the semiconductor industry for different device types, wafer sizes, and process technologies. Fab plans also help semiconductor equipment manufacturers understand the demand for their equipment. SEMI does not currently provide semiconductor demand forecasts. However, the

capacity (supply) side data provided in the fab database along with a monthly update on semiconductor equipment sales helps close the loop on the supply-demand equation.

The following is a summary of the current SEMI Market Data portfolio that can inform policymakers on trends and potential bottlenecks in the semiconductor supply chain.

1. Fab

World Fab Forecast – Provides high level summaries, charts, and graphs – in-depth analysis of capital expenditure, capacity, technology and products, down to the details of each fab – with forecasts over six quarters. This database includes more than 1,000 records of front-end semiconductor fabs and foundries.

- Executive summaries and high-level trends presented in more than 10 charts and 100 tables
- Three years of total data with six quarters of historical data and forecasts six quarters out
- Complete fab-cycle coverage, fab-by-fab, from planning, construction, production, and closure
- Fab-by-fab details on spending, capacity ramp, product type, technology node, and wafer size transition
- Quarterly Excel fab reports for data analysis and modeling by fabs

Note: Other custom and themed reports are derived from the World Fab Forecast.

SEMI is currently tracking 85 new fabs or major fab expansion projects that are expected to come online between 2020 through 2024. Of these, 60 are 300mm projects with six in the U.S., and 25 are 200mm projects with five in the United States. In line with these capacity expansions, SEMI forecasts 2021 Total Wafer Fab Equipment sales to range from $80B-$90 billion, representing growth of approximately 23-38%.

2. Equipment

Equipment Market Data Subscription (EMDS) – The industry standard for tracking semiconductor equipment, covering 90% of worldwide suppliers.

- SEMI Billings Report – monthly global billings for North American equipment manufacturers
- Worldwide Semiconductor Equipment Market Statistics (WWSEMS) – monthly report covers regional billings and 24 equipment categories

- Total Semiconductor Equipment Forecast – bi-annual forecast by region and equipment segment

Semiconductor Manufacturing Monitor – Covers the semiconductor manufacturing industry from capital equipment and fab capacity to semiconductors and electronics sales. Includes two full years of quarterly data and a one-quarter outlook for the semiconductor manufacturing supply chain, including leading integrated device manufacturers (IDMs), fabless, foundry, outsourced semiconductor assembly and test (OSAT) and equipment companies.

- End-to-end data on semiconductor manufacturing, from equipment to electronics sales
- Summarizes leading industry indicators by quarter (electronics and integrated circuit (IC) sales, IC Inventory, wafer shipment and fab utilization)
- Quarterly semiconductor capital expenditure by memory and non-memory
- Quarterly semiconductor equipment billings and equipment sales by leading semiconductor equipment manufacturers
- Global wafer fab capacity by region and by product type
- Revenues of leading IDMs, foundry, fabless, OSAT and semiconductor equipment companies
- Key industry drivers and headwinds

3. Materials

Materials Market Data Subscription – Quarterly report covering the worldwide semiconductor materials market. Subscription includes current revenue data along with two-year forecast and historical data from 2010 to the current year.

- Historical annual revenue of semiconductor materials by category and "ship-to" market region with forecasts through the next year
- Contains 10 segments for wafer fab related materials and seven segments for packaging related materials
- Detailed historical silicon, leadframe, bonding wire, electronic gas, photoresist and photoresist ancillary data obtained directly from the industries' leading suppliers

Silicon Wafer Market Monitor – Provides quarterly silicon wafer shipment data, broken out by region as well as wafer size, such as 150mm, 200mm, and 300mm; also covers supply/demand dynamics and silicon wafer pricing trends.

- Quarterly silicon wafer shipments by wafer size
- In-depth analysis of top five silicon wafer suppliers
- Data on silicon inventory, wafer manufacturing equipment investments, and CAPEX trends

- Insights into key silicon wafer market indicators

4. Packaging

Global Semiconductor Packaging Materials Outlook (GSPMO) – Comprehensive market research study examining semiconductor packaging technology trends and their impact on the packaging materials markets. Quantifies packaging materials markets; highlights new opportunities for advanced technology nodes and emerging package form factors; and presents forecasts through 2024.

- Features packaging technology, capacity, and utilization trends among suppliers
- Market size trends and projections reported in units and revenue and segmented by region
- Includes a market forecast to 2024

Worldwide OSAT Manufacturing Sites Database – Database tracking over 360 back-end facilities that provide outsourced semiconductor assembly and testing (OSAT) manufacturing services. Offers insights into global OSAT facilities in China, Taiwan, Korea, Japan, Southeast Asia, Europe, and the Americas.

- Includes new facility additions
- The world's top 20 OSAT companies
- More than 120 companies and up to 360 facilities
- More than 200 facilities with Test capabilities
- More than 90 facilities offering lead-frame Chip Scale Packages (CSP)
- More than 50 bumping facilities, including over 30 with 300mm wafer bumping capacity
- More than 50 facilities offering Wafer Level CSP technology
- New facilities offering FOWLP and FOPLP
- More than 100 facilities in China, around 100 in Taiwan, and 43 in Southeast Asia

5. Electronic Design

Electronic Design Market Data Report – Timely quarterly data on revenue and headcount trends from electronic design automation (EDA), semiconductor IP and service providers that enable semiconductor chip design.

- Features 4-year timespan by quarter
- Quarterly data breakout by product category
- Quarterly data breakout by geographic regions - Americas, EMEA, Japan, China, Korea, Taiwan, and India

- Historical data from 1996 to the current quarter presented via trend graphs
- Annual summary report with YoY growth rates covering a 5-year period
- Key industry drivers across geographic areas within the electronic design ecosystem

V. Policy Recommendations

Policymakers should embark on a whole-of-government approach to strengthen the semiconductor supply chain and make it more resilient. Incentives to strengthen the semiconductor supply chain are key to alleviate constraints. SEMI detailed in a previous submission to the Bureau of Industry and Security[1] three additional areas, that if addressed, could help alleviate constraints. These include workforce development, export controls, and transportation. Each continues to impact critical supply chains in the microelectronics industry and the concerns noted in April largely persist.

Incentives

- The Advanced Manufacturing Investment Credit (AMIC) included in the Build Back Better Act would provide a robust, temporary tax credit for investments in facilities and equipment to produce semiconductors and semiconductor manufacturing equipment.[2] SEMI was the first industry association to propose a tax credit for investments in the semiconductor manufacturing supply chain and we strongly support the AMIC and the related Facilitating American-Built Semiconductors (FABS) Act. By quickly providing a generally available tax credit, with an option for a direct payment, the AMIC provides the certainty needed for companies to immediately move forward with capacity expansions. Expanding the coverage of the AMIC to include facilities and equipment to produce semiconductor materials, as well as tax incentives for advanced semiconductor research, would further strengthen the semiconductor supply chain and should be adopted. We thank the Administration for its support of the AMIC and look forward to working with the Treasury Department and other key stakeholders to ensure its rapid and appropriate implementation.

- Congress must appropriate funding for the CHIPS Act provisions enacted in the FY 2021 National Defense Authorization Act (NDAA) to effectively address semiconductor supply chain constraints and increase supply over the long term. The Senate passed the U.S. Innovation and Competition Act on June 8, 2021, including robust funding for these programs.

[1] https://www.semi.org/sites/semi.org/files/2021-11/Apr%205%20Final%20SEMI%20Supply%20Chain%20Comments.pdf
[2] See Page 1554 https://rules.house.gov/sites/democrats.rules.house.gov/files/BILLS-117HR5376RH-RCP117-18.pdf

However, the House of Representative has not yet acted. Since it will take years for new capacity to come online, it is imperative that Congress act quickly to fund these vital programs and make the United States a globally competitive location for semiconductor supply chain investments. To that end, we strongly encourage the Administration to continue to urge Congress to move quickly to fund the CHIPS Act provisions. Given that time is of the essence, we would also recommend that Commerce begin standing up the new CHIPS programs to ensure these programs can begin operations quickly.

- Congress must ensure that the Commerce Department has the flexibility to provide incentives in the Section 9902 program for new and expanded facilities to produce SME and semiconductor materials. This will ensure that expanded U.S. semiconductor production is not restrained by shortages of needed equipment and materials. The House-passed FY 2022 NDAA included this important clarifying language and SEMI urges the Senate to include similar language in its FY 2022 NDAA bill, consistent with the White House's "Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth" report, which endorsed incentives to support SME and materials. It said, "Congress should authorize and fund incentives to support key upstream – including semiconductor manufacturing equipment, materials, and gases – and downstream industries throughout the supply chain."[3]

- SEMI also strongly encourages a non-discriminatory approach to the allocation of semiconductor supply chain incentives. This will ensure that the United States remains a competitive investment destination for the world's most advanced and innovative technology solutions, from semiconductors to automobiles. In addition to bringing the most advanced technologies and associated jobs to the United States, a non-discriminatory approach reinforces the Biden Administration's priority to collaborate with allies and will help ensure that U.S. companies will not face discrimination in other jurisdictions considering semiconductor incentives.

- Commerce must work closely with industry and solicit feedback from industry on the appropriate structure, objectives, and operating mechanisms for the CHIPS programs. SEMI urges Commerce to solicit industry feedback via public RFI's or other formal mechanisms so that industry can provide information to assist Commerce in the establishment and management of these vital programs.

[3] See Page 76 https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf

- Along with increasing capacity, better usage of existing capacity would also reduce supply constraints. Closer collaboration with other nations would maximize the efficiency of new investments and help avoid overcapacity. Leading edge demand incentives for next-generation capabilities, such as new broadband, 5G services, and Greentech, can free up capacity in the legacy nodes underpinning auto manufacturing, create broad economic value, and strengthen the nation's broadband infrastructure. AI-based forecasting with a tamed bullwhip could better analyze and identify supply imbalances.

In summary, policymakers must take a holistic approach to the semiconductor supply chain. The AMIC and CHIPS Act programs together will significantly increase semiconductor manufacturing capacity in the United States, preserve and increase the production of SME in the U.S. and, if implemented appropriately, grow semiconductor materials production in the United States. This will help ensure that supply constraints downstream of fabs do not migrate upstream of them – jeopardizing the capacity increases needed to ensure the strength and resiliency of this vital industry and countless industries dependent on semiconductors for their products and services. Making the AMIC permanent, long-term funding of the CHIPS Act programs and incremental improvements to these policies regarding materials and research incentives will provide a strong, lasting policy foundation to create a secure, resilient, innovative and growing semiconductor industry in the United States over the long term.