Qualcomm

Public Submission

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Mr. David Boylan
c/o Defense Industrial Base Division
Office of Technology Evaluation
Bureau of Industry and Security
U.S. Department of Commerce

Subject: Qualcomm Response to the Notice of Request for Public Comments on Risks in the Semiconductor Supply Chain

Reference: 86 Fed. Reg. 53031 (Sept. 24, 2021); RIN 0694–XC08; Docket # 2021-20348

Dear Mr. Boylan:

Qualcomm Incorporated[1] (together with its subsidiaries, "Qualcomm"), a U.S. company with its worldwide corporate headquarters in San Diego, California, has been the world's leader in wireless research and development ("R&D") and a leading supplier of wireless semiconductor chipsets for over thirty-five years. As a company that invents technology and designs semiconductors to bring that technology to life, Qualcomm works closely with fabrication plants ("fabs" or "foundries") to manufacture these designs in high quality and large volumes. Because our focus is on the semiconductor design, Qualcomm relies on foundry partners to manufacture its chips and is therefore directly impacted when its foundry partners lack capacity to meet demand.

Qualcomm continues to support the Administration's efforts to address risks in the semiconductor supply chain. On April 5, 2021, we submitted public comments to the Department of Commerce's Notice requesting comments related to the President's Executive Order 14017 on America's supply chains.[2] We appreciate the opportunity to

[1] Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, operates the Qualcomm CDMA Technologies ("QCT") semiconductor business, which develops and supplies integrated circuits and system software based on 3G/4G/5G and other technologies for use in mobile devices, wireless networks, devices used in the Internet of Things, broadband gateway equipment, consumer electronic devices, and automotive systems for telematics, connectivity, and digital cockpit (also known as infotainment). Qualcomm Incorporated includes Qualcomm's licensing business, Qualcomm Technology Licensing ("QTL"), and the vast majority of its patent portfolio.

[2] Qualcomm Response to the Notice of Request for Public Comments Related to President's Executive Order 14017 on America's Supply Chains (Apr. 5, 2021); *see also* Dep't of Commerce, Bureau of Indus.
(continued…)

provide this additional submission in response to the Department's latest Notice requesting comments on risks in the semiconductor supply chain "to accelerat[e] information flow across the various segments of the supply chain, identifying data gaps and bottlenecks in the supply chain, and potential inconsistent demand signals."[3]

The company draws upon its experience and expertise as a U.S. leader in microelectronics research and design for more than thirty-five years to answer the Department's questions related to "semiconductor product design," including Qualcomm's (1a) role in the semiconductor supply chain; (1b–1c) products, including technology nodes and device types; (1d–1h) experiences with the production process, including lead times and backlogs; (1i–1l) experiences with the current shortages; and (1m) recommendations to help address the shortage in both the short and long term.[4] Qualcomm remains committed to building and sustaining America's thriving semiconductor industry, and we look forward to working with the Administration to implement our shared goals.

1a. Qualcomm's Role in the Semiconductor Supply Chain

Qualcomm was one of the first semiconductor companies to utilize a "fabless" business model specializing on the first and foundational step of the semiconductor supply chain: invention and design. Since its founding in 1985, Qualcomm has invested more than $73 billion in R&D through its 2021 fiscal year to develop breakthrough technologies and solutions that empower the entire ecosystem. Qualcomm has developed sophisticated architecture and blueprints for many stages of the semiconductor supply chain from how semiconductors must be manufactured to how they will operate once fabricated. The process is highly R&D-intensive and precarious: developing semiconductor technology that will benefit an entirely new communications paradigm, like 5G, consumes decades of time, billions of dollars in human and technology resources, and comes with the risk of failure constantly looming, as these long-horizon investments may never be successful or widely used. Designing semiconductors also requires a highly specialized engineering workforce. Accordingly, Qualcomm is proud to lead the world in developing revolutionary designs that enable foundational 5G cellular technologies that power the Internet of Things ("IoT") and automotive industries, in addition to cell phones.

& Sec., Risks in the Semiconductor Manufacturing and Advanced Packaging Supply Chain, Notice of Request for Public Comments, 86 Fed. Reg. 14308 (Mar. 15, 2021).

[3] Dep't of Commerce, Bureau of Indus. & Sec., Risks in the Semiconductor Supply Chain, Notice of Request for Public Comments, 86 Fed. Reg. 53031 (Sept. 24, 2021).

[4] The company recognizes that the Department requested commenters to complete a fillable form, which specifies that "[a]ll comments are invited, with this form designed to facilitate submission of information from sellers of integrated circuits (in Sections 2 through 5) and purchasers of integrated circuits or related products (in Sections 6 through 8)." Given that the company does not fit these descriptions, it has opted to submit its comments through this document.

As part of the invention and design process, Qualcomm must work closely with manufacturing partners—both foundries and outsourced assembly and test ("OSAT")[5] firms who fabricate and package semiconductors on behalf of Qualcomm, as well as electronic design automation ("EDA") firms who provide the sophisticated tools that enable Qualcomm to design its chips. Qualcomm's relationship with its manufacturing and EDA partners, sometimes referred to as "collaborative manufacturing," is interconnected, interdependent, and fosters a constant cycle of innovation. Qualcomm must understand the capabilities and capacities of its manufacturing partners in order to develop workable designs, and foundries and EDA firms must keep their tools and processes up-to-date to implement Qualcomm's new technologies.[6] While foundries, OSAT firms, and EDA firms bring critical capabilities to this collaborative manufacturing process, the driving force behind the semiconductor ecosystem are Qualcomm's investments and semiconductor designs, fueled by R&D that continuously spurs millions of cutting-edge inventions for the entire industry, and investments from fabs and EDA firms who are incentivized to secure years of business.

Qualcomm's close partnership with foundries, OSAT firms, and EDA firms also improves and sustains the global semiconductor supply chain. Not only does Qualcomm's R&D help foundries, OSAT firms, and EDA firms improve their manufacturing processes and products, it also incentivizes these partners to discover new ways to ramp up more quickly, efficiently, and effectively to produce high volumes of chips and meet demand.[7] Qualcomm's technologies are responsible for many advanced manufacturing techniques that the industry relies on to power the supply chain. For example, Qualcomm works early on in the design and production cycle with foundry process technology teams at fabs to balance the introduction of new features (*e.g.*, a FinFET transistor or extreme ultraviolet lithography) while delivering desired chip performance and necessary output. Qualcomm also employs a "multisourcing strategy" to work with a variety of foundries and OSAT firms that can offer diverse sets of capabilities to meet Qualcomm's diverse semiconductor demands.[8] Indeed, Qualcomm has worked with every new foundry that has been successful in the last ten years, and we are dedicated to sustaining this leadership role and working with new U.S. and allied-based manufacturers for years to come.

[5] Foundries and OSATs provide manufacturing services to other semiconductor companies on a contract basis, including fabless firms.

[6] Gregory Tassey, *Competing in Advanced Manufacturing: The Need for Improved Growth Models and Policies*, J. ECON. PERSPECTIVES, 33 (Winter 2014), https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.28.1.27.

[7] *See* EURASIA GROUP, THE GEOPOLITICS OF SEMICONDUCTORS, 4 (Sept. 2020), https://www.eurasiagroup.net/files/upload/Geopolitics-Semiconductors.pdf.

[8] As a firm that requires foundry partners to manufacture our semiconductors using a wide range of process technologies from legacy to leading edge nodes, Qualcomm seeks to utilize the capabilities of all potential foundry partners globally.

1b–1c. Qualcomm's Products

Qualcomm leads the world in creating state-of-the-art designs which, on average, account for more than half of the value-add of a semiconductor chip.[9] The company designs a variety of chips for all node sizes, including older technology mature nodes in the 28 to 180 nanometer range (also known as "legacy nodes") and cutting-edge technology nodes in the 16 and below nanometer range (also known as "leading-edge" nodes) in order to meet diverse needs across industries and end uses. For example, legacy node process technology continues to be essential for accessory chips such as Power Management Integrated Circuits ("PMICs"), which manage power in any battery powered electronic device, as well as radio frequency chips and others that are found in automobiles, phones, and IoT devices. Of the roughly 169 semiconductors in a typical smartphone, approximately 95% are made using legacy node processes. Further, Qualcomm designs its microprocessors and communication modem chips, the "brains" of any device, in leading-edge nodes.[10] These microprocessors power critical and emerging technologies from advanced wireless communications and digital computing to artificial intelligence ("AI"), autonomous vehicles, and many other applications requiring advanced microprocessors. Semiconductors will also usher in a new generation of 5G and 6G products, and the revolutionary open RAN network architecture.[11] Qualcomm's inventions and semiconductors that bring these technologies to life help power a significant part of the global economy—5G alone is estimated to generate more than $13.2 trillion of global economic activity by 2035 and create up to 16 million new U.S. jobs between 2021 and 2025.[12]

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[9] SEMICONDUCTOR INDUS. ASSOC. & BOSTON CONSULTING GROUP, STRENGTHENING THE GLOBAL SEMICONDUCTOR SUPPLY CHAIN IN AN UNCERTAIN ERA, 13 (Exh. 4), 15 (Apr. 2021), https://www.semiconductors.org/wp-content/uploads/2021/05/BCG-x-SIA-Strengthening-the-Global-Semiconductor-Value-Chain-April-2021_1.pdf.

[10] For example, Qualcomm's current leading-edge product, the Qualcomm Snapdragon 888 processor, is produced in a 5 nanometer process and contains 11.8 billion transistors. Qualcomm's soon-to-be-announced leading-edge product will be produced in a 4 nanometer process and will have an even higher transistor count.

[11] "Open RAN" stands for "open or disaggregated radio access network" and refers to a 5G network that relies on technology architecture, including software and hardware components, that can be provided by multiple vendors and interoperate through open protocols and interfaces, including but not limited to standards adopted by the Third Generation Partnership Project (3GPP), Open Radio Access Network (O-RAN) Alliance, Telecom Infra Project, or any similar set of open interoperable standards for multi-vendor network equipment.

[12] IHS MARKIT, THE 5G ECONOMY: HOW 5G WILL CONTRIBUTE TO THE GLOBAL ECONOMY, 20 (Nov. 2019), https://www.qualcomm.com/media/documents/files/ihs-5g-economic-impact-study-2019.pdf; ACCENTURE STRATEGY, THE IMPACT OF 5G ON THE UNITED STATES ECONOMY, 5 (Feb. 2021), https://www.accenture.com/_acnmedia/PDF-146/Accenture-5G-WP-US.pdf.

1d–1h. Qualcomm's Experiences with the Production Process

As discussed above, Qualcomm is an integral partner in the semiconductor production process. Qualcomm's designs enable and spur innovations that accelerate and reinforce the entire production process. At the same time, as a fabless firm, the company relies on its foundry and OSAT partners, and their lead times and forecasting, to ensure sufficient manufacturing capacity and timely delivery of the company's products to its customers.

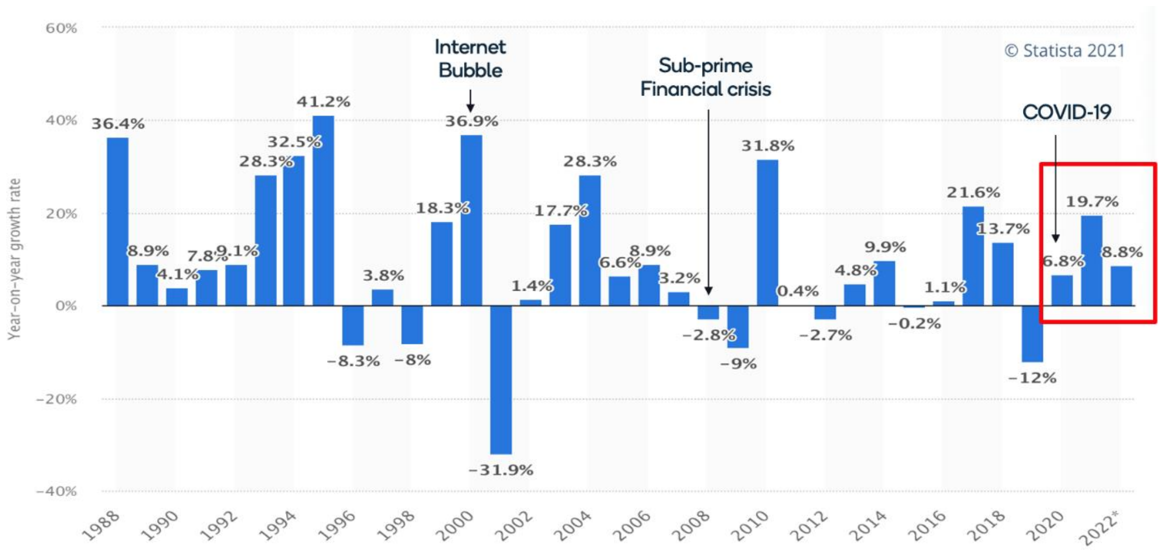
When there is sufficient foundry capacity to meet demand, the general lead time is 16 to 25 weeks from when Qualcomm submits an order with an experienced foundry partner to when the finished wafer is delivered. When demand exceeds capacity, however, foundry partners cannot even start to process new orders until they have addressed the backlog, extending lead times sometimes to more than a year. Manufacturing capacity is therefore one of the most significant sources of delays or bottlenecks for Qualcomm's products, and it is accordingly one of the most fundamental ways to improve and sustain the semiconductor supply chain.

The difficulty is that manufacturers cannot quickly increase or shift capacity when demand unexpectedly and significantly increases or shifts. Building and equipping a new state-of-the-art front-end semiconductor fab can take 18 to 24 months, on average. Ramping up the fab to produce high yields can take an additional 12 to 18 months, even with an experienced foundry and customer. When demand unexpectedly spikes as it has during the past year and half, it takes time for semiconductor supply to catch up and meet demand. Historically, the industry has been able to anticipate growth in demand and add supply accordingly because demand growth has generally been predictable. This recent increase in demand, prompted by the pandemic, was unforeseen and has therefore resulted in the industry requiring additional time to sufficiently increase supply.

Also, unlike other industries where an oversupply can be stored and sold at a later time, manufacturing an excess of certain types of semiconductors is highly costly because those chips are likely to quickly become outdated and can no longer be sold. The raw materials, equipment, and skilled personnel required to make semiconductors are also costly and must be tied to actual demand. Semiconductor manufacturers therefore cannot rely on speculation about potential growth. Instead, they must calibrate capacity growth based on forecasts using past market trends, which are necessarily imperfect because of constantly changing markets and unexpected events like a global pandemic.

Given this reliance on forecasting, the production of semiconductors is cyclical by nature with recurring periods of greater and reduced shipments (shown in Figure 1). Manufacturers produce more semiconductors when demand is high, resulting in increasing supply and increasing prices, which eventually leads to demand cooling off and an over-supply, all typically over the course of two to three years (shown in Figure 2). It is therefore not surprising to experience periods of enormous growth immediately preceding and following periods of decline. For instance, global semiconductor sales grew by $81 billion in 2010 and 2017, the highest years of annual year-over-year sales growth on record, and annual market growth is forecasted to be even higher in 2021 at $112 billion.[13] Meanwhile, several of the years just before and after these record-setting years registered negative growth, including 2008, 2009, 2012, 2015 and 2019.[14] Over the long run, however, the overall trajectory of global semiconductor demand—and the industry's ability to supply it—has been positive.

Figure 1. Semiconductor Annual Sales Growth, 1988 – 2020 (est. 2021 – 2022)[15]



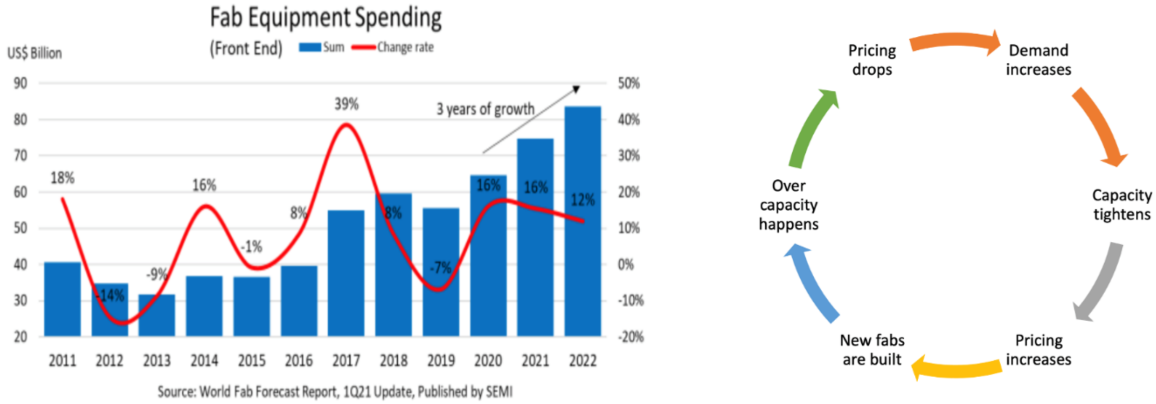
Source: WSTS

[13] IC INSIGHTS, INC., MID-YEAR (JULY) UPDATE TO THE MCCLEAN REPORT, 2-29 (2021).

[14] *Id*. at 2-20.

[15] WORLD SEMICONDUCTOR TRADE STATISTICS, *Global Semiconductor Industry Revenue Growth from 1988 to 2022* (June 23, 2021), https://www.statista.com/statistics/266976/forecast-revenue-growth-in-the-semiconductor-industry-worldwide/.

Figure 2. Fab Equipment Spending Patterns and Semiconductor Cycles[16]



1i–1l. Qualcomm's Experiences with the Current Shortage

Qualcomm, like many other businesses, is experiencing the effects of the current historic shortage. Unlike previous shortages where production of only select nodes were constrained, the company has experienced constraints from its manufacturing partners across all nodes from legacy to leading-edge. During the peak of the current shortage, there was not a single node where there was more supply than demand. Additionally, we have experienced the same dynamics that the overall semiconductor industry has, with demand outstripping supply in every area of Qualcomm's chip business, including handsets, IoT, radio frequency front-end ("RFFE"), and automotive.[17]

Similar to previous shortages in the semiconductor industry, the lack of manufacturing capacity to meet increased demand has been a major cause of the current shortage. As explained above, the semiconductor industry has historically been characterized by "boom and bust" cycles where the industry has moved from periods of undersupply to oversupply and back again. Short-term periods of undersupply are part of the industry's standard cycle and do not by themselves suggest a major deficiency in the semiconductor supply chain nor in the industry's ability to increase supply to meet demand. However, the main difference between this shortage and past shortages is

[16] SEMICONDUCTOR EQUIP. AND MATERIALS INT'L ("SEMI"), *World Fab Forecast Report, 1Q21* (Sept. 2021), https://www.semi.org/en/news-media-press/semi-press-releases/world-fab-forecast.

[17] While all semiconductor end markets have experienced demand growth over the past year, communication and computer products purchased by consumers constituted the vast majority of semiconductor end use demand. In 2020, semiconductor demand share by major end use categories broke down as follows: PC/computer (32.3%), communications (31.2%), consumer (12%), industrial (12%), automotive (11.4%), and government (1%). SEMICONDUCTOR INDUS. ASSOC., 2021 SIA FACTBOOK, 11 (May 5, 2021), https://www.semiconductors.org/wp-content/uploads/2021/05/2021-SIA-Factbook-FINAL1.pdf; SEMICONDUCTOR INDUS. ASSOC., 2021 STATE OF THE U.S. SEMICONDUCTOR INDUSTRY, 13 (Sept. 2021), https://www.semiconductors.org/wp-content/uploads/2021/09/2021-SIA-State-of-the-Industry-Report.pdf (*citing* WORLD SEMICONDUCTOR TRADE STATISTICS, 2021 WSTS END-USE SURVEY).

that the magnitude of the current increase in demand has been unprecedented and unanticipated because of the COVID-19 pandemic and the subsequent increased reliance on semiconductor-run devices.[18]

The semiconductor industry has responded to this historic increase in demand with historic output, and semiconductor sales reflect these increases in production. More semiconductors were sold in the third quarter of 2021 than in any quarter in the history of the industry, and total semiconductor sales in September 2021 were the highest ever in a month, demonstrating the industry's efforts to ramp up production.[19] Yet even these historic numbers have not kept up with the unexpected and historic levels of demand.

Qualcomm has helped mitigate the shortage's worst effects by creatively optimizing and expanding capacity, including by expediting tool qualifications, improving system process flow, and enhancing yields. For example, Qualcomm optimized its available capacity by redesigning some of its products to both reduce overall product size and to enable production in alternate, somewhat less constrained, fabs. While these changes have enabled Qualcomm to address the shortage and expedite delivery of our products, they have also caused considerable disruptions to Qualcomm's product roadmap and to Qualcomm's customers who have had to requalify these product changes.

The cycles of the semiconductor industry, combined with the complexities of forecasting and unpredictable singularities like a global pandemic, mean that there will likely always be disruptions to the global semiconductor supply chain. At the same time, future supply disruptions including shortages like this one can be mitigated. The semiconductor industry can (and will, based on every other past shortage) emerge from the current shortage by taking two steps: increasing fab utilization and capacity through capital spending in the short and medium term, as well as increasing overall fab capacity and capability through R&D in the long term.

In the short and medium term, semiconductor manufacturers are increasing their fab capacity utilization and capital spending. As an immediate short-term response to the shortage, manufacturers have ramped up utilization of existing fabs to historic levels. In 2021, fab capacity utilization is estimated to grow to 93.8%, the highest level since the boom year of 2000.[20] Over the medium term, the industry is significantly spending on semiconductor manufacturing equipment to add fab capacity. Capital equipment spending is expected to jump 30% to a new all-time record high of $148.2

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[18] MID-YEAR (JULY) UPDATE TO THE MCCLEAN REPORT, *supra* note 13, at 4-1.

[19] SEMICONDUCTOR INDUS. ASSOC., *3Q Global Semiconductor Sales Increase 27.6% Year-to-Year*, (Nov. 1, 2021), https://www.semiconductors.org/q3-global-semiconductor-sales-increase-27-6-year-to-year/.

[20] MID-YEAR (JULY) UPDATE TO THE MCCLEAN REPORT, *supra* note 13, at 3-2, 3-16.

billion in 2021.[21] In 2025, the final year of the forecast period, capital spending is expected to jump by 10% to $164.7 billion.[22]

In the long term, semiconductor design companies and their manufacturing partners can and must continue to invest in R&D to create more innovative, effective, and efficient production processes to meet demand, which is only expected to increase as the digital transformation takes hold. R&D investments will help to ensure future U.S. semiconductor industry supply chain security, as well as global semiconductor industry market share and industry leadership, because the staggering pace of technological change in the industry requires companies to develop more complex designs and technologies which can only be achieved through a continual commitment to R&D.[23] In 2020, U.S.-based semiconductor firms maintained 47% of global semiconductor sales and commensurately spent more on R&D as a percent of total sales (18.6%) than any other country's semiconductor industry.[24] There will likely be other future unexpected events that will disrupt the global semiconductor supply chain; for example, environmental events such as the cold wave in February 2021 that disrupted semiconductor production in Texas and industrial plant disruptions such as the Renesas fab fire in March 2021 that temporarily reduced production in Japan. Therefore, reliance on any number of fabs cannot singlehandedly ensure capacity to meet demand. Innovation to increase efficiency and productivity across all fabs, on the other hand, will promote and reinforce the resilience of the overall supply chain.

Even with these commitments, the semiconductor industry will still face hurdles without the proper regulatory environment and economic incentives. For instance, the process of building new fabs and developing new semiconductor designs is highly capital- and R&D-intensive. Many countries are accordingly heavily subsidizing semiconductor production through generous cash grants and tax incentives, including roughly $50 billion for manufacturing and other subsidies in China, $7–10 billion in South Korea, and $5–7 billion in Japan between 2000 to 2020.[25] Since 2020, South Korea and Japan have introduced even larger incentive plans; for example, in May 2021, South Korea announced its "K-Semiconductor Strategy" which would ease regulations, upgrade infrastructure, and provide tax credits up to 50% for R&D investments and 16% for semiconductor facility investments.[26] The U.S. Senate has passed legislation appropriating $52 billion in incentives for domestic semiconductor research, design, and manufacturing, but the legislation has not yet become law. While

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[21] *Id.* at 1-4.

[22] *Id*. at 3-2, 3-16.

[23] *2021 SIA Factbook*, *supra* note 17, at 16.

[24] *Id.* at 3, 21.

[25] SEMICONDUCTOR INDUS. ASSOC., U.S. NEEDS GREATER SEMICONDUCTOR MANUFACTURING INCENTIVES, 1 (July 2020), https://www.semiconductors.org/wp-content/uploads/2020/07/U.S.-Needs-Greater-Semiconductor-Manufacturing-Incentives-Infographic1.pdf.

[26] KBS WORLD, *"K-Semiconductor Belt Strategy" to Establish the World's Largest Supply Network by 2030* (May 17, 2021), http://world.kbs.co.kr/service/contents_view.htm?board_seq=403357.

some states offer helpful incentives, they are insufficient to compete with the significant incentives offered by some foreign governments. According to a 2017 analysis by the Organization for Economic Cooperation and Development, the United States ranked 32nd out of 35 nations in terms of the implied tax benefits provided by government research incentives for profitable firms.[27] Unsurprisingly, then, the majority of new fabs in the world have been built outside of the United States.

A lack of raw materials and a shortage of skilled workers are two other limiting factors. The supply chain depends on upstream suppliers of parts, software, and raw materials that are becoming increasingly concentrated. The United States is currently not educating and training sufficient numbers of workers with the necessary science, technology, engineering, and mathematics ("STEM") expertise or attracting enough talent from abroad to sustain the workforce needed for the semiconductor industry and other technology fields. An overwhelming 80% of graduate students in STEM fields are from foreign countries, but there are challenges attracting these workers because of immigration restrictions that limit the number of foreign graduates entering the United States.[28]

1m. Qualcomm's Recommendations to Address Supply Chain Risks

As an immediate action, the Federal Government should pursue critical reforms across the following key strategic fronts:

- **Semiconductor Incentives.** Congress should appropriate the proposed $52 billion in semiconductor incentives authorized by the CHIPS for America Act in order to help secure the global manufacturing supply chain so that the industry can better weather the current and future supply chain disruptions. Congress should also appropriate the proposed $1.5 billion to the Public Wireless Supply Chain Innovation Fund established by the USA Telecommunications Act, as well as enact federal R&D funding. Federal government support for R&D is imperative to ensure that semiconductor design companies can sustain the vast amounts of R&D needed to develop and manufacture state-of-the-art semiconductor designs.

- **Patent Law.** U.S. leadership in semiconductor R&D and design, and related technologies such as 5G and 6G, is critical for U.S. national security interests. The Federal Government must maintain a strong intellectual property rights enforcement regime for ecosystem-enabling patents, including foundational standards for semiconductor design and technology. A robust patent protection regime is necessary to appropriately incentivize private companies to invest in the costly and risky long-term R&D necessary for leadership in these technology

[27] OECD, REVIEW OF NATIONAL R&D TAX INCENTIVES AND ESTIMATES OF R&D TAX SUBSIDY RATES (2017), https://www.oecd.org/sti/rd-tax-stats-design-subsidy.pdf.

[28] SAN DIEGO REG'L ECON. DEV. CORP., QUALCOMM'S CONTRIBUTION TO SAN DIEGO'S ECONOMY (2019), https://www.sandiegobusiness.org/sites/default/files/EDC-QUALCOMM-STUDY-FINAL%20-WEB2.pdf.

areas. To that end, all legal remedies should be available for patent protections and particularly for standards-essential patents. The United States and allies should also explore policy and regulatory tools to stimulate licensing of transistor technology for multi-sourcing across the value chain.

- **Targeted and Rule-based Export Controls.** The Federal Government should control emerging technologies consistent with the standards set forth in the Export Control Reform Act of 2018 ("ECRA") by imposing targeted and rule-based export controls and avoid disrupting semiconductor supply, especially in legacy node chipsets. Unilateral controls would only hinder Qualcomm and other U.S. companies from selling in foreign markets, undermining their R&D investments and disadvantaging them against their foreign competitors, some of whom have both the technology capability and funding to develop global leadership in these areas.

- **National Semiconductor Technology Center ("NSTC").** The NSTC should be a pre-competitive research center for the EDA firms, design companies, and fabs to collaboratively work on high-volume manufacturing innovations at the earliest stages. Using the NSTC to drive collaborative innovation based on different transistor technologies would effectively leverage these innovations at different fabs which are eligible for U.S. government grant funding. This type of R&D would cost each semiconductor design company and EDA firm millions of dollars in research on their own—by consolidating within the NSTC, this research will have both more impact and value across the semiconductor value chain. An NSTC focused on advancing the role of U.S. companies in collaborative manufacturing between semiconductor design companies, EDA firms, and fabs will keep the U.S. ecosystem at the cutting edge and help balance new technical capabilities, volumes, features, and innovations for the entire semiconductor ecosystem.

Over the long term, to ensure sustained innovation, maintain supply chain resilience, and continue U.S. leadership at the helm of the semiconductor industry, the Federal Government must promote a regulatory environment that strengthens U.S. semiconductor design and R&D in the following ways:

- **Tax Incentives.** The Federal Government should provide greater incentives to encourage U.S. leadership at every stage of the semiconductor supply chain—including design. The existing U.S. research tax credit of 20% is helpful but insufficient to cover the massive investment needed for U.S. advanced semiconductor research. Congress should pass an advanced semiconductor research credit to increase the overall percentage of the credit for a narrowly defined category of research that requires massive upfront investments. Such incentives would line up with trading partners and competitors and will help keep Qualcomm and other U.S. design companies well-positioned to continue driving innovation across the fabs, EDA tools, and the entire information and communications technology ecosystem.

- **Intellectual Property Protections.** The Federal Government should support strong protections for intellectual property, including patents and trade secrets. In the semiconductor industry, patented technologies and trade secrets can include proprietary manufacturing processes, circuit designs, software source code, and business strategies. Maintaining and strengthening the ability to enforce patents and trade secret laws are essential to continuing American advances in semiconductor design and enabling the ecosystem.

- **STEM and Invention Education.** The Federal Government should implement a national strategy to increase the number of Americans, including women and other underrepresented minorities, graduating in STEM fields. The Federal Government should also develop an invention-based education framework and strategy across the K-12 educational system and beyond to help the next generation of inventors develop the skills needed to maintain American innovation leadership.

- **Immigration Law.** The Federal Government should maintain deemed export requirements and immigration laws that ensure that foreign nationals can work in the United States while protecting U.S. national security interests. For instance, the Federal Government should reform the high-skilled immigration system by eliminating counterproductive caps on green cards so qualified STEM graduates from U.S. colleges and universities, as well as STEM graduates from around the world, can work, innovate, and contribute to U.S. semiconductor companies. Foreign nationals in STEM fields, particularly those with advanced degrees, should automatically become eligible to work in the United States and contribute to the U.S. economy.

- **Foreign Relations.** The Federal Government should coordinate with allies and leverage a vast array of bilateral negotiations and diplomatic tools, including bilateral investment treaty talks, free trade agreements, sovereign wealth fund international forums, and other international deliberations on standards, onshoring percentages, and access to raw materials. The Federal Government should coordinate with allies to set a percentage target for onshoring leading-edge and mature node semiconductor supply. Qualcomm also supports the expanded role for the Quad, the proposed EU-U.S. Technology and Trade Council, and the establishment of a G7 Data and Technology Forum.

- **Standards Development.** Standards leadership is critical to a successful semiconductor ecosystem, because understanding and contributing to a standard helps better implement that standard in a semiconductor. The Federal Government should support the participation of U.S. companies in global standards setting and ensure that those standards are set in a fair, impartial, balanced, and consensus-based manner, in accordance with the fundamental rules of due process. The U.S. Innovation and Competition Act (passed by the Senate) and the National Institute of Standards and Technology for the Future Act (passed by the House Committee on Science, Space, and Technology) provide steps in the right direction by requiring the Federal Government to promote standards participation among U.S. companies and their allies.

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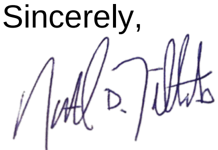
Qualcomm continues to support the Administration's efforts to address risks in the semiconductor supply chain. Qualcomm, like many other businesses, has been negatively affected by the current historic shortage; the company has experienced constraints at the peak of the shortage from its manufacturing partners across all nodes from legacy to leading-edge. The Federal Government should take immediate and significant steps to address supply chain risks and the current shortage by (1) boosting semiconductor incentives; (2) strengthening patent protections benefiting the semiconductor ecosystem; (3) enacting targeted and rule-based export controls; and (4) promoting collaborative innovation through the National Semiconductor Technology Center. Over the long term, the Federal Government should support an environment that promotes continued U.S. leadership, particularly in design and R&D, by focusing on the following policies: (1) implementing tax incentives for advanced semiconductor research; (2) strengthening intellectual property protections; (3) promoting STEM and invention education; (4) reforming immigration laws to attract qualified candidates to the semiconductor industry; (5) coordinating supply chain issues with strategic allies; and (6) supporting U.S. companies in setting global standards.

The role of semiconductors and semiconductor design has never been more important for the U.S. economy and national security, and we expect that importance only to grow. The pandemic has been a once-in-a-generation event that has created unanticipated global supply chain disruptions, including the current chip shortage. The semiconductor industry has always been cyclical, and it is working diligently to restore economic balance during this particularly acute under-supply environment. Qualcomm stands ready to work with the United States in exploring our policy recommendations to help mitigate the effects of future supply chain disruptions and meet the challenges to continued U.S. semiconductor industry leadership. If you have any additional questions or would like to discuss these comments further, please contact me at ntibbits@qualcomm.com.

Sincerely,



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