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US Trusted Semiconductors and the Role of Europe



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KEY POINTS

- US and European semiconductor industries and supply chains are tightly intertwined.
- Currently, the US Defense Microelectronics Activity's (DMEA) list of accredited, trusted semiconductor suppliers encompasses US-based suppliers with few exceptions for foreign firms like the British BAE Systems that are already tightly integrated into the defense industrial base.
- Several opportunities exist for the US and Europe to coordinate more closely on investments, supply chain standards, and markets for secure and trusted chips.
- However, a mutual reliance on East Asian suppliers and diverging national security views on China pose challenges to expanding US trusted semiconductor status to European producers and markets.

INTRODUCTION

The US semiconductor supply chain relies heavily on non-US markets and suppliers for a host of activities related to manufacturing. This includes material inputs, wafer fabrication, assembly, packing and testing, and advanced equipment for manufacturing state-of-the-art (SOTA) chips. Intel alone relies on over 16,000 different suppliers.¹ While Europe accounts for only 10 percent of the global semiconductor supply chain,² the US and European semiconductor industries and supply chains are tightly intertwined.

This paper explores the prospects for conceptualizing trust between the US and European elements of the global semiconductor market. Currently, the Defense Microelectronics Activity's (DMEA) list of accredited, trusted suppliers for the defense industrial base (DIB) encompasses US-based suppliers with few exceptions for firms like the British BAE Systems that are already tightly integrated into the DIB.³ The Department of Defense (DoD) often offers exemptions or waives the use of a trusted foundry or trusted suppliers for the DIB due to financial or scheduling reasons. Many DIB entities have therefore been able to circumvent guidelines for the use of a trusted foundry approach, trusted suppliers, and program protection plans.

As a result, extending or tiering trust to firms in allied or like-minded nations could provide additional security guidance to the DIB's selection of non-US suppliers. Figure 1 portrays current and potential conceptualizations of US-trusted semiconductors.

The following sections outline the supply chain interdependence between the US and Europe, the opportunities that exist for building greater semiconductor trust between the US and Europe, the challenges that remain, and future considerations.

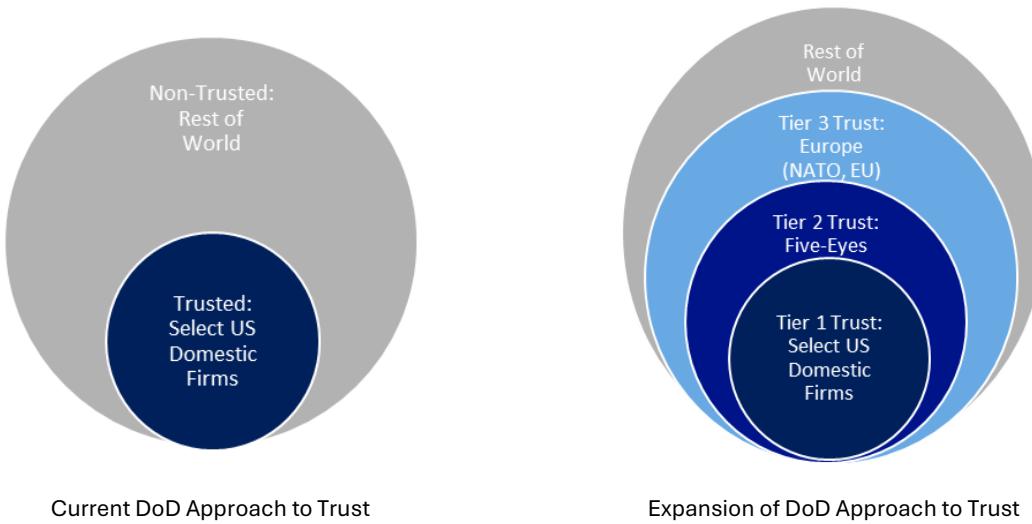


Figure 1. Notional concept of current US trust in semiconductor manufacturing firms and potential expansion.

US-EUROPE SUPPLY CHAIN INTERDEPENDENCE

The US and Europe have interconnected research and development (R&D) and intellectual property (IP) ecosystems. Both the US and European nations prioritize and excel in IP and R&D aspects of the semiconductor value chain.⁴ US R&D efforts collaborate closely with European counterparts. The Interuniversity MicroElectronics Centre (IMEC) in Belgium and CEA-Leti in France, two of the world's leading semiconductor research institutions, both have a decades-long track record of leading joint Europe-US R&D projects.⁵

Additionally, many US firms rely on European companies for IP licensing. Most notably, this includes the United Kingdom-based company, Arm, which licenses the architecture and processor core designs upon which nearly every modern smartphone relies. In recent years, Arm's market share has increased as it provides IP licensing for systems used in Internet of Things (IoT) applications.⁶

Europe is a major hub for suppliers of specialty gases and chemicals. The US semiconductor supply chain relies heavily on Europe for specialty gases and chemicals required for production. European Union (EU) companies account for approximately 34 percent of the gas and chemical supply for the international semiconductor market,⁷ and the EU represents roughly 65 percent of the total global supply chain activities related to specialty gases.⁸ For example, compared to the US supply chain for silicon carbide (SiC) wide bandgap (WBG) semiconductors, America's supply chain for gallium nitride (GaN) WBG devices remains insecure due to Taiwanese and European control of the supply market.⁹

European lithography technology is a chokepoint for the US supply chain. Europe plays a dominant role in exporting semiconductor manufacturing equipment. The EU dominates the market for microlithography and mask making equipment (73.4 percent market share), including over a 70 percent market share in optical exposure equipment.¹⁰ In particular, advanced (deep ultraviolet [DUV] and extreme ultraviolet [EUV]) lithography machinery is critical for chip manufacturers worldwide. Dutch company ASML has a monopoly on machinery for lithography with a nearly 100 percent share of the global market. ASML's EUV lithography machinery is essential for

manufacturing SOTA chips.¹¹ For instance, for 3nm process node chips, lithography comprises approximately 35 percent of the total manufacturing cost.¹² Since 2001, ASML has also been the sole source for US lithography needs after it acquired Silicon Valley Group.¹³ As a result, the geographic concentration of lithography suppliers in Europe—specifically, the Netherlands—is a single point of failure for US semiconductor supply chains that increases the risk of widespread disruptions.¹⁴

Europe remains a significant supplier of semiconductors for the global automotive industry. Although Asia-Pacific companies continue to dominate the market for advanced automotive chips, European firms like STMicroelectronics, Infineon Technologies, and NXP Semiconductors remain key market leaders as major producers of less advanced chips in the automotive industry.¹⁵ Europe currently accounts for nearly 25 percent of the market. However, Europe's suppliers—particularly the German market—are poised to grow with automotive semiconductor demand projected to triple by 2030.¹⁶

The European semiconductor supply chain is heavily reliant on US imports. Europe is a net importer in the global semiconductor market. Nearly 80 percent of suppliers for EU firms—and 63 percent of customers for EU firms—are companies located outside of Europe.¹⁷ The US is a key supplier for the European supply chain. For example, in 2022, nearly 47 percent of the EU's microparts and 44 percent of parts for EU semiconductor manufacturing machinery came from US suppliers.¹⁸ Aside from parts, European firms primarily depend on US companies for advanced design tools and, to a lesser degree, various intellectual property licenses.¹⁹

US capital is indispensable for European semiconductor markets. Investments from US firms are crucial for the European semiconductor industry. As of 2025, companies with primary headquarters and decision-making boards in the United States own over 51 percent shares in Europe's semiconductor markets.²⁰ Moreover, Intel's investment in its Ireland-based fab is Europe's only plant capable of manufacturing SOTA chips. The continent has no indigenous capacity for producing SOTA semiconductors.²¹ US investors also hold significant stakes in European manufacturers of electronic components for semiconductor manufacturing. Between 2015 and 2021, US firms accounted for over 54 percent of minority deals and over 26 percent of mergers and acquisitions in the European sector. Additionally, US venture capital (VC) has played an outsized role in the European market. Between 2003 and 2021, approximately 60 percent of VC investments in European elements of the semiconductor value chain came from non-European sources. US VC investments have made up the lion's share of foreign capital into Europe, dwarfing the investments received from Asian firms.²²

European chip-related firms are highly sensitive to performance fluctuations in the US semiconductor market. The Covid-19 pandemic's disruptions to the global semiconductor supply chain highlight how vulnerable European firms are to American market risks. For instance, two of the top four companies most impacted by US supply chain failures and shortages were the German wafer manufacturing firm Siltronic and ASML.²³ This should come as no surprise, particularly in the case of ASML. The ASML supply chain for EUV lithographic machinery relies on approximately 100,000 individual parts from over 5,000 different suppliers across the globe.²⁴ US firms account for roughly 27 percent of this supply chain.²⁵ Similarly, independent from mutual reliance on East Asian companies, US firms are also sensitive to European market changes. The top seven firms most exposed to risks from the European semiconductor market are all American companies: Hemlock Semiconductor; Micron; Applied Materials; Xilinx (now under AMD); Lam Research; Texas Instruments.²⁶

OPPORTUNITIES FOR BUILDING SEMICONDUCTOR TRUST WITH EUROPE

There are several areas where the US can work with European nations and firms to expand the US ecosystem of trusted suppliers.

The US and Europe can coordinate investments into comparative advantages and shared vulnerabilities. Both the US and the EU have passed major legislation to support their respective semiconductor industries. The US CHIPS and Science Act of 2022 dedicated \$52.7 billion to spur domestic semiconductor manufacturing, R&D, and workforce development. This includes roughly \$39 billion in subsidies for manufacturing semiconductors within the US and \$13 billion for semiconductor research and workforce training. The CHIPS and Science Act also enacted a 25 percent tax credit for investments in semiconductor manufacturing and processing equipment.²⁷ The European CHIPS Act of 2023 set forth €43 billion (approximately \$42.01 billion) for investments from EU members in the European semiconductor market by 2030. The EU's CHIPS Act laid out five strategic goals: (1) strengthen leadership in semiconductor R&D; (2) expand innovation capacity across all production stages; (3) increase EU chip manufacturing to 20 percent of the global market by 2030; (4) address the shortage of skilled workers in the semiconductor industry; and (5) improve the monitoring of global semiconductor supply chains.²⁸

Coordinating investments under these Acts and subsequent legislative efforts can better distribute funding across manufacturing, testing and evaluation, and packaging and assembly across both markets. Doing so can also address needs in regional chip clusters, including workforce development in local economies. Coordinated funding and incentives can also support joint initiatives to ensure supplies of critical minerals for semiconductor manufacturing.²⁹

More broadly, coordinating US investments in the European semiconductor market can help diversify the US supply chain for key inputs while also cultivating Europe's ability to supplement a US-produced "minimum viable capacity" of secure advanced logic chips. European companies like Infineon, X-Fab, and BAE Systems already have chip factories in the US, while US companies like Intel, GlobalFoundries, ON Semiconductor, IXYS, and Analog Devices have fabs in Europe. Coordinated US-EU investments in these transatlantic operations can build a more resilient supply chain by avoiding competition over similar fabrication capacities. By extending a degree of trust to European firms and the European operations of US firms, the US government can also provide guidance on alternative suppliers for DIB entities receiving waivers or exemptions related to US domestic trusted suppliers.

The US and Europe can further coordinate quality and security standards for mutually vulnerable supply chains. Since 2023, the US and the EU have been working together on a joint early-warning mechanism and increased transparency for supply chains and potential disruptions.³⁰ These efforts should continue in tandem with the development of joint standards and methods for supply chain analysis. Additionally, the EU can begin to align security standards with those emerging from the US National Institute of Standards and Technology (NIST) related to input and component provenance across semiconductor supply chains.³¹ Security standards can also extend to common export controls on shared geopolitical threats.

Europe can become a market for chips from Secure Enclave. Current US military and aerospace semiconductor demand for trusted semiconductors remains too low for Secure Enclave production to be financially viable for Intel. One avenue to support Secure Enclave is to recruit end-users from

allies like those in the Five Eyes and the North Atlantic Treaty Organization (NATO) in Europe and Canada. With common geopolitical security outlooks and existing interoperability frameworks, these partners represent a broader potential market for Secure Enclave outside the US government.

CHALLENGES TO GREATER TRUST

The US and Europe have a mutual reliance on East Asian suppliers. Roughly 75 percent of global wafer fabrication capacity is in East Asia and China. The production of logic chips is similarly concentrated in South Korea and Taiwan. Although Intel, Samsung, and Taiwan Semiconductor Manufacturing Company (TSMC) are all capable of manufacturing chips at 10nm nodes, only TSMC and Samsung have successfully mass-produced logic chips under 10nm, with TSMC dominating over 90 percent of the market.³² US dependency on TSMC extends to chips required for the F-35 and other military-grade devices.³³ Both the US and Europe are also deeply dependent on China for critical rare earth materials, testing, and packaging. Moreover, the EU remains a net importer of state-of-the-practice (SOTP) semiconductors with China as the leading exporter.³⁴

Intel has struggled to provide an alternative for SOTA chip production. Intel's poor financial performance in recent years has perpetuated US and European dependence on TSMC for SOTA chips. For instance, Intel's entry into Europe for semiconductor manufacturing was poised to be a critical expansion for US and European SOTA fabrication capabilities. Before 2024, Intel invested a total of \$88 billion in R&D and production in Europe. These investments, along with subsidies received under the European Chips Act, included:

- A manufacturing facility in Magdeburg, Germany, with \$11 billion in subsidies received from the German government;
- Doubling the manufacturing space in its Ireland plant for Intel 4 process technology; and
- An assembly and test facility in Poland for the chips made in Germany and Ireland.³⁵

However, Intel's series of corporate failures and workforce cuts has led to the shuttering of its European facilities, leaving only its established fab in Ireland. As a result, Intel has reduced its global fabrication goals, and Europe's chip manufacturing footprint increasingly hinges on the success of TSMC's factory in Germany.³⁶

Dueling CHIPS Acts have the potential to create a subsidy race. There is no consensus on the type of semiconductor ecosystem the US and Europe aim to establish.³⁷ Uncoordinated investments in the US and EU markets have the potential to leave governments competing for the same manufacturing business. As a result, firms considering business in either location may look to extract the greatest subsidies and incentives from governments. This would leave the US government and EU member states in a costly race to outbid each other for small pool of potential business.

Diverging national security views on China pose a threat to the supply chain and US trust in European semiconductors. In contrast to the US, Europe has traditionally been more accepting of Chinese presence and influence in economic markets. For the EU, national security remains a member state prerogative, including adherence to US controls on semiconductor technology released to China.³⁸ The Dutch government's initial resistance and ultimate agreement to US

controls involving ASML's technology³⁹ highlight the political and diplomatic friction facing greater trust-building across US-Europe semiconductor supply chains.

CONCLUSION: FUTURE CONSIDERATIONS

Future research can explore two crucial issues related to implementing a broader trust framework with partners abroad, including those in Europe. First, further research can investigate the application of aspects of a zero-trust mindset to the semiconductor supply chain. In recent years, the DoD has undertaken several efforts related to zero-trust architecture in digital computing and network environments.⁴⁰ The opportunity exists to leverage this momentum to establish verification criteria that domestic and foreign semiconductor manufacturers must meet in advance for inclusion into a network of trusted suppliers. How those criteria are developed and met represents a fertile area for future work. Second, and relatedly, subsequent research can explore the implementation of a transatlantic framework for blockchain verification across the semiconductor supply chain. Blockchain has already proven useful for elements of the semiconductor industry,⁴¹ and future work can explore the political opportunities and challenges associated with utilizing blockchain to build trust across international semiconductor value chains.

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ENDNOTES

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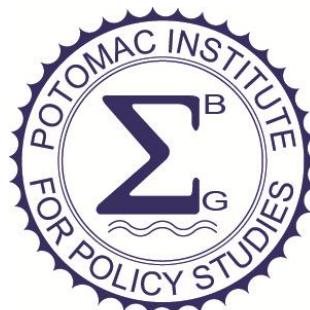
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