



The global semiconductor talent shortage

Key workforce challenges and strategies to overcome them

Industry trends and challenges

In 2022, Deloitte expected that the global semiconductor industry would need to add a million skilled workers by 2030, or more than 100,000 annually.¹ Two years later, that forecast still holds. But key industry trends continue to compound the talent challenge:

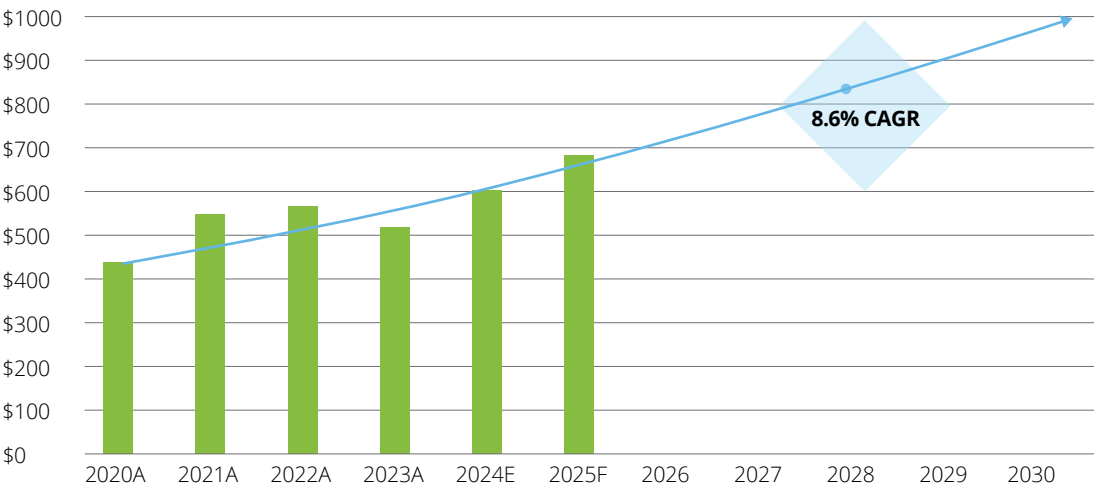
- 1. Advanced skills driven by demand for Generative AI (GenAI):** The talent needed for advancing technologies, such as GenAI, is often in high demand and can be difficult to attract and retain in a competitive talent market.
- 2. Looming talent cliff and low industry appeal:** The semiconductor industry is facing an aging workforce without a clear plan for succession, which may be further exacerbated by low industry appeal compared to the broader tech industry.
- 3. Global solutions needed for a global challenge:** Localization of manufacturing, as well as overall global demand trends, is contributing to a talent and skills shortage that spans the globe. Semiconductor companies are often left competing over the same insufficient pool of existing talent.
- 4. Talent outcomes tied to global chips laws:** Both the US and European Chips Acts include specific objectives and grant application requirements regarding workforce development that companies should commit to in order to receive funding, remain in compliance, and achieve growth objectives.

5. Repatriation of manufacturing and backend processes:

Geopolitical concerns and supply chain fragility continue to contribute to the onshoring of manufacturing (advanced node, trailing node, memory) and back-end ATP (assembly, test, and packaging) processes.

The cyclical chips industry experienced its seventh downturn since 1990, with revenues declining 9% to \$520 billion for 2023.² As a result, development of some new fabrication capacity has been extended,³ which has also likely delayed some of the immediate, short-term need for talent. This downturn is expected to be temporary, with revenue set to grow by 16% in 2024 to an all-time high of \$611 billion.⁴ With the industry back on track to reach the \$1 trillion figure for 2030 (figure 1),⁵ talent will be needed to fuel that growth. But now there's more time to optimize talent forecasts, mix, pipeline, skills and capabilities, and development plans. A richer understanding of the challenges driving the semiconductor talent shortages can enable semiconductor leaders to deploy targeted strategies to help address their looming talent needs.

Figure 1. The path to \$1 trillion in semiconductor revenues



WSTS – World Semiconductor Trade Statistics; CAGR – compound annual growth rate

■ WSTS actuals, estimates, and forecasts ■ \$1T slope

Advanced skills being driven by demand for GenAI

According to Deloitte's 2023 Smart Manufacturing: Generative AI for Semiconductors Survey, 72% of industry leaders surveyed predict that GenAI's impact on the semiconductor industry will be "high to transformative."⁶ Respondents saw high potential for Generative AI's use throughout their business, with heavier value realization expectations within core engineering, chip design and manufacturing, operations, and maintenance.⁷

Although GenAI may help alleviate some engineering talent shortages by addressing routine tasks and giving engineers more time to perform their core jobs better and faster,⁸ the GenAI skill set scarcity remains.

The semiconductor workforce is expected to need to exponentially grow its GenAI skill sets due to their shortage in the market. And leaders in the field are often in high demand across most sectors of the economy. Semiconductor companies should consider offering more novel benefits beyond competitive compensation, such as having a seat at the table, to better attract AI talent and leadership.⁹ Having proficient GenAI talent is key in driving the industry's ability to innovate and reap the benefits of this transformative technology.



Looming talent cliff and low industry appeal

An aging workforce, regulatory changes, newly required skill sets, and shifting employee expectations are changing the landscape of semiconductor talent. The lack of brand awareness and appeal in the semiconductor industry compared to better-known technology brands can make addressing these challenges more difficult for the industry.

Semiconductor companies seem to recognize that attracting and retaining new and diverse talent is more important than ever, yet it continues to be a challenge for many organizations. Building diversity can be difficult; currently only one-third of the US semiconductor industry employees identify as female and less than 6% as Black or African American.¹⁰ The US semiconductor workforce is also older than other technology industries: As of July 2024, 55% of the US semiconductor workforce is 45 or older, with less than 25% under the age of 35.¹¹ In Europe, 20% of the industry is 55 or older, with Germany expecting about 30% of their workforce to retire over the next decade.¹²

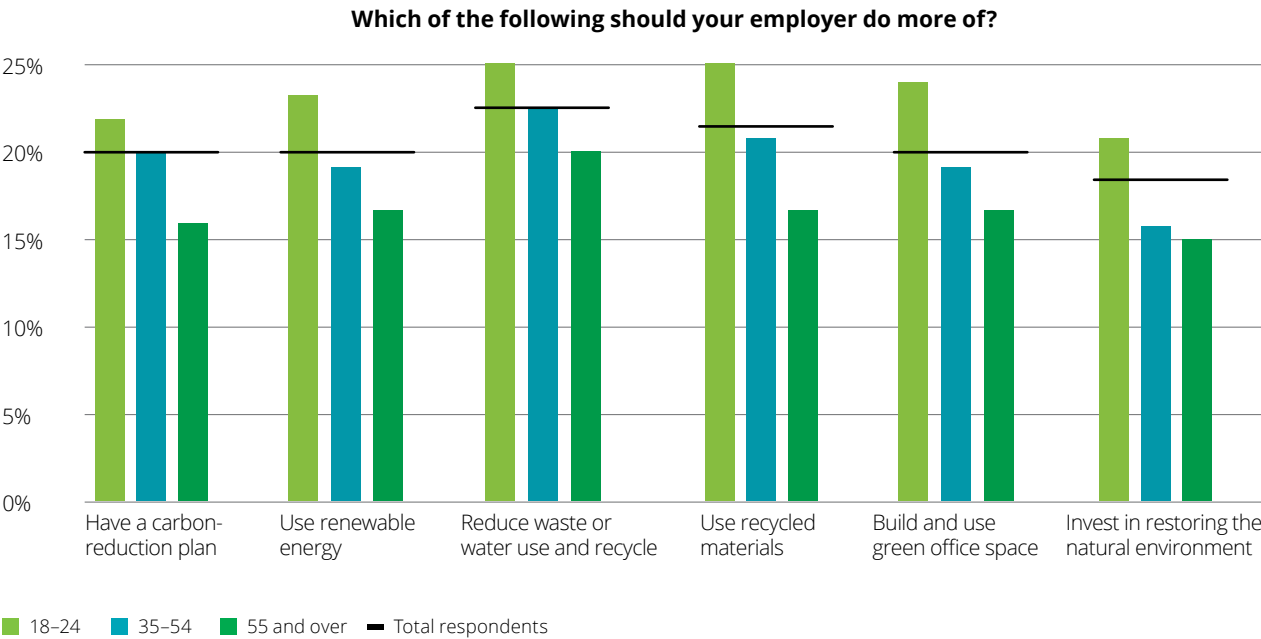
Commitment to sustainability goals is important for overall industry sustainability, as well as attracting prospective talent.¹³ According to Deloitte's most recent State of the Consumer Survey,

69% of employed adults surveyed want their companies to invest in sustainability efforts, with 24% saying they considered switching jobs for a more sustainable employer.¹⁴ And sustainability expectations are highest for those in the 18–34 age range (figure 2).¹⁵ Largely shielded from sustainability targets in the past, companies are now often expected to balance production output with their carbon footprint, requiring new knowledge and skill sets to optimize both production and sustainability.

Inconsistent knowledge management, and the lack of new talent to adopt institutional knowledge, presents an additional workforce barrier for many semiconductor companies.

Relative to other sectors of the technology industry, semiconductor organizations can offer a sense of trust, stability, and projected market growth—attractive qualities to the most recent college entrants.¹⁶ While semiconductor companies may have struggled with brand recognition and a competitive employee value proposition, investing in recent high school graduates could help reinvigorate talent pipelines that may be more attracted to stability and flexibility over rapid advancement.

Figure 2. The sustainability actions employees (by age) want to see



Source: Deloitte State of the Consumer Survey, March 2023.

Global solutions needed for a global challenge

The need for semiconductor talent is a global issue. Countries are not producing enough skilled talent to meet their workforce needs. And companies can't continue to tussle over the same finite talent pool while still expecting to successfully grow the industry, launch new (and expand existing) fabs, and keep up with rapid technological advances.

In the United States, where the majority of annual graduates with a master's degree in semiconductor-related engineering fields are foreign students, 80% of those graduates do not stay in the United States post-graduation.¹⁷ According to Deloitte China and Asia Pacific's most recent APAC Semiconductor Industry Trends Survey, 90% of companies surveyed highlighted talent acquisition and development as a top priority to sustain industry growth and competitiveness, while 63.3% highlighted talent capability and retention as major industry risks.¹⁸ As Asia looks to expand its semiconductor industry beyond key historical players, significant shortages can also be expected. For example, India's semiconductor industry is looking at a potential deficit of 250,000 to 300,000 professionals by 2027.¹⁹ For the European Union to achieve its goal of doubling its market share by 2030, an ambition set in the European Chips Act, it is estimated that the industry will need 400,000 additional workers.²⁰ Meanwhile, in the United States, the Semiconductor Industry Association estimates that of the more than 100,000 new industry jobs in manufacturing and design expected by 2030, 67,000 are at risk of going unfilled.²¹

Talent outcomes tied to global chips laws

For companies applying for, or having received, US CHIPS and Science Act funding, their workforce strategy, planning, development, and activation can be critical components for both grant eligibility and ongoing compliance. Funding opportunities require a clearly documented workforce strategy, commitments to training programs in concert with state and local educational entities, and expanded education and employment opportunities for economically disadvantaged individuals.²²

For the European Chips Act, applicants are asked to include information on their plans to invest in education, skills, and pipeline development, including differentiating between their normal workforce training activities and those targeting specific industry needs in the region.²³ As funding continues to be released, and fab expansion ramps up, the need for construction and facilities employees are expected to grow, further challenging the already constrained talent market.

Repatriation of manufacturing and back-end processes

Localization of manufacturing and regionalization of supply chains are compounding the semiconductor talent shortage. And there have been communications that talent challenges are contributing to delays in opening new plants.²⁴

Seeking to increase their individual shares of overall chip manufacturing from 10% to 20%, the United States and Europe have already allocated nearly \$100 billion in government funding.²⁵ For advanced node manufacturing specifically, Asia—predominantly Taiwan—continues to lead globally with well over 80% of the market share.²⁶ The United States is expected to increase its advanced node manufacturing share to 22% by 2027.²⁷ Europe is also looking to increase its market share through the European Semiconductor Manufacturing Company (ESMC), a joint investment by several semiconductor companies with the goal of bringing advanced node manufacturing to Europe.²⁸

In Asia, there is also investment to increase manufacturing outside of Taiwan. Japan has committed \$13 billion to reinvigorate manufacturing in the region,²⁹ including funds to support a joint venture founded in 2022 between several major Japanese companies with the goal of mass-producing the most leading-edge chips.³⁰ Malaysia, already strong in testing and packaging, is looking to invest more than \$100 billion to increase its design, advanced packaging, and manufacturing capabilities.³¹ India has also approved more than \$15 billion in investments to expand manufacturing capabilities in the country's growing industry.³²

Even with recent announcements of ATP capacity in Poland³³ and Arizona,³⁴ more than 80% of all ATP capacity still resides in Asia,³⁵ creating long and often fragile supply chains. Without additional

investments beyond the current US and European Chips Acts, the lack of ATP capacity outside of Asia could continue impeding US and European goals of semiconductor manufacturing self-sufficiency. The United States and Europe should invest in increasing their ATP capacities and work to develop and attract the necessary skilled talent.

The evolving and complex geopolitical landscape is likely to further affect the availability of talent supply globally and may continue to introduce artificially created imbalances. The United States has not only restricted export of advanced node AI chips and chipmaking equipment, but also limits US persons from performing work for certain Chinese chipmakers without special licensing.³⁶ In addition, the US government is working with allies across Europe and Asia to similarly control their exports to China.³⁷ To counteract, China has been aggressively recruiting expatriate talent—and is continuing to do so with high salaries, free homes, and more³⁸—creating a potentially more appealing job market compared to other semiconductor markets.

While the onshoring or reshoring of manufacturing can be critical to supply chain security, there are also benefits through “friendshoring”—partnering with suppliers from friendly countries—to provide more stability, while also increasing economic resilience of the global supply chain.³⁹ One example of this “friendshoring” can be found in the economic alliance between the United States and Japan to reduce reliance on single suppliers and stabilize the supply of essential electrical components.⁴⁰ This means adding production in places where it does not exist today, requiring talent with the right skills to help meet new capacity demands.

Talent strategies and solutions

To help mitigate the challenges outlined above and create new opportunities, semiconductor companies—and the industry as a whole—should consider these priorities across workforce planning and access; workforce skills, development, and retention; and technology enablement:

- 1. Workforce planning and access:** Companies should enable **agile workforce planning** by implementing talent strategies with a workforce mix that can help address their immediate operational needs while also allowing them to adjust to market fluctuations. And, in addition to improving brand marketing and job attractiveness to better recruit talent, semiconductor companies should have **comprehensive pipeline development and recruiting strategies**. These should be defined and implemented in coordination with other semiconductor companies, educational institutions, and industry and community organizations, prioritizing underrepresented populations for a more comprehensive global solution.
- 2. Workforce skills, development, and retention:** A right-skilled workforce starts with a skilled pipeline. While the pipeline is under development, companies should have a comprehensive view of their current skills and gaps, strategic knowledge management tools and processes, and flexible upskilling/reskilling programs that can allow for career path flexibility as technology advances and skills requirements change. Semiconductor companies can improve industry appeal and talent retention through a **shared value proposition** with an attractive and supportive culture, total rewards strategy, and comprehensive DEI (diversity, equity, and inclusion) and sustainability strategies. More clearly defined and attainable career paths can also help improve brand perception and meet the expectations of today's workforce.
- 3. Technology enablement:** HR organizations should have the **capabilities, tools, technology, and data insights** to assess their organizations' workforce supply, demand, and current and projected spend—enabling successful implementation of enterprise workforce strategies. With AI-enabled tools that span the talent life cycle, capabilities such as complex workforce scenario modeling can be more effectively leveraged. Changing workforce technologies also require **comprehensive change management strategies** to upskill employees, increase adoption, and optimize technological capabilities.

Workforce planning and access

To better attract new talent as opposed to continuing to compete for the same existing talent pool, the semiconductor industry should increase efforts to develop viable and long-lasting talent pipelines—including identifying and accessing more diverse and underrepresented talent—and address the lack of industry appeal. While there are company- and region-specific efforts to address semiconductor talent challenges,⁴¹ there currently is no comprehensive industrywide approach designed to address these issues while also providing long-term talent stability for the industry.

Workforce planning and talent strategies should enable optimal ways of working through a data-driven approach to innovation and human-centered solutions. Talent mix strategies should identify and leverage a diverse workforce mix across build, buy, and borrow models to help fill short- and long-term talent needs within target functions. To optimize their workforce planning, semiconductor companies should:

- **Leverage the industry's robust ecosystem** of partners—including trade organizations, educational institutions, and nonprofits—to act holistically and better address the global talent pipeline shortages.

- **Be mindful of talent integration** across vastly different corporate cultures as companies expand their global footprint. When talent integration isn't managed in a deliberate fashion, long-term retention can be at risk, potentially wasting pipeline development and talent attraction efforts.
- **Address the lack of industry awareness and appeal** through targeted marketing using a variety of media to help reach new and underrepresented populations and across adjacent industries. A publicly marketed value proposition can focus on global sustainability and reduced environmental impact, technological innovation, and creation of shared economic and social value—all of which can be very attractive to new talent.
- **Increase investment in younger generations**, as well as underrepresented populations, as targets for roles outside of traditional four-year education programs. Multiple semiconductor companies, as well as government and educational institutions, have already implemented training programs aimed at developing semiconductor facility technicians.⁴²



Workforce skills, development, and retention

Workforce strategies and career models should target specific skill development, increase workforce agility and mobility, and improve job appeal—with the goal of prioritizing needed capacity, addressing the aging workforce, and better attracting and retaining talent for long-term sustainability. Attracting a talent pipeline and retaining talent once onboard should be supported by a robust DEI strategy, total rewards strategy, and culture-to-values alignment to help improve workforce agility and mobility. Companies should have a shared value proposition with their employees that can both enable business objectives and support personal growth and priorities.

Understanding existing talent skill sets using market intelligence can identify skills gaps that are often exacerbated by rapid market growth. Building a talent strategy around a skills-based organization can match talent gaps with adjacent-skilled workers who can be great candidates for upskilling or reskilling.

Semiconductor companies should consider:

- Integrating internal supply and demand data with external staffing procurement to make better-informed talent decisions.
- Utilizing workforce data integration to remove manager bias evaluating the full-time/contingent/gig worker mix, helping to couple talent decisions with the overall business strategy.
- Leveraging workforce planning and modeling to help improve workforce planning, management, and efficiency.
- Addressing skills gaps through targeted solutions such as upskilling existing manufacturing and design talent or prioritizing specific pipeline segment development.
- Identifying adjacent skill sets, as workers may already possess skills that they may not be using today but can be fast-tracked to take on roles within semiconductor design and advanced manufacturing processes.
- Investing in regional cross-training and upskilling advanced node fabrication talent, creating a more flexible talent pool and broader career path options.
- Creating comprehensive knowledge management tools and processes to improve organizational skills retention.

Technology and HR enablement

As business leaders contend with new technology, it's important to understand the pulse of adoption and how to accelerate engagement, change management, and upskilling of the workforce. This can be especially true with advanced AI capabilities, which can augment talent and generate significant value. AI can be used as an integral part of talent acquisition and management, providing insights such as quantifying the potential impacts of AI on human roles or modeling complex workforce scenarios to drive strategic talent decision-making. Skills-based job architectures can be analyzed for opportunities to increase capabilities and efficiencies using AI, consolidating workforce gaps and reducing the total workforce spend.

Additionally, bringing technology and AI into workforce planning can help enable actionable plans for addressing skills-gap hotspots, identifying hiring and internal mobility target areas, and defining upskilling and reskilling opportunities. Deploying predictive analytics via AI-enabled tools to better forecast retention, performance, and longevity can optimize talent acquisition pipelines and internal mobility, leading to more clearly defined and attainable career paths.

The semiconductor industry is at an inflection point: Revenue is forecasted to reach \$1 trillion by 2030, but the industry continues to face widespread talent challenges, as outlined above. It is important that semiconductor companies look holistically across their current maturity, capabilities, and pain points to develop talent roadmaps enabled by robust technology solutions. Solution roadmaps should be discrete and actionable to help address semiconductor companies' short-term talent needs while also helping set up the global industry for long-term talent success and sustained advantage.

Contacts

Sergey Shchemelev

US Human Capital Semiconductor Leader
sshchemelev@deloitte.com

Christie Simons

Global Semiconductor CoE Leader
csimons@deloitte.com

Jordan Bish

EMEA Semiconductor Leader
jbish@deloitte.nl

Duncan Stewart

Managing Director of Global
Semiconductor Research
dunstewart@deloitte.ca

Teresa Lewis

US Semiconductor Talent Strategy Lead
terlewis@deloitte.com

Brandon Kulik

US Semiconductor Leader
bkulik@deloitte.com

Jan Nicholas

APAC Semiconductor Leader
jnicholas@deloitte.com

Karen Weisz

US Human Capital Semiconductor Advisor
kweisz@deloitte.com

Acknowledgements

The authors would like to thank Laura Winterton, Rebecca Greenberg, and Daniel Doubet for their contributions to the research and insights of this report.

Endnotes

1. Karen Weisz et al., "[The global semiconductor talent shortage](#)," Deloitte, 2022.
2. Worldwide Semiconductor Trade Statistics (WSTS), "[WSTS Semiconductor Market Forecast Fall 2023](#)," press release, November 28, 2023.
3. Asa Fitch, "[Intel delays \\$20 billion Ohio project, citing slow chip market](#)," *Wall Street Journal*, updated February 2, 2024.
4. WSTS, "[WSTS Semiconductor Market Forecast Fall 2023](#)."
5. WSTS, "[WSTS Semiconductor Market Forecast Spring 2024](#)," press release, June 4, 2024.
6. Bobby Mitra et al., "[How Generative AI is transforming the semiconductor industry](#)," Deloitte, 2024.
7. Ibid.
8. Belle Lin, "[Designing chips is getting harder. These engineers say chatbots and AI can help](#)," *Wall Street Journal*, February 6, 2024.
9. Kyle Langworthy, "[The seven keys to attracting top AI leadership talent](#)," *Forbes*, August 8, 2024.
10. Deloitte's Labor Market Intelligence, July 2024.
11. Ibid.
12. Anne-Françoise Pelé, "[Semiconductor capacity is up, but mind the talent gap](#)," *EE Times Europe*, April 15, 2024.
13. Steve Watkins, Duncan Stewart, and Bobby Mitra, "[Semiconductor sustainability trends](#)," February 2024.
14. Jennifer Steinmann et al., "[Engaged employees are asking their leaders to take climate action](#)," Deloitte, November 9, 2023.
15. Ibid.
16. Michael Stone, "[Gen Z: They crave stability and trust, so give it to them](#)," *Forbes*, May 18, 2021.
17. Semiconductor Industry Association (SIA), "[Chipping away: Assessing and addressing the labor market gap facing the U.S. semiconductor industry](#)," July 25, 2023.
18. Deloitte China, [APAC Semiconductor Industry Trends Survey](#), 2024.
19. Vijay Anand, "[This industry may be short 300,000 skilled professionals in India](#)," CNBC TV18, June 11, 2024.
20. Pelé, "[Semiconductor capacity is up, but mind the talent gap](#)."
21. SIA, [Chipping away: Assessing and addressing the labor market gap facing the U.S. semiconductor industry](#).
22. National Institute of Standards and Technology (NIST), US Department of Commerce, [Notice of Funding Opportunity \(NOFO\): CHIPS Incentives Program – Commercial Fabrication Facilities](#), April 19, 2024.
23. Official Journal of the European Union, "[Communication from the Commission on the Guidance on the application for an undertaking to obtain the status of integrated production facility and open EU foundry pursuant to Article 15 of the Chips Act Regulation \(EU\) 2023/1781](#)," August 20, 2024.
24. Michelle Toh, "[TSMC says its \\$40 billion chip project in Arizona faces a further delay](#)," CNN, January 19, 2024.
25. European Union, [European Chips Act](#), accessed September 2024; US Department of Commerce, "[ICYMI: Secretary Raimondo delivers update on CHIPS and Science Act implementation, lays road ahead for supercharging innovation and revitalizing American semiconductor manufacturing](#)," press release, February 27, 2024.
26. Chosunilbo, "[Editorial: Semiconductor factories leaving Korea for the US to weaken Korea's backbone industry](#)," *Chosun Daily*, updated May 10, 2025.
27. Trendforce, "[Foundry capacity market share of advanced process to decline in Taiwan, Korea until 2027, while US on the rise](#)," May 14, 2024.
28. Maurizio Di Paolo Emilio, "[TSMC, Bosch, Infineon, and NXP collaborate on European semiconductor manufacturing venture](#)," *Power Electronics News*, August 8, 2023.
29. Tetsushi Kajimoto and Sam Nussey, "[Japan to spend \\$13 bln for chip industry support in extra budget](#)," Reuters, November 10, 2023.
30. Government of Japan, "[Japan's pursuit of a game-changing technology ecosystem for semiconductors](#)," March 1, 2024.
31. Danial Azhar, "[Malaysia targets over \\$100 bln in semiconductor industry investment](#)," Reuters, May 28, 2024.
32. Sheila Chiang, "[India approves three chip plants with over \\$15 billion in investments to realize semiconductor ambitions](#)," CNBC, February 29, 2024.
33. Intel, "[Intel plans assembly and test facility in Poland](#)," press release, June 16, 2023.
34. Amkor Technology, "[Amkor announces US advanced packaging and test facility](#)," press release, November 30, 2023.
35. Raj Varadarajan et al., [Emerging resilience in the semiconductor supply chain](#), Boston Consulting Group (BCG) and SIA, May 2024.
36. Bureau of Industry and Security, U.S. Department of Commerce, "[Commerce implements new export controls on advanced computing and semiconductor manufacturing items to the People's Republic of China \(PRC\)](#)," press release, October 7, 2022.
37. Megan Kelly, "[Restrictions tighten on Chinese semiconductor firms](#)," *Automotive Logistics*, April 15, 2024.
38. Reuters, "[China quietly recruits overseas chip talent as US tightens curbs](#)," August 24, 2023.
39. Melania Rojas et al., "[Reshoring and 'friendshoring' supply chains](#)," Deloitte Insights, March 24, 2022.
40. Converge, "[Friendshoring between the U.S. and Japan: Strengthening the semiconductor and electronics supply chain](#)," July 17, 2024.
41. Intel, "[Intel launches its first US apprenticeship for manufacturing facility technicians](#)," press release, July 15, 2024; Maricopa Community Colleges, "[Learn the skills you need to get hired in one of Arizona's fastest-growing industries—in just 10 days](#)," accessed September 2024; Austin Community College District, [Semiconductor Technician Advanced Rapid Start \(STARS\) Program Matrix](#), accessed September 2024.
42. Ibid.



This publication contains general information and predictions only and Deloitte is not, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your business. Before making any decision or taking any action that may affect your business, you should consult a qualified professional adviser. Deloitte shall not be responsible for any loss sustained by any person who relies on this publication.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States, and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see www.deloitte.com/about to learn more about our global network of member firms.