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Closing the Talent Gap in the Semiconductor Industry

2026

This material was developed by McKinsey & Company for research and informational purposes and is published in collaboration with SEMI Foundation and the National Network for Microelectronics Education (NNME).

The analysis is intended to inform industry, education, and workforce stakeholders and was not commissioned, conducted, or used as part of the evaluation or selection of NNME Regional Nodes.

Executive summary (1/3)

Introduction and Context

The United States is entering the most significant expansion of domestic semiconductor manufacturing capacity in its history. Announced investments exceeding **$390 billion** across more than **16 states,** spanning logic, memory, analog, advanced packaging, and materials—are expected to begin ramping materially between **2026 and 2030**. These commitments underscore the semiconductor sector's central role in U.S. economic competitiveness, supply chain resilience, and national security.

This expansion creates a clear and persistent workforce challenge. The U.S. does not currently produce sufficient **engineers, technicians, or computer scientists** entering semiconductor roles to support the scale, speed, and geographic concentration of planned capacity. Without targeted intervention, talent shortages risk delaying fab start-ups, constraining production ramps, slowing design and R&D innovation, and reducing the realized impact of CHIPS Act incentives.

While today's workforce is roughly balanced with current demand, this equilibrium is temporary. Fab ramp timing, ecosystem expansion, and replacement demand driven by attrition and retirements are expected to create acute workforce pressure later this decade. Addressing these constraints requires coordinated action across education, industry, and government, aligned to both regional needs and a national semiconductor workforce strategy.

NNME's mission is to align education and employer-driven training to meet industry needs. Through Regional Nodes, NNME aims to build scalable, industry-aligned talent pipelines that collectively support a cohesive national strategy.

Workforce Demand

Projected semiconductor workforce demand grows rapidly and unevenly through 2030, driven primarily by manufacturing expansion. Across announced fab investments and baseline replacement needs, cumulative incremental demand is projected to reach **~189,000 FTEs** between **2026 and 2030,** including ~104,000 Engineers, ~73,000 Technicians, and ~12,000 Computer Scientists.

Demand is **highly concentrated geographically**, with the largest requirements in fab-intensive states including **Texas, California, Arizona, New York, Ohio, Oregon, and Idaho**. Peak hiring is compressed into narrow ramp windows, creating sharp near-term pressure rather than gradual national absorption.

Manufacturing roles drive the majority of demand. Approximately **~74% of incremental workforce needs** are manufacturing-related, with **manufacturing engineers and technicians** accounting for most new roles. Equipment manufacturing contributes an additional **~8%**, while **IC Design and R&D account for ~18%** (12% and 6% respectively), concentrated in established hubs such as California, Texas, Massachusetts, New York, Arizona, and Oregon.

Demand survey results reinforce these findings. **73% of employers** report significant difficulty hiring engineers today, exceeding challenges for technicians or computer science roles. Nearly all respondents expect shortages to **intensify over the next 3–5 years**, with many citing near-term hiring needs in the **hundreds of engineers per site**.

Executive summary (2/3)

Workforce Supply	Semiconductor workforce supply is driven by multiple pipelines, each with distinct dynamics and limitations. These include in-state and out-of-state graduates, international student retention, professional migration, and public- and private-sector initiatives. Projected supply is expected to reach **~62,000 FTEs** between **2026 and 2030.** Engineer supply is the most constrained. Only **~3% of engineering graduates** ultimately enter the semiconductor industry, limiting annual inflows from traditional degree pathways. Engineering supply changes gradually across all modeled scenarios, reflecting long education timelines, specialization requirements, and low industry entry rates. Survey results suggest these constraints are structural: employers consistently cite shortages in process, device, equipment, and systems engineering roles, as well as applied problem-solving capabilities. Technician supply is more elastic but uneven. **CHIPS-funded programs materially expand technician pipelines**, particularly through community colleges, apprenticeships, and quick-start models. Without CHIPS support, only **~13% of manufacturing technician demand** would be met. Even with funding, outcomes vary significantly by state based on employer participation and program maturity. State-level readiness differs meaningfully. Arizona has partially offset technician demand through coordinated pipeline investments but continues to face engineering shortages. California and New York experience supply pressure driven by net negative professional migration. Conversely, some states show relative graduate surpluses after migration, presenting an opportunity to strengthen **interstate mobility**, particularly for engineers who demonstrate higher willingness to relocate.
Future Workforce Needs and Talent Gaps	National modeling indicates a **persistent semiconductor workforce shortfall through 2030**, even under optimistic assumptions for productivity, migration, and CHIPS implementation. The total projected gap ranges from **~127,000 to ~157,000 FTEs** by 2030. Engineers represent the binding constraint. Engineering gaps are projected at **~83,000–88,000 FTEs**, accounting for approximately **~60% of total unmet demand**. Technician gaps range from **~38,000–63,000 FTEs**, depending on the scale and effectiveness of CHIPS-funded programs. Computer scientist gaps are comparatively small (**~6,000 FTEs**) but remain critical for design, automation, and modeling functions. Shortages are **geographically concentrated and slow to resolve**. Texas, California, New York, Arizona, and Oregon face the largest cumulative gaps due to overlapping fab ramps and ecosystem concentration. Ohio remains relatively well positioned in the near term but is projected to move into deficit later in the decade as Intel ramps toward full production. Structural drivers include fab buildouts outpacing education capacity, low engineering conversion into semiconductor careers, competition from adjacent industries, uneven geographic distribution of roles, and an aging workforce approaching retirement.

Executive summary (3/3)

Catalog of Current Solutions

Existing workforce initiatives deliver impact today but are **not structured to scale** to national semiconductor workforce needs.

Technician training programs produce fast, localized results. Employer-linked models, such as quick-start programs and apprenticeships, achieve **~70–90% placement**, but benefits remain concentrated in fab-adjacent regions and tied to specific hiring cycles.

Engineering programs generate long-term value but scale slowly. Faculty constraints, specialized infrastructure, and multi-year curricula limit throughput, and **conversion into semiconductor roles remains below 5%**. Many programs depend on single employers or short-term funding, increasing vulnerability to shifts in fab timing and demand.

Few initiatives are designed for replication across regions. Limited standardization in curricula, infrastructure, and performance metrics constrains national deployment, despite evidence of local success.

Gap Analysis and Action Planning

Closing the semiconductor talent gap requires **coordinated, role-specific action** across education, industry, and government.

- **Technician gaps** require rapid expansion of employer-linked, short-cycle training programs that can scale with manufacturing ramps.
- **Engineering gaps** require earlier exposure to semiconductor careers, targeted conversion from adjacent industries, enhanced graduate retention, and improved geographic mobility.
- **Regional strategies** should align workforce investments to local ecosystem strengths, manufacturing, equipment, design, or R&D, rather than pursuing isolated, state-by-state approaches.
- **Durable public–private coordination** is essential to enable replication, sustained funding, and shared accountability, particularly through national platforms such as NNME.

Without these interventions, workforce shortages, not capital, are likely to become the binding constraint on U.S. semiconductor expansion through 2030.

Final report

2026

1 **Demand**
How large is the workforce challenge, and where is it concentrated?

2 **Supply**
Where does semiconductor talent come from today?

3 **Future workforce needs**
What does the resulting talent gap look like?

4 **Catalog of current solutions**
Which solutions exist today, and how scalable are they?

5 **Gap analysis and action planning**
What could be done to close the remaining gap?

1. Demand

Semiconductor workforce demand will reach ~189k FTEs by 2030, driven primarily by manufacturing expansion

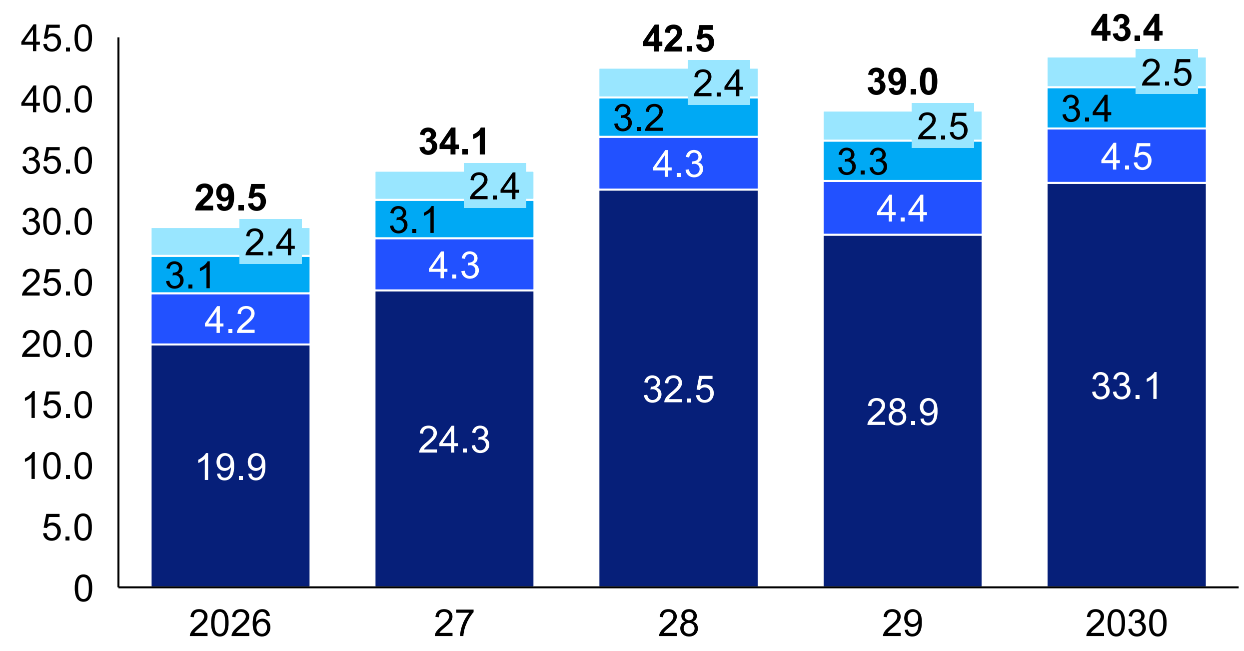
- **~104k Engineer, ~73k Technician, and ~12k Computer Scientist incremental semiconductor jobs** will be required between 2026–2030, reflecting announced fab expansions and baseline attrition replacement
- **~74% of incremental demand is manufacturing-related**, with manufacturing engineers and technicians accounting for the majority of new roles
- Demand is **highly concentrated in a small number of fab-heavy states**, creating sharp, near-term hiring pressure rather than gradual national absorption
- **Fab ramp timing creates demand spikes**, with peak hiring compressed into a narrow window that local pipelines are not designed to absorb

1. National semiconductor workforce demand reaches ~189k FTEs by 2030, driven by manufacturing roles

2026-30, thousands of FTEs

■ Manufacturing[1] ■ Equipment Manufacturing[2] ■ IC Design[3] ■ R&D[3]

Incremental semiconductor workforce demand, by function[4]



Cumulative total	30	64	106	145	189

Cumulative	% total
12	6%
16	8%
22	12%
139	74%

Key takeaways

~189k semiconductor jobs will be required to support new and expanded fabs by 2030

Manufacturing accounts for ~74% of incremental demand, making it the primary driver of workforce needs

Demand growth accelerates materially **after 2027** as multiple large fabs ramp in parallel

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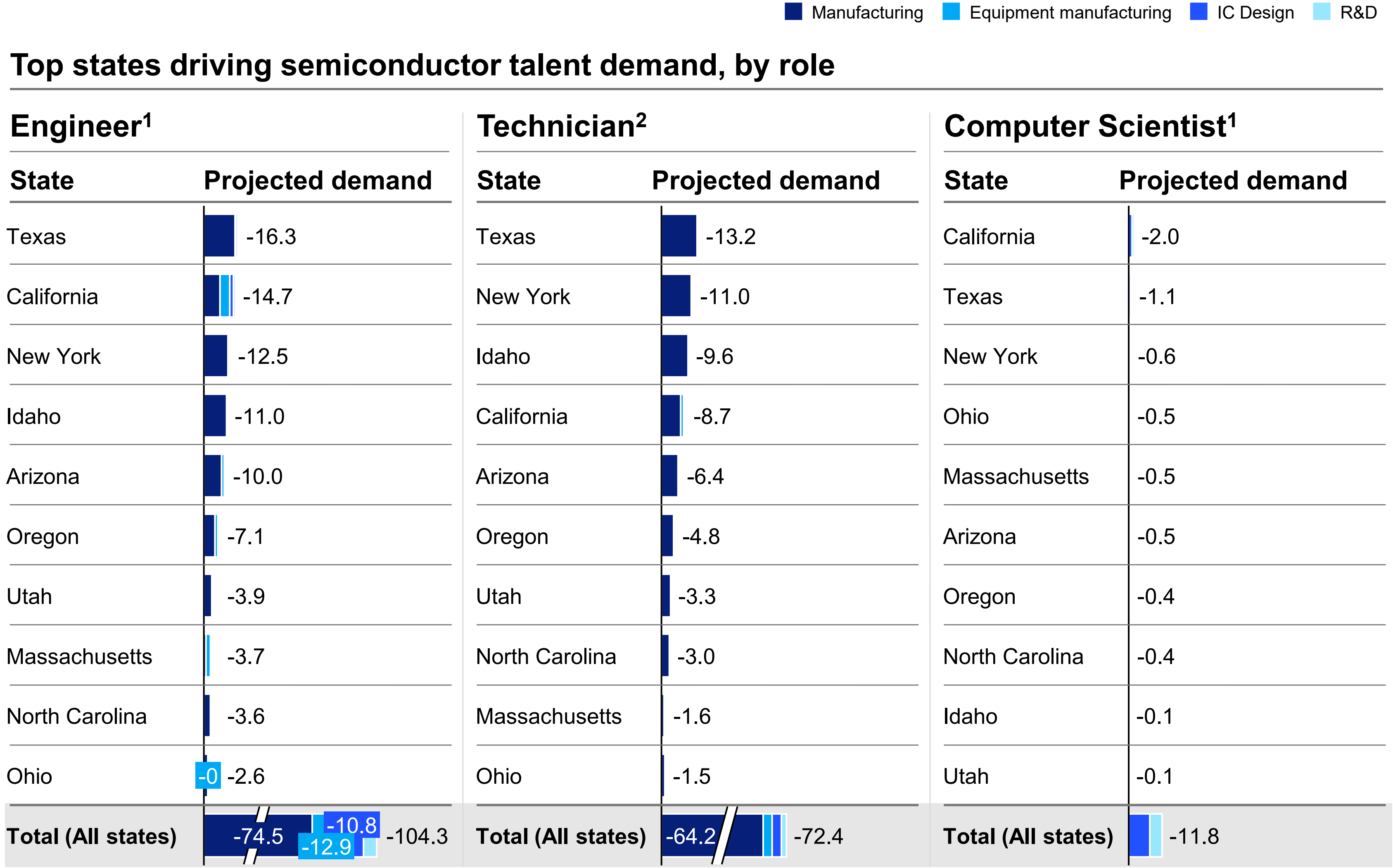
1. Manufacturing labor demand based on 36 publicly announced fabs listed in Q3 2025 SEMI WFF database with tool install starting in or after 2025; headcount estimates will increase if new fab announcements are made after publication of this page
2. Derived from attrition of existing and new equipment manufacturing engineers, based on state-level NAICS 333242 employment data
3. Derived from NSF-reported semiconductor R&D investment, allocated to states using NSF and SIA industry data, and translated into FTE using average wage rates and industry growth assumptions
4. All functions assumed to experience 5% industry attrition rate (based on reported turnover rates in company public filings)

Source: SEMI WFF, SIA, Lightcast, US Bureau of Labor Statistics, US Census Bureau, NSF, McKinsey industry benchmarks

1. Demand is concentrated in a small number of states, primarily by engineers and technicians

2026-30, thousands of FTEs



Top states driving semiconductor talent demand, by role

Engineer[1]

State	Projected demand
Texas	-16.3
California	-14.7
New York	-12.5
Idaho	-11.0
Arizona	-10.0
Oregon	-7.1
Utah	-3.9
Massachusetts	-3.7
North Carolina	-3.6
Ohio	-2.6
Total (All states)	-104.3

Technician[2]

State	Projected demand
Texas	-13.2
New York	-11.0
Idaho	-9.6
California	-8.7
Arizona	-6.4
Oregon	-4.8
Utah	-3.3
North Carolina	-3.0
Massachusetts	-1.6
Ohio	-1.5
Total (All states)	-72.4

Computer Scientist[1]

State	Projected demand
California	-2.0
Texas	-1.1
New York	-0.6
Ohio	-0.5
Massachusetts	-0.5
Arizona	-0.5
Oregon	-0.4
North Carolina	-0.4
Idaho	-0.1
Utah	-0.1
Total (All states)	-11.8

1-2: See core modeling appendix
3. Demand survey, N=30

Source: SEMI WFF, SIA, Lightcast, US Bureau of Labor Statistics, US Census Bureau, NSF, McKinsey industry benchmarks

Key takeaways

Engineer and technician roles account for ~70-80% of demand across all top high-growth states

A small set of fab-heavy states (e.g., TX, CA, NY, ID, AZ) drives most projected hiring needs

Computer scientist demand is modest and diffuse, compared with manufacturing-linked roles

73% of industry professionals[3] report **significant challenges to fill engineering roles** today (vs. 48% for technicians and 33% for computer science)

1. Automation and AI are accelerating shifts in semiconductor workforce demand

▢ Details to follow

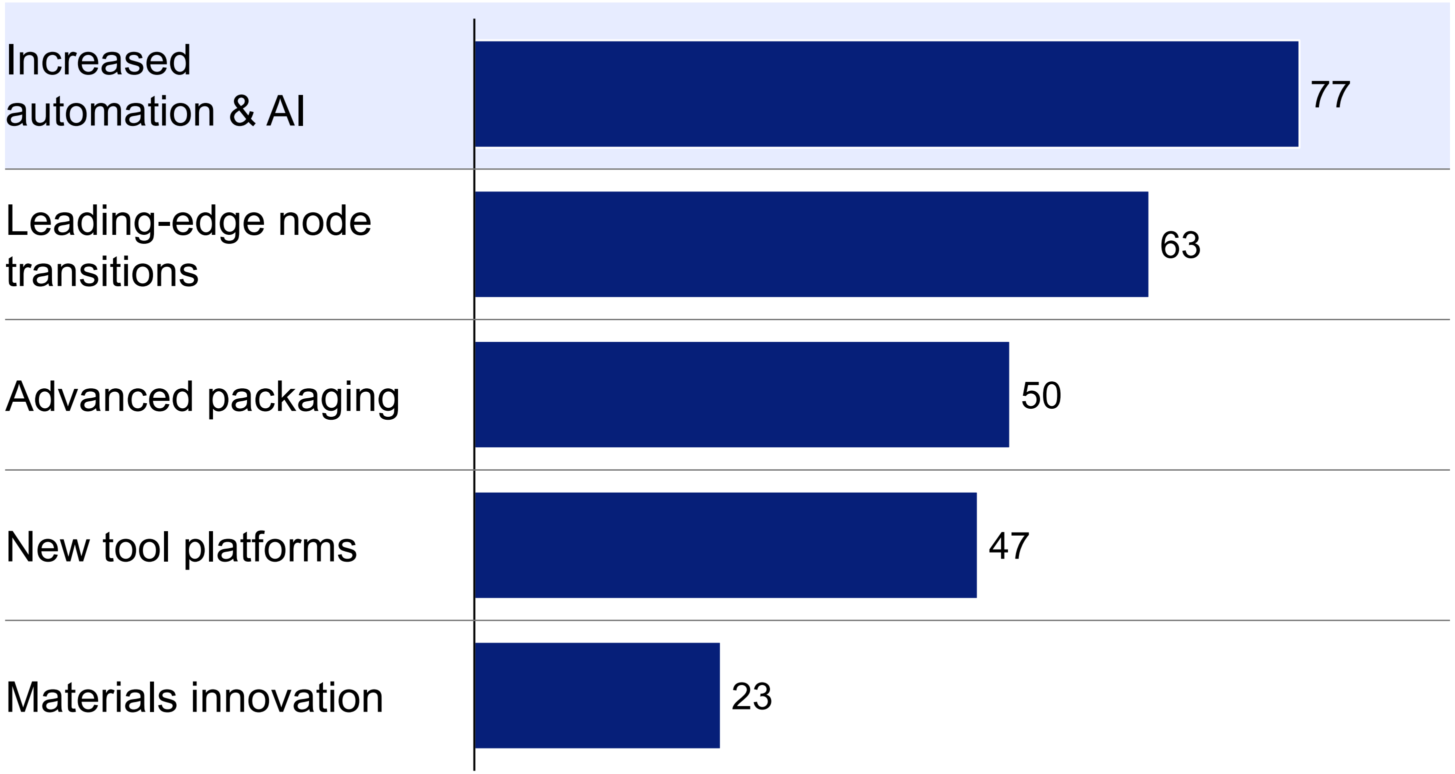
Employers report shifts in technology are having significant impacts on workforce needs

67%

of industry professionals believe technology changes have a significant impact on future hiring needs

These shifts are not only increasing demand, but also accelerating changes in the skill mix required across semiconductor roles

Technologic shifts most influencing future workforce needs, % of respondents



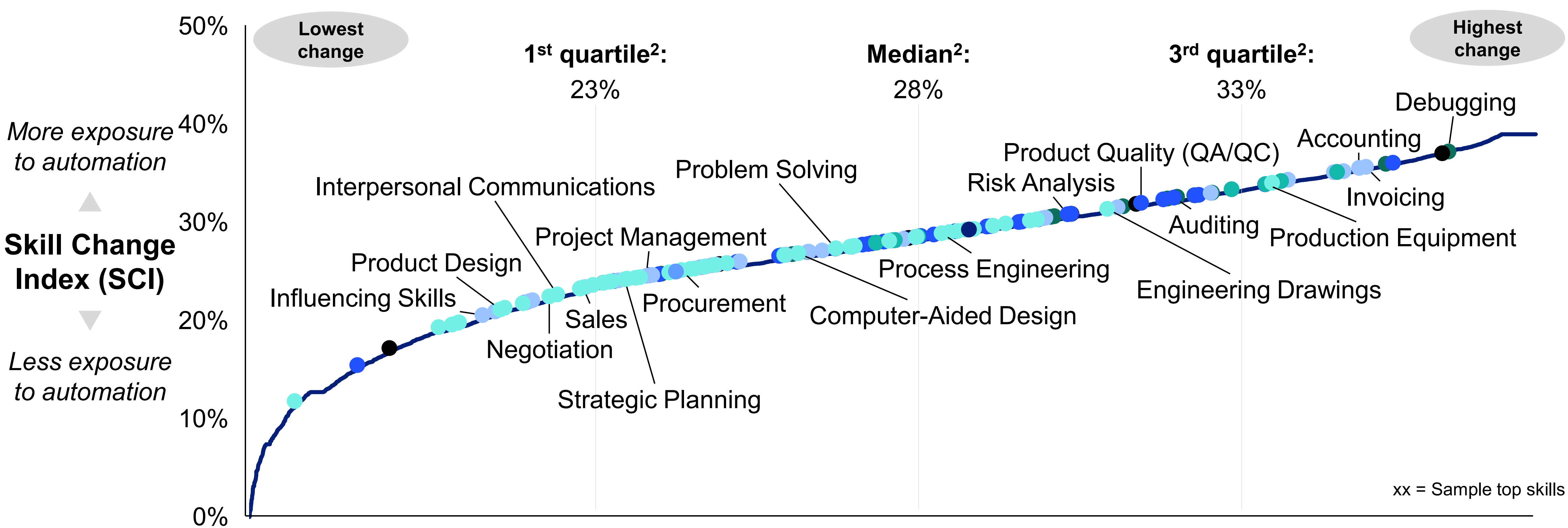
Increased automation & AI	77
Leading-edge node transitions	63
Advanced packaging	50
New tool platforms	47
Materials innovation	23

Survey N=30

1. Automation is reshaping skill requirements across semiconductor roles, driving the greatest change in digital, analytical, and systems-oriented skills by 2030

Skill categories: ● Communication, collaboration and creativity ● Management skills ● Information skills ● Digital skills ● Assisting and caring ● Handling and moving ● Working with machinery ● Constructing

Skill Change Index (SCI) distribution[1] across 6,800 skills



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1. Based on projected 2030 midpoint scenario of automation adoption of activities associated with skills, aggregated across occupations using employment-based weighting
2. Based on around 6.8k skills. We excluded skills that could not be linked to detailed work activities within occupations

Source: Lightcast, U.S. Bureau of Labor Statistics, McKinsey Global Institute analysis

2. Supply

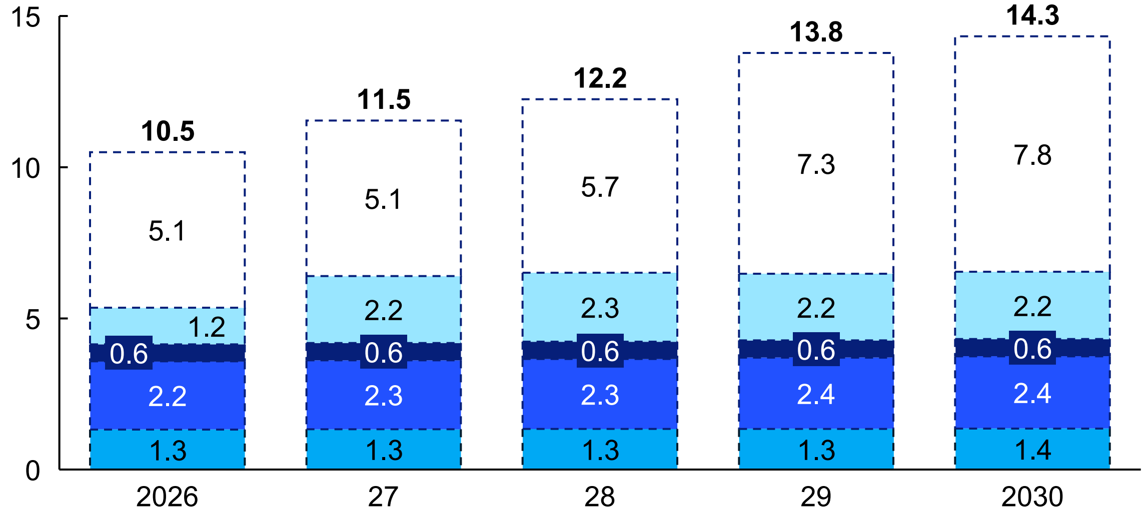
~62k FTE workforce supply is driven by a set of pipelines, with different dynamics for engineers and technicians

- **Only ~3% of engineering graduates enter the semiconductor industry**, limiting annual inflows from traditional degree pathways
- **Technician supply increases materially (~26k) with CHIPS-funded programs**, expanding near-term entry points
- **Engineer supply changes gradually across all modeled scenarios**, reflecting longer education and career timelines
- **Adjacent industries could contribute incremental talent**, with higher applicability for technicians than engineers

2. National semiconductor workforce supply grows steadily through 2030, through education pipelines, migration, and various initiatives

2026-30, thousands of FTEs

Incremental semiconductor workforce supply, by function



Cumulative

	2026	27	28	29	2030
With CHIPS	11	22	34	48	62
Without CHIPS	5	12	18	25	31

Cumulative

Supply from CHIPS Act	**~31k**
Supply without CHIPS Act	**~31k**

Key takeaways

Workforce supply increases each year through 2030, reflecting cumulative contributions from multiple pipelines

CHIPS-funded programs add ~31k FTEs, primarily expanding technician-oriented pathways

Bachelor's degrees account for ~70% of relevant graduate volume but expected to have lower industry entry due to broader curriculums

Master's and PhD programs are highly international, and ~35-40% of these graduates are expected to leave the U.S. after graduating

3-5: See core modeling appendix

Source: OECD 2019-2024, Lightcast, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks, press searches, company 10-K filings

2. Programs build confidence through fundamentals, while employers expect to complete applied training post-hire

Confidence is built in programs

Students (Self-assessment)

88%

Of respondents reported being moderately to extremely prepared[1] to enter a semiconductor role after program graduation

Applied readiness is completed on-the-job

Industry professionals (Program effectiveness)

83%

of industry professionals rate existing programs as neutral or ineffective[1] in developing workforce skills[2]

Key takeaways

- **Education programs successfully build foundational problem-solving skills**, giving graduates confidence to enter the semiconductor workforce
- **Employers expect role-specific and proprietary skills to be developed on-the-job**, shaping how graduates transition into full productivity

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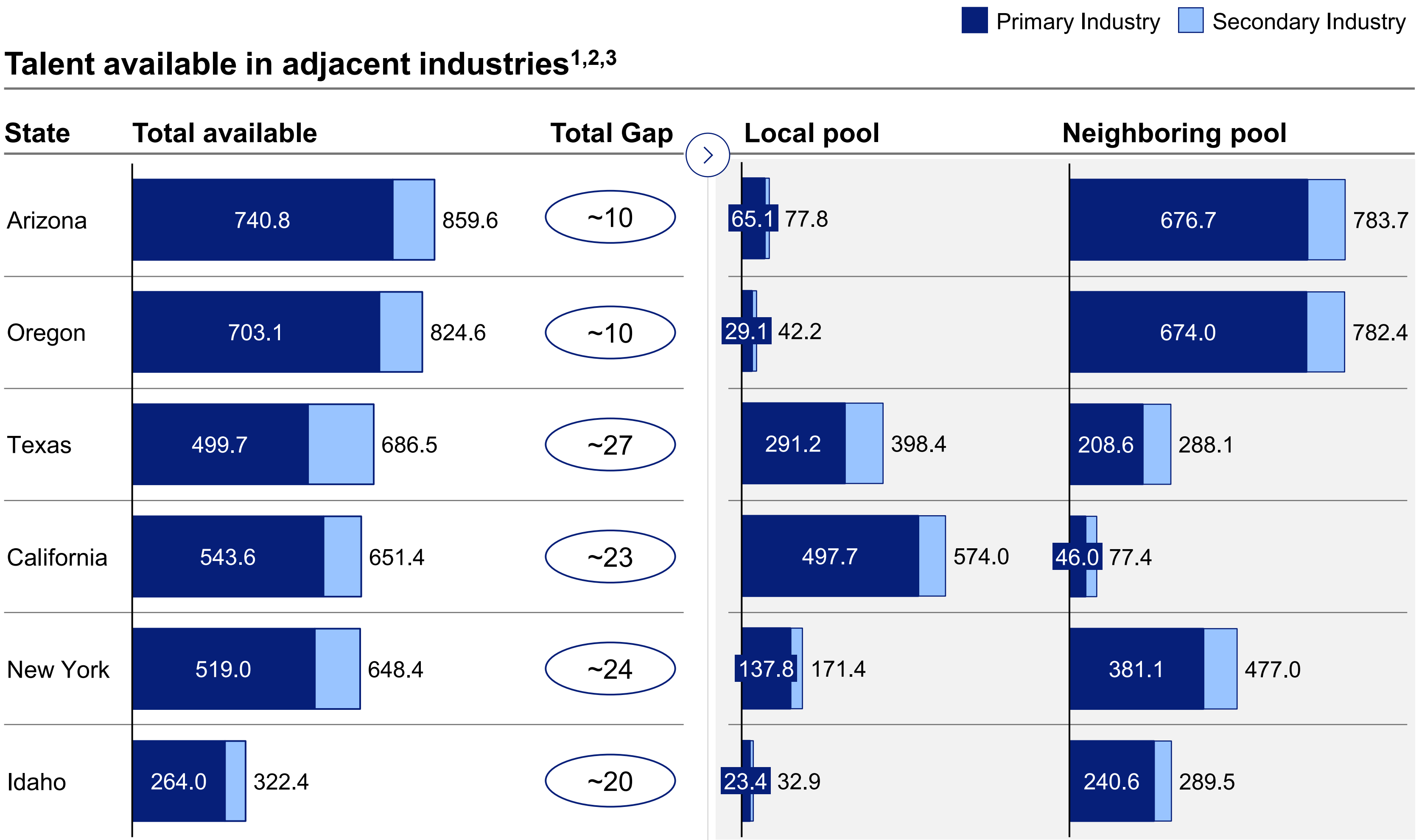
1. Respondents who answered 3, 4, or 5 on a scale of 1-5

Survey: N=25 for the supply survey and N=30 for the demand survey

2. Adjacent industries could be a viable source of talent for semiconductor companies

2024, thousands of FTEs

Talent available in adjacent industries[1,2,3]



1. Primary and secondary adjacent industries defined in the appendix methodology, with primary industries reflecting higher skill adjacency to semiconductors
2. 2024 employment data are used as the most recent complete dataset, as 2025 state-level data were not yet fully available at the time of analysis
3. The 2024 adjacent labor pool is assumed to be a steady source of availability, drawn down gradually over 2026–2030 rather than fully available in a single year

Source: Lightcast

Key takeaways

States vary in the size and composition of adjacent-industry talent pools, with larger states drawing more from in-state labor markets

Most adjacent talent is concentrated in primary industries with higher skill adjacency, enabling faster transitions into semiconductor roles

What we heard

Electrical fundamentals are non-negotiable, as candidates with experience in electrical systems, circuit boards, or control systems transition far more smoothly than generalists

Engineering manager

2. Engineering talent is geographically mobile, shaping how supply can be redistributed across regions

Engineer mobility enables targeted regional workforce strategies

86%

Of engineering respondents reported a moderate to high likelihood of relocating to a different region within the next 3-5 years

Key factors influencing engineers' willingness to relocate to high-need regions

- Higher compensation or financial incentives
- Clear career advancement opportunities
- Quality of life (schools, healthcare, safety, amenities)
- Proximity to family or personal ties

What we heard

Coming straight out of college, Idaho wasn't an obvious first choice. But after being here a few years, I can definitely see myself staying. I'm really excited about the growth of the company and the chance to work with cutting edge technology. At the end of the day, that was really the deciding factor

Recent engineering graduate

Survey N=25

3. Future workforce needs

The U.S. faces a persistent semiconductor workforce shortfall through 2030, even under optimistic assumptions

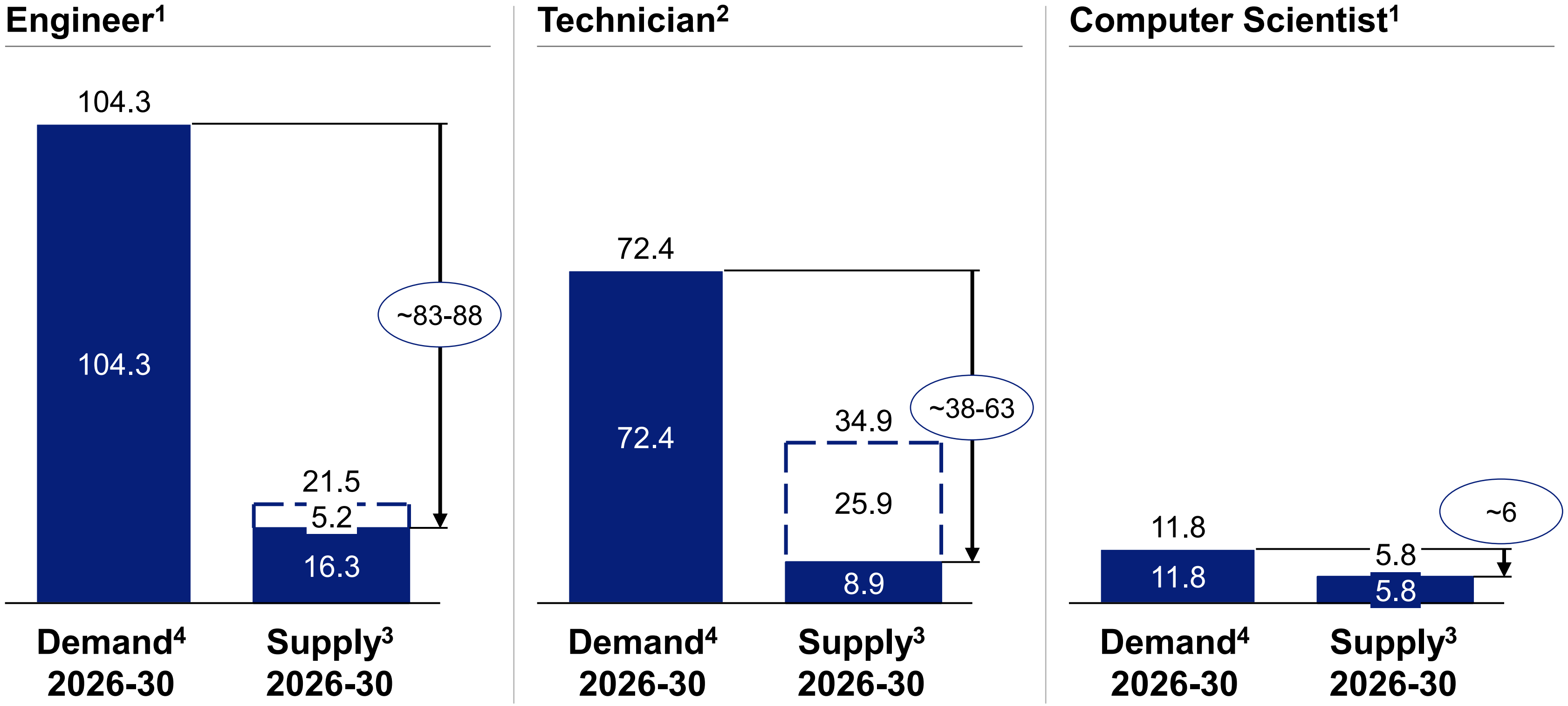
- **Total projected shortfall of ~127–157k FTEs by 2030**, even under optimistic assumptions on productivity, migration, and CHIPS funding
- **Engineers account for ~60% of total unmet demand**, reflecting long education timelines and low industry entry rates
- **Manufacturing roles drive the majority of shortages**, consistent with fab-led demand growth and concentrated ramp timing
- **Gaps are geographically concentrated and slow to resolve**, as workforce pipelines and migration adjust more slowly than capital deployment

3. US semi sector projected to be 83-88k engineers, 38-63k technicians, and 6k CS FTEs short by 2030

2026-30, thousands of FTEs

CHIPS · X Projected talent gap[5]

Total forecast semiconductor labor shortage (US)



Key takeaways

Engineers account for ~56–66% of the total projected shortfall, driven by long education timelines and low entry rates into semiconductors

Technician gaps are also material, while computer scientist gaps remain comparatively limited

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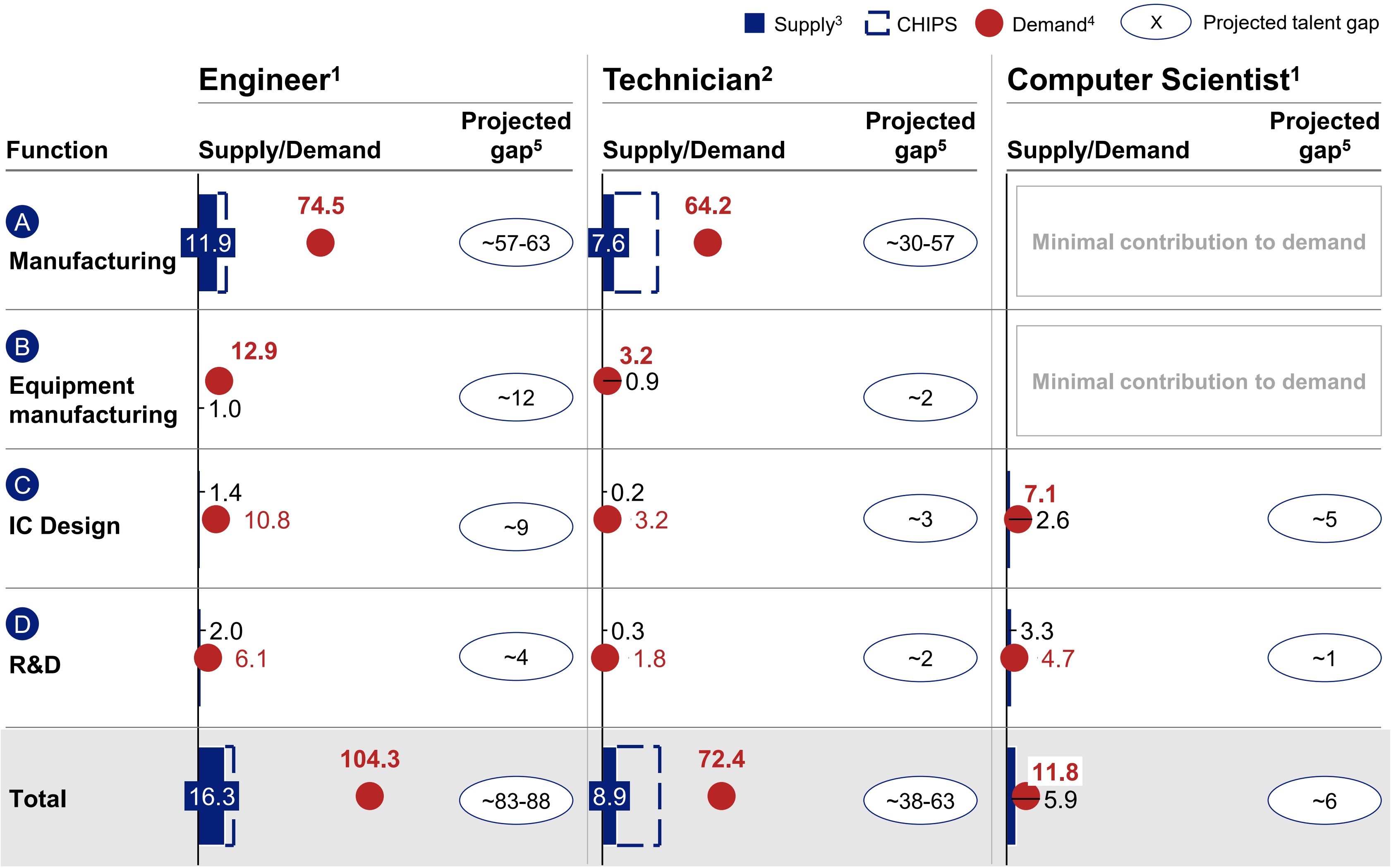
1. Includes 4-year degrees (Bachelors or equivalent), advanced programs (Masters, PhD) under relevant CIP codes | 2. Includes trade-schools, 2-year degree programs (Associate or equivalent), and workers trained through internal programs | 3. Supply of labor includes In-state graduates, out-of-state graduates, and entrants from other industries | 4. Labor demand based on 36 publicly announced front-end facilities (fabs) across 17 companies listed within Q3 2025 SEMI WFF database with tool install start dates starting 2025; headcount estimates will increase if new fab announcements are made after publication of this page; assumes 5% industry attrition rate (based on reported turnover rates in company public filings) | 5. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

3. Manufacturing roles drive ~70-75% of engineering and technician shortages through 2030

2026-30, thousands of FTEs



Key takeaways

Manufacturing engineers and technicians account for the majority of projected shortages, reflecting fab-led demand growth

CHIPS funding provides partial relief for technicians, with more limited impact on engineering gaps

Non-manufacturing functions contribute relatively little to overall shortages

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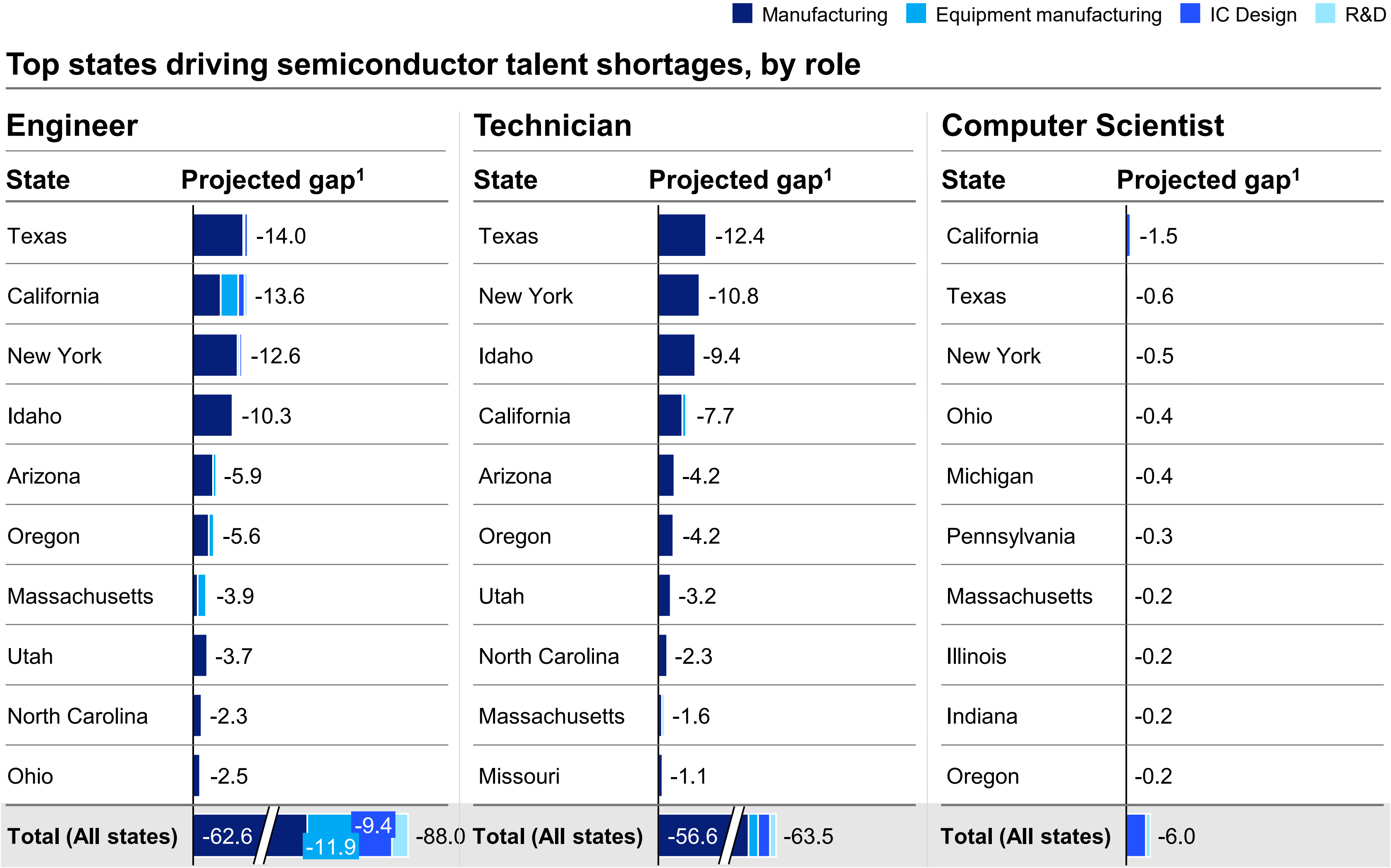
1. Includes 4-year degrees (Bachelors or equivalent), advanced programs (Masters, PhD) under relevant CIP codes | 2. Includes trade-schools, 2-year degree programs (Associate or equivalent), and workers trained through internal programs | 3. Supply of labor includes In-state graduates, out-of-state graduates, and entrants from other industries | 4. Labor demand based on 36 publicly announced front-end facilities (fabs) across 17 companies listed within Q3 2025 SEMI WFF database with tool install start dates starting 2025; headcount estimates will increase if new fab announcements are made after publication of this page; assumes 5% industry attrition rate (based on reported turnover rates in company public filings) | 5. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

3. Talent gaps are concentrated in a small number of states with major fab investments

2026-30, thousands of FTEs

Top states driving semiconductor talent shortages, by role



Engineer

State	Projected gap[1]
Texas	-14.0
California	-13.6
New York	-12.6
Idaho	-10.3
Arizona	-5.9
Oregon	-5.6
Massachusetts	-3.9
Utah	-3.7
North Carolina	-2.3
Ohio	-2.5
Total (All states)	-88.0

Technician

State	Projected gap[1]
Texas	-12.4
New York	-10.8
Idaho	-9.4
California	-7.7
Arizona	-4.2
Oregon	-4.2
Utah	-3.2
North Carolina	-2.3
Massachusetts	-1.6
Missouri	-1.1
Total (All states)	-63.5

Computer Scientist

State	Projected gap[1]
California	-1.5
Texas	-0.6
New York	-0.5
Ohio	-0.4
Michigan	-0.4
Pennsylvania	-0.3
Massachusetts	-0.2
Illinois	-0.2
Indiana	-0.2
Oregon	-0.2
Total (All states)	-6.0

Key takeaways

A small number of fab-heavy states account for the majority of unmet semiconductor labor demand

State-level shortages are dominated by manufacturing engineers and technicians, rather than design or CS roles

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1. Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. N=17; VP/Directors, Hiring managers, Workforce planning leads

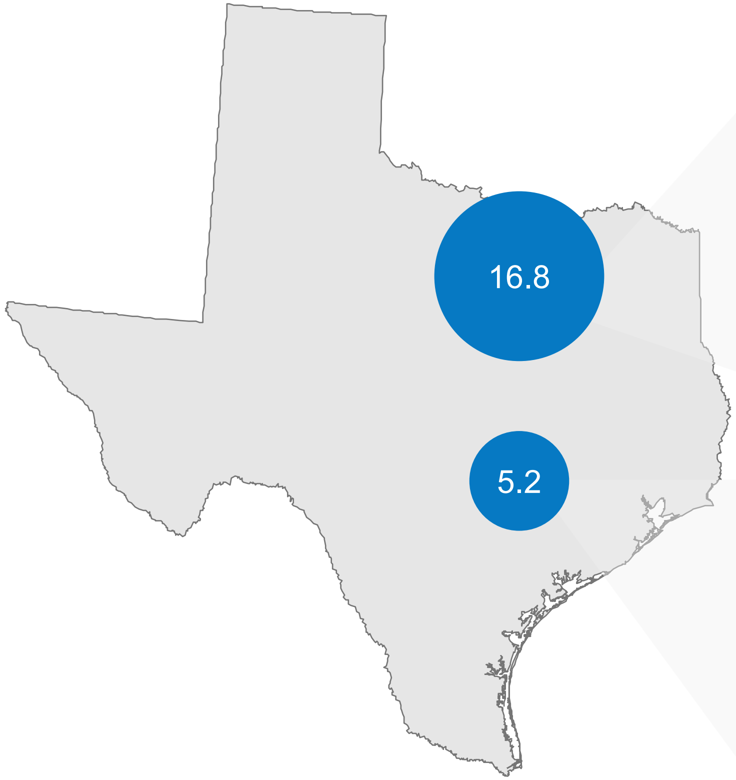
Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

3. Texas: Sub-state concentration of semiconductor talent gaps

2026-30, thousands of FTEs

Distribution of Texas' state-level talent gap across key MSAs[1]

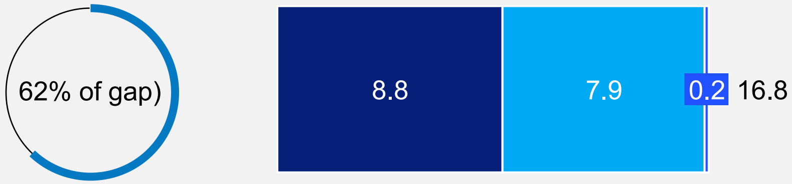
■ Engineer ■ Technician ■ Computer Scientist



DFW

MSA: 19100

Projected gap by role



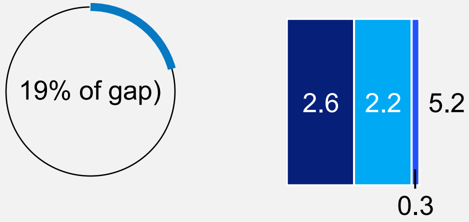
Top regional employers

- Texas Instruments
- Micron
- Analog Devices
- Global Wafers
- onsemi

Austin

MSA: 31080

Projected gap by role



Top regional employers

- Samsung
- AMD
- NXP
- Applied
- Intel

~19% of the statewide semiconductor workforce gap falls outside the two focus MSAs

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1. Metropolitan Statistical Areas (MSAs) are U.S. Office of Management and budget-defined regions reflecting integrated urban labor markets

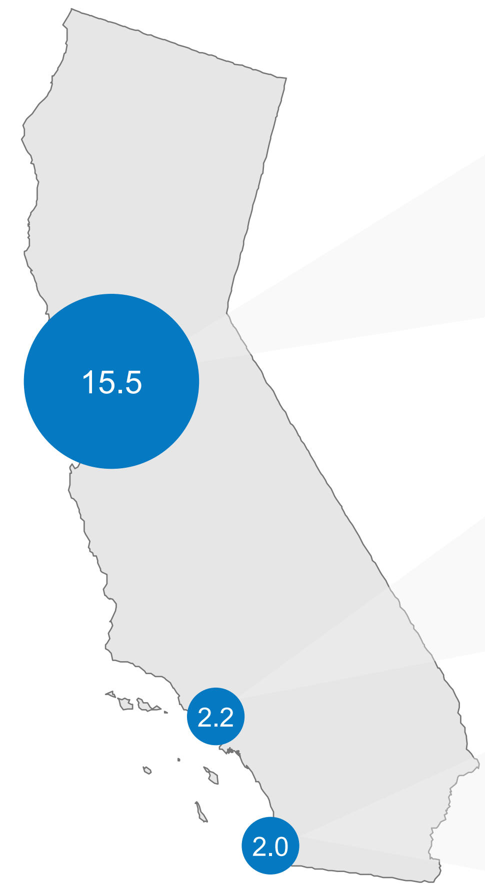
Source: Lightcast, McKinsey LaborCUBE

3. California: Sub-state concentration of semiconductor talent gaps

2026-30, thousands of FTEs

Distribution of California's state-level talent gap across key MSAs[1]

■ Engineer ■ Technician ■ Computer Scientist



Bay Area

MSA: 41860 + 41940

Projected gap by role

Top regional employers

- Broadcom
- Applied Materials
- AMD
- NVIDIA

Los Angeles

MSA: 31080

Projected gap by role

Top regional employers

- Western Digital
- Infineon
- Bosch

San Diego

MSA: 41740

Projected gap by role

Regional employers

- ASML
- Qualcomm
- pSemi

~16% of the statewide semiconductor workforce gap falls outside the three focus MSAs

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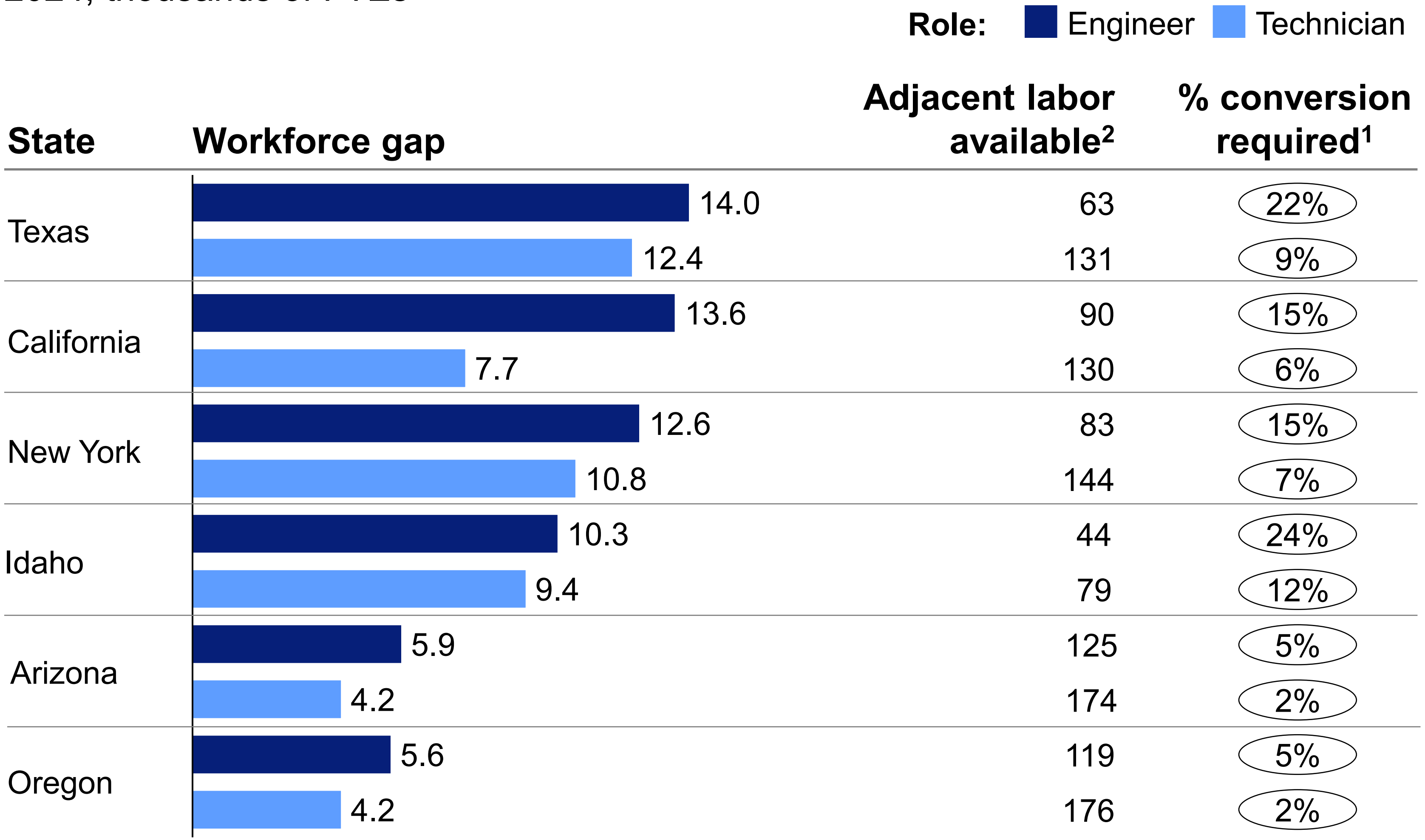
1. Metropolitan Statistical Areas (MSAs) are U.S. Office of Management and budget-defined regions reflecting integrated urban labor markets

Source: Lightcast, McKinsey LaborCUBE

3. Closing workforce gaps would require material conversion from adjacent industries

2024, thousands of FTEs



State	Role	Workforce gap	Adjacent labor available[2]	% conversion required[1]
Texas	Engineer	14.0	63	22%
	Technician	12.4	131	9%
California	Engineer	13.6	90	15%
	Technician	7.7	130	6%
New York	Engineer	12.6	83	15%
	Technician	10.8	144	7%
Idaho	Engineer	10.3	44	24%
	Technician	9.4	79	12%
Arizona	Engineer	5.9	125	5%
	Technician	4.2	174	2%
Oregon	Engineer	5.6	119	5%
	Technician	4.2	176	2%

Conversion rates shown reflect the implied share of adjacent labor required to close the gap; they do not represent assumed or proven achievable conversion outcomes

Key takeaways

Engineers: Implied conversion requirements vary materially by state (~5% to 24%). Rates above ~10–15% are likely infeasible without step-change interventions (e.g., wage pull, accelerated retraining, immigration)

Technicians: Implied conversion is consistently <10% and more plausibly achievable, supported by large adjacent labor pools and shorter retraining pathways

Computer scientists: Adjacent supply is ample; conversion needs are minimal (<1%)

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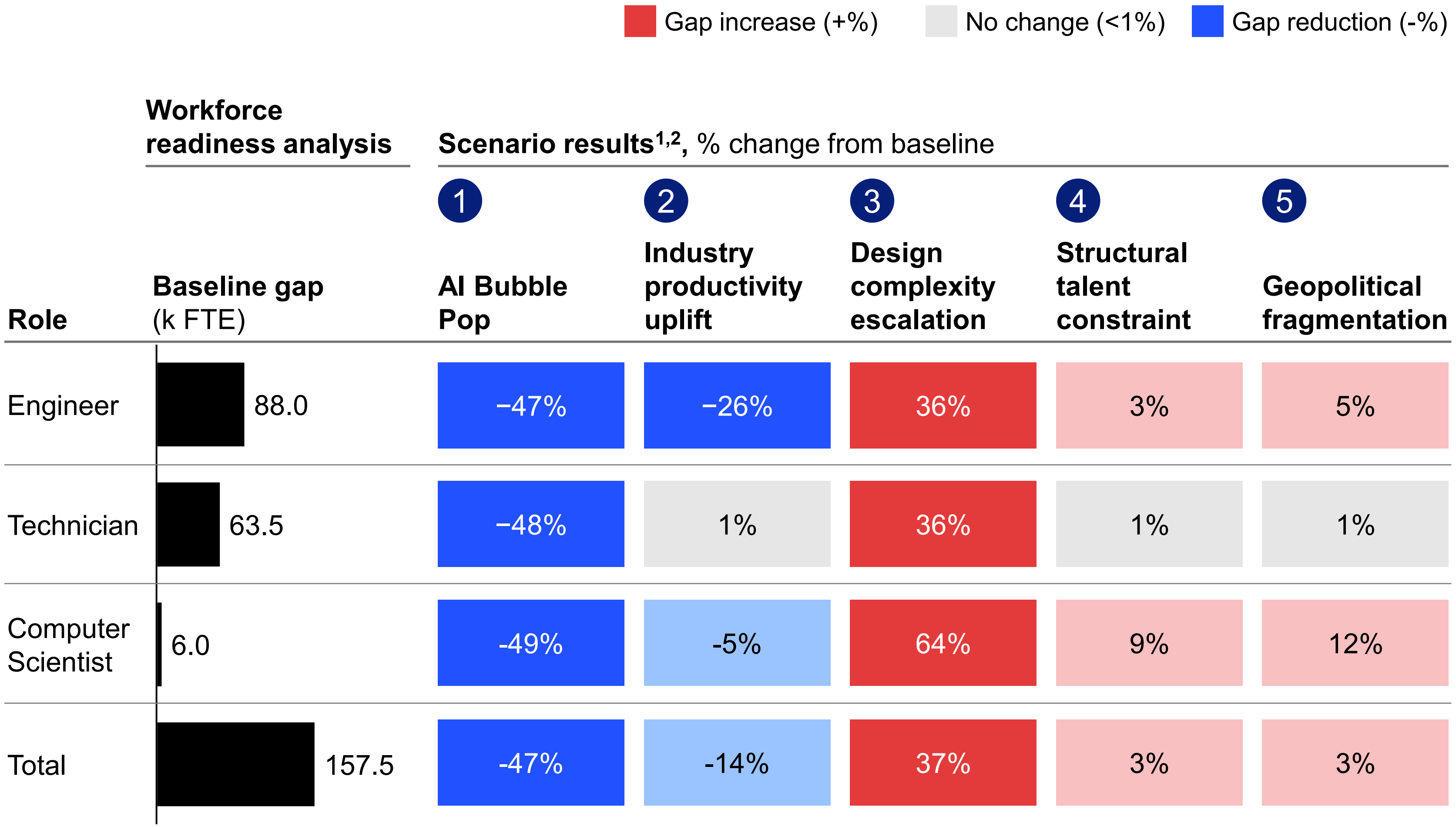
1. Assumed annual attrition (excluding retirements) across adjacent industries is ~5–10% per year; conversion requirements above this level would require step change interventions
2. Adjacent labor conversion reflects primary adjacent industries with the highest semiconductor-relevant skill transferability

Source: Lightcast

3. Scenario analysis highlights which conditions widen or ease workforce gaps



🟥 Gap increase (+%) ⬜ No change (<1%) 🟦 Gap reduction (-%)

	Workforce readiness analysis	Scenario results[1,2], % change from baseline				
Role	**Baseline gap** (k FTE)	① **AI Bubble Pop**	② **Industry productivity uplift**	③ **Design complexity escalation**	④ **Structural talent constraint**	⑤ **Geopolitical fragmentation**
Engineer	88.0	−47%	−26%	36%	3%	5%
Technician	63.5	−48%	1%	36%	1%	1%
Computer Scientist	6.0	-49%	-5%	64%	9%	12%
Total	157.5	-47%	-14%	37%	3%	3%

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1. The model is designed to assess the relative impact of key demand and supply drivers through scenarios rather than produce point forecasts
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Key takeaways

AI Bubble Pop significantly reduces workforce gaps as lower volume demand, delayed fab builds, and reduced voluntary attrition jointly ease hiring pressure across roles

Design Complexity Escalation creates the largest gap expansion, as rising node and system complexity increases headcount requirements per unit of output and reduces effective productivity

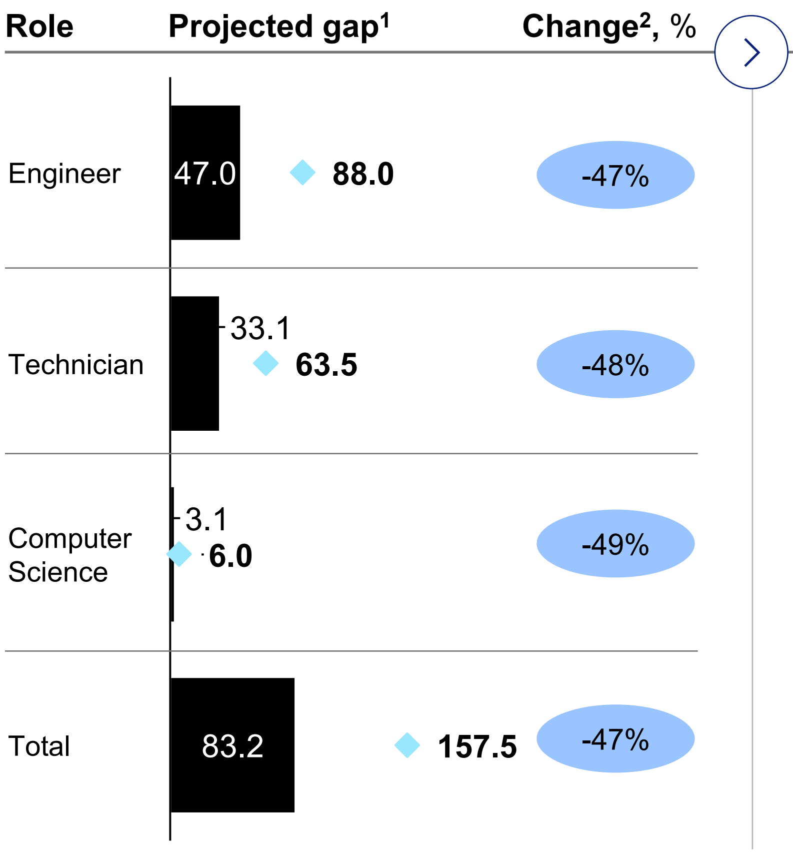
Structural Talent Constraint and Geopolitical Fragmentation reduce effective labor supply in more targeted ways, with impacts concentrated on engineers through education pipelines, professional migrations and international retention while technician supply remains relatively resilient

Scenario 1 – AI Bubble Pop

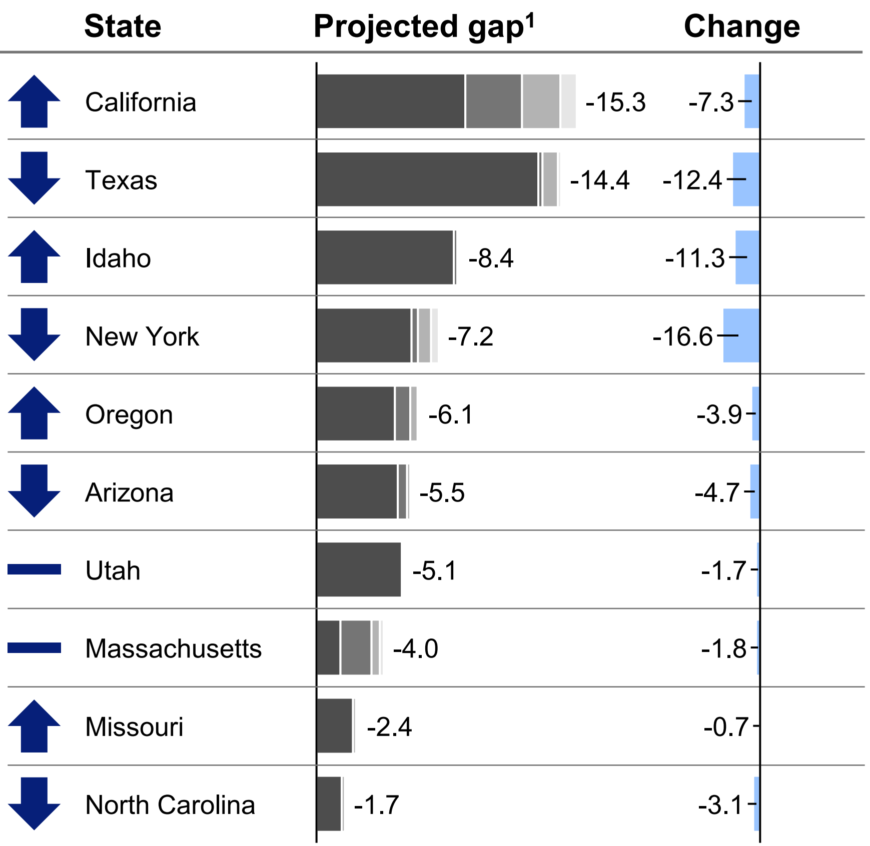
2026-30, thousands of FTEs

■ Current ◆ Base case ■ Reduced gap ■ Increased gap ■ Manufacturing ■ Equipment manufacturing ■ IC Design ■ R&D

Overall impact



Top 10 gaps



Key takeaways

Gap reductions remain broad based across roles, driven by lower volume demand and reduced attrition, with reduces net hiring needs and replacement demand

California emerges as the largest remaining gap, reflecting its existing concentration of equipment manufacturing and design and R&D roles rather than disproportionate exposure to delayed fab builds

States with large announced fab expansions see sharper pullbacks, as delayed Micron phases in New York and TSMC investments in Arizona reduce projected gaps

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1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

4. Catalog of current solutions

Existing workforce initiatives deliver impact today, but are not structured to scale to national semiconductor workforce needs

- **Technician training programs deliver fast, local impact**, with employer-linked models achieving **~70–90% placement**, but benefits remain concentrated in fab-adjacent regions
- **Engineering programs generate long-term value but scale slowly**, constrained by faculty capacity, specialized infrastructure, and multi-year curricula; conversion into semiconductor roles remains **<5%**
- **Many initiatives depend on single employers or short-term funding**, making outcomes vulnerable to fab timing shifts and hiring cycles
- **Few programs are designed for replication across regions**, with limited standardization in curricula, infrastructure, and performance metrics

4. Training programs deliver faster, more measurable impact, while education programs underpin long-term workforce sustainability

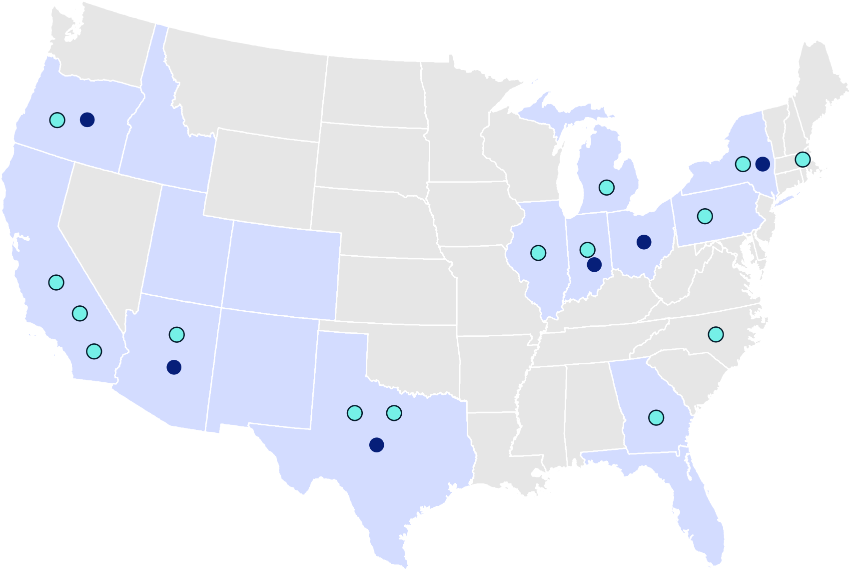
Topic	Finding	Description
Training programs	**Near-term, lower-cost, and demand-linked**	Short duration (2–8 weeks), lower cost per participant, often designed with employers who shape curriculum, fund programs, and support placement
	Impact is meaningful but concentrated	Placement rates often exceed 80% when tied to specific employers or apprenticeships; outcomes translate more directly into near-term FTE supply
	Primarily technician-focused	Most programs emphasize technician pathways, offering hands-on, cleanroom exposure, and practical, on-the-job skills for new and incumbent manufacturing workers
	Scale constrained by capacity and awareness	Expansion limited by faculty availability, cleanroom access, equipment time, and low program awareness among prospective participants
Education programs	**Higher cost, longer time horizon**	Supports broader learning (e.g., minors, credentials, undergraduate degrees) that builds engineering aptitude but does not consistently translate into semiconductor-specific roles
	Direct impact is harder to measure	Benefits accrue over multiple cohorts and years; FTE attribution is challenging since not all graduates enter the semiconductor industry
	Partnerships are critical sustainability	Programs sustain long-term interest, strengthen academic pipelines, and support advanced engineering and R&D talent, but rely on costly infrastructure and sustained industry engagement
Sustainability	**Geographically concentrated**	Training and education initiatives cluster around announced or planned manufacturing investments; education programs are further concentrated at top engineering institutions
	Training programs face higher funding risk	Many rely on direct subsidies (e.g., stipends, paid training, workforce grants), increasing vulnerability when public funding ends or hiring timelines shift
	Education programs are more durable	Curriculum and institutional capacity often remain beyond initial funding, even if near-term enrollment fluctuates
	Early signals of fragility	Training funding and technician placement are tightly linked to manufacturing timelines; fab delays or hiring slowdowns reduce placement and increase attrition to adjacent industries

4. Technician training scales locally near fabs, while engineering programs scale nationally with less geographic dependence

State	Ⓐ Engineering institutions	Ⓑ Institutions for technicians
Arizona	• Arizona State University	• Maricopa County Community College District
New York	• Cornell University	• Hudson Valley Community College
Texas	• Texas A&M University • University of Texas at Austin	• Austin Community College
Oregon	• Oregon State University	• Portland Community College
Ohio		• Lorain Community College
North Carolina	• North Carolina State University	
Pennsylvania	• Carnegie Mellon University	
Illinois	• University of Illinois Urbana-Champaign	• Ivy Tech Community College
California	• University of Southern California • Stanford University • University of California, Berkeley	
Georgia	• Georgia Institute of Technology	
Michigan	• University of Michigan	
Indiana	• Purdue University	
Massachusetts	• Massachusetts Institute of Technology	

○ Engineering institutions ● Technical institutions

▨ States with significant manufacturing investment[1]



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1. Fab investments published for 2026+ that are >$1B

4A. Engineering pipeline expansion delivers strong economic returns but requires sustained investment in early exposure

Increased engineering supply drives economic potential

~22.5k

Undergraduate and graduate degrees are awarded annually in semiconductor-relevant engineering and computer science majors across the top 15 institutions

Top semiconductor programs:

- Purdue University
- Arizona State University
- Georgia Institute of Technology
- Stanford University
- Oregon State University

~$16.8B

Maximum potential annual revenue[1] if all masters and undergraduate degree recipients in semiconductor-related fields enter the workforce as engineers

Engineers, graduating from the 15 top programs, generate a measurable maximum **total economic impact[2]:**

- $638M in local taxes
- $560M in state taxes
- $324M in federal taxes

Student exposure programs can be costly

Semiconductor facilities

~$10k Per student per year for cleanroom maintenance and faculty expenses

Summer programs

~$20k Per student per summer to cover program costs, including student stipends

Chip design lab

~$2k Per student per year

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[1] Revenue per FTE entering the semiconductor field: $744,312 [Semiconductor Industry Association 2025 Factbook]. Total potential is the revenue if all graduates from the top 15 schools identified (masters and undergraduates) within semiconductor related majors entered the semiconductor industry

[2] Additional details in appendix - Economic impact analysis is the total tax revenue generated from each incremental engineering job in semiconductor manufacturing via cost of goods sold and product imports; NAICS code 334413

Sources: Semiconductor Industry Association, Lightcast, university program leaders

4B. Technician pipeline expansion delivers strong economic returns with moderate cost to implement and sustain training programs

Increased technician supply drives economic potential

~2-3k

AAS and Quick Start certificates awarded annually in pathways across 6 distinguished Community Colleges for technician training

Top semiconductor programs:
- Maricopa Community College
- Austin Community College
- Portland Community College
- Lorain Community College

~$1.6B

Maximum potential annual revenue[1] if all graduates (Quick Start and Semiconductor AAS degree pathways) entered the workforce as technicians

Technicians, graduating from the six distinguished programs, generate a measurable maximum **total economic impact[2]:**

- $60M in local taxes
- $52M in state taxes
- $30M in federal taxes

Student exposure programs can be costly

Quick Start programs

~$1k	Per student for cleanroom maintenance and faculty expenses[3]

8-week programs

~$1-2k	Per student per summer to cover program costs, including student stipends

Apprenticeships

~$5-6k	Per student[4]

1.Revenue per FTE entering the semiconductor field: $744,312 [Semiconductor Industry Association 2025 Factbook]. Total potential is the revenue if all graduates from the top 6 schools identified (Quick Start and credit programs) within semiconductor related majors entered the semiconductor industry

2.Additional details in appendix - Economic impact analysis is the total tax revenue generated from each incremental job in semiconductor manufacturing via cost of goods sold and product imports; NAICS code 334413

3.Student stipends available for majority of programs ranging from $200-600

4.Variability based on capacity of program with respect to students. $5-6k reflects programs with 300-600 students

Sources: Semiconductor Industry Association, Lightcast, university program leaders, USDOL

5. Gap analysis and action planning

Closing the semiconductor talent gap requires coordinated, role-specific action across education, industry, and government

- **Technician gaps require rapid, employer-linked training expansion**, leveraging short-cycle, standardized programs that can scale with manufacturing ramps
- **Engineering gaps require early exposure, targeted conversion, and geographic mobility**, reflecting long education timelines and limited near-term elasticity
- **Regional strengths must be aligned to national manufacturing needs**, rather than addressed through isolated, state-by-state efforts
- **Durable public–private coordination is essential for scale**, enabling replication, sustained funding, and shared accountability across stakeholders

5. Six program components consistently determine whether semiconductor talent pipelines scale and deliver job-ready graduates

Industry overview

>20

Programs evaluated, training **~25,000 FTEs** annually across the 10 highest-demand states to identify the components most critical to building scalable, job-ready semiconductor talent pipelines

Top program components:

- Awareness
- Curriculum
- Infrastructure
- Partnerships
- Specialization
- Outreach

Component	Description
Awareness	• The extent to which students are exposed early in undergraduate tenure to semiconductor careers, pathways, and supplemental programs, shaping career interest and informing internship and employment decisions

Curriculum	• *Undergraduate degrees:*
	  • The degree to which semiconductor fundamentals, manufacturing concepts, and early hands-on experiences are emphasized in curriculum (electives or core curriculum)
	• *Masters:*
	  • The availability of semiconductor-specific master's degrees and associated applied research opportunities

Infrastructure	• The extent to which students have access to cleanrooms, equipment, and lab environments, enabling hands-on training and experiential learning at scale
Partnerships	• The depth and breadth of collaboration among educational institutions, employers, and industry organizations to foster the development of qualified talent to satisfy regional workforce demand
Specialization	• The degree to which programs focus on specific semiconductor technologies, research areas, or specified companies[1], shaping depth of expertise and alignment with industry needs
Outreach	• Structured engagement with K–12 and pre-college students, educators, and communities to introduce semiconductor careers, build foundational interest, and expand the future talent pipeline

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1. Programs anchored to a limited number of industry partners, increasing their risk to face company-specific hiring volatility and cyclicality

5. National talent gaps stem less from missing programs and more from limited scale, coordination, and early exposure

Program components	Observed industry gaps	Recommendations
Awareness	Many institutions exhibit low awareness of the semiconductor industry while making decisions regarding career paths and internships	**Launch early undergraduate exposure programs:** • Encourage industry speakers and site visits to introduce students to the semiconductor industry
Curriculum	*A significant portion of undergraduate degrees lack:* • Hands-on semiconductor exposure • Semiconductor-specific coursework embedded in core curricula, but rather offered as an elective *Semiconductor specific master's degrees:* • Not offered among several institutions studied	**Embed semiconductor fundamentals into core undergraduate curricula:** • Standardize semiconductor curriculum to embed foundational concepts into core engineering coursework among early tenured students • Incorporate low-cost labs integrated into engineering degree pathways[1] **Standardize master's curriculum:** • Enable nation-wide uptake of shared master's curriculum
Partnerships	Few regions demonstrate fully aligned, region-wide partnerships that aim to foster, develop, and grow the workforce talent pool	**Formalize cross-institution and industry partnerships:** • Co-develop curricula • Share training infrastructure to increase utilization and outreach • Expand placement opportunities across multiple employers
Infrastructure	Some institutions have limited access to cleanrooms (e.g. <7,000 sq. ft.), constraining hands-on training capacity and student throughput	**Invest in cleanroom facilities:** • Develop cleanrooms of capacity, serving institutions and employers • Increase hands on training capacity by maximizing facility utilization
Specialization	Few institutions exhibit a high degree of specialization within the university (e.g. wide bandgap focused research for the DoD), limiting scalability and replicability of programs	**Broaden industry partnerships and areas of specialization:** • Ensure programs remain transferable and scalable across institutions • Align specialization areas to industry-driven, workforce needs
Outreach[2]	Many states do not have K–12 exposure to semiconductor careers; High interest once students are exposed via teaching and cleanroom tours, but many remain unenlightened to the field entering college	**Scale structured K–12 outreach programs:** • Offer cleanroom field trips, teacher training, paid high-school internships, and curriculum modules that connect semiconductors to real-world, end-product applications

1. Labs that focus on semiconductors role within end-product lines (e.g. creating a button that lights up a ruler, labs that utilize chips and give exposure)
2. Outreach an important impact but does not immediately affect the supply of talent. Impact seen >4 years post integration, which makes it a lower tier component

5. Talent gaps vary widely by state, but common patterns emerge across awareness, outreach, and infrastructure (1/2)

State level analysis based on programs studied

Engineer gap, #k \| Technician gap, #k ☐ Strength ■ Potential gap

Components	New York 12.6 | 10.7	Texas 14.0 | 12.4	California 13.6 | 7.7	Oregon 5.6 | 4.2
Awareness	■ Low awareness early in tenure, with focused electives reserved for junior and seniors	■ Low program awareness[1] throughout student lifecycle, limiting overall exposure	■ Growing semiconductor exposure with entry to senior level electives but still limited awareness[1]	☐ Electronical & computer engineers have semiconductor focused curriculum
Curriculum	☐ Curriculum co-developed with industry partner (e.g. GlobalFoundries)	☐ Curriculum co-developed between ACC, UT, Samsung and TIE[2]	■ Lack of semiconductor specific master's program (e.g., UC Berkeley and Stanford)	☐ Co-developed curriculum with industry partners, e.g. PCC & Intel
Outreach	☐ Cornell's K-12 initiative surpassing 3,500+ prospective student visitors	■ Limited published K-12 initiatives to foster student or teacher engagement	☐ Stanford's Nano K-14 initiative supports development for middle school teachers	■ Limited published K-12 initiatives directly focusing on middle and high school students and teachers
Partnerships	☐ Semiconductor workforce development program with RPI, HVCC and GlobalFoundries	☐ Ecosystem consisting of UT at Austin, Texas A&M, TIE[3], Samsung, and ACC	■ Institution-level partnerships, but no regionally coordinated partnership framework	☐ Frontiers of advanced semiconductor technology unites 95 regional industry partners and institutions
Specialization	■ High specialization with singular industry partner, GlobalFoundries	☐ Broad industry mix (e.g. Samsung, Intel) with diverse technical needs	☐ Strong technical differentiation and partnerships within the region	☐ Diverse industry partners across technical domains, diversifying partnerships and employer pathways
Infrastructure	☐ Cleanroom access anchored by SUNY poly, Cornell and HVCC[2]	■ Small scale cleanrooms (e.g. UT and TAMU each have <12,000 sq. ft. respectively)	☐ Significant cleanroom access led by Stanford and UC Berkeley with a combined 23,000 sq. ft.	☐ 150,000 sq. ft. facility funded by NVIDIA at Oregon State will include new cleanroom space

1. Cited via an expert interview
2. HVCC received funding from GlobalFoundries for equipment and infrastructure
3. TIE is the Texas Institute for Electronics

5. Talent gaps vary widely by state, but common patterns emerge across awareness, outreach, and infrastructure (2/2)

State level analysis based on programs studied

Engineer gap, #k | Technician gap, #k ☐ Strength ■ Potential gap

Components	Massachusetts 3.9 | 1.6	Arizona 5.9 | 4.2	North Carolina 2.3 | 2.3	Ohio 2.5 | 1.2
Awareness	☐ Moderate awareness (e.g. 95% of MIT undergraduates participate in research opportunities)	■ Low awareness reported early in student tenure (freshman and sophomores)[1]	■ Growing due to recent funding and DoD support, still limited among early tenured students	■ Limited reported awareness, but growing with Intel's involvement within institutions[1]
Curriculum	■ Limited semiconductor specific curriculum within master's program (e.g. MIT does not have a program)	☐ Curriculum co-developed with ACA, ASU, Intel, and Maricopa CC for wide-spread adoption	☐ Top-tier master's degree program focused on wide bandgap semiconductors	☐ Co-developed curriculum among institutions and industry (e.g. LCC, Intel, SERP)
Outreach	■ Lack of K-12 educational and engagement initiatives published	☐ Microelectronics workforce development hub provides K-12 training and outreach	■ Few published K–12 education and outreach initiatives	■ Limited K–12 engagement initiatives, constraining pipeline to meet demand
Partnerships	☐ Industry consortium including Global- Foundries, TSMC, and TI and others	☐ Integrated ecosystem across Intel, ACA, ASU, and Maricopa CC	☐ CLAWS is part of the Microelectronics Commons, with integrated curriculum and cross-partner integration	■ Midwest Microelectronics Consortium, but lacking interdependency across regional partners
Specialization	☐ Strong research programs enabling engagement across a diverse set of industry partners	☐ Diverse industry partners across technical domains, leading to multiple potential focus areas	■ High specialization within wide-bandgap semiconductors	☐ Technical diversity across defense and commercial applications within the region
Infrastructure	☐ Significant cleanroom infrastructure, (e.g. MIT ~100,000 sq. ft.)	☐ Large scale cleanroom access, anchored by ASU's 50,000 sq. ft. cleanroom	■ Limited capacity for cleanrooms (e.g. 7,500 sq. ft. lab at NCSU)	■ Limited cleanroom capacity (e.g., OSU has ~6,000 sq. ft. cleanroom)

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[1] Cited via an expert interview

5. Catalog of future solutions: Industry-led initiatives to reduce labor shortages target core program components (1/2)

🟦 Short term levers
■ Long-term levers

Component addressed			Actions to reduce labor shortage	Single state example
Awareness	■	Ⓐ	**Embed industry professionals into academic programs** to actively champion supplemental opportunities and increase student awareness of career pathways	**Arizona:** Leverage TSMC and intel engineers as guest lecturers within ASU's core engineering courses
	■	Ⓑ	**Launch a course articulation pathway** allowing lower class students to shadow upper class semiconductor coursework to build early exposure and networks	**North Carolina:** Create pathway for underclassmen to shadow upperclassman in NCSU's wide bandgap masters program
	■	Ⓒ	Develop **incentives for teachers to foster student engagement** within supplemental research programs (e.g. competition prizes, financial incentives, etc.)	**New York:** Offer faculty stipends, course releases, or research seed grants tied to student engagement into REU[1] programs
	■	Ⓓ	**Create a semiconductor micro-internship program,** focusing on placing undergraduates in 2–3 week paid micro-rotations across during academic breaks	**Ohio:** Leverage broad spectrum of industry partners within SERP or MMES to provide opportunities for industry training
	■	Ⓔ	**Fund semiconductor industry ambassadors** who focus on advocating and growing semiconductor research opportunities that are closely aligned with regional partnerships	**California:** Recruit ambassadors from KLA, and Lam Research to engage with students, hosting on-campus events and hackathons
Partnerships	■	Ⓐ	Partner with industry to make **internships for-credit and mandatory** for select engineering degrees, ensuring consistent exposure and reducing variability in job readiness.	**North Carolina:** Coordinate with CLAWS partners to embed required industry rotations into engineering and technician degree pathway
	🟦	Ⓑ	Partner with industry to **transform employer lab access into competitive, cross-institution research programs** that builds applied, job-ready engineering skills, while fostering industry-relevant curriculum	**California:** Use the Innovation Hub to convene universities and industry partners around competitive, cross-institution research challenges using real industry labs and tools
Infrastructure	🟦	Ⓐ	**Leverage the regional partnerships and consortiums** to lead efforts aimed at expanding shared access to cleanroom facilities for institutions alike	**Texas:** Leverage established partnership between Texas A&M, UT and ACC to expand cleanroom access to all Texans
	■	Ⓑ	Develop, or utilize and existing, **private economic development corporation** that facilitates the investment of private semiconductor companies into university facilities	**North Carolina:** Use CLAWS, and wide-bandgap industry stakeholders to attract investment into silicon carbide research

1.Research experience for undergraduates (e.g. Cornell)

5. Catalog of future solutions: Industry-led initiatives to reduce labor shortages target core program components (2/2)

🟦 Short term levers

■ Long-term levers

Component addressed	Actions to reduce labor shortage	Single state example
Curriculum	Ⓐ **Create a shared "Fab-in-a-Box"** curriculum kit co-developed by industry and institutions that include hands-on project and equipment experience and case studies	**Massachusetts:** Leverage national research and innovation hub to pilot "Fab-in-a-Box" kit and curriculum
	Ⓑ **Launch industry-sponsored undergraduate capstone projects** to provide hands-on experience and exposure to industry-aligned roles and placement pathways	**Arizona:** TSMC and Intel to sponsor ASU's capstone project with real-world applications
	Ⓒ Introduce an **industry-sponsored "problem bank"** where companies submit real challenges that are used across coursework and supplemental research projects	**California:** Employer-submitted problems sets from leading Silicon Valley innovators
	Ⓓ **Standardize a wide-bandgap semiconductor-ready skills checklist** (process flow, tool familiarity, cleanroom protocols) required for defense focused schools	**North Carolina:** Use CLAWS to standardize skill requirements needed for silicon carbide-based applications
Outreach	Ⓐ Partner with companies to offer **paid high school internships**, enabling students to work on real-world semiconductor projects and build early career interest	**Texas:** Paid summer internships for high school students through Samsung
	Ⓑ **Develop structured exposure initiatives for K–12 students**, including industry-sponsored cleanroom field trips, teacher training programs (e.g. Texas Taylor ISD)	**Oregon:** Host student field trips at OSU's new cleanroom (NVIDIA sponsored)
	Ⓒ Integrate semiconductor specific **case studies** into established national high school organizations	**Ohio:** National Honor's society, Model UN to incorporate semiconductor case studies
	Ⓓ **Integrate semiconductor challenges into existing K-12 STEM competitions** (robotics, science fairs, hackathon's) rather than creating standalone programs	**North Carolina:** Integrate semiconductor specific projects into First robotics[1]
Specialization	Ⓐ **Form or utilize existing state-level semiconductor consortium** to coordinate industry & academic partnerships to broaden depth of industry engagement	**New York:** Leverage existing consortium to engage a broader range of employers
	Ⓑ **Tie specialization funding** to student throughput thresholds, ensuring programs demonstrate scalable impact rather than narrow research depth alone	**North Carolina:** Link silicon carbide funding to early tenure student research placement

1.High school robotics club local to North Carolina

Appendix

Appendix contents

Semiconductor ecosystem

We mapped the current U.S. semiconductor ecosystem to understand where activity is concentrated across manufacturing, design, IP/EDA, materials, and R&D

We analyzed announced fab investments, technology focus, and startup formation to identify where capacity, innovation, and talent demand are expanding

Key findings

- **Ecosystem activity is highly concentrated geographically:** Semiconductor manufacturing, design, and R&D cluster in a small number of states (e.g., CA, TX, AZ, NY, OR, OH)
- **Few regions have full value-chain depth:** Only select hubs combine fabs, equipment, materials, design, and R&D; most regions participate in one or two segments
- **Manufacturing investments are driving near-term pressure:** ~$390B+ in announced fab investments through 2030 are concentrated in AZ, NY, TX, OR, and OH
- **Innovation remains anchored in established hubs:** ~65% of U.S. semiconductor R&D startups are based in California (mostly Silicon Valley), typically at small scale (<50 employees)

Current ecosystem: US semiconductor ecosystem summary

Segment	Geography	Value-chain role	Implications for talent gap
All Ecosystem 	Activity clustered in CA, TX, AZ, OR, and the Northeast with uneven coverage across other regions	Mix of semiconductor, equipment, materials, and R&D partners; only a few regions show full value-chain depth	Ecosystem-level talent gaps reflect regional variation in value-chain depth, anchor employers, and workforce pipeline capacity
Manufacturing 	Strong clusters in AZ, TX, OR, NY, OH plus activity in the Southeast and Mountain West	Anchors front-end fabs, materials suppliers, and equipment firms; core production footprint	Fab announcements are driving rapid, near-term spikes in engineer and technician demand that exceed local education and training capacity
Chip Design 	Concentrated in CA, TX, AZ, the Northwest, and the Northeast with limited presence elsewhere	Driven by fabless firms and design teams requiring CS and electrical engineering depth	Design talent demand is concentrated in a small number of hubs, limiting the scale of sustainable demand in non-core regions
IP & EDA 	Highly concentrated in CA, TX, and select Northeast hubs with minimal dispersion	Software backbone for design including EDA tools and IP libraries; geographically narrow capability	Talent supply is constrained by the location of specialized firms and feeder programs; most states will contribute minimally
Research & Development 	Centered around major research universities and innovation hubs in CA, the Northeast, TX, and the Midwest	Supports early-stage innovation in materials, devices, packaging, and next-gen architectures	R&D talent supply tracks major research universities and funding centers, leaving regions without anchors exposed to persistent gaps

Source: Semiconductor Industry Association

Current ecosystem: Legend definition

Grouping	Definition	Examples
Semiconductors	Includes all segments of the semiconductor value chain: IP and EDA providers, fabless companies, foundries, integrated device manufacturers (IDMs), and OSAT facilities	NVIDIA, Texas Instruments, TSMC, Intel, Northrup Grumman, AMD, Micron
Equipment	Encompasses the wide range of specialized semiconductor manufacturing tools used across wafer fabrication and packaging processes, including deposition, photoresist coating, lithography, etching, ion implantation, and advanced packaging, all operating in highly controlled environments	ASML, KLA, Lam Research, Applied Materials, and TEL
Materials	Covers specialty and high-purity gases, chemicals, metals, substrates, and optical components that are critical inputs to chip fabrication and equipment manufacturing, ranging from silicon wafers and rare earth metals to helium and optical materials	SUMCO, EMD, Wacker Chemical, and Corning
University R&D Partner	Refers to universities with established semiconductor research programs that are formal partners of organizations such as the Semiconductor Research Corporation (SRC) or the National Nanotechnology Coordinated Infrastructure (NNCI)	ASU, Stanford, Georgia Institute of Technology, Purdue, and Oregon State University

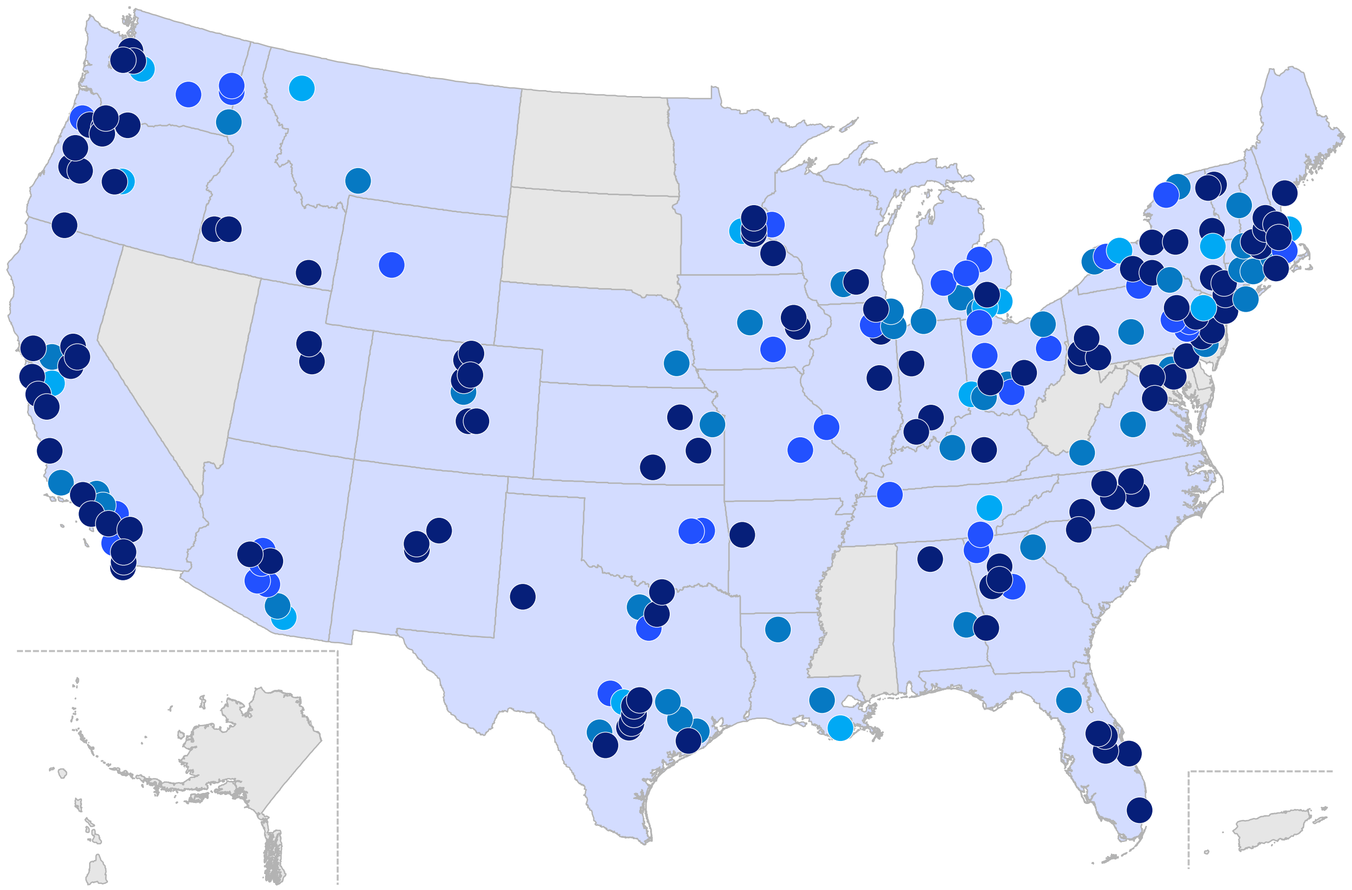
Source: Semiconductor Industry Association

Current ecosystem: US Semiconductor

Non-exhaustive

All Ecosystem

● Semiconductors ● Equipment ● Materials ● University R&D Partner



Source: Semiconductor Industry Association

Key takeaways

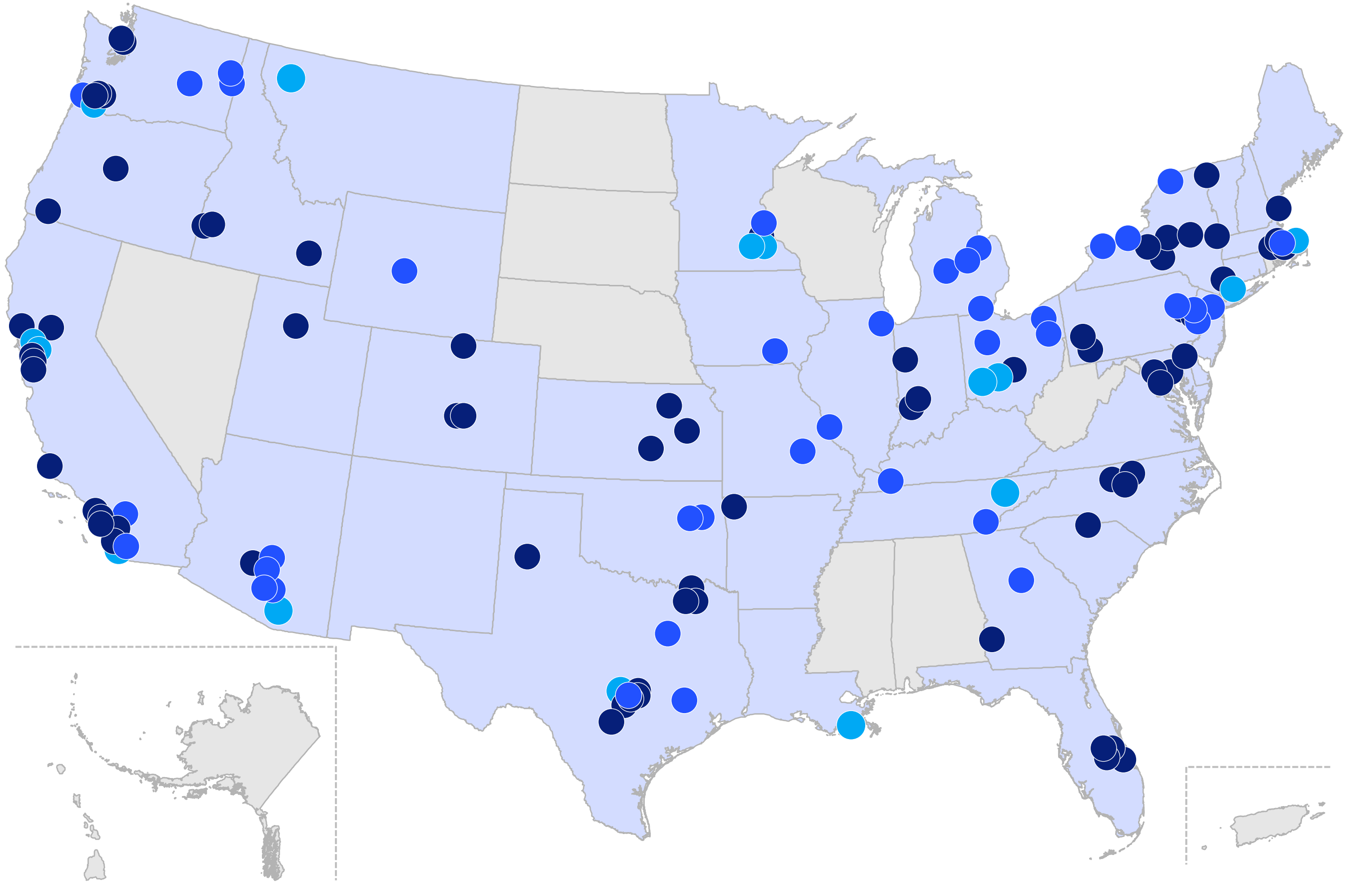
- **Geography:** Activity spans fabrication, equipment, materials, design, EDA, and R&D, but is unevenly distributed across regions
- **Value-chain role:** Only a limited number of regions have complete end-to-end semiconductor ecosystems
- **Implications for talent gap:** Workforce gaps persist where ecosystem scale outpaces education, training, and labor mobility capacity

Current ecosystem: US Semiconductor

Non-exhaustive

Manufacturing

● Semiconductors ● Equipment ● Materials ● University R&D Partner



Source: Semiconductor Industry Association

Key takeaways

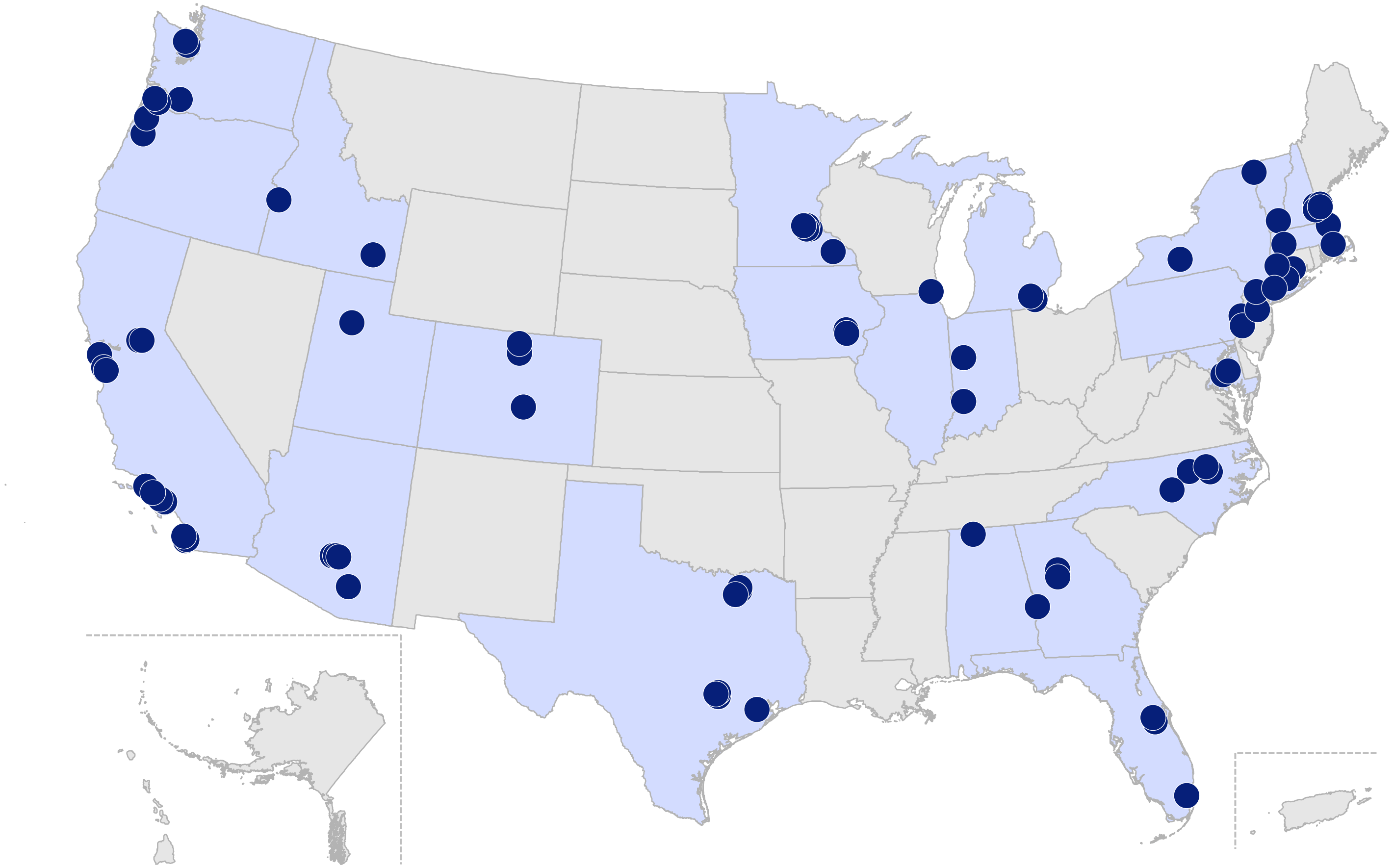
- **Geography:** Manufacturing assets are concentrated in AZ, TX, OR, NY, and OH, with additional clusters in the Southeast and Mountain West
- **Value-chain role:** These regions anchor front-end fabs, materials suppliers, and equipment partners
- **Implications for talent gap:** Highly localized demand places sustained pressure on technician and manufacturing engineer pipelines

Current ecosystem: US Semiconductor

Non-exhaustive

Chip Design

● Semiconductors ● Equipment ● Materials ● University R&D Partner



Source: Semiconductor Industry Association

Key takeaways

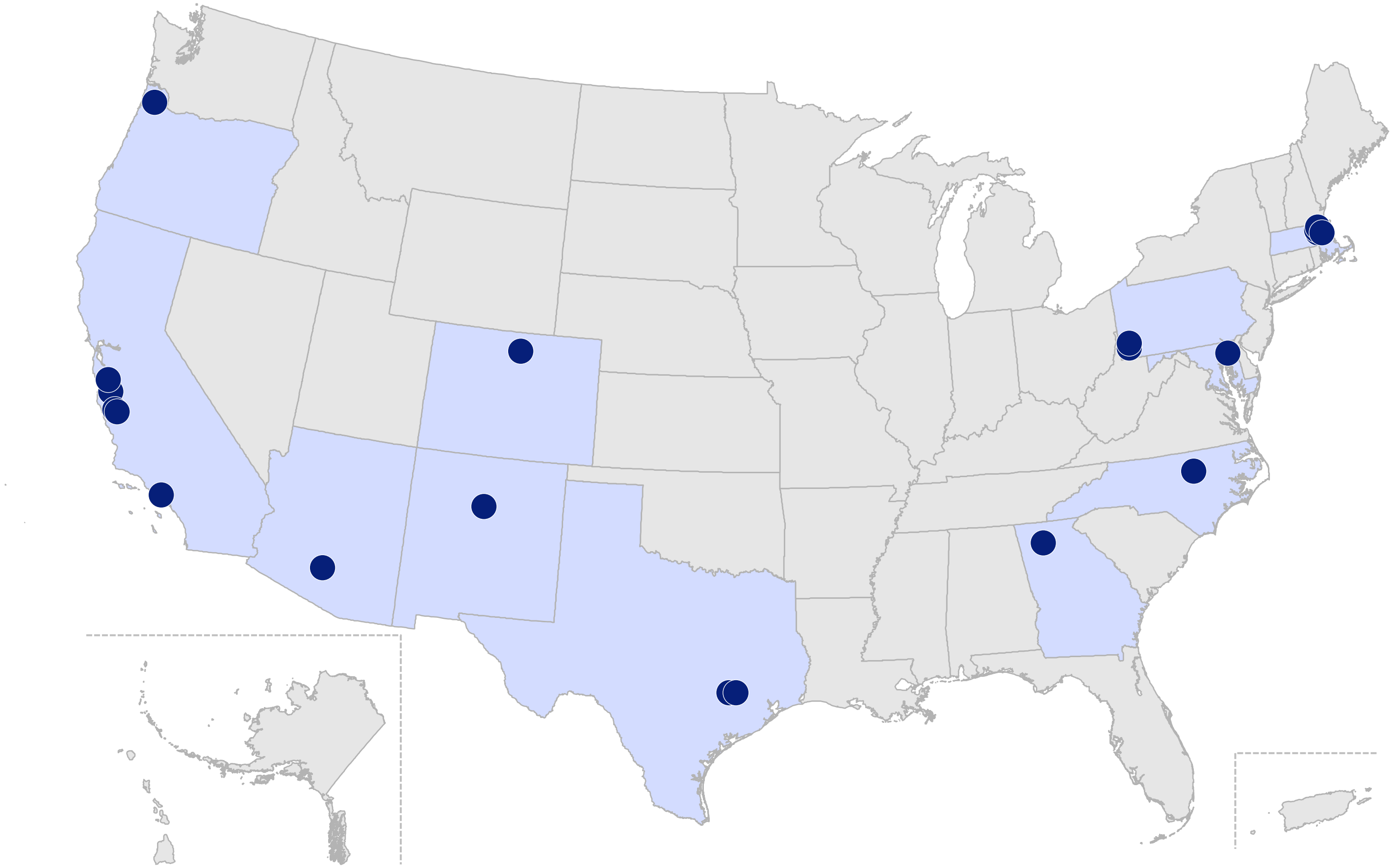
- **Geography:** Design activity is concentrated in coastal and tech-hub regions, with limited presence elsewhere
- **Value-chain role:** Design hubs depend on deep pools of computer engineering, electrical engineering, CS, and EDA skills
- **Implications for talent gap:** Regions without major design centers face constrained local supply of advanced design and CS talent

Current ecosystem: US Semiconductor

Non-exhaustive

IP & EDA

● Semiconductors ● Equipment ● Materials ● University R&D Partner



Source: Semiconductor Industry Association

Key takeaways

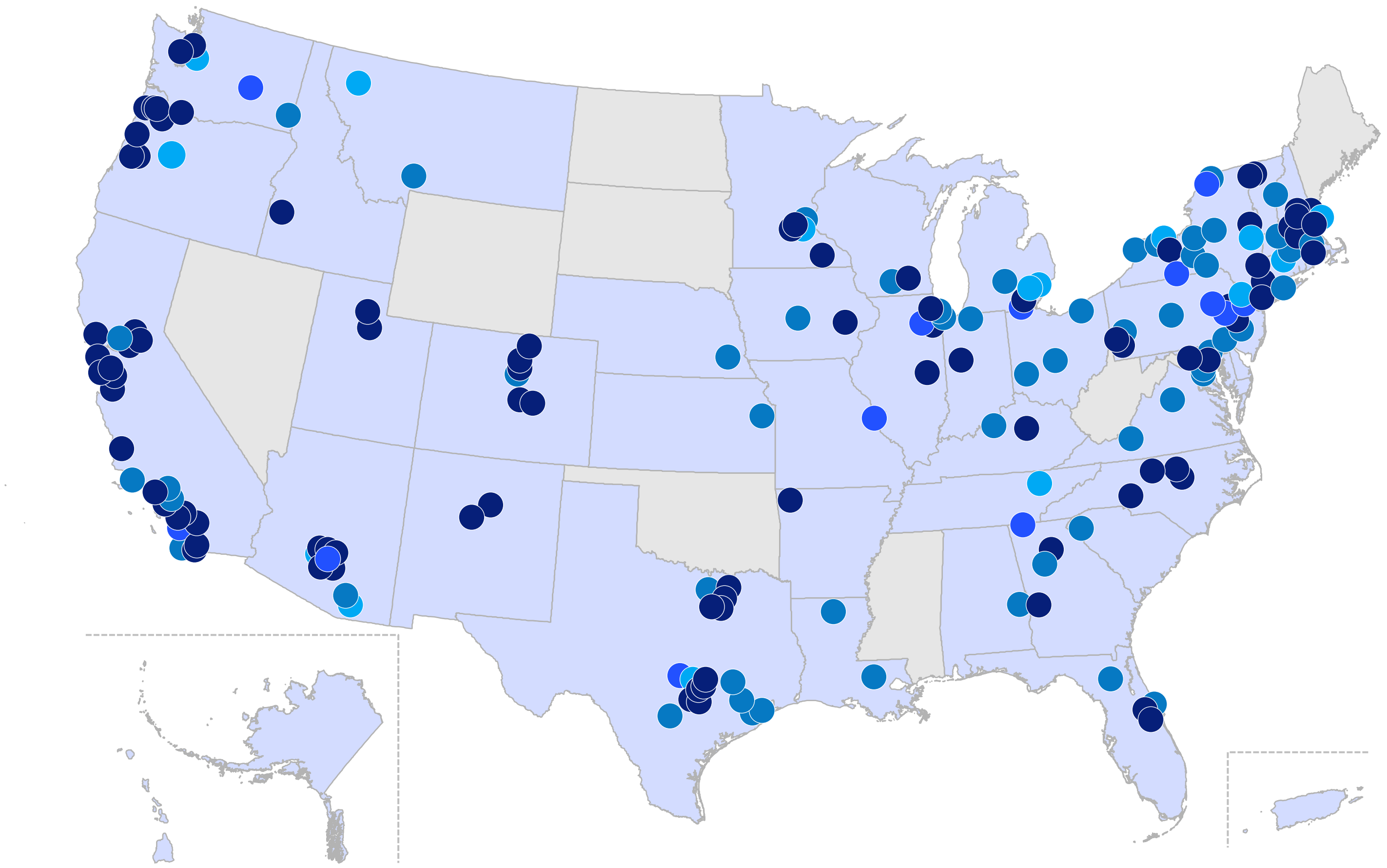
- **Geography:** IP and EDA activity is concentrated in a small number of states, primarily CA, TX, and the Northeast
- **Value-chain role:** These clusters provide the software backbone of chip design and are geographically narrow
- **Implications for talent gap:** Most regions lack both demand and supply for IP/EDA and CS-heavy semiconductor roles

Current ecosystem: US Semiconductor

Non-exhaustive

Research & Development

● Semiconductors ● Equipment ● Materials ● University R&D Partner



Source: Semiconductor Industry Association

Key takeaways

- **Geography:** R&D activity clusters around major research universities and innovation hubs
- **Value-chain role:** These regions anchor early-stage innovation in materials, devices, packaging, and next-gen architectures
- **Implications for talent gap:** Areas without strong research anchors show limited local supply of advanced and emerging-technology talent

Ecosystem investments: ~$390B+ of new manufacturing investments planned across the emerging U.S. semiconductor ecosystem

Non-exhaustive **Current as of December 2025**

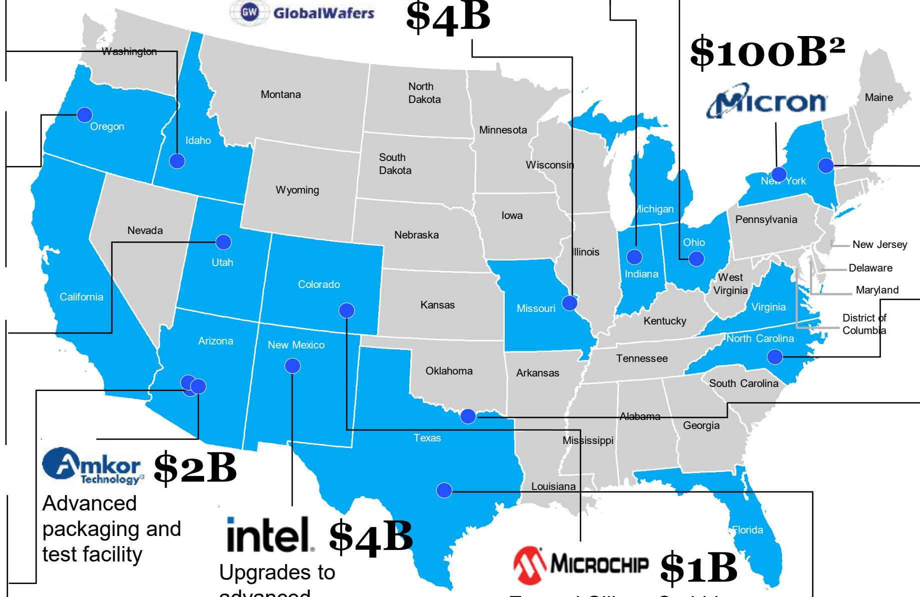
Announced US semiconductor manufacturing investments[1]

Micron $13B
One leading-edge foundry building memory circuits

intel $36B
Expanding logic hub with advanced 18A logic fabs / R&D

Texas Instruments $5.5B
Expanding hub with a second 28-130nm analog chip fab

tsmc $138B
Three leading-edge foundries focused on 2 & 3nm logic circuits



SK hynix $4B

GlobalWafers $4B

$100B[2] Micron

Amkor Technology $2B
Advanced packaging and test facility

intel $4B
Upgrades to advanced packaging facility

Microchip $1B
Expand Silicon Carbide (SiC) and Silicon (Si) Capacity

intel $28B[3]
Two leading-edge fabrication plants producing sub-5nm logic circuits

GlobalFoundries $16B
Expansion of 12-45nm logic chip production

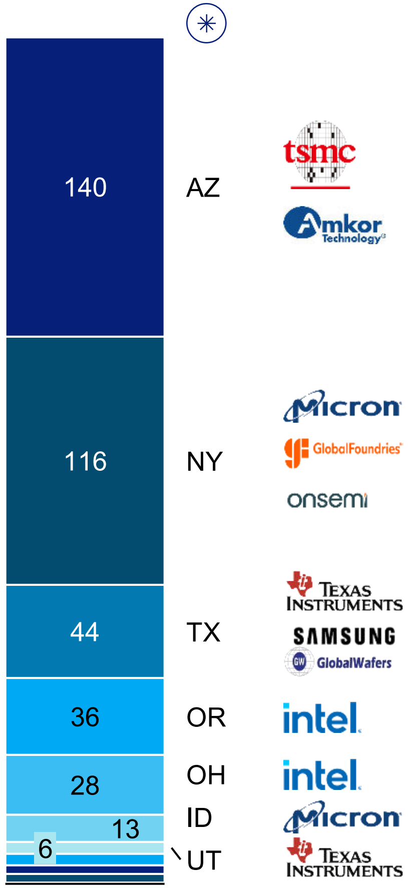
Wolfspeed $5B
Expansion of SiC Power Devices facility

Texas Instruments $20B
Scaling 300mm analog capacity (28-130n) at Sherman facility

GlobalWafers $4B
One factory producing 300mm silicon wafers

SAMSUNG $19B
One leading-edge plant producing sub-7nm logic chips, equipment to be installed in 2026+

US announcements by state[4], $B 2026+



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1. Callouts represent announcements ≥$1B while additional states highlighted are for announcements <$1B; majority of jobs are expected to be realized between 2026–2030 during standard fab ramp cycles
2. Estimated production start in 2030 with $100B over 10 years
3. Estimated investment expected to reach $100B over 10 years
4. Includes U.S. fab projects announced through Dec 1, 2025, counting only incremental capital expansion expected to occur from 2026 onward

Source: Semiconductor Industry Association; company reports; DoD press report; press release search

Ecosystem investments: 16+ new US investments slated for 2026 and beyond, led by major builds in Arizona and New York

Non-exhaustive

Company	**Location**	**Capacity** (WPM)	**Wafer size**	**Technology**	**Node size**	**Investment**[1] ($B)
TSMC	Phoenix, AZ	125,000	300mm	Logic	2nm/3nm	$138
Micron	Clay, NY	135,000	300mm	Memory	10-30 nm	$100
Intel	Hillsboro, OR	107,500	300mm	Logic	18A/R&D	$36
Intel	New Albany, OH	60,000	300mm	Logic	18A/20A	$28
Texas Instruments	Sherman, TX	165,000	300mm	Analog	28-130 nm	$20
Samsung	Taylor, TX	75,000	300mm	Logic	2nm/4nm	$19
GlobalFoundries	Malta, NY	130,000	300mm	Logic	12-45 nm	$16
Micron	Boise, ID	208,000	300mm	Memory	10-30 nm	$13
Texas Instruments	Lehi, UT	125,000	300mm	Analog	28-130nm	$5.5
Wolfspeed	Siler City, NC	100,000	200mm	SiC	*Wafers only*	$5
GlobalWafers	Sherman, TX	100,000	300mm	Wafer substrate	*Wafers only*	$4
GlobalWafers	St.Peters, MO	83,000	300mm	SiC	*Wafers only*	$4
SK Hynix	West Lafayette, IN	*TBD*	200mm	Memory	*Adv. Packaging*	$4
NXP	Austin, TX	520,000	200mm	Logic/Memory	65-180nm	$0.9
Microchip	Colorado Springs, CO	450,000	200mm	Analog/Memory	250 nm	$0.7
All other <$1B fabs						$5
Total						**~$390**

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1. Data includes fab investments announced by Dec 1, 2025 for projects commencing in 2026 or later. For in-progress or multi-phase facilities, only the remaining, forward-looking investment scheduled for 2026+ included

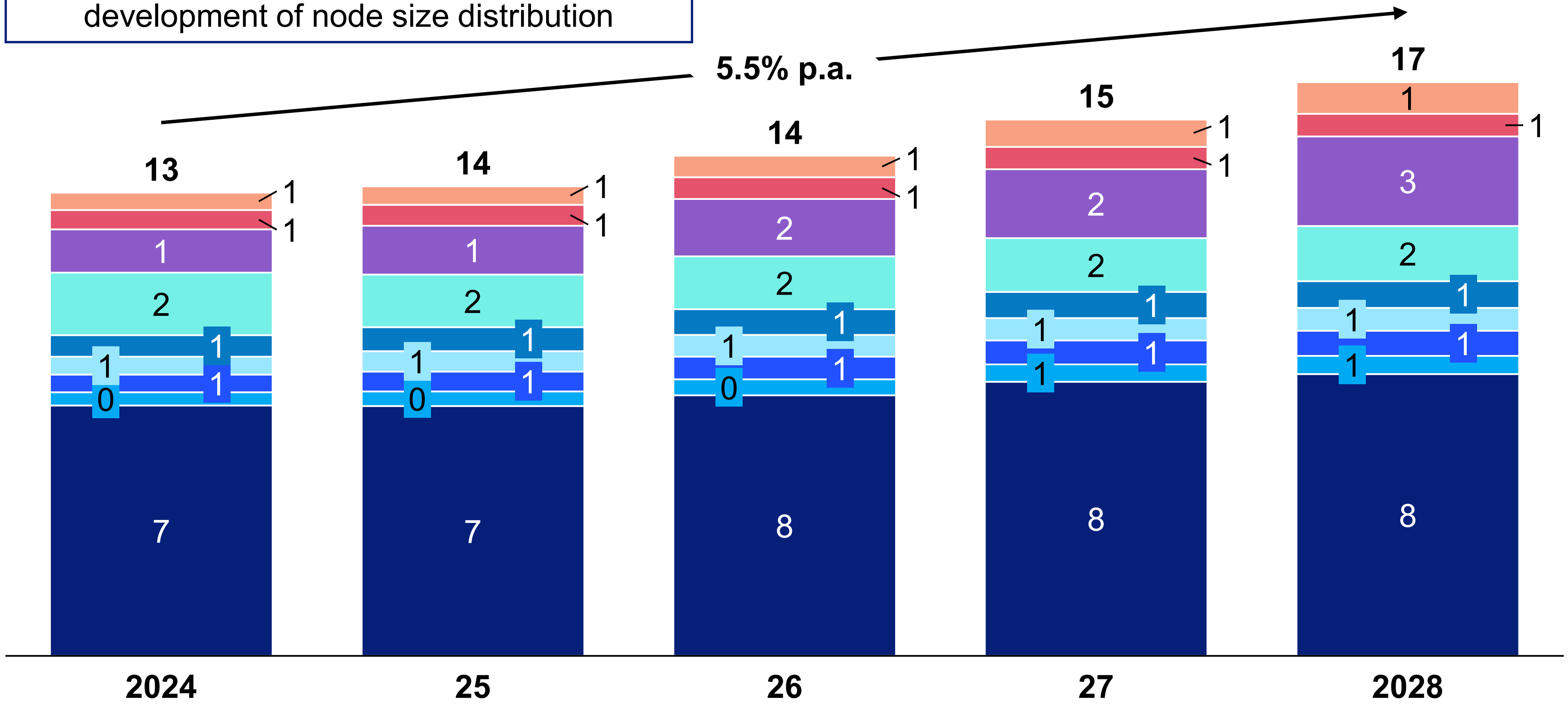
Source: Semiconductor Industry Association; company reports; DoD press report; press release search

Ecosystem investments: Majority of US fab investment in leading edge logic, analog, and memory

▨ Memory devices ▨ Non-memory devices

US semiconductor capacity by node size[1], in mn 300mm eq. wafers utilized capacity

No capacity forecast beyond 2028 due to high level of **uncertainty** regarding development of node size distribution



CAGR, in %

2024-28

16%	DRAM
4%	NAND/Flash
20%	7nm and below
-3%	10/14nm
6%	22/28nm
6%	40/55nm
9%	55/65mn
9%	90nm
3%	100nm and above

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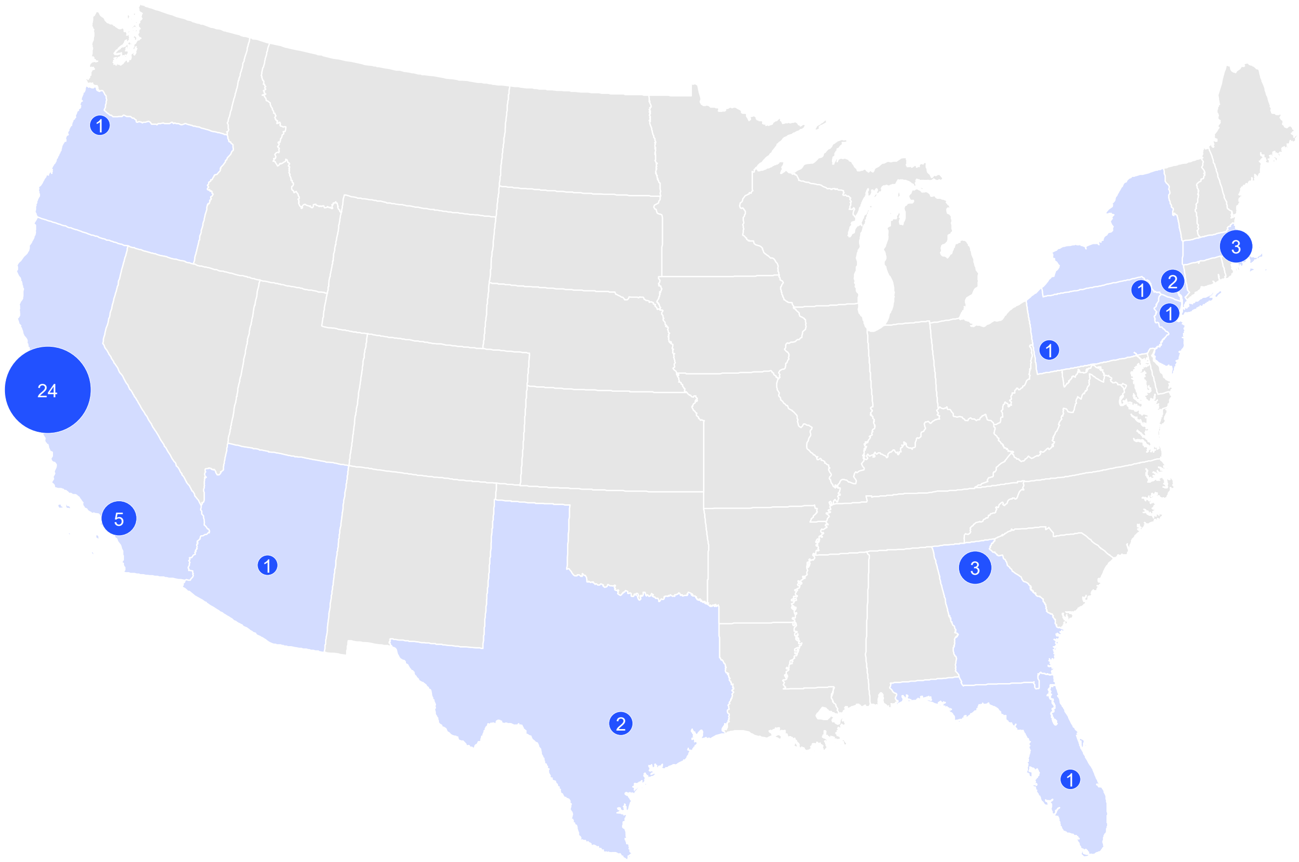
1. In case the SEMI WFF database did not differentiate between DRAM and NAND (fab produces both) the capacity was split 50/50 across the two

Source: SEMI WFF (March 2025), McKinsey

Ecosystem growth: Most new US semi R&D startups are likely to be <50 people and generally start in California

Non-exhaustive

R&D startup distribution by state, 2015-2025[1]



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1. Based on years founded

Source: Crunchbase

Key takeaways

- **Geography:** ~65% of R&D startups are based out of California, more than 80% of which are in Silicon Valley; the remainder are scattered across nine states
- **Scale:** ~60% operate with fewer than 50 employees; only one startup has more than 1,000 employees
- **Ecosystem:** R&D activity remains anchored in established innovation hubs; regions outside these clusters will likely require targeted incentives and partnerships to attract or grow similar startups

Ecosystem growth: US Semiconductor R&D startups

Non-exhaustive

No.	Startup Name	Year Established	HQ City	HQ State	Employee Count	Focus Area
1	Veevx	2022	Mesa	Arizona	11-50	Semiconductor design and iRAM chiplet developer
2	TenaFe	2019	Campbell	California	51-100	Semiconductor developer
3	Etched.ai	2022	Cupertino	California	51-100	Sohu developer, a chip designed specifically for running transformer models.
4	Retym	2020	Cupertino	California	11-50	Builds semiconductor technology
5	InPlay Inc.	2016	Irvine	California	11-50	Semiconductor developer
6	Axalume	2017	La Jolla	California	1-10	Photonic Chips
7	Furcifer Inc.	2015	Menlo Park	California	1-10	Advanced Materials
8	Tsavorite Scalable Intelligence	2023	Milpitas	California	251-500	Chiplets Architecture
9	SiLC Technologies	2018	Monrovia	California	51-100	Chip scale FMCW LiDAR solutions
10	Creature Algorithm	2024	Mountain View	California	1-10	Chip-level artificial intelligence system design
11	MatX	2022	Mountain View	California	11-50	AI chip designs that support large language models.
12	Oso Semiconductor	2022	Mountain View	California	1-10	High-performance chipsets for wireless applications
13	Enfabrica	2019	Mountain View	California	101-250	Semiconductor Engineering.
14	Lightmatter	2017	Mountain View	California	251-500	Semiconductor Chip Architecture
15	Ricursive Intelligence	2025	Palo Alto	California	1-10	Chip Design for AI
16	Alif Semiconductor	2019	Pleasanton	California	101-250	Semiconductor developer
17	Enosemi	2023	Sacramento	California	11-50	Silicon photonics chiplets & semiconductor design IP
18	LeapFrog Semiconductor	2020	San Diego	California	11-50	Chiplet based Modular and Scalable architecture
19	Overlord Labs, Inc.	2024	San Jose	California	11-50	Deep-tech semiconductor fusing analog IC precision and AI-powered digital
20	Persimmons	2023	San Jose	California	11-50	Generative AI Inference Chiplet
21	Celera Semiconductor	2018	San Jose	California	11-50	Analog semiconductor industry.
22	Ayar Labs	2015	San Jose	California	101-250	Semiconductor developer
23	Primemas	2022	Santa Clara	California	11-50	Semiconductor specializing in developing cost-effective, high-performance hub chiplets called Hublets.
24	EnCharge AI	2022	Santa Clara	California	11-50	Accelerator chip and development
25	Baya Systems	2023	Santa Clara	California	51-100	Chipset-based Semiconductor Systems
26	Celestial AI	2020	Santa Clara	California	101-250	Innovative use of semiconductor technology
27	Aeonsemi	2018	Santa Clara	California	51-100	Chip designs
28	Radical Semiconductor	2019	Studio City	California	11-50	Semiconductor developer
29	Bolt Graphics	2020	Sunnyvale	California	11-50	Semiconductor Builder
30	ANAFLASH	2017	Sunnyvale	California	11-50	Semiconductor developer
31	Soarce	2021	Orlando	Florida	2-10	Industrial manufacturers with nanofiber technology to make stronger, lighter, and cheaper products.
32	Twistient	2024	Atlanta	Georgia	1-10	Biorealistic chip design, nano-fabrication, and intelligent software.
33	Plaid Semiconductors	2023	Atlanta	Georgia	1-10	Advanced Interposers Technology chiplets integration
34	Falcomm	2021	Atlanta	Georgia	1-10	Semiconductor chip developer
35	Acuriant Technologies	2025	Boston	Massachusetts	251-500	Advance materials engineering
36	zeroRISC	2023	Boston	Massachusetts	11-50	Semiconductor developer
37	BraneCell Systems	2015	Cambridge	Massachusetts	101-250	Quantum AI chips
38	Solstice Advanced Materials	2025	Morris Plains	New Jersey	1001-5000	Specialty materials company; semiconductor materials
39	HFC Semiconductor	2019	Fishkill	New York	N/A	Semiconductor developer
40	Radical AI	2024	New York	New York	11-50	Materials research and development
41	AheadComputing	2024	Beaverton	Oregon	51-100	Semiconductor Innovator
42	NovoLINC	2024	Pittsburgh	Pennsylvania	1-10	Thermal interface solutions semiconductors and electronic chipsets
43	Cornelis Networks	2019	Wayne	Pennsylvania	101-250	Semiconductor high-performance networking designed
44	Extropic AI	2022	Austin	Texas	11-50	Chip building optimized to run large language models, or LLMs.
45	Uhnder	2015	Austin	Texas	11-50	Digital automotive radar-on-chip design

Source: Crunchbase

Appendix contents

Gap analysis

We built an integrated demand–supply workforce model to size semiconductor talent needs through 2030, incorporating fab announcements, ramp timing, baseline attrition, education pipelines, migration, and policy-driven supply levers

Key findings

- **Demand scales rapidly and unevenly:** ~189k incremental FTEs are required by 2030, driven by fab expansions and replacement hiring, with demand compressed into short ramp windows
- **Manufacturing drives incremental need:** ~74% of incremental demand is manufacturing-related, led by manufacturing engineers and technicians
- **Supply growth lags, especially for engineers:** ~3% of engineering graduates enter semiconductors; engineer supply adjusts slowly due to long education timelines and low entry rate
- **A persistent national shortfall remains:** Even under optimistic assumptions, the U.S. faces a ~127–157k FTE gap by 2030, with engineers ~60% of unmet demand
- **Gaps are geographically concentrated:** Shortages are largest in Texas, California, New York, Arizona, and Idaho

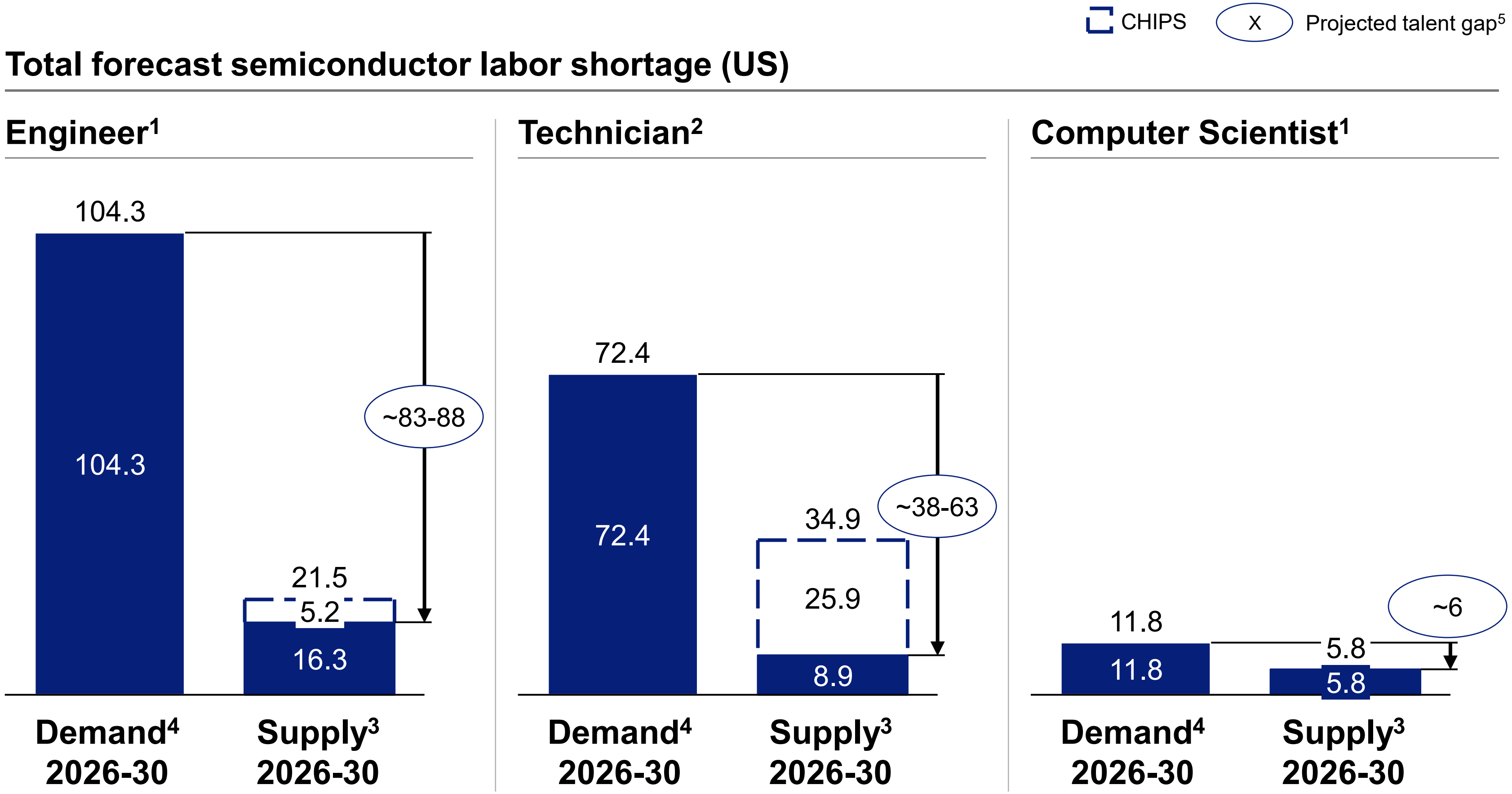
Four functional groups formed the focus of the talent gap analysis

Function	Subsectors	What they do	Role	Example companies
Manufacturing	Foundry manufacturing; Fabs; Packaging/Assembly/ Test (OSAT)	Run wafer fabs and assembly / test / packaging facilities that produce chips	**Engineer:** Process, equipment, yield, integration, reliability, industrial/facilities **Technician:** Operators, equipment techs, maintenance, metrology, facilities/utilities	Intel, Micron, GlobalFoundries, TSMC
Equipment Manufacturing	Equipment & materials suppliers	Build and support wafer fab tools, test equipment, and subsystems used in chip production	**Engineer:** Mechanical, electrical, controls, software, systems, applications, field service **Technician:** Assembly/build techs, install & field service techs, test techs	Applied Materials, Lam Research, KLA, ASML
IC Design	Chip design; EDA software; CoC and advanced packaging design	IC and system-on-chip design, verification, EDA tools, and supporting design teams in IDMs and fabless firms	**Engineer:** RTL/logic, analog/RF, physical design, verification, architecture, DFT, packaging co-design **Computer Scientist:** EDA algorithms, modeling & simulation, AI/ML for design automation **Technician:** Design validation, board bring-up, characterization, test support	**Fabless:** NVIDIA, AMD, Qualcomm, Broadcom **IDMs:** Intel, TI, Micron **EDA:** Synopsys, Cadence, Siemens EDA
R&D	Corporate and national labs; device, materials, and process R&D	Early-stage and next-gen research across devices, materials, processes, packaging, algorithms, and prototyping	**Engineer:** Device physics, materials science, process R&D, packaging R&D, prototyping **Computer Scientist:** Algorithm development, simulation, modeling **Technician:** Lab operations, tool support, validation, test & characterization	**R&D labs:** Intel Labs, IBM Research **Startups & consortia:** Applied research startups, university-affiliated labs

US semi sector projected to be 83-88k engineers, 38-63k technicians, and 6k CS FTEs short by 2030

2026-30, thousands of FTEs

Total forecast semiconductor labor shortage (US)



Key takeaways

Engineers account for ~56–66% of the total projected shortfall, driven by long education timelines and low entry rates into semiconductors

Technician gaps are also material, while computer scientist gaps remain comparatively limited

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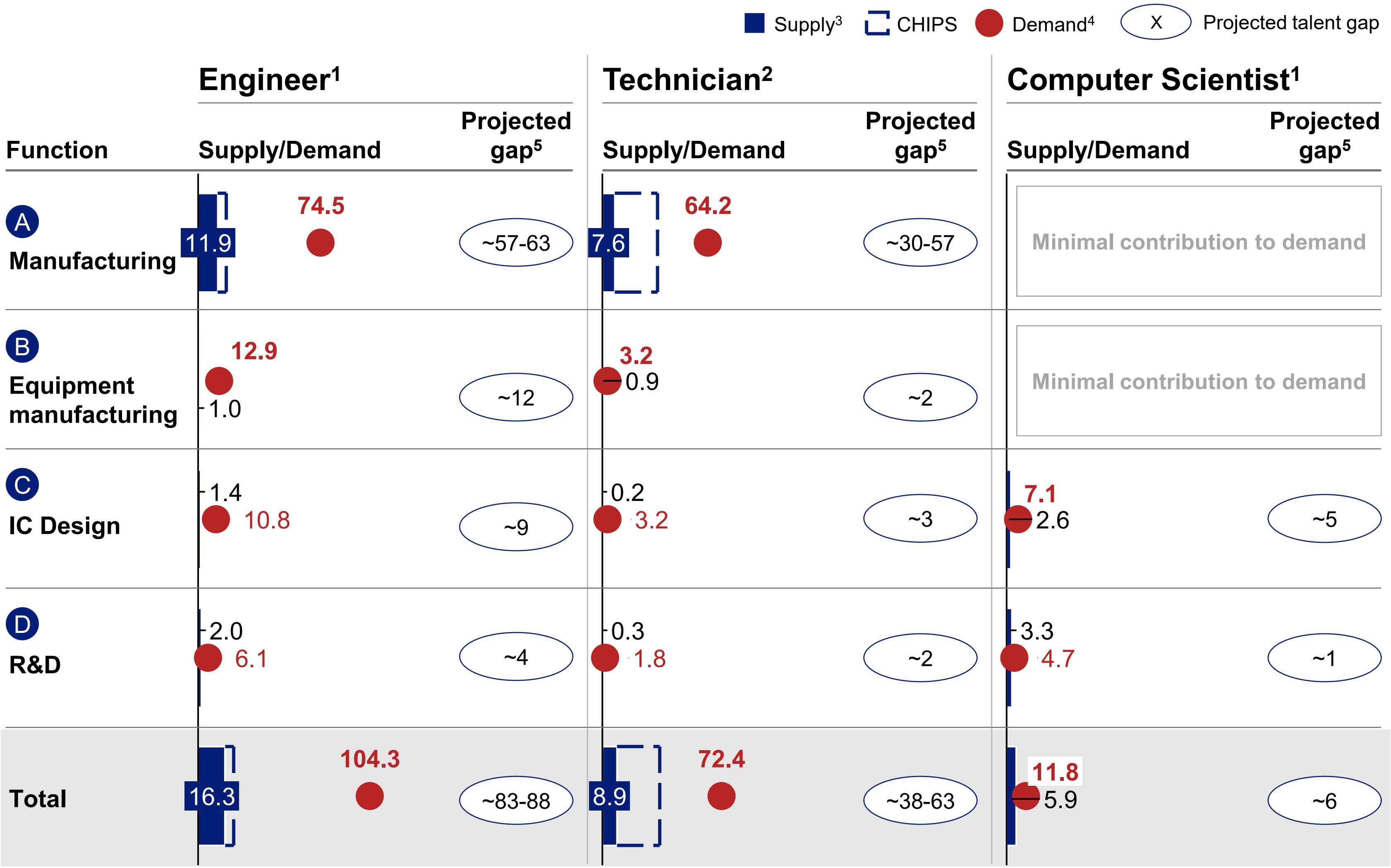
1. Includes 4-year degrees (Bachelors or equivalent), advanced programs (Masters, PhD) under relevant CIP codes | 2. Includes trade-schools, 2-year degree programs (Associate or equivalent), and workers trained through internal programs | 3. Supply of labor includes In-state graduates, out-of-state graduates, and entrants from other industries | 4. Labor demand based on 36 publicly announced front-end facilities (fabs) across 17 companies listed within Q3 2025 SEMI WFF database with tool install start dates starting 2025; headcount estimates will increase if new fab announcements are made after publication of this page; assumes 5% industry attrition rate (based on reported turnover rates in company public filings) | 5. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, Office, McKinsey industry benchmarks

Manufacturing roles drive ~70-75% of engineering and technician shortages through 2030

2026-30, thousands of FTEs



	Engineer[1]		Technician[2]		Computer Scientist[1]	
Function	Supply/Demand	Projected gap[5]	Supply/Demand	Projected gap[5]	Supply/Demand	Projected gap[5]
A Manufacturing	11.9 / 74.5	~57-63	7.6 / 64.2	~30-57	Minimal contribution to demand	
B Equipment manufacturing	1.0 / 12.9	~12	0.9 / 3.2	~2	Minimal contribution to demand	
C IC Design	1.4 / 10.8	~9	0.2 / 3.2	~3	2.6 / 7.1	~5
D R&D	2.0 / 6.1	~4	0.3 / 1.8	~2	3.3 / 4.7	~1
Total	16.3 / 104.3	~83-88	8.9 / 72.4	~38-63	5.9 / 11.8	~6

Key takeaways

Manufacturing engineer gaps remain large through 2030; announced CHIPS goals provide minor relief, but require additional talent programs

Technician gap could be reduced by 40% through CHIPS workforce funding; without it, only ~12% of demand is met

Surplus supply

Individuals in states with surplus supply (after migration, education flows) are assumed to transition to other industries due to insufficient in-state demand

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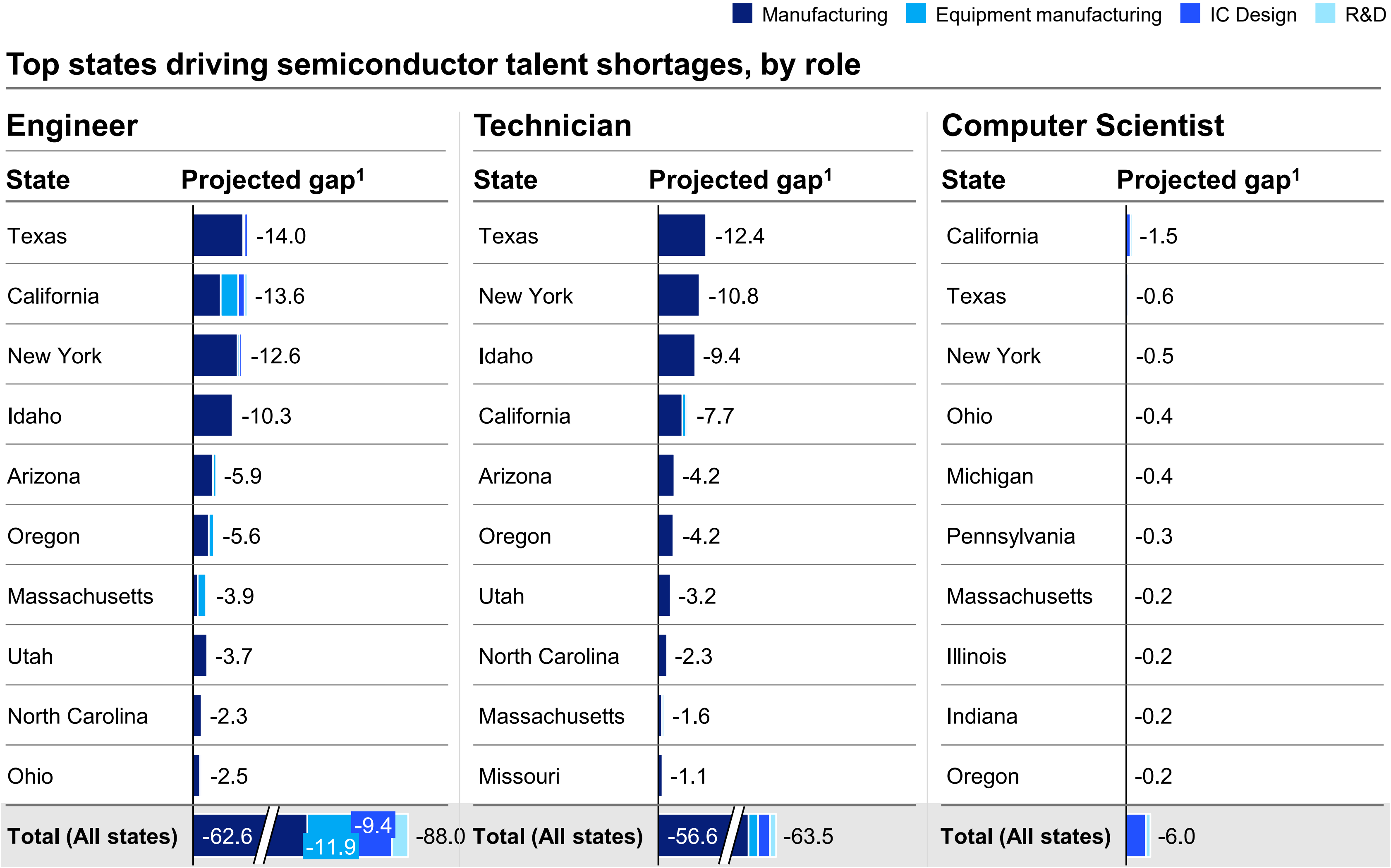
1. Includes 4-year degrees (Bachelors or equivalent), advanced programs (Masters, PhD) under relevant CIP codes | 2. Includes trade-schools, 2-year degree programs (Associate or equivalent), and workers trained through internal programs | 3. Supply of labor includes In-state graduates, out-of-state graduates, and entrants from other industries | 4. Labor demand based on 36 publicly announced front-end facilities (fabs) across 17 companies listed within Q3 2025 SEMI WFF database with tool install start dates starting 2025; headcount estimates will increase if new fab announcements are made after publication of this page; assumes 5% industry attrition rate (based on reported turnover rates in company public filings) | 5. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

Talent gaps are concentrated in a small number of states with major fab investments

2026-30, thousands of FTEs

Top states driving semiconductor talent shortages, by role



Engineer

State	Projected gap[1]
Texas	-14.0
California	-13.6
New York	-12.6
Idaho	-10.3
Arizona	-5.9
Oregon	-5.6
Massachusetts	-3.9
Utah	-3.7
North Carolina	-2.3
Ohio	-2.5
Total (All states)	-62.6 -11.9 -9.4 -88.0

Technician

State	Projected gap[1]
Texas	-12.4
New York	-10.8
Idaho	-9.4
California	-7.7
Arizona	-4.2
Oregon	-4.2
Utah	-3.2
North Carolina	-2.3
Massachusetts	-1.6
Missouri	-1.1
Total (All states)	-56.6 -63.5

Computer Scientist

State	Projected gap[1]
California	-1.5
Texas	-0.6
New York	-0.5
Ohio	-0.4
Michigan	-0.4
Pennsylvania	-0.3
Massachusetts	-0.2
Illinois	-0.2
Indiana	-0.2
Oregon	-0.2
Total (All states)	-6.0

Key takeaways

Talent gaps are geographically concentrated; A small number of fab-heavy states account for the majority of unmet semiconductor labor demand

Manufacturing roles drive state-level shortages; Across high-gap states, shortages are dominated by manufacturing engineers and technicians rather than design or CS roles

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1. Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. N=17; VP/Directors, Hiring managers, Workforce planning leads

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

A. Manufacturing roles will drive the largest state-level talent gaps through 2030

2026-30, thousands of FTEs

X Projected CHIPS impact

Top states driving semiconductor manufacturing talent shortages, by role

	Engineer		Technician	
State	**Projected gap[1]**	**CHIPS Impact[2]**	**Projected gap[1]**	**CHIPS Impact[2]**
Texas	-12.6	0.3	-12.0	1.3
New York	-11.2	0.2	-10.4	1.0
Idaho	-9.9	0.1	-9.3	0.5
California	-6.9	-	-6.0	-
Arizona	-5.0	3.1	-4.1	13.1
Oregon	-3.9	0.1	-3.8	0.5
Utah	-3.6	0.0	-3.1	0.2
North Carolina	-2.1	-	-2.2	-
Ohio	-1.8	-	-0.9	-
Missouri	-1.7	0.0	-1.1	0.1
Total (All states)	-62.6	5.2	-56.6	25.9

Key takeaways

Texas has the largest manufacturing gap (22.6k roles) despite strong education and positive migration; simultaneous Samsung, TI, and Coherent ramp-ups outpace near-term supply initiatives

California's manufacturing gap (12.9k) is supply-driven; net out-migration and high attrition from the nation's largest workforce create supply shortages

Arizona's demand is driven by large Intel and TSMC expansion; education pipelines, migration, and workforce initiatives mitigate but do not eliminate the resulting gap (9.1k roles)

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1. Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. 2. Based on NIST-announced CHIPS workforce development funding commitments by state. Funding is converted into incremental engineer and technician supply using estimated training costs ($10k per engineer, $3k per technician) and assumed to be deployed evenly over an average five-year period of performance, unless noted otherwise in award announcement, starting at fab production

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

Texas: engineer labor shortage is 87%, could potentially be reduced to 85% with CHIPS Act

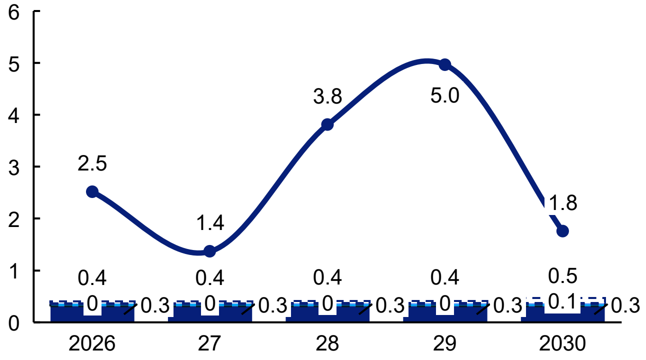
SAMSUNG COHERENT Texas Instruments

Demand[1] | ■ Professional net migration[2] | ■ In-state retained graduates[3] | ■ Out-of-state graduates[3] | ▨ Public/private initiatives (Non-CHIPS)[4] | ⬚ CHIPS Act[5,6]

XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

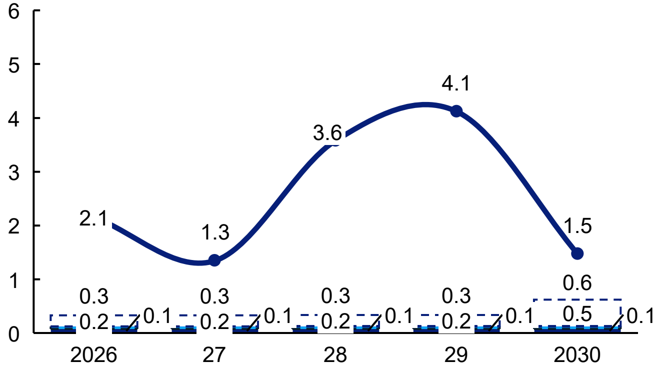
Engineers



Cumulative

Total demand	~14.4k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.3k	85%
Supply without CHIPS Act	~1.8k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~12.3k – ~12.6k	87%

Technicians



Cumulative

Total demand	~12.7k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~1.3k	85%
Supply without CHIPS Act	~0.6k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~10.7k – ~12k	95%

Recent announcements

- **Samsung (Taylor, TX)**
  - Taylor fab ramp shifted ~1–2 years later, pushing peak engineer and technician demand toward 2026+
  - Multi-phase fab capacity (85k+ WPM) remains planned, sustaining elevated workforce demand through 2030
- **Texas Instruments (Sherman, TX)**
  - Continued phased build-out of the mega-site (105k+ WPM), with high volume production starting in 2029
- **Coherent (Sherman, TX)**
  - Expansion of existing facility for InP device production

Takeaways

- **Texas has largest projected engineer labor gap, with ~12k engineer shortfall** (~87% of total projected demand) by 2030
- Texas produces **~5k+ engineering graduates annually**, but only **~50 (<1%)** transition into semiconductor fab roles, covering **~3% of projected annual engineer demand**
- **Public/private workforce initiatives (non-CHIPS) contribute only ~4% of total projected engineer supply and ~1% of technician supply**
- **CHIPS Act funding accounts for ~39% of total projected workforce supply,** reducing the technician gap (~95% to ~85%), but only modestly improving engineer shortage (~87% to ~85%)

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

New York: engineer labor shortage is 100%, could potentially be reduced to 99% with CHIPS Act

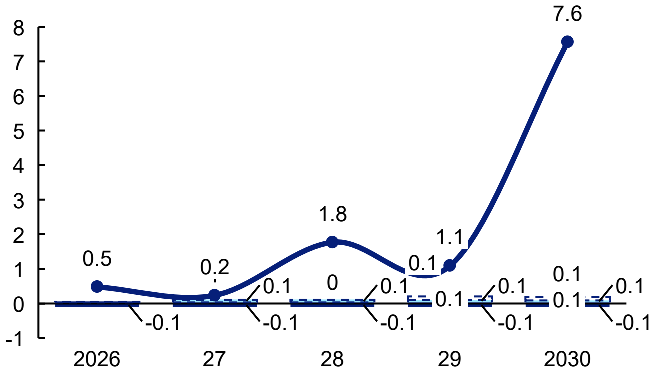
Micron GlobalFoundries

● Demand[1] ■ Professional net migration[2] ■ In-state retained graduates[3] ■ Out-of-state graduates[3] ▨ Public/private initiatives (Non-CHIPS)[4] ☐ CHIPS Act[5,6]

○ XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

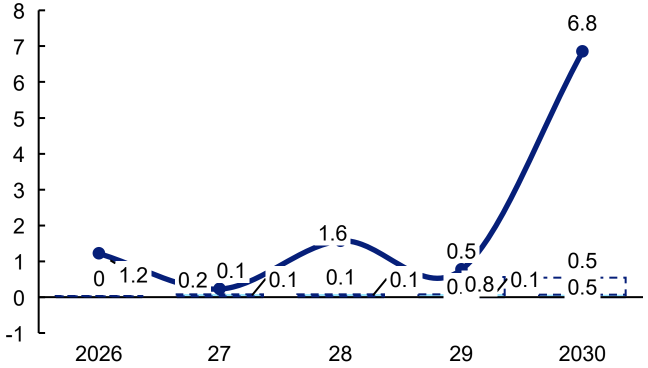
Engineers



Cumulative

Total demand	~11.1k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.2k	99%
Supply without CHIPS Act	~0k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~11k – ~11.2k	100%

Technicians



Cumulative

Total demand	~10.6k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~1k	89%
Supply without CHIPS Act	~0.2k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~9.4k – ~10.4k	98%

Recent announcements

- **Micron (Clay, NY)**
  - — Announced multi-phase investment totaling ~330K+ WPM (300mm-equivalent) across ramps beginning ~2029
- **GlobalFoundries (Malta, NY)**
  - — Capacity expansion at Malta, totaling ~120K+ WPM (300mm-equivalent) across incremental phases starting 2028
- **Onsemi (Syracuse, NY)**
  - — Power/analog manufacturing expansion beginning 2026
- **SUNY Polytechnic (Albany, NY)**
  - — Research-scale 300mm fab (1.3k WPM) ramping in 2026

Takeaways

- **New York exhibits near-total engineer shortage, with ~11.1k demand vs. ~0.2k supply (w/ CHIPS)**, resulting in a ~99–100% engineer gap across years
- **Engineer supply is constrained by net negative professional migration (~-0.5k) and limited graduate inflows,** offset only marginally by public/private initiatives and CHIPS
- **Technician outcomes are CHIPS-dependent, with ~90% of demand and ~81% of total supply driven by CHIPS Act funding**, reducing shortage from ~98% to ~89%

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

Idaho: engineer labor shortage is 94%, could potentially be reduced to 93% with CHIPS Act

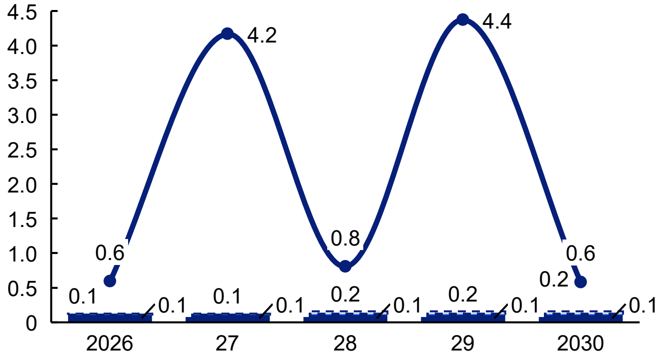
Micron

●— Demand[1]
■ Professional net migration[2]
▨ In-state retained graduates[3]
▨ Out-of-state graduates[3]
▨ Public/private initiatives (Non-CHIPS)[4]
☐ CHIPS Act[5,6]

◯ XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

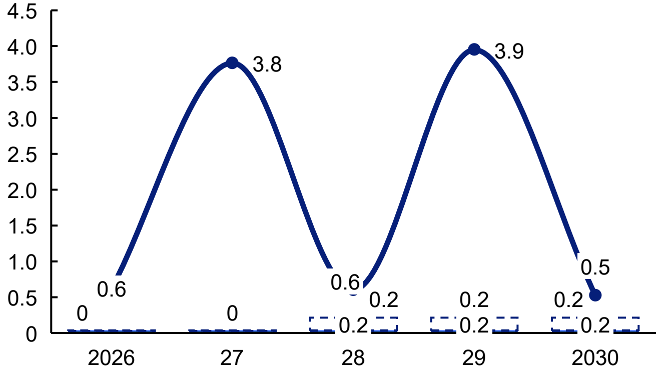
Engineers



Cumulative

Total demand	~10.5k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.1k	93%
Supply without CHIPS Act	~0.6k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~9.8k – ~9.9k	94%

Technicians



Cumulative

Total demand	~9.5k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.5k	92%
Supply without CHIPS Act	~0.2k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~8.7k – ~9.3k	98%

Recent announcements

- **Micron (Boise, ID)**
  - **Announced a large-scale fab totaling ~210K+ WPM (300mm-equivalent) across phased ramps,** with initial production beginning ~2027 and additional phases coming online through ~2029
  - **Single-site investment drives the majority of Idaho's projected workforce demand,** resulting in concentrated annual deficits of ~4.2K engineers and ~3.9K technicians during ramp years (2027 and 2029)

Takeaways

- **Demand highly concentrated in single large fab,** driving ~10.5K engineer and ~9.5k technician demand through 2030
- **Structural supply constraints in a small state, with engineer supply of ~0.1k (w/ CHIPS) vs. ~10.5K demand,** resulting in ~93–94% engineer shortage
- **Technician gap remains large even with CHIPS, with ~92% shortage w/ CHIPS (vs. ~98% w/o CHIPS)** and ~3.9K annual deficits in ramp years (2027, 2029)
- **CHIPS Act is the primary source of technician supply (~56% of demand and ~74% of total supply),** with no meaningful non-CHIPS public/private contribution

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

California: engineer labor shortage is estimated at 92%, with the CHIPS Act expected to have limited impact on closing the gap

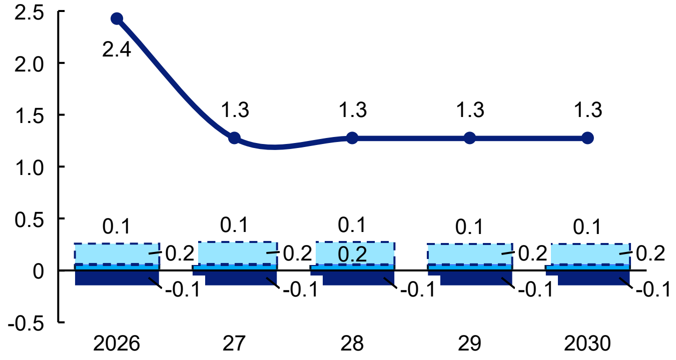
BOSCH

● Demand[1] ■ Professional net migration[2] ■ In-state retained graduates[3] ■ Out-of-state graduates[3] ▢ Public/private initiatives (Non-CHIPS)[4] ▢ CHIPS Act[5,6]

(XX%) Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

Engineers



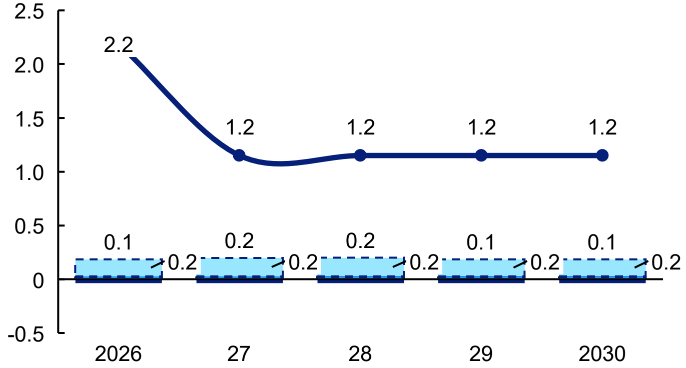
Cumulative

Total demand	~7.5k
Supply from CHIPS Act	N/A
Supply without CHIPS Act	~0.6k
Total estimated shortage (w. CHIPS/w.o CHIPS)	~6.9k – ~6.9k

Labor shortage with CHIPS Act: 92%

Labor shortage without CHIPS Act: 92%

Technicians



Cumulative

Total demand	~6.8k
Supply from CHIPS Act	N/A
Supply without CHIPS Act	~0.8k
Total estimated shortage (w. CHIPS/w.o CHIPS)	~6k – ~6k

Labor shortage with CHIPS Act: 89%

Labor shortage without CHIPS Act: 89%

Recent announcements

- **Bosch (Roseville, CA):**
  - Announced expansion of legacy semiconductor manufacturing capacity totaling **~65k WPM (300mm-equivalent)**, with production beginning **~2026**

Takeaways

- **Engineer shortage driven primarily by underlying labor dynamics rather than new fab announcements**
- Large installed base of semiconductor manufacturing sustains **ongoing replacement demand**, with attrition accounting for **~85% of total engineer demand**
- California produces a large graduate pool (**~10k+ combined engineers and technicians annually**), but **net negative professional migration (-0.5% YoY)** and net negative graduate outflows materially reduce available in-state supply

1-6: See methodology appendix

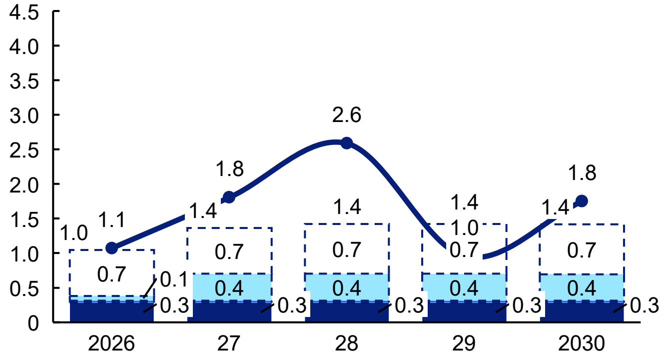
Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

Arizona: engineer labor shortage is 61%, could potentially be reduced to 18% with CHIPS Act

- Demand[1]
- ■ Professional net migration[2]
- ▨ In-state retained graduates[3]
- ▨ Out-of-state graduates[3]
- ▨ Public/private initiatives (Non-CHIPS)[4]
- ☐ CHIPS Act[5,6]
- XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

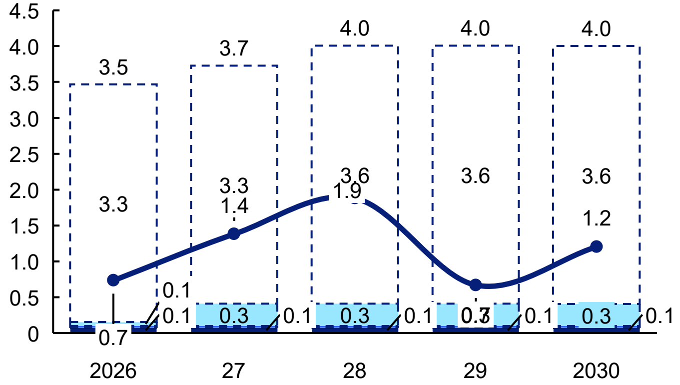
Engineers



Cumulative

Total demand	~8.2k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~3.5k	18%
Supply without CHIPS Act	~3.2k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~1.5k – ~5k	61%

Technicians



Cumulative

Total demand	~5.9k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~17.4k	0%
Supply without CHIPS Act	~1.8k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~0k – ~4.1k	70%

Recent announcements

- **TSMC (Phoenix, AZ):**
  - — Total committed capacity of 110k+ WPM (300mm equiv.)
  - — Added a new small pilot (2k) and shifted to more diversified mix of mid-size (10k, 20k) vs an early 25k-WSPM plan size
  - — Ramp dates shifted 1–2 years later across nearly all TSMC fabs due to construction timeline shifts
- **Intel (Chandler, AZ):**
  - — Chandler's next major fab moved ~2 years later, pushing out peak labor demand to 2028 and beyond

Takeaways

- There is still a **~1.5-~5k engineers gap despite CHIPS funding**, indicating need for additional public/private initiatives to close the gap beyond 2027
- CHIPS Act significantly boosts technician workforce (creates 11.5k jobs) **beyond projected demand needs**
- CHIPS Act funding accounts for **~52% of total projected engineering supply**
- Delayed fab ramp dates require workforce initiatives to scale to meet future-year demand (2028- beyond)

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

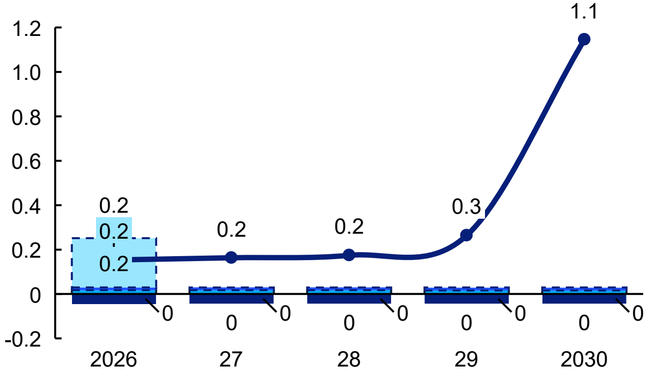
Ohio: engineer labor shortage is estimated at 92%, with the CHIPS Act expected to have limited impact on closing the gap

● Demand[1] ■ Professional net migration[2] ■ In-state retained graduates[3] ■ Out-of-state graduates[3] ▨ Public/private initiatives (Non-CHIPS)[4] ⬚ CHIPS Act[5,6]

XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

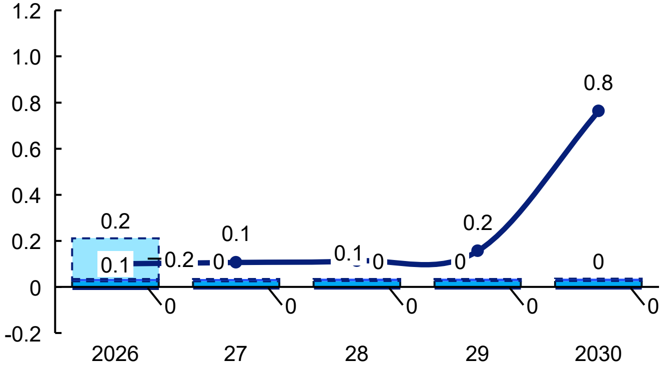
Engineers



Cumulative

Total demand	~1.9k	Labor shortage with CHIPS Act
Supply from CHIPS Act	N/A	92%
Supply without CHIPS Act	~0.1k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~1.8k	92%

Technicians



Cumulative

Total demand	~1.2k	Labor shortage with CHIPS Act
Supply from CHIPS Act	N/A	76%
Supply without CHIPS Act	~0.3k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~0.9k	76%

Recent announcements

- **Intel (New Albany, OH):**
  - Two announced leading-edge 300mm fabs at New Albany, each with **~30K WPM** capacity, totaling **~60k WPM (300mm)**
  - **Ramp timelines shifted ~3 years later than initially planned (beginning ~2029),** pushing peak workforce demand into late 2020s and early 2030s

Takeaways

- **Engineer demand (~1.9k) driven by delayed ramp of a single large greenfield site,** with demand back-loaded in 2029+
- **Ohio exhibits net negative professional migration (~-0.2k engineers) despite a strong graduate pipeline (~0.15k in-state and out-of-state graduates),** limiting retained in-state supply
- **Near-term public/private initiatives contribute materially to engineer supply (~0.2k; ~12% of demand)** due to early ramp expectations, with limited visibility into continuation in later years

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

North Carolina: engineer labor shortage is estimated at 70%, with the CHIPS Act expected to have limited impact on closing the gap

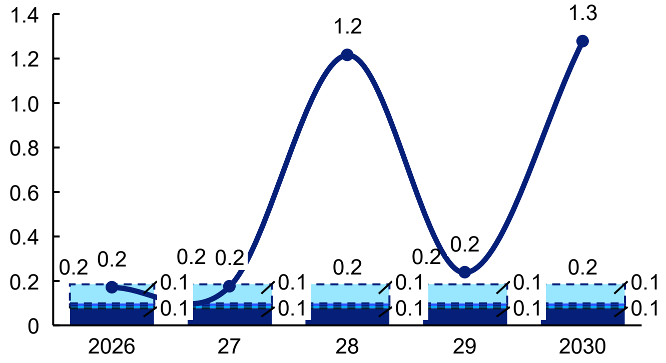
Wolfspeed

● Demand[1] ■ Professional net migration[2] ▨ In-state retained graduates[3] ▨ Out-of-state graduates[3] ▨ Public/private initiatives (Non-CHIPS)[4] ⬚ CHIPS Act[5,6]

XX% Labor shortage

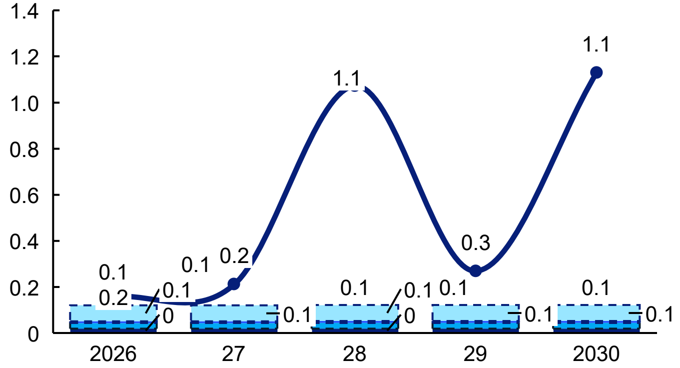
U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

Engineers



Cumulative		
Total demand	~3.1k	Labor shortage with CHIPS Act
Supply from CHIPS Act	N/A	70%
Supply without CHIPS Act	~0.9k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~2.1k – ~2.1k	70%

Technicians



Cumulative		
Total demand	~2.8k	Labor shortage with CHIPS Act
Supply from CHIPS Act	N/A	79%
Supply without CHIPS Act	~0.6k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~2.2k – ~2.2k	79%

Recent announcements

- **WolfSpeed (Siler City, NC):**
  - Expansion of the John Palmour (JP) Manufacturing Center for silicon carbide, **totaling ~100k WPM (300mm-equivalent)**, expected to be one of the largest SiC fabs globally
  - **Phased ramp beginning ~2028, with an additional expansion in ~2030,** creating step-change workforce demand concentrated in a single site

Takeaways

- Engineer supply remains limited relative to demand, with ~0.9k supply without, **resulting in a ~70% engineer shortage**
- **Engineer supply composition driven primarily by positive professional net migration (~0.4k; ~42% of supply)** and **public/private initiatives (~0.4k; ~47% of supply)**
- **Technician outcomes are independent of CHIPS,** with public/private initiatives accounting for ~0.3k (~57% of total supply)

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

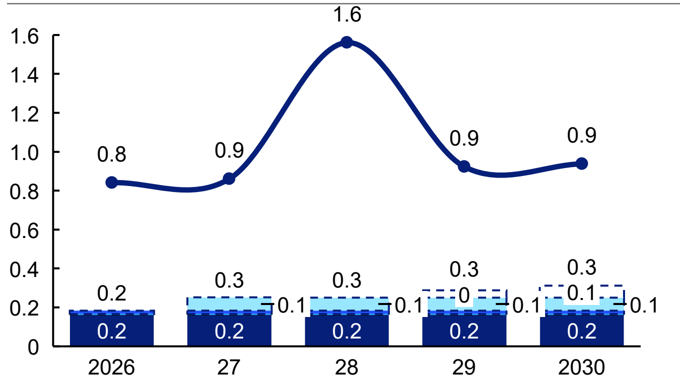
Oregon: engineer labor shortage is 77%, could potentially be reduced to 75% with CHIPS Act

Demand[1]
Professional net migration[2]
In-state retained graduates[3]
Out-of-state graduates[3]
Public/private initiatives (Non-CHIPS)[4]
CHIPS Act[5,6]

XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

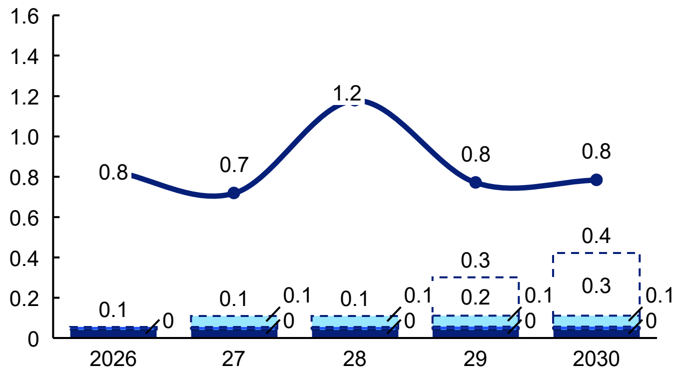
Engineers



Cumulative

Total demand	~5.1k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.1k	75%
Supply without CHIPS Act	~1.2k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~3.8k – ~3.9k	77%

Technicians



Cumulative

Total demand	~4.3k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.5k	77%
Supply without CHIPS Act	~0.5k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~3.3k – ~3.8k	89%

Recent announcements

- **Intel (Hillsboro, OR):**
  - Announced expansion of existing manufacturing footprint with a **300mm fab totaling ~20K WPM**
  - Production beginning **~2028,** adding workforce demand on top of an already large installed manufacturing base

Takeaways

- **Engineer shortage driven by scale of existing manufacturing base and incremental expansion**, with ~5.1k engineer demand vs. ~1.2k supply without CHIPS, resulting in a ~77% deficit
- **Engineer supply supported primarily by positive professional net migration (~0.8k; ~16% of demand),** while in-state retained graduates remain limited (~0.02k)
- **Public/private initiatives and CHIPS provide incremental engineer supply (~0.3k and ~0.1k respectively),** reducing but not eliminating structural gaps in later years
- **Technician outcomes are highly CHIPS-dependent,** with CHIPS Act accounting for ~12% of demand and ~51% of total supply, reducing technician shortage from ~89% to ~77%

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

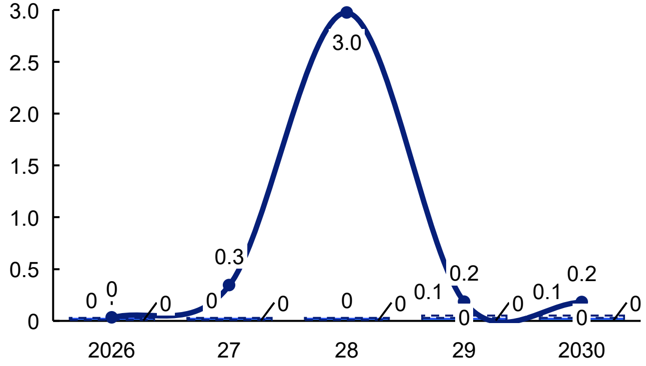
Utah: engineer labor shortage is 96%, could potentially be reduced to 95% with CHIPS Act

●— Demand[1] ■ Professional net migration[2] ■ In-state retained graduates[3] ■ Out-of-state graduates[3] ▨ Public/private initiatives (Non-CHIPS)[4] ⬚ CHIPS Act[5,6]

XX% Labor shortage

U.S. manufacturing workforce, incremental annual k FTE, 2026-2030

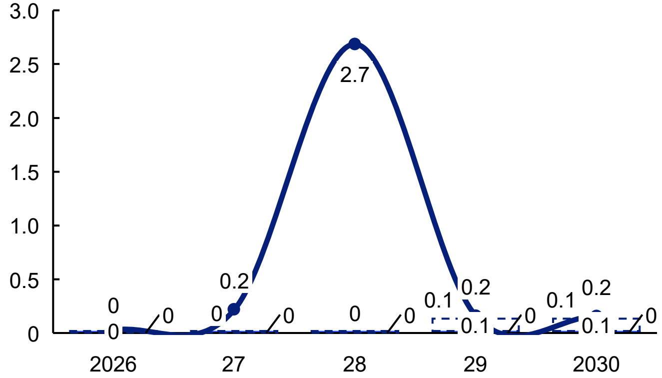
Engineers



Cumulative

Total demand	~3.7k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0k	95%
Supply without CHIPS Act	~0.1k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~3.5k – ~3.6k	96%

Technicians



Cumulative

Total demand	~3.2k	Labor shortage with CHIPS Act
Supply from CHIPS Act	~0.2k	90%
Supply without CHIPS Act	~0.1k	Labor shortage without CHIPS Act
Total estimated shortage (w. CHIPS/w.o CHIPS)	~2.9k – ~3.1k	97%

Recent announcements

- **Texas Instruments (Lehi, UT)**
  - **Expansion of existing manufacturing footprint with a 300mm fab totaling ~70k WPM**, representing a large-scale analog capacity addition
  - **Phased ramp beginning ~2028,** creating a sharp, concentrated increase in workforce demand at a single site

Takeaways

- **Engineer supply remains structurally limited in a small state,** with ~0.1k supply without CHIPS and <0.1k with CHIPS, resulting in a ~96% engineer shortage without CHIPS and ~95% with CHIPS
- **Engineer supply relies primarily on out-of-state graduates (~50% of supply) and CHIPS Act (~24% of supply),** with no contribution from public/private initiatives
- **Technician outcomes are highly CHIPS-dependent, with CHIPS Act accounting for ~7% of demand and ~70% of total supply**, reducing technician shortage from ~97% to ~90%

1-6: See methodology appendix

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

B. Equipment manufacturing talent gaps will remain engineer-driven through 2030

2026-30, thousands of FTEs

X Projected CHIPS impact

Top states driving semiconductor equipment manufacturing talent shortages, by role

	Engineer		Technician	
State	**Projected gap[1]**	**CHIPS Impact[2]**	**Projected gap[1]**	**CHIPS Impact[2]**
California	-4.4	—	-0.9	—
Massachusetts	-2.1	—	-0.5	—
Connecticut	-1.3	—	-0.3	—
Oregon	-1.2	—	-0.3	—
Arizona	-0.8	0.4	-0	1.9
New York	-0.5	—	-0.1	—
Texas	-0.4	—	-0	—
Montana	-0.4	—	-0.1	—
Idaho	-0.3	—	-0.1	—
Pennsylvania	-0.2	—	-0	—
Total (All states)	-11.9	0.4	-2.4	1.9

Key takeaways

Engineer gaps are concentrated in states with existing OEM capacity; CA, MA, CT, and OR account for ~75% of the total gap, with limited planned U.S. investment beyond established players

Interstate mobility offers limited relief for engineering shortages; ~0.8k surplus engineers nationally are insufficient to close an ~11k gap, requiring expansion of domestic education pipelines

Technician surpluses are widespread (31 of 50 states); limited equipment-manufacturing demand in most states creates potential reallocation toward semiconductor manufacturing, but technicians structurally are less mobile than engineers

---

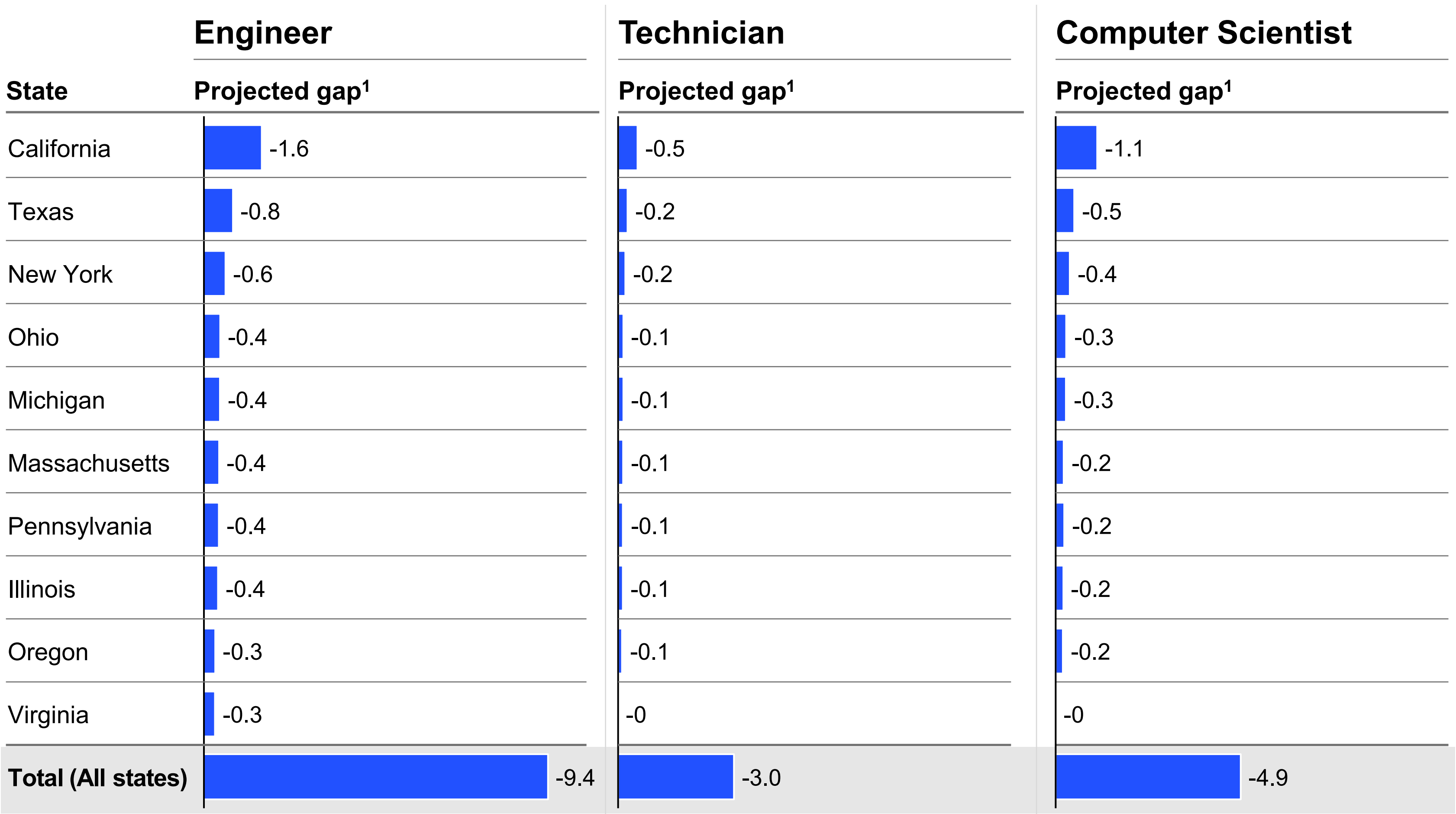
1. Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. Based on NIST-announced CHIPS workforce development funding commitments by state. Funding is converted into incremental engineer and technician supply using estimated training costs ($10k per engineer, $3k per technician) and assumed to be deployed evenly over an average five-year period of performance, unless noted otherwise in award announcement, starting at fab production

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

C. IC Design talent gaps are modest and geographically dispersed due to location flexibility

2026-30, thousands of FTEs

Top states driving semiconductor IC design talent shortages, by role



State	Engineer Projected gap[1]	Technician Projected gap[1]	Computer Scientist Projected gap[1]
California	-1.6	-0.5	-1.1
Texas	-0.8	-0.2	-0.5
New York	-0.6	-0.2	-0.4
Ohio	-0.4	-0.1	-0.3
Michigan	-0.4	-0.1	-0.3
Massachusetts	-0.4	-0.1	-0.2
Pennsylvania	-0.4	-0.1	-0.2
Illinois	-0.4	-0.1	-0.2
Oregon	-0.3	-0.1	-0.2
Virginia	-0.3	-0	-0
Total (All states)	-9.4	-3.0	-4.9

Key takeaways

IC Design talent gaps are dispersed nationally; design work is often location-flexible and more frequently emerging outside existing clusters, resulting in gaps aligned with where firms are investing in IC design and corporate functions

Oregon shows a small IC design gap despite high projected R&D spend (~$9B in 2024); strong graduate supply, and positive professional migration expected to help fill demand

---

[1] Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. Based on NIST-announced CHIPS workforce development funding commitments by state. Funding is converted into incremental engineer and technician supply using estimated training costs ($10k per engineer, $3k per technician) and assumed to be deployed evenly over an average five-year period of performance, unless noted otherwise in award announcement, starting at fab production

Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

D. R&D talent gaps are smaller and reflect the broad distribution of process and device research

2026-30, thousands of FTEs

Top states driving semiconductor R&D design talent shortages, by role

	Engineer	Technician	Computer Scientist
State	**Projected gap[1]**	**Projected gap[1]**	**Projected gap[1]**
California	-0.7	-0.3	-0.4
New York	-0.4	-0.1	-0.2
Texas	-0.3	-0.1	-0.1
Michigan	-0.3	-0.1	-0.1
Pennsylvania	-0.3	-0.1	-0.1
Ohio	-0.3	-0.1	-0.1
Massachusetts	-0.2	-0.1	-0
Illinois	-0.2	-0.1	-0
Virginia	-0.1	-0	-0
Missouri	-0.1	-0	-0
Total (All states)	-4.1	-1.5	-1.1

Key takeaways

Computer scientist gaps are materially smaller than engineer deficits; overall large volumes of computer science graduates limit the scale of shortfall despite small share of computer science entrants (~1.7%) into semiconductors

California drives the largest absolute R&D engineer gap, reflecting the size of its existing semiconductor research footprint; however, gaps remain moderate and supported primarily by in-state graduate pipelines

1. Gap is defined as Supply-Demand, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers are assumed to transition to other industries | 2. Based on NIST-announced CHIPS workforce development funding commitments by state. Funding is converted into incremental engineer and technician supply using estimated training costs ($10k per engineer, $3k per technician) and assumed to be deployed evenly over an average five-year period of performance, unless noted otherwise in award announcement, starting at fab production

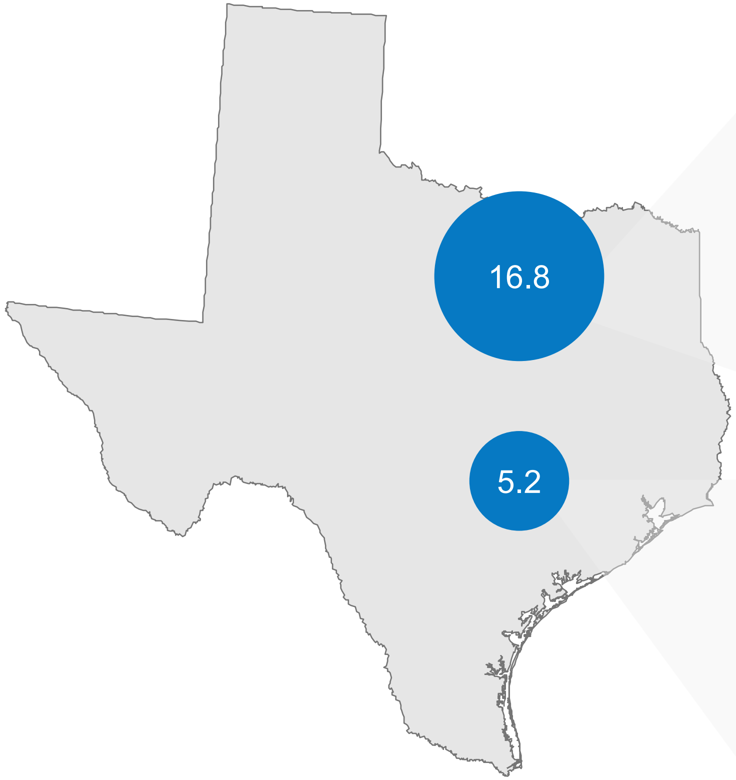
Source: SEMI, SIA, OECD 2019-2024, IPEDS, US Bureau of Labor Statistics, US Census Bureau, NSF, CHIPS Program Office, McKinsey industry benchmarks

Texas: Sub-state concentration of semiconductor talent gaps

2026-30, thousands of FTEs

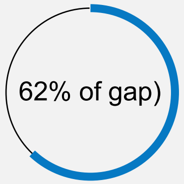
Distribution of Texas’ state-level talent gap across key MSAs[1]

■ Engineer ■ Technician ■ Computer Scientist

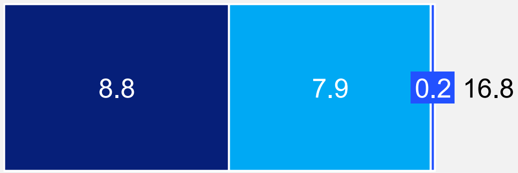


DFW

MSA: 19100



Projected gap by role

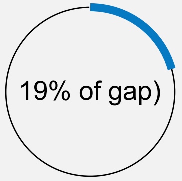


Top regional employers

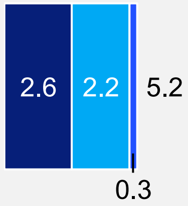
- Texas Instruments
- Micron
- Analog Devices
- Global Wafers
- onsemi

Austin

MSA: 31080



Projected gap by role



Top regional employers

- Samsung
- AMD
- NXP
- Applied
- Intel

~19% of the statewide semiconductor workforce gap falls outside the two focus MSAs

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1. Metropolitan Statistical Areas (MSAs) are U.S. Office of Management and budget-defined regions reflecting integrated urban labor markets

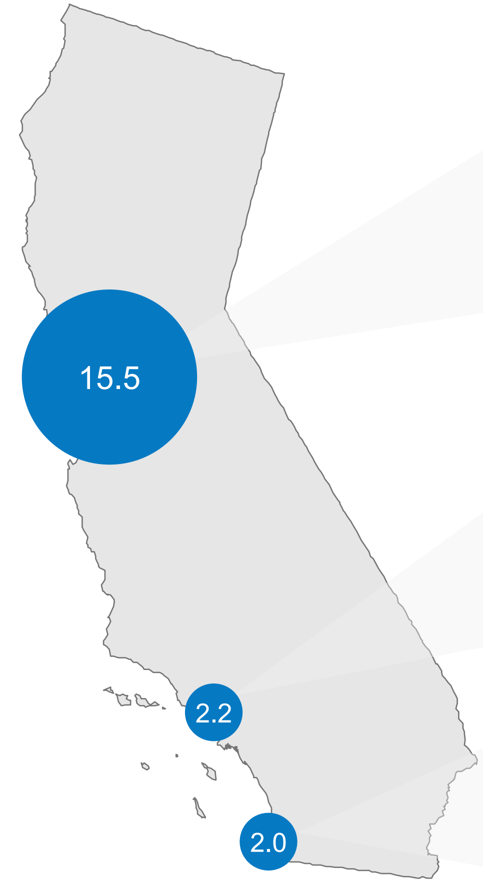
Source: Lightcast, McKinsey LaborCUBE

California: Sub-state concentration of semiconductor talent gaps

2026-30, thousands of FTEs

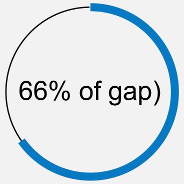
Distribution of California's state-level talent gap across key MSAs[1]

■ Engineer ■ Technician ■ Computer Scientist

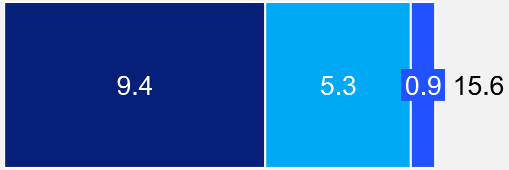


Bay Area

MSA: 41860 + 41940



Projected gap by role

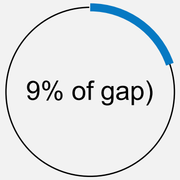


Top regional employers

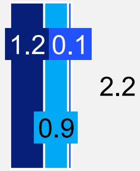
- Broadcom
- Applied Materials
- AMD
- NVIDIA

Los Angeles

MSA: 31080



Projected gap by role

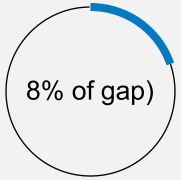


Top regional employers

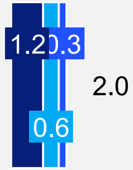
- Western Digital
- Infineon
- Bosch

San Diego

MSA: 41740



Projected gap by role



Regional employers

- ASML
- Qualcomm
- pSemi

~16% of the statewide semiconductor workforce gap falls outside the three focus MSAs

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1. Metropolitan Statistical Areas (MSAs) are U.S. Office of Management and budget-defined regions reflecting integrated urban labor markets

Source: Lightcast, McKinsey LaborCUBE

Approach for forecasting incremental semiconductor workforce gaps from 2026-2030

Inputs validated through public press, government reports, and industry publications (e.g., NSF, SIA)

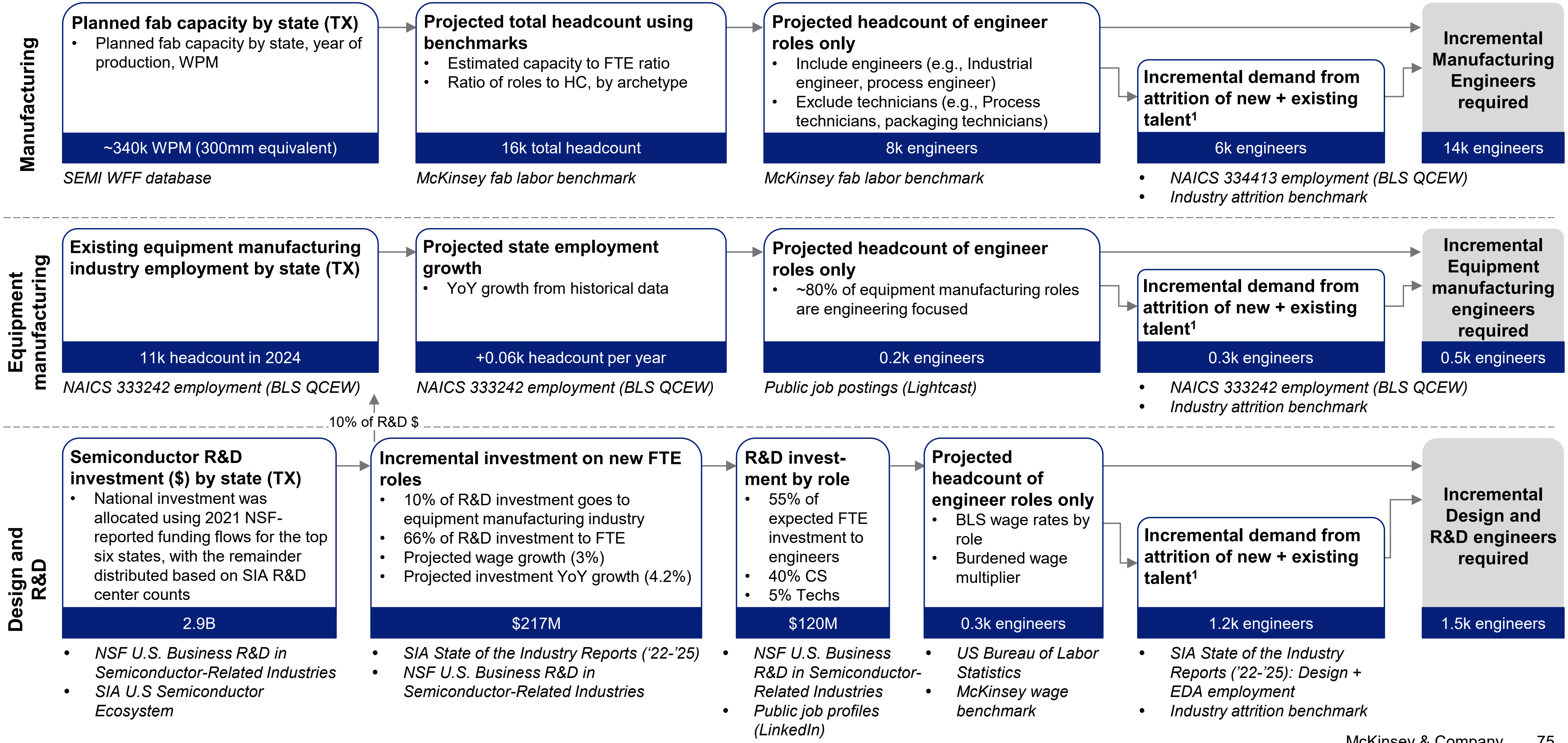
Approach		Data sources
Demand	• Incremental workforce needs estimated from fab expansions and new capacity announcements • FTE requirements derived using benchmark FTE-to-capacity ratios and fab ramp curves • Role splits allocated using benchmarks from $1B+ semiconductor companies • Adjustments included for attrition, backfill, and lifecycle differences across fabs	• SEMI World Fab Forecast • McKinsey Fab Labor Benchmark • SIA U.S. Semiconductor Ecosystem • NSF • US Bureau of Labor Statistics
Supply	• Incremental talent supply measured through in-state engineering and technician graduates • In-field retention applied to estimate graduates entering semiconductor-relevant roles • Professional migration patterns incorporated to capture inflow from adjacent industries • State-level workforce availability compared to demand to identify functional gaps	• IPEDS / Lightcast • CHIPS Program Office • US Bureau of Labor Statistics • OECD Education Statistics • McKinsey Org Data Platform • US Census Bureau

1. Labor demand based on 27 publicly announced front-end facilities (fabs, pilots, and R&D's) across 13 companies listed within 2025Q3 SEMI WFF database with tool install start dates starting 2026; headcount estimates will increase if new fab announcements are made after publication of this page; assumes 5% industry attrition rate (based on reported turnover rates in company public filings)
2. Estimated employment for separations and hires in Semiconductor and Related Device Manufacturing (NAICS 334413) by State was calculated based on a 5-year average net change in the industry
3. Statewide education attainment and growth from new graduates entering from out of state assumes 2% annual growth rate of engineering and technician graduates YoY, with 52% of engineer graduates entering engineer roles (based on 2021 US Census STEM employment report) and 3% of engineers and technicians entering semi jobs (based on historical BLS employment data); specific CIP code roles within semiconductor industry used, additional details in Appendix
4. Non-CHIPS Act initiatives based on publicly announced programs per the 5 states of Arizona, Texas, New York, Ohio, and Indiana
5. Based on NIST-announced CHIPS workforce development funding commitments by state. Funding is converted into incremental engineer and technician supply using estimated training costs ($10k per engineer, $3k per technician) and assumed to be deployed evenly over an average five-year period of performance, unless noted otherwise in award announcement, starting at fab production

Demand Methodology: Example model deep dive on calculation of Texas Engineering Demand

Illustrative

XXX Source



Manufacturing

Planned fab capacity by state (TX)
- Planned fab capacity by state, year of production, WPM

~340k WPM (300mm equivalent)

SEMI WFF database

Projected total headcount using benchmarks
- Estimated capacity to FTE ratio
- Ratio of roles to HC, by archetype

16k total headcount

McKinsey fab labor benchmark

Projected headcount of engineer roles only
- Include engineers (e.g., Industrial engineer, process engineer)
- Exclude technicians (e.g., Process technicians, packaging technicians)

8k engineers

McKinsey fab labor benchmark

Incremental demand from attrition of new + existing talent[1]

6k engineers

- *NAICS 334413 employment (BLS QCEW)*
- *Industry attrition benchmark*

Incremental Manufacturing Engineers required

14k engineers

Equipment manufacturing

Existing equipment manufacturing industry employment by state (TX)

11k headcount in 2024

NAICS 333242 employment (BLS QCEW)

Projected state employment growth
- YoY growth from historical data

+0.06k headcount per year

NAICS 333242 employment (BLS QCEW)

Projected headcount of engineer roles only
- ~80% of equipment manufacturing roles are engineering focused

0.2k engineers

Public job postings (Lightcast)

Incremental demand from attrition of new + existing talent[1]

0.3k engineers

- *NAICS 333242 employment (BLS QCEW)*
- *Industry attrition benchmark*

Incremental Equipment manufacturing engineers required

0.5k engineers

10% of R&D $

Design and R&D

Semiconductor R&D investment ($) by state (TX)
- National investment was allocated using 2021 NSF-reported funding flows for the top six states, with the remainder distributed based on SIA R&D center counts

2.9B

- *NSF U.S. Business R&D in Semiconductor-Related Industries*
- *SIA U.S Semiconductor Ecosystem*

Incremental investment on new FTE roles
- 10% of R&D investment goes to equipment manufacturing industry
- 66% of R&D investment to FTE
- Projected wage growth (3%)
- Projected investment YoY growth (4.2%)

$217M

- *SIA State of the Industry Reports (‘22-’25)*
- *NSF U.S. Business R&D in Semiconductor-Related Industries*

R&D investment by role
- 55% of expected FTE investment to engineers
- 40% CS
- 5% Techs

$120M

- *NSF U.S. Business R&D in Semiconductor-Related Industries*
- *Public job profiles (LinkedIn)*

Projected headcount of engineer roles only
- BLS wage rates by role
- Burdened wage multiplier

0.3k engineers

- *US Bureau of Labor Statistics*
- *McKinsey wage benchmark*

Incremental demand from attrition of new + existing talent[1]

1.2k engineers

- *SIA State of the Industry Reports (’22-’25): Design + EDA employment*
- *Industry attrition benchmark*

Incremental Design and R&D engineers required

1.5k engineers

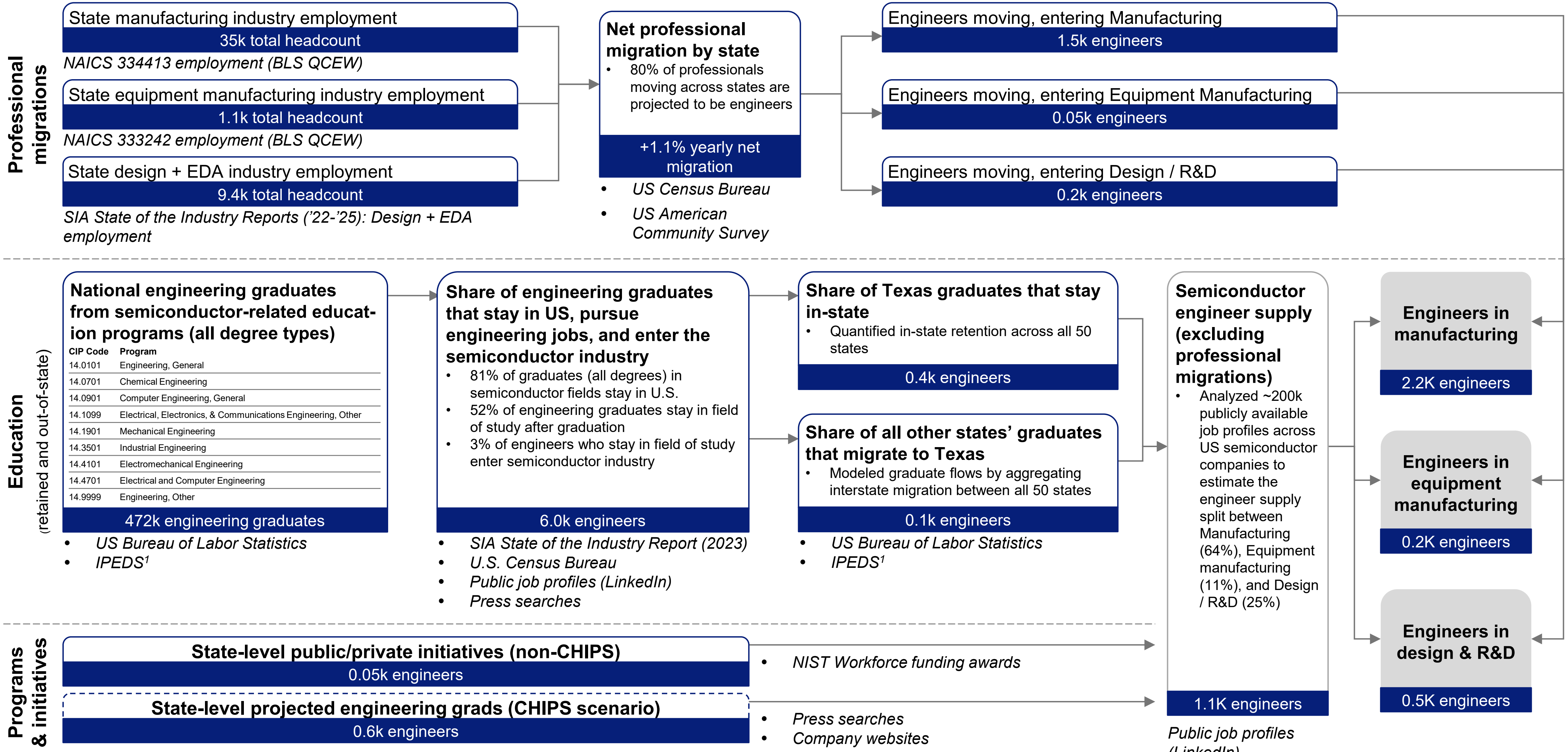
---

1. Attrition benchmarked using reported rates from major U.S. fabs and applied to new and existing labor force to estimate demand for backfill roles

Supply Methodology: Example model deep dive on calculation of Texas Engineering Supply

Illustrative

XXX Source



Professional migrations

State manufacturing industry employment
35k total headcount
NAICS 334413 employment (BLS QCEW)

State equipment manufacturing industry employment
1.1k total headcount
NAICS 333242 employment (BLS QCEW)

State design + EDA industry employment
9.4k total headcount
SIA State of the Industry Reports ('22-'25): Design + EDA employment

Net professional migration by state
- 80% of professionals moving across states are projected to be engineers

+1.1% yearly net migration
- *US Census Bureau*
- *US American Community Survey*

Engineers moving, entering Manufacturing
1.5k engineers

Engineers moving, entering Equipment Manufacturing
0.05k engineers

Engineers moving, entering Design / R&D
0.2k engineers

Education (retained and out-of-state)

National engineering graduates from semiconductor-related education programs (all degree types)

CIP Code	Program
14.0101	Engineering, General
14.0701	Chemical Engineering
14.0901	Computer Engineering, General
14.1099	Electrical, Electronics, & Communications Engineering, Other
14.1901	Mechanical Engineering
14.3501	Industrial Engineering
14.4101	Electromechanical Engineering
14.4701	Electrical and Computer Engineering
14.9999	Engineering, Other

472k engineering graduates
- *US Bureau of Labor Statistics*
- *IPEDS*[1]

Share of engineering graduates that stay in US, pursue engineering jobs, and enter the semiconductor industry
- 81% of graduates (all degrees) in semiconductor fields stay in U.S.
- 52% of engineering graduates stay in field of study after graduation
- 3% of engineers who stay in field of study enter semiconductor industry

6.0k engineers
- *SIA State of the Industry Report (2023)*
- *U.S. Census Bureau*
- *Public job profiles (LinkedIn)*
- *Press searches*

Share of Texas graduates that stay in-state
- Quantified in-state retention across all 50 states

0.4k engineers

Share of all other states' graduates that migrate to Texas
- Modeled graduate flows by aggregating interstate migration between all 50 states

0.1k engineers
- *US Bureau of Labor Statistics*
- *IPEDS*[1]

Semiconductor engineer supply (excluding professional migrations)
- Analyzed ~200k publicly available job profiles across US semiconductor companies to estimate the engineer supply split between Manufacturing (64%), Equipment manufacturing (11%), and Design / R&D (25%)

1.1K engineers
Public job profiles (LinkedIn)

Engineers in manufacturing
2.2K engineers

Engineers in equipment manufacturing
0.2K engineers

Engineers in design & R&D
0.5K engineers

Programs & initiatives

State-level public/private initiatives (non-CHIPS)
0.05k engineers
- *NIST Workforce funding awards*

State-level projected engineering grads (CHIPS scenario)
0.6k engineers
- *Press searches*
- *Company websites*

---

1. Integrated Postsecondary Education Data System from the National Center for Education Statistics

IC Design and R&D: Estimating split using industry structure and education pipelines

Approach		Resulting split within Design + R&D[4]	
Demand	• Used **share of U.S. semiconductor industry revenue** as a proxy for engineering headcount by archetype • Segmented industry into **four business models**[1] • Estimated archetype-level Design & R&D employment shares and IC Design vs R&D splits • Aggregated results to derive a **national IC Design vs R&D** demand split	**IC Design:**	**~65%**
		R&D:	**~35%**
Supply	• Used 2024[2] U.S. graduate output from relevant programs[3] as proxy for IC Design vs R&D supply • Mapped degree programs to IC Design or R&D based on curriculum focus and typical career outcomes • Weighted all Master’s and PhD graduates and ~20% of Bachelor’s graduates to reflect progression into advanced semiconductor roles	**IC Design:**	**~40%**
		R&D:	**~60%**

Key takeaways

Graduate education (MS/PhD) is the primary driver of IC Design and R&D supply

IC Design demand (~65%) exceeds expected supply pipeline (~40%), suggesting a structural mismatch

Traditional education pathways skew toward **process/device R&D**, while **IC Design demand is growing**, particularly given expected node and architecture complexity

---

1. Fabless (primarily IC design), IDMs (IC design and R&D), Foundries (primarily R&D / process development), and Other participants (OSAT, equipment, materials, & services)
2. 2024 represents the most recent year with complete graduate completion data available
3. For Relevant programs include EE/EECS, Computer Engineering, Materials Science, Chemical Engineering, Industrial/Manufacturing Engineering, and Physics-related disciplines
4. Estimates are applied at an aggregate level, assumed to be consistent across states, and remain broadly stable under reasonable changes to assumptions

Source: Lightcast, NSF, company 10-k filings, McKinsey semiconductor research

There will exist a surplus of workforce supply that might present a pool of talent to attract to states with high expected gaps

FTEs (2026-2030) across all semiconductor functions[1]

State	Engineer	Technician	Computer scientist
Indiana	878	790	-
Vermont	289	139	163
Arizona	276	63	33
Illinois	252	305	71
Alabama	139	171	114
North Carolina	134	120	27
Delaware	131	89	167
Louisiana	131	179	120
Hawaii	122	83	54
West Virginia	112	124	31
Iowa	111	115	35
Wisconsin	100	93	161
Maryland	98	75	71
Rhode Island	98	54	86
Connecticut	97	65	36
Mississippi	94	120	79
Kentucky	90	164	33
Oklahoma	88	78	105
Arkansas	85	113	30
Alaska	82	68	49
Total	**4,394**	**4,095**	**3,154**

1. State labor surpluses were excluded from workforce analysis, as surplus workers are assumed to transition to other industries

Appendix contents

Adjacent industries

We assessed **adjacent industries** as a semiconductor talent source by mapping skill adjacencies across **124 occupations in 57 industries**, sizing regional labor pools, and estimating **required conversion**

Findings were validated through case examples and interviews to assess **feasibility**, identify **transferable skills**, and highlight **effective onboarding models**

Key findings

- **Large adjacent talent pools exist, but access is uneven:** Adjacent industries offer meaningful supply, but availability varies sharply by state, role, and proximity
- **Conversion feasibility varies by role:** Technician gaps typically require moderate conversion (<10%), while engineering gaps frequently require high conversion (>10-15%)
- **Skill adjacency determines success:** Roles anchored in process control, equipment operation, automation, and systems engineering convert more readily
- **Execution and coordination are critical:** Successful conversions pair adjacent-industry hiring with structured onboarding and hands-on training; scaling could be achieved through standardized pathways and coordinated industry-government investment

Adjacent industries represent a potential labor source to help address projected semiconductor workforce gaps

Non-exhaustive

Context

① Adjacent industries represent a large, diverse pool of talent with semiconductor-relevant skills

② We size this opportunity by mapping 124 occupations across 57 adjacent industries and estimating the conversion required to close state-level workforce gaps

③ Realizing this potential will require coordinated industry and government action to enable targeted reskilling and transitions

Adjacent industries provide foundational skills for semiconductor talent

industries

- Advanced Electronics
- Aerospace & Defense
- Aerospace mfg.
- Aircraft parts and aux equip. mfg.
- Automotive (including EV)
- Computer Programming, general
- IT/Telecommunications
- Medical Device and Biotech
- Power generation systems

Secondary industries

- Chemical mfg.
- Energy generation & distr.
- Food and beverage mfg.
- Foundries (metals)
- Oil & Gas
- Industrial machinery mfg.
- Manufacturing support
- Paper product mfg.
- Shipbuilding

What we heard

Regardless of prior industry, candidates must have a foundational understanding of electrical theory - including Ohm's law and circuit-level concepts. Otherwise ramp up times for on-the-job-training and yield a low ROI

- Industry CHRO

Engineers have more options than ever, and industries like tech and medical devices are competing head-to-head for the same skills

- Industry CHRO

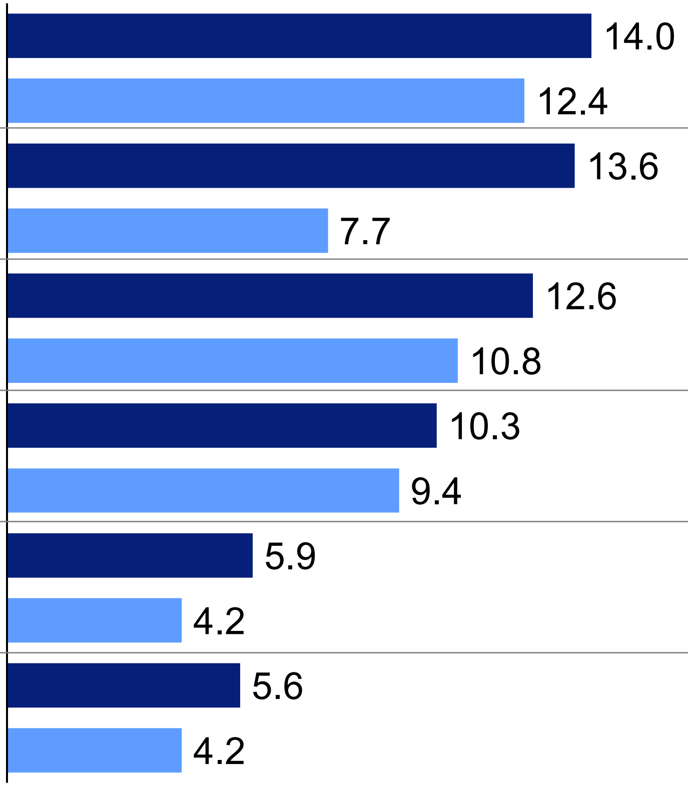
---

1. The analysis is conducted at an aggregate level, reflecting uncertainty in how converted talent would ultimately be allocated across semiconductor functions

Closing workforce gaps would require material conversion from adjacent industries

2024, thousands of FTEs

Role: 🟦 Engineer 🟦 Technician



State	Role	Workforce gap	Adjacent labor available[2]	% conversion required[1]
Texas	Engineer	14.0	63	22%
	Technician	12.4	131	9%
California	Engineer	13.6	90	15%
	Technician	7.7	130	6%
New York	Engineer	12.6	83	15%
	Technician	10.8	144	7%
Idaho	Engineer	10.3	44	24%
	Technician	9.4	79	12%
Arizona	Engineer	5.9	125	5%
	Technician	4.2	174	2%
Oregon	Engineer	5.6	119	5%
	Technician	4.2	176	2%

Conversion rates shown reflect the implied share of adjacent labor required to close the gap; they do not represent assumed or proven achievable conversion outcomes

---

1. Assumed annual attrition (excluding retirements) across adjacent industries is ~5–10% per year; conversion requirements above this level would require step change interventions
2. Adjacent labor conversion reflects primary adjacent industries with the highest semiconductor-relevant skill transferability

Source: Lightcast

Key takeaways

Engineers: Implied conversion requirements vary materially by state (~5% to 24%). Rates above ~10–15% are likely infeasible without step-change interventions (e.g., wage pull, accelerated retraining, immigration)

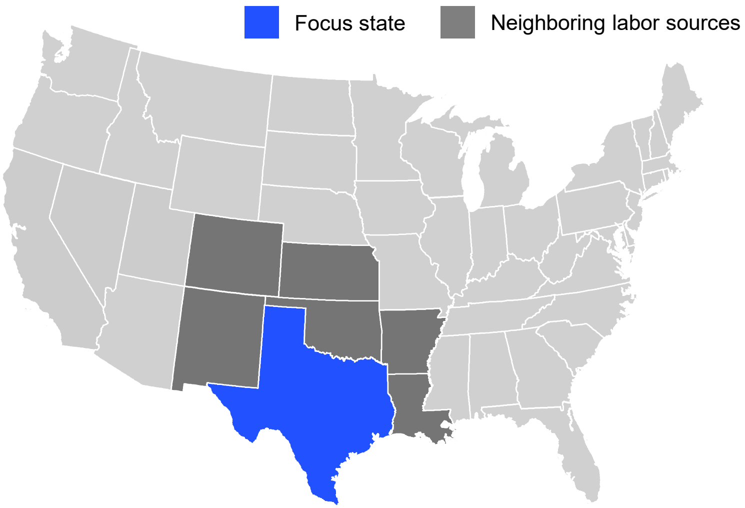
Technicians: Implied conversion is consistently <10% and more plausibly achievable, supported by large adjacent labor pools and shorter retraining pathways

Computer scientists: Adjacent supply is ample; conversion needs are minimal (<1%)

Texas: Adjacent industries could provide a source of ~63k engineers and ~131k technicians to close Texas's labor gap

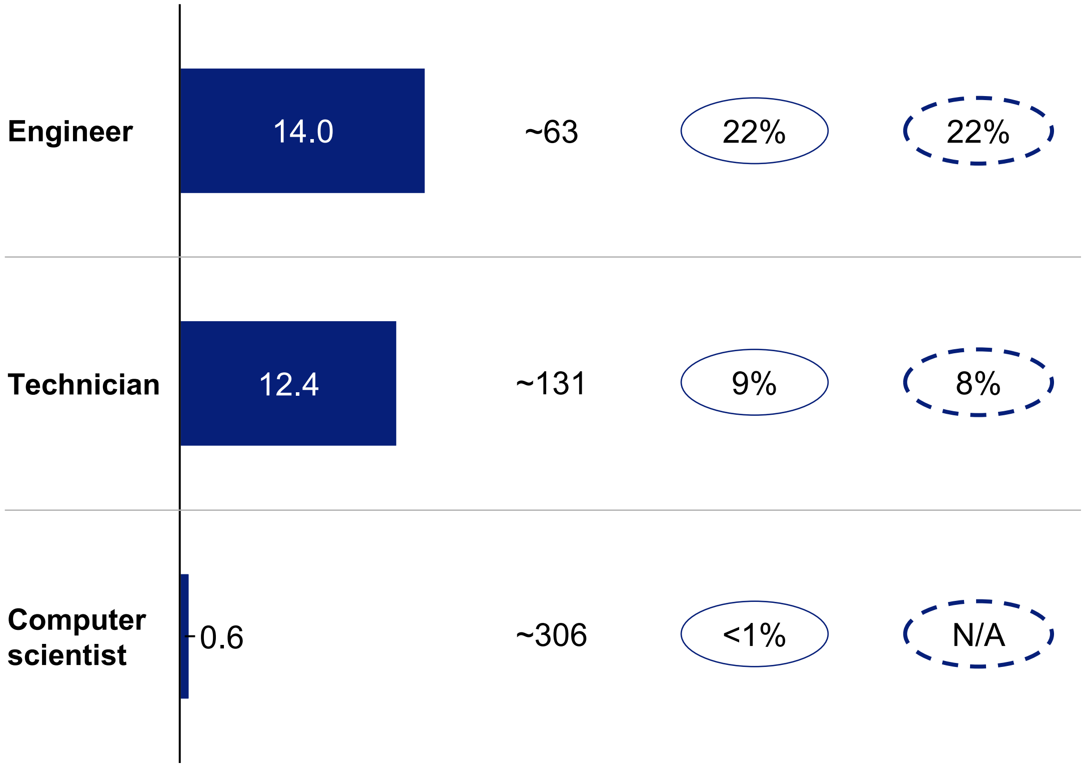
2024, thousands of FTEs

Supply of adjacent labor pools



Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~29	+	~33	=	~63
Technician	~66	+	~65	=	~131
Computer scientist	~196	+	~110	=	~306



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	14.0	~63	22%	22%
Technician	12.4	~131	9%	8%
Computer scientist	0.6	~306	<1%	N/A

Primary adjacent industries selected based on highest skill transferability; ***secondary adjacent industries may offer additional potential (+24k engineers)***

Implications

Closing the gap from primary adjacent industries would require **high conversion (~22%)**, with limited CHIPS offset (<1%)

A large primary adjacent labor pool allows gap closure with **moderate conversion (~9%)**, with limited CHIPS offset

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

---

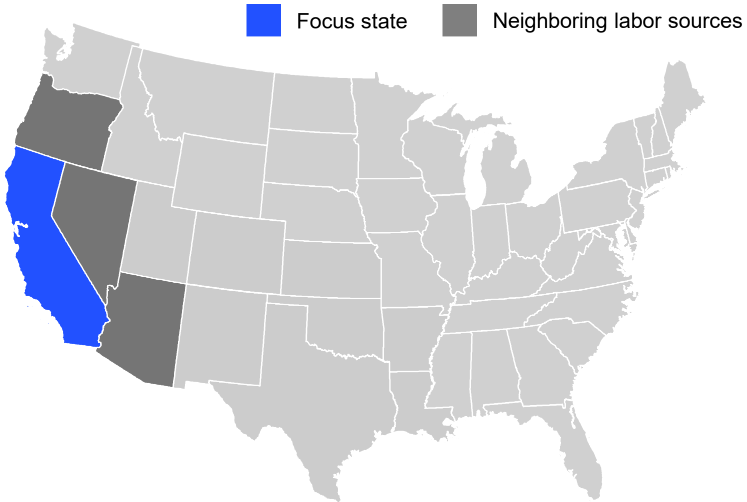
1. The 2024 adjacent labor pool is assumed to be a steady source of availability and is drawn upon gradually over the 2026-2030 period, rather than being available all at once in a single year
2. Adjacent industries include primary (Tier 1) industries as defined in the methodology and reflect a 2024 employment baseline
3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

California: Adjacent industries could provide a source of ~90k engineers and ~130k technicians to close California’s labor gap

2024, thousands of FTEs

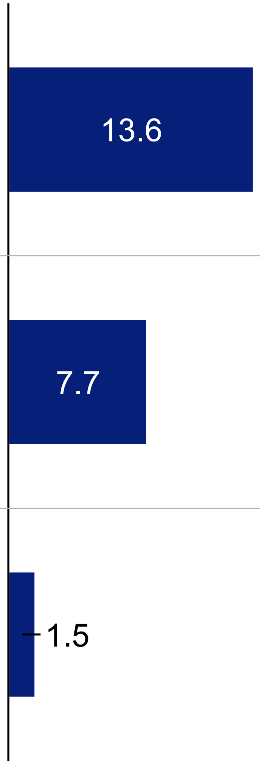
Supply of adjacent labor pools



Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~83	+	~7	=	~90
Technician	~114	+	~16	=	~130
Computer scientist	~300	+	~23	=	~323

Projected gap



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	13.6	~90	15%	N/A
Technician	7.7	~130	6%	N/A
Computer scientist	1.5	~323	<1%	N/A

*Primary adjacent industries selected based on highest skill transferability; **secondary adjacent industries may offer additional potential (+14k engineers)***

Implications

Closing the gap from primary adjacent industries only would require **high conversion (~15%)**

A large primary adjacent labor pool allows gap closure with **moderate conversion (~6%)**

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

---

1. The 2024 adjacent labor pool is assumed to be a steady source of availability and is drawn upon gradually over the 2026-2030 period, rather than being available all at once in a single year
2. Adjacent industries include primary (Tier 1) industries as defined in the methodology and reflect a 2024 employment baseline
3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

New York: Adjacent industries could provide a source of ~83k engineers and ~144k technicians to close New York's labor gap

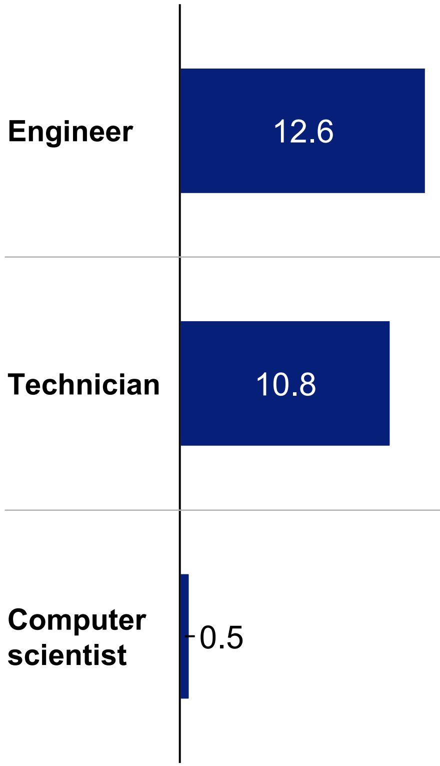
2024, thousands of FTEs

Supply of adjacent labor pools

Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~16	+	~67	=	~83
Technician	~37	+	~108	=	~144
Computer scientist	~85	+	~206	=	~292

Projected gap



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	12.6	~83	15%	15%
Technician	10.8	~144	7%	7%
Computer scientist	0.5	~292	<1%	N/A

*Primary adjacent industries selected based on highest skill transferability; **secondary adjacent industries may offer additional potential (+18k engineers)***

Implications

Closing the gap from primary adjacent industries only would require **high conversion (~15%)**, with limited CHIPS offset (<1%)

A large primary adjacent labor pool allows gap closure with **moderate conversion (~7%)**, with limited CHIPS offset (<1%)

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

---

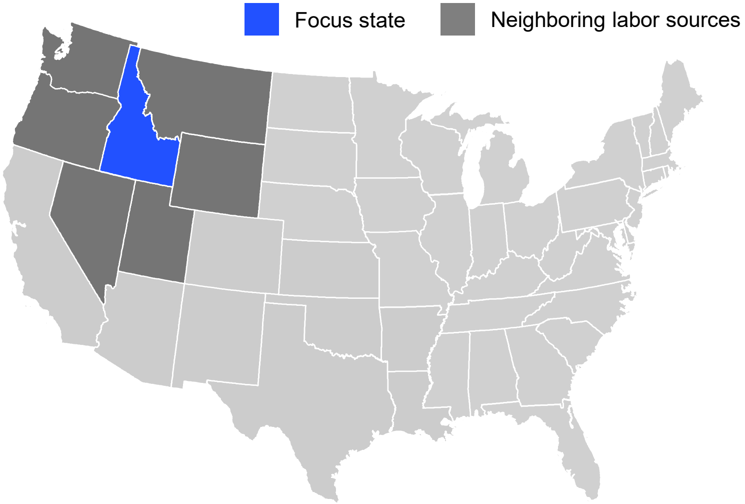
1. The 2024 adjacent labor pool is assumed to be a steady source of availability and is drawn upon gradually over the 2026-2030 period, rather than being available all at once in a single year
2. Adjacent industries include primary (Tier 1) industries as defined in the methodology and reflect a 2024 employment baseline
3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

Idaho: Adjacent industries could provide a source of ~44k engineers and ~79k technicians to close Idaho's semi labor gap

2024, thousands of FTEs

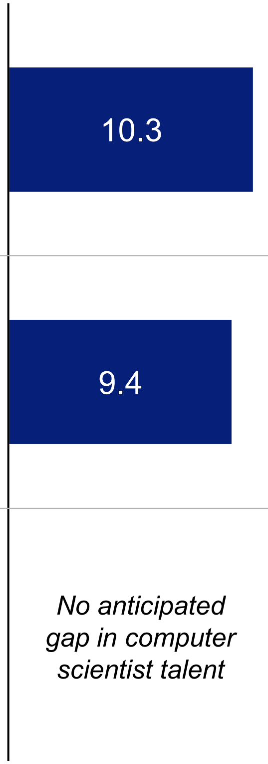
Supply of adjacent labor pools



Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~5	+	~39	=	~44
Technician	~6	+	~72	=	~79
Computer scientist	~12	+	~129	=	~142

Projected gap



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	10.3	~44	24%	23%
Technician	9.4	~79	12%	11%
Computer scientist	*No anticipated gap in computer scientist talent*	~142	<1%	<1%

Primary adjacent industries selected based on highest skill transferability; ***secondary adjacent industries may offer additional potential (+7k engineers)***

Implications

Closing the gap from primary adjacent industries only would require **high conversion (~24%)**, with limited CHIPS offset

Despite large adjacent labor pool, gap closure would require **high conversion (~12%)**, with limited CHIPS offset

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

---

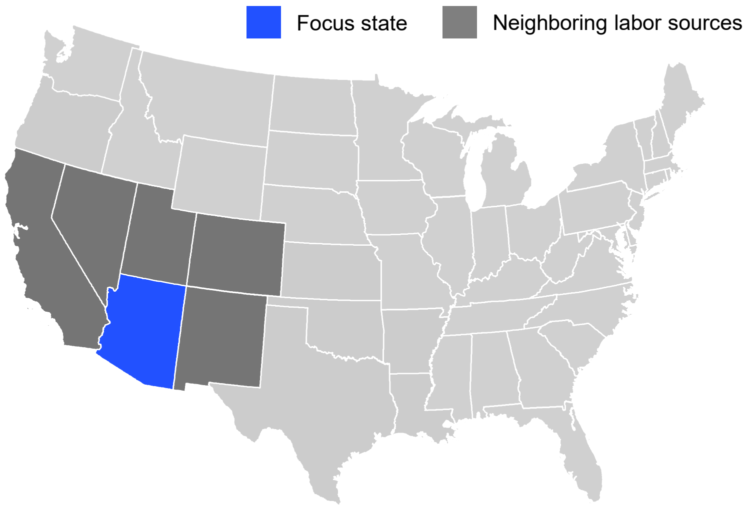
1. The 2024 adjacent labor pool is assumed to be a steady source of availability and is drawn upon gradually over the 2026-2030 period, rather than being available all at once in a single year
2. Adjacent industries include primary (Tier 1) industries as defined in the methodology and reflect a 2024 employment baseline
3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

Arizona: Adjacent industries could provide a source of ~125k engineers and ~174k technicians to close Arizona's labor gap

2024, thousands of FTEs

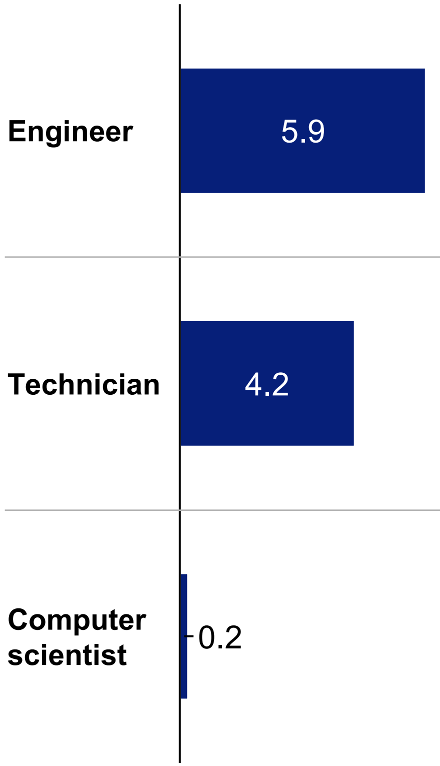
Supply of adjacent labor pools



Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~5	+	~114	=	~119
Technician	~8	+	~168	=	~176
Computer scientist	~16	+	~392	=	~408

Projected gap



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	5.9	~125	5%	2%
Technician	4.2	~174	2%	<1%
Computer scientist	0.2	~442	<1%	<1%

Primary adjacent industries selected based on highest skill transferability; ***secondary adjacent industries may offer additional potential (+16k engineers)***

Implications

Closing the gap from adjacent industries would require **low conversion (~5%)**, which could be filled by expected attrition (5%)

A large primary adjacent labor pool in California allows gap closure with **low conversion (~2%)**

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

---

1. The 2024 adjacent labor pool is assumed to be a steady source of availability and is drawn upon gradually over the 2026-2030 period, rather than being available all at once in a single year
2. Adjacent industries include primary (Tier 1) industries as defined in the methodology and reflect a 2024 employment baseline
3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

Oregon: Adjacent industries could provide a source of ~119k engineers and ~176k technicians to close Oregon's semi labor gap

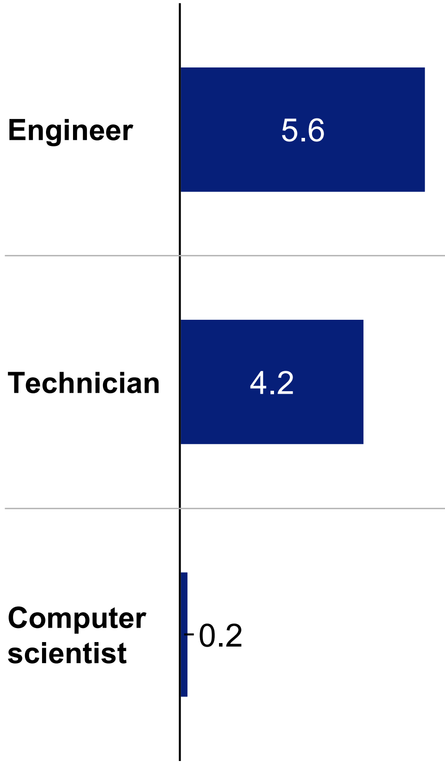
2024, thousands of FTEs

Supply of adjacent labor pools

Total 2024 adjacent industries labor pool[1]

	Focus state		Neighboring states		Total
Engineer	~11	+	~113	=	~125
Technician	~19	+	~155	=	~174
Computer scientist	~35	+	~407	=	~442

Projected gap



	Projected gap	Total adj. available[2]	% Required[3]	% Required w/CHIPS
Engineer	5.6	~119	5%	5%
Technician	4.2	~176	2%	2%
Computer scientist	0.2	~408	<1%	N/A

Primary adjacent industries selected based on highest skill transferability; ***secondary adjacent industries may offer additional potential (+16k engineers)***

Implications

Closing the gap from adjacent industries would require **low conversion (~5%)**, which could be filled by expected attrition (5%)

A large primary adjacent labor pool in California allows gap closure with **low conversion (~2%),** with limited CHIPS offset (<1%)

Demand is small relative to adjacent supply, indicating **no binding labor constraint**

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3. Percent required reflects the share of the total adjacent labor pool that would need to transition to meet projected cumulative 2026–2030 workforce gaps

Source: Lightcast

[Case example] Adjacent industries and schools leveraged for a Tier 1 company to fill labor shortage

SAMSUNG SAMSUNG SDI

Situation

Tier 1 OEM looking to **source manufacturing labor for a new plant**

Local **semiconductor talent** was projected to be insufficient to close the shortage, **so adjacent industries were leveraged** to draw from a labor pool of similarly trained talent

Approach

Adjacent industries

- Trained **local engineers** with **no semiconductor manufacturing** experience by transferring **senior engineers** from company headquarters to **provide expert guidance** and instill company culture
- Hired talent with **no semiconductor experience** but who were familiar with **semiconductor technology** such as PLC programing, servo drives or vision systems knowledge by recruiting talent from the nearby **assembly environments** (e.g., bottling, automotive)

Education

- Recruited directly from **technical universities** in the area by conducting connectivity events and programs such as **job fairs** and **students plant open days**, and **sponsored student education** with commitment to **work at the plant** after graduation
- Attracted students at **technical high schools and community colleges** by establishing **contracts with school programs** to encourage people enter the semiconductor industry

Result

- **60% maintenance technicians** with experience on a technology from an adjacent industry
- **6 months** to fully staff new production line
- **400+ maintenance technicians** hired from adjacent industries
- **75% retention** after the first seven years of plant operation

Source: Press searches, company website

[Case example] Tier 1 company leveraged adjacent industries to fill demand/supply shortage

LG Energy Solution

Situation

Hiring production engineers and technicians is increasingly challenging in a fast-growing and technology-oriented production industry

Approach

Adjacent industries

- Hired talent from **adjacent industries** with experience in **logistics, automation, and chemicals**
- Most talent came from **Tier 1 suppliers** and automotive industries (e.g., Mercedes-Benz)
- Offered cash bonus to current employees for successful referrals
- Hired from available, nearby industries and focused on apparent skill level with machines
- Training was conducted based on the skill level of the new hire

Education

- Organized programs with local universities such as **guest lectures** and **conferences** to encourage students to work for the company after graduation
- Advertised through several public channels such as banner on the freeway and inside the city and radio
- Offered **internships** and **summer school** for **high school students** who were interested in a career in semiconductors

Result

- **4+ adjacent industries** used to hire talent
- 25% of plant labor acquired from **adjacent industries**
- **2,000+** new engineers hired from **adjacent industries**
- **100% automated trainings** to quickly upskill new hires

Source: Press searches, company website

[Case example] Attracting engineering and technician talent to Nevada

TESLA

Situation

In 2014, Tesla selected a **remote greenfield site** outside Reno, Nevada with a limited local engineering and technician pool

The Gigafactory required a rapid ramp to ~10K engineers, technicians, and production roles**, far exceeding the region's existing manufacturing employment base**

From the start, **Tesla faced a structural talent gap that required sourcing beyond the local market** and from adjacent industries

Approach

Enhanced pay and equity participation

- Beyond competitive wages and benefits, Tesla provided stock benefits to production and technician workers, shifting compensation norms for factory roles

Logistics and quality-of-life support

- Transportation support (e.g., free shuttles) to ease commuting from distant cities (up to 2 hours away)

Active, high-volume recruiting

- Focused hiring sprints managing heavy interview volumes for technicians and continuously increasing sourcing radius

Talent training and development:

- Partnership with University of Nevada, Reno, providing coursework and hands-on experience

Result

- Tesla **met minimum labor requirements** to support factory launch and initial production ramp
- **Established a scalable recruiting and training pipeline** capable of sustaining operations for 10+ years

Tesla Gigafactory (Sparks, Nevada)

Source: Press searches, company website

Skill adjacency explains why certain engineering roles are more convertible than others in semiconductor

Roles that have >45% skill overlap with
Industrial Engineer (General)

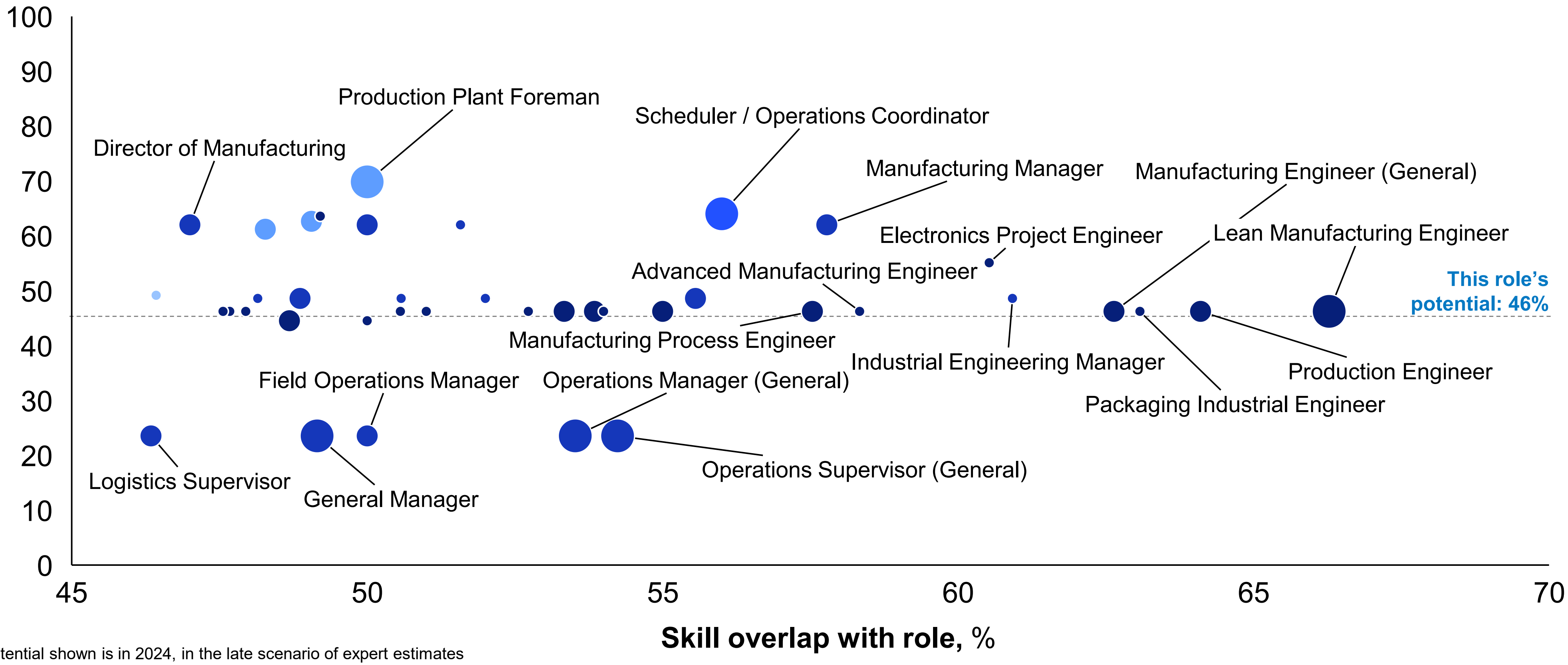
Select occupation groups:

- ● STEM
- ● Management
- ● Sales and Administrative
- ● Production
- ● Business, Finance, and Legal

- ● <1% of sector employment
- ● 1-5% of sector employment
- ● 5-10% of sector employment

Technical automation potential¹, %

Reminder: Not equivalent to adoption outlook in 2030



1. Technical automation potential shown is in 2024, in the late scenario of expert estimates

Note: Occupations shown have at least 0.75% of employment in the same sector selected

Source: Lightcast, U.S. Bureau of Labor Statistics, McKinsey Global Institute analysis

Successful conversions pair short-cycle entry pathways with structured on-the-job training

Technicians

Quick start programs

Portland Community College (Intel)

- ~10–14-days
- Exposure to fab environments, safety equipment and drive baseline skill development
- High industry placement with Intel partnership

Work-study pilot programs

Austin Community College (Samsung)

- ~4-8 weeks[1]
- 7 mandatory labs tied directly to Samsung tool and process needs
- Hybrid model to provide foundational technical knowledge, safety and practical experience

Recommended talent criteria

Texas instruments

- Required electrical aptitude
- Common industries/backgrounds include:
    - Automotive, military background, advanced technology etc.

Engineers

Onboarding training

Samsung

- ~6-8 weeks hands-on training
- Training delivered through partnership with Austin Community College
- Co-designed curriculum to deliver training specific for Samsung

On-the-job training

KLA (University of Michigan, Stanford)

- ~6 months
- Co-developed curriculum to accelerate development and provide hands-on experience
- Internal development program for systems engineering

Recommended talent criteria

Micron

- Strong foundation of electrical theory and problem solving
- Advanced degrees (MS/PhD) or equivalent experience
    - Hardware engineers, optical engineers, AI engineers, systems engineers, etc.

What we heard

Technicians are in high demand and can be pulled from any adjacent industry, as long as they have a background in electrical theory

- Engineering Manager

Semiconductor engineering is not a plug-and-play transition. The technical depth and specificity of the roles mean that engineers coming from adjacent industries still require extensive training and ramp time

- VP of Talent Acquisition

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1. Advanced manufacturing production program (AMP) is an 8-week course that provides foundational skills and experience for individuals with no manufacturing experience. STARS program is an accelerated 4-week program for individuals with prior manufacturing skills

Source: External interviews, survey results

Appendix contents

Scenario modeling

We tested a focused set of scenarios to assess how workforce gaps respond to changes in demand, productivity, migration, and policy assumptions

We designed the model for reuse allowing SEMI to explore additional or modified scenarios using the same framework

Key findings

- **Demand and productivity levers materially move the gap:** Only *AI Bubble Pop* and *Productivity Uplift* scenarios meaningfully reduce shortages (−14% to −47%); incremental supply expansion alone does not close gaps
- **Design complexity is the largest risk:** *Design Complexity Escalation* drives the biggest gap expansion (+37%), with significant most exposure across all roles
- **Engineers remain the binding constraint in supply-driven futures:** Engineer gaps reflect long education timelines, low industry entry rates, and sensitivity to migration and retention
- **Technician supply is comparatively resilient:** Technician gaps are more stable across scenarios, supported by domestic training pathways and faster post-training conversion

Semiconductor workforce outcomes vary under different technology and policy futures

🟦 Prioritized for analysis

Scenario	Description
① **AI Bubble Pop**	A correction in AI-driven semiconductor demand slows advanced-chip investment, delays fab build-outs, and reduces incremental hiring
② **Industry productivity uplift**	Sustained productivity gains driven by process standardization, automation, and tool-enabled execution, which reduce labor intensity and allow routine engineering tasks to be executed by technicians, while engineers focus on higher-value work
③ **Design complexity escalation**	Rising scaling challenges and node complexity increase the need for specialized engineers, technicians, and computer scientists per node
④ **Structural talent constraint**	A broad supply-side stress in which the effective availability of talent declines materially, driven by lower graduate volumes, reduced STEM participation, and weaker industry entry
⑤ **Geopolitical fragmentation**	Geopolitical tensions and policy divergence reduce international graduate retention and workers willingness or ability to relocate across states tightening access to critical talent pools
⑥ **Policy-driven talent expansion**	Strong realization of CHIPS Act funding and public/private initiatives increases graduate output retention and workforce participation over time expanding semiconductor talent supply

We modeled possible futures based on updated scenarios and have refined demand- and supply-side levers

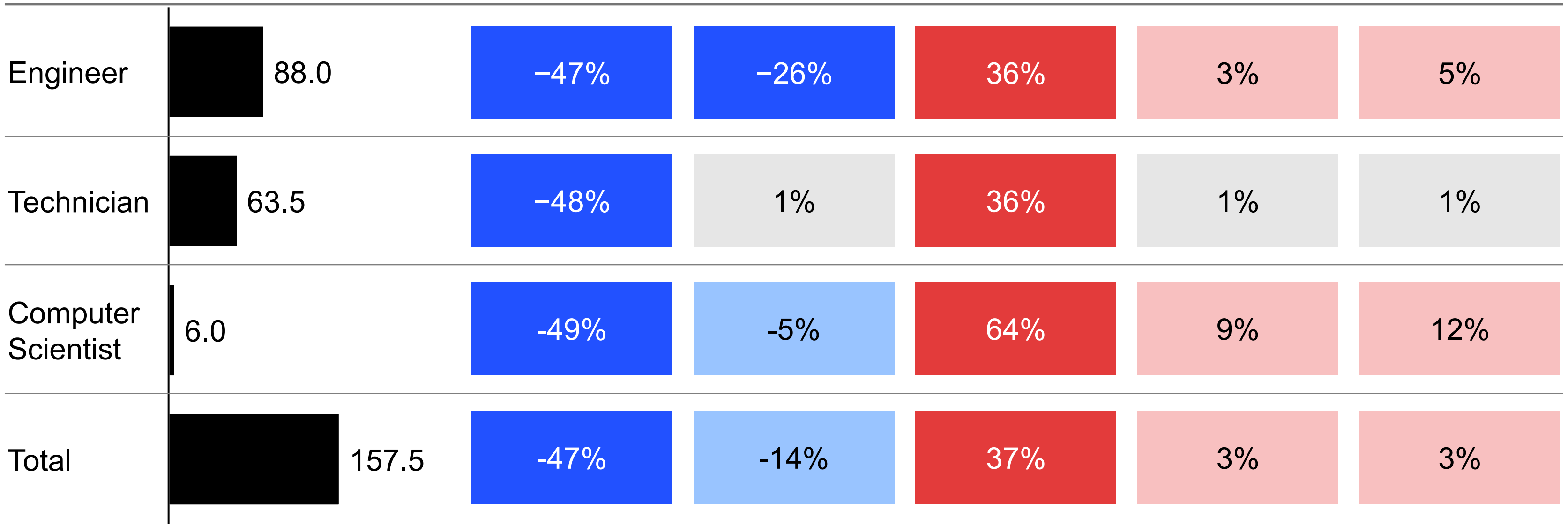
▢ Prioritized for analysis ▌ Demand lever ▌ Supply lever

Lever	① AI bubble pop	② Industry productivity uplift	③ Design complexity escalation	④ Structural talent constraint	⑤ Geopolitical fragmentation	⑥ Policy-driven talent expansion
Industry wafer demand growth (%)	-20%					
Attrition changes (pp)	-1%		+1.5%			+1%
Fab productivity improvement (%)		+25%				
Design productivity improvement (%)		+15%	-20%			
Headcount per node required (%)			30%			
Role structure shift (pp)		−10% Eng / +10% Tech				
Capex and fab build timing (years)	+1.5 yr					
Graduate volume change (%)				-10%		10%
STEM persistence after graduation (pp)	-5%			-10%		5%
Industry entry rate (pp)	-0.2%			-0.4%		0.2%
Professional net migration (%)				-10%	-25%	
CHIPS + public/private initiatives realization (%)	-30%					10%
Graduates staying in the country (pp)					-20%	5%

Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Scenario analysis highlights which conditions widen or ease workforce gaps

🟥 Gap increase (+%) ⬜ No change (<1%) 🟦 Gap reduction (-%)



	Workforce readiness analysis	**Scenario results[1,2], % change from baseline**				
Role	**Baseline gap** (k FTE)	① **AI Bubble Pop**	② **Industry productivity uplift**	③ **Design complexity escalation**	④ **Structural talent constraint**	⑤ **Geopolitical fragmentation**
Engineer	88.0	−47%	−26%	36%	3%	5%
Technician	63.5	−48%	1%	36%	1%	1%
Computer Scientist	6.0	-49%	-5%	64%	9%	12%
Total	157.5	-47%	-14%	37%	3%	3%

Key takeaways

AI Bubble Pop significantly reduces workforce gaps as lower volume demand, delayed fab builds, and reduced voluntary attrition jointly ease hiring pressure across roles

Design Complexity Escalation creates the largest gap expansion, as rising node and system complexity increases headcount requirements per unit of output and reduces effective productivity

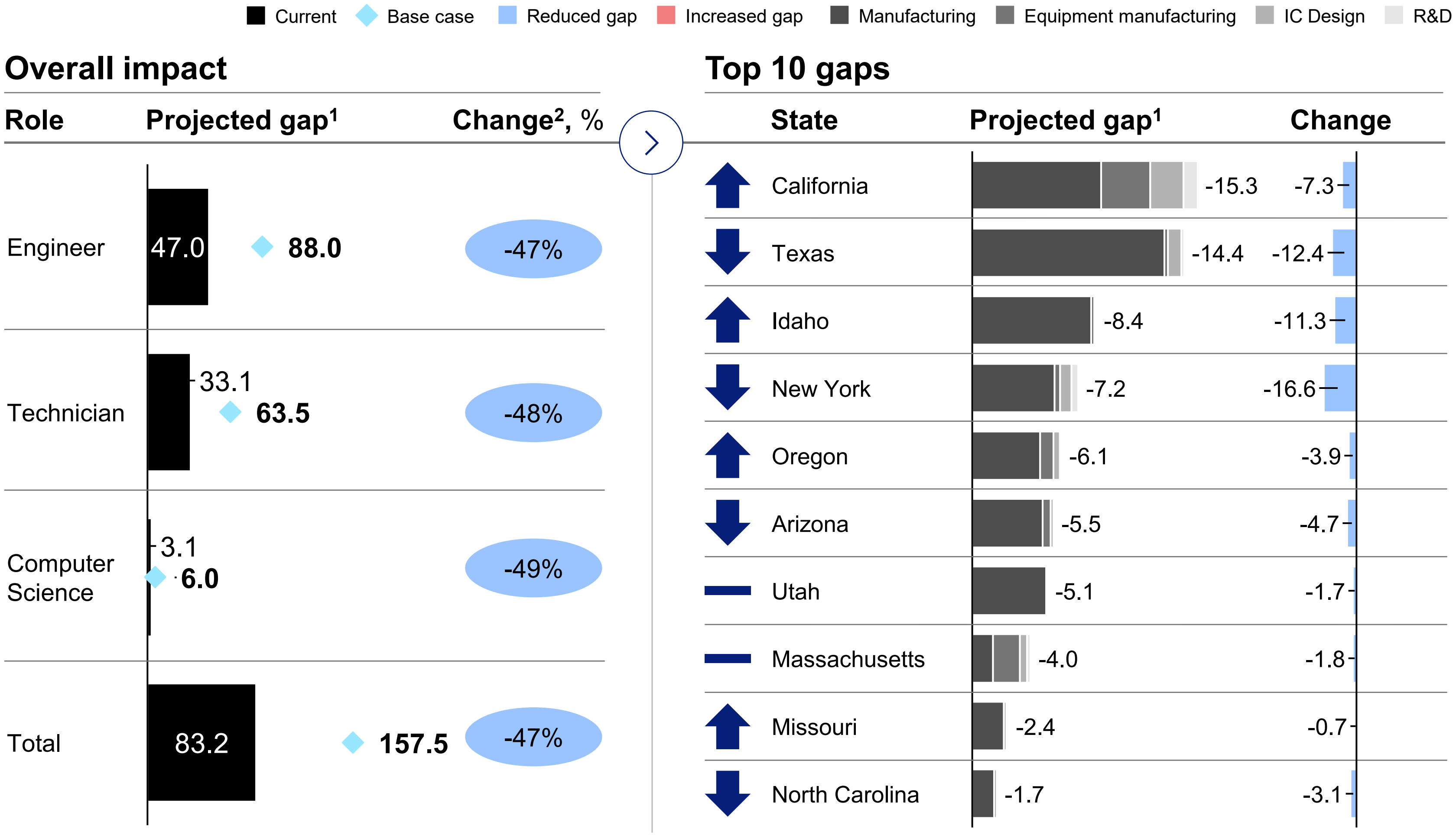
Structural Talent Constraint and Geopolitical Fragmentation reduce effective labor supply in more targeted ways, with impacts concentrated on engineers through education pipelines, professional migrations and international retention while technician supply remains relatively resilient

---

1. The model is designed to assess the relative impact of key demand and supply drivers through scenarios rather than produce point forecasts
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Scenario 1 – AI Bubble Pop

2026-30, thousands of FTEs



Key takeaways

Gap reductions remain broad based across roles, driven by lower volume demand and reduced attrition, with reduces net hiring needs and replacement demand

California emerges as the largest remaining gap, reflecting its existing concentration of equipment manufacturing and design and R&D roles rather than disproportionate exposure to delayed fab builds

States with large announced fab expansions see sharper pullbacks, as delayed Micron phases in New York and TSMC investments in Arizona reduce projected gaps

1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

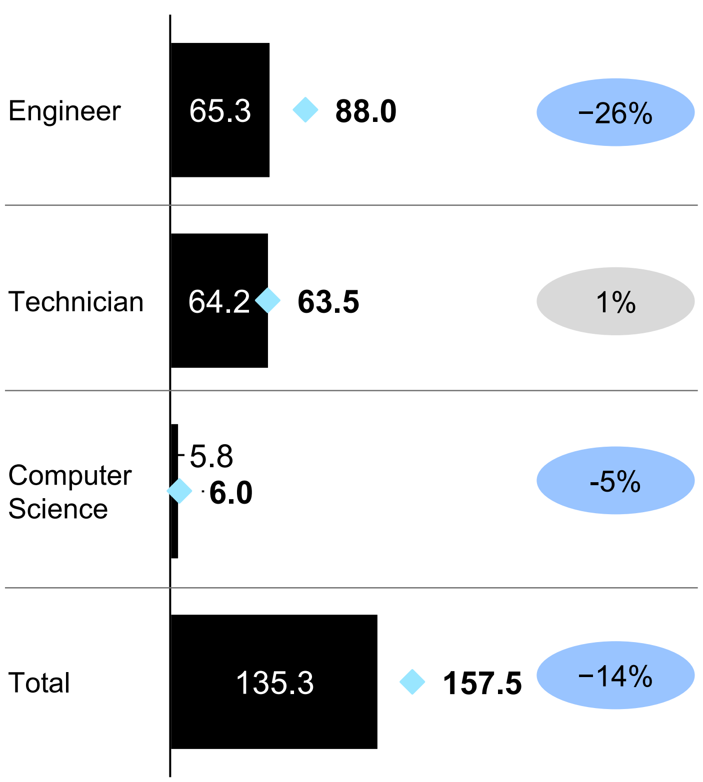
Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Scenario 2 – Industry productivity uplift

2026-30, thousands of FTEs

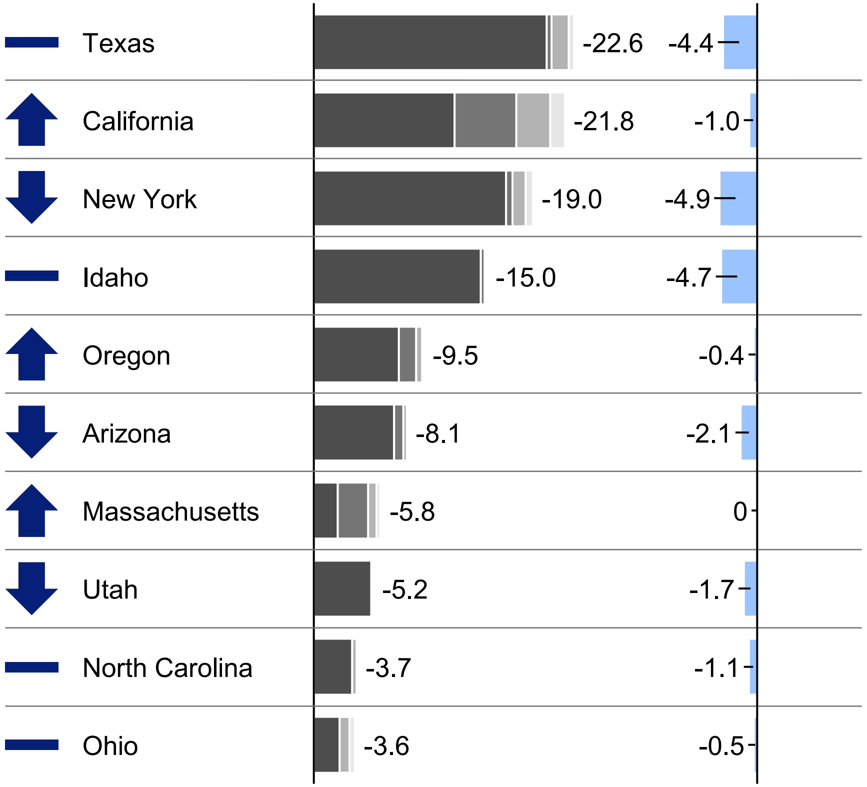
■ Current ◆ Base case 🟦 Reduced gap 🟥 Increased gap ■ Manufacturing ■ Equipment manufacturing ■ IC Design ■ R&D

Overall impact



Role	Projected gap[1]	Change[2], %
Engineer	65.3 ◆ 88.0	−26%
Technician	64.2 ◆ 63.5	1%
Computer Science	5.8 ◆ 6.0	-5%
Total	135.3 ◆ 157.5	−14%

Top 10 gaps



	State	Projected gap[1]	Change
–	Texas	-22.6	-4.4
↑	California	-21.8	-1.0
↓	New York	-19.0	-4.9
–	Idaho	-15.0	-4.7
↑	Oregon	-9.5	-0.4
↓	Arizona	-8.1	-2.1
↑	Massachusetts	-5.8	0
↓	Utah	-5.2	-1.7
–	North Carolina	-3.7	-1.1
–	Ohio	-3.6	-0.5

Key takeaways

Engineer gaps decline materially at -26% while technician gaps remain ~flat at +1%, consistent with productivity gains reducing overall labor intensity while task reallocation shifts some work from engineers toward technicians

State rankings shift based on incremental role mix and magnitude of improvement, with manufacturing-intensive states showing larger reductions in incremental gaps and moving down the list

Productivity improvements materially ease pressure but do not eliminate gaps, indicating additional supply-side actions would be required to close workforce gaps

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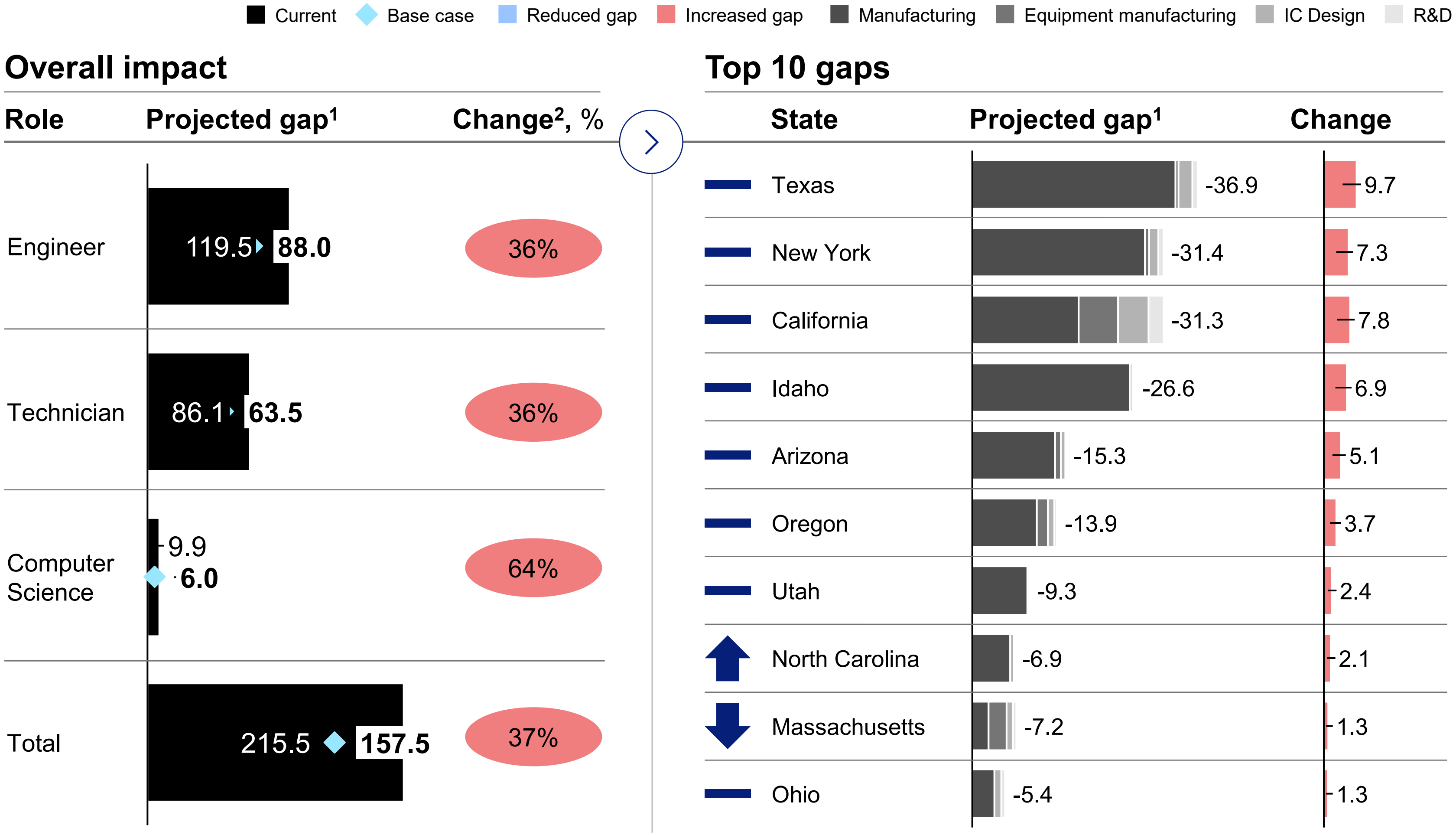
1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Scenario 3 – Design complexity escalation

2026-30, thousands of FTEs



Key takeaways

Computer scientist gaps increase most sharply, reflecting strong exposure to front-end design, verification, physical implementation, and system integration complexity

State-level impacts remain broadly proportional, with limited reordering across states as design complexity and productivity losses affect incremental demand similarly and TSMC investments in Arizona reduce projected gaps

Gap expansion across all functions is driven by higher labor intensity from step changes in node complexity, indicating this scenario would most significantly widen the workforce gap if realized

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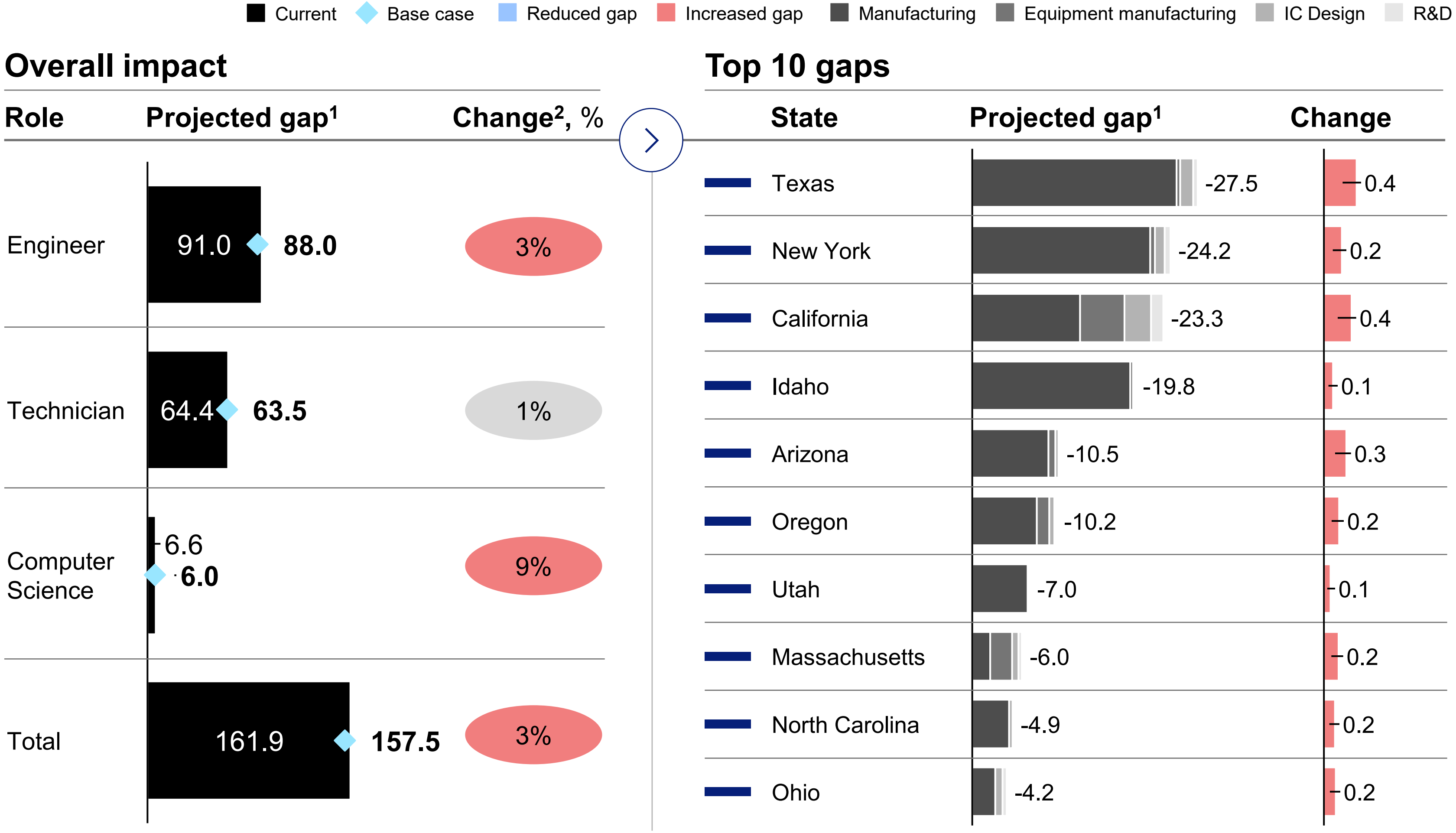
1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Scenario 4 – Structural talent constraint

2026-30, thousands of FTEs



Key takeaways

Total gap expansion remains modest at +3%, as education and professional migrations supply represent only a portion (20-30%) of overall workforce supply and have a limited impact on aggregate gaps

Engineer gaps increase more than technician gaps, as declines in industry entry rates and professional net migration disproportionately affect engineers, while technicians are assumed to enter the industry at high rates once trained

State-level impacts are muted and broadly proportional, with limited reordering across states as supply constraints affect workforce similarly across states

---

1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

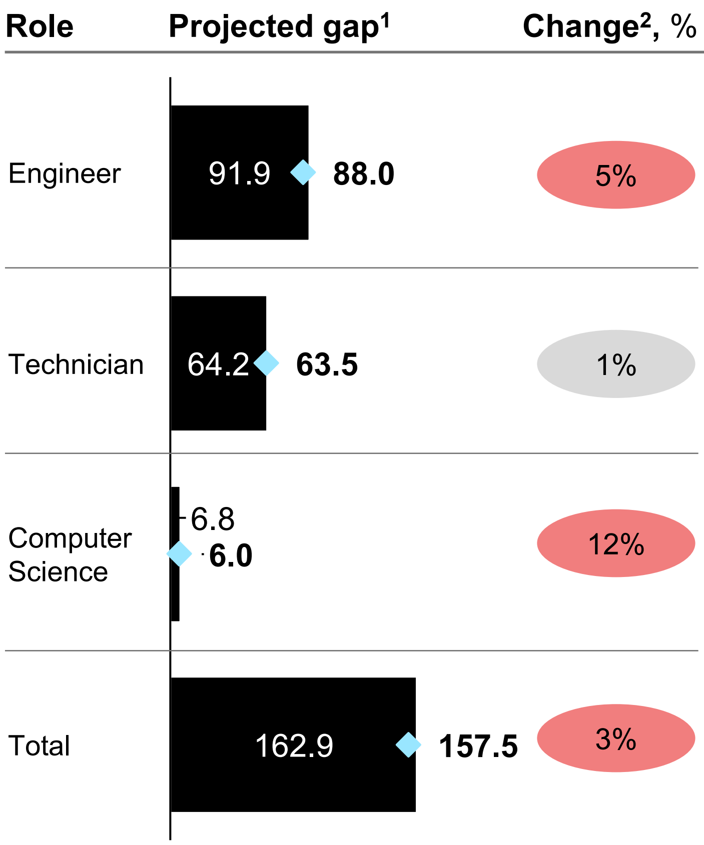
Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Scenario 5 – Geopolitical fragmentation

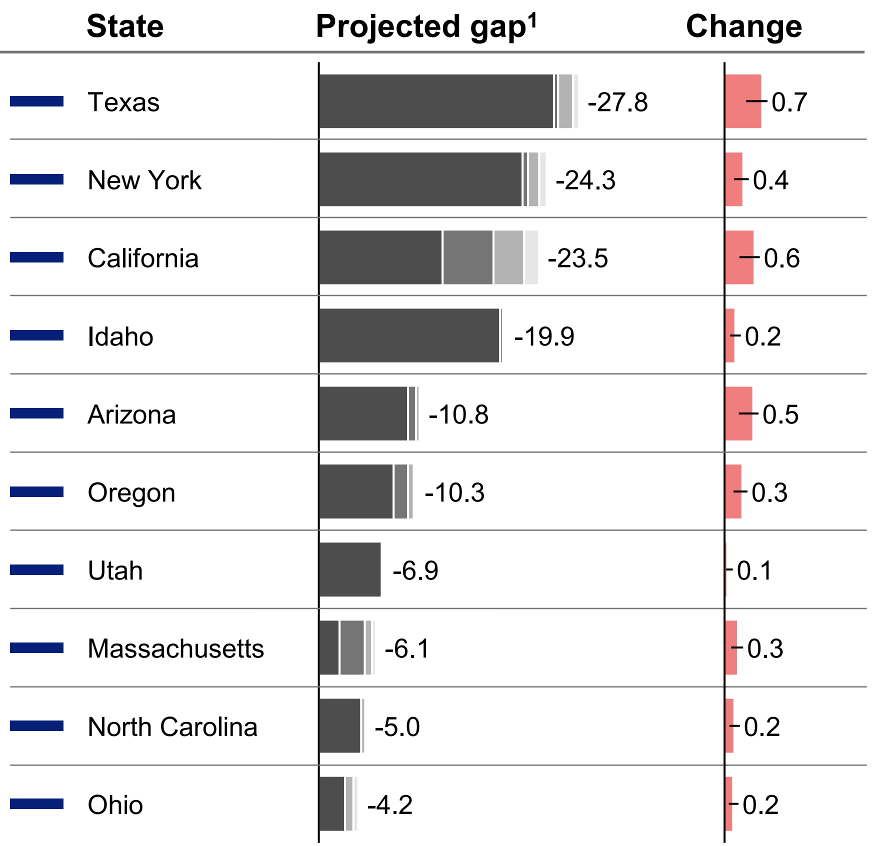
2026-30, thousands of FTEs

■ Current ◆ Base case ■ Reduced gap ■ Increased gap ■ Manufacturing ■ Equipment manufacturing ■ IC Design ■ R&D

Overall impact



Top 10 gaps



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1. Gap is defined as Demand-Supply, for states with a shortfall, excluding CHIPS impact. State labor surpluses are noted but excluded, as surplus workers assumed to transition to other industries
2. Scenario magnitudes are illustrative and grounded in historical reference points and results should be interpreted directionally and relative across scenarios

Source: McKinsey semiconductor research, WSTS demand data, BLS labor market and attrition data, SIA and Oxford Economics workforce analyses, semiconductor company 10-K filings

Key takeaways

Geopolitical fragmentation has a structurally limited impact on total workforce gaps, as shocks to international mobility and graduate retention affect only a subset of roles and supply channels

Impacts concentrate on engineers and computer scientists, reflecting higher reliance on foreign-born talent and international graduates, while technician supply remains largely insulated due to domestic training pathways

State-level effects remain broadly proportional, as migration and retention shocks reduce incremental supply without materially reshaping demand patterns or geographic concentration

Appendix contents

Catalog of current solutions

We reviewed existing semiconductor workforce programs to assess scale, effectiveness, and alignment with industry needs

We evaluated programs across five criteria including effectiveness, ROI, scalability, and replicability

We validated findings through interviews with employers, program leaders, and program participants to test real-world workforce readiness

Key findings

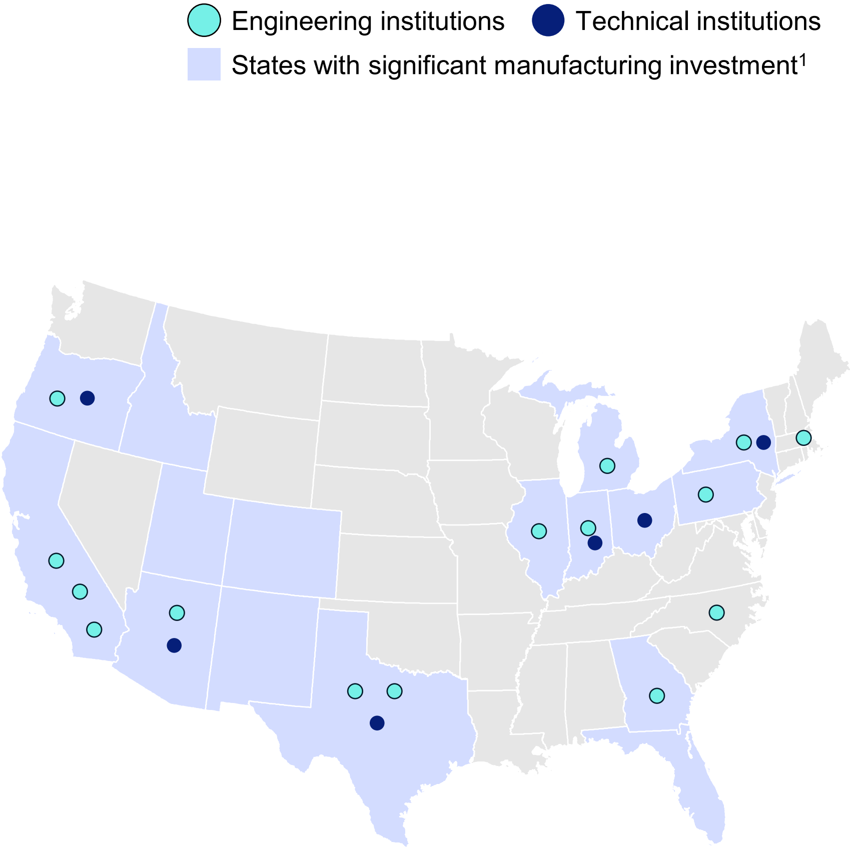
- **Training programs deliver fast impact, but remain local:** Employer-linked technician programs achieve ~70–90% placement, yet benefits are concentrated near fabs and tied to specific hiring windows
- **Engineering programs build long-term supply, but scale slowly:** Faculty capacity, cleanroom access, and multi-year curricula constrain throughput; <5% of engineering graduates enter semiconductor roles
- **Many initiatives are fragile by design:** Heavy reliance on single employers or short-term funding makes outcomes sensitive to fab timing shifts and hiring slowdowns
- **Replication, not availability, is the binding constraint:** Few programs are standardized for cross-region deployment, limiting national scale despite proven local success.

Training programs deliver faster, more measurable impact, while education programs underpin long-term workforce sustainability

Topic	Finding	Description
Training programs	**Near-term, lower-cost, and demand-linked**	Short duration (2–8 weeks), lower cost per participant, often designed with employers who shape curriculum, fund programs, and support placement
	Impact is meaningful but concentrated	Placement rates often exceed 80% when tied to specific employers or apprenticeships; outcomes translate more directly into near-term FTE supply
	Primarily technician-focused	Most programs emphasize technician pathways, offering hands-on, cleanroom exposure, and practical, on-the-job skills for new and incumbent manufacturing workers
	Scale constrained by capacity and awareness	Expansion limited by faculty availability, cleanroom access, equipment time, and low program awareness among prospective participants
Education programs	**Higher cost, longer time horizon**	Supports broader learning (e.g., minors, credentials, undergraduate degrees) that builds engineering aptitude but does not consistently translate into semiconductor-specific roles
	Direct impact is harder to measure	Benefits accrue over multiple cohorts and years; FTE attribution is challenging since not all graduates enter the semiconductor industry
	Partnerships are critical sustainability	Programs sustain long-term interest, strengthen academic pipelines, and support advanced engineering and R&D talent, but rely on costly infrastructure and sustained industry engagement
Sustainability	**Geographically concentrated**	Training and education initiatives cluster around announced or planned manufacturing investments; education programs are further concentrated at top engineering institutions
	Training programs face higher funding risk	Many rely on direct subsidies (e.g., stipends, paid training, workforce grants), increasing vulnerability when public funding ends or hiring timelines shift
	Education programs are more durable	Curriculum and institutional capacity often remain beyond initial funding, even if near-term enrollment fluctuates
	Early signals of fragility	Training funding and technician placement are tightly linked to manufacturing timelines; fab delays or hiring slowdowns reduce placement and increase attrition to adjacent industries

Technician training scales locally near fabs, while engineering programs scale nationally with less geographic dependence

State	Ⓐ Engineering institutions	Ⓑ Institutions for technicians
Arizona	- Arizona State University	- Maricopa County Community College District
New York	- Cornell University	- Hudson Valley Community College
Texas	- Texas A&M University - University of Texas at Austin	- Austin Community College
Oregon	- Oregon State University	- Portland Community College
Ohio		- Lorain Community College
North Carolina	- North Carolina State University	
Pennsylvania	- Carnegie Mellon University	
Illinois	- University of Illinois Urbana-Champaign	- Ivy Tech Community College
California	- University of Southern California - Stanford University - University of California, Berkeley	
Georgia	- Georgia Institute of Technology	
Michigan	- University of Michigan	
Indiana	- Purdue University	
Massachusetts	- Massachusetts Institute of Technology	



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1. Fab investments published for 2026+ that are >$1B

A. Engineering pipeline expansion delivers strong economic returns but requires sustained investment in early exposure

Increased engineering supply drives economic potential

~22.5k

Undergraduate and graduate degrees are awarded annually in semiconductor-relevant engineering and computer science majors across the top 15 institutions

Top semiconductor programs:

- Purdue University
- Arizona State University
- Georgia Institute of Technology
- Stanford University
- Oregon State University

~$16.8B

Maximum potential annual revenue[1] if all masters and undergraduate degree recipients in semiconductor-related fields enter the workforce as engineers

Engineers, graduating from the 15 top programs, generate a measurable maximum **total economic impact[2]:**

- $638M in local taxes
- $560M in state taxes
- $324M in federal taxes

Student exposure programs can be costly

Semiconductor facilities

~$10k Per student per year for cleanroom maintenance and faculty expenses

Summer programs

~$20k Per student per summer to cover program costs, including student stipends

Chip design lab

~$2k Per student per year

1.Revenue per FTE entering the semiconductor field: $744,312 [Semiconductor Industry Association 2025 Factbook]. Total potential is the revenue if all graduates from the top 15 schools identified (masters and undergraduates) within semiconductor related majors entered the semiconductor industry

2.Additional details in appendix - Economic impact analysis is the total tax revenue generated from each incremental engineering job in semiconductor manufacturing via cost of goods sold and product imports; NAICS code 334413

Sources: Semiconductor Industry Association, Lightcast, university program leaders

A. Engineering workforce solutions pair degree programs with industry-backed initiatives, with varying scalability and impact

Non-exhaustive

⬜ Deep dive to follow

Institution	Degree Programs	Supplemental initiatives[1]
① Purdue University	✓	Birck Nanotechnology center, SCALE, UPWARDS
② UC Berkeley	✓	Berkeley Marvell NanolLab, sensor & actuator center (BSAC), new silicon initiative
③ Geogia Institute of Technology	✓	Institute for electronics and nanotechnology, 3D Systems Packaging Research Center
④ Stanford	✓	Stanford nanofabrication facility (SNF), SystemX alliance
⑤ MIT	✓	MIT.nano Consortium, Microsystems technology laboratories
⑥ University of Illinois Urbana-Champaign	✓	Holonyak micro & nanotechnology lab (HMNTL)
⑦ Arizona State University	✓	Macrotechnology works in partnership with Intel and TSMC
⑧ University of Texas at Austin	✓	Texas nanofabrication facility (TNF), microelectronics research center (MRC)
⑨ Cornell University	✓	Cornell NanoScale science & technology facility
⑩ Oregon State University	✓	New Jen-Hsun Huang and Lori Mills Huang Collaborative Innovation Complex to open in late 2026
⑪ Carnegie Mellon University	✓	Semiconductor device & systems research labs, CONIX research center
⑫ North Carolina State University	✓	NNCI nanofabrication facility, FREEDM systems center
⑬ University of Southern California	✓	USC nanofabrication facility, nano lab
⑭ Michigan University	✓	Lurie nanofabrication facility, SURE/SROP, M-SHORE REU
⑮ Texas A&M University	✓	Texas A&M Semiconductor Institute (TSI), WAVE-Program

1.Structured, non-degree programs (e.g. research groups) with flagship initiatives, sponsored projects, research assistantships, etc.

Deep dive focus

- **Effectiveness:**
  - Infrastructure (e.g., cleanroom access, lab training, access to equipment, packaging resources)
  - Curriculum (e.g. technical knowledge, problem solving and hands-on experience)
  - Enrollment and faculty capacity
- **Return on investment (ROI):**
  - Estimated number of roles filled within the industry per unit cost
  - Cost per student for degree or participation in initiatives
- **Replicability and scalability:**
  - To the extent the solution can be deployed outside of current footprint and organization
- **Alignment to workforce needs:**
  - Extent to which the solution aligns with in-demand roles and industry needs for skilled talent

A1. Purdue offers various employer-backed initiatives to provide hands-on experience beyond typical degree programs

College infrastructure

- 25,000 sq. ft. cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - Electrical & computer engineering
  - Material science
  - Computer Material science
  - Mechanical
  - Chemical
- Master of Science in Microelectronics and semiconductors available

	Degree programs	Supplemental programs/initiatives
Curriculum	• Semiconductor-focused coursework appears late in tenure (junior or senior year) • Coursework is heavily classroom based, little practical, industry specific, lab exposure • Lack of intersectionality across majors	• **Birck:** Significant applicable hands-on experience through research and employer-backed projects • **SCALE and UPWARDS:** Supplemental to core coursework, not required for entry into industry
ROI	• ~2,326 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to: — ~$1.7B in industry revenue — ~$157M in local, state and federal tax revenue	• **Birck:** Program growth from 30 to 50+ students in recent years. • **SCALE and UPWARDS:** ~400 students, scaled across over 19 universities[2]
Workforce alignment	• Top university for semiconductor talent production, uniquely combining classroom instruction with fab-level infrastructure • Medium alignment based on election to pursue supplemental courses later in student tenure • Low overall industry awareness for students within engineering fields	• Recent increases in employer-backed investments into the programs • SK Hynix ~$3.9B investment into Purdue's Research Park to advance AI and semiconductors. Investment brings SK hynix's facility into the Research Park

Gaps identified

- Late exposure to semiconductor industry
- Limited hands-on, industry specific, opportunities in degree program

> The lack of early, hands-on exposure in core programs limits awareness and interest in semiconductors, as students are drawn to adjacent industries via early internships
>
> **Former Birck researcher and Purdue graduate**

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1. Graduates of all engineering majors reflecting total potential outreach
2. Numbers reflect cited students within SCALE's program, UPWARDS has not published total student involvement

Source: Birck research center, Purdue publicly available research information, Purdue industry partners

A2. UC Berkeley leverages supplemental initiatives to embed semiconductor concepts into a top-ranked engineering program

College infrastructure

- 15,000 SF cleanroom, class 100
- Lab-space
- EDA capabilities
- Hands-on training
- Limited packaging resources
- Engineering degrees offered:
  - — Electrical
  - — Material science
  - — Computer science
  - — Mechanical
  - — Chemical
- Semiconductor manufacturing certificate programs
- Masters in science & engineering[4]

	Degree programs	Supplemental programs/initiatives
Curriculum	• One of the world's top-ranked undergraduate computer engineering degrees with interdisciplinary, hands-on education • Higher level semiconductor specific courses[1] with several one-hour minilabs — Of which two are within the core curriculum	• **New Silicon Initiative (NSI)[3]:** Reintroducing IC design and silicon specific courses into engineering curriculum, taken as electives • **Marvell NanoLab:** One of the few college facilities with access to wafer-processing capabilities
ROI	• 2,132 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.6B in industry revenue — ~$144M in local, state and federal tax revenue	• Fellowship and scholarship recipients represent a small portion (~8 students) of program population • **Marvell NanoLab:** serves 350 researchers annually
Workforce alignment	• External Advisory board includes leaders from the semiconductor industry to align academic needs with industry relevance	• NSI is backed by Apple, with NSI fellowships and scholarships available • Marvell NanoLab received contributions from Lam research. Paving way for multimillion dollar semiconductor manufacturing etching system • 16 corporate sponsors, including NVIDIA, Apple, Intel, KLA

Gaps identified

- Scalability limited by cleanroom capacity
- Lack of semiconductor specific masters degree
- Significant draw from advanced technology companies (e.g. Apple), pulling students from semiconductors
- Limited program awareness

> “”
>
> I had limited knowledge and no exposure to the semiconductor industry during my tenure as an undergraduate industrial engineering major
>
> **Recent UC Berkeley graduate**

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1. Semiconductor electronics, integrated-circuit design, microfabrication technology, microelectric Devices and Circuits
2. Enrollment numbers from 2023
3. Typically a graduate level initiative
4. Semiconductor concentration without direct semiconductor masters program

Source: UC Berkeley course catalog, NSI silicon initiative, corporate access program, marvell-nanolab resources

A3. Georgia Institute of Technology drives workforce development via early career awareness and industry-backed experiences

College infrastructure

- 28,500 SF cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - Electrical
  - Material science Computer science
  - Mechanical
  - Chemical
- Offers typical masters in engineering programs without specific semiconductor degree

	Degree programs	Supplemental programs/initiatives
Curriculum	• Semiconductor concepts are embedded within electrical engineering core curriculum • Microelectronics, solid-state devices, fabrication and MEMS courses available through elective pathways	• **Institute for Electronics & Nanotechnology (IEN)[1]:** $400M fabrication facility working toward early exposure to the field, accessibility and applied research • Hands-on training available to students external to Geogia Tech
ROI	• ~1,634 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.2B in incremental industry revenue — ~$111M in local, state and federal tax revenue • ~150 undergrad students took micro electrics packaging and fabrication[3]	• Hires students for work-study paid opportunities with hands-on cleanroom training • ~700 people took IENs new-user orientation, 193 enrolled in short courses in the past 3 years[2] Emphasizing growth of interest in the field
Workforce alignment	• Moderate industry alignment with state-of-the-art facility, while lacking overall core semiconductor curriculum	• Offers research experience for teachers (middle school through college) to conduct nanotech research and learn how to incorporate this into their lesson • Industry parters include: IBM, intel, GlobalFoundries

Gaps identified

- Awareness of IEN program and offerings for young tenured students
  - Outreach is normally done via word of mouth

> It's important for us to reach kids who don't know what career options are available in nanotechnology, We want them to know that whatever they're interested in, there is a pathway for them
>
> **Georgia Tech Associate Director**

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1. Formerly known as the microelectronics research center
2. Each semester, more than 800 students K-12 participate in IEN's intro to nanotech virtual lesson. Emphasize approachability and accessibility to industry to help future workforce pipeline
3. Labs taught by IEN staff. Includes integrated circuit fabrication and microelectronic fabrication (semiconductor materials and fabrication)

Source: Georgia Tech CHIPS research, future microelectronics workforce, conferred degrees

A4. Stanford empowers workforce development through industry-backed research initiatives and top ranked engineering programs

College infrastructure

- 11,000 SF cleanroom
  - Class 100
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - Electrical
  - Material science
  - Mechanical
  - Chemical
- No specified masters degree specific for semiconductors

	Degree programs	Supplemental programs/initiatives
Curriculum	• High alignment of electives available (entry and senior level) engineering courses[1] available for semiconductor devices, energy and electronics • Baseline semiconductor literacy taught in core curriculum via electrical and material science majors only	• **Stanford nanofabrication facility (SNF)[1]:** Develop and share models that empower and support faculty, academic, industry and government leaders
ROI	• 742 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$552M in industry revenue — ~$50M in local, state and federal tax revenue • High median salaries among graduates, ~$159k with 150 EE masters graduates	• 600 annual users with fellowship and project opportunities for students to work directly with tools and materials. Community college internships[2] available • Nano for K-14 program for teachers to increase exposure and curriculum
Workforce alignment	• High philanthropic engagement from alumni (NVIDIA CEO, TSMC partnership) through financial donations, e.g. Jen-Huang Engineering Center	• Professional developmental programs for teachers • Collaboration with TSMC, SNF was renovated to be one of the foremost chipmaking academic facilities to drive chipmaking research

Gaps identified

- Lack of semiconductor masters degree
- Limited cleanroom capacity
- Significant draw from advanced technology companies, pulling students from semiconductors

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1. Covers semiconductor physics, band theory, quantum effects, and devices (diodes, transistors, solar cells, LEDs). EE116, EE312. EE410 and EE241
2. Part of larger nano@standford initiative that includes SNF and SNSF
3. For students in the Bay area to gain experience in cleanrooms, cutting edge research, in areas including electronics, MEMS, optics, physics, biology/biotechnology, medicine, and chemistry
4. SystemX alliance is for graduate level students industry affiliate program, connecting Stanford faculty and students to conduct research and talent development

Source: Nanolabs at Stanford, nanofabrication facility at Stanford, Stanford university publicly available information

A5. 95% of MIT undergraduate students participate in research opportunities, driving hands-on, industry specific experience

College infrastructure

- 100,000 sq. ft. cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Limited packaging resources and research
- Engineering degrees offered:
  - Electrical engineering and computer science
  - Electrical science and engineering
  - Material science and engineering
  - Chemical
  - Mechanical
- Offers Masters in Science and engineering without dedicated semiconductor degree

	Degree programs	Supplemental programs/initiatives
Curriculum	• Electrical engineering core course curriculum includes semiconductor specific courses: — Microelectronic devices & circuits[1], advanced IC/circuit design	• **MIT.nano:** Nanofabrication facilities with a fabrication facility (fab.nano) and a facility for micro to sub-nanoscale structures (characterization.nano)[2] • **Microsystems technology laboratories (MTL)2:** Research focused on materials and nanofabrication
ROI	• 856 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$637M in industry revenue — ~$58M in local, state and federal tax revenue	• 150+ tools and instruments installed, 44 dedicated staff members • 95% of all senior graduates participated in research opportunities during undergraduate years
Workforce alignment	• Wide variety of elective course offerings, significantly more than found elsewhere, that allow students to further specialize in semiconductors	• Consortium of industry partners that fund and support programs direction, including representatives from GlobalFoundries, TI, TSMC and others • $175M in research sponsored by industry[3]

Gaps identified

- Small program scale limits annual contributions to semiconductor industry
- Lack of dedicated masters degree for semiconductor research

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1. Covers semiconductor junction and MOS systems, device, processing and yield engineering
2. Utilized state of the art facilities, portfolio covers MEMS, bio-MEMS, molecular devices, nanotechnology, sensors, and actuators. Includes semiconductor manufacturing and supply chain
3. Funding for all MIT.nano initiatives

Source: MIT.nano, MIT course catalog, registrar, MIT admissions

A6. University of Illinois Urbana-Chapaign leverages a prestigious engineering program and industry partnerships to refine curriculum

College infrastructure

- 9,000 sq. ft. cleanroom
  - — Class 100 & 1000
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - — Electrical engineering and computer science
  - — Electrical science and engineering
  - — Material science and engineering
  - — Chemical
  - — Mechanical

	Degree programs	Supplemental programs/initiatives
Curriculum	• #5 ranked undergraduate engineering program[1] — Offers semiconductor specified classes such as semiconductor devices as electives	• **Holonyak Micro and Nanotechnology Lab (MNTL):** facility for photonics, microelectronics, biotechnology and nanotechnology research
ROI	• 1,707 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.3B in industry revenue — ~$115M in local, state and federal tax revenue • 95% of computer science graduates have internship, co-op during degree program with 97% having either employment or plans of further education post graduation	• 15 Class 100 and 1000 cleanrooms and 46 general purpose labs — Open to faculty and external research • $2M Future of Semiconductors (FuSe) grant from the NSF — ~$200k directed toward new potential semiconductor students raising awareness and able to earn a certificate through hands-on training[2] with opportunity to scale
Workforce alignment	• Top rated engineering program with alignment through the Illinois Semiconductor Workforce Network. Leads the effort which aims to provide an ecosystem of partners and industry-aligned training	• Partner with the Semiconductor Research Corporation, pushing direct industry relevance within research opportunities

Gaps identified

- Cleanroom size and capacity limits total scalable potential of the program
- Weaker geographic alignment than other top ranked institutions

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1. Ranking by US News & World Report (September 2025 publication)
2. In partnership with Parkland college, where students do not have access to equipment

A7. Arizona State university pairs state-of the art facilities with a replicable and scalable workforce development program

College infrastructure

- ~50,000 cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - Electrical engineering and computer science
  - Electrical
  - Material science & engineering
  - Chemical
  - Mechanical
- Masters in Semiconductor materials and devices

	Degree programs	Supplemental programs/initiatives
Curriculum	• Electrical Engineering provides the fundamental device and system understanding required in fabs, • Semiconductor-specific coursework is elective • One of the largest engineering educators	• **Macrotechnology Works (MTW)[2]:** technical readiness through industry-grade, hands-on experience • **Microelectronics Workforce Development Hub (MWDH)[3]:** Pipeline designed to educate, train, and credential talent for semiconductor roles. Includes K-12 training and development
ROI	• 6.7% growth rate of engineering degrees[1] • 2,247 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.7B in industry revenue — ~$152M in local, state and federal tax revenue	• 12,000 students have taken microelectronic technical electives since 2022 (20% increase) • 4,600+ are employed with industry partners in Arizona, including Intel, TSMC, Microchip, Amkor and others • 1,800+ ASU prep students, a K-12 outreach initiative
Workforce alignment	• Workforce alignment through advisory boards, hiring, capstones, and curriculum feedback with major corporations, including intel, TSMC, AMKOR and others	• Investment from industry leaders, including AMKOR, Intel and TSMC • Hosts companies, allowing students to expanding networking, internship, and job placement opportunities

Gaps identified

- Perceived program reputation relative to other institutions analyzed (e.g., ranked outside the top 20 national engineering programs)

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1. Growth rate from 2023 to 2024
2. Includes Center for Advanced Wafer-Level Packaging Applications and Development, Advanced Electronics and Photonics, and Solar fab
3. Access to equipment through Macrotechnology Works facilities

Source: Microelectronic works, infrastructure and ASU publicly available educational data

A8. University of Texas leverages a top-tier engineering program, coupled by a cohesive training ecosystem with educational partners

TEXAS
The University of Texas at Austin

College infrastructure

- 12,000 SF cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Limited packaging resources
- Engineering degrees offered:
  - Electrical& computer engineering
  - Electrical engineering
  - Material science and engineering
  - Chemical
  - Mechanical
- Offers Masters in Science and engineering without dedicated semiconductor degree

	Degree programs	Supplemental programs/initiatives
Curriculum	• Nationally ranked engineering program — #11 electrical engineering program — #8 computer science program • Minor in semiconductor science and engineering available[1] • Masters degree developed to keep up with demand[2]	• **Texas Nanofabrication Facility (TNF):** Facilities for micro- and nanoscale device fabrication[3] with access to a cleanroom • **Microelectronics Research Center (MRC):** Research and training center focused on microelectronics, device physics, materials, and semiconductor-related technologies
ROI	• 991 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$738M in industry revenue — ~$67M in local, state and federal tax revenue	• **SUPREME REU participant:** cultivate skilled undergraduate researchers and hosts 5 participants each summer in research with additional start-up programs
Workforce alignment	• Specialized semiconductor minors and new masters programs are derived through deep industry partnerships (e.g. Samsung)	• **Partnership** with ACC and Texas institute of electronics (TIE) to launch a semiconductor training center[4] at UT's campus • One of 16 schools to obtain funding from NSF's $81M grant over 5 years as part of the NNCI

Gaps identified

- Moderately sized cleanroom for total undergraduates, limiting capacity for scalability
- Limited packaging resources

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1. In addition to coursework, students must complete one required class, and a choice of their own 4 elective courses to obtain minor
2. Students partner with faculty member in Masters program to develop a research opportunity. Students will intern during the summer and carry out the research
3. Advanced tools such as photolithography, etching, thin-film deposition and metrology.
4. TIE is a pure-play foundry. Association trains students to go from UT to the workforce, but also ACC to UT.

Source: Cockrell school of engineering, Institute for electronics, TXIE, NNCI, class catalog

A9. Cornell leverages classroom curriculum, engineering prestige and applicable industry exposure to qualify talent

College infrastructure

- 15,000 SF Cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - — Electrical engineering and computer science
  - — Electrical science and engineering
  - — Material science and engineering
  - — Chemical
  - — Mechanical
- Offers Masters in Science and engineering without dedicated semiconductor degree

	Degree programs	Supplemental programs/initiatives
Curriculum	• Engineering majors provide a broad spectrum of foundational skills — Concentrations through electives allow for further specialization in semiconductors later in tenure	• **NanoScale science and technology center (CNF):** Research initiative exposing student to fab and manufacturing environments — **Research experience for undergraduates (REU):** Early exposure to facilities
ROI	• 1,064 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$792M in industry revenue — ~$72M in local, state and federal tax revenue	• Supported by 20+ staff members • K-12 visits with active experimentation with ~3,500 visitors (K-12 to graduate prospects) • 700 annual users and open-access for students, faculty, start-ups and large companies
Workforce alignment	• Majors within applicable degrees provide baseline knowledge to semiconductor concepts	• Member of NNCI, who initially provided a 5 year-$7.5M grant • REU initiative funded by NSF • Integrates research, classroom knowledge and industry exposure to drive projects and experience

Gaps identified

- Smaller relative graduates within applicable majors, limiting scale
  - — Largely driven by institution prestige
- Less exposure to advanced packaging

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1. Covers semiconductor junction and MOS systems, device, processing and yield engineering

Source: Publicly available data for Cornell and school of engineering

A10. Oregon State University drives workforce development through state-of the art infrastructure and industry involvement

College infrastructure

- Cleanroom and 2 lab-spaces:
  - New facility to be ~150,000 sq. ft. with state-of-the-art cleanroom
- EDA capabilities
- Packaging resources
- Engineering degrees offered:
  - Electrical engineering and computer science
  - Electrical engineering
  - Material science
  - Chemical
  - Mechanical
- No dedicated Masters degree in semiconductors

	Degree programs	Supplemental programs/initiatives
Curriculum	• Electronics & computer engineering majors have areas of focus that are specific to semiconductors (e.g. integrated circuits) along with additional elective coursework	• **Jen-Hsun Huang and Lori Mills Huang Collaborative Innovation complex[1]:** New facility for research and advanced computing, materials, AI, robotics and microelectronic domains • **Research centers[2]:** IC design, electronic materials & devices, process technology and packaging
ROI	• 1,604 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.2B in industry revenue — ~$108M in local, state and federal tax revenue	• New facilities expand engineering program capacity and broadens potential participation • 90% of graduates are in employment or further study
Workforce alignment	• Electronics & computer engineering program has development partnerships with HP and intel • Faculty includes members of NSF career awardees, bringing specific expertise to the program	• 33+ years in partnership with the NSF design center • Academic partner to other industry initiatives (e.g.Corvallis Microtechnology initiative, Oregon Nanoscience and Microtechnology institute)

Gaps identified

- Lack of undergraduate industry specific coursework, specifically in masters programs
- Lower tier engineering program relative to other top schools identified in producing top tier engineering and design talent

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1. Project underway, to open in 2026. will house on of the most powerful university supercomputers
2. CDADIC, Consortium of leading semiconductor companies; MaSC a user friendly & innovation center d=focused on thin-film deposition, device fabrication and material analysis; NNI, leading edge nano-tech infrastructure, photonics and advanced energy systems

Source: Oregon State course catalog, Semiconductor innovation, workforce education

A11. Carnegie Mellon University drives core fundamentals through research infrastructure, but is limited by degree pathways

College infrastructure

- 8,500 sq. ft. cleanroom
  - Class 10/100
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering undergraduate and masters degrees offered:
  - Electrical engineering and computer science
  - Electrical science and engineering
  - Material science and engineering
  - Chemical
  - Mechanical
- No masters degree specific to Semiconductors

	Degree programs	Supplemental programs/initiatives
Curriculum	• Core engineering undergraduate degrees provide conceptual knowledge through associated coursework (e.g. integrated circuits) but lacks specified semiconductor-focused curriculum • Recently added a chip design course within the engineering department as an elective	• **Semiconductor Device & systems research lab:** Supports advanced research and graduate training in semiconductor devices and systems • **Bertucci Nanotechnology Laboratory (BLN)**: manufacturing, material science, nanotechnology and other fields to produce scalable, reproducible semiconductors
ROI	• 1,372 engineers awarded degrees within masters or undergraduate programs related to semiconductors. All graduates produce up to: — ~$1.0B in industry revenue — ~$93M in local, state and federal tax revenue	• BNL houses over 80 deposition, etching, lithography and metrology tools, enabling the production of semiconductors. Includes 19 wet chemistry decks and 3 EMI-shielded rooms • Responsible for >$50M per year of research advancing the field
Workforce alignment	• Electrical and Computer engineering has received ~$48M in sponsored research with >5 NSF awards • Chip design course includes an initiative that works with industry partners, fostering scholarships and fellowships to students within the program	• Funding from the Semiconductor Research Corporation • Over 40 faculty members utilize facility for research through an advanced collaboration approach with industry partners

Gaps identified

- Lack of semiconductor specific graduate or undergraduate concentrations
- Limited cleanroom space, constraining potential scalability

Source: Lurie nanofabrication facility information, Michigan public data and information, M-SHORE REU

A12. North Carolina State University leverages infrastructure and DOD-backed applied research initiatives to drive skill development

College infrastructure

- 7,400 sq. ft. of class 100 cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - Electrical & computer science engineering
  - Computer science
  - Material science and engineering
  - Chemical
  - Mechanical
- New wide Bandgap Semiconductor Masters degree

	Degree programs	Supplemental programs/initiatives
Curriculum	• Online, industry specific courses available (e.g. material science in processing of semiconductor devices) • Degrees integrates baseline semiconductor material (e.g. integrated circuits, semiconductor physics and fabrication)	• **Nanofabrication facility (NNF):** Shared cleanroom that supports micro and nano-fabrication, including lithography, etching, and others • **CLAWS:** Focused on wide bandgap semiconductors, research foundry for silicon carbide research
ROI	• 1,658 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$1.2B in industry revenue — ~$112M in local, state and federal tax revenue	• **NNCI:** over 2,000 tools available, enabling students to build prototypes and obtain real industry experience • **CLAWS:** DOD focused initiative to advance the defense technology. Employs a research foundry approach to development
Workforce alignment	• Part of the Research Triangle Park (RTP), home to hundreds of companies, enabling close collaboration between academia and industry to accelerate semiconductor research, training, and workforce placement	• In 2023, awarded $39.4M from the DOD as regional innovation hub in wide bandgap semiconductors[1] • CLAWS is one of eight regional hubs for the Microelectronics Commons

Gaps identified

- Weak geographic proximity to nanofabrication development
- Lack of scalability due to specialization on wide bandgap semiconductors

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[1] Includes NC state, along with 6 other industry partners; Wolfspeed, Coherent Corp., General Electric, Bluglass, Adroit Materials and Kyma Technologies, Inc.

Source: North Carolina State public data, NNF, regional semiconductor innovation hub, CLAWS

A13. University of Southern California drives training via federally supported, defense oriented, research initiatives

College infrastructure

- 10,000 sq. ft. cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - — Electrical engineering and computer science
  - — Electrical science and engineering
  - — Material science and engineering
  - — Chemical
  - — Mechanical
- No masters degree specific to Semiconductor

	Degree programs	Supplemental programs/initiatives
Curriculum	• Minimal industry specific coursework, while baseline concepts are developed in respective degree offerings	• **USC nanofabrication facility:** core facility for nanofabrication, characterization, lithography, imaging, among others. • **Information Sciences Institute (MOSIS 2.0):** Next-gen manufacturing process and facility
ROI	• 1,084 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$807M in industry revenue — ~$73M in local, state and federal tax revenue	• Cleanroom comes with additional fees for use • MOSIS 2.0 supports programs such as CA DREAMS[1], a defense research and training hub, to advance the development of semiconductor technologies
Workforce alignment	• Partnerships with the department of defense, along with other industry partners, resulting in one of the top semiconductor related defense oriented researchers	• Industry, and government support from Dupont, IBM, Samsung, Air Force of Scientific Research, and others • CA DREAMS awarded $31.9M, one of two project supported by Northrup Grumman

Gaps identified

- Moderately sized cleanroom for number of undergraduates awarded degrees
- DOD specificity limits scalability to all aspects of the semiconductor industry

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1. California Defense Ready Electronics and Microdevices Superhub

Source: nanofab, CA DREAMS, USC public data and information, Viterbi school

A14. Michigan drives core fundamentals through research infrastructure, but is limited by degree pathways

College infrastructure

- 110,000 sq. ft. of cleanroom lab-space
- EDA capabilities
- Hands-on training
- Packaging resources
- Engineering degrees offered:
  - — Electrical engineering
  - — Computer science
  - — Material science and engineering
  - — Chemical
  - — Mechanical
- No masters degree specific to Semiconductor but offers concentrations

	Degree programs	Supplemental programs/initiatives
Curriculum	• Electrical engineering incorporates semiconductor device theory into core degree curriculum (EECS 320) — Solid state electronics lab offers hands on experience to semiconductor fab and testing , offered as an elective • No direct graduate or masters degrees offered	• **Lurie nanofabrication facility:** Facility supporting micro and nanofabrication • **M-SHORE REU[1]:** Microelectronics, sensing hardware and semiconductor systems, nanofabrication of semiconductor material, devices and technology
ROI	• 974 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to — ~$725M in industry revenue — ~$66M in local, state and federal tax revenue	• **M-SHORE REU:** Opportunities for nine students to participate in a 10-week summer training, receiving a $6,500 stipend
Workforce alignment	• Insufficient industry-co-developed semiconductor tracks or manufacturing-focused education	• **M-SHORE REU:** NSF funded research experiences for undergraduate programs, with additional support with the Semiconductor Research Corporation • KLA partnership to develop and train employees

Gaps identified

- Limited scale of M-SHORE initiative due to cost of program
- Lack of direct masters degrees for engineers, which are in highest demand for employers

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1. Michigan Semiconductor Hands-on Research Experience

Source: Lurie nanofabrication facility information, Michigan public data and information, M-SHORE REU

A15. TAMU offers various employer-backed initiatives to provide hands-on experience beyond typical degree programs

College infrastructure

- 6,500 SF cleanroom
- Lab-space
- EDA capabilities
- Hands-on training
- Limited packaging resources
- Engineering degrees offered:
  - Electrical
  - Material science & engineering
  - Computer science
  - Mechanical
  - Chemical
- Semiconductor manufacturing certificate programs
- Master of Science in Microelectronics and Semiconductors

	Degree programs	Supplemental programs/initiatives
Curriculum	• Semiconductor-focused coursework available appears late in tenure (junior or senior year) for specific majors • Certifications available for limited credits (~7 credit hours) • Engineering program ranked 9th nationally	• **Semiconductor Institute (TSI):** Multidisciplinary research organization developed in response to chips act to advance R&D and manufacturing in focused research areas[2] • **Microelectronics & Nanofabrication facilities:** cleanroom space for lithography, deposition, etching, metrology and other research initiatives
ROI	• 2,105 engineers awarded degrees within masters or undergraduate programs related to semiconductors. Graduates produce up to: — ~$1.6B in industry revenue — ~$142M in local, state and federal tax revenue	• $1.28M in funding for workforce advancement (wave-chip program) • 350 registrants at the second Texas semiconductor summit, 50% increase[3] • TSI aims to train over 7,500 individuals in hardware verification skills and 109 instructors through various initiatives
Workforce alignment	• High industry engagement, launched a new Master of Science program in microelectronics and semiconductors, — Possible by $1 million grant from Samsung Austin Semiconductor	• High industry engagement, with global partners to align curriculum and industry needs — TSMC, Applied materials, TEL

Gaps identified

- Low semiconductor relevant coursework early in tenure, with some majors not being exposed to any curricula
- Limited cleanroom space bottlenecks scalability

> I did not know about potential programs offered by Texas A&M, or about the broader semiconductor industry. I became aware of the industry after obtaining an internship with Samsung, which I pursued out of the company reputation, as opposed to industry specificity
>
> **Recent TAMU graduate**

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1. State-of the art cleanroom facility projected to be delivered in Q4 of 2025
2. Areas of focus include: CHIPS-in-Space, Wafer front end processing, disruptive lithography, metrology, novel materials, digital twins
3. Relative increase reported from 2023 to 2024, Texas semiconductor institute is put on by Texas A&M semiconductor institute, bringing people together to shape the future of the industry

Source: TSI annual reports and publicly available institution data, Texas semiconductor summit, engineering department public data and information

A. High-impact engineering programs align early exposure, employer partnerships, and scalable training infrastructure

		Ranking[1]	
Criteria	**Description**	**High success characteristics**	**Low success characteristics**
Effectiveness	Evidence that the solution achieves its stated objectives	• High public program perception defined as a top 20 engineering program • Strong employer engagement and placement pathways[3] • Strong semiconductor master's degree	• Low programmatic perception • Limited employer engagements and placement pathways[3] • Limited semiconductor-specific curriculum, including elective courses
ROI	The estimated industry and economic impact via roles filled	• Greater than 1,500 graduates[2] • Early exposure to semiconductor research and coursework • High throughput enabled by faculty capacity and cleanroom scale	• Limited talent population due to program size constraints • Late semiconductor exposure due to low program awareness • Limited lab and cleanroom availability
Replicability	The degree to which the solution can be deployed beyond the organization or region where it currently exists	• Programs can be replicated without capital equipment[4]	• Programs are highly specialized and built around complex ecosystems
Scalability	The likelihood that the solution can be expanded to meaningfully reduce the national semiconductor talent shortage	• >28,000 sq. ft. cleanroom for new-student engagement • Low operating costs per student • Funding availability for continued operations	• <10,000 sq. ft. cleanroom • High operating cost per student • Funding constraints needed to sustain operations
Workforce alignment	The extent to which the solution increases supply for the most in-demand roles and aligns with industry requirements for skilled talent	• Geographic proximity to high talent demand areas • Significant industry partnerships for research and placement opportunities	• Geographic mis-alignment with future developments • A lack of industry partnerships limits clear pathways for students to enter the industry

1. Rating scaled 1-3, with 3 being the most valuable
2. Defined by the number of undergraduates within semiconductor related undergraduate and graduate degrees (engineering and computer science)
3. Partnerships that facilitate apprenticeships or post-graduate jobs in the industry
4. Standardized curriculum, awareness programs

A. Engineering programs vary widely in national impact, driven by differences in scale, replication, and industry alignment

3 → 1 Most to least effective programs

Institution	Effective-ness	ROI	Replica-bility	Scala-bility	Workforce alignment	Average	Rationale
Purdue University	3	3	3	3	2.5	2.9	Established semiconductor ecosystem anchored by industry support
Arizona State University	2	3	3	3	3	2.8	Strong community college collaboration (ACC and ACA), proximity to industry demand, offset by lower engineering prestige
Georgia Institute of Technology	3	2	3	3	2	2.6	Top-tier engineering institution with focus on research limited by geographic proximity to semiconductor hub
Stanford University	3	1	3	2.5	3	2.5	TSMC partnership, educational prestige, but does not have a specific masters degree, limited cleanroom space
Oregon State University	2	2	2.5	3	3	2.5	Targeted semiconductor investment from NVIDIA for 150k sq. ft. cleanroom, lower ranking and prestige of engineering program
Texas A&M University	3	3	3	1	2.5	2.5	Industry collaboration with TSMC and ACC, highly ranked engineering program, limited cleanroom
University of California, Berkeley	3	3	2	2.5	2	2.5	Top tier engineering and computer science programs, high industry engagement, limited by draw from tech companies (Apple)
Massachusetts Institute of Technology	3	1	3	3	2.5	2.5	World-class research, large cleanroom and prestige with limited graduate throughput
University of Texas at Austin	3	1	3	2.5	3	2.5	High degree of industry partnerships (ACA and ACC), industry specific minors and master’s degrees available
University of Illinois Urbana-Champaign	3	3	2.5	2	1.5	2.4	Top-tier engineering program, industry partnerships with SRC, with weaker geographic alignment
North Carolina State University	3	2	3	1.5	2	2.3	Top tier institution for wide bandgap semiconductors, specificity limits scalability
Carnegie Mellon University	3	2	3	2	1	2.2	Strong design and semiconductor research with limited workforce-scale throughput, NSF research awards, SRC partnership
University of Southern California	2	2	2	1.5	3	2.1	Defense-driven semiconductor research limiting scalability
Cornell University	3	1	2	2.5	1	1.9	Highly specialized nanofabrication expertise serving a small, high-impact talent cohort
University of Michigan	2	1	1.5	3	1	1.7	Strong engineering programs, partnership with KLA, limited semiconductor curriculum

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1. Ranking from 1-3, with 3 being the best programs available

B. Technician pipeline expansion delivers strong economic returns but can be costly to implement and sustain training programs

Increased technician supply drives economic potential

~2-3k

AAS and Quick Start certificates awarded annually in pathways across 6 distinguished Community Colleges for technician training

Top semiconductor programs:
- Maricopa Community College
- Austin Community College
- Portland Community College
- Lorain Community College

~$1.6B

Maximum potential annual revenue[1] if all graduates (Quick Start and Semiconductor AAS degree pathways) entered the workforce as technicians

Technicians, graduating from the six distinguished programs, generate a measurable maximum **total economic impact[2]:**

- $60M in local taxes
- $52M in state taxes
- $30M in federal taxes

Quick Start programs

~$1k	Per student for cleanroom maintenance and faculty expenses[3]

8-week programs

~$1-2k	Per student per summer to cover program costs, including student stipends

Apprenticeships

~$5-6k	Per student[4]

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[1] Revenue per FTE entering the semiconductor field: $744,312 [Semiconductor Industry Association 2025 Factbook]. Total potential is the revenue if all graduates from the top 6 schools identified (Quick Start and credit programs) within semiconductor related majors entered the semiconductor industry

[2] Additional details in appendix - Economic impact analysis is the total tax revenue generated from each incremental job in semiconductor manufacturing via cost of goods sold and product imports; NAICS code 334413

[3] Student stipends available for majority of programs ranging from $200-600

[4] Variability based on capacity of program with respect to students. $5-6k reflects programs with 300-600 students

Sources: Semiconductor Industry Association, Lightcast, university program leaders, USDOL

B. Technician workforce solutions deliver faster impact when anchored in employer-backed, applied training and direct job pathways

Non-exhaustive

▢ Deep dive to follow

Institution	Credited program	Supplemental programs	Expedited programs	Notes
① Portland Community College	✓	✓	✓	Intel-backed quick start program and apprenticeships
② Maricopa Corporate Colleges	✓	✓	✓	Intel-backed quick start program; TSMC and Intel sponsored apprenticeships
③ Austin Community College	✓	✓	✓	STARS program; Infineon and Samsung are apprenticeship partners
④ Hudson Valley Community College	✓	✓		Semiconductor technology certificates, GlobalFoundries sponsored apprenticeships
⑤ Ivy Tech Community College	✓	✓		Green2gold program creates pathway from technicians to bachelor's degrees
⑥ Lorain Community College	✓	✓	✓	SERP program in partnership with Technet and Intel
⑦ Mohawk Valley Community College	✓	✓	✓	Support employer sponsored apprenticeships with Wolfspeed
⑧ Texas State Technical College	✓			Industry aligned technician training
⑨ Growing Apprenticeships in Nanotechnology and Semiconductors (GAINS)		✓		Industry standardized apprenticeship initiative

Deep dive focus

- **Effectiveness:**
  - Infrastructure (e.g., cleanroom access, lab training, access to equipment, packaging resources)
  - Curriculum (e.g. technical and practical knowledge, problem solving and hands-on experience)
  - Class size, duration and run rate
  - Faculty capacity
- **Return on investment (ROI):**
  - Placement rates within the industry post degree or certification
  - Cost of program or degree
  - Funding and equipment donations
- **Replicability and scalability:**
  - To the extent the solution can be deployed outside of current footprint and organization
- **Alignment to workforce needs:**
  - Extent to which the solution aligns with in-demand roles and industry needs for skilled talent
  - Association involvement

B1. PCC leverages industry partnerships and curriculum to drive skill development, while faculty capacity limit scalability

Institution infrastructure

- 1,150 sq. ft. cleanroom
- Lab-space
- Donated equipment and tools
- 4 campus locations
- AAS credited degree offerings:
  - Microelectronics manufacturing technology
  - Electronic engineering technology
- Location: Oregon

	Credited programs	Expedited programs	Supplemental programs (inc. apprenticeships)
Curriculum	• 75% classroom and 25% lab • Deeper technical and system-level skills	• Utilized locally adopted Maricopa curriculum • Intel mediated curriculum adoption • Drive practical knowledge, hands-on experience	• Direct employer-sponsored programs with the goal to provide industry specific, hands-on experience

ROI	• ~25 graduates[3] from credited programs per year:
	  – $18.6M industry revenue
	  – $2M in tax revenue
	• ~16% of students enter credited programs as Quick Start alumni
		• ~250 students[3] per year with average class size of 15:
		  – $186M in industry revenue
		  – $17M in tax revenue
		• Free program with $500 stipend for students
		• 60% placement rate[1]
			• 95% of PCC graduates placed at Intel prior to workforce reductions[2]

Workforce alignment	• Monthly Advanced Manufacturing advisory meetings involving industry, workforce and governmental partners to refine curriculum	• Regular adjustments to programs based on employer feedback, cohort outcomes and hiring partner input	• Direct employer commitment to training pipeline • Guaranteed interviews with hiring partners

Gaps identified

Funding, faculty and facility capacity limits scale

Industry awareness and outreach

> *Funding, lab, and staffing constraints limit the scalability of credit and quick-start programs, particularly during peak demand*
>
> **Program Dean**

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1. Students enter medical or broader electronics field based on interests in electronics or math
2. Placement outcomes within industry highly sensitive to industry hiring cycles
3. Figures estimated based on expert calls and limited publicly available data

Source: Microelectronics technology at PCC, expert interviews, PCC.edu

B2. Maricopa County Community College offers an ecosystem of initiatives with industry and institutional partners within a geographic hotbed

MARICOPA COMMUNITY COLLEGES

Institution infrastructure

- >1,000 sq. ft. cleanroom
- Lab-space
- 10 campus locations
- AAS 2-year degree offerings:
  - — Semiconductor Manufacturing
- CCL offerings (<1 year):
  - — Semiconductor manufacturing
  - — Industrial technology for semiconductor
- Location: Arizona

	Credited programs	Expedited programs	Supplemental programs (inc. apprenticeships)
Curriculum	• Hands-on lab and technical knowledge development through	• Essential knowledge and skills via hands-on learning • Automated industrial technology certificate	• **ACA[1]:** Mix of classroom and on-the-job training provided by MCCCD • **Future48 Workforce Accelerator**: Full-size cleanroom to train students; Provides custom employment pathway

ROI	• ~400 graduates[3] from credited programs per year
	  • $297M in industry revenue
	  • $27M in tax revenue
		• Arizona leads nation pay for semiconductor technicians, $30/hr
		• ~300 students trained[3]
		  • $223M in industry revenue
		  • $20M in tax revenue
			• **ACA:** Apprentices to be hired as intel employees as core skills are developed[2]

Workforce alignment	• High with large investment from Intel and TSMC into the curriculum	• Program developed in partnership with (INTEL) • Expanding quick Start program to Glendale CC, increase access. Funding from Natcast	• Investment from government and industry leading • **FWA:** $5M in funding from governor, ACA contributing $15 for infrastructure at MCCCD campus location

Gaps identified

Low early-awareness

Strengths

- Strong industry involvement
- Significant scale, spanning multiple campus locations
- Strong infrastructure

> *Students often discover semiconductors too late; once exposed, interest is high. Expanding early, non-traditional pathways like high-school apprenticeships is critical to growing the workforce*
>
> **Industry CHRO**

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1. Arizona Commerce Authority
2. Hand-tooling, pneumatic, hydraulic, mechanical and vacuum systems, electronics, handling chemicals and gas
3. Figures estimated based on limited publicly available data

Source: Maricopa corporate, Arizona Commerce Authority, Maricopa education, BLS

B3. Austin Community College is a part of a broader industry and institutional wide ecosystem driving outreach and scale

Institution infrastructure

- NXP semiconductor advanced manufacturing lab
- ~800 sq. ft. cleanroom
- Access to equipment and tools
- 11 campus locations
- AAS credited degree offering in Automation, robotics and semiconductor technology
- Offers bachelors of applied technology
- Location: Texas

	Credited programs	Expedited programs	Supplemental programs (inc. apprenticeships)
Curriculum	• **Bachelors of applied technology (BAT):** Drives technician skill development and professional progression (technicians to managers) • Leadership, supply chain, etc.	• **Advanced Manufacturing Production (AMP):** 8-week entry level program with no prior experience • **Upskilling Programs:** Open enrollment for incumbent manufacturing individuals seeking skill development; 14-16 courses • **STARS program (Rapid technician training):** Advanced technician training for those coming from adjacent industries	• **Undergraduate-Starts:** Engineering development program in partnership with Samsung, training engineers specific to Samsungs needs. Applied learning for new employees without prior hands-on, semiconductor tooling experience

ROI	• ~400 graduates from credited programs per year[1]
	  • $298M in industry revenue
	  • $27M in tax revenue
		• **AMP:** ~100 graduates per year, $1000 per student cost with >90% placement rate, 8-weeks
		• All programs have ~250-350 graduates per year[1]:
		  • $261M in industry revenue
		  • $24M in tax revenue
			• Pilot cohort was completed at the University of Texas, with two additional cohorts in 2026
			• Texas A&M launched two cohorts with the Texas Institute for Electronics (TIE)

Workforce alignment	• Samsung sends current employees to program to upskill within the company so hiring/promotional efforts can be internal	• Company partnerships in training programs, tailored specific to company needs	• 7 labs that are directly supporting Samsungs workforce needs • UT Austin, Texas A&M, Texas Institute for Electronics

Gaps identified

Program design is highly tailored to individual industry partners, with curricula aligned to single employers rather than focusing on replicable training for broader industry needs

> *We developed stars for engineers since industry leaders were emphasizing that they do not need theoretical skill development, the desperately need hands on experience*
>
> **Program Dean**

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1. Figures estimated based on expert calls and limited publicly available data

Source: Semiconductor manufacturing at ACC, bachelors of applied technology, expert interviews

B4. Hudson Valley Community College partners with GlobalFoundries to deploy proprietary training programs

Institution infrastructure

- >1,000 sq. ft. cleanroom
- Lab-space
- Access equipment and tools through $500,000 Global Foundries grant
- AAS credited degree offerings:
  - — Electrical engineering technology-electronics
  - — Electrical technology: Semiconductor manufacturing technology

	Credited programs	Supplemental programs (inc. apprenticeships)
Curriculum	• Hands-on principles and practices relevant to the industry • Prior to graduation, students will work in field service, test and manufacturing • Semiconductor Technology Certificate (25 credits): — Specialized training for digital electronics, electro-mechanical devices, semiconductor manufacturing	• **GlobalFoundries (GF) Workforce training and apprenticeship:** Offers 18-month technician training and apprenticeship program • **Semiconductor Scholars:** Partnered with Rensselaer Polytechnic Institute to support, develop and expand the semiconductor pipeline
ROI	• Hybrid approach to training, incorporating theory and lab based curriculum • ~120 graduates[1] from GlobalFoundries training program combined with credited graduates per year • $36M in industry revenue • $8M in tax revenue	• **GF:** No-cost training as part of employment • Full-time paid position, with potential for promotion upon completion • Opportunity to pursue further education,. reimbursed by GF • **Scholars:** Ability to leverage RPIs class 100 cleanroom, faculty expertise
Workforce alignment	• Educational and industry collaboration among training and educational curriculum • Utilized TEC-smart, training facility for semiconductor manufacturing with classroom and cleanroom space	• Direct industry placement for technicians, while learning basic technical skills, on-the job training and toolset qualifications • $500,000 gift supporting specialized equipment

Gaps identified

Low rates of student throughput and scale within the scholars program

Specialization of teaching, curriculum and placement with regards to partnerships (GlobalFoundries)

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[1] Figures estimated based on limited publicly available data

Source: GlobalFoundries apprenticeship program, HVCC north, course catalog

B5. Ivy Tech Community College leverages partnerships to develop replicable and scalable training curricula

Institution infrastructure

- 2,000 sq. ft. class 1000 cleanroom
- Lab-space
- Access to equipment and tools
- AAS credited degree offerings:
  - — Electrical Technology: Semiconductor Manufacturing Technology
- Location: New York

	Credited programs	**Supplemental programs (inc. apprenticeships)**
Curriculum	• Hands-on principles and practices relevant to the industry • Prior to graduation, students will work in field service, test and manufacturing • Semiconductor fabrication certificates available	• **Semiconductor workforce development program:** Partnership with Purdue to develop pilot programs for recruitment, training, and placing students into the industry — **Green2gold:** upscale initiative for educational development for community college graduates to pursue
ROI	• Largest accredited statewide community college system, largest potential outreach and scale • ~55 graduates[1] from all programs offered per year • $17M in industry revenue • $4M in tax revenue	• **Pilot Programs:** Co-developed curriculum with Purdue to increase access of Purdue's coursework for Ivy Tech students. Increases total outreach and impact • ~100 students trained[1] — $30M in industry revenue — $7M in tax revenue
Workforce alignment	• Certificate and education curriculum are developed in partnership with the applied research institute and Purdue	• Collaboration on corporate training models for industry driven requirements, talent attraction

Gaps identified

Lack of company-backed apprenticeship opportunities and sponsorships

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[1] Figures estimated based on limited publicly available data from all credited and supplemental programs

Source: Ivy Tech semiconductor partnerships, Green2Gold, engineering Purdue

B6. Lorain Community College leverages apprenticeships, credited programs and corporate sponsorships to foster talent development

Institution infrastructure

- Class 10,000 cleanroom
- Lab-space
- Access to equipment and tools
- AAS credited degree offerings:
    - Microelectronics and manufacturing
- Location: Ohio

	Credited programs	Expedited programs	Supplemental programs (inc. apprenticeships)

Curriculum	• **Semiconductor Cleanroom Maintenance Technology**: 1-year technical certificate
	• **Microelectronic and manufacturing program** (**MEMS):** Job-focused educational pathway for people entering the advanced manufacturing field
		• **Fast track[1]:** Courses that last 16 weeks or shorter. Focus on electromechanical systems, microelectronics, semiconductor wafers, electronic printed circuit board (PCB) hardware
		  • Microelectronic and manufacturing
		  • Micro electromechanical systems
			• **Microelectronic and manufacturing program (MEMS):** Job-focused program that builds on micro electromechanical systems certificate
			• **SERP[3]:** Launched state-wide initiative to develop curriculum, training opportunities and build skills aligned with Ohio's semiconductor sector

ROI	• ~21 graduates[4] from expedited certificate and credited programs per year
	  • $6M in industry revenue
	  • $1M in tax revenue
		• Pathway to furthering education
		• ~100 students trained[4]
		  • $30M in industry revenue
		  • $7M in tax revenue
			• **SERP:** Advancing awareness and accessibility for students to access advanced manufacturing training

Workforce alignment	• **MEMS:** 80 fabricators in NE Ohio • Tied to the "Silicon Heartland"[2] created through Intel's investment into the mid-west	• Intel's investment into Ohio drives significant demand for "ready now" technicians, where they cannot wait for typical 2-year credited training	• **SERP:** Support from Intel, Ohio's TechNet and the SEMI foundation

Gaps identified

Longer duration fast track programs

Fast-Track requires 12-month residency prior to enrollment, barrier to entry

“”

Lorain is a standout example that connects semiconductor fundamentals to end-products. They do hands-on learning and applied projects that enable students, including K–12 participants, to build simple, chip-enabled devices

Managing Director of Economic development

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1. Must be an Ohio resident for 12 months
2. High-tech manufacturing hub
3. Ohio's Semiconductor Educator Relaunch Program
4. Figures estimated based on expert interviews and limited publicly available data

Source: Lorain mechatronics, fast track

B. Effective technician training combines program diversity, shared infrastructure, and strong industry partnerships

		Ranking[1]	
Criteria	**Description**	**High success characteristics**	**Low success characteristics**
Effectiveness	Evidence that the solution achieves its stated objectives	• Offers Quick start program • Apprenticeship opportunities • Credited AAS degree specific to industry	• No Quick Start Program • No direct apprenticeship opportunities • Limited semiconductor-specific curriculum
ROI	The estimated industry and economic impact via roles filled	• Top 1/3 of programs analyzed as it relates to graduates from Quick Start and degrees programs	• Bottom 1/3 of programs analyzed as it relates to graduates from Quick Start and degrees programs
Replicability	The degree to which the solution can be deployed beyond the organization or region where it currently exists	• Programs can be replicated without capital equipment[4] • Intersectionality with institutions and industry partners	• Programs are highly specialized and built around complex ecosystems • Lack of inter-connection between institutions and industry partners
Scalability	The likelihood that the solution can be expanded to meaningfully reduce the national semiconductor talent shortage	• >1,000 sq. ft. cleanroom with access to other instructions infrastructure via partnerships • Funding availability for continued operations	• <500 sq. ft. cleanroom • High operating cost per student • Funding constraints needed to sustain operations
Workforce alignment	The extent to which the solution increases supply for the most in-demand roles and aligns with industry requirements for skilled talent	• Geographic proximity to high talent demand areas • Regionally aligned partnerships (industry and institution) for research and placement opportunities	• Geographic mis-alignment with future developments • A lack of industry partnerships limits scalability of program

1. Rating scaled 1-3, with 3 being the most valuable

B. Technician program success combines infrastructure with broader institutional and industry partnerships to drive scalable training

3 → 1 Most to least effective programs

Institution	Effective-ness	ROI	Replica-bility	Scala-bility	Workforce alignment	Average	Rationale
Maricopa Community College	3	3	3	3	3	3	Large, multi-campus ecosystem with strong industry and institutional partnerships, enabling geographically distributed, replicable training
Austin Community College	3	3	3	2	3	2.8	Well-integrated regional ecosystem with industry and university partners, supporting scalable and replicable training aligned to local semiconductor workforce needs
Portland Community College	3	2	2	3	2	2.4	Established program with hands-on training, but constrained by aging equipment, limited faculty capacity. Weaker industry alignment with the degrease in intel's hiring needs
Lorain Community College	3	1	3	3	2	2.4	Strong regional ecosystem and industry involvement, but a required 12-month residency prior to enrollment limits scalability and reduces near-term workforce impact; limited cross-institutional partnerships
Ivy Tech Community College	2	2	2	3	2	2.2	Strong collaboration with Purdue support replicable training models, but limited apprenticeship availability and placement impact due to lack on industry partners
Hudson Valley Community College	2	1	2	3	3	2.2	Close partnership with a single anchor employer enables targeted training, but program specificity and limited diversification of industry partners constrain replicability and broader scalability

---

1. Ranking from 1-3, with 3 being the best programs available

Best-practice coordination tools & KPIs for workforce initiatives

Practical guidance to improve accountability, comparability, and scaling decisions

Purpose: Ensure public and private workforce initiatives are tracked consistently, comparable across regions, and decision-relevant – enabling NNME and partners to identify what works, what scales, and where intervention is needed

Initiative type	Recommended coordination tools	Core KPIs to track	Why this matters
Training programs (short-term, demand-linked)	• Standardized program-level outcome tracker • Employer-validated placement reporting • Quarterly cohort updates	• Participants enrolled / completed • Semiconductor job placement rate (%) • Time to placement (months) • Average cost per participant • Cost per placed hire • Employer partners engaged • 6–12 month retention rate	• Translates activity into near-term FTE supply • Enables ROI comparisons across programs and regions • Supports rapid scaling of proven models
Education programs (longer-term pipelines)	• Lightweight graduate outcomes tracker • Alumni follow-up surveys (6–24 months) • Standard definition of “semiconductor-aligned placement”	• Enrollments and completions • Share of graduates entering semiconductor roles (%) • Share entering semiconductor-adjacent roles (%) • Time from graduation to placement • Estimated cost per semiconductor-placed graduate • Employer engagement intensity (e.g., internships, capstones)	• Improves visibility into education-to-industry conversion • Allows comparison with training pathways on impact • Strengthens long-term pipeline accountability
Ecosystem sustainability & scale readiness	• Regional portfolio tracker • Pilot maturity and risk assessment template	• Funding durability (multi-year vs grant-based) • Dependence on single employer or fab • Geographic concentration vs diversification • Capacity utilization (seats filled / available) • Replication readiness	• Identifies fragile initiatives early • Flags scale-ready programs for replication • Supports resilient, nationally consistent ecosystem design

Methodology: Derive federal, state and local tax revenue generated for each incremental semiconductor engineer

Defining workforce

NAICS code 334413
US Semiconductor and related manufacturing

- **Goal:** Calculate how much tax revenue is generated when one additional full-time semiconductor manufacturing worker (FTE) is added to the economy
- **Ideology:** A single semiconductor job generates more than just that worker's wages, it triggers further direct and indirect economic activity. An economic impact analysis determines the total economic activity created from each incremental employee within the sector. From the total economic activity, the tax revenue at the local, state and federal levels can be generated
- **NAICS code:** Each industry defined using standardized NAICS[2] codes**.**

Identify direct and indirect impact

Direct impact per FTE
Labor income and production output generated by one additional semiconductor manufacturing worker

Total indirect impact
Economic activity generated through the semiconductor supply chain as a result of one additional semiconductor manufacturing FTE

- **Direct impact (non-exhaustive):**
  - An average industry wage
  - Employee benefits
  - Production output
- **Indirect impact (non-exhaustive):**
  - Suppliers
  - Utilities
  - Imports

Apply effective tax rate

Light-cast applies effective tax rates
Light-cast internally integrates tax rates using TPI, proprietor data and economic modeling to generate local, state and federal tax revenue

- **Taxes on Production and Imports (TPI):** TPI consists of state and local taxes (e.g property, licenses, sales, and product taxes) along with federal excise taxes on goods and services
- **Economic modeling:** Internal modeling of the labor market using multiple government and private sector sources
- **Proprietor data:** Utilize data from the Bureau of Economic Analysis to aggregate tax returns and personal income reports

Output

- $28.4k in local taxes
- $24.9k in state taxes
- $14.4k in federal taxes

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1. Standard Occupational Classification system used by the U.S. Bureau of Labor Statistics to categorize occupations
2. North American Industry Classification System

Source: Light-cast Input-Output Scenario, Type 2 Model, as of 1/9/2026. Estimated at national level, BLS data

Appendix contents

Gap analysis and action planning

We analyzed leading programs to **identify core components that are most critical in driving workforce outcomes**

We assessed state-level partnerships to surface relative **strengths and persistent gaps**

We translated these gaps into targeted, industry-informed **actions across key program components**

Key findings

- **Talent gaps stem from structural programmatic limitations, not program quantity:** Constraints across awareness, curriculum, infrastructure, partnerships, specialization, and outreach limit scale and job readiness
- **Late awareness narrows the engineering pipeline:** Across all regions, exposure often occurs after critical academic and career decisions, despite strong retention once engaged
- **Scalable outcomes require coordinated partnerships:** Community colleges, universities, and employers must operate as an integrated ecosystem, aligning training and job-placement pathways with industry needs
- **Hands-on experience drives job readiness and scale:** Exposure to applied training environments accelerates employees time-to-productivity and increases workforce readiness

Six program components consistently determine whether semiconductor talent pipelines scale and deliver job-ready graduates

▨ Details to follow

Industry overview

>20

Programs evaluated, training **~25,000 FTEs** annually across the 10 highest-demand states to identify the components most critical to building scalable, job-ready semiconductor talent pipelines

Top program components:

- Awareness
- Curriculum
- Outreach
- Partnerships
- Specialization
- Infrastructure

Component	Description
Awareness	• The extent to which students are exposed early in undergraduate tenure to semiconductor careers, pathways, and supplemental programs, shaping career interest and informing internship and employment decisions

Curriculum	• *Undergraduate degrees:*
	  • The degree to which semiconductor fundamentals, manufacturing concepts, and early hands-on experiences are emphasized in curriculum (electives or core curriculum)
	• *Masters:*
	  • The availability of semiconductor-specific master's degrees and associated applied research opportunities

Infrastructure	• The extent to which students have access to cleanrooms, equipment, and lab environments, enabling hands-on training and experiential learning at scale
Partnerships	• The depth and breadth of collaboration among educational institutions, employers, and industry organizations to foster the development of qualified talent to satisfy regional workforce demand
Specialization	• The degree to which programs focus on specific semiconductor technologies, research areas, or specified companies[1], shaping depth of expertise and alignment with industry needs
Outreach	• Structured engagement with K–12 and pre-college students, educators, and communities to introduce semiconductor careers, build foundational interest, and expand the future talent pipeline

---

1. Programs anchored to a limited number of industry partners, increasing their risk to face company-specific hiring volatility and cyclicality

Semiconductor talent is produced by coordinated regional partnerships, not a single program or institution

Institution and industry partner individual contribution

①

Institution

Role: Engineering development; R&D-driven hands-on experience

Undergraduate degree:

Engineering and computer science degrees deliver general problem-solving aptitude

Masters Programs:

MS in microelectronics and semiconductors

Supplemental programs:

Cleanroom exposure and research centers for hands-on experience with semiconductor specific tools and equipment

②

Community College

Role: Delivers hands-on technical and foundational training

Credited degrees:

Semiconductor specific AAS degrees

Expedited Programs (2-8 weeks):

Technician training for lab exposure (cleanroom, bunny suits, etc.) and general aptitude

Supplemental programs and apprenticeships:

Employer-backed apprenticeship opportunities

③

Industry partner[1]

Role: Talent demand signal, industry growth, association and/or employer

Investment:

Direct infrastructure investment into the region

Talent demand:

Creates demand for qualified engineering and technician talent

Ecosystem

Description	Parties involved
Employer Partnerships Employer-backed Quick Start program tailored for rapid uptake of technician skills for specified employer. Placement rates are often >90%	② ③
On the-job-training: Provide specific on-the-job training for rapid uptake in hands-on applications and environmental exposure. Employer partnership with institutions provides direct placement pipeline	① ③
Partnership: Co-develop curriculum, standardize training, share resources and expand placement opportunities to align with workforce demand	① ② ③
Upskill initiatives (helpful but not required): Pathway for upskilling from community colleges to universities	① ②

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1. Employers and associations

Example: Texas semiconductor talent is a collaborative effort between ACC, Texas A&M and Samsung, providing industry ready talent to meet demand

Institution and industry partner individual contribution

①

Texas A&M University

Role: Develop general engineering aptitude

Undergraduate degree:

Engineering and computer science degrees provide general aptitude

Masters Programs:

M.S. in Microelectronics and Semiconductor

Supplemental programs:

TSI research center developed in response to the CHIPS act to advance Semiconductor research

②

Austin Community College

Role: Develop foundational and technical expertise

Credited degrees:

Bachelors of applied technology

AAS in automation and semiconductor technology

Supplemental training (4-8 weeks):

4-week advanced manufacturing, Upskill program, STARS program[1]

Rapid training aligned to employer-defined skill requirements

③

Samsung

Role: Talent demand signal, industry growth and employer

Investment:

$19B in announced semiconductor investments into Texas

Talent demand:

High demand for qualified, work-ready technicians and engineers

Provide feedback for real time skill requirements to develop in curriculum

Ecosystem

Description

- **Employer training:** Samsung fostered program with ACC to send new engineers to a ~6-8 week-long training program to develop hands-on skills specific to Samsung
    - **Training cohorts**: ACC and Texas A&M have partnered to create pilot programs, with additional partnerships from the University of Texas, to drive and foster engineering specific training. Co-utilization of faculty and infrastructure to increase scalability and reach of program
    - **STARS and U-STARS (closed enrollment for Samsung employees):** Training manufacturing technician incumbents wanting to switch industries to semiconductor. U-STARS is for engineers that lack hands-on skills
- **Partnership:** ACC, Texas A&M, TIE[2], and Samsung to co-develop curriculum, standardize training and skill development to foster scalability and replicability

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1. Program definitions available in the deep dive pages in the appendix
2. Employer and association

National talent gaps stem less from missing programs and more from limited scale, coordination, and early exposure

Program components	Observed industry gaps	Recommendations
Awareness	Many institutions exhibit low awareness of the semiconductor industry while making decisions regarding career paths and internships	**Launch early undergraduate exposure programs:** • Encourage industry speakers and site visits to introduce students to the semiconductor industry
Curriculum	*A significant portion of undergraduate degrees lack:* • Hands-on semiconductor exposure • Semiconductor-specific coursework embedded in core curricula, but rather offered as an elective *Semiconductor specific master's degrees:* • Not offered among several institutions studied	**Embed semiconductor fundamentals into core undergraduate curricula:** • Standardize semiconductor curriculum to embed foundational concepts into core engineering coursework among early tenured students • Incorporate low-cost labs integrated into engineering degree pathways[1] **Standardize master's curriculum:** • Enable nation-wide uptake of shared master's curriculum
Partnerships	Few regions demonstrate fully aligned, region-wide partnerships that aim to foster, develop, and grow the workforce talent pool	**Formalize cross-institution and industry partnerships:** • Co-develop curricula • Share training infrastructure to increase utilization and outreach • Expand placement opportunities across multiple employers
Infrastructure	Some institutions have limited access to cleanrooms (e.g. <7,000 sq. ft.), constraining hands-on training capacity and student throughput	**Invest in cleanroom facilities:** • Develop cleanrooms of capacity, serving institutions and employers • Increase hands on training capacity by maximizing facility utilization
Specialization	Few institutions exhibit a high degree of specialization within the university (e.g. wide bandgap focused research for the DoD), limiting scalability and replicability of programs	**Broaden industry partnerships and areas of specialization:** • Ensure programs remain transferable and scalable across institutions • Align specialization areas to industry-driven, workforce needs
Outreach[2]	Many states do not have K–12 exposure to semiconductor careers; High interest once students are exposed via teaching and cleanroom tours, but many remain unenlightened to the field entering college	**Scale structured K–12 outreach programs:** • Offer cleanroom field trips, teacher training, paid high-school internships, and curriculum modules that connect semiconductors to real-world, end-product applications

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1. Labs that focus on semiconductors role within end-product lines (e.g. creating a button that lights up a ruler, labs that utilize chips and give exposure)
2. Outreach an important impact but does not immediately affect the supply of talent. Impact seen >4 years post integration, which makes it a lower tier component

Talent gaps vary widely by state, but common patterns emerge across awareness, outreach, and infrastructure (1/2)

State level analysis based on programs studied

Engineer gap, #k | Technician gap, #k ☐ Strength ■ Potential gap

Components	New York 12.6 | 10.7	Texas 14.0 | 12.4	California 13.6 | 7.7	Oregon 5.6 | 4.2
Awareness	■ Low awareness early in tenure, with focused electives reserved for junior and seniors	■ Low program awareness[1] throughout student lifecycle, limiting overall exposure	■ Growing semiconductor exposure with entry to senior level electives but still limited awareness[1]	☐ Electronical & computer engineers have semiconductor focused curriculum
Curriculum	☐ Curriculum co-developed with industry partner (e.g. GlobalFoundries)	☐ Curriculum co-developed between ACC, UT, Samsung and TIE[2]	■ Lack of semiconductor specific master's program (e.g., UC Berkeley and Stanford)	☐ Co-developed curriculum with industry partners, e.g. PCC & Intel
Outreach	☐ Cornell's K-12 initiative surpassing 3,500+ prospective student visitors	■ Limited published K-12 initiatives to foster student or teacher engagement	☐ Stanford's Nano K-14 initiative supports development for middle school teachers	■ Limited published K-12 initiatives directly focusing on middle and high school students and teachers
Partnerships	☐ Semiconductor workforce development program with RPI, HVCC and GlobalFoundries	☐ Ecosystem consisting of UT at Austin, Texas A&M, TIE[3], Samsung, and ACC	■ Institution-level partnerships, but no regionally coordinated partnership framework	☐ Frontiers of advanced semiconductor technology unites 95 regional industry partners and institutions
Specialization	■ High specialization with singular industry partner, GlobalFoundries	☐ Broad industry mix (e.g. Samsung, Intel) with diverse technical needs	☐ Strong technical differentiation and partnerships within the region	☐ Diverse industry partners across technical domains, diversifying partnerships and employer pathways
Infrastructure	☐ Cleanroom access anchored by SUNY poly, Cornell and HVCC[2]	■ Small scale cleanrooms (e.g. UT and TAMU each have <12,000 sq. ft. respectively)	☐ Significant cleanroom access led by Stanford and UC Berkeley with a combined 23,000 sq. ft.	☐ 150,000 sq. ft. facility funded by NVIDIA at Oregon State will include new cleanroom space

1. Cited via an expert interview
2. HVCC received funding from GlobalFoundries for equipment and infrastructure
3. TIE is the Texas Institute for Electronics

Talent gaps vary widely by state, but common patterns emerge across awareness, outreach, and infrastructure (2/2)

State level analysis based on programs studied

Engineer gap, #k | Technician gap, #k ☐ Strength ■ Potential gap

Components	Massachusetts 3.9 | 1.6	Arizona 5.9 | 4.2	North Carolina 2.3 | 2.3	Ohio 2.5 | 1.2
Awareness	☐ Moderate awareness (e.g. 95% of MIT undergraduates participate in research opportunities)	■ Low awareness reported early in student tenure (freshman and sophomores)[1]	■ Growing due to recent funding and DoD support, still limited among early tenured students	■ Limited reported awareness, but growing with Intel's involvement within institutions[1]
Curriculum	■ Limited semiconductor specific curriculum within master's program (e.g. MIT does not have a program)	☐ Curriculum co-developed with ACA, ASU, Intel, and Maricopa CC for wide-spread adoption	☐ Top-tier master's degree program focused on wide bandgap semiconductors	☐ Co-developed curriculum among institutions and industry (e.g. LCC, Intel, SERP)
Outreach	■ Lack of K-12 educational and engagement initiatives published	☐ Microelectronics workforce development hub provides K-12 training and outreach	■ Few published K–12 education and outreach initiatives	■ Limited K–12 engagement initiatives, constraining pipeline to meet demand
Partnerships	☐ Industry consortium including Global- Foundries, TSMC, and TI and others	☐ Integrated ecosystem across Intel, ACA, ASU, and Maricopa CC	☐ CLAWS is part of the Microelectronics Commons, with integrated curriculum and cross-partner integration	■ Midwest Microelectronics Consortium, but lacking interdependency across regional partners
Specialization	☐ Strong research programs enabling engagement across a diverse set of industry partners	☐ Diverse industry partners across technical domains, leading to multiple potential focus areas	■ High specialization within wide-bandgap semiconductors	☐ Technical diversity across defense and commercial applications within the region
Infrastructure	☐ Significant cleanroom infrastructure, (e.g. MIT ~100,000 sq. ft.)	☐ Large scale cleanroom access, anchored by ASU's 50,000 sq. ft. cleanroom	■ Limited capacity for cleanrooms (e.g. 7,500 sq. ft. lab at NCSU)	■ Limited cleanroom capacity (e.g., OSU has ~6,000 sq. ft. cleanroom)

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1. Cited via an expert interview

Catalog of future solutions: Industry-led initiatives to reduce labor shortages target core program components (1/2)

🟦 Short term levers

⬛ Long-term levers

Component addressed		Actions to reduce labor shortage	Single state example
Awareness	⬛	Ⓐ **Embed industry professionals into academic programs** to actively champion supplemental opportunities and increase student awareness of career pathways	**Arizona:** Leverage TSMC and intel engineers as guest lecturers within ASU's core engineering courses
	⬛	Ⓑ **Launch a course articulation pathway** allowing lower class students to shadow upper class semiconductor coursework to build early exposure and networks	**North Carolina:** Create pathway for underclassmen to shadow upperclassman in NCSU's wide bandgap masters program
	⬛	Ⓒ Develop **incentives for teachers to foster student engagement** within supplemental research programs (e.g. competition prizes, financial incentives, etc.)	**New York:** Offer faculty stipends, course releases, or research seed grants tied to student engagement into REU[1] programs
	⬛	Ⓓ **Create a semiconductor micro-internship program,** focusing on placing undergraduates in 2–3 week paid micro-rotations across during academic breaks	**Ohio:** Leverage broad spectrum of industry partners within SERP or MMES to provide opportunities for industry training
	⬛	Ⓔ **Fund semiconductor industry ambassadors** who focus on advocating and growing semiconductor research opportunities that are closely aligned with regional partnerships	**California:** Recruit ambassadors from KLA, and Lam Research to engage with students, hosting on-campus events and hackathons
Partnerships	⬛	Ⓐ Partner with industry to make **internships for-credit and mandatory** for select engineering degrees, ensuring consistent exposure and reducing variability in job readiness.	**North Carolina:** Coordinate with CLAWS partners to embed required industry rotations into engineering and technician degree pathway
	🟦	Ⓑ Partner with industry to **transform employer lab access into competitive, cross-institution research programs** that builds applied, job-ready engineering skills, while fostering industry-relevant curriculum	**California:** Use the Innovation Hub to convene universities and industry partners around competitive, cross-institution research challenges using real industry labs and tools
Infrastructure	🟦	Ⓐ **Leverage the regional partnerships and consortiums** to lead efforts aimed at expanding shared access to cleanroom facilities for institutions alike	**Texas:** Leverage established partnership between Texas A&M, UT and ACC to expand cleanroom access to all Texans
	⬛	Ⓑ Develop, or utilize and existing, **private economic development corporation** that facilitates the investment of private semiconductor companies into university facilities	**North Carolina:** Use CLAWS, and wide-bandgap industry stakeholders to attract investment into silicon carbide research

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1.Research experience for undergraduates (e.g. Cornell)

Catalog of future solutions: Industry-led initiatives to reduce labor shortages target core program components (2/2)

🟦 Short term levers

■ Long-term levers

Component addressed		Actions to reduce labor shortage	Single state example
Curriculum	■ Ⓐ	**Create a shared "Fab-in-a-Box"** curriculum kit co-developed by industry and institutions that include hands-on project and equipment experience and case studies	**Massachusetts:** Leverage national research and innovation hub to pilot kit
	■ Ⓑ	**Launch industry-sponsored undergraduate capstone projects** to provide hands-on experience and exposure to industry-aligned roles and placement pathways	**Arizona:** TSMC and Intel to sponsor ASU's capstone project with real-world applications
	■ Ⓒ	Introduce an **industry-sponsored "problem bank"** where companies submit real challenges that are used across coursework and supplemental research projects	**California:** Employer-submitted problems sets from leading Silicon Valley innovators
	■ Ⓓ	**Standardize a wide-bandgap semiconductor-ready skills checklist** (process flow, tool familiarity, cleanroom protocols) required for defense focused schools	**North Carolina:** Use CLAWS to standardize skill requirements
Outreach	■ Ⓐ	Partner with companies to offer **paid high school internships**, enabling students to work on real-world semiconductor projects and build early career interest	**Texas:** Paid summer internships for high schools students through Samsung
	■ Ⓑ	**Develop structured exposure initiatives for K–12 students**, including industry-sponsored cleanroom field trips, teacher training programs (e.g. Texas Taylor ISD)	**Oregon:** Host student field trips at OSU's new cleanroom (NVIDIA sponsored)
	■ Ⓒ	Integrate semiconductor specific **case studies** into national high school organizations	**Ohio:** National Honor's society, Model UN to incorporate semiconductor case studies
	■ Ⓓ	**Integrate semiconductor challenges into existing K-12 STEM competitions** (robotics, science fairs, hackathon's) rather than creating standalone programs	**North Carolina:** Integrate projects into First robotics[1]
Specialization	🟦 Ⓐ	**Form or utilize existing state-level semiconductor consortium** to coordinate industry & academic partnerships to broaden depth of industry engagement	**New York:** Leverage existing consortium to engage a broader range of employers
	🟦 Ⓑ	**Tie specialization funding** to student throughput thresholds, ensuring programs demonstrate scalable impact rather than narrow research depth alone	**North Carolina:** Link silicon carbide funding to early tenure student research placement

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[1] High school robotics club local to North Carolina

Appendix contents

We have engaged **60+** individuals from the semiconductor ecosystem to shape our answer

Focus	Method	N=	Organization participants
Demand	**Interviews**	3	GlobalFoundries KLA Keep Looking Ahead
	Focus group	10	intel Lam Research BROADCOM AMD SAMSUNG NXP TERADYNE NVIDIA
	Survey	30	BROADCOM ANALOG DEVICES RENESAS cadence Qualcomm GlobalFoundries FLUENCE A Siemens and AES Company intel NXP illuminate USA AMD saras STATSChipPAC Lam Research qorvo GlobalFoundries TERADYNE mattson technology Google MARVELL SCREEN SAMSUNG
Supply	**Interviews**	17	P UC Berkeley GT Portland Community College Austin Community College District JobsOhio TEXAS The University of Texas at Austin ASU Arizona State University ATM CENTRAL STATE UNIVERSITY ARIZONA COMMERCE AUTHORITY
	Focus group	6	P TEXAS The University of Texas at Austin GT **Current employers:** micron tsmc SAMSUNG
	Survey	25	W UNIVERSITY of WASHINGTON AU Portland Community College SCRIPPS COLLEGE Duke UNIVERSITY ATM P UC San Diego Dartmouth BUCKNELL TEXAS The University of Texas at Austin GT ASU Arizona State University Y UC Berkeley BINGHAMTON UNIVERSITY STATE UNIVERSITY OF NEW YORK

We have engaged 60+ individuals from the semiconductor ecosystem to shape our answer

Supply

Engagement	Position	Institution
Interviews (17)	Professor of Electrical and Computer Eng.	Purdue University
	Director of Semiconductor Education & Research Program	Central State University
	Program Dean (+5 program colleagues)	Portland Community College
	Dean of Advanced Manufacturing	Austin Community College
	VP of Business Development	Arizona Commerce Authority
	Former Managing Director	JobsOhio
	Technician Quick Start Graduate	Portland Community College
	Intel Process Engineer	UC Berkeley
	Samsung Product Operations Engineer	Texas A&M
	Northrup Grumman Systems Engineer	Purdue University
	Intel Process Integration Engineer	Arizona State University
	Micron Process Engineer	Georgia Tech
Focus Group (6)	TSMC Process Integration Engineer	Purdue University
	Texas Instruments Engineer	Purdue University
	Northrup Grumman Systems Engineer	Purdue University
	Micron Engineer I	Georgia Tech
	Micron Process Engineer	Georgia Tech
	Samsung Equipment Engineer	University of Texas
Survey (25)	W UNIVERSITY of WASHINGTON AU Portland Community College SCRIPPS COLLEGE Duke UNIVERSITY ATM P UC San Diego Dartmouth BUCKNELL TEXAS GT ASU Arizona State University Y UC Berkeley BINGHAMTON UNIVERSITY STATE UNIVERSITY OF NEW YORK	

Demand

Engagement	Position	Company
Interviews (3)	Board Member	GlobalFoundries
	CHRO	KLA
	VP Global Talent Acquisition	KLA
Focus Group (10)	CMP Innovation Engineer	Texas Instruments
	Former Director	NXP Semiconductors
	Engineering Manager	Intel
	Process Development Integration Eng.	Intel
	Senior Material Program Manager	Lam Research
	Commodity Manager	Teradyne
	Sr. Principal Engineer, IC Design	Broadcom
	Principal, Technical Staff	AMD
	Staff Engineer	Samsung
	Senior Engineer, ASIC Power	NVIDIA
Survey (30)	BROADCOM TI ANALOG DEVICES RENESAS cadence Qualcomm FLUENCE intel NXP TERADYNE illuminate USA mattson technology AMD saras Google STATSChipPAC MARVELL Lam qorvo GlobalFoundries SCREEN SAMSUNG	

Appendix contents

Demand survey

N=30

We launched a demand survey to understand **near- and mid-term semiconductor hiring needs and talent gaps**

We received **30 responses from industry leaders and hiring managers** across large semiconductor companies, spanning engineering and technician roles

Survey respondents note

- **Engineering shortages are the primary constraint:** 73% of employers report significant difficulty hiring engineers – far exceeding technician or CS roles
- **Pressure will intensify**: Nearly all respondents expect shortages to worsen over the next 3-5 years, with near-term hiring needs reaching hundreds of engineers per respondent
- **The core gap is applied, fab-relevant skills**: Shortfalls center on process knowledge, equipment troubleshooting, advanced packaging, and automation
- **Technician skill gaps are operational**: Hands-on readiness (equipment operation, troubleshooting, cleanroom skills) is the primary constraint as technician demand accelerates
- **Current training pathways are insufficient at scale**: 83% rate existing workforce programs as neutral or ineffective

Engineering talent shortages are the most acute, impacting multiple regions and critical parts of the value chain (1/5)

Shortages are most pronounced in engineering roles

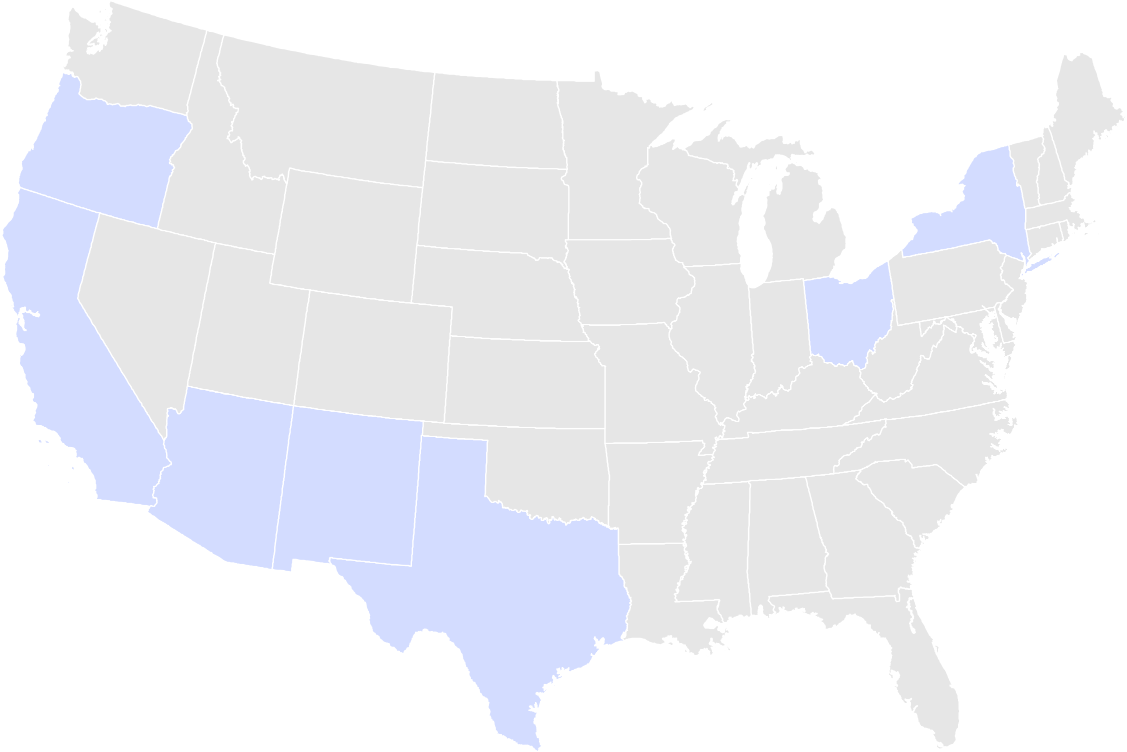
73%

of industry professionals report significant challenges to fill **engineering roles** today

(vs. 48% for technicians and 33% for computer science)

Hiring challenges are driven by:
- Limited supply
- Compensation pressure
- Experience gaps

States most frequently identified as facing the greatest hiring challenges



States most often cited
1. Arizona
2. California
3. Texas
4. New York
5. Oregon

Survey N=30

Engineering talent shortages are expected to worsen, while the current talent pool already exhibits applied skill gaps (2/5)

Talent shortages expected to worsen

93%

of industry professionals expect moderate to severe talent shortages in the next 3-5 years

Respondents report **individual hiring needs as high as 250+ FTE** over the next 12-24 months

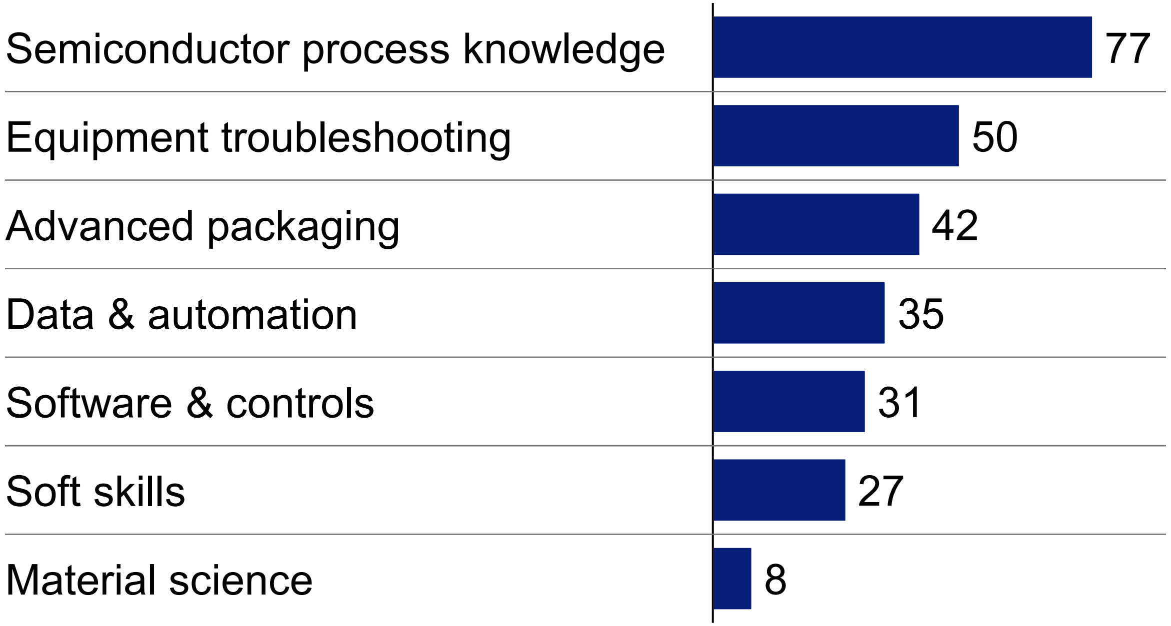
Top roles in the next 12-24 months[2]

- Design engineers
- Process engineers
- Field service engineers
- Packaging & Assembly engineers
- Integration & yield engineers

Current talent pool exhibits applied skill gaps

43% Cited severe skill gaps within current the talent pool

Top talent gaps[1], % of respondents



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1. Represents the percentage of respondents selecting the action as one of three main talent gaps

Survey N=30

Technician talent shortages are expected to worsen, while the current technician workforce exhibits significant applied skill gaps (3/5)

Talent shortages expected to worsen

64%

of industry professionals expect moderate to severe talent shortages in the next 3-5 years

Majority of respondents report **individual hiring needs up to** **50 FTE** over the next 12-24 months

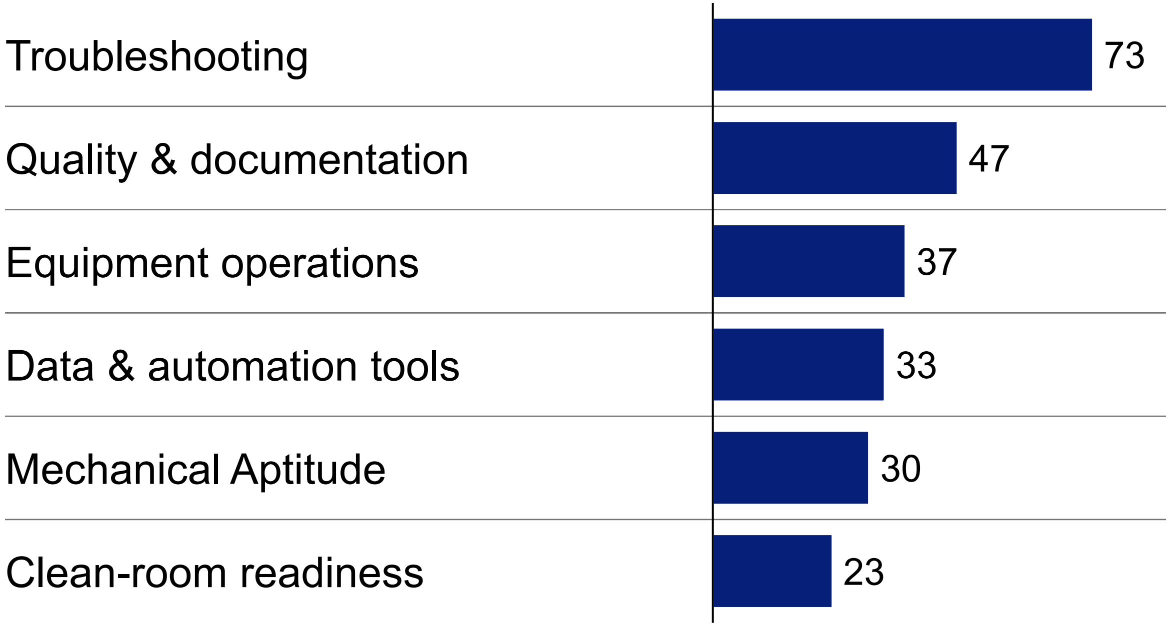
Top roles in the next 12-24 months

- Technicians
- Metrology technicians

Current talent pool exhibits applied skill gaps

38% Cite severe skill gaps within the current talent pool

Top talent gaps[1], % of respondents



Troubleshooting	73
Quality & documentation	47
Equipment operations	37
Data & automation tools	33
Mechanical Aptitude	30
Clean-room readiness	23

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1. Represents the percentage of respondents selecting the action as one of three main talent gaps

Survey N=30

Current workforce development programs are not consistently producing job-ready semiconductor talent at scale (4/5)

Employers report limited effectiveness of existing workforce development programs

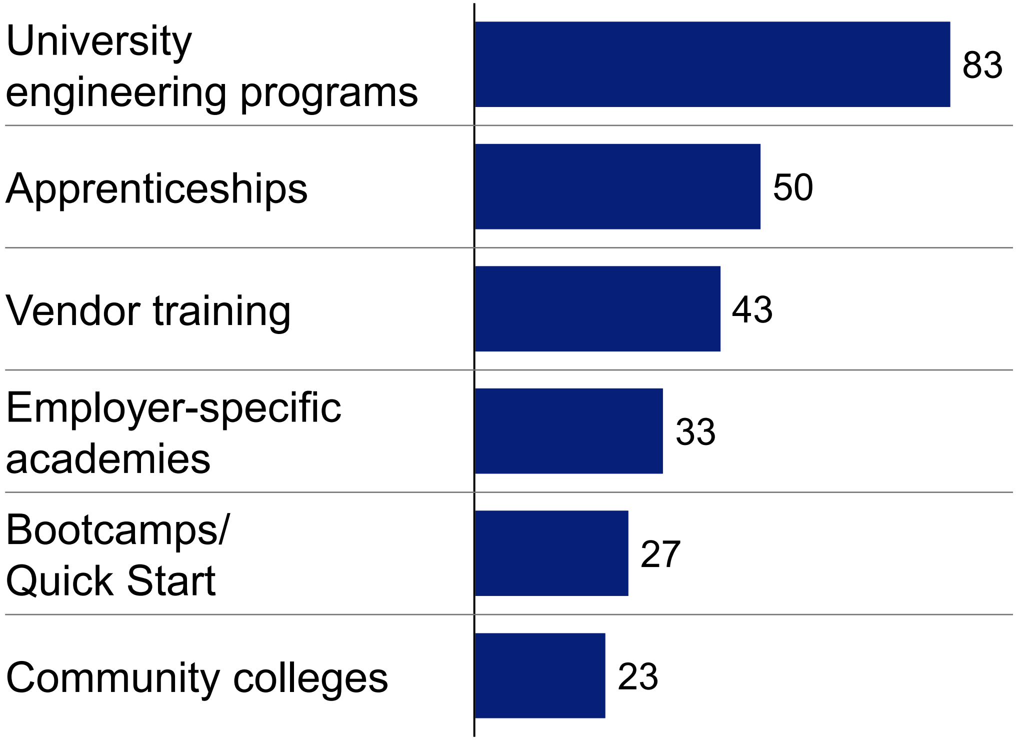
83%

of industry professionals rate existing programs as neutral or ineffective[1] in developing workforce skills[2]

Scaling existing programs alone is unlikely to close talent gaps

Some industry leaders emphasize prioritizing foundational problem-solving skills and industry exposure, with role-specific technical skills developed on the job

Relative usefulness of existing programs (despite overall low effectiveness), % respondents



Actions employers believe would help close talent gaps

- Stronger employer-training partnerships
- Hands-on training
- Compensation adjustments
- Regional training hubs

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1. Respondents answered on a scale of 1 through 5, where 1 is ineffective, 3 is neutral and 5 is very effective
2. No respondents rated development programs as extremely effective (respondents reporting a 5)

Survey N=30

Automation and AI are accelerating shifts in semiconductor workforce demand (5/5)

🟦 Details to follow

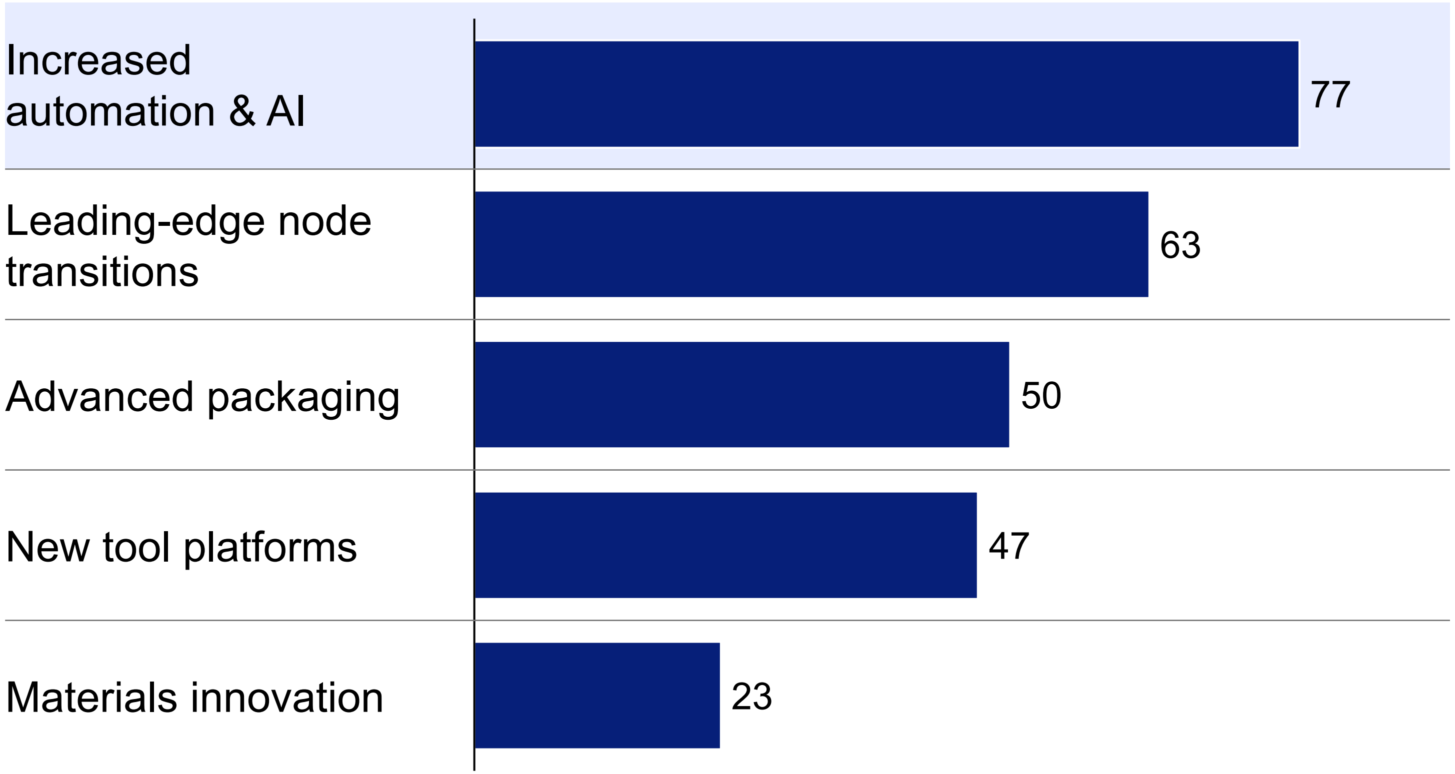
Employers report shifts in technology are having significant impacts on workforce needs

67%

of industry professionals believe technology changes have a significant impact on future hiring needs

These shifts are not only increasing demand, but also accelerating changes in the skill mix required across semiconductor roles

Technologic shifts most influencing future workforce needs, % of respondents



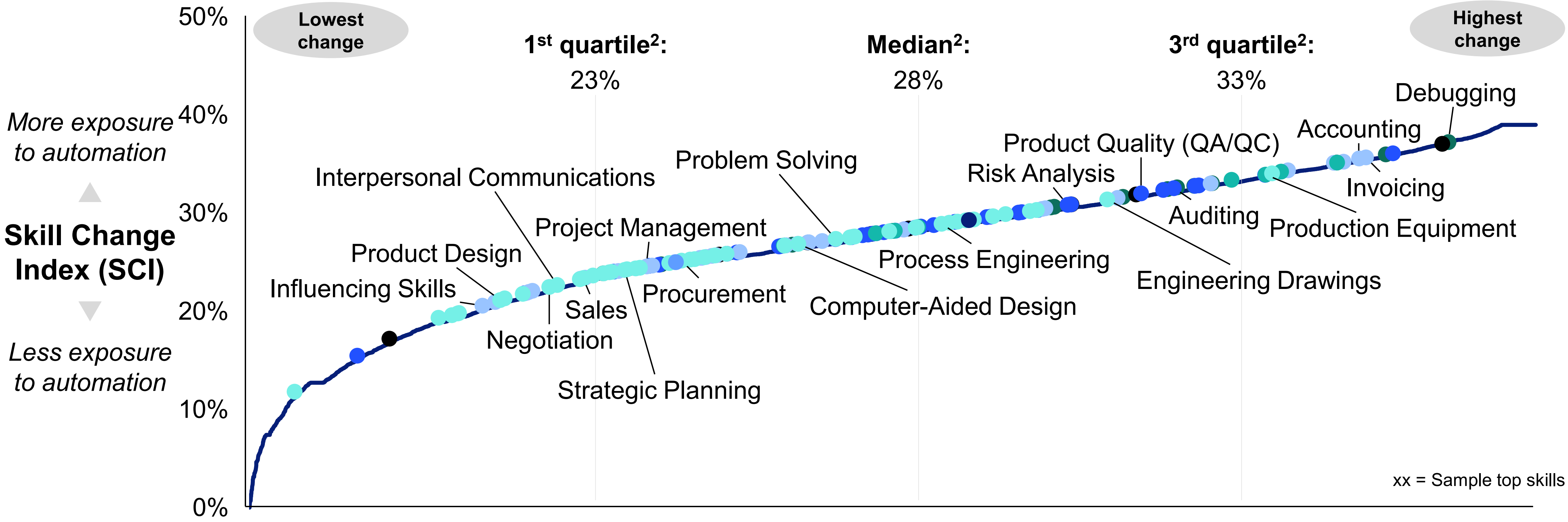
Survey N=30

Automation is reshaping skill requirements across semiconductor roles, driving the greatest change in digital, analytical, and systems-oriented skills by 2030

Skill categories: ● Communication, collaboration and creativity ● Management skills ● Information skills ● Digital skills ● Assisting and caring ● Handling and moving ● Working with machinery ● Constructing

Skill Change Index (SCI) distribution[1] across 6,800 skills

● Top skills relevant to sector — All skills in US workforce



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1. Based on projected 2030 midpoint scenario of automation adoption of activities associated with skills, aggregated across occupations using employment-based weighting
2. Based on around 6.8k skills. We excluded skills that could not be linked to detailed work activities within occupations

Source: Lightcast, U.S. Bureau of Labor Statistics, McKinsey Global Institute analysis

Appendix contents

Supply survey

N=25

We launched a supply survey to understand **student experiences, program effectiveness, accessibility gaps, and early career trajectories** across semiconductor education pathways

We received **25 responses from engineering and technician graduates** from university and community college programs (e.g., degree programs, quick-start pathways)

Survey respondents note

- **The talent gap starts before enrollment:** 83% of respondents had little to no familiarity with semiconductor careers prior to entering their program
- **Programs build fundamentals, not job-ready specialization:** 79% of respondents report feeling moderately prepared, while only a small share feel fully job-ready; applied fab-specific skills are developed post-hire
- **Employers expect on-the-job skill completion:** Most respondents indicate troubleshooting, automation, documentation, and process knowledge are learned after entry
- **Retention is strong once talent enters the industry:** 71% of respondents report a high likelihood of remaining in semiconductors over the next 3–5 years
- **Engineering talent is geographically mobile:** 86% of engineering respondents report willingness to relocate

The semiconductor talent gap begins before enrollment, driven by weak early awareness rather than lack of interest in STEM (1/5)

Prior to enrollment, most students report limited exposure to semiconductor careers

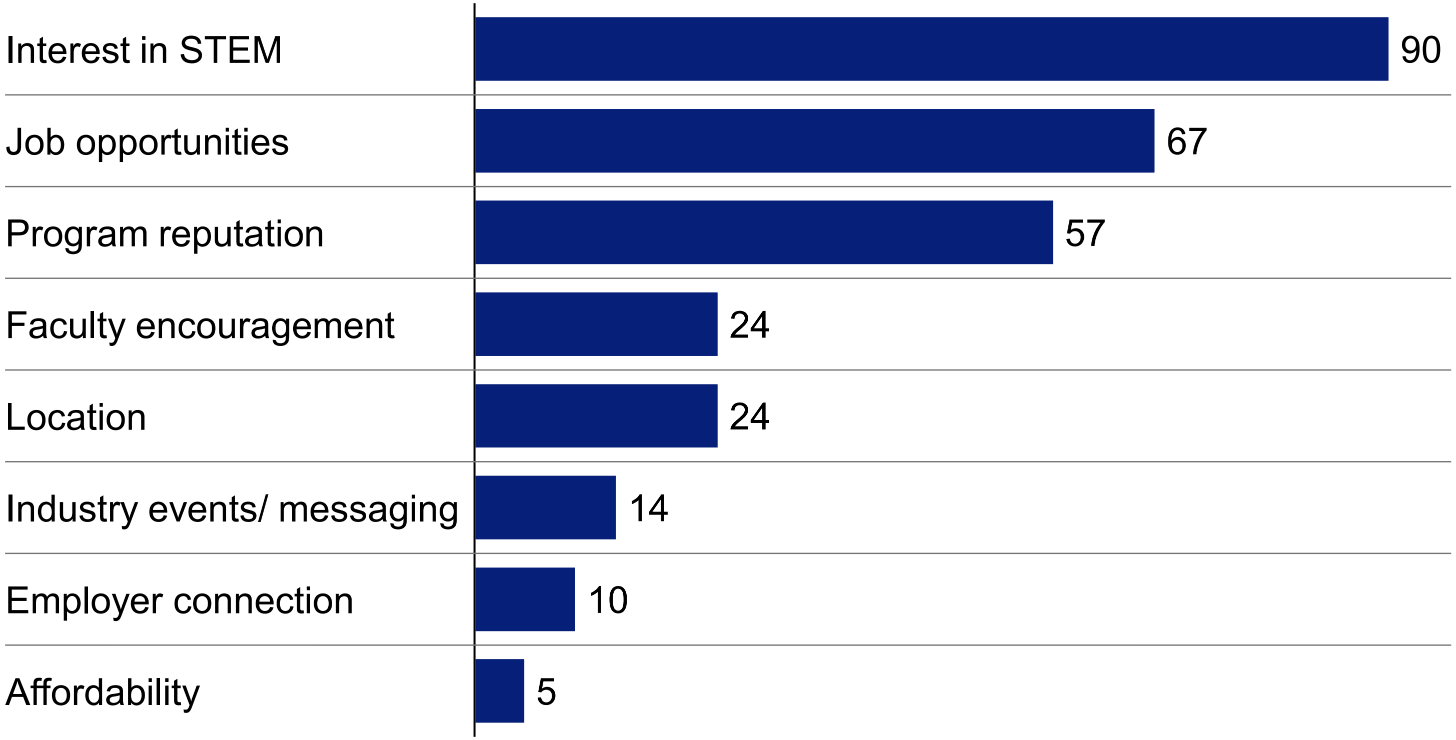
83%

of industry professionals had little to no familiarity[1] with the industry prior to enrollment into specified programs

Primary fields of study for respondents:

- Electrical engineering
- Mechanical engineering
- Computer science

Most influential factors to pursue semiconductor programs,
% respondents[2]



1.Respondents reporting a 1 or a 2 (on a scale from 1 to 5)
2. Each respondents chose three factors

Survey N=25

Programs reliably produce strong problem-solvers, but applied, proprietary skills are learned post-hire (2/5)

Foundational skills are developed in programs; proprietary skills are built on the job

79%

Of respondents reported feeling moderately prepared[1] to enter a semiconductor role after graduation

- Only two respondents felt extremely prepared[2]

Program elements students value most:

- Hands-on labs
- Semiconductor-specific curriculum
- Faculty expertise

Program gaps limiting students' job-ready confidence

- Exposure to industry tools and software
- Process and equipment fundamentals
- Data and automation skills
- Cleanroom readiness

Capabilities most often developed post-hire:

- Troubleshooting
- Data and automation skills
- Documentation & quality processes
- Semiconductor process

What we heard

Universities do a good job teaching fundamentals, but the reality is that most of our tools and systems are proprietary. You can't fully train on them in school, people really learn once they're inside the fab

Engineering Manager

1.Respondents who answered 3 or 4, on a scale of 1-5
2.Responding 5

Survey N=25

Programs build confidence through fundamentals, while employers expect to complete applied training post-hire (3/5)

Confidence is built in programs

Students (Self-assessment)

88%

Of respondents reported being moderately to extremely prepared[1] to enter a semiconductor role after program graduation

Applied readiness is completed on-the- job

Industry professionals (Program effectiveness)

83%

of industry professionals rate existing programs as neutral or ineffective[1] in developing workforce skills[2]

Key takeaways

- **Education programs successfully build foundational problem-solving skills**, giving graduates confidence to enter the semiconductor workforce
- **Employers expect role-specific and proprietary skills to be developed on the job**, shaping how graduates transition into full productivity

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1. Respondents who answered 3, 4, or 5 on a scale of 1-5

Survey: N=25 for the supply survey and N=30 for the demand survey

High retention means workforce growth depends primarily on awareness, entry, and early conversion, not downstream fixes (4/5)

Intrinsic industry factors drive retention; external constraints drive attrition

71%

of industry professionals reported a high[1] likelihood of staying within the industry in the next 3-5 years

Primary drivers for retention

- Interest in technology
- Compensation
- Career growth
- Job stability

Top reasons to leave the industry

- Workload and stress
- Location
- Culture issue
- Limited advancement opportunities
- Compensation

Retention is strong once talent enters the industry – making early awareness and entry the primary levers for long-term workforce growth

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[1] Respondents who answered 4 or 5, on a scale of 1-5

Survey N=25

Engineering talent is geographically mobile, making relocation incentives a viable lever to address regional workforce gaps (5/5)

Engineer mobility enables targeted regional workforce strategies

86%

Of engineering respondents reported a moderate to high likelihood of relocating to a different region within the next 3-5 years

Key factors influencing engineers' willingness to relocate to high-need regions

- Higher compensation or financial incentives
- Clear career advancement opportunities
- Quality of life (schools, healthcare, safety, amenities)
- Proximity to family or personal ties

What we heard

Coming straight out of college, Idaho wasn't an obvious first choice. But after being here a few years, I can definitely see myself staying. I'm really excited about the growth of the company and the chance to work with cutting edge technology. At the end of the day, that was really the deciding factor

Recent Engineering graduate

Survey N=25

McKinsey
& Company

NSF

DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA

SEMI
FOUNDATION

NNME
NATIONAL NETWORK FOR MICROELECTRONICS EDUCATION