Semiconductor Coalition Factsheet

In draft form, not for public audiences.

Job Quality

- The White House 100-Day report on resilient supply chains cites a very high average salary for the semiconductor workforce ($163,871 on average in 2019)[1]. However, this figure is inflated by professional and management salaries that obscure the lower wages earned by frontline production workers. The production workforce earns salaries closer to the median for other manufacturing jobs.
    - According to SEMI, a global trade association, common manufacturing titles such as Production Worker/Material Handler and Semiconductor Processing Technician have salary ranges of $21,700 to $45,180 and $28,320 to $70,320, respectively.[2]
    - The Bureau of Labor Statistics shows similar median salaries for production workers. Occupational Employment and Wage Statistics (OEWS) survey data from May 2021 found the median production wage to be $18.01 per hour or $37,460 annually, about the same as the national average for production workers in all industries of $18.13 per hour or $37,710.[3]

Racial Inequity

- An analysis of seven semiconductor manufacturing firms' Form EEO-1 reports suggests the semiconductor workforce has approximately the following demographic makeup:[4]

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[1] Building Resilient Supply Chains, Revitalizing American Manufacturing, And Fostering Broad-Based Growth. 100-Day Reviews under Executive Order 14017. June 2021.https://www.whitehouse.gov/wp-content/uploads/2021/06/100-day-supply-chain-review-report.pdf

[2] SEMI. https://careers.semi.org/career-explorer?job-category=7

[3] Bureau of Labor Statistics, Occupational Employment and Wage Statistics (OEWS) survey, May 2021. https://www.bls.gov/oes/current/oes_nat.htm

[4] Race and Gender data were provided by the companies' Form EEO-1 reports that were voluntarily disclosed by each company and are publicly available online. Our analysis combines the reports of: Analog Devices, Broadcom, Intel, Microchip, Micron Technology, Qorvo, Skyworks, and Texas Instruments. We also analyzed forms from seven companies that have some fabrication of semiconductors in the United States. The forms were all recent and the data primarily includes year-end 2021 and 2020 workforce demographics. The data presented in the publicly available EEO-1 forms capture the race and gender of 106,060 U.S. workers in the semiconductor industry. According to the Semiconductor Industry Association, there were 277,000 direct workers in the industry in 2022. The data available for analysis may be biased due to the factory locations of the companies that made their data publicly available.

    - Hispanic and Black workers are underrepresented at 7.9% and 4.9% of the industry workforce in comparison to the general population (18.9% and 13.6%, respectively).
        - Hispanic and Black workers are more concentrated in “blue collar” occupations, comprising 15.1% and 9.1% of that workforce, respectively.
        - There is severe underrepresentation of Hispanic and Black people in upper management, with each group comprising just 1.8% of the industry’s executives.
    - Women are underrepresented in the semiconductor workforce (24.1%). White collar occupational groups have a higher share of women (25.5%) compared to the Blue collar occupational groups (20.9%).
        - Only 14.5% of the industry’s executives are women.
- A 1992 report on the demographics of the high tech manufacturing workforce showed that in 1990, the semiconductor and electronics industries employed more women than they do today and actually employed a somewhat more representative number of Black and Hispanic workers in 1990 compared to today.[5]
    - In 1990, 38% of the industry’s workforce were women.
    - The workforce was 8.2% Hispanic and 5.5% Black, relative to the US population, which was 9% Hispanic and 12.1% Black.
        - Relative to the total population, Hispanic workers were at a 9% deficit in 1992 and are at a 62% deficit today.
        - Relative to the total population, Black workers were at a 64% deficit in 1992 and are at a 74% deficit today.
- In the early 1970s, workers began to form organizing committees affiliated to the United Electrical Workers (UE) at Silicon Valley semiconductor companies–National Semiconductor (later acquired by Texas Instruments), Siltec, Fairchild (later acquired by Onsemi), Siliconix (later acquired by Vishay Technologies), Semimetals, Signetics (later acquired by Philips), Intel, AMD and others. The UE asked the Department of Labor for the workforce demographic information the companies file as recipients of Federal contracts. They sought to document systematic discrimination and racial, national and sex segregation practiced by the firms. The Office of Federal Contract Compliance Programs refused to disclose the information, saying that the companies considered demographic breakdowns of their workforce a trade secret. In recent years, under public and shareholder pressure to show commitments to diversity, some companies have finally begun to voluntarily disclose this information.[6]

Union Busting

[5] Siegel, Lenny. “Analysis of High-Tech Employment Patterns in Eight Leading US High-Tech Centers” Pacific Studies Center. September 1992.
[6] Bacon, David. “Roots of Social Justice Organizing in Silicon Valley” *Reimagine*. https://www.reimaginerpe.org/20-2/bacon-Valley-social-justice-organizing

- From its inception, leaders of the semiconductor industry have made their anti-union stance well known. Robert Noyce, co-founder of Intel, once said “remaining non-union is essential for survival for most of our companies. If we had the work rules that unionized companies have, we’d all go out of business.”[7]
- Decades later in a 2016 interview with Commonwealth Magazine, current TSMC Chairman Morris Chang described his experience in the 1970s as head of global semiconductors for Texas Instruments, saying “the American high-tech sector decided then that it would not allow unions.” Later adding, “good companies should be able to request that workers not form unions.”[8]
- TSMC has maintained its anti-union position to present day, demonstrating “zero interest in doing business” even with construction-phase-only unions in Arizona where the company is currently building two new fabs in Phoenix. Instead, TSMC has opted to hire out-of-state workers at subpar wages.[9]
- During Chang’s time at Texas Instruments, the company illegally fired 6 workers[10] in Attleboro, MA for distributing leaflets with wage information as part of a union organizing campaign.
- In the 1970s and 1980s, targeting and firing workers who were publicly supportive of unionization efforts was common practice in the industry, as was surveilling workers’ activities to detect any potential organizing efforts.
- In his 1993 report *Silicon Fist in a Velvet Glove*, former UE organizer Michael Eisenscher outlines some of the industry’s ‘union avoidance’ strategies:
    - “During the industry's early development these firms developed sophisticated systems for screening new hires, designing benefit programs to compete with those negotiated by unions, establishing in-house systems for employee complaint resolution, and taking vigorous and immediate action at the first sign of worker organization. They were aided by industry trade organizations like the AEA and its predecessor, the Western Electronics Manufacturers Association (WEMA), which provided union-avoidance training, exchanged intelligence between firms, and is believed to have funneled mutual aid to smaller firms targeted by unions.”[11]
- David Bacon, a worker at National Semiconductor (later acquired by Texas Instruments) in the ‘70s and ‘80s who was fired for his organizing activity, described how HR departments were tasked with “identifying sources of problems and trying to

[7] Hyde, A. (2003). In Working in Silicon Valley: Economic and legal analysis of a high-velocity labor market (p. 155), M.E. Sharpe.
[8] Chen, Liang-rong. “Exclusive Interview with Morris Chang, One Key to Success – No Unions” *Commonwealth Magazine.* 10/28/2016. https://english.cw.com.tw/article/article.action?id=15
[9] Harris, Lee. “‘Zero Interest in Doing Business’: TSMC Snubs Phoenix Construction Workers” *The American Prospect*. 04/07/2023. https://prospect.org/labor/2023-04-07-based-tsmc-snubs-phoenix-construction/
[10] NLRB Case No. 1-CA-13191
[11] Eisenscher, Michael. “Silicon Fist in a Velvet Glove” Unpublished manuscript. 1993

eliminate them as quickly as possible...They studied us, they identified possible trouble makers, they looked for what and who workers were connected to, and these companies shared information. When I was fired [for organizing], they black listed me. We had a committee member at AMD and she told me my name came up on the list when I tried to get a job there."

- Despite the rapid growth of its workforce, the tech sector remains one of the least unionized major industries in the country.[12] Union density rates in the computer manufacturing and electronics manufacturing industries are both less than 1%.[13]

Environmental & Workplace Health Hazards

- Semiconductor fabrication is a chemical intensive process with very little regulatory oversight in the U.S. or globally. The exact chemicals companies use throughout the fabrication process are often treated as a trade secret, leaving workers in the dark about what toxics they are being exposed to and the long-term health effects of said exposure.
- An analysis of 81 of the most commonly used chemicals in the larger electronics manufacturing industry, of which semiconductors are a part, found that:[14]
    - 30 are recognized as carcinogens (cause cancer)
    - 40 are recognized as mutagens (cause mutations)
    - 45 are recognized as reproductive toxins (cause birth defects)
- Standards for exposure to toxic chemicals at work, known as permissible exposure limits (PELs), are few and far between, weakly enforced, and woefully inadequate at protecting workers from serious adverse health effects in the United States.[15]
    - The federal Occupational Safety and Health Administration (OSHA) acknowledges many of its PELs for toxic chemicals in the workplace are outdated and inadequate for ensuring protection of worker health and have not been updated in over 50 years. Former agency head David Michaels estimates 90% of OSHA's PELs date to industry standards of the 1960s and are not safe.
    - Penalties for breaching these inadequate workplace standards are minimal. OSHA's maximum penalty for a serious violation is merely $15,625 per violation.

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[12] Harnett, Sam. "Tech Workers Organizing Is Nothing New ... But Them Actually Forming Unions Is" *KQED.* 06/02/2021. https://www.kqed.org/news/11874325/tech-worker-organizing-is-nothing-new-but-actually-forming-unions-is

[13] http://unionstats.com/ . CIC Codes 3365 and 3390.

[14] This data was originally developed by researchers at Northwestern University, later augmented by researchers at Greenpeace International, and then incorporated into the PHAROS Project.

[15] Taube, Ruth Silver. "Silver Taube: OSHA's limits for toxic exposure cause preventable harm to Silicon Valley workers" San Jose Spotlight. 5/11/2023. https://sanjosespotlight.com/silver-taube-oshas-limits-for-toxic-exposure-cause-preventable-harm-to-silicon-valley-workers/

    - Additionally, OSHA has assigned PELs for less than 500 chemicals in total, while there are tens of thousands of chemicals workers could be exposed to.
- The disparity between what regulatory bodies consider “permissible” and what the biomedical literature says regarding exposure limits is vast and causes serious presentable harm. For example, the California Division of Occupational Safety and Health allows 100 parts per million for exposure to Ethylbenzene (a common chemical used in the semiconductor industry),[16] although the biomedical literature detected serious adverse health effects at 0.06 parts per million,[17] more than 1,660 times less than the legally allowable exposure.
- Standards for exposure to toxic chemicals at work are also much weaker than standards for environmental exposure to these same toxics in the community,[18] leaving those most vulnerable to high exposure the least protected.
- Silicon Valley, the birthplace of the semiconductor industry, has more EPA Superfund hazardous waste sites than any other place in the United States, mostly related to the mismanagement of chemical wastes from the electronics industry. Intel was listed on 3 such sites.[19]
- Even after many of the U.S. semiconductor fabs were closed and offshored to mostly Asian countries in the 1990s, some of the chemicals that were phased out in the U.S. and known to be health hazards continued to be used in South Korean fabs (despite companies saying they changed the formulations everywhere), exposing Korean workers to dangerous chemicals. Contemporary studies of women who work in the semiconductor industry in South Korea found elevated rates of miscarriage and cancer.[20]
    - Korean studies found that the fabs used about 430 different chemical products each. These included more than 130 deemed to be dangerous enough that employees exposed to them must undergo special health checks; those chemicals are called CMR agents—shorthand for carcinogens, mutagens, and reproductive toxins. In addition to benzene and ethylene

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[16]IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 77. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. *National Library of Medicine.* https://www.ncbi.nlm.nih.gov/books/NBK390915/

[17] Taube, Ruth Silver. “Silver Taube: OSHA’s limits for toxic exposure cause preventable harm to Silicon Valley workers” *San Jose Spotlight.* 5/11/2023. https://sanjosespotlight.com/silver-taube-oshas-limits-for-toxic-exposure-cause-preventable-harm-to-silicon-valley-workers/

[18] Taube, Ruth Silver. “Silver Taube: OSHA’s limits for toxic exposure cause preventable harm to Silicon Valley workers” *San Jose Spotlight.* 5/11/2023. https://sanjosespotlight.com/silver-taube-oshas-limits-for-toxic-exposure-cause-preventable-harm-to-silicon-valley-workers/

[19] CERCLA EPA superfund data and Schlossberg, Tatiana. “Silicon Valley Is One of the Most Polluted Places in the Country” *The Atlantic*. 9/22/2019. https://www.theatlantic.com/technology/archive/2019/09/silicon-valley-full-superfund-sites/598531/

[20] Simpson Cam. “American Chipmakers Had a Toxic Problem. Then They Outsourced It” *Bloomberg.* 6/15/2017. https://www.bloomberg.com/news/features/2017-06-15/american-chipmakers-had-a-toxic-problem-so-they-outsourced-it

glycol ethers (EGEs), they've historically included arsenic, hydrofluoric acid, and trichloroethylene.
    - Samsung and other semiconductor companies will not release the specific chemicals that workers have to handle on the job, claiming the information is proprietary. This makes it incredibly difficult for workers to know which chemicals they are personally exposed to and assess how dangerous their job is.[21]
- A 1992 paper compiled the various health consequences to semiconductor manufacturing based on data from electronics manufacturing in the United States in the 1980s.[22]
    - "The systemic poisoning rate for electronics workers is consistently greater than other manufacturing industry workers, and semiconductor workers have the highest rates among electronics workers. Whereas the manufacturing industry rate never exceeds 20 percent of occupational illnesses resulting from a hazardous chemical exposure, the figure can approach 40 percent for electronics workers and exceed 40 percent for semiconductor workers."
        - The paper also noted the increased risk of miscarriage for women. Several studies have found the risk was twice that of women who did not work in semiconductor manufacturing.
- Despite industry efforts to brand itself as "green", semiconductor manufacturing is both a water and energy intensive process.
    - Semiconductor manufacturing is projected to consume 237 terawatt hours (TWh) of electricity globally by 2030, roughly equivalent to Australia's 2021 electricity consumption.
    - By 2030, Samsung Electronics' emissions from semiconductor manufacturing alone will exceed 32 million tonnes of CO2e per year, higher than Denmark's total emissions in 2021.
    - Producing advanced 2nm microchips requires more than twice as much water and three times as much electricity as 28nm chips. Carbon emissions have also more than doubled for making the most advanced chips.[23]

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[21] Tremonti, Anna Maria; Bartlett, Sandra. "'Let me die with my mother': Samsung to compensate sick workers, but many will never recover" *CBC Radio.* 1/29/2019. https://www.cbc.ca/radio/thecurrent/the-current-for-january-29-2019-1.4995965/jan-29-2019-episode-transcript-1.4997818

[22] LaDou J: Health Issues in the Global Semiconductor Industry. Annals Academy of Medicine, Singapore, 23(5):765-769, 1994. https://icrt.co/wp-content/uploads/2020/10/HEALTH-ISSUES-IN-THE-GLOBAL-SEMICONDUCTOR-INDUSTRY.pd f

[23] Garcia Bardon, Marie; Parvais, Bertrand. "The Environmental Footprint of Logic CMOS Technologies" EETimes. 12/14/2020. https://www.eetimes.com/the-environmental-footprint-of-logic-cmos-technologies/

    - In 2019, company disclosures showed that Intel consumed three times as much water as Ford Motor Company and produced twice as much hazardous waste.[24]
    - A 2020 paper by researchers at Apple and Harvard University found that information and computing technology is expected to account for as much as 20% of global energy demand by 2030, with hardware responsible for more of that footprint than the operation of a system. Chip manufacturing, as opposed to hardware use and energy consumption, accounts for most of the carbon output.[25]
    - TSMC has the biggest carbon footprint in the semiconductor industry.[26] The company accounts for approximately 5% of Taiwan's total national energy consumption (greater than the city of Taipei)[27] and the figure is set to rise to 7.2% in 2022, according to Greenpeace.[28]
    - Samsung is the second biggest carbon emitter in the semiconductor industry, emitting nearly 13 million tons of CO2 equivalents in 2020.[29]
- Semiconductor manufacturing is a water intensive process. Most chemical processes require Ultrapure Water (UPW), which is thousands of times purer than drinking water. It takes roughly 1,400 to 1,600 gallons of municipal water to make 1,000 gallons of UPW, with fabs using up to 5 million gallons daily.[30] The fabs' water use is concerning since it could compete with the needs of local residents, agriculture, and other industries. The semiconductor industry has responded by adopting new technologies to recycle and return wastewater to drinking water standards.[31] However, the industry still relies on massive water consumption, often in the most drought stricken parts of the country, particularly in Arizona and other parts of the Southwest Intel's new fab in Rio Rancho New Mexico used so much water that

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[24] Crawford, Alan; King, Ian; Wu, Debby. "The Chip Industry Has a Problem With Its Giant Carbon Footprint" *Bloomberg*. 4/8/2021. https://www.bloomberg.com/news/articles/2021-04-08/the-chip-industry-has-a-problem-with-its-giant-carbon-footprint#xj4y7vzkg

[25] Udit, Gupta; Young Geun Kim; Sylvia Lee; Jordan, Tse; Hsien-Hsin S. Lee; Gu-Yeon Wei; David Brooks; Carole-Jean Wu. "Chasing Carbon: The Elusive Environmental Footprint of Computing" Harvard University. 10/28/2020. https://arxiv.org/pdf/2011.02839.pdf

[26] https://www.cnbc.com/2021/11/03/tsmc-samsung-and-intel-have-a-huge-carbon-footprint.html

[27] Tsai, Alynne. "TSMC's push toward green energy" *Taipei Times*. 07/17/2020. https://www.taipeitimes.com/News/editorials/archives/2020/07/17/2003740051

[28] Shead, Sam. "The global chip industry has a colossal problem with carbon emissions" *CNBC*. 11/3/2021. https://www.cnbc.com/2021/11/03/tsmc-samsung-and-intel-have-a-huge-carbon-footprint.html

[29] Shead, Sam. "The global chip industry has a colossal problem with carbon emissions" *CNBC*. 11/3/2021. https://www.cnbc.com/2021/11/03/tsmc-samsung-and-intel-have-a-huge-carbon-footprint.html

[30] Govindan, Prakash. "Water's Critical Role in Semiconductor Manufacturing" *Industry Today*. 1/18/2022. https://industrytoday.com/waters-critical-role-in-semiconductor-manufacturing/

[31] Calma, Justine. "Water shortages loom over future semiconductor fabs in Arizona" *The Verge*. 8/18/2021. https://www.theverge.com/22628925/water-semiconductor-shortage-arizona-drought

it prompted fierce fights with local farmers over water rights.[32] Droughts have already been a problem for chip manufacturers in Taiwan.[33]

[32] Southwest Organizing Project. “Intel Inside New Mexico: A Case Study of Environmental Economic Injustice” 1995

[33] Yang, Stephanie. “The Chip Shortage Is Bad. Taiwan’s Drought Threatens to Make It Worse.” *Wall Street Journal.* 4/16/2021. https://www.wsj.com/articles/the-chip-shortage-is-bad-taiwans-drought-threatens-to-make-it-worse-11618565400