SAFE JOBS HEALTHY FAMILIES

PREPARED BY

Grecia Reséndez

Consultant at Safe Jobs Healthy Families
MPA '22 Candidate, Goldman School of Public Policy
University of California, Berkeley

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EXECUTIVE SUMMARY

Since the late 1960s, the electronics industry has been recruiting cannery and agricultural workers into, what they advertised as, the "clean industry". In reality, manufacturing parts in the electronics industry came at a great cost as workers were being exposed to toxins that were detrimental to their well-being. Pregnant employees were extremely susceptible as many of these chemicals were neurotoxins that caused developmental disorders in their off-springs as well as miscarriages. New regulations have helped reduce the amount of toxins employees are exposed to but this does not undo the damages placed upon these workers, their children, and the surrounding communities. The electronics industry chose to put profit over people and as a result, many workers suffered preventable miscarriages or have children in special education programs; some of these children will need care for the rest of their life. County governments have absorbed the negative externalities of these industries by funding health programs and special education programs and in doing so, have set a bad precedent for future industries.

With the support of Safe Jobs Healthy Families in this report, I, outline the correlation between working around certain chemicals in the electronics industry and neurological damage to fetuses. Additionally, I make the case that preventing employee exploitation requires companies to be held financially accountable. In this case, the electronics industry should be held financially accountable for the expenses incurred by current and previous electronics workers and for the children who are in special education programs as a result of exposure to said toxins.

HISTORICAL CONTEXT

During the late 1960s, the electronics industry[1] boomed in Silicon Valley, and to fill the demand companies sought out workers, many of whom were women of childbearing age, economically disadvantaged, and a large part were Latinos, Philipinos, and Vietnamese. Working in this industry required precision and extremely clean conditions because the smallest speck of dust could compromise the quality of an electronics piece, such as a wafer[2], a crucial component for electronics pieces. This meant that air circulation and air purification were imperative to keep dust at 100 times lower than that of hospital standards[3]. Additionally, many employees wore shoe covers, hairnets, and gowns. These manufacturing standards, which were used to protect the products being manufactured, gave the illusion that this was a "clean industry": something the electronics industry advertised itself as. In reality, this industry was exposing its employees to many harmful chemicals, some of which are listed below, with minimal to no personal protective equipment[4].

- Manganese
- Mercury & inorganic mercury compounds
- Methanol
- Methylene chloride
- Styrene
- Trichloroethylene
- Toluene
- Xylenes
- Lead

Exposure to the chemicals listed above impacts the nervous system, cardiovascular, development, and kidney function[5]. However, the impacts of these chemicals go

[1] For the purposes of this report, the electronics industry that will be discussed is related to the manufacturing of electronics materials. Henceforward the electronics industry will refer to jobs under the Standard Industrial Classification (SIC code) 367, the electronics and components accessory and/or job description titles semiconductor processing technicians. More recently this number is identified as North American Industry Classification System (NAICS) 3344 this classification relates to the manufacturing sector of said industry. Hereinafter the electronics industry may be also referred to as the industry. (See *NAICS 3344* in glossary)
[2] See *wafer* in glossary
[3] See State of the Arts Reviews: Occupational Medicine (1986)
[4] This is not a comprehensive list of chemicals used in the electronics industry.
[5] see Council on Environmental Quality *Chemical Hazards to Human Reproduction* (1981), *Semiconductor Industry Study* (1981), and Hanley & Belfus, Inc. *State of the Art Reviews: Occupational Medicine* (1981).

beyond the damage done to the workers. For pregnant employees, these chemicals are detrimental to their unborn children.

As the electronics industry began to expand, its workforce research on the safety of working around toxic chemicals was also growing. Then the Toxic Substances Control Act of 1976 (TSCA) was introduced in an attempt to regulate existing and new chemicals entering commerce. However, TSCA grandfathered in chemicals that were created and used before the formation of the act[6]. This created a lot of grey areas for chemicals already in use. By the early 1980s reports came out linking the relationship between exposure to toxic chemicals and reproductive health, such as increases in miscarriages, and children born with developmental disabilities[7]. While the risks associated with exposure to these chemicals were well-documented, they had little to no impact on the electronics industry's approach to its work conditions.

In addition to exposing employees to dangerous toxins, the electronics industry was simultaneously polluting the environments it operated. In 1981, it was discovered that the Fairchild Semiconductor facility in San Jose had a leaking tank of chemicals that were flowing into the municipal water system. As community members became more aware of the ongoing dangers, organizations such as Santa Clara Center for Occupational Safety and Health (SCCOSH) put pressure on the industry to stop the exposure to employees and the pollution. As a result, Fairchild and other semiconductor companies faced lawsuits as workers suffered cancer and some had children born with physical and/or mental defects. Over the years some companies moved to other states, such as Texas and Arizona, where there are fewer worker protection laws[8] and some have gone overseas. Additionally, over the past 35 years there have been numerous lawsuits in the U.S. against electronics companies in California and elsewhere. Many of these cases have obtained substantial compensation for children harmed in utero because the companies did not warn or protect their mothers from exposure to developmental toxics[9]. Nonetheless, many semiconductor companies still operate in California using said chemicals.

[6] For more information see *Summary of the Toxic Substances Control Act*
[7] For more information see Council on Environmental Quality *Chemical Hazards to Human Reproduction* (1981).
[8] *THE BEST AND WORST STATES TO WORK IN AMERICA,* Oxfam America Inc. (2022). Also, see appendix 1
[9] Hawes, A. J.D., personal communication May 6, 2022

Superfund Sites

Many electronics companies have been irresponsible with the handling and dumping of toxic chemicals, resulting in many of these sites being classified as Superfund sites[10]. These are sites with so much pollution that the Environmental Protection Agency (EPA) has flagged them as needing long-term clean-up. During the early 1980s, it was discovered that multiple electronics companies (not just Fairchild) had leaked toxic chemicals, primarily trichloroethane, into the water system of Silicon Valley. The Regional Water Quality Control Board surveyed 59 companies and found that 73% of them leaking underground storage tanks. During the late 1980s, it was discovered that 19 public and 43 private water wells were contaminated with toxic chemicals used by the electronics industry[11] which led to 500+ lawsuits against IBM, Fairchild Semiconductor, and Teledyne.

These chemical leaks did not end in the 1980s as Santa Clara County is still feeling the impacts of toxic chemical leaks today. In the state of California alone there are 97 Superfund sites with 23 active Superfund sites in Santa Clara County. Out of the 23 active sites in Santa Clara County, nine are or were semiconductor facilities, all of which are on the National Priority List[12]. The map below shows Superfund sites in the San Francisco Bay Area, with a heavy concentration of them in Santa Clara County; where all but one site, are listed as National Priority by the EPA.

[10] Superfund Sites are recognized by EPA as sites that are severely polluted locations within the United States. These sites require long-term responses to clean up hazardous material contamination. See *Superfund Site* in glossary
[11] Hanley & Belfus Inc. (1986). pp 7-8.
[12] National Priority List (NPL) The National Priorities List (NPL) is the list of sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

Superfund Sites in San Francisco Bay Area

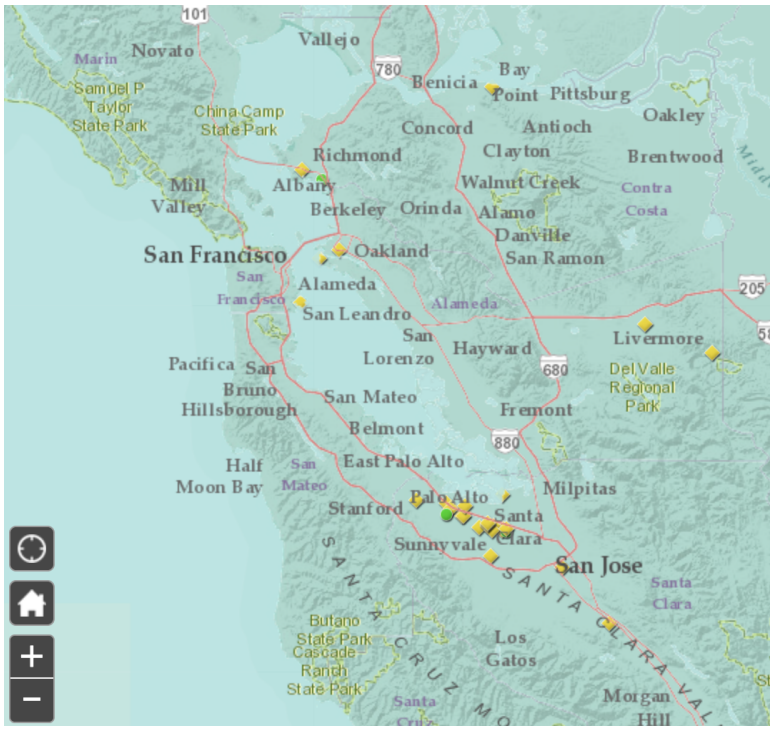


Image adapted from the United States Environmental Protection Agency. (2022). *Superfund National Priorities List (NPL) Where You Live Map*.

Electronics Companies that are classified as Superfund Sites in Santa Clara County

- Synertech, Inc.
- Intersil Inc/Siemens Components
- National Semiconductor Corp.
- Monolithic Memories
- Applied Material
- Intel Magnetics
- Advanced Micro Devices, Inc.
- Signetics, Inc.
- Fairchild Semiconductor Corp

Present Day

While the presence of the electronics industry seems to be fading in California, the impacts of the industry are visible today. These impacts are the Superfund Sites, health issues among electronics workers, and it can be seen in damage done to women's reproductive health. The link between exposure to these chemicals is clear. The link

between exposure to these chemicals and a fetus is also clear. This report highlights the impacts these chemicals have on reproductive health, highlighting some cases of children impacted by exposure to these chemicals. This report also looks into the trends and spending of special education programs in California. Furthermore, it draws the conclusion that the electronics industry should be held financially responsible for the children and women impacted by way of funding special education classes in the state of California.

METHODOLOGY

First, I will present chemical exposure research from multiple sources documenting the following: the impact these chemicals have on reproductive health, the standards for these chemicals in the workplace, case studies, employment trends by county in California, outlines the link between these companies and Superfund sites, and then discuss special education programs. The research section below will provide evidence linking long-term exposure to these chemicals and their impact on reproductive health. Some reports showing the impacts of these chemicals will go as far back as the 1980s- this will support the claim that the electronics industry knew about the dangers of these chemicals early on but acted negligently by exposing employees, of childbearing age to these harmful toxins at the expense of their health. Second, I will present the findings of a survey that was distributed to people who worked in the electronics industry while pregnant and gave birth to children with disabilities. The survey has been a step in trying to quantify how many employees' children have been impacted by chemical exposure. Both approaches have their strengths and weaknesses that will be further discussed in the area below.

Chemical Exposure Research

This area includes four main areas, research, case studies, data by county in California, and the amount spent on special education programs in California. First is research that links exposure to the chemicals listed above to increased miscarriages and disabilities in children of mothers exposed. Second are real cases of, now adults, who are severely disabled due to their mothers working in the electronics industry around neurotoxins. The third is data shows what counties hired the most electronics workers and the impacts. Fourth, is a general overview of the amount spent on special education and the challenges surrounding supporting these programs. The limitations of this method are that without access to the birth records of those enrolled in special

education it is impossible to properly quantify how many children in special education have or had parents working in the electronics industry. The strengths of this method are that we can utilize previous research in the electronics industry, outline the impact through people's stories, and analyze how it all relates to the impacted communities.

Survey

The survey released by Safe Jobs Healthy Families asked survey takers general questions about themselves, their children, and their occupations. The survey targeted three main communities within Santa Clara County: Latinos, Philipinos, and Vietnamese. There was no timeline for the survey as the main question was very broad and applied to employees who worked in the electronics industry while pregnant and said the child was born with a developmental disability. The goal has been to collect as much data on the link between chemical exposures in the electronics industry and children born with disabilities. Additionally, since electronics companies are still manufacturing electronics parts with the use of toxic chemicals, there is a desire to cast a wide net; to get information on past employees and current employees that may still be at risk. Outreach for this survey was conducted through webinars presentations, newsletters, community center advertisements, email blasts, and word of mouth. One limitation to this method has been outreach, as COVID-19 regulations have only allowed for virtual outreach. Unfortunately, a large part of the population this survey is intended to target does not have adequate access to virtual tools and resources. The overall goal was to hopefully reach family members who worked in this community. The second limitation was the amount of time allotted from the time the survey was distributed to when this report was completed. The strength of this method is being able to gather specific data that is otherwise unavailable to the public.

Both the research and the survey method have allowed for a comprehensive analysis on the impact the electronics industry has had on its employees and the communities in which it operates.

CHEMICAL EXPOSURE RESEARCH

Exposure to the organic and inorganic solvents listed below have been known to negatively impact the person exposed with immediate and long-term systems. These impacts have been well documented with some reports specifically looking into the electronics industry usage of these chemicals, work environment, and regulation. Nonetheless, these chemicals were still utilized in the manufacturing of electronics.

Impacts of Chemical Exposure

As early as the 1980s reports linking these impacts were made available. Public pressure prompted The California Department of Industrial Relations Division of Occupational Safety and Health (Cal/OSHA) to put together a task force dedicated to this industry. The report, published in 1980 researched the working conditions of electronics workers in Santa Clara County and San Mateo County[13]. The report confirmed that employees were being exposed to chemicals at a rate far beyond the limits put in place by Cal/OSHA. At the same time, reports were being conducted on the consequences of chemical exposure. The *Hazard Assessment of the electronics Component Manufacturing Industry*[14] worked to research the dangers of the electronics industry and how to improve standards by reducing the dangers to workers. In 1982 the final report was published which showed a comprehensive

[13] California Department of Industrial Relations Division of Occupational Safety and Health. Taskforce on the electronics Industry. (1981). *Semiconductor Industry Study.*
[14] (1980)*Hazard Assessment of the electronics Component Manufacturing Industry*

overview of the chemicals used in the electronics industry and their effects on workers who were exposed[15].

Then the Council on Environmental Quality released a report specifically detailing the dangers of working around these chemicals and reproductive health. Some of the initial research was conducted on mice with theories on what this might mean to humans[16]. At the time, parent occupation was not recorded on birth certificates so researchers were unable to tie a direct link between birth defects and exposure to chemicals. However, many studies were beginning to piece together the dangers electronics employees were being subjected to. In 1986 *Occupational Medicine: The Microelectronics Industry* was published. The book further supported previous research on the dangers of such chemicals, more specifically it outlined the danger of inhaling them. The book covered the effects of many chemicals used to produce microelectronics such as toluene, xylene, trichloroethylene, and lead. It also went a step further to outline the impacts these chemicals have on reproductive health[17]. In 1992 MassCOSH released a book to help guide pregnant workers who worked around dangerous chemicals.

In 2001 The *Clinical Environmental Health and Toxic Exposure* further outlined that the problem was not just exposure but inadequate ventilation systems for employees. The report outlined the problem associated with chemical exposure and in particular, it explained the issue with the "clean rooms"[18] ventilation system within electronics. At first glance clean rooms, appear to be well-ventilated workstations, equipped with ventilation hoods and fans. However, the air circulation in clean rooms are designed to protect the integrity of the products being produced and not the employee. More often, the fumes being circulated in clean rooms come back around and the fumes fall directly into the work area of employees[19].

[15] (1982)*Hazard Assessment of the electronics Component Manufacturing Industry: Final Report*
[16] Council on Environmental Quality (1981). *Chemical Hazards to Human Reproduction.*
[17]Department of Occupational Health, Pacific Medical Center, San Francisco. (1986). State of the Art Review: Occupational Medicine. The Microelectronics Industry
[18] Clean Rooms: Rooms designed to manufacture delicate microelectronics. These rooms are designed to minimize the amount of airborn particles that may threaten the quality of the product being made. See *Clean Rooms* in glossary
[19] Sullivan and Krieger, (2001). *Clinical Environmental Health and Toxic Exposure*

Below is an overview of each chemical, the symptoms they cause to the persons exposed, and its impacts on the fetus. The information listed below is the most current information available. All of these chemicals are still used in microelectronics manufacturing today, with the exception of lead which was banned in 2006.

Chemical Solvent	Symptoms of Exposure	Impacts on Fetus
Manganese	Dust or fumes impact the nervous system. Symptoms of manganese toxicity also known as manganism have symptoms that resemble Parkinson's disease. These symptoms include insomnia, memory loss, hand tremors, exaggerated reflexes, headache, eye issues, sore throat, anxiety, irritability, and muscle cramps[20].	Findings suggest exposure has an impact on fetal growth[21].
Mercury & inorganic mercury compounds	Impact the nervous system. Long-term inorganic mercury vapor exposure is similar to that of long-term mercury vapor exposure. These chemicals cause neurological disturbances, memory loss, skin rash, and kind abnormalities.	Damage to the fetus's lungs, kidneys, brain spinal cord, nerves, hearing, and vision[22].
Methanol	Inhaling or oral exposure can cause nausea, headache, dizziness, insomnia, gastric issues, giddiness, conjunctivitis, blurred vision, and blindness.	Exposure to this chemical in the first trimester of pregnancy impacts organogenesis and leads to craniofacial abnormalities [23].
Methylene chloride (also known as	Causes dose-related central nervous system (CNS) depression. Symptoms of exposure happen within minutes to hours and include lightheadedness, drowsiness, headache, slurred speech,	Reports suggest that exposure to industrial dichloromethane releases may be a risk factor for childhood germ cell tumors, teratomas, and possibly Adult

[20] CDC, (2019). The National Institute for Occupational Safety and Health (NIOSH). *Manganese*.
[21] National Library of Medicine. (2011). *Maternal Blood Manganese Levels and Infant Birth Weight.*
[22] CDC, (2017). National Biomonitoring Program. *Mercury Factsheet*
[23] Rogers, J.M. et. al (1993) The developmental toxicity of inhaled methanol in the CD-1 mouse, with quantitative dose—response modeling for estimation of benchmark doses

dichloromethane or DMC)	delayed reaction times, irritability, impaired gait, and stupor[24]	acute myeloid leukemia (AML)[25]
Styrene	Known carcinogen and impact the nervous system and exposure causes changes in color vision, tiredness, delayed reaction time, issues concentrating, and issue balancing[26].	studies confirm that maternal pulmonary exposure results in plastic particles that pass on to fetal tissues and render the fetus and placenta are vulnerable to adverse effects[27].
Trichloroethylene (TCE).	Exposure causes confusion, sleepiness, fatigue, headache, and a feeling of euphoria. It also has an effect on the liver, kidneys, gastrointestinal system, and skin. Chronic exposure impacts the nervous system. TCE is associated with kidney, liver, and cervical cancer[28].	Exposure to this toxin in utero can increase the risk of a baby being born with cardiac defects and immune disorders.
Toluene	Can cause CNS symptoms along with ventricular arrhythmia, nausea, vomiting, respiratory depression, chemical pneumonitis, and electrolyte imbalances.	Impacts to a fetus, when exposed in utero, include intrauterine growth retardation, premature delivery, congenital malformation, and postnatal developmental retardation[29].
Xylenes	Can irritate the eyes, nose, skin, and throat. Prolonged exposure and a high level of exposure can cause dizziness, confusion, headache, loss of muscle coordination, and death.	Prolonged exposure to this chemical while pregnant increases the risk of spontaneous abortion[30].
Lead	Abdominal pain, constipation, tiredness, headaches, loss of appetite, irritability, memory loss, weakness, pain or tingling sensation in hands and/or feet,	Damage to the nervous system.

[24] ATSDR, (2017). Toxic Substanes Portal. *Medical Management Guidelines for Methylene Chloride.*
[25] National Library of Medicine (NIH), (2017). Exposure to ambient dichloromethane in pregnancy and infancy from industrial sources and childhood cancers in California.
[26] ATSDR, (2014). Toxic Substanes Portal. *Public Health Statement for Styrene.*
[27] National Library of Medicine (NIH), (2020). Nanopolystyrene translocation and fetal deposition after acute lung exposure during late-stage pregnancy
[28] EPA, (). Trichoroethylene.
[29] NIH, (1991). *Reproductive and developmental toxicity of toluene: a review.*
[30] CDC, (2019). The National Institute for Occupational Safety and Health (NIOSH). :U.S. Department of Health & Human Services Xylene.

	miscarriages, stillbirths and infertility. Exposure at high levels can lead to anemia, weakness, kidney damage, brain damage and death[31].	

Due to a combination of public pressure and published research, chemical exposure standards were adjusted. However, most standard changes are inadequate, which will be discussed in detail in the next section. Additionally, while some of this research is from 1980s, it is important to note that, many of the employees working during these times are still around today and are living with chronic health problems, and reproductive health problems. Furthermore, many children were exposed while in utero and as a result were born with developmental issues; children who otherwise would have been born with no developmental disabilities or malformation.

Setting the Standards

Standards set by California Occupational Safety and Health Administration (hereinafter referred to as Cal/OSHA) was originally set in 1970 when PEL[32] was established to help regulate the use of these toxic chemicals. However, these standards proved insufficient for two reasons. The first issue was compliance with new regulations, which was hard to track leaving many companies to continue to manufacture electronics in the same way. Audits of workplaces are only conducted by Cal/OSHA when injuries are reported. The second issue is the standards not being sufficient to protect workers who are exposed. The standards set by Cal/OSHA allow for much higher concentration of these chemicals than the standards set by the Environmental Protection Agency (EPA). Since the TSCA the EPA has had the authority to set standards for chemical exposure based on data and research findings. Cal/OSHA standards are hundreds of times higher than what the EPA has deemed safe. This means that legally employers are allowed to expose their employees to these chemicals at levels that are detrimental to their overall health and still be in compliance with Cal/OSHA standards.

Below is a list of the chemicals mentioned above. The table both show the standards of Cal/OSHA and the Chronic Health Protective Exposure Limits (PELS) limits set by the EPA[33] in a unit measure of parts per million (PPM). Under the EPA column, there are the

[31] CDC, (2021) The National Institute for Occupational Safety and Health (NIOSH). Health Problems Cause by Lead.
[32] PEL: Permissible Exposure Limit. See PEL in glossary
[33] For a detailed examination of the gap between workplace and environmental standards for a large array of toxics see "Occupational Health Hazard Risk Assessment Project for California: Identification of chemicals of concern,

standards set by the Environmental Protection Agency for each chemical. To the right of that column are the Cal/OSHA standards for each chemical. The last column shows the difference between the two sets of standards. In summation, there is a wide discrepancy between the limits legally allowed in the workplace by Cal/OSHA and what has been tested to be safe from the EPA. These discrepancies have real consequences which will be further discussed in the next section through the stories of Mark and Darryl.

Permissible Exposure Limits in the Workplace: EPA versus Cal/OSHA

Substance	EPA	CAL- OSHA	Difference between EPA & OSHA
Manganese (7439-96-5)	0.0001 ppm	0.89 ppm	890 times
Mercury (7439-97-6) & inorganic mercury compounds	.0000037 ppm	.00016 ppm	43 times
Methanol (87-56-1)	3 ppm	200 ppm	67 times
Methylene chloride (75-09-2)	.12 ppm	25 ppm	208 times
Styrene (100-42-5)	.21 ppm	100 ppm	476 times
Trichloroethylene (79-01-6)	0.111 ppm	25 ppm	225 times
Toluene (108-88-3)	.079 ppm	100 ppm	1265 times
Xylenes: technical (1330-20-7), o-xylene (95-47-6), m-xylene (108-38-3) and p-xylene (106-42-3) isomers	.16 ppm	100 ppm	625 times

Case Studies

Mark Rueda Flores

Yvette Flores, was in her early twenties when she began to work at Spectra-Physics. Yvette worked in a small room for eight to ten hours a day, with little to no ventilation; at times, the smell of the chemicals she worked around would cause her to leave her workstation in order to get some fresh

possible risk assessment, and examples of health protective occupational air concentrations" December 2007 https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/HESIS/CDPH%20Document%20Library/riskreport.pdf

air. Her job required her to mix an adhesive using powder from a box and a liquid chemical. She was never told what chemicals she was handling, furthermore, she was never given any Personal Protective Equipment (PPE). While working there, she got pregnant but it resulted in a miscarriage. Her second pregnancy was that of her son Mark. When Mark was born there were issues- "His eyes were crossed. His testicles had failed to descend. His hips were dislocated. He was unable to suck on a breast or bottle. His head was covered with large blood blisters, known as hematomas"[34]. As the years progressed it became evident that Mark was severely disabled. And it was later discovered that the power and solvent Yvette was working around were, lead dust, methanol, and lead fumes. Mark, now 43 is severely mentally disabled and can not go out unaccompanied. His mother Yvette is his primary caregiver and every day she wonders who will care for Mark when she no longer can.

Darryl

Darryl's mother was working in the electronics industry when she was pregnant. Her job was to clean electronics components with solvents such as methyl ethyl ketone and methanol. She was given a paper mask as personal protective equipment for what she was being exposed to. However, paper masks offer no real respiratory protection against solvent vapors. As a result of this exposure, Darryl was born with microcephaly. Darryl's mother was under the assumption that if her son had surgery to expand his cranium his brain would have a chance to grow. She was later informed that Darryl's brain had stopped growing which resulted in his skull staying small and not expanding. More specifically, the chemical exposures had slowed the growth of Darryl's brain and as a result, the diameter of his skull at birth was also very small. The

[34] Morris, J. (2015). *The Impenetrable World of Mark Flores*. The enter for Public Integrity. Workers' Rights. July 1, 2015.

company Darryl's mother worked for insisted on running some genetic tests on Darryl with the premise that his condition was a result of genetics. The test was done and came back negative, in other words, his microcephaly was not inherited or due to any genetic disorder, and therefore his mom's exposures were the only credible explanation.

Mark and Darryl are not alone. The electronic industry's main workforce is women of childbearing age and as a result, many children have been born with developmental disabilities. These disabilities are a direct result of manufacturing electronics with the use of toxic chemicals, most of which, pass through the uterine wall and impact the fetus. Examining workforce trends in this industry allows us to understand what counties have been most impacted by this exposure.

Employment Trends

Electronics Workers per Population (2010-2020)

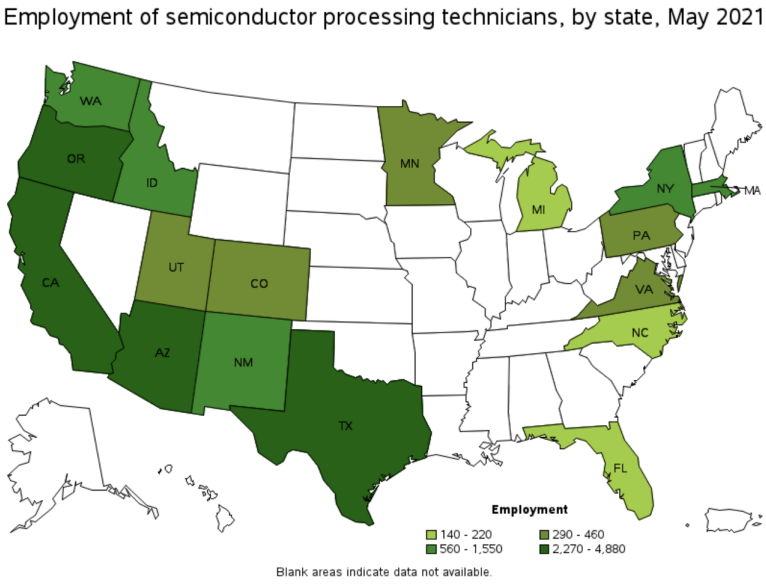


Image adapted by The United States Bureau of Labor and Statistics: Occupational Employment and Wages, May 2021 Occupational Employment and Wage Statistics: 51-9141 Semiconductor Processing Technicians

The current trend for electronics workers have relatively stayed the same. With the highest number of electronics workers in the state of California. Most recent trends show Oregan is the state with the highest concentration of electronics workers by population, employing 2.47 employees per thousand. Texas is the second highest with .37 employees per thousand and California is third with .30 electronics workers per

thousand[35]. Many electronics companies moved out of California in the early 2000s but the highest concentration of companies is still in Santa Clara County. When comparing the numbers by the U.S. Labor and Statistics to the population per county by the U.S. Census Bureau for the last ten year, these counties have the highest concentration of electronics workers by the population: Santa Clara County, Yuba County, Alameda County, Orange County, and Ventura County. Santa Clara County employs the highest percentage per population at 2.19%[36].

All Employees in Private NAICS 3344 Semiconductor and electronic component mfg. for All establishment sizes in, California by county, NSA by Population 2010-2020

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Santa Clara	2.260%	2.336%	2.323%	2.315%	2.281%	2.174%	2.102%	2.110%	2.138%	2.081%	2.018%	2.194%
Yuba	0.789%	0.957%	0.486%	0.304%	0.472%	0.515%	0.544%	0.564%	0.495%	0.442%	0.663%	0.567%
Alameda	0.463%	0.489%	0.471%	0.420%	0.384%	0.388%	0.389%	0.357%	0.390%	0.370%	0.376%	0.409%
Orange	0.423%	0.436%	0.442%	0.381%	0.394%	0.396%	0.396%	0.378%	0.390%	0.430%	0.409%	0.407%
Ventura	0.401%	0.383%	0.352%	0.355%	0.338%	0.381%	0.368%	0.372%	0.391%	0.382%	0.384%	0.373%
San Diego	0.209%	0.190%	0.171%	0.162%	0.169%	0.169%	0.169%	0.176%	0.170%	0.151%	0.161%	0.173%
Placer	0.223%	0.216%	0.205%	0.168%	0.166%	0.168%	0.171%	0.149%	0.159%	0.100%	0.078%	0.164%
Sonoma	0.129%	0.139%	0.160%	0.185%	0.145%	0.170%	0.154%	0.155%	0.143%	0.155%	0.166%	0.155%
Santa Barbara	0.138%	0.146%	0.138%	0.130%	0.126%	0.123%	0.115%	0.116%	0.116%	0.124%	0.133%	0.128%
San Mateo	0.147%	0.155%	0.147%	0.139%	0.134%	0.104%	0.090%	0.025%	0.024%	0.026%	0.057%	0.095%
Los Angeles	0.092%	0.093%	0.086%	0.083%	0.084%	0.083%	0.125%	0.115%	0.114%	0.087%	0.083%	0.095%
Santa Cruz	0.081%	0.079%	0.101%	0.095%	0.124%	0.072%	0.071%	0.065%	0.060%	0.059%	0.046%	0.078%
Riverside	0.068%	0.072%	0.067%	0.057%	0.060%	0.061%	0.059%	0.052%	0.051%	0.048%	0.042%	0.058%
Sacramento	0.035%	0.069%	0.060%	0.052%	0.041%	0.031%	0.031%	0.028%	0.025%	0.030%	0.031%	0.039%
Tulare	0.091%	0.090%	0.088%	0.083%	0.000%	0.000%	0.000%	0.070%	0.000%	0.000%	0.000%	0.038%
El Dorado	0.020%	0.021%	0.000%	0.030%	0.031%	0.026%	0.040%	0.049%	0.052%	0.063%	0.067%	0.036%
Nevada	0.055%	0.056%	0.089%	0.000%	0.079%	0.000%	0.000%	0.000%	0.000%	0.018%	0.009%	0.028%
San Bernadino	0.022%	0.023%	0.020%	0.020%	0.018%	0.021%	0.020%	0.022%	0.027%	0.028%	0.030%	0.023%
Monterey	0.000%	0.000%	0.025%	0.030%	0.028%	0.036%	0.034%	0.000%	0.022%	0.019%	0.018%	0.019%
San Francisco	0.000%	0.026%	0.028%	0.000%	0.028%	0.008%	0.007%	0.016%	0.020%	0.027%	0.031%	0.017%
San Luis Obispo	0.000%	0.024%	0.000%	0.000%	0.035%	0.020%	0.017%	0.018%	0.021%	0.021%	0.021%	0.016%
Contra Costa	0.016%	0.017%	0.020%	0.009%	0.009%	0.011%	0.016%	0.014%	0.014%	0.012%	0.010%	0.013%
San Joaquin	0.000%	0.000%	0.010%	0.008%	0.000%	0.000%	0.000%	0.013%	0.000%	0.000%	0.016%	0.004%
Fresno	0.000%	0.000%	0.005%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.007%	0.007%	0.002%
Marin	0.000%	0.000%	0.005%	0.006%	0.000%	0.000%	0.000%	0.000%	0.002%	0.002%	0.001%	0.002%

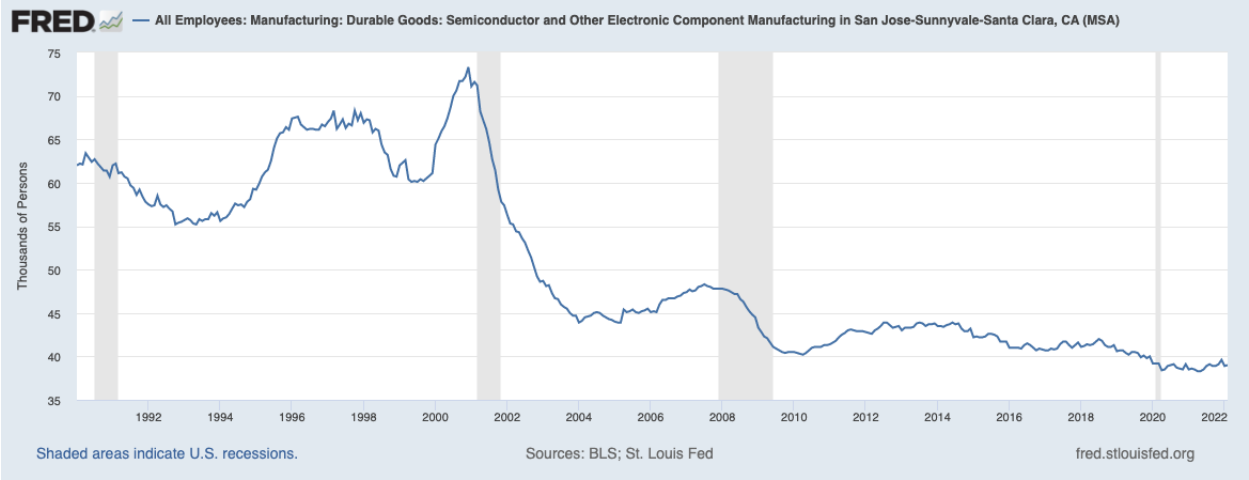
Sources: The United States Bureau of Labor and Statistics and the U.S. Census Bureau, Population Division 2010-2020

Most recent estimates show the electronics industry in California is responsible for employing 942,000 employees and $97.6 billion in labor income. The electronics industry in Silicon Valley is mostly viewed as a positive boom, with reports indicating

[35] The United States Bureau of Labor and Statistics: Occupational Employment and Wages, May 2021 Occupational Employment and Wage Statistics
[36] The United States Bureau of Labor and Statistics: Occupational Employment and Wage Statistics (2010-2020) & U.S. Census Bureau, Population Division (2010-2020)

that the industry has contributed billions nationally[37]. Further supporters of the industry add that jobs in this industry pay higher than the average salary[38]. However, what externalities are being pushed to the employees, the communities, the counties, and the state. Only accounting for the direct dollars of the electronics industry will not give us a holistic view of its actual impact. The county of Santa Clara has been at the forefront of this booming industry and as a result, has seventeen major Superfund sites listed in the EPA[39]. That is seventeen locations that have been severely impacted, largely by the electronics industry.

Semiconductor Employment Trends in Santa Clara County



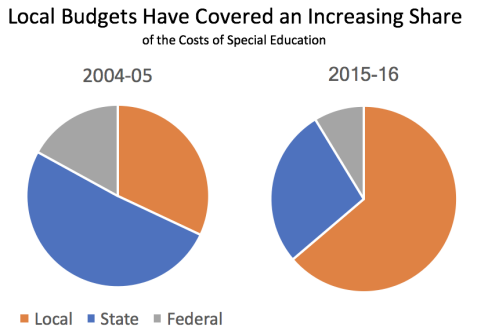
Graph adapted from FRED, Federal Reserve Bank of St. Louis;
https://fred.stlouisfed.org/series/SMU06419403133440001, April 12, 2022.

The chemical leaks that occurred in the 1980s have given Santa Clara County the reputation of being one of the most polluted counties in California. However, what is not widely publicized is the continued use of toxic chemicals in these workplaces and how these impacts go beyond the employees. Children are being born with physical and/or mental disabilities. These children enter the special education programs funded by the State and county. Some of these children, such as in the case of Mark Flores,

[37] *The Economic Impact of the U.S. electronics Manufacturing Sector*. IPC Build electronics Better. (2020).
[38] The United States Bureau of Labor and Statistics: Occupational Employment and Wages, May 2021 Occupational Employment and Wage Statistics
[39] For more see EPA *Superfund Redevelopment Program: Superfund Sites in Reuse in California* and see *Superfund Sites* in glossary

need assistance far after the age of 22, which is when most state and federally funded special education programs stop.

Children in Special Education Programs (2008-2012)



Adapted from Petek, G., (2019). *Overview of Special Education in California*

Over the years the state of California has been spending more and more on special education programs. A 2019 estimate showed that California was spending $27,000 annually to educate a child with special needs[40]. California uses federal, state, and local money to fund these programs. However, as the cost of special education programs has grown the state is noticing that it is local funds that are compensating for increased costs. In 2014-15 local funding for these programs covered more than half of the cost[41]. The information provided above details the impact of exposure to these chemicals in utero. If we use only one of these chemicals for example, such as lead, we know the impacts of such chemicals pass on to the fetus and impact the nervous system. Lead which was banned in 2006, would mean that the youngest children who were exposed to lead while fetuses would be fifteen-sixteen years old right now. We can imagine many other workers who are still being impacted and exposed as well as those who came before. The children who are in special education programs and had mothers who were working in the electronics industry should be considered when discussing program funding. This is a direct external cost that should be paid for by the electronics industry.

The research above affirms that there is a link between exposure to these chemicals and developmental disabilities and malformation. To take it a step further Safe Jobs Healthy Families sought to identify those impacted in Santa Clara County and that work led us to develop a survey.

[40]Petek, G., (2019). *Overview of Special Education in California*
[41] Kocivar, C. (2020) *Special Education Costs Flood School Budgets*

SURVEY RESULTS

To get more detailed data regarding those impacted by exposure to chemicals, Safe Jobs Healthy families released a survey. The survey was released in January 2022 and the promotion of the survey was geared towards women who were working while pregnant and gave birth to a child with a developmental disability[42]. Most of the outreach efforts were focused in the county of Santa Clara due to the concentration of electronics industries in that county. The survey outreach was made available in three languages, English, Spanish, and Vietnamese. Further, the outreach efforts were mainly toward the Latinx community, the Vietnamese community, and the Filipino community. As previously mentioned there were limitations of this survey due to the virtual setting in which it was promoted and the time since the release of the survey. With only twelve respondents the survey findings are not statistically significant. The summary of the results is as follows.

There were a total of 12 responses to the survey. Three respondents reported having a child with a developmental disability and six did not answer while one respondent said no. All respondents lived in Santa Clara county while pregnant. Children were diagnosed with a developmental disability at various stages ranging from ten-month-olds to four-year-olds. Most respondents said they received their child's diagnosis from a doctor while one respondent stated "other". When asked what they were told about their child's disability one respondent said "Gross neurological impact because the development of her brain stopped at the beginning of the 2nd trimester". Almost all respondents had or have their child in a special education program. Most respondents worked within Santa Clara County while pregnant and were working full time. One respondent recalled working around cleaning solvents, chemicals, solders, or sprays. Respondents worked around these chemicals from four hours a day to the entire workday. One respondent answered yes to the question regarded being offered PPE but indicated "other" when asked if they were provided with a paper mask, cloth covering for face, cartridge respirator, fans, bunny suit/hazmat suit, smock, and/or gloves.

Not all of the respondents answered every question as the survey allows respondents to skip sections. Efforts are still being made to elicit more participation. What we have

[42] See Appendix C for full survey questions, Appendix D for full survey and Appendix E outreach material.

gathered from the survey has been beneficial; Safe Jobs Healthy Families has made efforts to discuss each respondent's story in more detail.

ANALYSIS

The information provided in this report highlights the dangers of exposure to these chemicals and that the electronics industry was aware of such dangers. Studies mentioned here date as far back as the 1980s. Furthermore, the standards of exposure enforced after these studies were released were not sufficient at keeping employees from experiencing harm to their reproductive health. By acting negligently and putting employees of reproductive age at risk this industry placed its external cost on local and state governments. While some lawsuits have been filed against this industry, due to exposure to chemicals, the true extent of those impacted is unknown. These externalities have caused real harm to the communities impacted, as the children impacted were robbed of the chance of having an otherwise healthy life.

While the costs of these externalities stem beyond special education programs it is an important area to start on. In order to ensure that the industry and others like it take accountability for their actions, there should be monetary compensation for employees impacted. In this report, I am focused on employees who worked in the electronics industry while pregnant and gave birth to children with developmental disabilities. More specifically, the developmental disabilities that this report highlights are those that have proven to be a result of exposure to chemicals and solvents used by said industry. With the rising cost of special education classes, financial accountability from this industry and those like it should be a bigger focus. Adequate financial support from the electronics industry would lessen the financial restriction of special education programs and set a precedent for other industries in regard to external costs.

CRITERIA

To measure the impacts of different recommendations a set of three criteria were used, those are cost, equality, and a state value. These criteria, which are defined below, were ranked on a three-point scale; one point being the lowest end and represented by “low”, two points representing the middle point and represented by “moderate” and three points being the highest-ranking and represented by “high”. For the cost, a “high” rank indicates the cost will be higher which may be viewed as a negative score, while a “high” rank for the criteria of equality and state value is viewed as positive.

Additionally, not all criteria were weighted the same, both equality and state value are weighted higher than the criteria of cost. This is because cost encompasses only that of the implementation of the recommendations which can easily be outweighed by equity and state and local value. Therefore, I note that the most favorable outcome is one that scores high on equality and state value, regardless of the rank it has on the criteria of cost. If a recommendation is "high" or "moderate" in cost and ranks "high" in equality and "high" in state value then any initial cost will be an investment that will be returned to the state or local government in the future.

Recommendations that may be beneficial in the short term but cost more in the long term were scored low. Recommendations that provided conflicting short-term and long-term values but had the combination of those values equal to a positive overall outcome were scored as moderate. Recommendations that provide the state with more value, both short-term and long term were scored higher.

Cost

The cost criteria were done in brevity to give a general idea of which recommendations would cost the most to implement. Both long and short-term costs were taken into consideration when ranking each recommendation was conducted. These costs include industry externalities, data collection, standard enforcement, auditing, and the cost of incentives.

Equality

The equality criteria is defined as giving each person impacted an equal amount of support; the support, we are discussing in the recommendations would be financial support that the company would pay into special education programs. Once systems are in place to track the level of impact of these externalities the criteria should be changed to reflect equity criteria and not equality[43]. In these initial stages setting equality, standards would be both impactful and set a good foundation for the overall goal. Once systems are in place to better track externalities, the goal should be equity

[43] Equity is defined as an understanding that different people may require more or less support depending on their situation. Additionally, equity seeks to act on those inequities by provided different resources dependant on need, which is looked at holistically. Equality is defined as providing all people with the same resources regardless of situation.

since people have been impacted at various levels with each impacted person requiring different levels of support.

State & Local Value

The state and local value criteria look at how the state and local government gains economically from each recommendation. Value is defined as being a positive impact on the state as it related to costs. Things to consider when thinking of cost within this criteria are, externalities, such as the cost of cleaning up Superfund sites, the cost of special education programs, increased medical costs due to exposure to toxins, and any other cost that is placed on employees, consumers, local and state governments that are not being paid for by the industry. Another economic value to keep in mind is that of improved workplace standards that improve the quality of life of employees and in turn make that state and local government valuable areas to work in.

CRITERIA MATRIX

Criteria Matrix

	Cost	Equality	State & Local Value
Let Present Trends Continue	High	Low	Low
Strengthen Workforce Safety Regulations	Moderate	Moderate	High
Incentivise Companies for Employee Safety	High	Moderate	High
Hold Industry Financially Responsible	Moderate	High	High

RECOMMENDATIONS

Let Present Trends Continue:

The easiest option would be to keep the status quo. electronics companies could remain operating as is and this would appear to be the most cost-effective option. However, without really tracking the externalities that these companies impose on the local, county, and state-level we cannot be certain that this is the most cost-effective solution in the long run. The evidence is clear that while these companies provide economic growth, they are simultaneously pushing other costs onto the communities they impact.

Strengthen Workforce Safety Regulation:

This option would push for Cal/OSHA to strengthen their chemical exposure guidelines to meet be at or below EPAs current regulations. Furthermore, companies would be required to be more transparent about the chemicals their employees are exposed. Proper PPE guidelines with new regulations should be displayed and proper PPE should be provided. This option would also require that workplaces be subject to random audits in order to ensure compliance.

Incentivize Employer for Employee Safety:

This option could only occur in conjunction with strengthening workplace safety and regulations. Offering incentives to employers who comply with more adequate employee safety regulations would be beneficial for both employees and employers. For this recommendation, the employer would have to be deemed a safe work environment in which the external costs of that company are relatively low and do not include externalities relating to chemical exposure. The incentives can be in the form of tax credits, or rebates.

Create Database to Track Externalities:

The recommendation would seek to centralize information that would be beneficial in analyzing other links associated with the occupation. Creating a centralized database in which one could access the occupation of parent(s) alongside developmental disabilities and birth defects would help keep companies accountable. Additionally, this would aid in being able to track the external cost of industries, such as the electronics industry.

Hold Companies Financially Responsible:

This option would include companies being held financially accountable for some of their externalities by way of paying for special education services within the states they operate in. Ideally, we would get to the point in which this industry does not create workplace hazards that increase miscarriages, developmental disabilities, birth defects, or sterility. However, even if this is reached, and even if workplaces can prove they are safer now than in the past, it does not erase the damage done to those impacted. Therefore, regardless of new or future compliance with stricter regulations, the electronics industry should pay for the cost of children in special education programs now and in the past if at least one of the parents worked in the electronics industry while pregnant. Furthermore, if a child needs care outside the special education system the electronics industry should pay for that care.

GLOSSARY

AB 602: Also known as The Special Education Program, which provides funding to special education local plan areas (SELPA) based on the SELPA's average daily attendance (ADA) and other data elements.

Clean Rooms: Rooms designed to manufacture delicate microelectronics. These rooms are designed to minimize the number of airborne particles that may threaten the quality of the product being made. Microelectronics products such as wafers are produced in such rooms. There are three different types of cleanrooms: Mixed-flow rooms with vertical laminar hood workstations, mixed flow rooms with aisles and core areas, and vertical-laminar-flow clean rooms.

EPA: Acronym for the United States Environmental Protection Agency

NAICS Code: Created in 1997 to track economic trends of businesses and has largely replaced the SIC Code in job classifications. This system of identification is used in Canada, the United States, and Mexico.

NAICS 3344: A subgroup under NAICS 334, which is listed as "Computer and Electronics Product Manufacturing". Subgroup 3344 relates to the job classification identified as "Semiconductor and Other electronics Component Manufacturing" making it the closest classification to the original SIC code 367.

National Priority List (NPL): Used to classify Superfund Sites by the EPA, NPLs are sites of national priority among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the U.S.A. and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

PEL: Permissible Exposure Limit.

Semiconductor Processing Technical: Perform any or all of the following functions in the manufacture of electronics semiconductors: load semiconductor material into furnace; saw formed ingots into segments; load individual segment into crystal growing chamber and monitor controls; locate crystal axis in ingot using x-ray

equipment and saw ingots into wafers; and clean, polish, and load wafers into series of special-purpose furnaces, chemical baths, and equipment used to form circuitry and change conductive properties.

SIC Code: Standard Industrial Classification (SIC) codes are four-digit numerical codes assigned by the U.S. government to business establishments to identify the primary business of the establishment. The classification was developed to facilitate the collection, presentation, and analysis of data; and to promote uniformity and comparability in the presentation of statistical data collected by various agencies of the federal government, state agencies, and private organizations.

Superfund Site: Designated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, these sites are recognized as severely polluted locations within the United States. These sites require long-term responses to clean up hazardous material contamination.

Wafers: (also called a slice or substrate) is a thin slice of semiconductor, such as a crystalline silicon (c-Si), used for the fabrication of integrated circuits and, in photovoltaics, to manufacture solar cells. The wafer serves as the substrate for microelectronics devices built-in and upon the wafer.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), (2017). U.S. Department of Health & Human Services. Toxic Substances Portal. *Medical Management Guidelines for Methylene Chloride.* January 12, 2017. Web accessed April 1, 2022 < *https://wwwn.cdc.gov/TSP/MMG/MMGDetails.aspx?mmgid=230&toxid=42#:~:text=Methylene%20chloride%20exposure%20causes%20dose,%2C%20impaired%20gait%2C%20and%20stupor.*>

Agency for Toxic Substances and Disease Registry, (ATSDR), (2014). U.S. Department of Health & Human Services. Toxic Substanes Portal. *Public Health Statement for Styrene.* March 26, 2016. Web Accessed April 1, 2022 <https://wwwn.cdc.gov/TSP/PHS/PHS.aspx?phsid=419&toxid=74>

Hawes, A. J.D., personal communication May 6, 2022

Center for Diseases and Control Prevention, (2017). U.S. Department of Health & Human Services: National Biomonitoring Program. *Mercury Factsheet . April 7, 2017. Web access Apri 7th, 2022* <*https://www.cdc.gov/biomonitoring/Mercury_FactSheet.html*>

Center for Diseases and Control Prevention (CDC), (2019). The National Institute for Occupational Safety and Health (NIOSH). *Manganese*. July 24, 2019. Web access April 5, 2022 <https://www.cdc.gov/niosh/topics/manganese/default.html#:~:text=Exposure%20to%20manganese%20dust%20or,severe%20depression%2C%20anxiety%20and%20hostility.>

Center for Diseases and Control Prevention (CDC), (2019). The National Institute for Occupational Safety and Health (NIOSH). :U.S. Department of Health & Human Services. *Xylene*. June 21, 2019. Web Accesses April, 1, 2022. <https://www.cdc.gov/niosh/topics/xylene/default.html#:~:text=Exposure%20to%20xylene%20can%20irritate,duration%2C%20and%20work%20being%20done.>

Center for Diseases and Control Prevention, (2021) The National Institute for Occupational Safety and Health (NIOSH). Health Problems Cause by Lead.

Council on Environmental Quality *Chemical Hazards to Human Reproduction* (1981), State of California Dept. of Industrial Relations Division of Occupational Safety Health Task Force on the electronics Industry *Semiconductor Industry Study 1981*

Department of Occupational Health, Pacific Medical Center, San Francisco. (1986). *State of the Art Review: Occupational Medicine. The Microelectronics Industry.* Vol. 1 No. 1. ISSN 0885-114X. Hanley & Belus, Inc. Pennsylvania.

FRED (2022). *All Employees: Manufacturing: Durable Goods: Semiconductor and Other electronics Component Manufacturing in San Jose-Sunnyvale-Santa Clara, CA (MSA).* U.S. Bureau of Labor Statistics and Federal Reserve Bank of St. Louis, [SMU06419403133440001], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SMU06419403133440001, May 5, 2022.

IPC, (2020). *The Economic Impact of the U.S. electronics Manufacturing Sector*. IPC Build electronics Better. (2020).

Kocivar, C. (2020) *Special Education Costs Flood School Budgets.* Ed 100. February 3, 2020. Web accessed March 17, 2022. <https://ed100.org/blog/special-education-costs-flood-school-budgets>

LaDou, Joseph M.D., (1985). *Occupational Medicine: The Microelectronics Industry.* Vol 1. No.1 (1985).

OEHHA, (2007). *Occupational Health Hazard Risk Assessment Project for California: Identification of chemicals of concern, possible risk assessment, and examples of health protective occupational air concentrations*. December 2007 https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/OHB/HESIS/CDPH%20Document%20Library/riskreport.pdf

Oxfam America, (2022). *THE BEST AND WORST STATES TO WORK IN AMERICA.* Oxfam America Inc. Web Accessed May 1, 2022 <https://www.oxfamamerica.org/explore/countries/united-states/poverty-in-the-us/best-states-to-work/>

Pasquini D., & Laird, L. (1982)*Hazard Assessment of the Electronics Component Manufacturing Industry: Final Report.* Environmental Chemistry Department, Systems & Measurements Division, Research Triangle Institute, Research Triangle Park, NC. April 1982.

Pasquini D. Burger, R. Ph.D. & Boeniger, M. (1980)*Hazard Assessment of the Electronics Component Manufacturing Industry*. Environmental Chemistry Department, Systems & Measurements Division, Research Triangle Institute, Research Triangle Park, NC. November 7, 1980

Petek, G. (2019). *Overview of Special Education in California*. Legislative Analyst's Office, January 21, 2020

National Library of Medicine (NIH), (1991). National Center for Biotechnology Information. Environmental Health Perspectives. *Reproductive and developmental toxicity of toluene: a review.* August 1991. 94: 237-244. DOI: 10.1289/ehp.94-1567945.

National Library of Medicine (NIH), (2011). *Maternal Blood Manganese Levels and Infant Birth Weight.* Epidemiology. Author manuscript. Published in final edited form as: Epidemiology. 2009 May; 20(3): 367–373. doi: 10.1097/EDE.0b013e31819b93c0

National Library of Medicine (NIH), (2017). *Exposure to ambient dichloromethane in pregnancy and infancy from industrial sources and childhood cancers in California.* Int J Hyg Environ Health. 2017 Oct;220(7):1133-1140. doi: 10.1016/j.ijheh.2017.06.006. Epub 2017 Jun 24.

National Library of Medicine (NIH), (2020). Nanopolystyrene translocation and fetal deposition after acute lung exposure during late-stage pregnancy (2020). Part Fibre Toxicol. 2020 Oct 24;17(1):55. Doi: 10.1186/s12989-020-00385-9.

Rogers, J.M. et. al (1993) *The developmental toxicity of inhaled methanol in the CD-1 mouse, with quantitative dose—response modeling for estimation of benchmark doses*. Developmental Pharmacology and Toxicology Vo. 47. Issue 3. Pp. 173-188

Sullivan and Krieger, (2001). *Clinical Environmental Health and Toxic Exposure. Williams & Wilkins. June 12, 2001*.

SICcode.com, Industry Classification Efforts, (2022). *SIC Code 367 - electronics Components and Accessories*, (accessed on March 23, 2022) https://siccode.com/sic-code/367/electronics-components-accessories

The United States Environmental Protection Agency. EPA. (2022). *Superfund National Priorities List (NPL) Where You Live Map*. EPA. (2022). Web Accessed April 14, 2022

<https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=33cebcdfdd1b4c3a8b51d416956c41f1>

U.S. Census Bureau, (2020). *Population Division (2010-2020)*

The United States Bureau of Labor and Statistics: Occupational Employment and Wages, May 2021 Occupational Employment and Wage Statistics

United States Environmental Protection Agency. (2021). Law & Regulations: Summary of the Toxic Substances Control Act. October 2021. Accessed April 4, 2022, <https://www.epa.gov/laws-regulations/summary-toxic-substances-control-act>

United States Environmental Protection Agency, (2022). *Superfund Redevelopment Program: Superfund Sites in Reuse in California*. April 1, 2022. Web accessed < https://www.epa.gov/superfund-redevelopment/superfund-sites-reuse-california>

Appendix A

The Best States to Work Index: How states rank on Worker Protection Policies

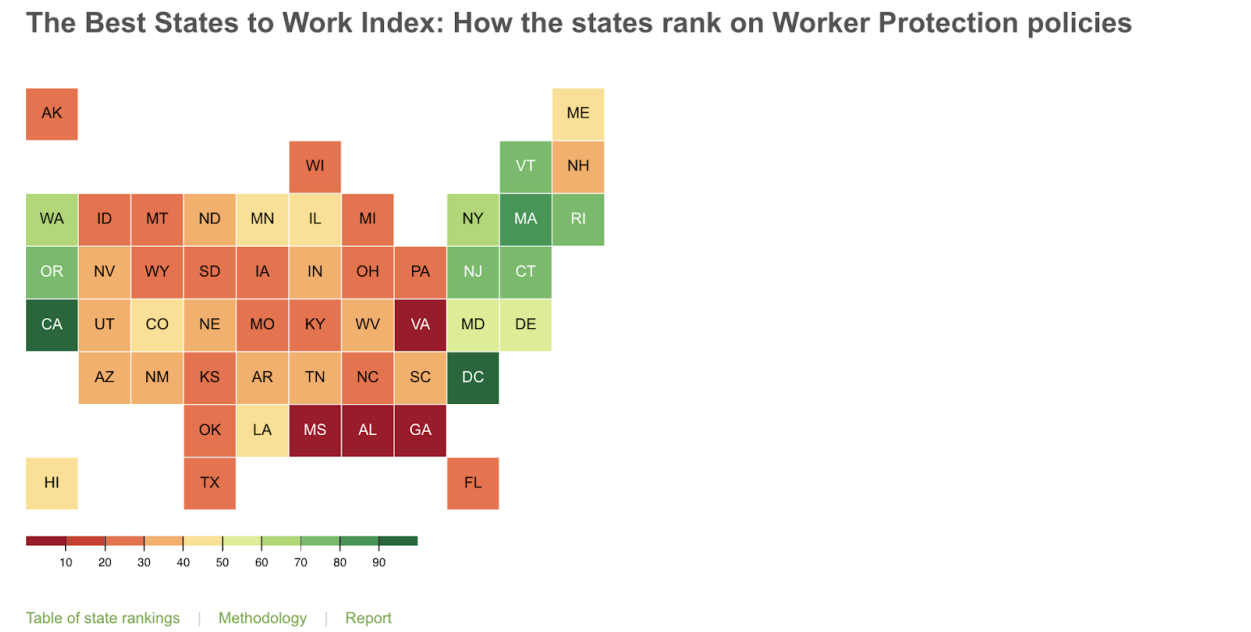


Chart adapted from Oxfam America, (2022). *THE BEST AND WORST STATES TO WORK IN AMERICA.* Oxfam America Inc. Web Accessed May 1, 2022 <https://www.oxfamamerica.org/explore/countries/united-states/poverty-in-the-us/best-states-to-work/>

Appendix B

Disability category by grade level in California K-12 schools, 2018/19 school year

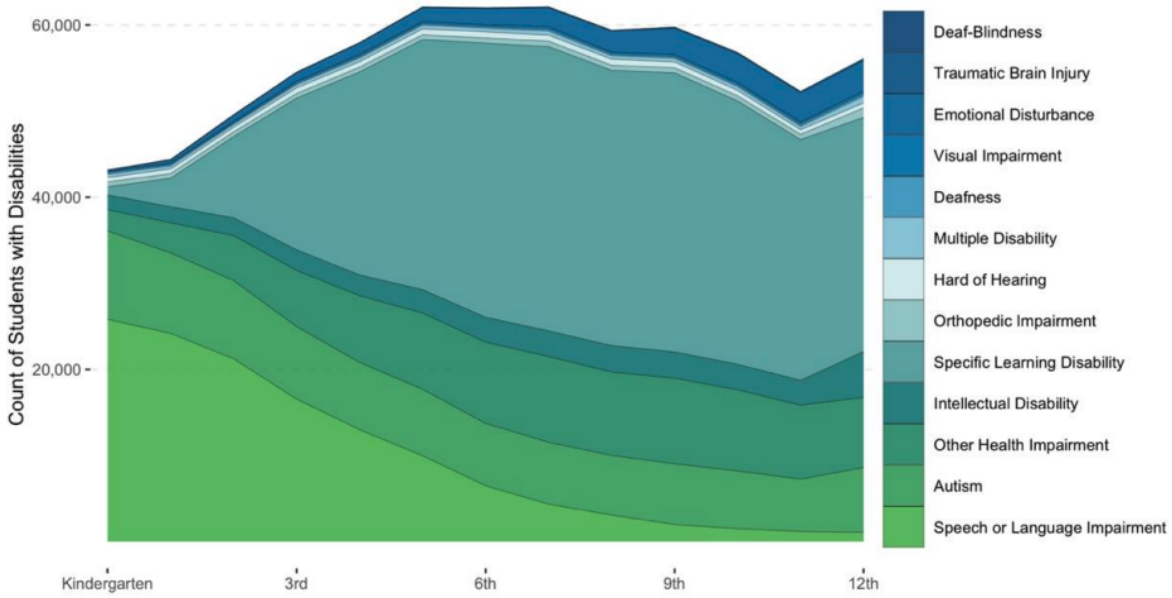


Chart adapted from California Special Education Funding System Study: A Descriptive Analysis of Special Education Funding in California (2020). Data from DataQuest 2018/19 Special education enrollment by age and disability statewide report (CDE, 2020a).

Appendix C

Survey Questions_ English Version

PhraseID EN
SV_1TT4oDrrVg3npD8

QID00_ "My son Mark is 42 but he will never have a job or an independent life. When I got pregnant I was working in electronics assembly; I wasn't told I was working around the lead and other toxins that can harm a developing brain and I wasn't given any protection either." How many other electronics workers have been lied to and not protected? How many children have paid the price of this failure by the "clean industry"? How can we hold the industry accountable? These are questions we are working to answer. Please help by completing the questionnaire and letting others know about our project.
Please do your best to answer every question.

QID1_ First Name
QID2_ Last Name
QID3_ Email Address
QID4_ Phone Number
QID5_ Do you have a child with special needs due to developmental disability?
QID5_Choice1 Yes
QID5_Choice2 No
QID42_ What year was your child born?
QID43_ What month and date was your child born? (mm/dd)
QID9_ What city were you living in during your pregnancy?
QID10_ Where were you living during your pregnancy (street address)?
QID11_ How old was your child when you learned that she/he/they had a developmental disability?
QID12_ How did you learn that she/he/they had a developmental disability?
QID12_Choice1 Doctor informed me
QID12_Choice2 Social worker informed me
QID12_Choice3 I sought out medical advice
QID12_Choice4 Other (specify below)

QID13_ What were you told about this disability?
QID14_ Is your child attending special education classes?
QID14_Choice1 Yes
QID14_Choice2 No
QID14_Choice3 Not at the time but they did in the past
QID15_ What school or facility is your child enrolled in special ed?
QID16_ When (month/year) did your child last attend special ed classes?
QID17_ What school or facility did your child attend for special ed classes?
QID18_ Does your child live with you at this time?
QID18_Choice4 Yes
QID18_Choice5 No
QID18_Choice6 Other
QID19_ Do you get in home support service assistance to help care for your child?
QID19_Choice1 Yes
QID19_Choice2 No
QID21_ During your pregnancy did you work outside the home?
QID21_Choice1 Yes
QID21_Choice2 No
QID22_ What kind of work did you do when you were pregnant?
QID22_Choice1 electronics Assembly
QID22_Choice2 Semiconductor Fabrication Work
QID22_Choice3 Office Work
QID22_Choice4 Food Services
QID22_Choice5 Transportation
QID22_Choice7 Agricultural Work
QID22_Choice8 Other
QID23_ Where was your job located? (be as specific as possible)
QID24_ Who was the employer?
QID25_ How many hours per week did you usually work?
QID26_ What were your basic job duties?
QID27_ About how long before your child 's due date did you stop work at this job?
QID28_ As far as you recall did you use and/ or work around any cleaning solvents, chemicals, solders, or sprays in your job?
QID28_Choice1 Yes

QID28_Choice2 Maybe/Unsure
QID28_Choice3 No
QID29_ What solvents, chemicals, solders and/or sprays do you remember using or working around?
QID30_ How much time did you work around each such material on a typical day?
QID31_ What odors do you recall smelling if any, when working around any such material (be specific)?
QID44_ Were you provided PPE (personal protective equipment)?
QID44_Choice1 Yes
QID44_Choice2 Maybe
QID44_Choice3 No
QID32_ What PPE (personal protective equipment) were you provided? (select all that apply
QID32_Choice1 Paper Masks
QID32_Choice3 Other (specify)
QID32_Choice5 Cloth Covering for Face
QID32_Choice6 Cartridge Respirator
QID32_Choice7 Fans
QID32_Choice8 I was NOT given anything to put in front of my nose or mouth
QID32_Choice9 Bunny Suit/Hazmat Suit
QID32_Choice10 Smock
QID32_Choice11 Gloves
QID33_ If you were given a mask to wear were you still able to smell chemicals in your area?
QID33_Choice1 Yes
QID33_Choice2 Maybe/Unsure
QID33_Choice3 No
QID34_ If you were working around chemicals at your job did you ever feel the following symptoms? (select all that apply)
QID34_Choice1 Dizzy
QID34_Choice2 Nauseated
QID34_Choice3 Light-headed
QID34_Choice4 Other (specify)
QID34_Choice5 I felt no symptoms

QID35_ Did you ever see anyone taking samples of the air in the area where you worked?
QID35_Choice1 Yes
QID35_Choice2 Maybe/Unsure
QID35_Choice3 No
QID36_ If so, were you informed of the results of the samples?
QID36_Choice1 Yes
QID36_Choice2 Maybe/Unsure
QID36_Choice3 No
QID37_ What were you told regarding the samples?
QID38_ At work were you told that was safe?
QID38_Choice1 Yes
QID38_Choice2 Maybe/Unsure
QID38_Choice3 No
QID38_Choice4 I was NOT told anything about SAFETY
QID45_ At work were you told that everything was within legal limits?
QID45_Choice1 Yes
QID45_Choice2 Maybe/Unsure
QID45_Choice3 No
QID39_ During your pregnancy were you ever evacuated at work because of chemical fumes or vapors?
QID39_Choice1 Yes
QID39_Choice2 Maybe/Unsure
QID39_Choice3 No
QID40_ Did you ever go to the nurse at work because you were not feeling well?
QID40_Choice1 Yes
QID40_Choice2 Maybe/Unsure
QID40_Choice3 No
QID41_ If you did seek medical attention, what were you told?

Survey Title Survey Questionnaire for Parents of Developmentally Disabled Children
Survey Description Survey Questionnaire for Parents of Developmentally Disabled Children - specifically geared toward parents who worked in the electronics industry while pregnant.

Appendix D

Survey Finding (names and personal information omitted)

	Respondant	1	2	3	4	5	6	7	8	9	10	11	12
StartDate	Start Date	[redacted]											
EndDate	End Date												
Status	Response Type												
IPAddress	IP Address												
Progress	Progress												
Duration (in s	Duration (in seconds)												
Finished	Finished												
RecordedDate	Recorded Date												
LocationLatitu	Location Latitude												
LocationLongi	Location Longitude												
DistributionCh	Distribution Channel												
UserLanguage	User Language												
QID1	First Name												
Q2	Last Name												
Q3	Email Address												
Q4	Phone Number												
Q5	Do you have a child with special needs due to developmental disability?	Yes			No	Yes	Yes						
Q5	What year was your child born?	1979				1991	1988						
Q6	What month and date was your child born? (mm/dd)	12/79				11/21	11/20						
Q7	What city were you living in during your pregnancy?	San Jose				San jose	San Jose						
Q8	Where were you living during your pregnancy (street address)?	19th street San Jose				725 Harrison Street, San Jose, CA	6570 Boston Post Court						
Q9	How old was your child when you learned that she/he/they had a developmental disability?	Unfortunately I can't remember right now-I believe around somewhere around 2 to 4 years old				10 months	1 1/2 yea4s						
Q10	How did you learn that she/he/they had a developmental disability? - Selected Choice	I sought out medical advice				Doctor informed me	Other (specify below)						
Q10_4_TEXT	How did you learn that she/he/they had a developmental disability? - Other (specify below) - Text						I saw subtle differences in his mannerisms						

Q11	What were you told about this disability?	No				Gross neurological impact because the development of her brain stopped at the beginning of the 2nd trimester.	That without brain surgery he would die. That it would take years for him to improve, that he would be delayed and they were not sure how much he could learn and even still how long he might live.							
Q12	Is your child attending special education classes?	Not at the time but they did in the past				Not at the time but they did in the past	No							
Q15	What school or facility is your child enrolled in special ed?													
Q16	When (month/year) did your child last attend special ed classes?	I can't remember the year but he was 24 I believe				May 2013								
Q17	What school or facility did your child attend for special ed classes?	Rouluea Childrens Center				San Jose unified school district pre-k thru post secondary								
Q18	Does your child live with you at this time? - Selected Choice	Yes				Yes	Yes							
Q18_6_TEXT	Does your child live with you at this time? - Other - Text													
Q19	Do you get in home support service assistance to help care for your child?	Yes				Yes	No							
Q19	During your pregnancy did you work outside the home?	Yes				Yes	Yes							
Q20	What kind of work did you do when you were pregnant?	Electronic Assembly				Office Work	Other							
Q21	Where was your job located? (be as specific as possible)	Mountain View California												
Q22	Who was the employer?	Spectra physics												
Q23	How many hours per week did you usually work?	40-48 hours per week												
Q24	What were your basic job duties?	Spraying frit on a small end of tube- cleaning with another substance I can't remember what it was called												
Q25	About how long before your child 's due date did you stop work at this job?	I believe it was two weeks before due date												

Q26	As far as you recall did you use and/or work around any cleaning solvents, chemicals, solders, or sprays in your job?	Yes												
Q27	What solvents, chemicals, solders and/or sprays do you remember using or working around?													
Q28	How much time did you work around each such material on a typical day?													
Q29	What odors do you recall smelling if any, when working around any such material (be specific)?													
Q41	Were you provided PPE (personal protective equipment)?													
Q30	What PPE (personal protective equipment) were you provided? (select all that apply) - Selected Choice													
Q30_3_TEXT	What PPE (personal protective equipment) were you provided? (select all that apply) - Other (specify) - Text													
Q31	If you were given a mask to wear were you still able to smell chemicals in your area?													
Q32	If you were working around chemicals at your job did you ever feel the following symptoms? (select all that apply) - Selected Choice													
Q32_4_TEXT	If you were working around chemicals at your job did you ever feel the following symptoms? (select all that apply) - Other (specify) - Text													
Q33	Did you ever see anyone taking samples of the air in the area where you worked?													
Q34	If so, were you informed of the results of the samples?													
Q35	What were you told regarding the samples?													
Q36	At work were you told that was safe?													
Q42	At work were you told that everything was within legal limits?													
Q37	During your pregnancy were you ever evacuated at work because of chemical fumes or vapors?													
Q38	Did you ever go to the nurse at work because you were not feeling well?													
Q39	If you did seek medical attention, what were you told?													

Appendix E

Survey Outreach Flyers (English, Spanish, and Vietnamese)


Con bạn có bị khuyết tật khiến chậm phát triển?
và
Bạn đã làm việc trong ngành công nghiệp điện tử trong khi mang thai?
KHI BẠN MANG THAI MỖI NGÀY NGHĨA LÀ ĐƯA CON BẠN ĐẾN SỞ MỖI NGÀY
quét mã khảo sát
Nếu bạn...
Làm việc trong ngành công nghiệp điện tử, đang mang thai con trẻ bị khuyết tật phát triển bẩm sinh, chúng tôi muốn lắng nghe ý kiến của bạn
Tham gia cuộc khảo sát của chúng tôi
Phản hồi của bạn có thể giúp xác định các mối nguy hiểm trong công việc góp phần gây ra khuyết tật phát triển ở con cái
Tham gia cuộc khảo sát ở đây
[bit.ly/safejobs_healthyfamilies]
Câu hỏi? Xin liên lạc
Nhắn tin 408.412.0090
survey@safejobshealthyfamilies.org
www.safejobshealthyfamilies.org