Essential Chemistries

Providing Benefits Across the U.S. Economy

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U.S. Chamber of Commerce

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Executive Summary

The U.S. Chamber of Commerce (USCC) engaged third-party experts in environmental and economic policy to evaluate the economic and fiscal impacts of specific sectors reliant on essential fluorochemistries across the U.S. economy. This report examines the dependence of seven critical U.S. sectors, including aerospace manufacturing, data centers, defense equipment and systems, energy transition, health care, mobility, and semiconductors on essential fluorochemistries, including per- and polyfluoroalkyl (PFAS) substances. Essential fluorochemistries are vital for numerous technologies due to their reliability, effectiveness, and durability. Exploring replacements across these sectors is complex and challenging and will likely take decades. This study primarily addresses the key uses of fluoropolymers, fluorinated gases (f-gases), and other fluorinated substances, such as heat transfer fluids. Fluoropolymers are a type of extremely durable plastics that exhibit performance characteristics such as extreme heat, friction, chemical, and water resistance. F-gases are a group of synthetic gases that commonly include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), hydrofluoroolefins (HFOs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) and are often used as refrigerants and support important applications, including fire suppression and meter dose inhalers. Fluoropolymers and f-gases are key inputs to the seven critical sectors.

- **Aerospace manufacturing.** Ensure safety, efficiency, and reliability through their use in critical components, such as fuel systems, hydraulic fluids, and high-performance coatings.
- **Data centers.** Rely on f-gases to cool electronic components and in fire suppression systems.
- **Defense.** Requires them for critical applications, such as guided missiles, vehicles, and military personal protective equipment (PPE).
- **Energy transition and emerging energy technologies.** Contain coatings for solar panels, wind turbine towers and blades, and subcomponents of lithium-ion batteries for energy storage systems and electric vehicles.
- **Health care.** Uses primarily for medical device technologies, packaging drugs and medical equipment, and refrigerating drugs.
- **Mobility.** Employs in almost all aspects, from the semiconductors used for automatic controls to necessary engine coolants, in comfort heating and cooling, and in the production of automotive hoses, seals, and gaskets.
- **Semiconductor manufacturing:** Utilizes throughout semiconductor manufacturing, including in process chemistries, manufacturing equipment, and facilities infrastructure for integral performance properties not found in fluorine-free alternatives.

The U.S. Chamber, in collaboration with FTI Consulting, compiled this report to identify the materials and processes in each sector that are most vulnerable to the loss of essential fluorochemistries. We estimate the potential lost economic output, employment, labor income, and GDP, as well as the lost fiscal impacts for federal, state, and local governments should these fluorochemistries become unavailable as shown in Table 1. The share of the seven sectors dependent on essential fluorochemistries supports approximately 6.1 million jobs that would be at risk if these chemistries were no longer available. Furthermore, these sectors support over $2.4 trillion in output, nearly $1 trillion in GDP, over $550 billion in labor income, and over $200 billion in combined federal, state, and local tax revenues.

Table 1 – The Economic and Fiscal Impact of Selected Sectors Dependent on Fluorochemistries

Metric	Total Impacts	Unit
Employment	6.1	Million Jobs
Output	$2,413	(2024 $ billions)
GDP	$988	(2024 $ billions)
Labor Income	$553	(2024 $ billions)
Federal Tax Revenues	$140	(2024 $ billions)
State and Local Tax Revenues	$69	(2024 $ billions)

Table 2 – The Employment Impact of Selected Sectors Dependent on Fluorochemistries

Sector	Direct Jobs (thousands)	Indirect Jobs (thousands)	Induced Jobs (thousands)	Total Jobs (thousands)
Mobility	977.8	856.7	723.5	2,557.9
Semiconductors	293.2	526.0	531.2	1,350.4
Air Travel	387.1	76.8	251.5	715.4
Data Centers	139.5	324.7	191.5	655.6
Health Care	126.1	108.8	130.5	365.4
Defense	99.6	50.9	92.2	242.7
Energy Transition	77.0	67.0	68.4	212.3
Total	**2,100.2**	**2,010.7**	**1,988.8**	**6,099.7**

Table 2 depicts the U.S. job contribution of each of the seven sectors dependent on essential fluorochemistries.

Introduction and Context

Scientific breakthroughs in the mid-1900s led to the discovery of per- and polyfluoroalkyl substances (PFAS).[1] PFAS are a group of synthetic fluorine-based chemistries defined as having a chain of carbon and fluorine atoms linked together.[2] They are known for their exceptional strength and durability.[3] These essential fluorochemistries support the foundation of the modern economy, sustaining critical functions across many sectors.

Types of fluorochemistries are used in consumer products such as food packaging, cosmetics, and water-repellent materials despite the availability of potential replacement options. In food packaging, these chemicals have been used to provide grease resistance, but alternatives like wax-coated paper and biodegradable polymers can achieve comparable results. In cosmetics, PFAS can offer waterproofing and enhanced product texture and durability.[4] However, non-fluorinated alternatives have been identified to provide comparable results.[5] Water-repellent materials, commonly treated with PFAS, can instead utilize silicone or other coatings that offer comparable performance.[6] Companies in these selected sectors have made certain commitments to utilize alternatives where available.

Nevertheless, due to their exceptional performance and durability, fluorochemistries have proven to be indispensable, especially but not limited to the seven targeted sectors in this report— aerospace manufacturing, data centers, defense, energy transition, health care, mobility, and semiconductors. These chemistries add significant value to the U.S. economy, which is highlighted by the lack of available replacements in these sectors, with most viable alternatives, if feasible, projected to take 5 to 20 years to develop and implement. In the defense and semiconductor sectors, for example, some applications have undetermined time frames to create replacements for fluorochemistries.[7]

The U.S., along with many other countries worldwide, is considering public policies that could threaten the existence of all fluorochemistries and therefore cause severe disruption to our economy and the everyday products consumers depend on.

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1 https://pfas-1.itrcweb.org/wp-content/uploads/2020/10/history_and_use_508_2020Aug_Final.pdf

2 https://www.americanchemistry.com/chemistry-in-america/chemistries/fluorotechnology-per-and-polyfluoroalkylsubstances-pfas

3 While these essential fluorochemistries are useful, environmental and health concerns have been raised due to the fact that the fluorine-carbon bond is so strong. These chemicals are slow to break down, causing buildup throughout the environment.

4 https://www.fda.gov/cosmetics/cosmetic-ingredients/and-polyfluoroalkyl-substances-pfas-cosmetics

5 https://one.oecd.org/document/ENV/CBC/MONO(2024)4/en/pdf

6 https://www.coatingsworld.com/buyersguide/profile/siltech-corp/view_where-silicon-materials-can-replace-pfas/

7 https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/Report-on-Critical-PFAS-Substance-Uses.pdf

This report summarizes the necessary uses of fluorochemistries required to support essential economic and societal functions across aerospace manufacturing, data centers, defense, energy transition, health care, mobility, and semiconductors. Combined, the share of these sectors dependent on essential fluorochemistries supports an estimated 6.1 million direct, indirect, and induced jobs across the U.S. economy.

To estimate the contribution of essential fluorochemistries to the U.S. economy, each of the seven selected sectors have been assigned a percentage or share of market value, indicating the extent to which the sector depends on fluorochemistries. Sectors that are entirely reliant on fluorochemistries and have no viable alternatives are assumed to be fully impacted, meaning that any disruption in essential fluorochemistries' supply would impact the entire production of the sector. For example, the automobile industry currently has no practical alternatives and is not expected to adopt substitutes on an industrywide scale for at least 15 years.[8] Therefore, this entire sector's contribution to the U.S. economy is included in the results. In some cases, like pharmaceuticals, where fluorochemistries are used mainly in packaging and refrigeration, only a portion of the sector's contribution to the overall economy is included.

8 https://echa.europa.eu/documents/10162/57812f19-8c98-ee67-b70f-6e8a51fe77e5

Methodology and Approach

The IMPLAN Model

IMPLAN is a leading provider of commercial input-output (IO) models with its namesake IMPLAN model. IMPLAN is an IO model of regional and national economies, such as the economies of the U.S., Canada, European nations, and other developed economies globally.

IO models are a widely used economic tool that helps analyze the connections between different sectors of an economy. These models provide a way to measure the flow of goods and services between industries, representing all transactions occurring between sectors. They illustrate how the output of one sector becomes the input of another, creating a network of interdependencies. IMPLAN uses a Leontief Production Function, which is a type of IO model that describes the relationship between inputs and outputs in an economy assuming fixed proportions of inputs required to produce a unit of output across different sectors or industries.

Key Outputs

IMPLAN produces six main metrics, which are defined as the following:

Employment—The number of jobs identified are those supported in the sectors dependent on essential fluorochemistries.

Output—The value of an industry's production output is the sum of sales to final users (e.g., GDP) plus the sales to other industries (intermediate inputs). It is a measure of total economic activity.

GDP—GDP, or value-added, is defined as the total market value of all final goods and services. It is a measure of the wealth created by economic activity.

Labor Income—The household income provided is that which is supported by the jobs dependent on essential fluorochemistries.

Federal Tax Revenues—Incremental tax revenues for the federal government are included because of higher levels of economic activity, such as higher income tax payments.

State and Local Tax Revenues—Incremental tax revenues for state and local governments are also included because of higher levels of economic activity, such as higher sales tax payments.

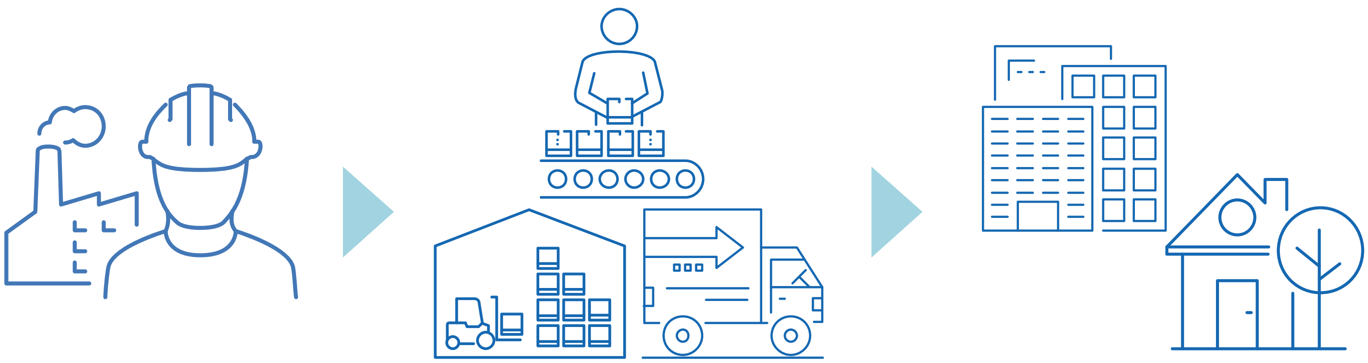
IMPLAN calculates how a direct change in employment or expenditures, the direct impact, will then influence the rest of the economy. IMPLAN describes these ancillary or ripple effects through its indirect and induced multiplier effects as shown in **Figure 1**.

Figure 1

Direct Effects
Immediate impacts of a specific economic activity.

Indirect Effects
Secondary impacts resulting from the initial economic activity.

Induced Effects
Tertiary impacts caused by increased household income generated by direct and indirect effects.



Example: Building a new factory creates direct effects like job creation and increased local spending.

Example: The factory construction boosts demand for raw materials, transportation services, and other industries, creating additional jobs and income.

Example: Employees of the new factory spend their wages on goods and services, stimulating further economic activity and supporting local businesses.

The types of IMPLAN effects are defined as follows:

- ***Direct Effect:*** The direct effect is the direct employment or output associated with the production of products containing essential fluorochemistries. Examples include automobiles or airplane manufacturing.
- ***Indirect Effect:*** The indirect effect is the impact on the regional or national supply chain. For instance, automobile manufacturers may purchase finished tires from a tire company. Service sectors, such as legal or accounting, that may be employed by the manufacturer would also have indirect impacts.
- ***Induced Effect:*** The induced effect is the consumer expenditures supported by the wages paid to the employees of the direct and indirect economic sectors.

Total Effect: The total effect is the sum of the direct, indirect, and induced impacts.

Aerospace Manufacturing Sector Modeling

Essential fluorochemistries are vital to the aerospace manufacturing sector, with critical applications along the value chain and production stages. Their primary uses include hydraulic systems, wiring, and insulation due to their durability, high-temperature resistance, and corrosion protection. In hydraulic systems, fluoropolymers create high pressures with minimal water usage and protect metals from corrosion by altering electrical potential. Fluoropolymers are also utilized in aircraft components like seals, gaskets, and wiring insulation because of their high strength, lightweight, chemical resistance, and low friction properties. Additionally, f-gases are used in fire suppression systems.

There are currently no feasible alternatives to many uses of essential fluorochemistries in the aerospace manufacturing sector, where they are crucial for insulation, high-temperature permeability, and clear displays.[9] As such, all the sectors in the IMPLAN model related to the production of aircraft were included in the analysis, and their total direct, indirect, and induced impact on the U.S. economy was modeled.[10] Note, this analysis only examines the role of fluorochemistries in aerospace manufacturing rather than the entire air travel sector, including airlines.

Data Centers Sector Modeling

Data centers are a fixture of today's digitally connected society, and the sector is projected to grow rapidly. It is projected that over the next four years, there will be some 120–130 hyperscale data centers coming online, fueling the U.S. data center market that is expected to exceed $99 billion in total revenue by the end of 2024.[11,12] Essential fluorochemistries, including low global warming potential (GWP) f-gases, play a critical role in large-scale temperature control at data centers, both through traditional temperature control techniques and through new technologies, such as two-phase immersion cooling (2-PIC).[13] In traditional large-scale temperature control, f-gases are used in air-cooling systems for electronic components. In 2-PIC, electronic components are submerged in a fluorochemical heat transfer liquid with a low boiling point.[14] As the chemical evaporates, the rising vapor helps cool the components. The chemical then condenses and returns to the system, creating a closed loop. Additionally, f-gases play an important role in fire suppression systems in many data centers.

If these fluorochemistries were no longer available, data centers would be forced to find alternatives. To estimate the overall impact of data centers on the U.S. economy, the total revenue of the data center market

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9 https://echa.europa.eu/documents/10162/57812f19-8c98-ee67-b70f-6e8a51fe77e5

10 Note, IMPLAN does not differentiate between civilian and military aircraft manufacturing. As such, all aircraft, including military aircraft, are included in the aerospace manufacturing sector.

11 https://www.statista.com/outlook/tmo/data-center/united-states

12 https://www.srgresearch.com/articles/hyperscale-data-centers-hit-the-thousand-mark-total-capacity-is-doubling-every-four-years

13 https://www.chemours.com/en/pfas-advocacy/data-centers

14 https://www.gigabyte.com/Solutions/liquidstack-two-phase

was allocated across states based on the total number of data centers located in each state.[15] For example, Virginia, home to approximately 13% of all data centers in the U.S., was assigned 13% of the total data center market revenue. In each state, the total estimated revenue was modeled to estimate the direct, indirect, and induced economic contribution of data centers.

Defense Equipment and Systems Sector Modeling

The defense sector relies on essential fluorochemistries due to their unique properties that are needed in the development, production, and operation of critical equipment used by the Armed Forces.[16] Fluorochemistries contribute significant capabilities to national security because they provide exceptional thermal stability, chemical resistance, and performance in extreme environments, which are properties integral to mission-critical applications.[17]

Fluoropolymers are used in pyrotechnics and in the manufacture of munitions for missile systems.[18] In addition, fluorochemistries are used in firefighting foams used in military vessels and vehicles. Fluoropolymers are also used in coatings and other materials to enhance water and oil repellency and increase heat resistance.[19] Fluoropolymers like polytetrafluoroethylene (PTF) are used on textiles for manufacturing PPE, such as suits to guard personnel from chemical and biological threats. Additionally, most refrigerants used in military cooling and refrigeration applications can be classified as PFAS. Known non-PFAS alternatives may pose flammability, toxicity, or high-pressure concerns.[20] Currently, there are no viable replacements for essential fluorochemistries used to manufacture critical components used in the defense sector. The timeline for alternatives is projected to take at least 5 to 20 years.[21]

To quantify the economic impact of the share of the defense industry dependent on essential fluorochemistries, the IMPLAN model analysis assessed the economic impact of essential fluorochemistries to four defense applications—PPE, guided missiles, radar systems, and military tank manufacturing. The IMPLAN model contains individual sectors for guided missile manufacturing and military tank manufacturing. Because of a lack of viable alternatives, these sectors were included in the analysis, and their total direct, indirect, and induced impact on the U.S. economy was modeled.

Estimating the impact on the manufacturing of PPE and radar systems was more challenging to model because these businesses are subsectors of broader IMPLAN manufacturing sectors. FTI reviewed each subsector within the

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[15] https://www.datacentermap.com/usa/

[16] https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/Report-on-Critical-PFAS-Substance-Uses.pdf

[17] Ibid.

[18] Ibid.

[19] Ibid.

[20] Ibid.

[21] Ibid.

surgical appliance and supplies manufacturing sector, where PPE manufacturing is classified. Just 4 out of the 84 subsectors in this sector applied to the manufacturing of PPE, leading to the assumption that 4.8% of the larger sector would be affected.

The same methodology was applied to radar systems, where fluorochemistries are critical in the production of semiconductors, lithium batteries, and other critical electronic components along the defense supply chain.[22] Following a review of each subsector within the search, detection, and navigation instruments manufacturing sector within the IMPLAN model where radar systems are classified, it was assumed that only 1.7% of the broader sector is dependent on essential fluorochemistries. In both the PPE and radar cases, the share of the sector identified as dependent on fluorochemistries was used to model the direct, indirect, and induced economic contribution of the subsectors across states.

Energy Transition Sector Modeling

Essential fluorochemistries play a crucial role in renewable and clean energy technologies, such as solar panels and wind turbines. They are also integral to battery energy storage systems, electric vehicles, and the lithium-ion batteries that power them. These applications are vital to advancing the energy transition.[23]

In the wind and solar sector, fluoropolymer coatings help equipment withstand rain, hail, and environmental contaminants.[24] Fluoropolymers are used in paints and coatings on wind turbine towers and blades to provide weather resistance and increase service life.[25] Moreover, manufacturers use fluoropolymers in subcomponents in lithium-ion batteries, such as heat transfer materials or insulation.[26] The Department of Defense estimates that fully eliminating fluorochemistries from battery energy storage would likely take more than 10 years.[27]

To model the economic contribution of wind energy component manufacturing in the U.S., the total nationwide manufacturing capacity (in gigawatts) of towers, blades, and nacelles was identified from the U.S. Department of Energy's *Land-Based Wind Market Report: 2023 Edition*.[28] The total component cost per kilowatt was identified from the National Renewable Energy Laboratory's 2022 *Cost of Wind Energy Review*.[29] This data was used to estimate the total market size of each of the tower, blade, and nacelle manufacturing sectors in the U.S. This total market size was then allocated across states based on known

[22] Ibid.

[23] https://www.chemours.com/en/pfas-advocacy/solar-wind-energy

[24] https://fluoropolymerpartnership.com/fluoropolymer-applications-and-uses/energy/

[25] https://www.chemours.com/en/pfas-advocacy/solar-wind-energy

[26] https://www.acq.osd.mil/eie/eer/ecc/pfas/docs/reports/Report-on-Critical-PFAS-Substance-Uses.pdf

[27] Ibid.

[28] https://www.energy.gov/sites/default/files/2023-08/land-based-wind-market-report-2023-edition.pdf

[29] https://www.nrel.gov/docs/fy24osti/88335.pdf

locations of tower, blade, and nacelle manufacturing facilities. In total, the total revenue of wind tower, blade, and nacelle manufacturers was estimated at over $10 billion.

Similarly, the total 2023 U.S. value of shipments of solar panels was identified from the U.S. Energy Information Administration (EIA) and allocated across states using the locations and manufacturing capacity of facilities.[30,31] The EIA provides data on 90% of shipments; after scaling to 100%, it was estimated that the size of the solar panel market in the U.S. was nearly $13 billion. Finally, lithium-ion battery pack prices were combined with the location and manufacturing capacity of battery manufacturing facilities across the U.S. to estimate total market size across states., The U.S. lithium-ion battery market was estimated at nearly $16 billion.

In each case, the estimated revenue for individual components was mapped to appropriate IMPLAN sectors (such as fabricated structural metal manufacturing for wind towers or storage battery manufacturing for lithium-ion batteries) and used to model the direct, indirect, and induced economic contribution of the sector across states.[32,33]

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Health Care Sector Modeling

Fluoropolymers and f-gases play a crucial role in the health care sector owing to their limited chemical reactivity, strength, low friction, and role as insulators.[34] Medical device technologies, packaging for drugs and medical equipment, surgical tools that require sterilization, and refrigeration for pharmaceutical components like vaccines rely on the properties of fluorochemicals that are currently irreplaceable.[35,36] Some pharmaceuticals may be at risk; broad definitions of PFAS would include common medicines, such as Prozac and Lipitor.[37]

The use of fluorochemistries in the pharmaceutical industry is prevalent but not reflected in the ingredient list for the drugs themselves. Instead, fluoropolymers are

[30] https://www.eia.gov/renewable/monthly/solar_photo/

[31] https://www.solarpowerworldonline.com/u-s-solar-panel-manufacturers/ Note, additional desktop research was performed to identify the available production capacity of both operating and partially operating plants.

[32] https://about.bnef.com/blog/lithium-ion-battery-pack-prices-hit-record-low-of-139-kwh/

[33] https://www.charged-the-book.com/na-ev-supply-chain-map

[34] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/overly-broad-pfas-restrictions-could-endanger-healthcare-quality-and-cost

[35] https://www.advamed.org/wp-content/uploads/2024/03/One-pager-final-PFAS-AdvaMed-2023.08.22.pdf

[36] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/overly-broad-pfas-restrictions-could-endanger-healthcare-quality-and-cost

[37] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8933701/

often found in the packaging for drugs, while f-gases are used for the cold cycle refrigeration of drugs that require it.[38,39] Packaging made with fluorochemistries increases the shelf life for drugs and prevents humidity that could damage medicines, while refrigeration is essential for storing and transporting drugs as well as being critical in some labs where drugs are produced.[40,41] Since both the exact amount of f-gases and fluoropolymers used in the packaging and cooling and the extent to which existing drugs could be classified as PFAS are unknown, 30% of the pharmaceutical sector in IMPLAN was assumed to be dependent on these fluorochemistries.

Medical device manufacturing could also be affected if essential fluorochemistries were no longer available. Surgical tools manufacturing encompasses items like surgical knives, catheters, and other tools with more specialized applications.[42] Surgical tools must be sterile to ensure that no outside contaminants on the tools enter the patient's body. Fluorochemistries are essential to the sterility of medical devices critical to patient care. For example, in catheters, fluoropolymers help reduce the likelihood of clots and reduce the friction on the outside of the catheter to help with patient comfort.[43] Not all surgical tools included in the IMPLAN model's surgical tool manufacturing sector rely on fluorochemistries. However, some items rely directly on fluorochemistries, such as inhalers that use them as a propulsion mechanism for medicine.[44,45] Based on a review of each subsector within IMPLAN's surgical tool manufacturing sector, the Chamber and its experts estimated that roughly 22% of the total sector would be affected if essential fluorochemistries were no longer available.

Finally, medical technologies often rely on fluorochemistries. These supplies include medical wires, ventilators, implants like joint replacements, and support equipment like hospital gowns.[46,47,48] Fluorochemistries are also found in packages for medical supplies like needles to ensure they can be sterilized for patient care. Some subsectors in IMPLAN's medical supplies manufacturing sector model directly use plastics and components that would be drastically impacted by a ban. These subsectors were

[38] https://www.chemours.com/en/pfas-advocacy/medical-devices

[39] https://www.advamed.org/wp-content/uploads/2024/03/One-pager-final-PFAS-AdvaMed-2023.08.22.pdf

[40] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/overly-broad-pfas-restrictions-could-endanger-healthcare-quality-and-cost

[41] https://www.chemours.com/en/pfas-advocacy/medical-devices

[42] https://www.chemours.com/en/pfas-advocacy/medical-devices

[43] https://www.energy.gov/sites/default/files/2023-08/land-based-wind-market-report-2023-edition.pdf

[44] https://www.chemours.com/en/pfas-advocacy/medical-devices

[45] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/overly-broad-pfas-restrictions-could-endanger-healthcare-quality-and-cost

[46] https://www.chemours.com/en/pfas-advocacy/medical-devices

[47] https://www.advamed.org/wp-content/uploads/2024/03/One-pager-final-PFAS-AdvaMed-2023.08.22.pdf

[48] https://www.americanchemistry.com/chemistry-in-america/news-trends/blog-post/2023/overly-broad-pfas-restrictions-could- endanger-healthcare-quality-and-cost

assumed to be fully affected if essential fluorochemistries were not available. Other subsectors manufacture goods that do not directly rely on fluoropolymers but rather are sterilized with fluorochemistries. For these subsectors, it was assumed that 30% of the subsector would be affected. The share of each subsector was summed to find the total share of the medical supplies manufacturing sector that could be impacted if essential fluorochemistries were no longer available.

Mobility Sector Modeling

Automobiles and heavy trucks are a part of everyday life for many across the U.S. and consist of thousands of individual parts.[49] For many, cars are not just a convenience but a necessity, enabling mobility and independence while supporting economic activity across the country. Recent estimates indicate that 74% of Americans have access to their own car, while only 14% do not have access to any car, including from friends, family, or rideshare options.[50]

Fluoropolymers are essential in mobility applications, especially in improving the performance and lifespan of various components. They are used in engine coolants, lubricants, and coatings to enhance fuel efficiency, minimize wear and friction, and prevent corrosion. Due to their ability to withstand heat, chemicals, and abrasion, fluoropolymers are also employed in the production of automotive hoses, seals, and gaskets.

[49] https://www.chicagofed.org/publications/blogs/midwest-economy/2019/what-do-we-know-about-the-origin

[50] https://www.statista.com/forecasts/997211/car-ownership-in-the-us

Essential fluorochemistries are used extensively in automobiles, heavy trucks, and mobility solutions for mechanical components, electronics, air-conditioning, and electric vehicle (EV) batteries[51] due to their durability, heat, water, oil, and chemical resistance. Key applications include the following:

- ***Mechanical Components:*** Fluoropolymers are essential in manufacturing automotive lubricants, fuel hoses, seals, and gaskets. They provide critical properties such as water and oil repellence and resistance to extreme temperatures.
- ***Air-Conditioning Systems:*** Both combustion and electric vehicles use f-gases. HFC-134a is a common coolant with a GWP of 1,430, which replaced ozone-depleting CFC-12 coolants.[52] Advancements in the field have led to replacement options for HFC-134a with more environmentally friendly alternatives, such as lower GWP HFCs, HFC blends, and HFOs.[53]
- ***Electronics:*** There are an average of 1,000–3,000 semiconductors in modern vehicles. These are vital for safety features, fuel efficiency, infotainment, navigation, and electronic systems like power windows and door locks.
- ***Electric Vehicle Batteries:*** PFAS are critical in lithium-ion battery production and are used as a separator material to improve electrode adhesion, reduce short circuits, and enhance battery performance and safety. F-gases are also used as coolants to prevent battery overheating during charging.

Essential fluorochemistries contribute to decreased vehicle weight, increased fuel economy, and overall reliability, making vehicles safer and more advanced. They also extend the useful life of vehicles by providing durability and reducing wear and tear.

There are currently no viable substitutes for essential chemistries in the majority of automotive and mobility manufacturing, including critical applications like semiconductors and battery components.[54] Research suggests that it could take at least 15 years to develop and transition to PFAS-free alternatives in key applications like semiconductors and battery components.[55] All sectors in the IMPLAN model related to the production of automobiles were included in the analysis and their total direct, indirect, and induced impact on the U.S. economy was modeled.

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51 Note, IMPLAN does not differentiate between EV and stationary storage battery manufacturing. As such, all batteries, including EV batteries, are included in the energy transition sector to avoid double counting.

52 https://www.epa.gov/mvac/refrigerant-transition-environmental-impacts

53 https://www.epa.gov/sites/default/files/2016-12/documents/international_transitioning_to_low-gwp_alternatives_in_res_and_com_ac_chillers.pdf

54 https://www.semi.org/en/blogs/semi-news/fluorinated-chemicals-are-essential-to-semiconductor-manufacturing-and-innovation, https://echa.europa.eu/documents/10162/57812f19-8c98-ee67-b70f-6e8a51fe77e5

55 Ibid.

Semiconductor Sector Modeling

In 2023, the U.S. exported $52.7 billion worth of semiconductors, making it the leading export in the electronic products category, and placing it sixth overall in total exports.[56] Semiconductors are essential to current and future technological advancements. The manufacturing process of semiconductors involves over 2,000 complex steps and utilizes a wide range of materials.[57] This intricate process relies heavily on chemicals, equipment, and facilities that incorporate fluoropolymers, which are integral to semiconductor production.

Fluorochemistries are used in semiconductor production due to their inertness, cleanliness, low flammability, temperature stability, durability, and other unique performance characteristics. These qualities are especially important in the following applications:

Photolithography: Fluorochemistries are used in critical photolithography formulations like chemically amplified resists, antireflective coatings, barrier layers, and buffer coatings which are essential to nanometer-scale precision in semiconductor devices.

Wet Chemistries: Fluorinated surfactants are added to wet chemistries such as etchants, wet clean chemistries, plating, and planarization to assist with wettability of nanometer-sized device features.

Plasma Etch/Wafer Clean and Deposition: Fluorinated gases are essential for directional etching and cleaning of silicon features and cleaning of chemical vapor deposition chambers.

Articles: Fluoropolymers are contained in semiconductor manufacturing equipment and facility infrastructure for safety, contamination control, resilience, and other factors.

Lubricants: Fluorinated lubricants are essential to the precision and reliability of robotics, automation, and vacuum systems needed to achieve nanoscale precision.

Heat Transfer Fluids: Fluorinated heat transfer fluids and fluorinated refrigerants ensure precise temperature control in specific manufacturing processes and enable testing of semiconductor products to ensure performance.

Assembly, Test, Packaging, and Substrates: Fluorochemistries provide the combination of necessary properties to ensure hermetic sealing, device durability, and other product reliability purposes for packaged semiconductor devices.

[56] https://www.semiconductors.org/wp-content/uploads/2024/05/SIA-2024-Factbook.pdf

[57] https://www.semiconductors.org/wp-content/uploads/2023/05/FINAL-PFAS-Consortium-Background-Paper.pdf

Many materials used in these diverse applications are extremely difficult to replace, and most alternatives to replace fluoropolymers are projected to take more than 15 years to develop.[58] In certain applications such as plasma etch/wafer clean, non-fluorinated alternatives may not be viable substitutes due to the basic chemistry and physics of etching silicon and its compounds. When developing the assumptions for the economic analysis, it was assumed that the semiconductor sector would be fully impacted if essential fluorochemistries were not available.

The total market value of the U.S. semiconductor industry was first determined to be $275 billion using data from the Semiconductor Industry Association's 2023 and 2024 Factbooks.[59,60] The total market value was then proportionally allocated across states using IMPLAN data.

[58] https://www.semiconductors.org/wp-content/uploads/2023/05/FINAL-PFAS-Consortium-Background-Paper.pdf

[59] https://www.semiconductors.org/wp-content/uploads/2024/05/SIA-2024-Factbook.pdf

[60] https://www.semiconductors.org/the-2023-sia-factbook-your-source-for-semiconductor-industry-data/

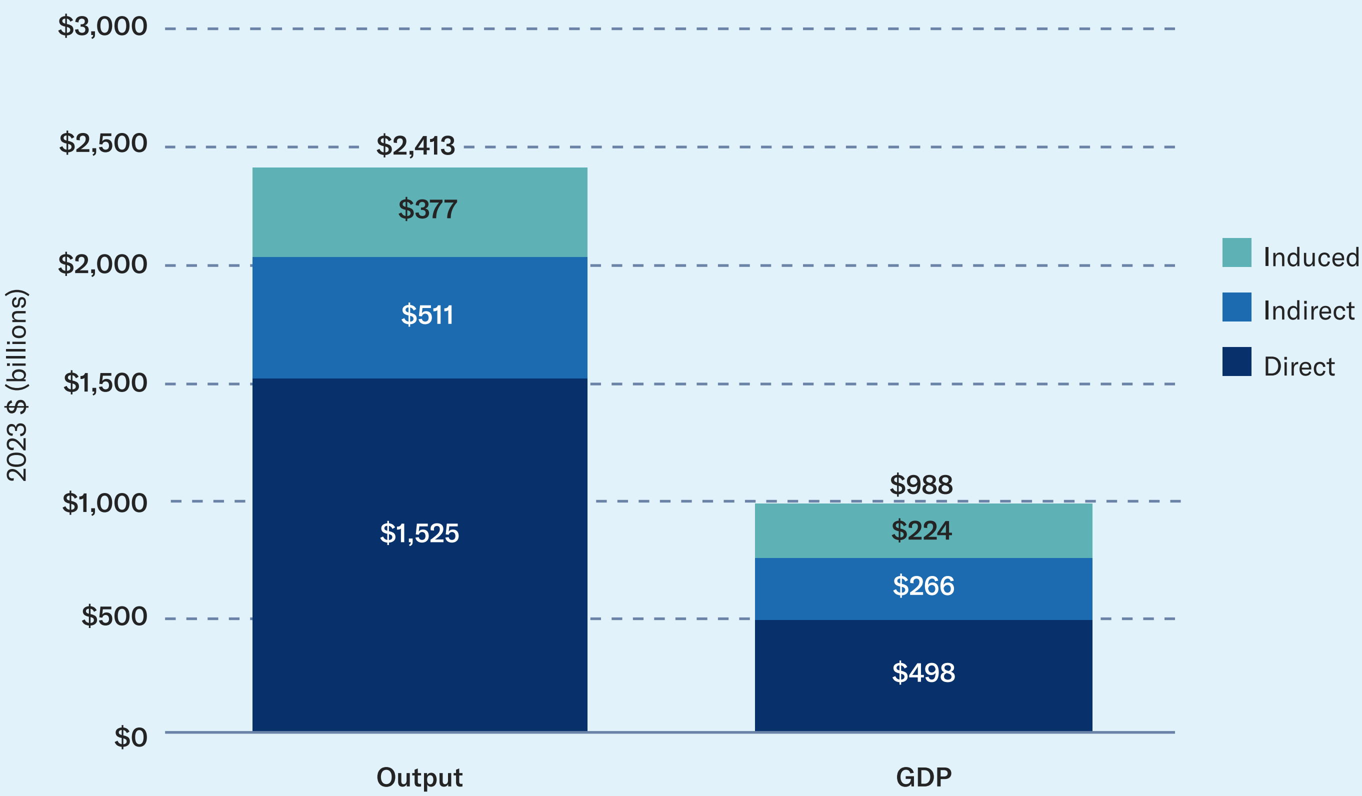
Economic Impact Results

This section describes the economic contribution of the seven selected sectors dependent on essential fluorochemistries to the U.S. economy.

Output and GDP Impacts

In total, these sectors contributed over $2.4 trillion of output to the U.S. economy as summarized in Figure 2. The direct output generated by sectors dependent on essential fluorochemistries surpassed $1.5 trillion. There were also $511 billion of indirect impacts and $377 billion of induced impacts. The seven sectors also support nearly $1 trillion in U.S. GDP.[61] This is equivalent to 3.7% of the total U.S. GDP and is similar in size to that of Saudi Arabia's GDP. Direct, indirect, and induced GDP contributions total $498 billion, $266 billion, and $224 billion, respectively.

Figure 2 – Output and GDP Impacts of Selected Sectors Dependent on Fluorochemistries



[61] https://www.bea.gov/news/2024/gross-domestic-product-fourth-quarter-and-year-2023-second-estimate, https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=SA

Figure 3, summarizes the distribution of economic output impacts of the selected sectors across the U.S. states. California has the highest impact, with over $341 billion in output being generated in the state, followed by Texas and states in the Great Lakes region of the country.

Similar to Figure 3, Figure 4 summarizes the state-level GDP impact of the selected sectors dependent on essential fluorochemistries. GDP results typically mirror output results as GDP is a subset of output. As a result, the largest GDP impacts are seen in California, Texas, and states in the Great Lakes region, such as Michigan, Indiana, and Ohio. In some states, GDP impacts (representing value added) are noticeably lower than output (representing total sales). In regions like the Northeast, a car may be sold in New York, yet manufactured in another state, reflecting leakages across states.

Figure 3—Total Output Impact for States of Selected Sectors Dependent on Fluorochemistries

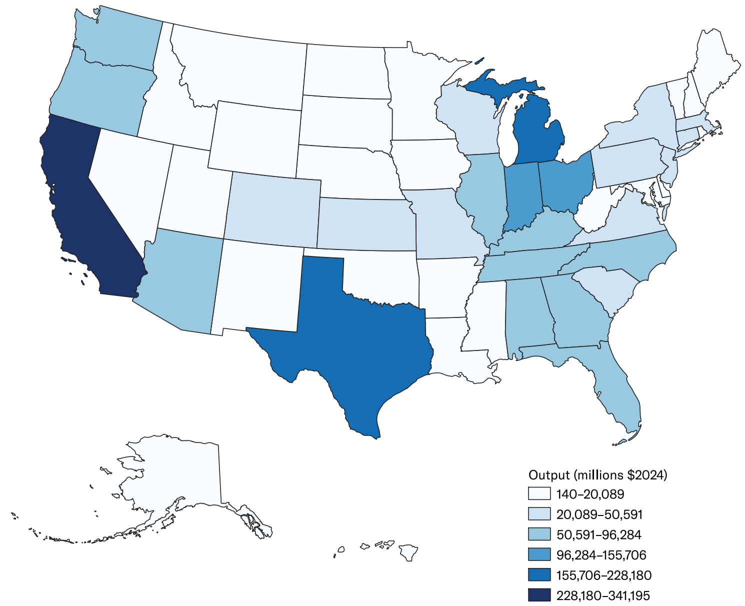


Figure 4—Total GDP Impact for States of Selected Sectors Dependent on Fluorochemistries

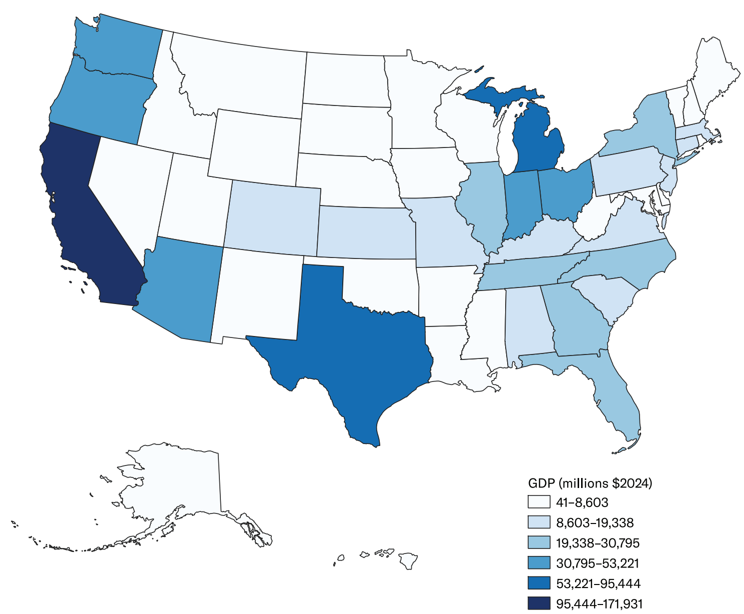


Figure 5 – Employment Impacts of Selected Sectors Dependent on Fluorochemistries

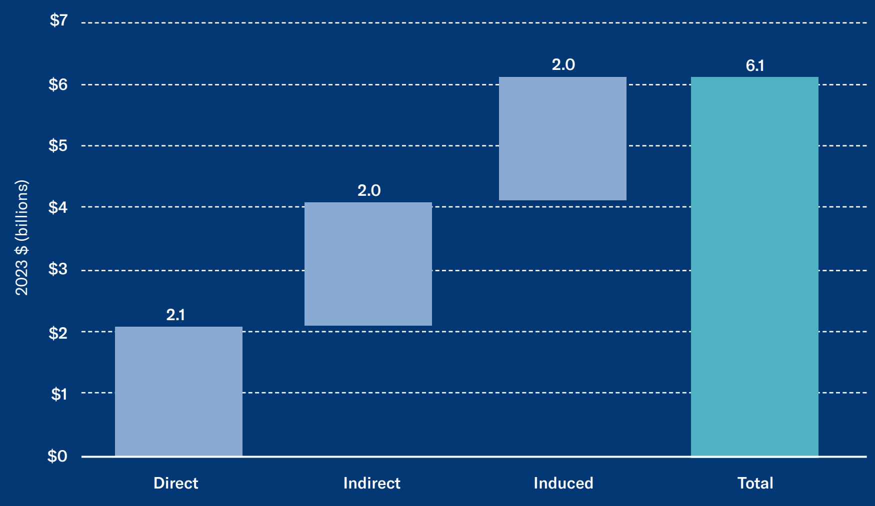
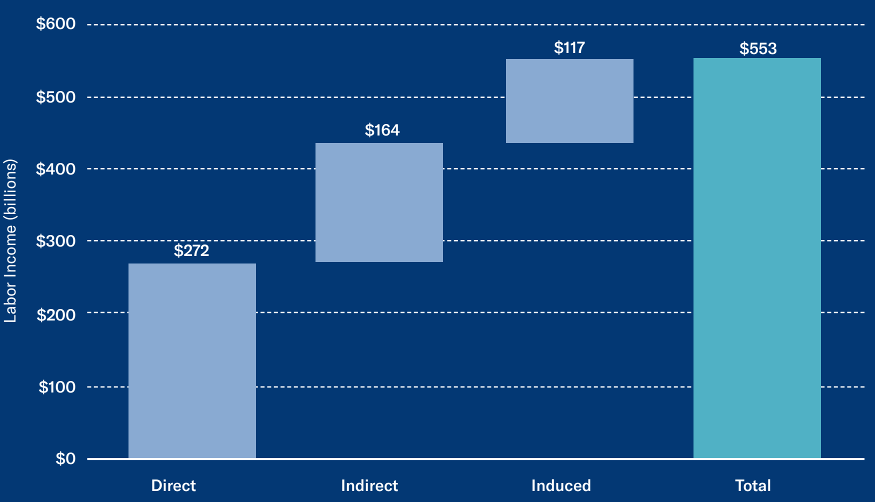


Figure 6 – Labor Income Impacts of Selected Sectors Dependent on Fluorochemistries



Employment and Labor Income Impacts

The selected sectors dependent on essential fluorochemistries support 6.1 million U.S. jobs as seen in Figure 5. Direct employment amounted to 2.1 million jobs, with 2 million jobs each being attributed to both indirect and induced employment.

Figure 6 summarizes the labor income impacts of the selected sectors dependent on essential fluorochemistries. Total labor income impacts are over $550 billion, with direct, indirect, and induced impacts totaling $272, $164, and $117 billion, respectively. The $272 billion in direct labor income is directly associated with the 2.1 million direct jobs across the selected sectors and equates to an average annual salary of $129,500.[62] This amount is close to double the median household income in the U.S. in 2022, indicating that workers in the selected sectors are typically earning well above the average wage for U.S. workers.[63]

[62] 272,000,000,000/2,100,000 = 129,500 rounding to the nearest hundred

[63] https://fred.stlouisfed.org/series/MEHOINUSA646N

Employment impacts are usually proportional to economic output and GDP because higher levels of economic activity generate increased demand for goods and services, leading to more employment opportunities to meet this demand. The state-level employment and labor income impacts of the selected sectors dependent on essential fluorochemistries summarized in Figure 7 and Figure 8 demonstrate that the employment and labor income impacts align with the trends of output and GDP impacts. Comparing labor income and employment reveals slight geographic variations in job distribution and labor income. These differences reflect wage disparities across various states.

Figure 7—Total Employment Impact for States of Selected Sectors Dependent on Fluorochemistries

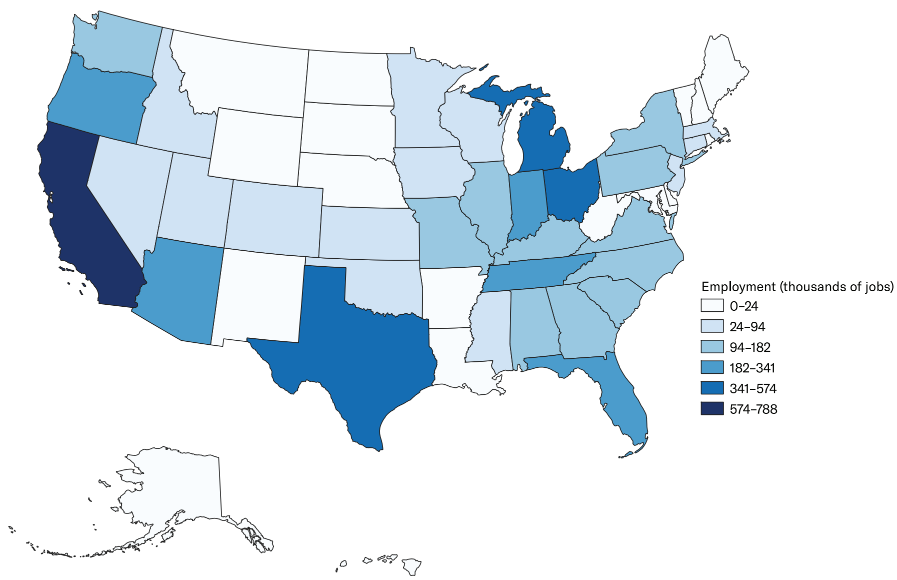
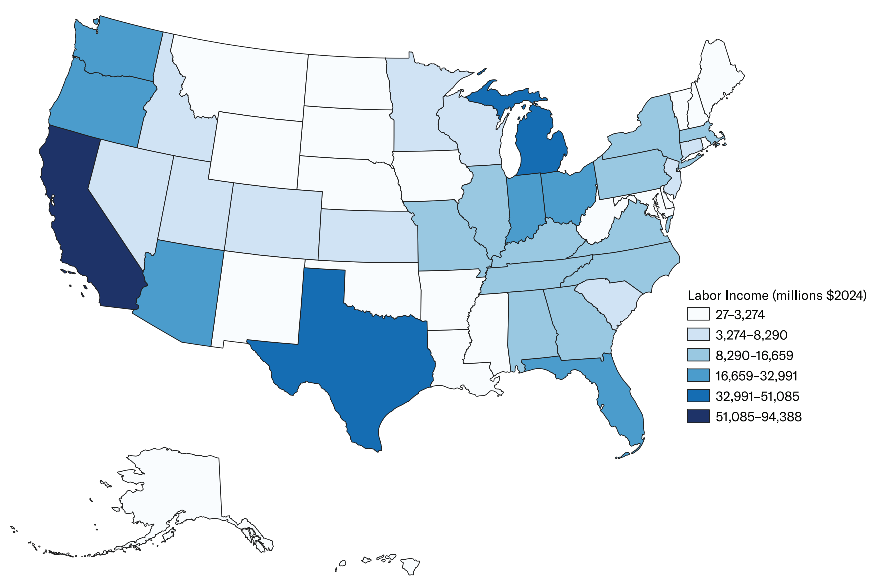


Figure 8—Total Labor Income Impact for States of Selected Sectors Dependent on Fluorochemistries



Federal, State, and Local Tax Revenue Impacts

Figure 9 summarizes the contribution of the selected sectors dependent on essential fluorochemistries to federal, state, and local tax revenues. The total impact on federal tax revenue is $140 billion, with direct, indirect, and induced impacts contributing $67 billion, $44 billion, and $30 billion, respectively.

Figure 9 – Federal, State, and Local Impacts of Selected Sectors Dependent on Fluorochemistries

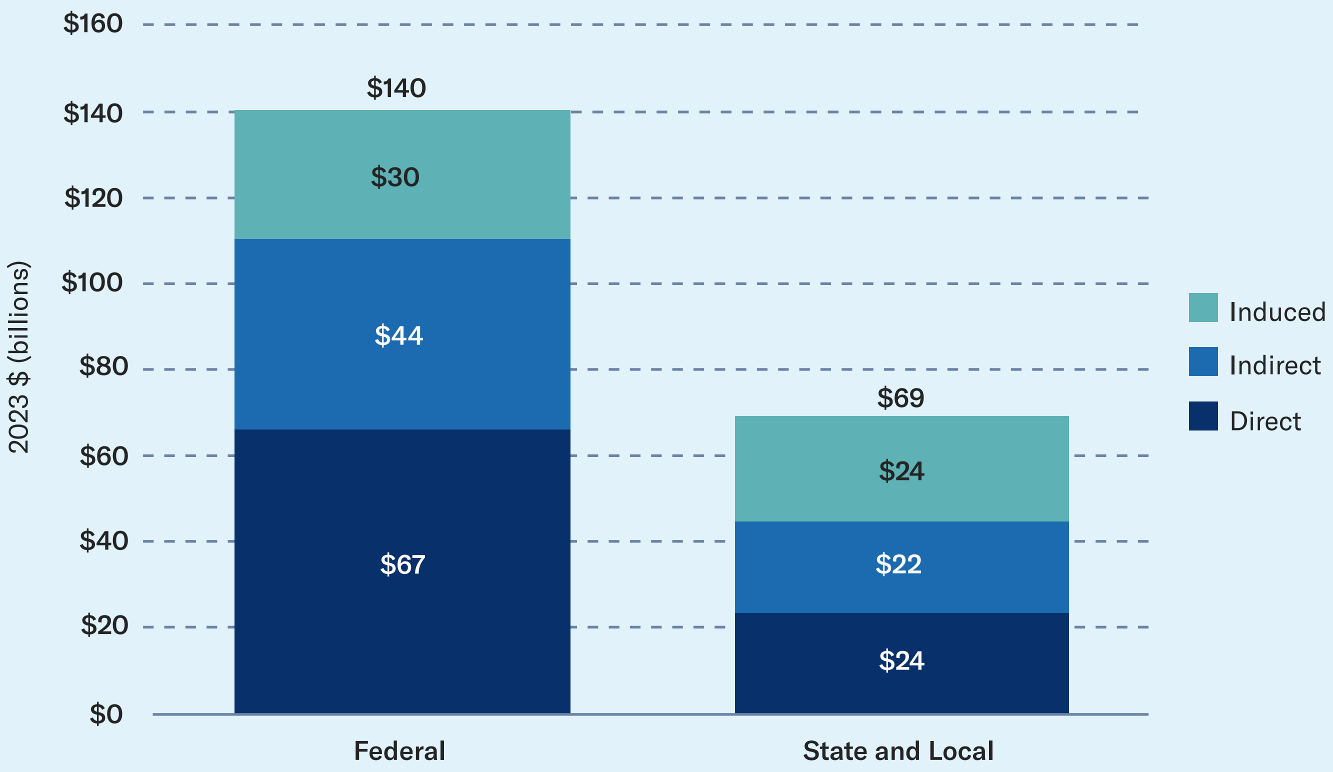


Figure 10 and Figure 11 show the distribution of tax revenues at the state level. These impacts generally follow the same distribution as the previous results. The economic activity of the sectors dependent on essential fluorochemistries generates taxable income and consumption, leading to greater tax collections. Also, state and local tax collection distributions depend on regional tax priorities. This connection is particularly evident in the Northeast, where higher state and local tax rates contribute to increased state and local tax revenue relative to output.

Figure 10—Total Federal Taxes Impact for States of Selected Sectors Dependent on Fluorochemistries

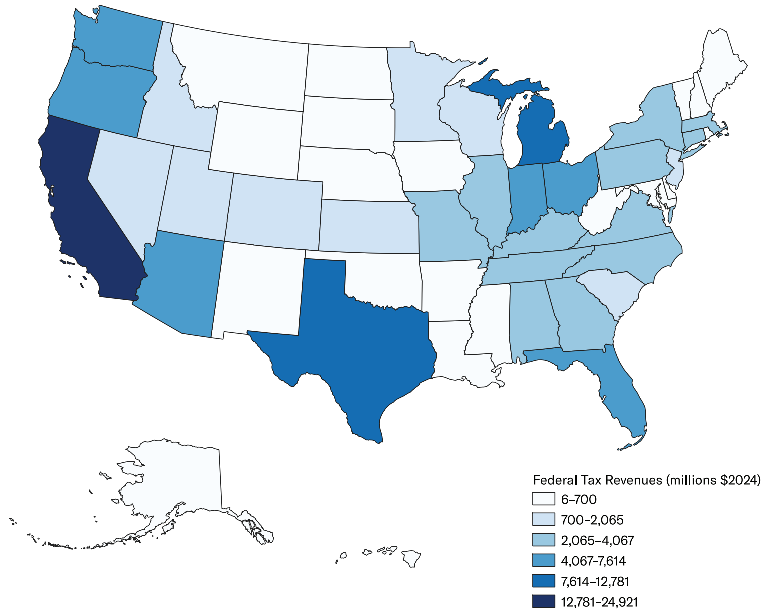
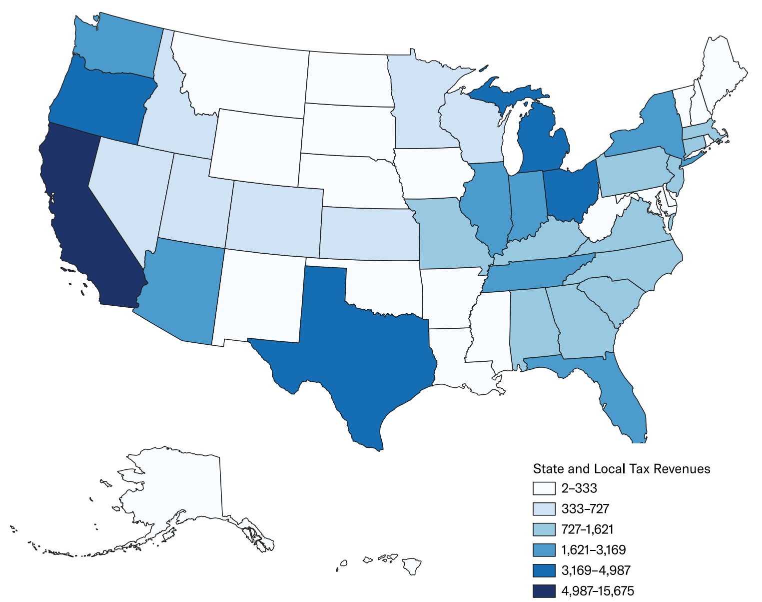


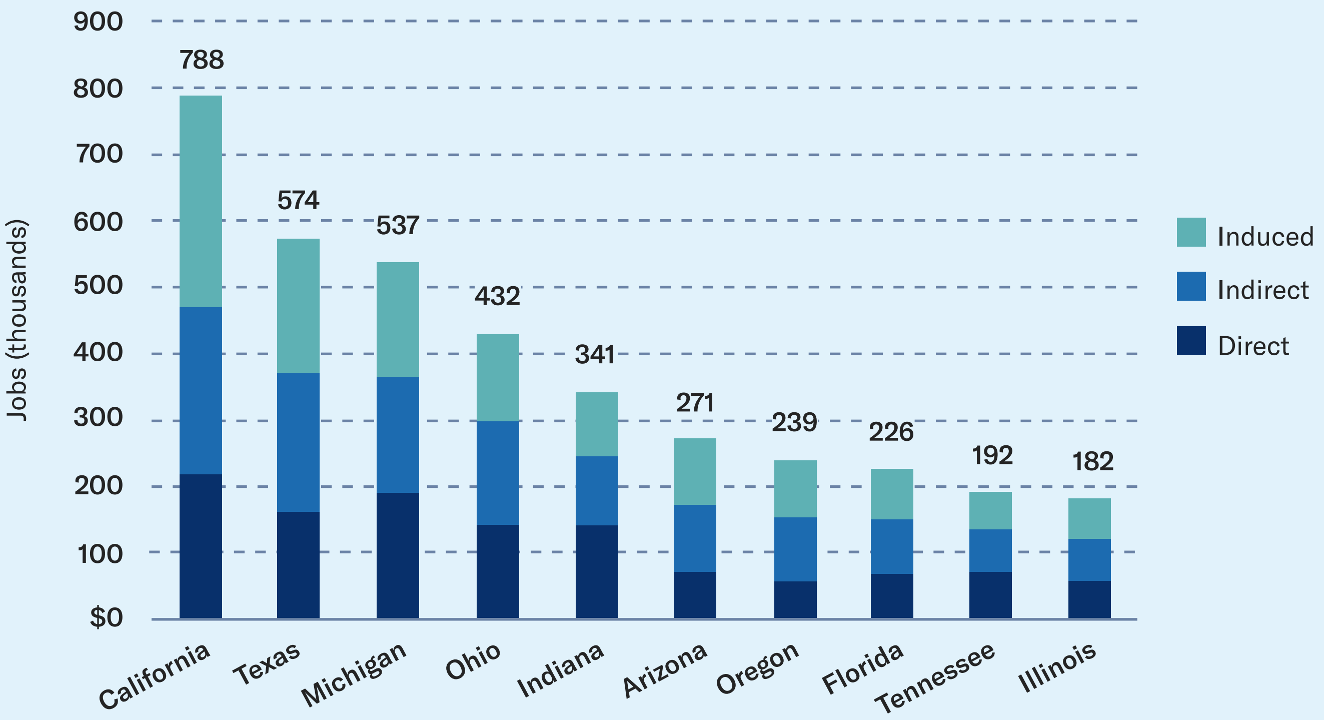
Figure 11—Total State and Local Taxes for States of Selected Sectors Dependent on Fluorochemistries



State and Sector-Specific Results

Figure 12 displays the states with the highest employment across the seven sectors that are dependent on essential fluorochemistries—aerospace manufacturing, data centers, defense equipment and systems, energy transition, health care, mobility, and semiconductors. Noticeably, California, Texas, and Michigan, which are hubs for the semiconductor, data centers, and mobility sectors, respectively, have the most jobs dependent on fluorochemistries.

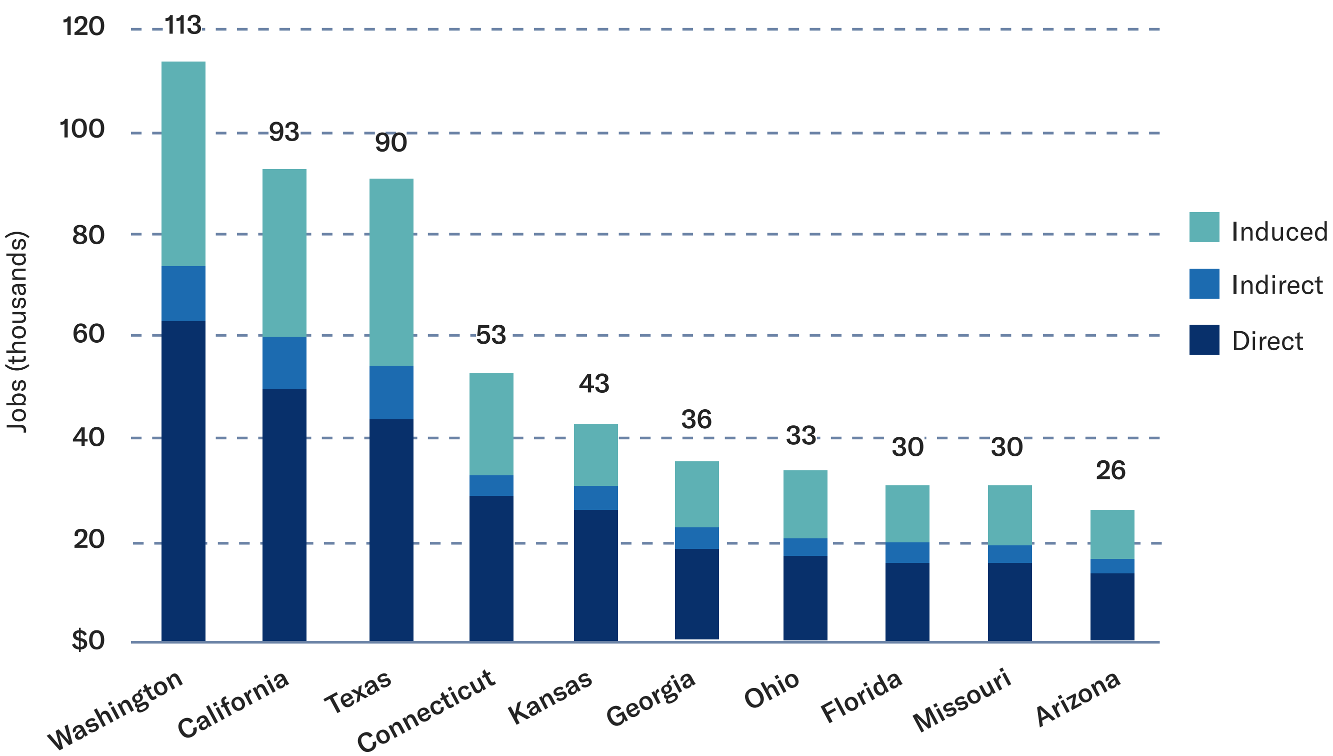
Figure 12—Top 10 States With Employment Dependent on Fluorochemistries



Aerospace Manufacturing

When comparing the top 10 states for aerospace manufacturing in terms of employment, notable states include Washington, California, and Texas as shown in Figure 13.[64] Washington's aerospace-related supply chain is the largest in the U.S., having produced over 33,000 commercial and military aircraft over the last 100 years.[65] California also boasts a strong aerospace sector, along with Texas, which is the biggest recipient of defense spending in the U.S. due to the production of the F-35 Joint Strike Fighter aircraft.[66,67,68]

Figure 13—Top 10 States With Employment in Aerospace Manufacturing Dependent on Fluorochemistries



[64] The IMPLAN model does not differentiate between civilian and military aircraft manufacturing. As such, all aircraft manufacturing is included in the Aerospace Manufacturing results.

[65] https://choosewashingtonstate.com/why-washington/our-key-sectors/aerospace/

[66] https://teamca.org/aerospace/

[67] https://gov.texas.gov/uploads/files/business/TexasAerospaceReport.pdf

[68] https://www.f35.com/f35/about/economic-impact.html

Figure 14—Total GDP Supported by the Aerospace Manufacturing Sector Dependent on Fluorochemistries

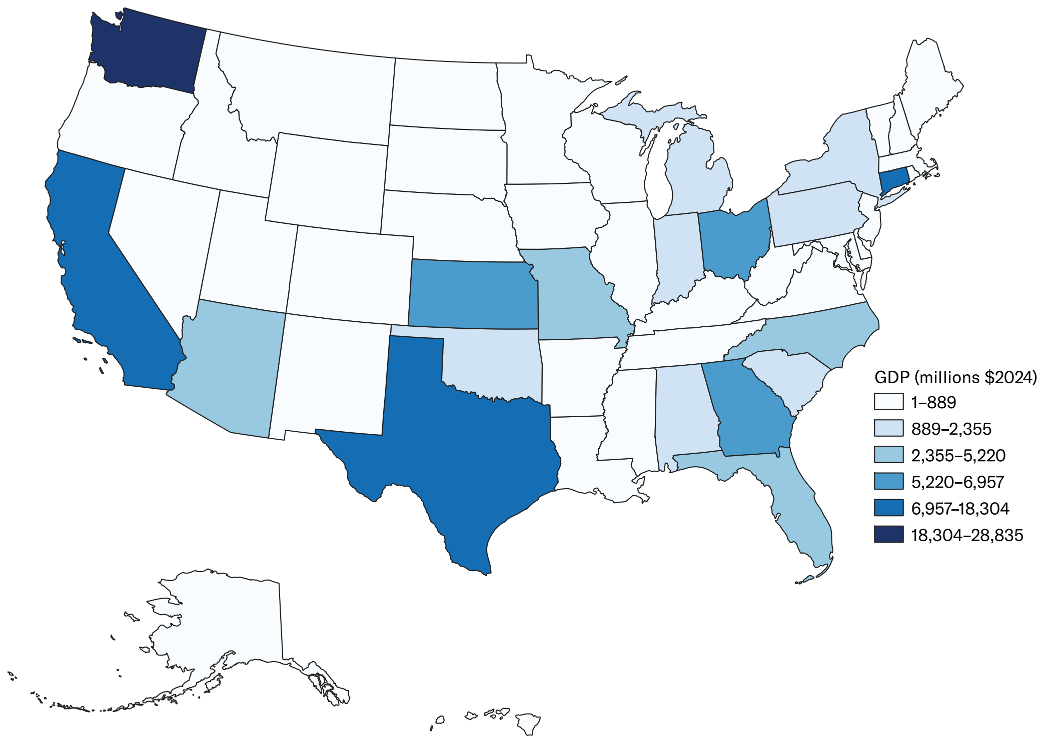


Figure 14 illustrates that the value creation from aerospace manufacturing dependent on essential fluorochemistries is highly concentrated in Washington, California, Texas, and Connecticut. Each state boasts economic strengths as Washington, California, and Texas have an array of aerospace manufacturers. Moreover, Connecticut is known as a leading player in manufacturing aircraft engine parts and hosts Aerospace Alley, which is an industrial hub with many advanced manufacturing companies.[69]

[69] https://www.advancect.org/our-economy/key-industries/aerospace-and-defense/

Data Centers

As shown in Figure 15, Virginia, Texas, and California are the top three states with the highest data center employment. Virginia is the most affected because it hosts one of the largest data center markets globally due to its availability of extensive fiber connectivity, tax incentives, and affordable power sources.[70,71] Dallas-Fort Worth in Texas and Silicon Valley in California are among the largest data center hubs in the U.S., boasting extensive inventories to meet high demand for data processing and storage.[72]

Figure 16 shows that data centers contribute the greatest amount of GDP in Virginia, California, Texas, and Ohio. Key economic clusters include California, which is home to Silicon Valley, and Virginia, which is known for its advanced technological infrastructure.

Figure 15—Top 10 States With Employment in the Data Centers Sector Dependent on Fluorochemistries

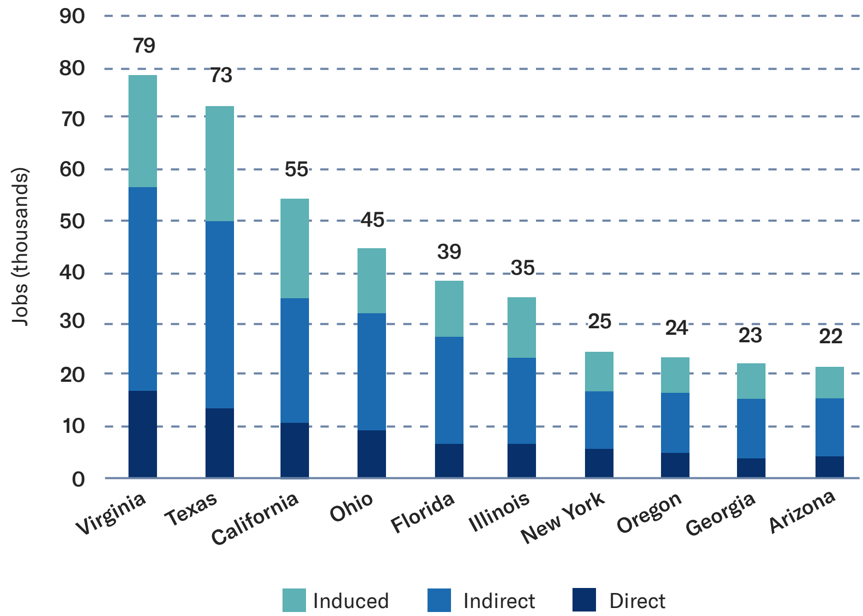
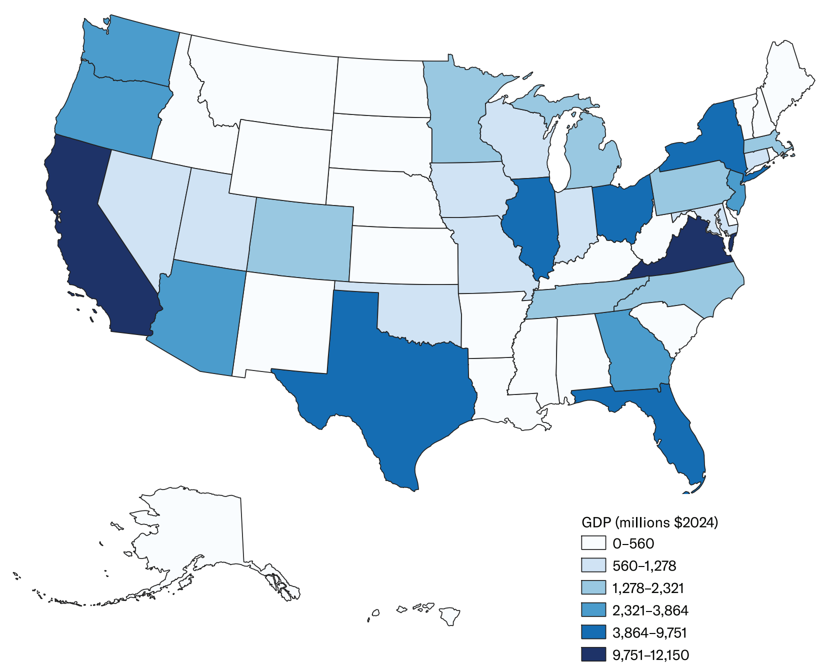


Figure 16—Total GDP Supported by the Data Centers Sector Dependent on Fluorochemistries



[70] https://www.datacenterdynamics.com/en/news/northern-virginia-tops-data-center-location-list-dominated-by-the-us/

[71] https://www.vedp.org/industry/data-centers

[72] https://www.cbre.com/insights/reports/global-data-center-trends-2024f

Defense

Fluorochemistries are a crucial component of the defense sector's supply chain. Any disruption in their availability could have significant impacts, jeopardizing jobs in California, Arizona, and across the U.S.

Other key states include those that are home to critical defense infrastructure, such as Colorado and Florida. The top 10 states for employment supported by the defense sector are displayed in Figure 17.

Figure 17—Top 10 States With Employment in the Defense Sector Dependent on Fluorochemistries

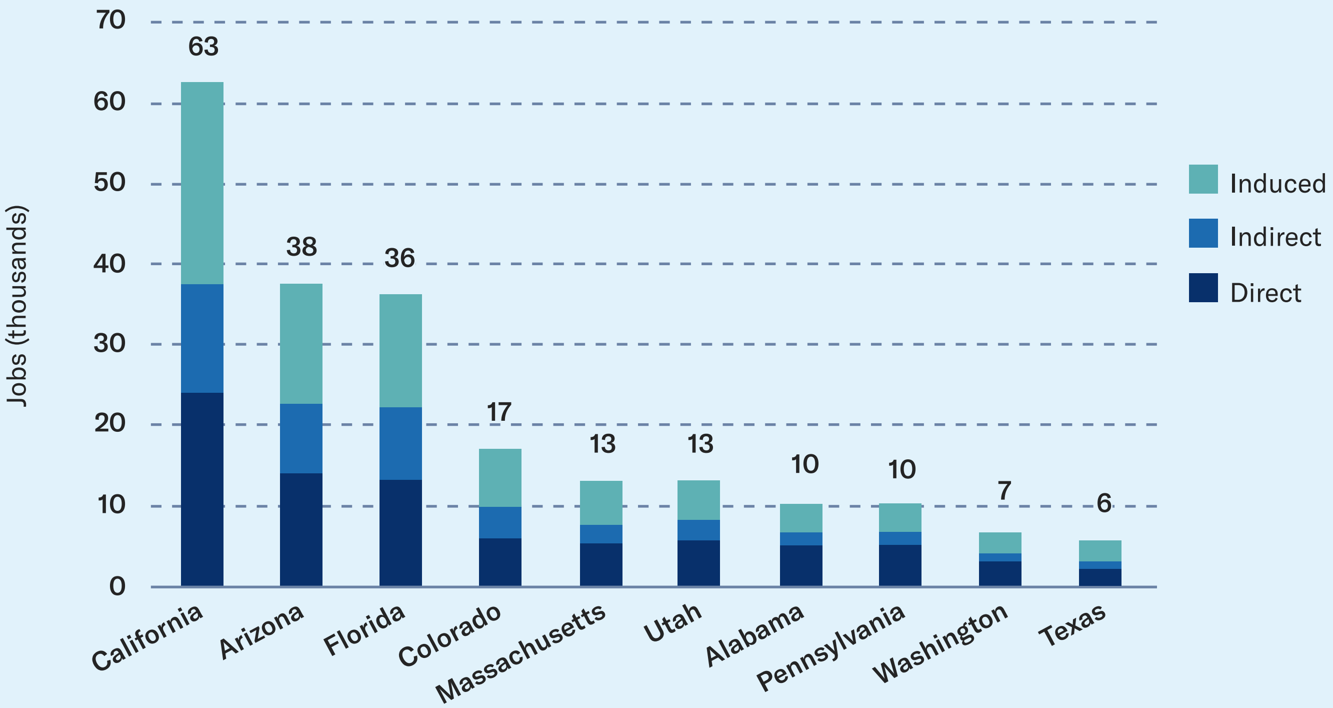


Figure 18—Total GDP Supported by the Defense Sector Dependent on Fluorochemistries

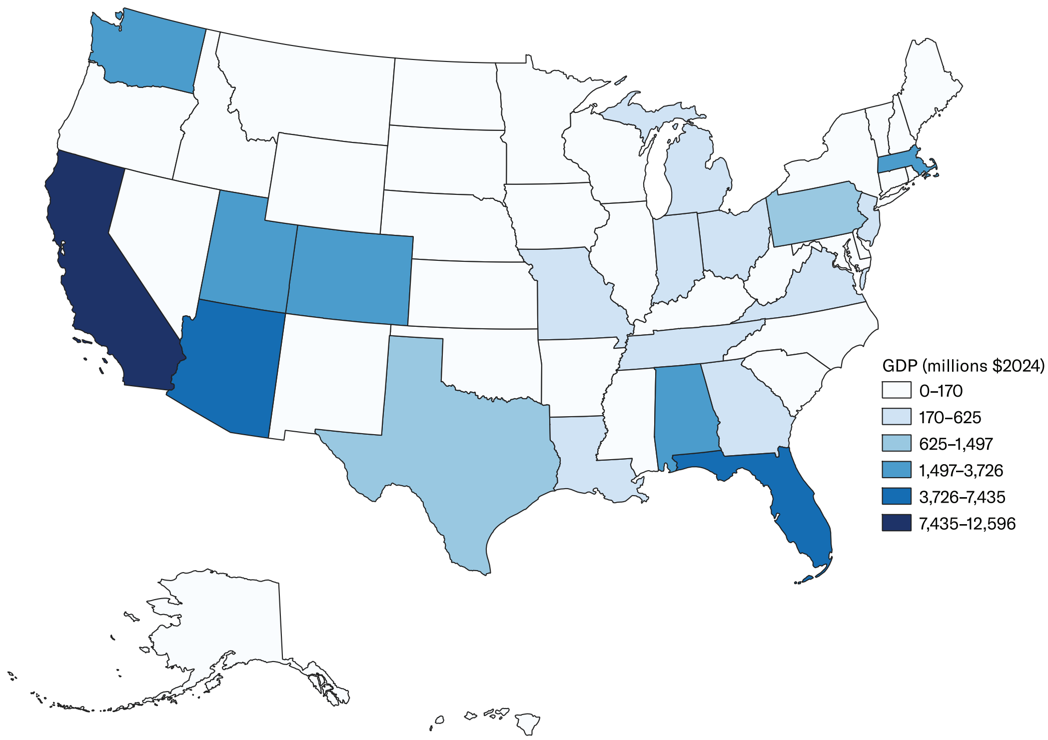


Figure 18 displays the GDP generated by the defense sector, highlighting that significant value is created in California, Florida, and Arizona. California, which ranks first in total defense contract expenditures, demonstrates its significant impact on national security in key industries like guided missile and electronics manufacturing.[73,74] Similarly, Florida ranks fifth nationally in defense contract expenditure and is the second largest producer of space and defense systems manufacturing in the U.S.[75,76] Additionally, Arizona is at the forefront of guided missile and space vehicle manufacturing, along with optics and photonics manufacturing.[77]

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[73] https://business.ca.gov/industries/aerospace-and-defense/

[74] https://militarycouncil.ca.gov/wp-content/uploads/sites/81/2024/06/2023_California_Statewide_MEIS.pdf

[75] https://www.floridajobs.org/docs/default-source/communicationsfiles/2023-florida-manufacturing-report.pdf

[76] https://www.poweringflorida.com/explore-industries/aerospace-defense.html

[77] https://www.azcommerce.com/industries/aerospace-defense/

Energy Transition

Jobs supported by the production of energy transition components like solar panels and lithium-ion batteries are concentrated in Ohio, Georgia, and Nevada. These 3 states account for more than half of the jobs in the top 10 states, with a combined total of 108,700 positions, as illustrated in Figure 19. Employment in Ohio will be particularly affected by these changes, where approximately 24% of clean energy jobs are in manufacturing.[78]

The value created in the energy transition sector from supply chains dependent on essential fluorochemistries is shown in Figure 20, where Ohio, Georgia, Nevada, and Texas are leading contributors. There are multiple wind tower manufacturers in Texas, while Ohio and Georgia have large solar manufacturers. In addition, Nevada, Ohio, and Georgia all have significant battery manufacturing capacity.

Figure 19—Top 10 States With Employment in the Energy Transition Sector Dependent on Fluorochemistries

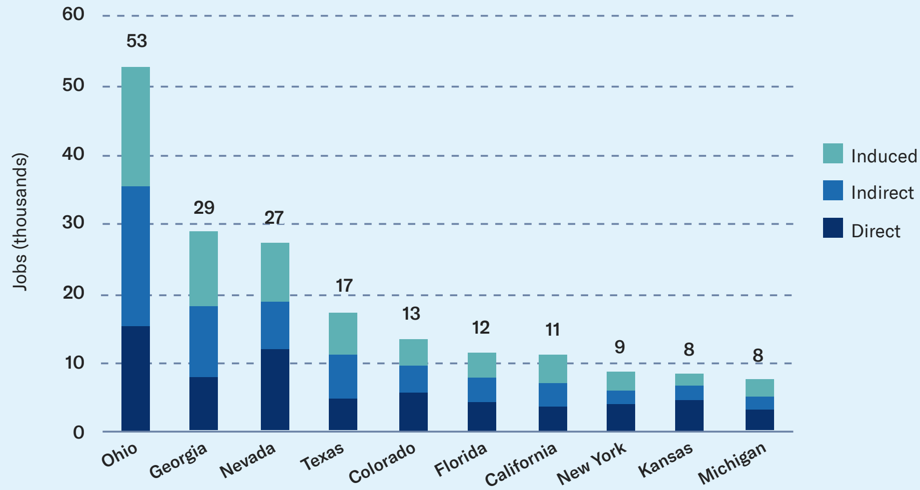
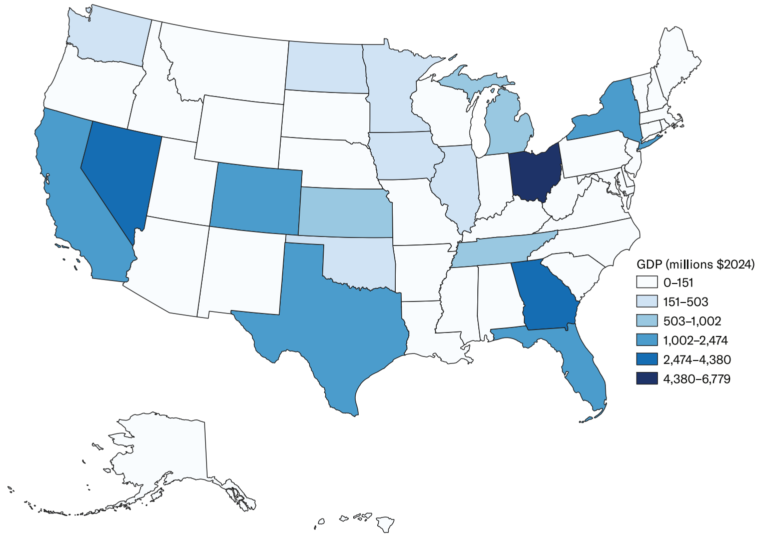


Figure 20—Total GDP Supported by the Energy Transition Sector Dependent on Fluorochemistries



[78] https://www.cleanjobsmidwest.com/state/ohio

Health Care

The health care sector utilizes fluorochemistries in manufacturing, particularly in states like California, New Jersey, and Illinois. As shown in Figure 21, the portion of the health care manufacturing sector reliant on fluorochemistries supports 243,600 in the top 10 states.

Figure 22 displays the distribution of GDP created by the share of the health care sector that is dependent upon fluorochemistries, with noticeable economic clusters in the Northeast, South, and Midwest. California, New Jersey, Illinois, Indiana, and Texas have the highest amount of GDP creation due to their robust medical device manufacturing sectors.

Figure 21—Top 10 States With Employment in the Health Care Sector Dependent on Fluorochemistries

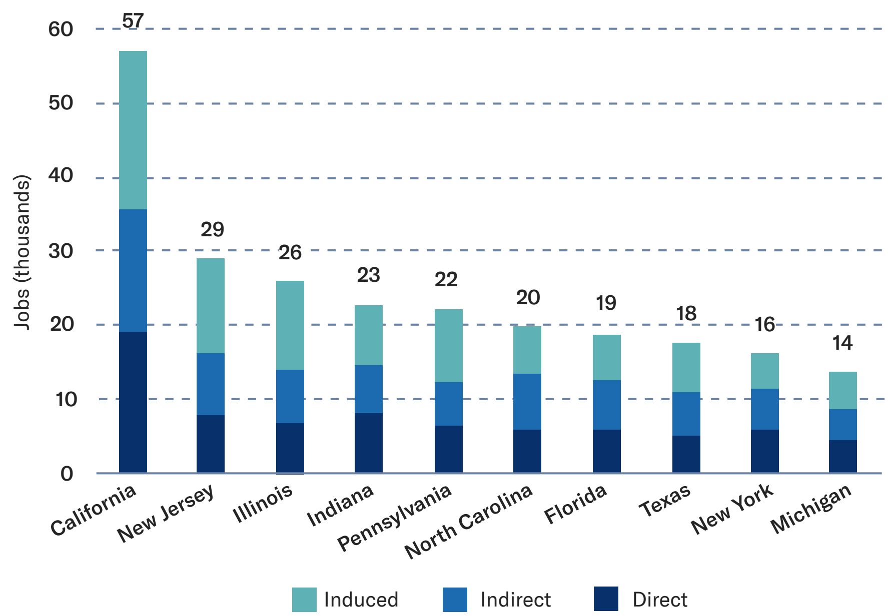
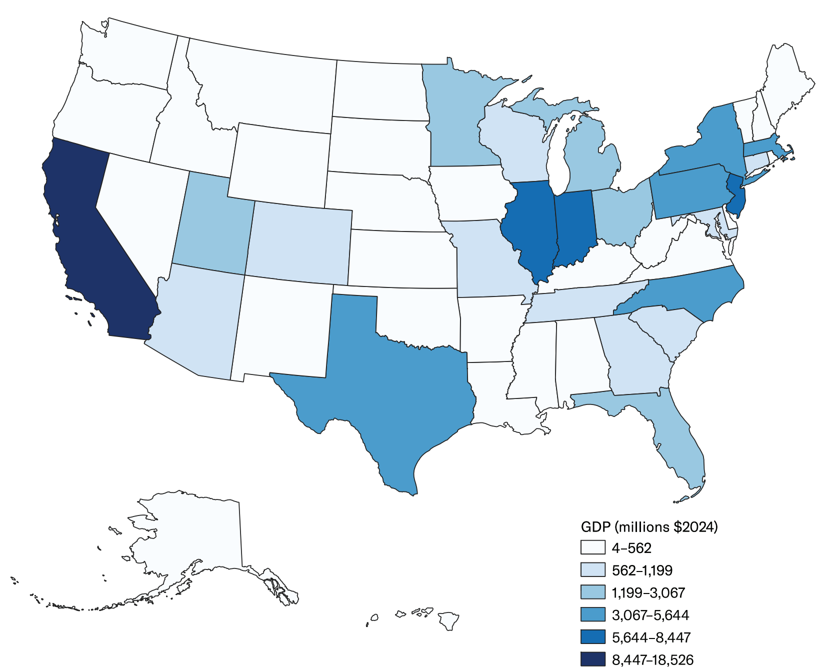


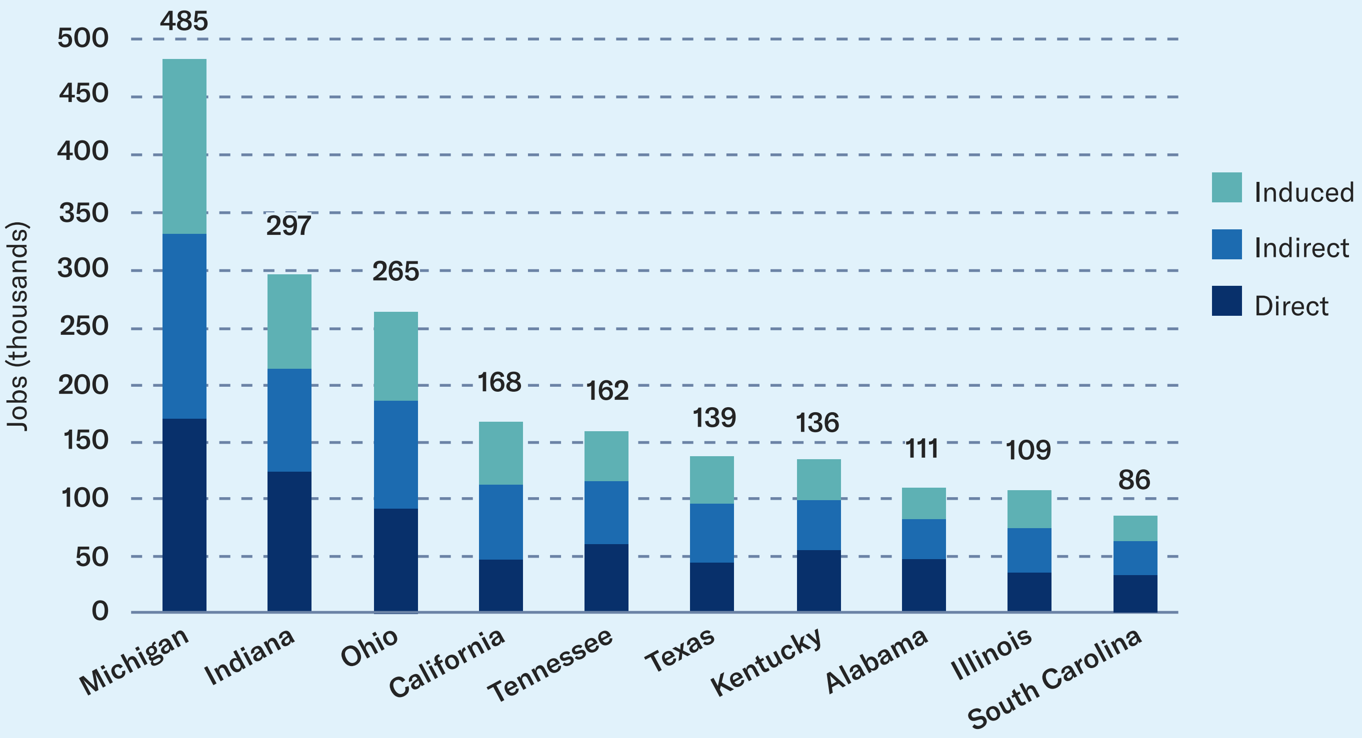
Figure 22—Total GDP Supported by the Health Care Sector Dependent on Fluorochemistries



Mobility

The mobility sector, which is heavily dependent on essential fluorochemistries, supports significant employment in Michigan, Indiana, and Ohio as seen in Figure 23. These states form America's industrial heartland, with Michigan known as the epicenter of the U.S. automotive industry. Michigan accounts for approximately 19% of national production and boasts the largest employment numbers in the sector, with around 484,600 jobs across the state dependent on fluorochemistries.[79]

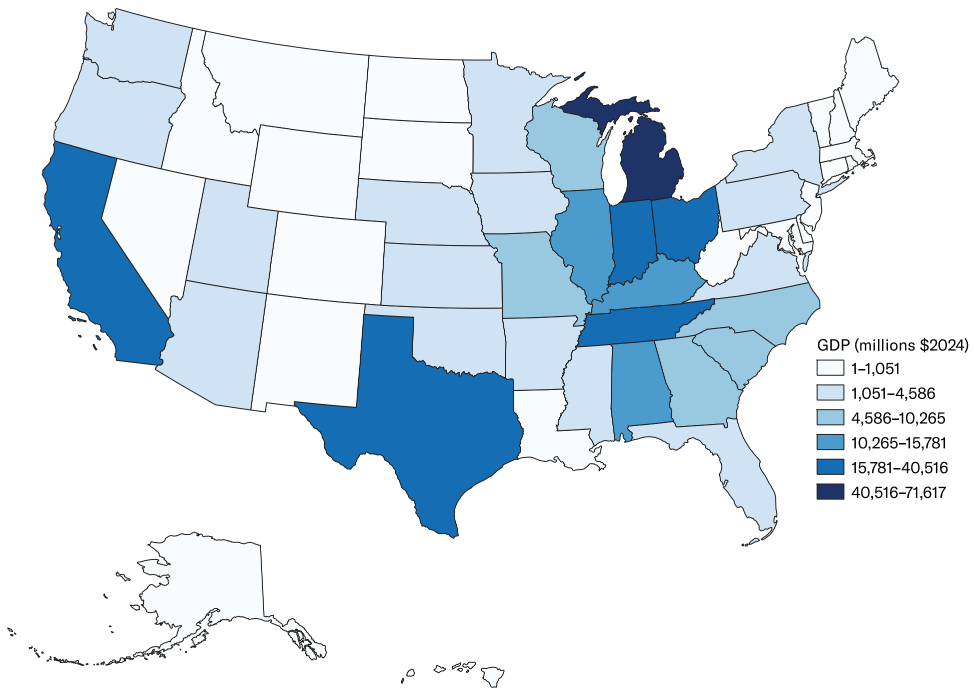
Figure 23—Top 10 States With Employment in the Mobility Sector Dependent on Fluorochemistries



[79] https://www.michiganbusiness.org/industries/mobility-and-automotive-manufacturing/

As illustrated in Figure 24, Michigan, Indiana, Ohio, and California generate the highest GDP from automotive manufacturing. Significant economic clusters include the Midwest and Southern states, such as Alabama, Georgia, and Kentucky, which reflects the recent growth and investment in automotive manufacturing in the region.[80]

Figure 24—Total GDP Supported by the Mobility Sector Dependent on Fluorochemistries



[80] https://siteselection.com/issues/2021/nov/it-s-everywhere.cfm

Semiconductors

As displayed in Figure 25, employment within the semiconductor sector is heavily concentrated in several key states, including California, Texas, and Oregon. Most notably, California, home to Silicon Valley, which hosts many technology giants, has the most jobs in this sector boasting more than 42,000 positions. These jobs are heavily dependent on essential fluorochemistries, making them vulnerable to disruptions in their availability. Texas also has significant employment in the sector due to the presence of specialized semiconductor companies.

Figure 26, shows that GDP in the semiconductor sector, which is highly dependent on fluorochemistries, is concentrated in key states such as California, Oregon, and Texas. California leads in both employment and GDP.

Figure 25—Top 10 States With Employment in the Semiconductor Sector Dependent on Fluorochemistries

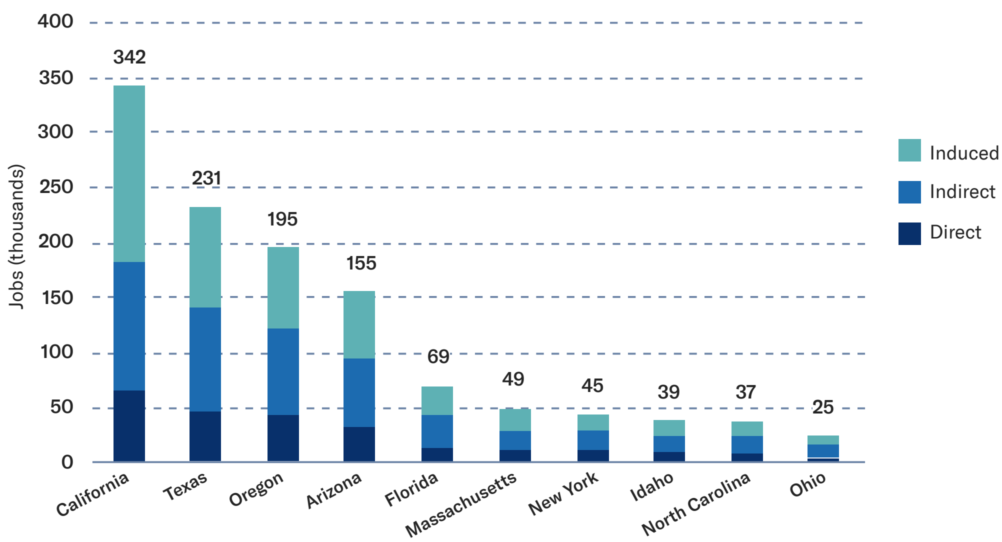
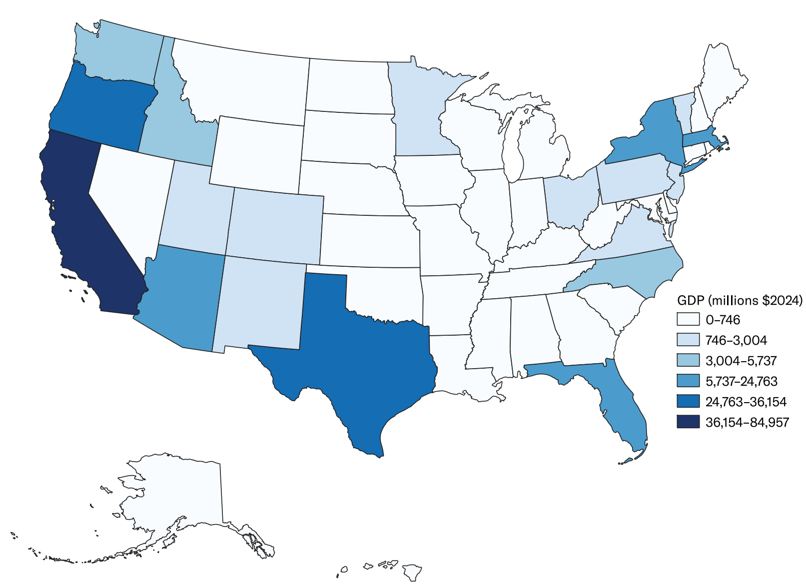


Figure 26—Total GDP Supported by the Semiconductor Sector Dependent on Fluorochemistries



Conclusions

The economic and fiscal impacts of the seven selected sectors reliant on essential fluorochemistries are significant to the U.S. economy. Each application of essential fluorochemistries addresses challenges that have no available and feasible replacement options. The key applications that are dependent upon these chemistries in each targeted sector include the following:

- In **aerospace manufacturing**, fluoropolymers are used to create hydraulic systems, wiring, and insulation materials, which enhances the durability of aircraft.
- F-gases are crucial to the operation of **data centers** because of air cooling, 2-PIC cooling, and fire suppression systems, which enable them to be efficient and safe.
- Essential fluorochemistries are integral to the manufacturing of guided missiles and tanks in the **defense** sector because they function well in extreme environments.
- In the **energy transition**, fluorochemistries support the development of renewable energy technologies, including solar panels, wind turbines, and lithium-ion batteries, by providing critical materials that improve efficiency and lifespan.
- Fluorochemistries in **health care** are vital to the production of medical devices, pharmaceuticals, diagnostic equipment, and product packaging, ensuring high standards of performance and safety.
- The **mobility** sector utilizes fluoropolymers to increase the lifespan and performance of mechanical components, such as air-conditioning systems, electronics, and electric vehicle batteries.
- **Semiconductors** use fluorochemistries as key components in the manufacturing process and are indispensable to the operation of modern semiconductor fabrication facilities.

Conclusions Cont.

The seven sectors chosen for analysis in this report highlight how crucial aspects of the U.S. economy rely on essential fluorochemistries. Collectively, essential fluorochemistries support nearly 4% of the U.S. GDP while upholding the jobs of over 6 million workers across these seven sectors. In addition, these chemistries support approximately $2.4 trillion in output, $988 billion in GDP, and $553 billion in labor income across the U.S. The share of these sectors dependent on essential

billion in federal tax revenues along with $69 billion in state and local tax revenues. Interrupting the use of essential fluorochemistries will impact all 50 U.S. states plus D.C. The states that will experience the most significant impacts from any sudden policy changes include California, Michigan, Texas, Ohio, and Indiana. These states are key hubs for the targeted industries, such as automotive manufacturing, defense, and health care for which fluorochemistries are indispensable

Appendix

Table 3—State-Level Impacts, All Seven Sectors

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	64,266.1	140.8	17,785.9	10,475.0	2,494.4	1,168.2
Alaska	140.4	0.5	40.5	27.1	5.9	2.1
Arizona	96,284.2	271.4	44,114.4	24,106.1	6,309.6	2,654.6
Arkansas	7,919.1	23.6	2,555.3	1,563.2	19.6	9.7
California	341,194.6	788.0	171,931.5	94,387.8	12,512.0	7,328.1
Colorado	25,272.6	74.4	11,983.2	6,938.4	331.9	146.3
Connecticut	29,918.5	70.5	16,941.1	8,289.9	48.9	26.2
Delaware	855.6	2.4	422.5	175.7	0.1	0.1
District of Columbia	1,093.0	2.6	566.3	348.5	0.6	0.3
Florida	70,735.9	226.3	30,794.9	18,159.5	1,569.5	622.1
Georgia	58,328.3	164.2	24,341.6	13,762.9	35.8	16.1
Hawaii	531.7	1.7	229.1	130.3	30.5	18.8
Idaho	16,837.6	46.7	6,497.2	4,088.7	1,329.2	608.2
Illinois	76,957.6	181.7	29,403.0	16,659.1	4,744.3	2,836.4
Indiana	146,964.7	340.8	51,491.8	27,002.6	6,863.6	3,300.6
Iowa	11,250.9	34.3	3,872.8	2,477.7	570.2	279.6
Kansas	27,566.5	72.3	10,441.7	5,983.8	1,442.3	655.4
Kentucky	69,502.9	148.5	17,468.4	11,169.1	2,715.2	1,547.2
Louisiana	3,134.9	9.7	1,144.8	705.2	152.6	76.9
Maine	4,684.2	13.7	1,921.7	1,099.8	4,325.5	2,791.0
Maryland	7,906.9	21.0	3,728.9	1,948.2	1,066.5	685.4
Massachusetts	36,874.5	93.6	18,782.6	11,045.9	3,681.3	1,651.4
Michigan	228,180.5	537.2	79,458.5	43,636.3	11,311.8	5,143.2
Minnesota	19,750.2	57.7	8,603.1	5,130.9	3,030.4	1,685.9
Mississippi	16,990.3	36.3	3,740.2	2,408.9	545.8	333.3
Missouri	50,590.7	119.8	17,519.4	10,126.3	2,378.3	1,081.1
Montana	980.4	3.4	319.4	218.3	52.7	23.6
Nebraska	8,202.7	21.3	3,048.0	1,583.7	982.3	447.9
Nevada	12,965.3	39.7	5,554.8	3,475.0	921.3	369.9
New Hampshire	4,074.6	11.6	1,742.0	1,172.8	279.9	122.1
New Jersey	27,449.4	67.5	14,031.9	7,869.4	2,064.7	1,423.7
New Mexico	6,861.1	17.9	2,525.3	1,479.8	251.0	251.0
New York	49,429.7	125.1	23,246.4	13,657.4	3,859.7	2,470.5

North Carolina	56,567.8	151.5	23,679.8	12,058.0	3,097.1	1,551.6
North Dakota	3,218.9	8.3	953.6	632.8	1,190.8	266.9
Ohio	155,706.2	431.7	53,221.2	32,990.7	8,854.6	4,755.4
Oklahoma	14,107.0	43.2	4,605.7	3,273.6	984.7	389.1
Oregon	88,973.6	238.7	42,497.2	23,686.5	8,043.4	4,575.7
Pennsylvania	41,702.7	115.9	18,015.6	10,681.9	5,704.6	2,858.7
Rhode Island	1,612.5	3.8	718.9	342.3	92.2	56.2
South Carolina	48,774.5	108.3	13,507.9	7,877.2	1,953.3	1,142.8
South Dakota	4,351.1	13.4	1,414.1	934.7	219.1	72.3
Tennessee	82,944.5	191.9	26,884.1	15,360.1	4,257.1	2,078.4
Texas	216,927.9	574.5	95,444.2	51,085.1	16,536.6	5,950.6
Utah	20,088.9	63.4	8,321.3	4,978.8	1,225.8	567.1
Vermont	5,242.3	14.5	1,968.8	1,275.8	549.4	342.6
Virginia	43,742.0	126.8	19,338.4	10,650.9	2,708.6	1,309.3
Washington	75,854.3	170.0	40,743.0	20,129.4	7,339.9	2,727.8
West Virginia	5,037.6	13.0	1,844.7	1,023.7	234.3	115.0
Wisconsin	24,062.8	62.3	8,434.9	4,658.6	1,157.1	600.3
Wyoming	777.3	2.5	237.0	157.9	41.8	12.8

Table 4—State-Level Impacts, Aerospace Manufacturing Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	5,003.8	13.7	2,355.0	1,227.1	303.4	122.8
Alaska	69.0	0.3	25.7	17.9	3.8	1.2
Arizona	9,603.2	26.2	5,084.4	2,543.0	668.3	240.2
Arkansas	1,800.7	5.4	778.4	393.7	99.2	39.2
California	31,380.9	92.6	15,369.6	10,008.5	2,472.2	1,414.2
Colorado	1,123.7	3.3	578.4	339.9	84.4	33.4
Connecticut	23,009.8	52.5	13,807.6	6,514.1	1,886.7	939.9
Delaware	223.1	0.6	113.8	55.4	13.3	8.8
District of Columbia	32.9	0.1	13.0	12.7	1.8	0.3
Florida	9,850.7	30.4	4,409.0	2,636.6	712.7	230.4
Georgia	13,681.8	35.7	6,810.9	3,429.4	866.5	350.8
Hawaii	2.4	0.0	1.1	0.6	0.1	0.1
Idaho	344.2	1.1	111.4	77.4	18.6	7.7
Illinois	1,950.4	6.1	818.2	547.7	127.3	61.4
Indiana	4,081.0	9.6	2,241.1	956.1	250.2	89.6

Iowa	504.3	1.9	222.6	156.5	35.1	13.4
Kansas	15,743.6	42.7	6,956.9	3,821.4	935.1	401.2
Kentucky	1,317.2	4.1	538.4	340.2	75.3	35.6
Louisiana	699.9	2.0	295.2	185.1	39.6	19.1
Maine	1,106.7	3.1	489.7	260.8	65.0	40.6
Maryland	1,784.0	4.3	888.6	424.6	111.9	58.1
Massachusetts	2,031.5	6.0	829.9	695.0	164.4	69.2
Michigan	2,743.4	7.8	1,238.2	670.7	168.1	60.8
Minnesota	932.6	2.6	431.3	218.2	55.3	27.8
Mississippi	464.6	1.4	203.4	114.8	27.1	14.6
Missouri	11,018.1	30.3	5,219.6	3,141.6	728.3	281.2
Montana	145.0	0.6	57.1	44.8	10.5	4.2
Nebraska	216.1	0.7	78.3	52.7	11.9	5.1
Nevada	211.6	0.7	90.0	48.0	13.3	3.7
New Hampshire	645.2	1.9	241.1	162.8	38.0	14.8
New Jersey	854.6	2.4	413.7	237.2	61.7	34.2
New Mexico	183.1	0.5	86.3	45.5	11.2	4.1
New York	2,461.7	7.7	1,220.0	786.7	190.9	104.2
North Carolina	5,677.5	11.0	3,843.7	1,046.1	340.5	118.1
North Dakota	196.7	0.5	97.4	41.7	10.7	2.7
Ohio	12,123.7	33.1	6,300.1	3,270.7	798.0	312.5
Oklahoma	6,147.5	19.6	2,092.0	1,809.7	368.4	124.5
Oregon	1,606.2	5.6	732.8	518.5	120.5	77.8
Pennsylvania	4,880.3	14.8	2,099.0	1,502.8	345.2	139.9
Rhode Island	26.1	0.1	13.3	8.7	2.1	0.9
South Carolina	3,962.0	11.0	1,741.1	1,050.2	257.2	113.7
South Dakota	22.7	0.1	7.6	4.1	1.0	0.2
Tennessee	648.2	2.3	301.6	194.0	44.7	16.3
Texas	35,231.5	90.3	18,303.7	9,315.9	2,333.3	631.8
Utah	1,590.2	5.8	712.0	485.0	114.2	46.4
Vermont	607.6	2.1	225.2	179.7	39.5	20.0
Virginia	778.7	2.1	437.8	218.2	56.8	25.5
Washington	51,902.1	113.1	28,835.0	14,017.0	3,899.5	1,222.0
West Virginia	1,022.7	3.2	371.3	281.8	58.5	23.7
Wisconsin	828.8	2.4	331.6	207.1	49.6	20.7
Wyoming	36.4	0.1	7.2	3.0	0.9	0.3

Table 5—State-Level Impacts, Data Centers

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	944.5	3.7	363.7	225.9	52.9	23.5
Alaska	-	-	-	-	-	-
Arizona	5,913.8	22.0	2,721.4	1,595.8	399.3	167.8
Arkansas	201.1	0.7	86.7	45.7	11.4	5.2
California	19,311.0	54.6	11,174.3	5,845.0	1,550.6	912.2
Colorado	4,083.7	13.4	2,069.4	1,167.9	295.6	119.5
Connecticut	1,364.4	4.4	678.5	410.1	111.2	52.3
Delaware	321.8	1.0	157.3	72.6	18.0	8.6
District of Columbia	976.0	2.4	505.3	311.3	55.2	22.5
Florida	10,196.9	38.9	4,730.7	2,706.1	742.2	253.7
Georgia	6,179.1	22.5	3,023.9	1,761.1	425.4	176.8
Hawaii	484.6	1.6	211.9	120.3	28.3	17.2
Idaho	351.8	1.3	147.3	82.9	21.0	9.5
Illinois	10,548.2	35.5	5,312.4	3,204.9	769.9	390.7
Indiana	2,600.6	9.7	1,079.2	662.1	151.6	75.3
Iowa	1,721.0	5.6	754.0	390.6	96.2	51.3
Kansas	977.4	3.3	426.2	236.2	57.6	24.0
Kentucky	1,374.7	5.2	560.1	349.1	77.5	38.5
Louisiana	860.8	3.3	331.5	193.1	42.5	20.6
Maine	297.5	1.1	122.8	76.1	18.1	9.5
Maryland	2,347.7	8.3	1,081.0	659.4	161.5	85.8
Massachusetts	3,784.4	11.5	1,983.4	1,195.3	309.1	118.6
Michigan	3,877.2	14.3	1,723.2	1,041.5	253.9	113.9
Minnesota	3,466.8	11.8	1,653.5	1,018.7	243.4	137.7
Mississippi	201.3	0.8	67.8	38.3	8.9	4.8
Missouri	2,718.9	9.3	1,277.8	741.1	174.9	68.8
Montana	215.5	0.8	79.1	47.8	11.9	4.6
Nebraska	1,123.6	3.5	545.6	251.8	64.7	28.0
Nevada	2,254.0	7.0	1,170.1	528.9	154.8	50.9
New Hampshire	510.3	1.7	243.2	153.3	36.7	12.6
New Jersey	5,074.2	15.9	2,645.9	1,532.1	398.9	210.4
New Mexico	615.0	2.0	258.4	128.8	32.4	19.1
New York	9,058.1	24.9	5,154.6	2,805.6	723.4	415.6
North Carolina	4,703.5	17.4	2,142.7	1,265.7	307.6	133.6
North Dakota	125.3	0.4	46.5	27.5	6.3	1.7

Ohio	11,985.4	45.0	5,206.4	3,121.1	724.8	382.7
Oklahoma	1,775.2	6.9	644.1	398.0	88.0	41.2
Oregon	7,480.7	23.8	3,863.5	2,033.3	520.0	265.2
Pennsylvania	4,955.9	17.4	2,320.7	1,425.7	340.6	161.2
Rhode Island	352.6	1.2	159.3	98.4	24.4	11.0
South Carolina	1,155.9	4.6	466.7	293.2	70.7	31.8
South Dakota	194.3	0.6	78.1	43.6	10.5	4.5
Tennessee	3,591.1	12.4	1,733.1	984.9	236.7	123.2
Texas	20,407.2	72.8	9,750.7	5,713.1	1,375.0	644.5
Utah	2,199.3	7.6	1,031.0	550.4	139.9	61.5
Vermont	209.4	0.7	88.6	52.8	12.5	6.4
Virginia	24,169.2	78.7	12,149.8	6,713.6	1,703.3	722.0
Washington	5,560.4	13.4	3,342.0	1,503.4	434.0	163.4
West Virginia	129.6	0.5	49.3	30.2	6.6	3.3
Wisconsin	2,476.7	8.4	1,155.0	631.2	157.6	77.3
Wyoming	557.1	1.9	185.1	126.0	33.2	9.3

Table 6—State-Level Impacts, Defense Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	3,645.0	10.5	2,029.8	1,004.6	253.0	97.6
Alaska	2.3	0.0	0.6	0.4	0.1	0.0
Arizona	13,325.7	37.6	7,435.1	3,729.8	978.4	360.4
Arkansas	331.3	1.0	170.4	84.3	21.4	8.4
California	22,447.5	62.5	12,596.0	7,756.9	1,944.6	1,093.0
Colorado	6,398.0	17.1	3,725.8	1,980.4	506.6	191.3
Connecticut	51.7	0.1	30.8	12.7	3.8	2.1
Delaware	25.3	0.1	12.4	4.2	1.2	0.6
District of Columbia	0.4	0.0	0.2	0.2	0.0	0.0
Florida	11,206.6	36.2	5,726.5	3,451.1	930.8	288.7
Georgia	435.4	1.5	229.2	128.2	31.1	13.1
Hawaii	5.6	0.0	2.8	1.5	0.4	0.2
Idaho	9.4	0.0	3.4	2.0	0.5	0.3
Illinois	145.3	0.5	78.7	51.5	11.8	5.8
Indiana	370.9	1.2	191.6	99.0	24.1	10.3
Iowa	126.7	0.4	56.6	38.8	8.6	3.8
Kansas	47.8	0.1	23.5	13.1	3.2	1.3

Kentucky	237.5	0.8	107.4	68.9	15.2	7.2
Louisiana	432.9	1.2	215.8	114.9	26.2	11.7
Maine	202.2	0.8	102.1	63.2	15.0	8.3
Maryland	311.0	0.8	168.1	87.8	22.4	11.5
Massachusetts	4,190.5	13.4	2,165.8	1,729.3	413.3	161.7
Michigan	1,212.2	4.0	625.5	364.7	89.6	32.7
Minnesota	293.8	0.9	152.7	79.2	19.8	10.5
Mississippi	185.3	0.6	83.9	48.3	11.4	6.2
Missouri	903.8	2.5	472.1	251.7	60.8	22.9
Montana	10.0	0.0	3.6	2.2	0.5	0.3
Nebraska	27.3	0.1	16.3	5.9	1.6	0.7
Nevada	128.8	0.4	61.7	32.2	8.9	2.7
New Hampshire	154.4	0.5	72.9	55.4	12.5	4.8
New Jersey	477.6	1.3	268.1	154.9	40.0	22.1
New Mexico	223.5	0.6	118.2	64.4	15.7	5.4
New York	271.1	0.8	136.5	92.2	22.0	12.7
North Carolina	128.6	0.5	59.0	34.1	8.3	3.8
North Dakota	42.0	0.1	24.1	11.4	2.8	0.6
Ohio	738.8	2.0	347.5	161.9	41.2	19.2
Oklahoma	60.6	0.2	18.0	13.6	2.9	1.2
Oregon	64.5	0.2	28.6	17.6	4.2	2.4
Pennsylvania	3,234.9	9.8	1,496.5	985.6	232.7	97.0
Rhode Island	27.9	0.1	14.5	8.4	2.1	1.0
South Carolina	221.0	0.6	87.2	38.5	10.5	5.9
South Dakota	72.7	0.2	39.5	16.3	4.4	1.1
Tennessee	867.7	2.7	405.7	227.1	54.3	23.8
Texas	1,974.4	5.9	1,141.5	599.1	148.2	39.8
Utah	3,805.5	13.3	1,869.4	1,244.5	294.7	120.5
Vermont	10.1	0.0	4.1	2.4	0.6	0.3
Virginia	591.7	1.4	380.4	157.6	43.9	18.7
Washington	2,795.7	7.0	1,788.8	884.3	244.7	72.2
West Virginia	136.2	0.6	62.4	46.4	9.7	3.8
Wisconsin	174.0	0.5	70.6	36.6	9.3	4.6
Wyoming	24.0	0.1	7.1	3.0	0.9	0.2

Table 7—State-Level Impacts, Energy Transition Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	-	-	-	-	-	-
Alaska	-	-	-	-	-	-
Arizona	-	-	-	-	-	-
Arkansas	-	-	-	-	-	-
California	4,104.8	11.2	2,039.1	1,299.4	321.9	202.3
Colorado	3,987.5	13.3	1,527.4	1,075.8	253.9	104.1
Connecticut	-	-	-	-	-	-
Delaware	-	-	-	-	-	-
District of Columbia	-	-	-	-	-	-
Florida	3,345.5	11.5	1,361.7	923.6	243.3	86.7
Georgia	9,573.2	28.9	4,379.9	2,772.7	650.7	322.4
Hawaii	-	-	-	-	-	-
Idaho	-	-	-	-	-	-
Illinois	973.9	3.0	417.5	259.4	61.5	33.2
Indiana	131.1	0.4	53.6	32.6	7.5	3.8
Iowa	1,393.9	4.6	503.2	344.3	77.8	32.9
Kansas	2,448.4	8.5	767.1	539.7	122.4	54.5
Kentucky	-	-	-	-	-	-
Louisiana	-	-	-	-	-	-
Maine	-	-	-	-	-	-
Maryland	-	-	-	-	-	-
Massachusetts	-	-	-	-	-	-
Michigan	2,311.5	7.6	903.4	641.1	149.1	72.8
Minnesota	780.3	2.2	334.2	224.4	52.0	28.7
Mississippi	-	-	-	-	-	-
Missouri	-	-	-	-	-	-
Montana	-	-	-	-	-	-
Nebraska	-	-	-	-	-	-
Nevada	8,689.3	27.2	3,700.9	2,535.3	655.9	270.2
New Hampshire	-	-	-	-	-	-
New Jersey	-	-	-	-	-	-
New Mexico	-	-	-	-	-	-
New York	2,897.9	8.6	1,342.0	997.0	234.1	128.6
North Carolina	45.8	0.1	18.8	11.7	2.8	1.4
North Dakota	908.7	2.8	320.9	211.4	46.6	10.5

Ohio	16,948.8	52.6	6,779.2	4,326.0	982.8	515.8
Oklahoma	514.3	1.7	187.3	112.7	25.1	10.2
Oregon	-	-	-	-	-	-
Pennsylvania	-	-	-	-	-	-
Rhode Island	-	-	-	-	-	-
South Carolina	21.5	0.1	8.5	5.4	1.3	0.7
South Dakota	499.3	1.7	151.1	115.7	25.5	7.7
Tennessee	2,222.7	6.6	1,002.0	611.9	143.4	57.9
Texas	5,778.8	17.2	2,474.1	1,573.1	366.8	135.0
Utah	-	-	-	-	-	-
Vermont	-	-	-	-	-	-
Virginia	-	-	-	-	-	-
Washington	845.5	2.1	381.8	223.0	58.7	26.9
West Virginia	121.8	0.4	46.2	38.3	7.7	3.4
Wisconsin	-	-	-	-	-	-
Wyoming	-	-	-	-	-	-

Table 8—State-Level Impacts, Health Care Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	651.2	1.8	269.0	142.8	34.6	20.4
Alaska	16.2	0.1	3.7	2.5	0.5	0.2
Arizona	2,371.4	7.2	1,035.8	560.2	142.5	69.5
Arkansas	258.3	0.8	101.6	56.8	13.7	8.1
California	30,115.2	56.9	18,526.0	6,508.7	1,972.6	1,581.4
Colorado	2,640.2	7.2	1,198.6	625.4	160.6	79.0
Connecticut	1,942.2	4.6	1,163.5	520.3	151.6	102.0
Delaware	221.3	0.5	122.4	33.3	10.5	7.7
District of Columbia	71.7	0.1	41.4	20.5	4.0	4.2
Florida	6,768.7	18.9	3,067.2	1,490.1	420.5	206.8
Georgia	1,934.4	5.3	908.7	481.7	118.7	71.5
Hawaii	12.0	0.0	5.1	3.3	0.7	0.4
Idaho	114.9	0.3	40.1	24.1	6.0	3.6
Illinois	13,914.6	25.9	8,446.9	3,253.4	906.4	647.3
Indiana	12,538.8	22.8	7,356.4	2,306.4	685.5	355.8
Iowa	508.0	1.1	248.9	108.2	27.5	15.3
Kansas	952.6	2.1	408.3	210.1	50.3	38.4

Kentucky	770.7	1.7	372.8	148.3	38.8	27.1
Louisiana	250.3	0.7	97.8	47.7	11.2	6.9
Maine	696.5	1.8	308.3	162.1	40.3	38.5
Maryland	2,224.9	4.6	1,195.4	523.1	142.4	110.6
Massachusetts	6,263.7	11.3	3,988.8	1,423.8	433.3	251.5
Michigan	5,635.8	13.8	2,629.6	1,238.3	325.2	185.6
Minnesota	3,405.5	10.4	1,773.5	997.0	243.4	143.2
Mississippi	368.8	1.0	108.0	65.8	14.8	12.4
Missouri	2,074.3	4.8	944.9	415.0	106.3	65.5
Montana	119.6	0.4	37.6	23.6	5.7	2.9
Nebraska	986.9	2.5	561.6	212.3	57.5	27.4
Nevada	437.0	1.1	168.0	84.1	23.4	13.2
New Hampshire	449.3	1.4	206.8	139.3	32.1	18.2
New Jersey	14,119.8	29.0	7,960.8	4,177.2	1,099.5	854.4
New Mexico	398.1	1.0	120.3	62.9	15.2	9.2
New York	8,360.6	16.4	4,051.5	1,700.0	474.1	423.3
North Carolina	9,191.8	20.0	4,380.6	1,776.4	489.0	302.7
North Dakota	34.6	0.1	12.9	11.4	2.2	0.6
Ohio	3,569.6	8.9	1,707.5	759.4	193.4	131.8
Oklahoma	463.0	1.2	188.5	89.4	21.5	11.4
Oregon	537.9	1.5	211.1	127.1	30.7	23.5
Pennsylvania	10,160.9	22.2	5,644.2	2,597.9	670.4	384.3
Rhode Island	681.7	1.5	326.9	156.5	41.6	30.2
South Carolina	2,326.7	5.5	863.0	407.7	107.8	92.3
South Dakota	286.7	0.8	155.1	65.1	17.3	4.5
Tennessee	2,093.4	5.7	1,075.9	552.9	135.3	68.7
Texas	7,345.7	17.7	3,555.8	1,686.6	428.4	181.5
Utah	3,770.8	11.2	1,521.9	851.7	211.1	113.0
Vermont	171.9	0.5	60.4	39.7	9.1	7.9
Virginia	1,070.6	2.7	476.5	253.6	64.6	49.7
Washington	1,055.2	2.4	495.8	245.3	67.5	38.0
West Virginia	553.8	1.2	251.6	105.3	26.4	17.0
Wisconsin	1,674.5	4.7	706.1	379.5	94.5	62.9
Wyoming	21.2	0.0	6.6	2.4	0.8	0.9

Table 9—State-Level Impacts, Mobility Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	53,996.5	111.1	12,759.2	7,868.8	1,849.2	903.3
Alaska	45.3	0.1	7.7	4.5	1.0	0.6
Arizona	10,967.9	23.5	3,074.9	1,816.0	452.6	219.5
Arkansas	4,969.7	14.6	1,283.1	903.0	207.1	110.4
California	86,112.7	168.0	27,269.9	16,467.6	4,147.4	3,143.7
Colorado	2,094.6	6.0	734.4	463.3	113.1	53.1
Connecticut	2,930.6	7.2	980.8	667.6	175.3	94.6
Delaware	63.1	0.2	16.3	9.9	2.2	2.1
District of Columbia	2.3	0.0	0.7	0.5	0.1	0.1
Florida	7,441.0	21.4	2,309.2	1,450.0	388.1	172.7
Georgia	26,028.7	68.9	8,752.4	5,046.2	1,224.5	669.8
Hawaii	11.9	0.0	2.5	1.6	0.4	0.3
Idaho	1,857.8	5.4	526.8	356.7	86.0	42.2
Illinois	48,588.3	108.5	13,954.4	9,122.7	2,134.6	1,275.7
Indiana	127,116.3	296.9	40,515.8	22,912.7	5,446.8	2,630.4
Iowa	6,712.2	19.9	1,976.2	1,366.0	307.8	153.8
Kansas	7,184.7	15.0	1,778.3	1,117.0	262.0	130.2
Kentucky	65,519.9	136.0	15,780.9	10,193.4	2,245.0	1,299.8
Louisiana	846.4	2.4	191.9	157.3	31.4	17.5
Maine	834.0	2.4	251.6	167.0	39.0	26.0
Maryland	834.5	1.9	231.7	155.1	37.0	23.5
Massachusetts	1,063.9	2.4	300.2	216.0	52.8	26.3
Michigan	210,718.7	484.6	71,616.8	39,227.5	9,846.3	4,471.0
Minnesota	5,583.1	14.6	1,989.6	1,156.1	280.2	161.4
Mississippi	15,553.0	31.8	3,227.0	2,096.4	473.8	289.0
Missouri	31,992.5	67.3	8,859.4	5,131.7	1,200.6	585.2
Montana	418.5	1.3	116.9	84.1	20.0	9.7
Nebraska	5,696.9	14.2	1,778.6	1,021.3	242.6	118.3
Nevada	934.0	2.4	241.7	172.2	44.3	21.3
New Hampshire	715.8	1.8	252.0	153.3	37.1	17.2
New Jersey	1,908.5	5.0	579.2	442.4	107.1	72.5
New Mexico	80.2	0.2	21.4	11.8	2.9	1.7
New York	8,730.8	22.1	3,106.6	2,017.8	492.6	338.1
North Carolina	23,814.2	65.5	7,497.9	4,709.9	1,121.8	568.6
North Dakota	1,658.5	3.7	359.9	258.4	55.5	16.0

Ohio	102,421.8	265.1	29,876.4	19,438.5	4,418.7	2,489.0
Oklahoma	5,042.1	13.3	1,431.0	823.0	187.2	86.9
Oregon	4,700.0	12.6	1,507.5	908.5	221.7	128.0
Pennsylvania	14,205.2	39.5	4,585.6	3,010.1	706.5	391.6
Rhode Island	275.9	0.6	131.9	22.9	10.3	6.6
South Carolina	40,913.3	86.0	10,265.1	6,036.5	1,494.1	892.9
South Dakota	2,177.1	6.9	668.6	485.1	109.2	34.5
Tennessee	73,342.7	161.6	22,301.8	12,751.5	3,058.0	1,501.9
Texas	65,613.3	139.2	24,457.6	10,706.1	2,822.9	1,011.3
Utah	5,098.6	14.6	1,732.6	1,026.1	251.5	124.6
Vermont	332.1	0.8	84.9	59.6	13.5	9.2
Virginia	12,333.1	28.6	3,871.3	2,068.2	527.4	314.4
Washington	4,510.2	9.9	1,653.8	869.6	236.4	120.6
West Virginia	3,024.1	7.0	1,051.2	511.2	123.1	62.6
Wisconsin	18,700.3	45.6	6,096.7	3,358.0	834.5	428.7
Wyoming	138.5	0.4	31.0	23.5	6.0	2.1

Table 10— State-Level Impacts, Semiconductor Sector

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	25.1	0.1	9.2	5.8	1.4	0.6
Alaska	7.5	0.0	2.9	1.8	0.4	0.1
Arizona	54,102.2	155.0	24,762.7	13,861.3	3,668.5	1,597.1
Arkansas	358.0	1.0	135.2	79.7	19.6	9.7
California	147,722.6	342.3	84,956.6	46,501.7	12,512.0	7,328.1
Colorado	4,944.8	14.1	2,149.3	1,285.7	331.9	146.3
Connecticut	619.8	1.7	279.8	165.2	48.9	26.2
Delaware	1.0	0.0	0.4	0.3	0.1	0.1
District of Columbia	9.7	0.0	5.8	3.3	0.6	0.3
Florida	21,926.5	68.9	9,190.5	5,501.9	1,569.5	622.1
Georgia	495.6	1.5	236.4	143.6	35.8	16.1
Hawaii	15.2	0.0	5.8	3.1	0.8	0.7
Idaho	14,159.6	38.6	5,668.1	3,545.7	1,197.0	544.9
Illinois	836.9	2.3	375.0	219.5	732.8	422.3
Indiana	126.0	0.3	54.2	33.6	297.9	135.4
Iowa	284.8	0.8	111.3	73.4	17.2	8.9
Kansas	212.1	0.6	81.4	46.2	11.6	5.8

Kentucky	282.9	0.8	108.8	69.2	263.5	139.1
Louisiana	44.6	0.1	12.5	7.0	1.7	1.1
Maine	1,547.4	4.5	647.2	370.7	4,148.1	2,668.2
Maryland	404.7	1.1	164.1	98.3	591.4	395.9
Massachusetts	19,540.5	49.1	9,514.5	5,786.6	2,308.5	1,024.1
Michigan	1,681.7	5.1	721.8	452.5	479.7	206.4
Minnesota	5,288.0	15.2	2,268.2	1,437.3	2,136.3	1,176.8
Mississippi	217.3	0.7	50.1	45.3	9.8	6.4
Missouri	1,883.1	5.5	745.6	445.4	107.4	57.4
Montana	71.9	0.2	25.0	15.8	4.1	2.0
Nebraska	151.9	0.4	67.6	39.8	603.8	268.4
Nevada	310.5	0.9	122.3	74.4	20.7	8.0
New Hampshire	1,599.7	4.3	726.0	508.6	123.4	54.6
New Jersey	5,014.6	13.7	2,164.2	1,325.5	357.6	230.0
New Mexico	5,361.1	13.6	1,920.7	1,166.4	490.6	211.4
New York	17,649.6	44.6	8,235.3	5,258.1	1,722.7	1,048.2
North Carolina	13,006.4	37.0	5,737.1	3,214.1	827.1	423.5
North Dakota	253.2	0.7	92.0	70.9	1,066.7	234.9
Ohio	7,918.1	24.9	3,004.1	1,913.1	1,695.6	904.3
Oklahoma	104.4	0.3	44.8	27.1	291.7	113.7
Oregon	74,584.3	195.0	36,153.8	20,081.5	7,146.4	4,078.9
Pennsylvania	4,265.6	12.3	1,869.6	1,159.8	3,409.2	1,684.6
Rhode Island	248.2	0.3	73.0	47.3	11.6	6.4
South Carolina	174.1	0.5	76.2	45.7	11.7	5.6
South Dakota	1,098.3	3.2	314.0	204.7	51.2	19.8
Tennessee	178.7	0.6	64.0	37.9	584.6	286.5
Texas	80,577.0	231.3	35,760.9	21,491.1	9,061.9	3,306.7
Utah	3,624.4	10.9	1,454.4	821.2	214.4	101.1
Vermont	3,911.1	10.3	1,505.6	941.7	474.2	298.8
Virginia	4,798.6	13.3	2,022.5	1,239.7	312.6	178.9
Washington	9,185.2	22.0	4,245.7	2,386.9	2,399.1	1,084.7
West Virginia	49.4	0.1	12.7	10.4	2.2	1.3
Wisconsin	208.4	0.6	74.8	46.1	11.6	6.1
Wyoming	-	-	-	-	-	-

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