Essential Chemistries: Providing Benefits Across the U.S. Economy

Part 2: Examining the Impact of Possible Restrictions on Heating, Cooling, & Building Materials

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U.S. Chamber of Commerce

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Executive Summary

This U.S. Chamber of Commerce ("USCC") report — part of a broader body of research on the importance of essential fluorochemistries to the U.S. economy — evaluates the economic and fiscal impacts of select applications in the residential heating and cooling, commercial heating and cooling, and building materials sectors. A previous report conducted on behalf of USCC by third-party experts estimated the economic impacts of essential fluorochemistries on seven key sectors across the economy, finding that over 6 million jobs and nearly $1 trillion in GDP relied on fluorochemistries. **Table 16**, located in the appendix, summarizes the findings of that report.

Fluorochemistries are used in many products for their superior physical qualities that resist decomposition, avoid water damage, and improve thermal efficiency. For example, roofing and siding materials are weatherized with fluorochemistries to prolong their lifespan. Replacements for products containing fluorochemistries may be unavailable, more expensive, or simply of a lower quality, all of which increases costs for consumers. Certain alternative refrigerants in heating, cooling, and refrigeration systems are less energy efficient, which would also increase costs for consumers. This report studies the economic activity and highlights the potential household costs that would be put at risk if the use of fluorochemistries were restricted for the following applications:

As refrigerants in residential and commercial heat pumps, central air conditioner systems, and commercial refrigeration systems.

In components of residential and commercial heating, cooling, and refrigeration equipment such as O-rings, gaskets, and seals.

In residential building materials, such as blowing agents for spray-foam insulation, roofing and concrete sealant.

Table 1 – Economic Activity at Risk

Metric	Total Impacts	Unit
Output	131.7	2024 $ billions
Employment	519,927	Job-years
GDP	68.0	2024 $ billions
Labor Income	38.4	2024 $ billions
Federal Tax Revenues	9.1	2024 $ billions
State and Local Tax Revenues	5.8	2024 $ billions

Table 1 displays the economic output, employment, GDP, and labor income, as well as federal, state, and local tax revenues that would be put at risk if restrictions on fluorochemistries in these applications were implemented. Roughly $132 billion in output, more than half a million jobs, over $68 billion in GDP, more than $38 billion in labor income, and roughly $15 billion in federal, state, and local tax revenues combined are at risk.

In addition to the potential impacts on American competitiveness, restrictions on fluorochemistries also risk increasing greenhouse gas emissions by reducing the energy efficiency of heating and cooling equipment. Using less efficient alternatives to fluorochemistries in heating and cooling equipment will require more energy to meet demand from consumers and businesses. New homes, if required to install less effective insulation and building materials, would have less energy efficient building envelopes and consume more energy for heating and cooling. This report estimates that increased electricity demand due to restrictions on fluorochemistries in the first year is roughly 2.6 million megawatt-hours ("MWh") per year in the residential sector, 8.5 million MWh in the commercial sector, and roughly 1 million MWh from alternative building materials. This effect increases each year over the analysis period 2025–2035, as additional heating and cooling equipment and new homes with alternative building materials are constructed, reaching a total of 129 million MWh per year across all applications, the equivalent output of 107 average-sized coal-fired power plants.

Figure 1 displays increased electricity demand in the first year for the top ten states, while **Figure 2** shows the growth of increased electricity consumption over time.

Figure 1 – First-Year Incremental Electricity Consumption Impacts, Total, Top 10 States

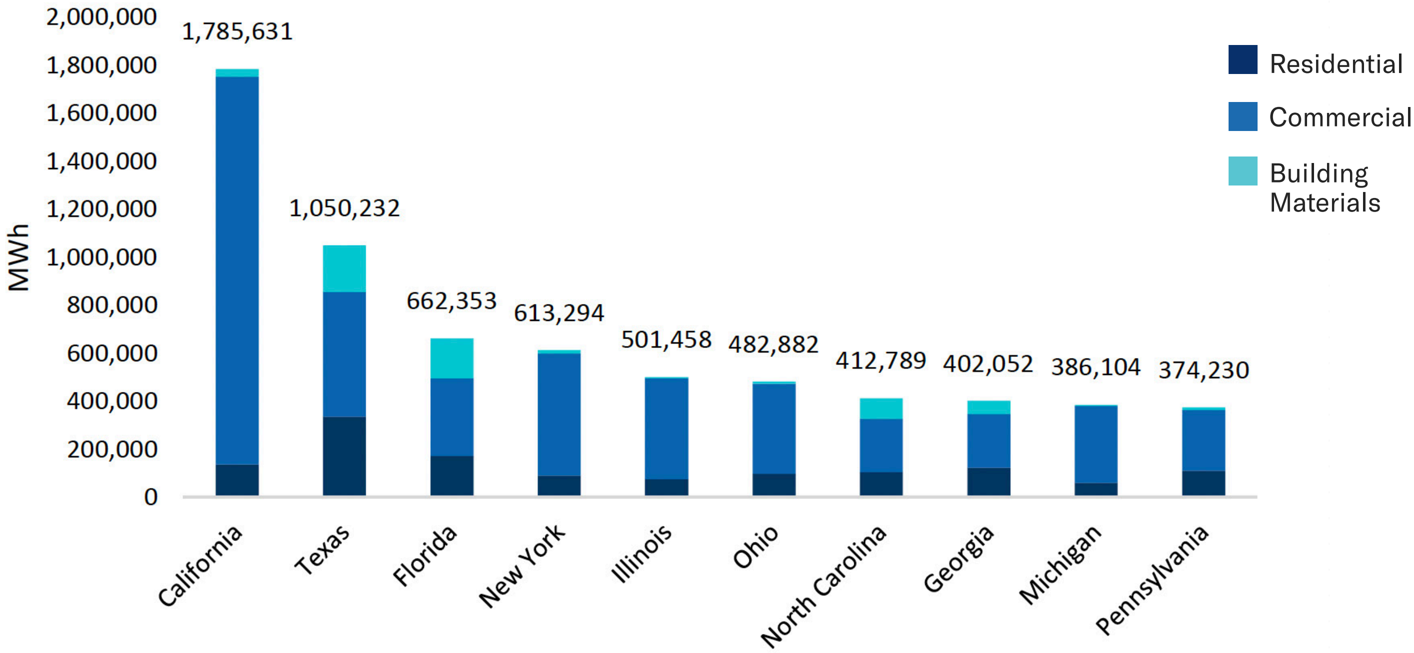
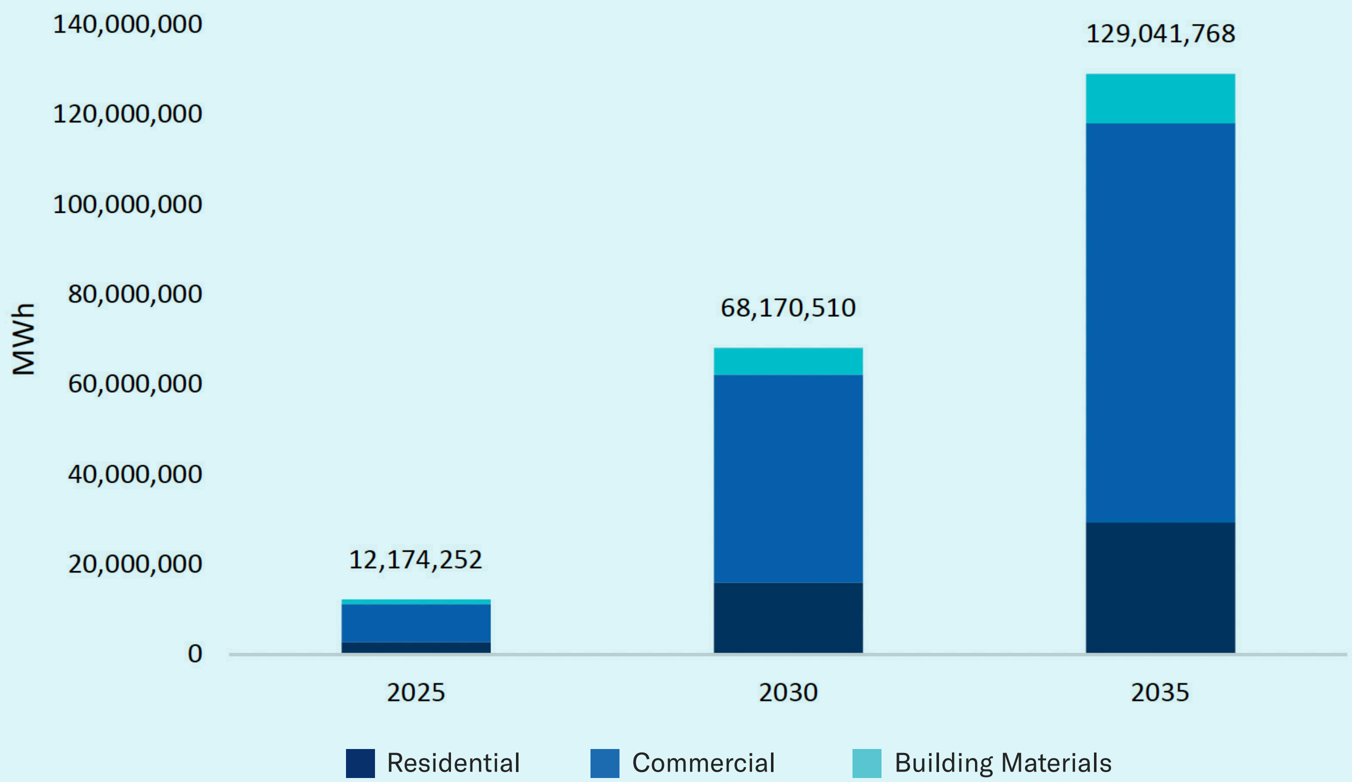
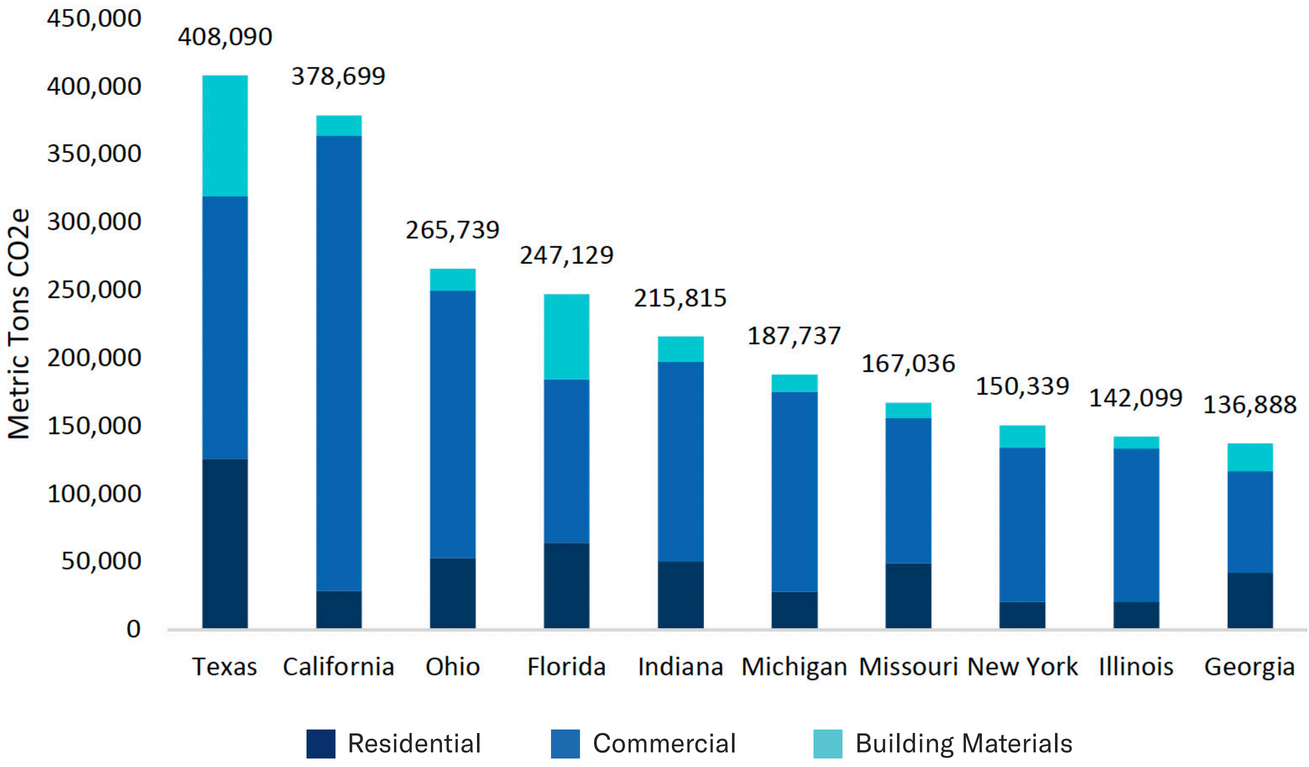


Figure 2 – Incremental Electricity Consumption Impacts by Year, Total



Limitations on fluorochemistries would increase energy consumption, generating nearly 1 million metric tons of carbon-dioxide equivalent greenhouse gases ("CO2e") in the residential heating and cooling sector, 2.8 million metric tons CO2e in the commercial heating and cooling sector, and 0.6 metric tons CO2e from building materials in the first year. Combined, these incremental emissions are equivalent to adding more than 1 million vehicles to the road.[1] **Figure 3** highlights the top ten states by incremental emissions impacts.

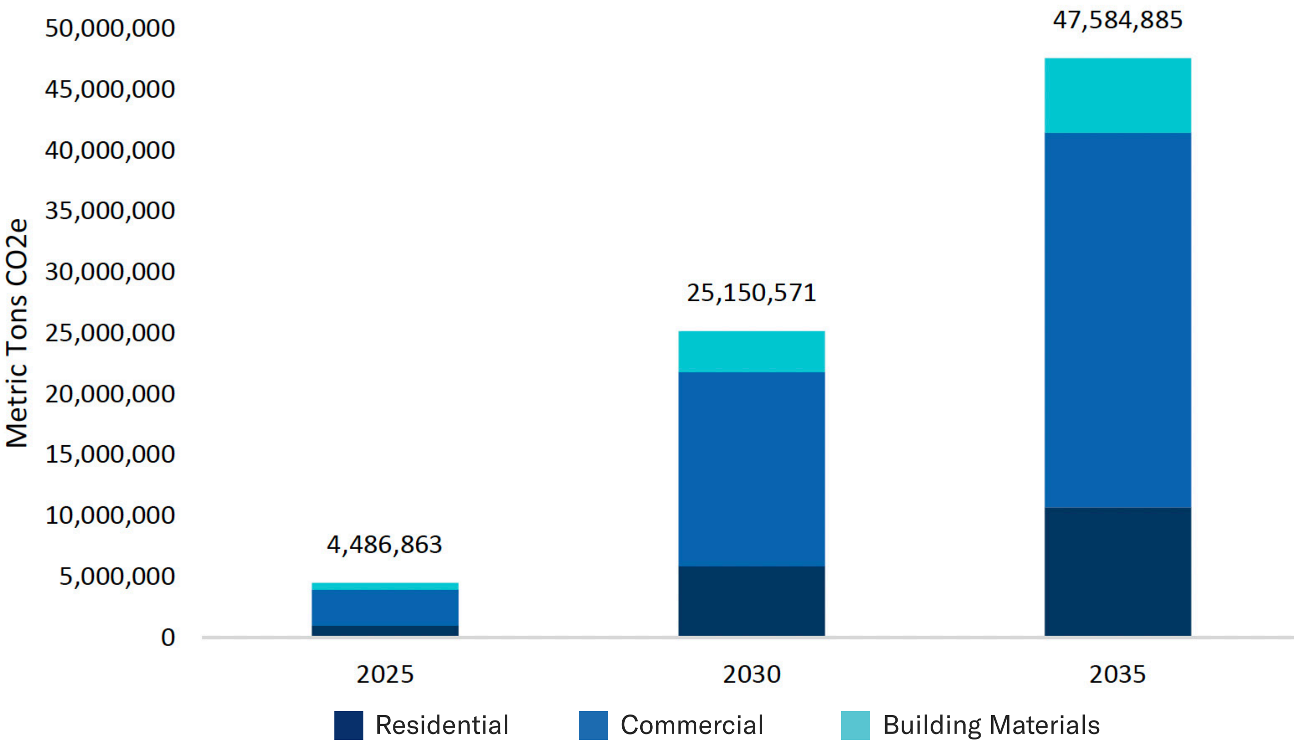
Figure 3 – First-Year Incremental Emissions Impacts, Total, Top 10 States



[1] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-calculations-and-references. The average gas-powered vehicle emits 4.29 metric tons CO2e per year.

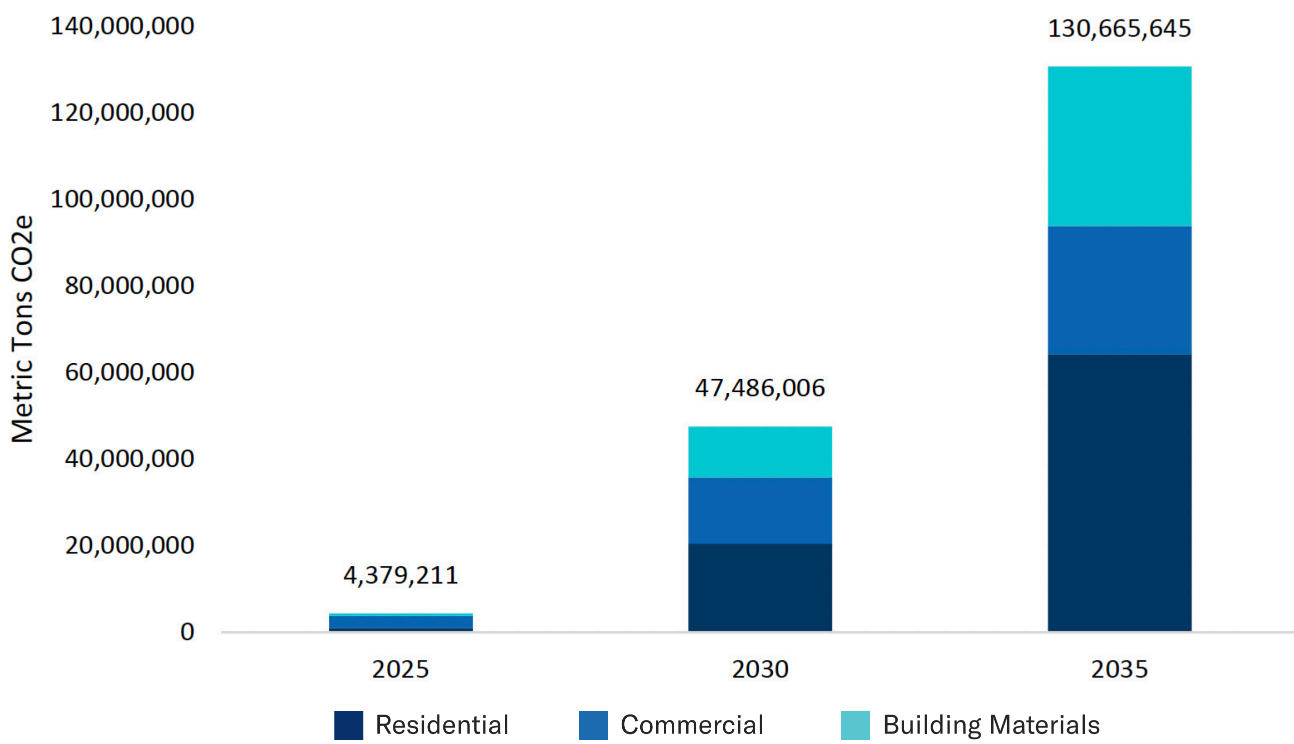
The annual incremental emissions that could be generated by restrictions on fluorochemistries grow to 48 million metric tons by 2035, as shown in **Figure 4.**

Figure 4 – Incremental Emissions Impacts by Year, Total



As displayed in **Figure 5**, these incremental emissions accumulate over the period 2025–2035, reaching a total of over 130 million metric tons CO2e.

Figure 5 – Cumulative Emissions Impacts



Introduction and Context

Fluorochemistries play a vital role in our modern economy. A previous report conducted by third-party experts in economic and environmental modeling on behalf of the U.S. Chamber of Commerce ("USCC") found that seven key sectors dependent on essential fluorochemistries (aerospace manufacturing, data centers, defense equipment and systems, energy transition, health care, mobility, and semiconductors) support over 6 million American jobs and nearly $1 trillion in GDP. This report expands on previous research by identifying the impact of fluorochemistries in building materials and in heating and cooling, and the value they provide in terms of energy efficiency, cost savings, and emission reductions in residential and commercial applications. The study also examines the effects possible limits on fluorochemistries would have on household costs.

The use of modern fluorochemistries is endangered by current and potential legal and regulatory actions at the federal and state level. For example, Maine recently established a ban on intentionally added fluorochemistries in carpets, rugs, and fabric treatments to include — among other products — cleaning products, cookware, cosmetics, and dental floss.[2] Colorado and Vermont have enacted targeted consumer product bans as well.[3] SB 903, pending in the California senate, would ban essential fluorochemistries in all consumer products, including fluorinated gases ("f-gases").[4]

F-gases — in particular hydrofluoroolefins ("HFOs") and hydrochlorofluoroolefins ("HCFOs"), notable for their low global warming potential ("GWP"), have many applications. F-gases are used as refrigerants in heating and cooling systems, including heat pumps, air conditioning systems, and refrigeration systems. Their low toxicity and low flammability make them safer and more energy efficient than alternative refrigerants.[5] In addition, the chemical properties of f-gases used in heat pumps have been engineered over time to lessen their impact on the environment. HFOs emerged as the successor to hydrofluorocarbons ("HFCs") in 2008.[6] Compared with typical HFCs, HFOs, HCFOs have an insignificant 100-year GWP, and compared with alternative refrigerants, HFOs and HCFOs are significantly more energy efficient.[7,8] HFOs also comply with the international Kigali Amendment to the Montreal Protocol, which established a global phasedown schedule of HFCs, and the American Innovation and Manufacturing ("AIM") Act of 2020, which empowered the EPA to regulate HFCs and facilitate the U.S.' transition to alternative products.[9]

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2 https://martenlaw.com/news/state-action-on-pfas-expands-with-bans-labeling-and-reporting-requirements

3 Ibid.

4 https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB903

5 https://pmc.ncbi.nlm.nih.gov/articles/PMC9207706

6 https://pub.norden.org/temanord2024-522/temanord2024-522.pdf

7 https://pmc.ncbi.nlm.nih.gov/articles/PMC9207706

8 https://info.ornl.gov/sites/publications/Files/Pub200582.pdf

9 https://www.epa.gov/climate-hfcs-reduction/background-hfcs-and-aim-act

Heat pumps can offer savings on residential energy bills.[10] Data from the Air-Conditioning, Heating, and Refrigeration Institute ("AHRI") indicates that interest in heat pumps is growing: in 2023, more heat pumps were sold than gas furnaces.[11] The Inflation Reduction Act ("IRA") provides explicit support to further manufacturing and deployment of heat pumps and high efficiency HVAC equipment. Homeowners who install qualified heat pumps — powered by electricity or natural gas — or high efficiency air conditioners may claim a tax credit of 30% toward total costs, up to $2,000.[12] This credit may be applied to equipment or labor costs and is nominally in effect through 2032. A ban on f-gas refrigerants would reduce the financial incentive to install heat pumps and air conditioners offered by the IRA. Installation activity in the short-to-medium term could slow as installers grapple with changes to building codes, the learning curve associated with new equipment, and consumer resistance to installing equipment with flammability concerns, lower overall energy efficiency, and higher electricity costs. Similarly, manufacturers of heat pumps and air conditioning equipment that utilize f-gas refrigerants and fluorochemistries-containing components such as O-rings, gaskets, and seals could face significant disruptions if fluorochemistries were restricted. Manufacturers would need to design, test, and produce new equipment that could operate with alternative refrigerants and components. Disruption of manufacturing or installation may also increase costs and dilute the benefit of a $2,000 tax credit incentive. Additionally, heat pumps and air conditioners with less energy efficient alternative refrigerants would limit long-term consumer savings on heating and cooling bills. F-gases are also common refrigerants in commercial refrigeration equipment, helping keep perishable foods at safe temperatures. Requiring commercial businesses to use less efficient CO2-based refrigeration systems would increase energy costs and could ultimately raise costs for consumers.

This report examines the potential economic impact of restrictions on fluorochemistries through different pathways. First, the report identifies the jobs and economic activity that would be at risk due to restrictions on fluorochemistries affecting the residential heating and cooling equipment manufacturing and installation sectors and the disposable income reductions of residential users of more expensive and less efficient alternative equipment. Next, the report examines similar impacts that would occur in the commercial sector. Finally, the report identifies building materials that utilize fluorochemistries such as spray foam insulation and estimates increased new home heating and cooling costs due to decreases in energy efficiency associated with using alternative products.

10 https://www.energy.gov/articles/pump-your-savings-heat-pumps

11 https://www.ahrinet.org/analytics/statistics/monthly-shipments

12 https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit

Methodology and Approach

This study was conducted primarily using public data from Princeton's Net-Zero America Study, the Energy Information Administration ("EIA"), the Census Bureau, and data from other federal, state, and trade association sources. Annual residential and commercial heat pump and central air conditioner installation and manufacturing activity was estimated, highlighting the economic activity at risk due to potential restrictions on fluorochemistries, particularly due to f-gases and equipment components that contain these chemistries. Changes to equipment costs, as well as potential impacts to equipment manufacturing and installation activity are estimated. Energy efficiency losses due to replacement refrigerants in both residential and commercial applications were utilized to estimate increased energy costs. Similarly, increased energy costs due to the use of alternative, less effective building materials such as roofing and spray foam installation were calculated for newly constructed homes. Both the economic activity at risk and the increased costs for consumers served as inputs to the IMPLAN model and were used to calculate the total annual economic activity at risk including the jobs, GDP, and tax revenues that could be lost due to restrictions on fluorochemistries.

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 help analyze the connections between different sectors of an economy. These models 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, defined as follows:

Employment: The number of jobs are those supported by the economic activity being evaluated.

Output: The value of an industry's production output is the sum of sales to final users (i.e., 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: Total household income earned by those whose jobs are supported by the economic activity being evaluated.

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 6.**

Figure 6

Direct Effects

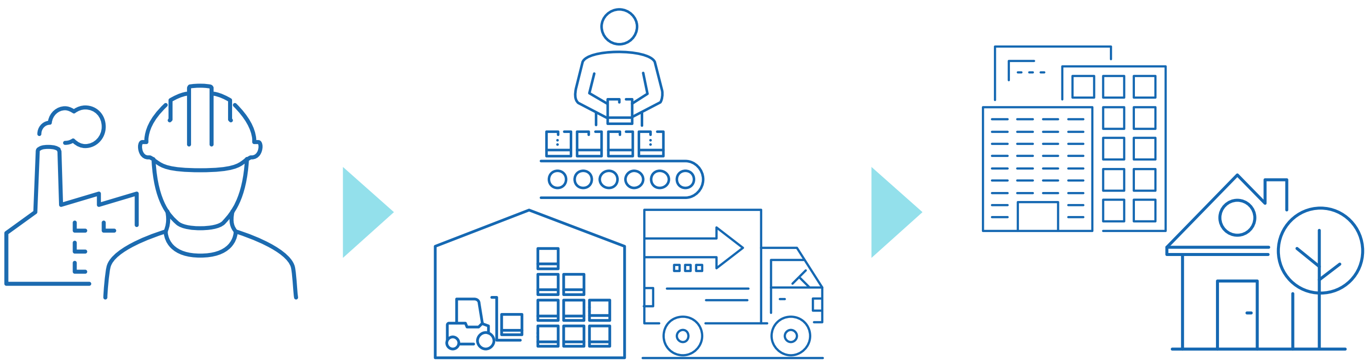
Immediate impacts of a specific economic activity.

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.

Residential Heating and Cooling

Installation Labor at Risk

The IMPLAN model was used to estimate state-level spending on labor for the installation of heat pumps and central air conditioners. Princeton University's Net-Zero America Project ("NZAP") projects the stock of residential heat pumps under different electrification scenarios between 2020 and 2050.[13] The change in equipment stocks between 2025 and 2035 was utilized to capture the annual average impact of near-term disruptions to the sector. An average of NZAP's "High" and "Less-High" electrification projections was used because it provides a view of heat pump adoption that is largely in line with projections from ISO-NE and NYISO, two of the regions that make up the U.S. electric grid.[14,15]

Table 2 displays NZAP's estimates of the number of units that will be installed between 2025–2035. Although heat pump water heaters are projected to see larger growth over the period, the total stock of installed heat pump water heaters is projected to be smaller than the stock of heat pumps.

The labor costs of installing heat pumps were estimated using data from the EIA.[16] Assuming these prices represent a national average, adjustment to the state level was achieved using construction cost indices published by RSMeans and an inflation adjustment using CPI data.[17,18] Finally, state-level labor costs were multiplied by the state-level NZAP projections to produce state-level estimates of spending on labor for installation of heat pumps.

Table 2 – Projection of Residential Heat Pumps Installed (2025-2035)

Heat Pump Type	Stock Installed
Residential Heat Pump Water Heater	26,643,232
Residential Heat Pumps	23,431,418

[13] https://netzeroamerica.princeton.edu/; Note, NZAP data excludes Alaska and Hawaii. As such, these states are not included in certain residential and commercial heating and cooling impact estimates.

[14] https://www.nyiso.com/documents/20142/43675604/05_2024%20Building%20Electrification%20Assumptions%20ESPWG.pdf/c84c96a6-4bff-250b-ef35-18ced7f0e46c

[15] https://www.iso-ne.com/static-assets/documents/100010/final-2024-heating-electrification-forecast.pdf

[16] https://www.eia.gov/analysis/studies/buildings/equipcosts/pdf/full.pdf

[17] https://www.rsmeans.com/media/wysiwyg/quarterly_updates/2021-CCI-LocationFactors-V2.pdf

[18] https://www.bls.gov/regions/mid-atlantic/data/consumerpriceindexhistorical_us_table.htm

To estimate state-level spending on labor for central air conditioner installation, the difference between a Department of Energy ("DOE") estimate of the total number of heating and cooling systems replaced in the U.S. per year (3 million) and the number of heat pump installations projected in NZAP was calculated to derive an estimated number of central air conditioners installed in the U.S. each year (more than 863,000). Total central air conditioner installations were allocated across states according to the EIA Residential Electricity Consumption Survey's ("RECS") data on the number of central air conditioners currently installed in each state.[19] State-level estimates of central air conditioner installations were multiplied by construction cost index adjusted installation labor costs to produce a state-level estimate of spending on labor for central air conditioner installation.

Spending on labor for heat pump and central air conditioner installation over the 2025-2035 period was modeled in IMPLAN to estimate the economic and fiscal impact at risk each year. Installation labor spending for residential heat pumps and air conditioners was estimated at an annual average of $8.7 billion.

Manufacturing at Risk

To estimate the jobs and economic activity that could be at risk from an abrupt shift in the use of f-gas refrigerants and other fluorochemistries that are used in heating and cooling equipment components such as O-rings, seals, and gaskets, publicly-available data from the Air-Conditioning, Heating, and Refrigeration Institute ("AHRI") on the number of residential heat pump and central air conditioning units manufactured in 2023 was multiplied by an average price per unit assumption of $3,000 to calculate the total value of the equipment.[20,21] The total value of equipment was allocated across states based on state-level upstream output of the HVACR equipment and water heating manufacturing industry estimated in an economic analysis published by the AHRI.[22] Finally, the potential change in state-level output was used to estimate jobs and other economic activity associated with residential heat pump and central air-conditioning manufacturing. Manufacturing is estimated to generate $25 billion in output each year.

Increased Equipment and Installation Costs

Restricting the use of f-gases would require alternative refrigerants such as propane in residential heating and cooling equipment. A potential transition to propane is complicated by the fact that most building and fire codes and regulations do not permit the use of propane as a residential refrigerant because propane, unlike f-gases, is highly flammable.[23]

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[19] https://www.eia.gov/consumption/residential/data/2020/state/pdf/State%20Air%20Conditioning.pdf

[20] https://www.ahrinet.org/system/files/2024-02/December%202023%20Statistical%20Release.pdf

[21] AHRI defines residential heat pumps and ACs as those with a BTUh output of 64,900 or less.

[22] https://www.ahrinet.org/system/files/2023-12/AHRI_EconContribution_111523_FINAL.pdf

[23] https://refrigerants.com/wp-content/uploads/2019/12/SDS-R290-Propane.pdf

However, for the purpose of analyzing the costs associated with an f-gas restriction, it is assumed that the relevant regulations would be amended to allow for the use of propane in residential heating and cooling. Manufacturers would need to invest time and money to design new systems to accommodate propane as a refrigerant in the domestic market. In addition, propane-based units are expected to be more expensive due to their specialized design and installation requirements. Currently, a propane-based heat pump marketed in the United Kingdom is approximately 48% more expensive than a comparable model that uses an f-gas refrigerant.[24,25] A study by the California Energy Commission ("CEC") estimated that residential central air conditioning equipment that uses propane would be an average of 5% more expensive.[26] These cost increase estimates were applied to the equipment costs of heat pumps and central air conditioners derived from the EIA.[27]

Installation costs for heat pumps and central air conditioners estimated previously were multiplied by 5% to reflect the additional training and specialized equipment necessary for technicians to install propane-based equipment. The increase in equipment and installation costs were combined and multiplied by the projected state-level installations of heat pumps and central air conditioners estimated previously to produce an estimate of state-level increased spending on equipment and installation. Across all states, increased spending was estimated at $7.2 billion per year. This increased spending was modeled in IMPLAN as a loss of household disposable income to estimate the jobs and economic activity at risk from potential restrictions on fluorochemistries.

Ongoing maintenance costs for propane-based heat pumps and central air conditioners could be higher than current models because of the additional safety training technicians may be required to receive and the increased cost of replacement parts for more complicated equipment. However, it is difficult to make assumptions regarding the potential frequency of maintenance activity and the cost differential associated with that maintenance. As such, increased maintenance costs are not included in this report, and because increased maintenance costs are not estimated, it can be assumed that the impacts estimated here represent a potential underestimate of restrictions on fluorochemistries.

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24 https://www.theheatpumpwarehouse.co.uk/shop/heat-pumps/air-source-heat-pumps/samsung-heat-pumps/samsung-ehs-gen-7-r290-heat-pump-8kw/

25 https://www.theheatpumpwarehouse.co.uk/shop/heat-pumps/air-source-heat-pumps/samsung-heat-pumps/samsung-8kw-r32-monobloc-air-source-heat-pump/

26 https://www.energy.ca.gov/sites/default/files/2024-05/CEC-500-2024-043.pdf

27 Ibid.

Heating and Cooling Energy Efficiency Losses

Heating and cooling equipment that uses alternative refrigerants is also expected to be less energy efficient. A study by the Oak Ridge National Laboratory found that heat pumps switching from a common f-gas refrigerant, R-454C, to propane, could result in roughly 12% less efficiency in terms of cooling output per unit of electricity.28 In this analysis, a similar refrigerant, R-454B, is compared to propane, with an assumed efficiency loss of 15% for heat pumps and central air conditioners.

To calculate the additional electricity consumption resulting from less efficient heating and cooling equipment, the projected annual average installations of heat pumps and central air conditioners estimated previously were multiplied by state-level annual average household electricity demand for space heating and cooling (for heat pumps), water heating (for heat pump water heaters), and space cooling (for central air conditioners) published in the RECS data. RECS consumption estimates of electricity for heating and cooling are averaged across all equipment types, including heat pumps and electric resistance heaters. Average state-level consumption of electricity for space heating by heat pumps was calculated using the RECS microdata by weighting household-level consumption by square footage.

To account for the higher coefficient of performance ("COP") of heat pump water heaters relative to electric resistance (3.0 vs. 1.0), the annual average consumption of electricity for electric water heating was first scaled down to 33% and then multiplied by the number of heat pump water heaters installed.29,30 The state-level consumption figures of electricity for each equipment type were multiplied by average state-level residential electricity prices to estimate the total annual cost of electricity for heat pumps and central air conditioners. The spending estimates were then multiplied by 15% to estimate the additional spending on electricity that could result from restrictions on fluorochemistries. Total additional spending on electricity due to energy efficiency losses is estimated at $483 million in the first year. By 2035, additional spending on electricity due to less efficient refrigerants could reach $5.3 billion. This spending was modeled in IMPLAN as a loss of household disposable income.

Energy Demand and Emissions Impacts

Less efficient heating and cooling equipment lead to increased residential electricity consumption. In total, a restriction on fluorochemistries would lead to an additional 2.6 million MWh of electricity demanded in its first year. Assuming a constant rate of heating and cooling equipment installation, additional consumption grows to 29 million MWh of electricity by 2035.

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[28] https://info.ornl.gov/sites/publications/Files/Pub200582.pdf

[29] https://www.energy.gov/energysaver/electric-resistance-heating

[30] https://sustainabletechnologies.ca/app/uploads/2017/11/ASHPWH_Tech-Brief2.pdf

Emissions from increased electricity consumption were calculated using the EPA's state-level eGRID emissions rates for annual CO2 equivalent ("CO2e") output and adjusted from pounds to metric tons.[31] In total, increased residential electricity consumption is expected to produce 974,000 metric tons CO2e in the first year. As more heating and cooling equipment with alternative refrigerants is installed, that figure grows to 10.7 million tons CO2e by 2035 for a cumulative effect of 64 million tons of CO2e.

Note, total residential equipment replacements and installations of three million units per year results in roughly 33 million affected households by 2035. This represents just 22% of the 147 million housing units in the United States.[32]This level of replacement over a ten year period may be viewed as a conservative estimate of changes to the equipment stock. As such, actual electricity demand and emissions impacts could be larger.

Commercial Heating and Cooling

Installation Labor at Risk

NZAP projections of commercial heat pump installations were also used to estimate state-level spending on labor for commercial heat pumps.[33] installation of heat pumps and central air conditioners. Princeton University's Net-Zero America Project ("NZAP") projects the stock of residential heat Unlike residential heat pumps, NZAP publishes commercial heat pump installations in giga-joule per hour ("GJ/h") units, a measure of total energy output among all installed heat pumps. For this analysis, it was necessary to convert these units into the number of heat pumps installed. To make the conversion, the average maximum output capacity of a representative commercial unit (150K BTUh) was calculated using AHRI sales data.[34] Then, the total average energy output was divided by the average maximum output of the representative heat pump to form an initial estimate of the number of heat pumps installed. However, this would assume continuous operation of equipment at maximum output at all times. In reality, equipment is not likely to run continuously at maximum output, instead peaking during the summer cooling months. To account for this, the initial estimate was multiplied by the ratio of peak to average consumption of electricity for commercial cooling.[35]

For heat pump water heaters, output per water heater was assumed to be 140K BTUh based on a representative heat pump water

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31 https://www.epa.gov/egrid

32 https://fred.stlouisfed.org/series/ETOTALUSQ176N

33 NZAP data excludes Alaska and Hawaii, resulting in a $0 impact from heat pumps in these states in this report.

34 https://www.ahrinet.org/system/files/2024-02/December%202023%20Statistical%20Release.pdf

35 https://loadshape.epri.com/enduse

heaters, output per water heater was assumed to be 140K BTUh based on a representative heat pump water heater's technical manual and the assumption of an 80°F ambient indoor temperature.[36] Conservative assumptions of a high indoor ambient temperature (which raises energy output per unit) and a relatively large representative heat pump water heater should result in a conservative estimate of the number of commercial heat pump water heaters installed. **Table 3** displays estimates of the total number of units installed between 2025–2035.

EIA estimates of labor costs to install commercial heat pumps and commercial heat pump water heaters were adjusted for inflation and the state-level RSMeans construction cost index. Labor costs were then multiplied by the number of installations projected at the state-level over the period 2025–2035 to produce total spending on labor costs for commercial heat pump installation. Total spending was modeled in IMPLAN to estimate the total jobs and economic activity that would be at risk from fluorochemistries restrictions and used to generate annual average estimates across the 2025–2035 time period. Installation spending on labor for commercial heat pumps and air conditioners was estimated at an annual average of $4.3 billion.

Manufacturing at Risk

To estimate the jobs and economic activity that could be at risk from an abrupt shift in the use of fluorochemistries, data from AHRI on the number of commercial heat pump and central air-conditioning units manufactured in 2023 was multiplied by an average price per unit assumption of $7,500 to calculate the total value of the equipment.[37,38] This total value of equipment estimate was allocated across states based on the relative state-level upstream output of the HVACR equipment and water heating manufacturing industry estimated in a recent economic analysis published by AHRI.[39] Finally, the potential change in state-level output was used to estimate jobs and other economic activity associated with heat pump and central air-conditioning manufacturing. Total manufacturing spending is estimated at $2.2 billion.

Table 3 – Projection of Commercial Heat Pumps Installed (2025–2035)

Heat Pump Type	Stock Installed
CommercialHeat Pump Water Heater	412,816
CommercialHeat Pumps	4,042,365

[36] https://files.myrheem.com/webpartners/ProductDocuments/4063EC7A-CFFC-4C41-90D5-718F1DA8AE8C.pdf

[37] https://www.ahrinet.org/system/files/2024-02/December%202023%20Statistical%20Release.pdf

[38] AHRI defines commercial heat pumps and air conditioners as equipment with 65K BTU or higher.

[39] https://www.ahrinet.org/system/files/2023-12/AHRI_EconContribution_111523_FINAL.pdf

Increased Equipment and Installation Costs

The total equipment and labor cost associated with replacing and maintaining commercial heating and cooling equipment is difficult to estimate given the wide range of commercial equipment in use, such as small walk-in refrigerators compared to large supermarket-size refrigeration systems. As such, it is not possible to form a reliable assumption of the increased cost of replacing, installing, or maintaining commercial heating and cooling equipment. Similarly, given the potentially large cost of this equipment, it is unlikely that businesses would pass on the total capital cost of equipment to consumers in a single year via increased prices as they might with increased operational costs such as increased electricity use. Instead, capital costs would likely be amortized over a longer time period. This report does not include a quantitative analysis of potential equipment, installation, and maintenance cost increases for commercial heating and cooling equipment; because these costs are not estimated, it can be assumed that the impacts estimated here represent a potential underestimate of the total cost of restrictions on fluorochemistries.

Cooling and Refrigeration Energy Efficiency Losses

Increased consumption of electricity due to decreased refrigerant energy efficiency was estimated separately for commercial refrigeration, commercial air conditioning, and commercial heat pumps. Chillers, another prevalent type of heating and cooling equipment in the commercial sector, may also be affected by potential restrictions on fluorochemistries; however, due to a lack of research estimating analogous efficiency losses for chillers with alternative components and refrigerants, quantitative analysis of this equipment was not included in this report.

For commercial refrigeration, Commercial Buildings Electricity Consumption Survey (“CBECS”) data on total consumption of electricity for commercial refrigeration at the Census division level was allocated among states by population and multiplied by 10% to reflect an assumed share of the building stock replacing refrigeration equipment each year.[40] A study by the Oak Ridge National Laboratory found that the use of alternative refrigerants in commercial refrigerators would be 70% as energy efficient as R-454C, one of the proposed refrigerants to be restricted.[41,42] The size of this difference varies with ambient temperature and other operating conditions; as such, a more conservative assumption is that alternative refrigerants require 25% more electricity to achieve the same cooling effect as R-454C. Total electricity use for commercial refrigeration was multiplied by 25% to model the energy efficiency loss from using alternative refrigerants, resulting in additional energy use. Finally, multiplying additional energy consumption by EIA estimates of state-level average commercial electricity prices resulted in additional spending on electricity for commercial refrigeration. Assuming that owners of commercial real estate can pass on these costs to consumers (for businesses like supermarkets) or taxpayers (for schools and government buildings), increased spending

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[40] https://www.eia.gov/consumption/commercial/data/2018/ce/pdf/e5.pdf

[41] https://info.ornl.gov/sites/publications/Files/Pub200582.pdf

[42] Based on a comparison of refrigerants’ coefficients of performance at 95°F.

of electricity for commercial refrigeration was modeled in IMPLAN as a loss of household disposable income. This figure in the first year is estimated at $355 million. As a greater share of the commercial building stock replaces their refrigeration equipment each year, that figure grows to $3.5 billion of increased spending on electricity by 2035. For commercial air conditioning, CBECS data on the amount of air-conditioned floorspace at the Census division level was allocated among states according to population.[43] Each state's derived share of total air-conditioned floorspace was multiplied by 10% of national commercial consumption of electricity for cooling, assuming 10% of the building stock replaces its air conditioning equipment each year, to calculate the amount of consumption in each state that will be shifted to equipment with alternative refrigerants.[44] Like Residential Heating and Cooling Energy Efficiency Losses, an assumed 15% energy efficiency loss from switching to alternative refrigerants was multiplied by state-level consumption to estimate additional electricity consumption for commercial refrigeration due to alternative refrigerants. Finally, this figure was multiplied by EIA data on state-level commercial electricity prices, resulting in state-level estimates of additional spending on electricity for commercial refrigeration. Across all states, additional spending is estimated at $281 million in the first year. As a greater share of the overall commercial building stock replaces their air conditioning equipment, annual additional spending on electricity grows to $2.8 billion by 2035.

For commercial heat pumps, the projected annual average of commercial heat pumps and commercial heat pump water heaters by state was used as the number of heat pumps installed each year.[45] CBECS data on electricity space heating, cooling, and water heating intensities were multiplied by the average square footage per buildings that use electric space heating, electric cooling and electric water heating, respectively.[46,47] The products of these calculations is estimated average electricity consumption per building of heat pump heating, heat pump cooling, and heat pump water heater heating. Heat pump installation projections were multiplied by average electricity consumption for heating and cooling separately. Heat pump water heater installation projections were multiplied by average electricity consumption for water heating. Combined, these products represent the total consumption of electricity from commercial heat pumps and commercial heat pump water heaters. Total consumption was multiplied by 15% to calculate the additional electricity consumed by heat pumps with less efficient refrigerants. Finally, additional consumption was multiplied by EIA data on state-level commercial electricity prices to calculate the additional spending on electricity for commercial heat pumps. Additional spending is estimated at $733 million, which grows to $8 billion annually by 2035 as additional heat pumps are installed.

Energy Demand and Emissions Impacts

Less efficient refrigerants produces an incremental electricity demand across all

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[43] https://www.eia.gov/consumption/commercial/data/2018/bc/pdf/b22.pdf

[44] https://www.eia.gov/consumption/commercial/data/2018/ce/pdf/e5.pdf

[45] NZAP data excludes Alaska and Hawaii, resulting in a $0 impact from heat pumps in these states in this report.

[46] https://www.eia.gov/consumption/commercial/data/2018/ce/pdf/e6.pdf

[47] https://www.eia.gov/consumption/commercial/data/2018/bc/pdf/b1.pdf

equipment in the first year of 8.5 million MWh. By 2035, this annual increase grows to 89 million MWh.

Emissions from increased electricity were calculated using the EPA's eGRID emissions factors for state-level output and converted to metric tons of CO2e.[48] Increased emissions due to less efficient refrigerants is estimated at 2.8 million metric tons of CO2e in the first year. This annual effect grows to nearly 30 million metric tons CO2e per year by 2035, for a cumulative impact on domestic emissions of 70 million metric tons CO2e over 2025–2035.

Note, total commercial air conditioner and refrigeration equipment replacements of 10% of demand each year results in all commercial equipment stock replaced by 2035. Similarly, the installation of over 4 million heat pumps represents a large share of the roughly 5.9 million commercial buildings.[49] This level of replacement and adoption over a ten year period may be viewed as aggressive. However, given the shorter lifespan of commercial equipment and the phaseout of certain refrigerants under the Kigali Amendment, it was viewed as reasonable. As such, actual electricity demand and emissions impacts could be smaller if the commercial equipment stock transition occurs over a longer time period.

Building Materials

Fluorochemistries are present in a wide array of building materials that insulate, weatherize, and otherwise improve the quality of new construction. For example, f-gases are used to spray foam insulation in attics and crawlspaces, rooftop shingles may be coated with fluorochemistries to prolong their lifespan and help reflect sunlight, and concrete sealant on patios and around foundations may use fluorochemistries for their durability. EnergyStar estimates that a properly insulated home could see up to a 15% reduction in home heating and cooling costs.[50] Assuming that restrictions on fluorochemistries would negatively affect the performance of the products used to insulate homes, this report assumes that new homes constructed with alternative building materials would require 15% more energy consumption to heat and cool compared to homes constructed with building materials containing fluorochemistries.

To project additional spending on energy for heating and cooling attributed to alternative building materials, estimates of new residential construction by state from the 2023 Building Permits Survey ("BPS") were used.[51] Data from the 2023 Survey of Construction ("SOC") was used to estimate

[48] https://www.epa.gov/egrid

[49] https://www.eia.gov/consumption/commercial/data/2018/bc/pdf/b1.pdf

[50] https://www.energystar.gov/saveathome/seal_insulate/methodology

[51] https://www.census.gov/construction/bps/current.html

the number of new residences each year that would install central air conditioning, heat pumps, fossil fuel-based furnaces, or electric furnaces.[52] SOC microdata was used to estimate the percentage of each heating or cooling equipment type by census division. The number of residences using each kind of equipment was then multiplied by the annual average household consumption of the appropriate fuel taken derived from RECS, except for residences using heat pumps, where RECS microdata on electricity consumption adjusted by square footage was used for a more granular estimate of average consumption.[53] The consumption values were then multiplied by the state average fuel prices to estimate total spending on fuels. Finally, total spending was multiplied by 15% to account for the estimated increase in heating and cooling costs due to less efficient building materials. Increased spending on fuel across all states is estimated at $202 million per year. Total increased spending on fuels could rise to $2.2 billion annually by 2035.

Energy Demand and Emissions Impacts

The incremental increased consumption of electricity across all electric fuel types is approximately 1 million MWh per year. As new homes are added to the housing supply over 2025–2035, this additional effect grows to 11 million MWhs per year by 2035.

The additional consumption of electricity and other heating fuels produces emissions. Emissions factor estimates from the EPA's Emissions Factors Hub and eGRID were multiplied by state-level estimates of additional energy use to estimate the incremental emissions attributable to less efficient building materials each year. In 2025, an estimated 557,000 metric tons CO2e of additional emissions are generated; by 2035, this effect grows to 6.1 million metric tons CO2e per year for a cumulative total of 36 million metric tons of CO2e.[54,55]

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52 https://www.census.gov/construction/soc/index.html

53 https://www.eia.gov/consumption/residential/data/2020/index.php?view=consumption

54 https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf

55 https://www.epa.gov/egrid

Economic Impacts

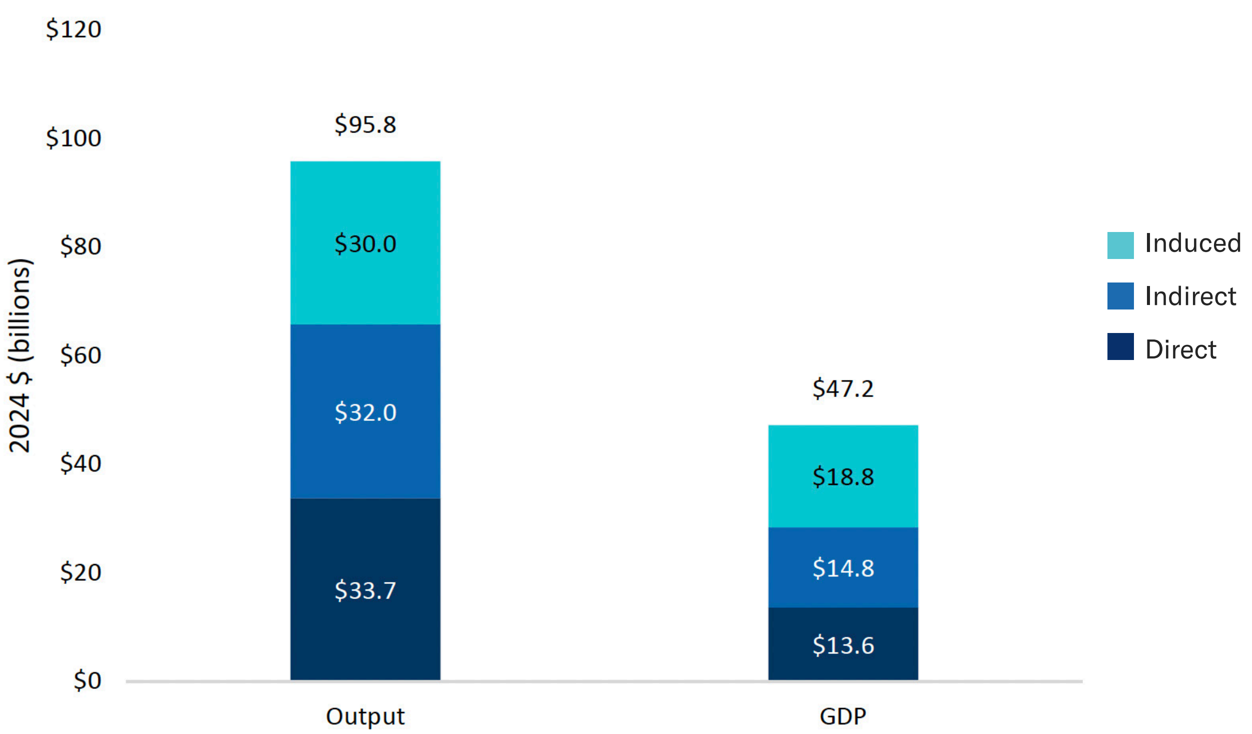
This section describes the economic activity at risk in residential heating and cooling applications, commercial heating and cooling applications, and in building materials that could result from a restriction on the use of f-gases requiring the use of less efficient and more expensive equipment and materials.

Residential Heating and Cooling

Output and GDP Impacts

Restrictions on fluorochemistries in residential heating and cooling are expected to place $96 billion in economic output and $47 billion in GDP at risk each year by 2035, as summarized in Figure 7. Economic output is split between direct (35%), indirect supply chain (33%), and induced consumer spending impacts (32%). Spending on heat pump and central air conditioner installation labor and the manufacturing of heat pumps and central air conditioners comprise the nearly $34 billion of direct impacts. Manufacturing heat pumps and central air conditioners makes up 84% and 81% of indirect economic output and GDP, respectively, but only 33% of induced economic output and GDP. Equipment and installation costs and energy efficiency losses contribute induced impacts through a reduction of household disposable income.[56] Combined, they represent 52% of induced economic output and GDP at risk.

Figure 7 – Output and GDP at Risk, Residential Heating and Cooling

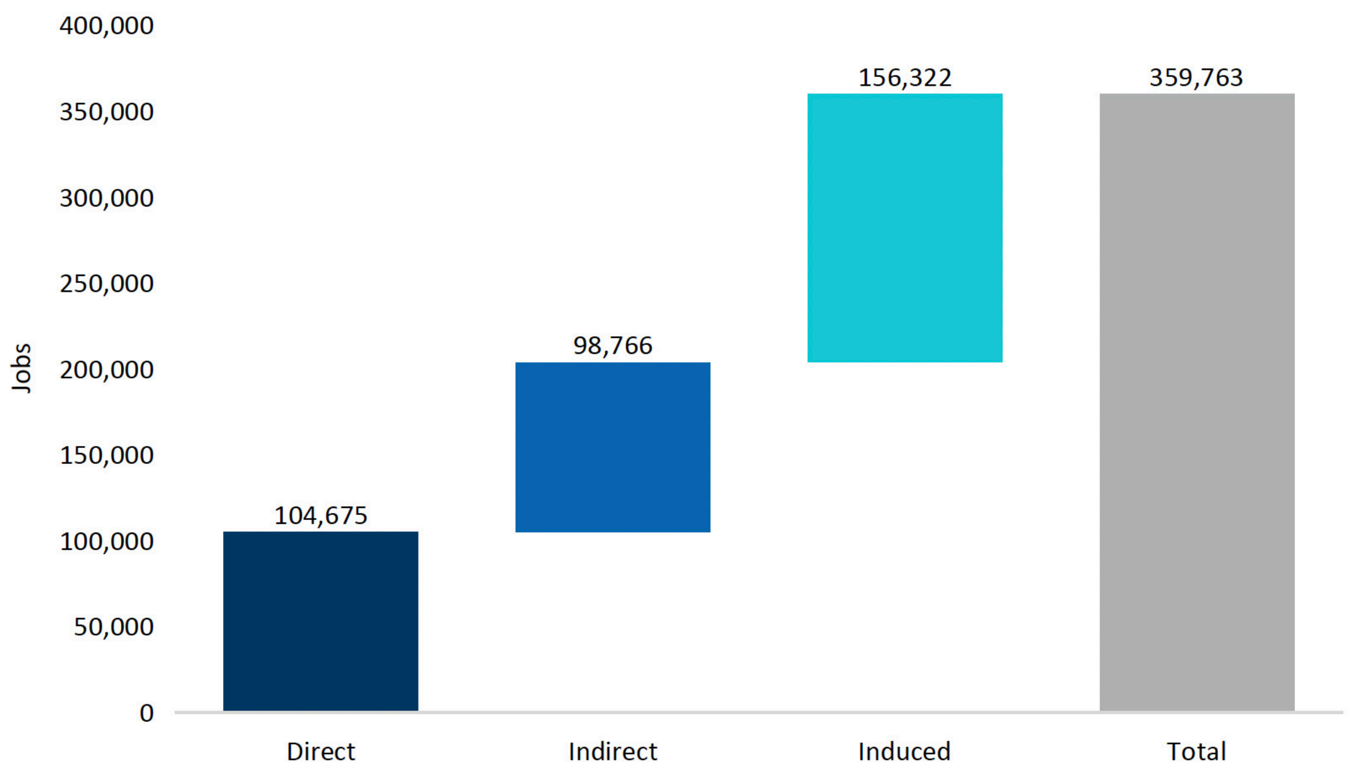


[56] The reduction in disposable income from energy efficiency losses is presented in this report as the cumulative impact of higher electricity bills by 2035.

Employment and Labor Income Impacts

Overall, an estimated 359,763 jobs are at risk in the residential heating and cooling sector, as shown by **Figure 8**.[57] Heat pump and central air conditioner installation makes up 50% of direct employment impacts. While heat pump and air conditioner installation technicians must hold certifications to operate, they are not required to earn a four-year college degree, opening up opportunities for workers with different educational backgrounds. According to the Bureau of Labor Statistics ("BLS"), there were an estimated 441,200 heating, air-conditioning, and refrigeration mechanics and installers employed in the U.S. in 2023. Heat pump and air conditioner installation is projected to support roughly 53,000 jobs each year, many of which will be new positions created to meet rising demand. BLS currently projects ten-year growth of over 40,000 jobs.[58]

Figure 8 – Jobs at Risk, Residential Heating and Cooling

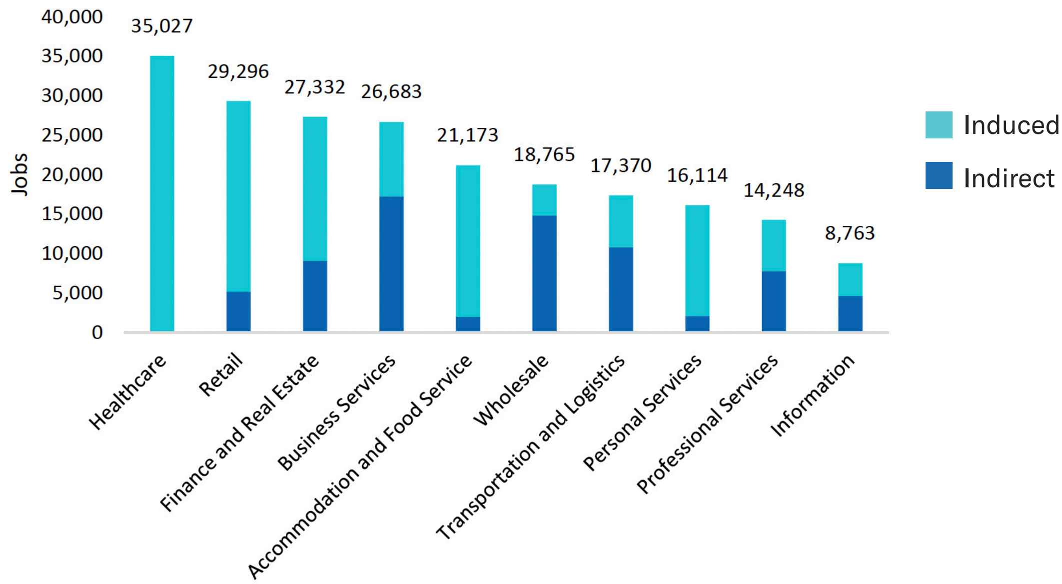


[57] Note, restrictions on f-gases may not impact all employment related to the heating and cooling sector and the exact effect is difficult to quantify. As such, these figures should be interpreted as an upper bound on potential impacts.

[58] https://www.bls.gov/ooh/installation-maintenance-and-repair/heating-air-conditioning-and-refrigeration-mechanics-and-installers.htm

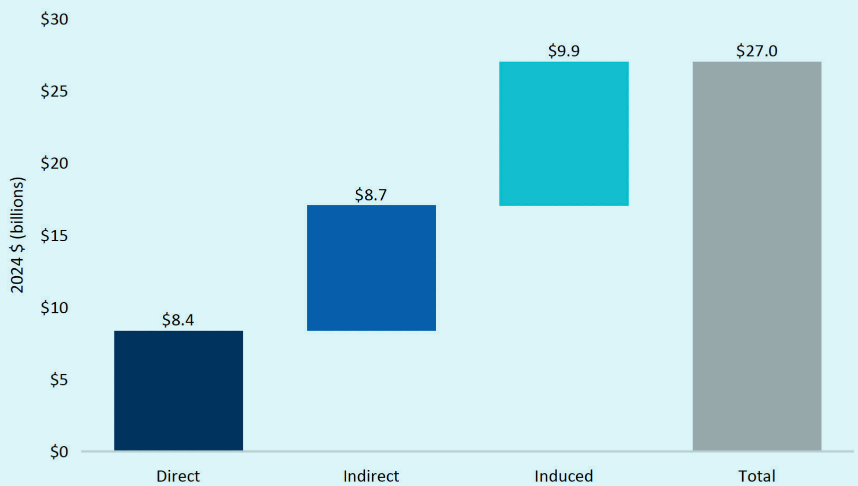
Figure 9 shows the distribution of residential heating and cooling's indirect and induced employment impacts across economic sectors. More than 35,000 jobs, or 14% of indirect and induced jobs, are at risk in the healthcare sector. There are also significant impacts in other sectors, with more than 25,000 jobs at risk in the retail, business services, and finance and real estate sectors.

Figure 9 – Jobs at Risk, Residential Heating and Cooling, Top 10 Sectors



The average annual salary of the nearly 105,000 direct jobs at risk in residential heating and cooling is roughly $80,200, as shown in **Figure 10.**[59] The median annual earnings for full-time workers aged 25-34 with a high school degree and no college education was $41,800 in 2022.[60] This analysis seems to suggest that the heat pump and air conditioner installation and manufacturing jobs directly supported could be an attractive career for this segment of the labor force. An additional $8.7 billion indirect and $9.9 billion in annual induced labor income across the economy would also be at risk by 2035.

Figure 10 – Labor Income at Risk, Residential Heating and Cooling



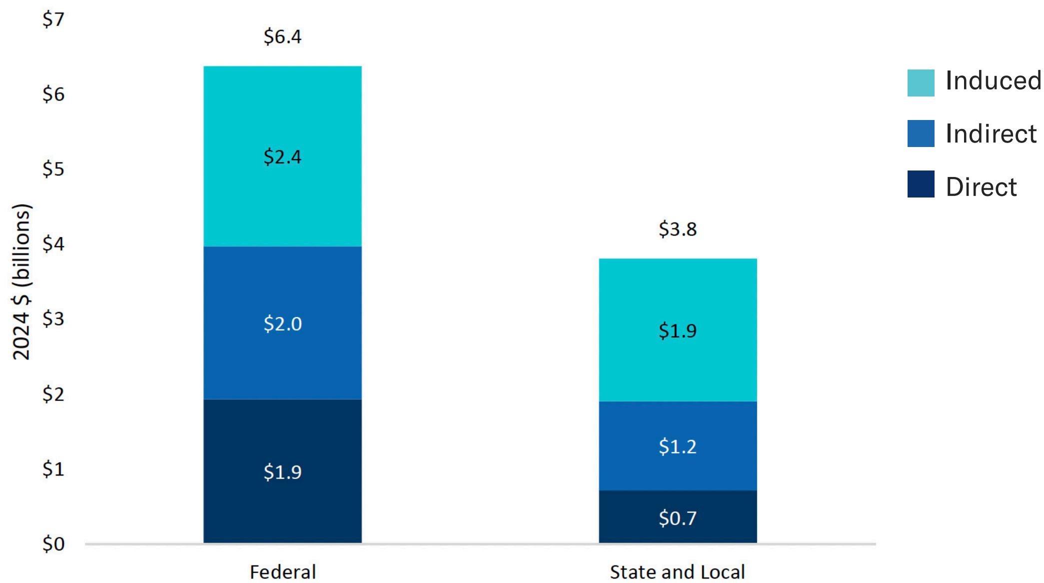
[59] $8.4 billion divided among 104,675 jobs.

[60] https://nces.ed.gov/programs/coe/indicator/cba/annual-earnings

Federal, State, and Local Tax Revenue Impacts

As shown in **Figure 11**, an estimated $6.4 billion in annual federal tax revenue from the direct, indirect, and induced impacts of residential heating and cooling activity each year would be at risk by 2035. State and local government revenues at risk total $3.8 billion annually.

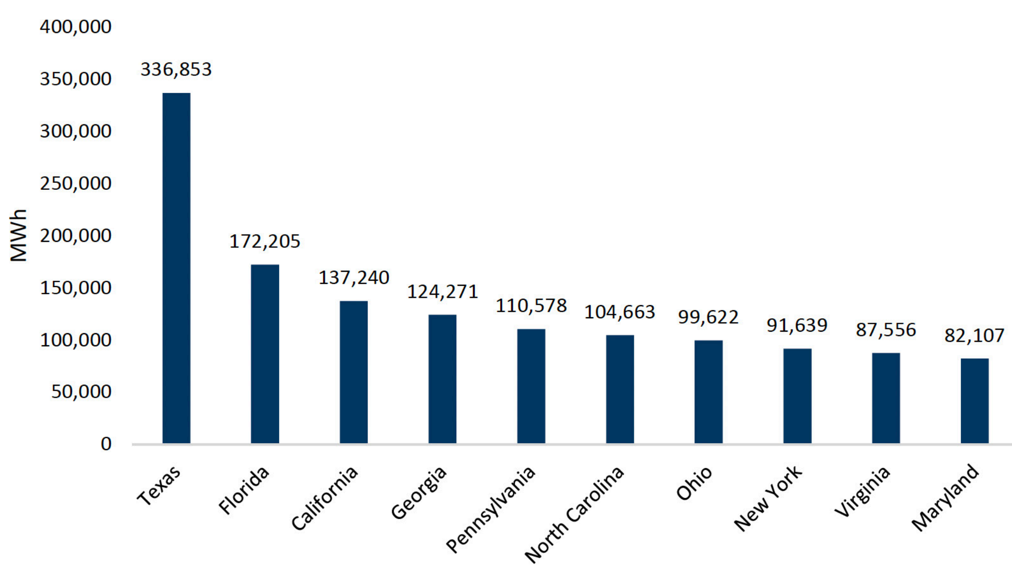
Figure 11 – Federal, State, and Local Tax Revenues at Risk, Residential Heating and Cooling



Electricity Consumption Impacts

Less efficient refrigerants in residential heating and cooling equipment lead to higher energy bills for consumers. Texas is projected to install the most new heating and cooling equipment of all US states. By using alternative refrigerants, they would consume the most additional electricity. In total, 2.6 million additional MWh would be consumed in the first year, which is close to the annual output of two average coal-fired power plants.[61]

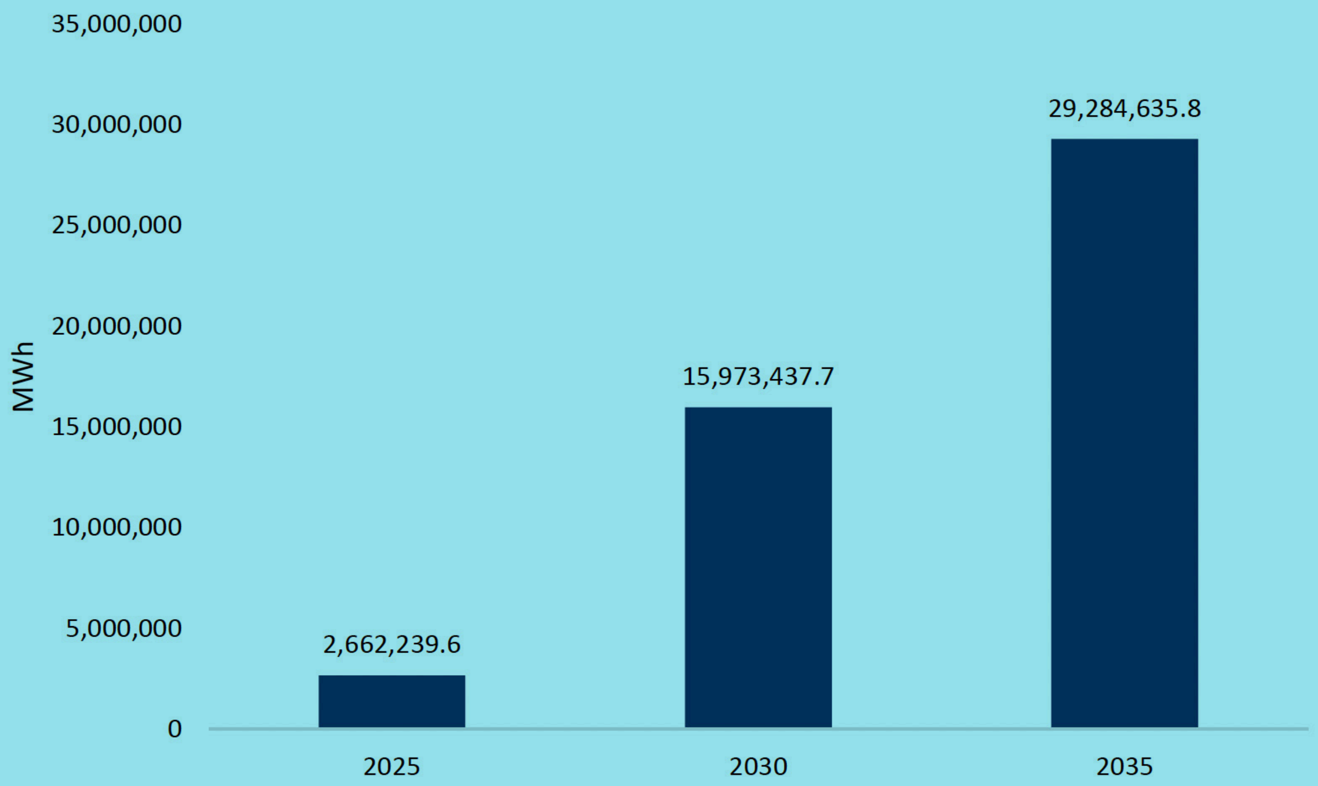
Figure 12 – First-Year Incremental Electricity Consumption Impacts, Residential Heating and Cooling, Top 10 States



[61] Based on an average coal plant capacity of 332 MW (https://www.brattle.com/wp-content/uploads/2023/04/A-Review-of-Coal-Fired-Electricity-Generation-in-the-U.S..pdf) and a 2023 average coal plant capacity factor of 42.4%. (https://www.eia.gov/electricity/annual/html/epa_04_08_a.html).

As more equipment using alternative refrigerants is installed, incremental electricity consumption due to less efficient refrigerants grows to over 29 terawatt-hours ("TWh") in 2035, which is roughly the annual output of twenty-four average size coal-fired power plants.[62] In 2023, there were 1,450 TWh of electricity sold to residential customers, suggesting that residential energy efficiency losses from the use of alternative refrigerants are significant.[63]

Figure 13 – Incremental Electricity Consumption Impacts by Year, Residential Heating and Cooling



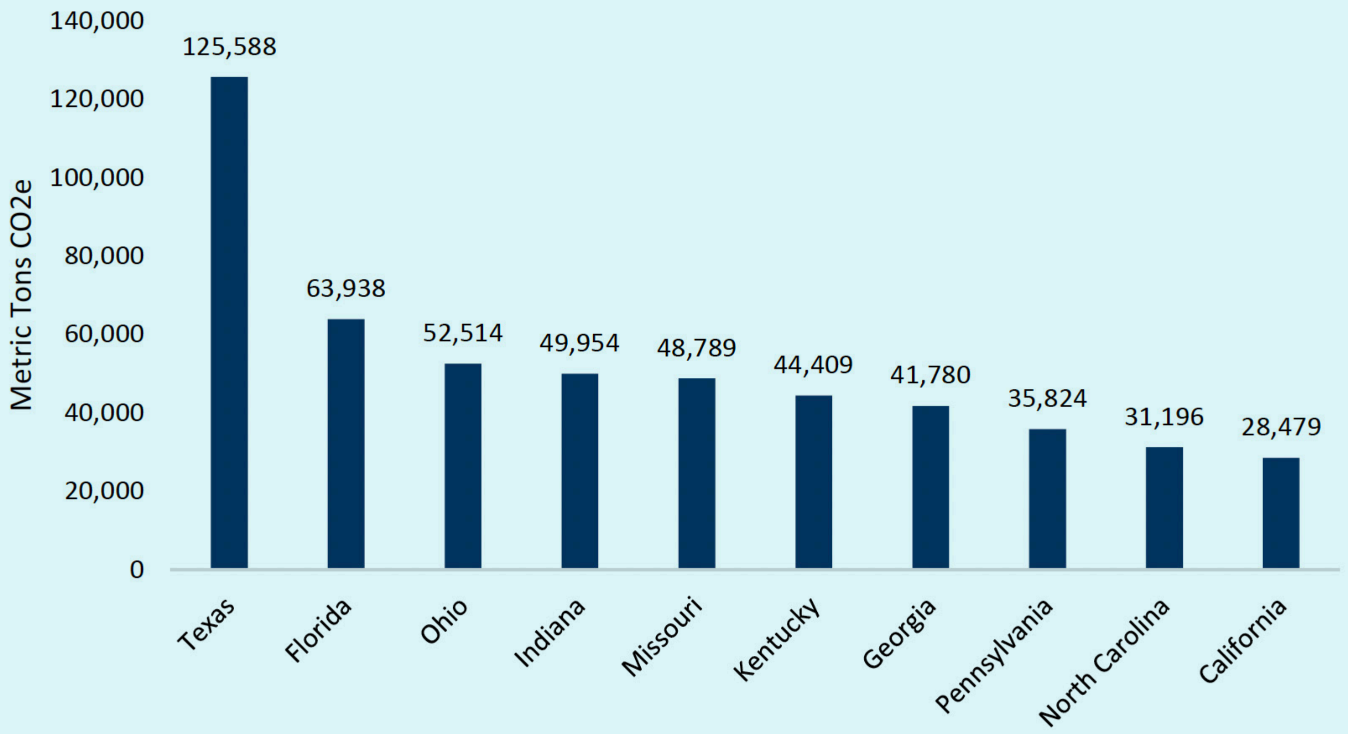
[62] 1 TWh = 1 million MWh

[63] https://www.eia.gov/electricity/sales_revenue_price/pdf/table_2.pdf

Emissions Impacts

The increased energy use associated with less efficient refrigerants in residential heating and cooling equipment has a significant effect on domestic emissions. Across all states, an incremental 974,000 metric tons of carbon-dioxide equivalent ("CO2e") are expected to be generated in the first year of restrictions on fluorochemistries in residential heating and cooling. This is equivalent to adding 227,000 passenger vehicles to the road. The state-level results highlighted in **Figure 14** show the most additional emissions would be produced in Texas, followed by Florida and Ohio. The amount of emissions generated depends on the volume of new heating and cooling equipment installed and the emissions intensity of the electric grid generation portfolio associated with each state.

Figure 14 – First-Year Incremental Emissions Impacts, Residential Heating and Cooling, Top 10 States



Annual incremental emissions grow over the 2025–2035 analysis period as more equipment using alternative refrigerants is installed if f-gas restrictions are implemented. In 2035, the annual incremental impact is 10.7 million metric tons CO2e, equivalent to adding 2.5 million cars to the road. This brings cumulative emissions impact to 64 million additional metric tons CO2e over the time period.

Figure 15 – Incremental Emissions Impacts by Year, Residential Heating and Cooling

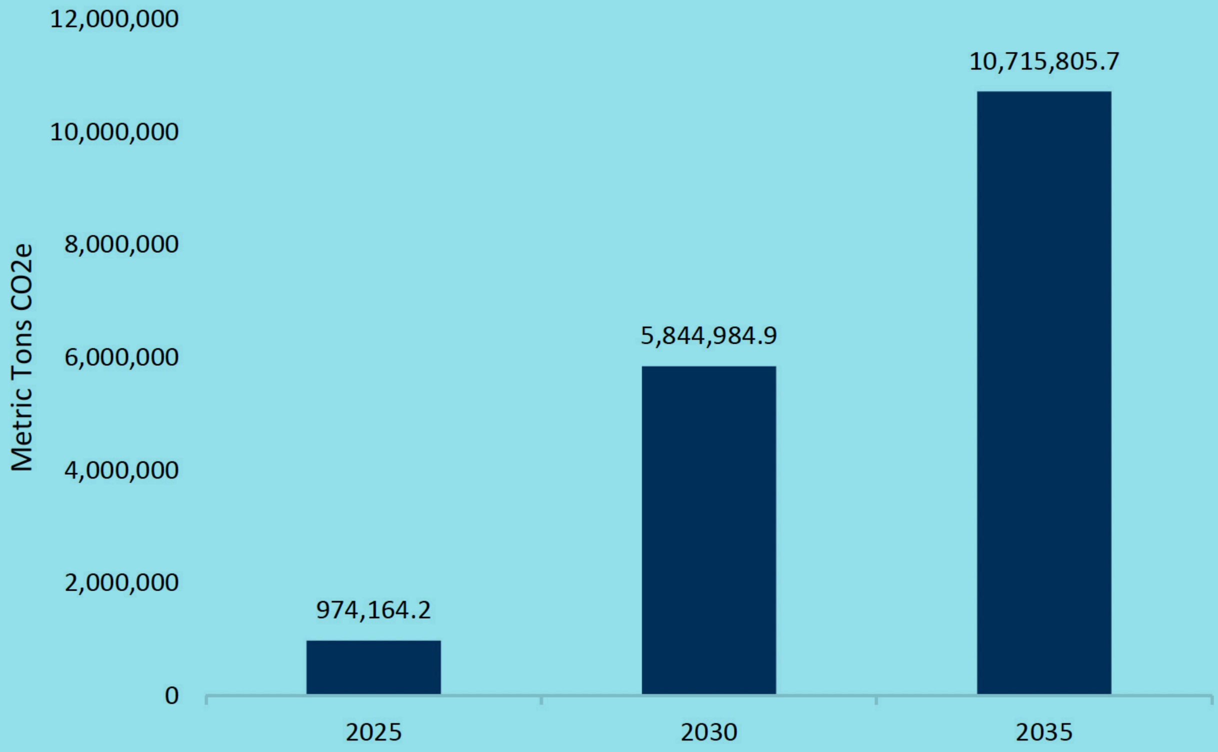
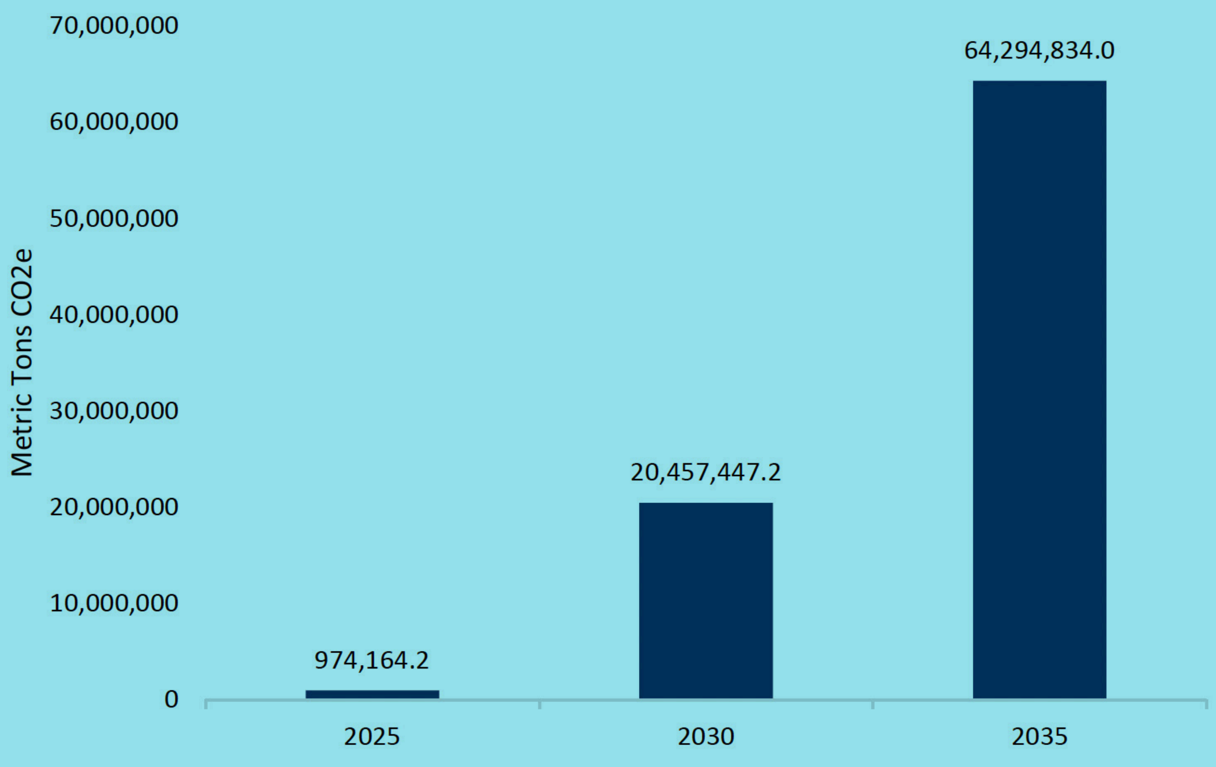


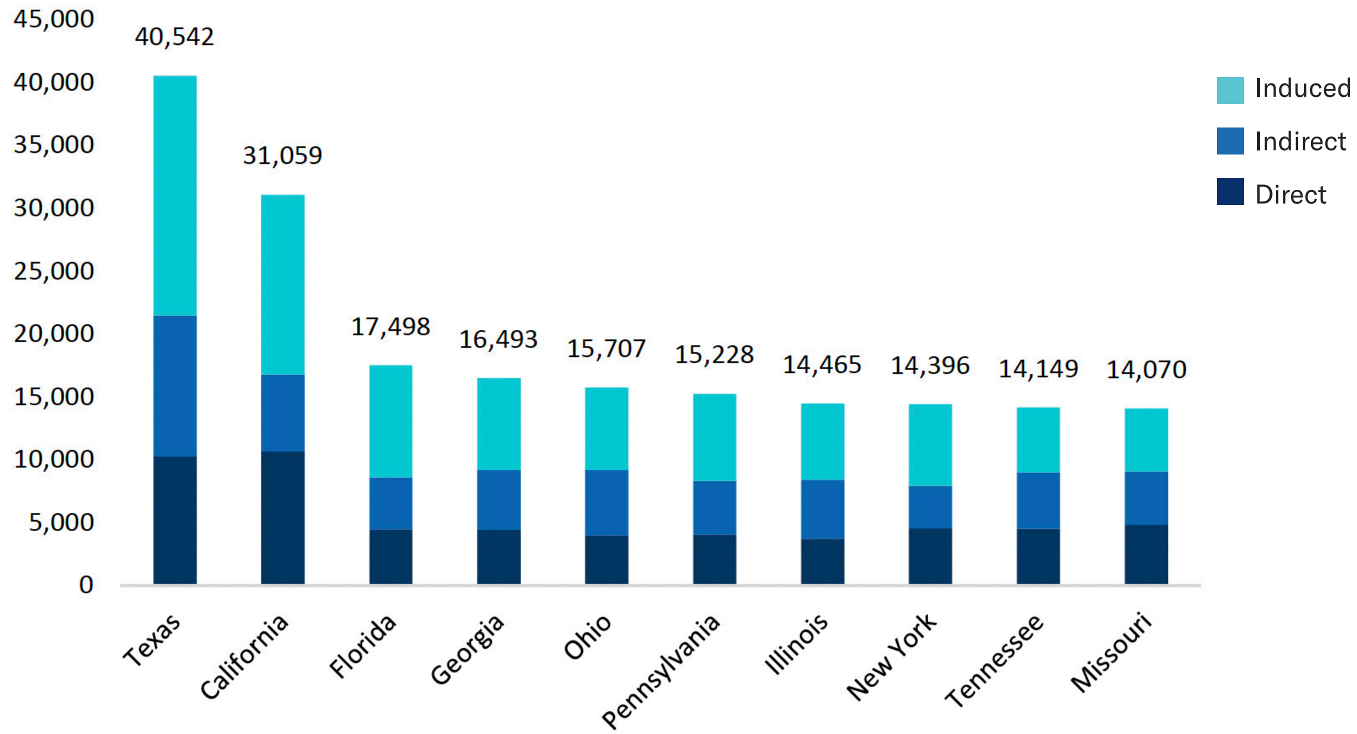
Figure 16 – Cumulative Emissions Impacts of Residential Heating and Cooling



State-Level Impacts

Figure 17 ranks the top ten states by number of jobs at risk by 2035 due to restrictions on fluorochemistries in residential heating and cooling. Of the more than 40,000 jobs at risk in Texas, roughly 22,500 are supported by heat pump and central air conditioner manufacturing. Note, this analysis does not directly account for jobs related to the manufacturing, distribution, or reclaim of f-gas refrigerants. As such, this is a conservative estimate.

Figure 17 – Jobs at Risk, Residential Heating and Cooling, Top 10 States



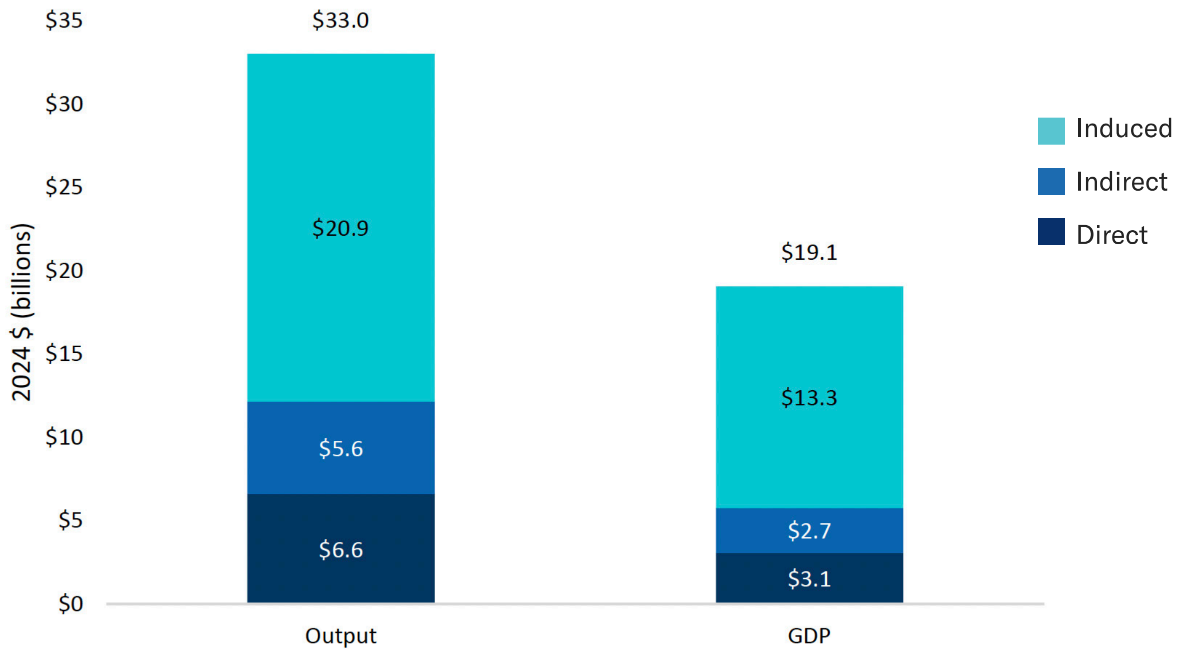
Commercial Heating and Cooling

Output and GDP Impacts

Restrictions on fluorochemistries in commercial heating and cooling are expected to place $33 billion in economic output and over $19 billion in GDP at risk each year by 2035, as summarized by Figure 18. Economic output is primarily induced (63%) because the contribution of increased commercial electricity bills due to less efficient refrigerants is exclusively induced. Spending on heat pump and central air conditioner installation labor and the manufacturing of heat pumps and central air conditioners comprise the nearly $6.6 billion of direct impacts and $5.6 billion of indirect impacts. Energy efficiency losses generate induced impacts through a reduction of household disposable income.[64]

[64] The reduction in disposable income from energy efficiency losses is presented in this report as the cumulative impact of higher electricity bills by 2035.

Figure 18 – Output and GDP at Risk, Commercial Heating and Cooling



Employment and Labor Income Impacts

Overall, an estimated 145,247 jobs are at risk in commercial heating and cooling, as shown by Figure 19. While heat pump and air conditioner installation technicians must hold certifications to operate, they are not required to earn a four-year college degree, opening up opportunities for workers with different educational backgrounds. According to the BLS, there were an estimated 441,200 heating, air-conditioning, and refrigeration mechanics and installers employed in the U.S. in 2023. Commercial heat pump and air conditioner installation is projected to support approximately 19,000 jobs each year, many of which will be new positions created to meet rising demand. BLS currently projects ten-year growth of over 40,000 jobs.[65]

[65] https://www.bls.gov/ooh/installation-maintenance-and-repair/heating-air-conditioning-and-refrigeration-mechanics-and-installers.htm

Figure 19 – Jobs at Risk, Commercial Heating and Cooling

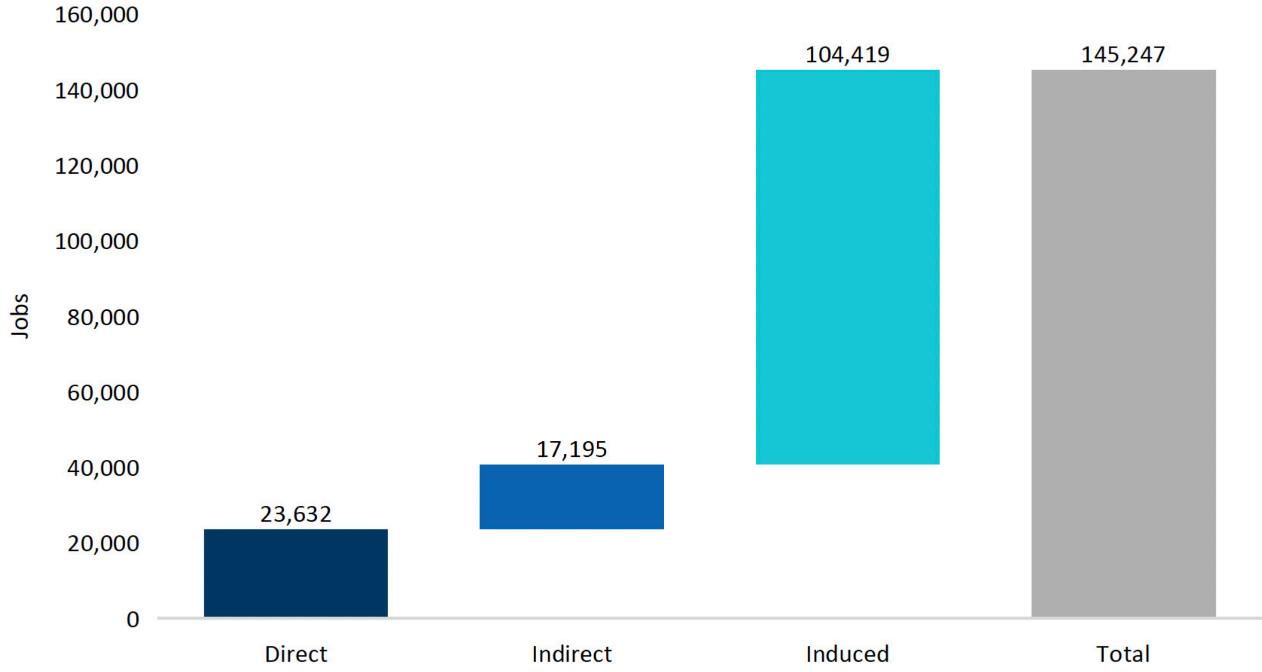
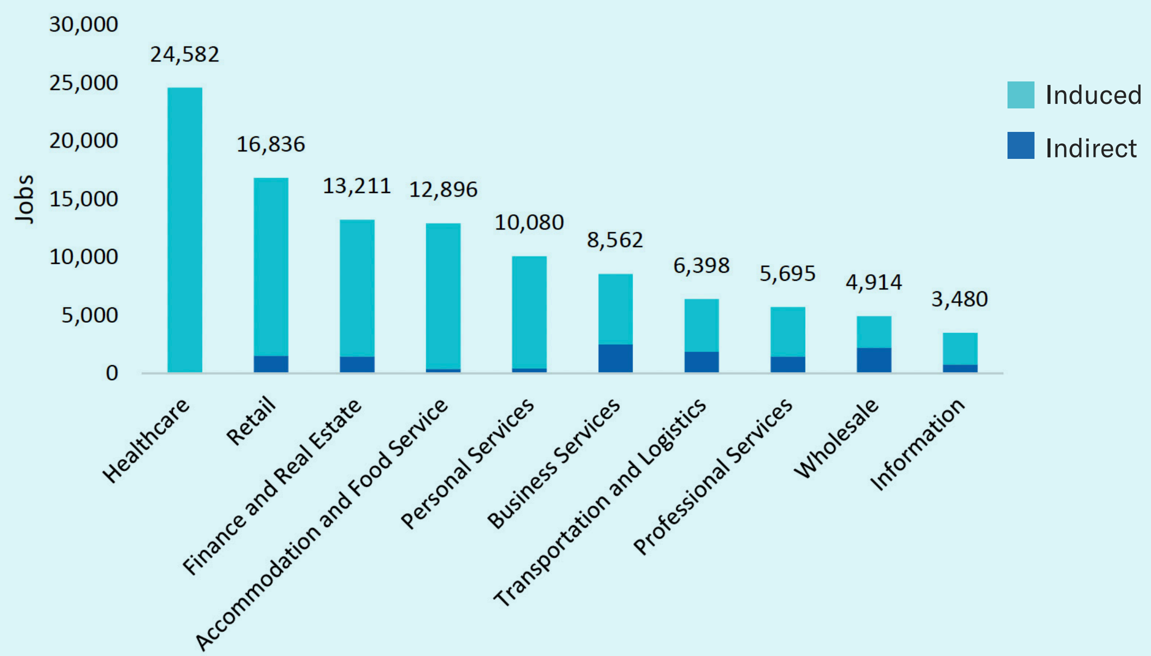


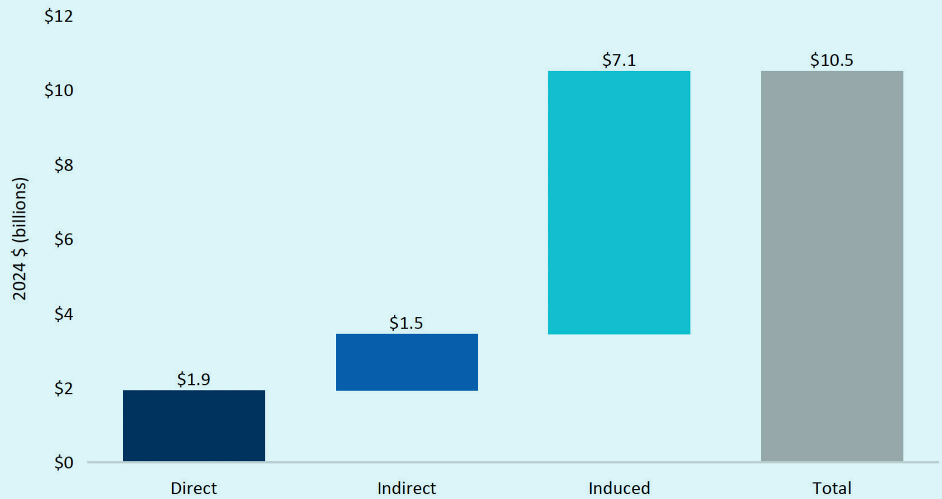
Figure 20 shows the distribution of commercial heating and cooling's indirect and induced employment impacts across economic sectors. Nearly 25,000 jobs, or 20% of indirect and induced jobs, are at risk in the healthcare sector. There are also significant impacts in other sectors, with nearly 43,000 jobs at risk in the retail, business services, and finance and real estate sectors combined.

Figure 20 – Jobs at Risk, Commercial Heating and Cooling, Top 10 Sectors



The average annual salary of the nearly 24,000 direct jobs at risk in commercial heating and cooling is an estimated $80,399, according to the data in **Figure 21.**[66] The median annual earnings for full-time workers aged 25-34 with a high school degree and no college education was $41,800 in 2022.67 This suggests that the heat pump and air conditioner installation and manufacturing jobs directly supported could be an attractive career for this segment of the labor force. An additional $1.5 billion indirect and $7.1 billion in annual induced labor income across the economy would also be at risk by 2035.

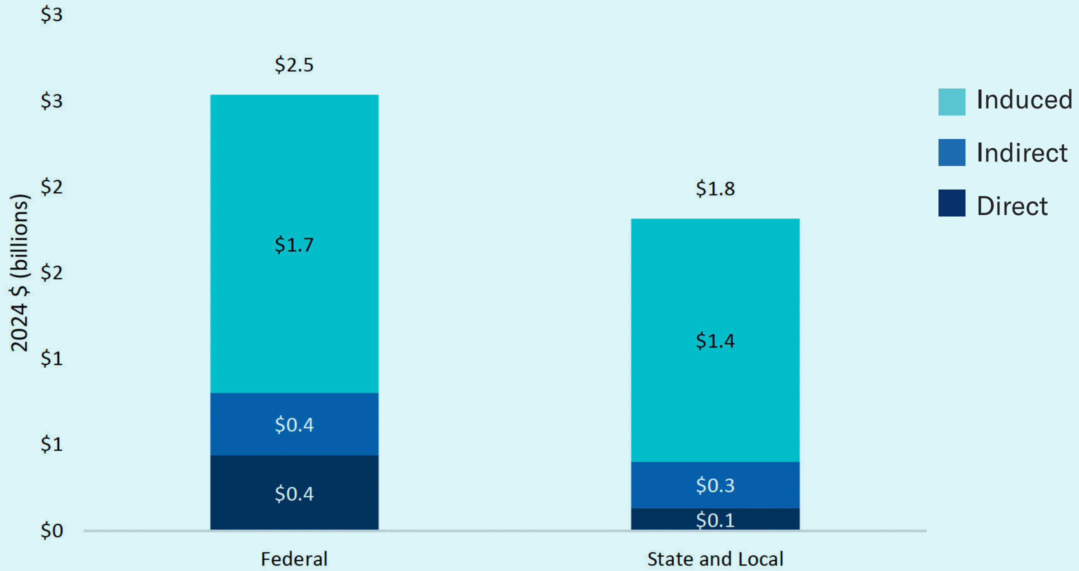
Figure 21 – Labor Income at Risk, Commercial Heating and Cooling



Federal, State, and Local Tax Revenue Impacts

As shown in **Figure 22**, an estimated $2.5 billion in annual federal tax revenue from the direct, indirect, and induced impacts of commercial heating and cooling activity each year would be at risk by 2035. State and local government revenues at risk total $1.8 billion annually.

Figure 22 – Federal, State, and Local Tax Revenues at Risk, Commercial Heating and Cooling



[66] $1.9 billion divided among 23,632 jobs

[67] https://nces.ed.gov/programs/coe/indicator/cba/annual-earnings

Electricity Consumption Impacts

Less efficient refrigerants in commercial heating and cooling equipment lead to higher energy bills. California is expected to use the most additional energy because of its large population and economy, as well as its larger projected installations of heat pumps. California is projected to install 118,000 commercial heat pumps on an annual average basis. New York is projected to install the next highest amount, 26,000. In total, 8.5 million additional MWh would be consumed in the first year of the analysis period, which is roughly equivalent to the annual output of seven average size coal-fired power plants.[68]

Figure 23 – First-Year Incremental Electricity Consumption Impacts of Top 10 States, Commercial Heating and Cooling

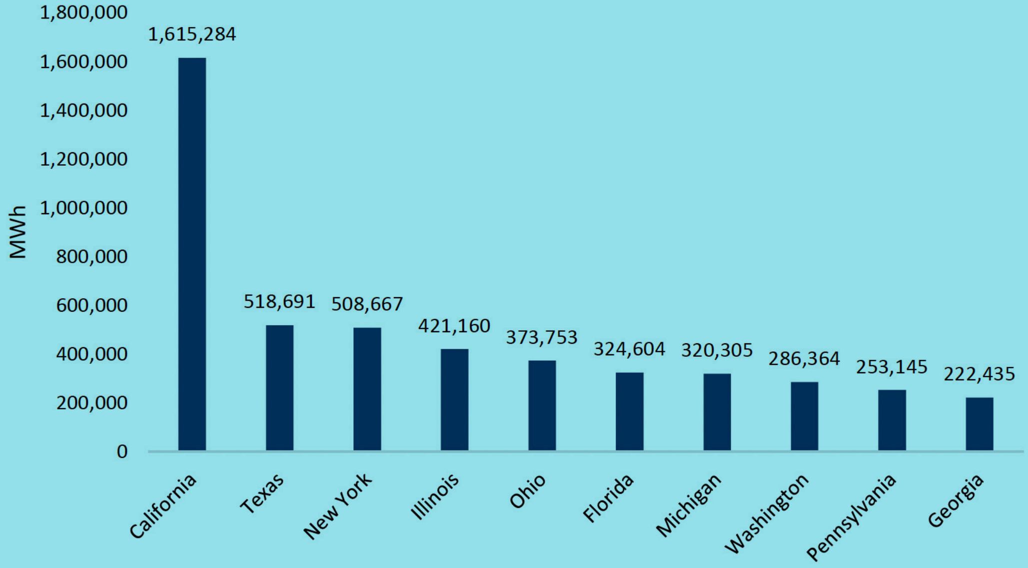
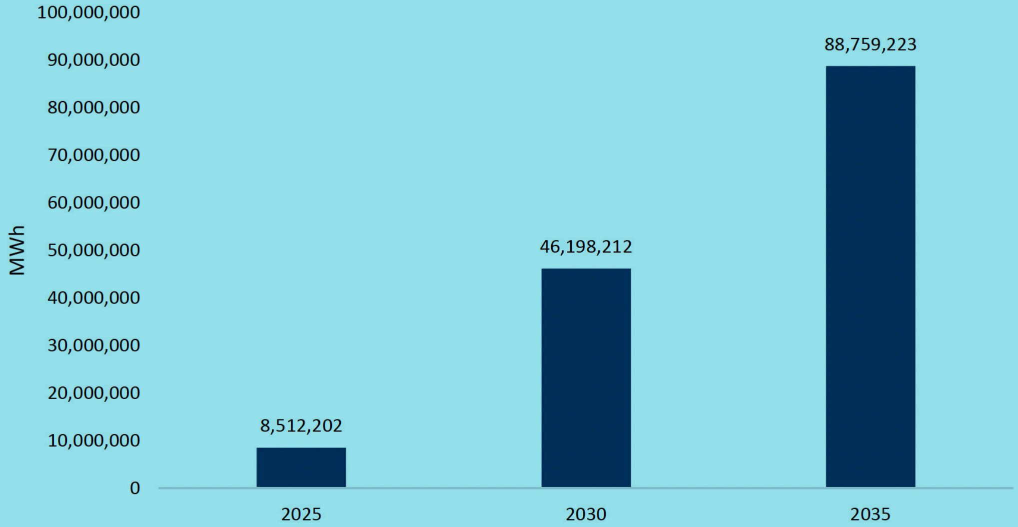


Figure 24 – Incremental Electricity Consumption Impacts by Year, Commercial Heating and Cooling



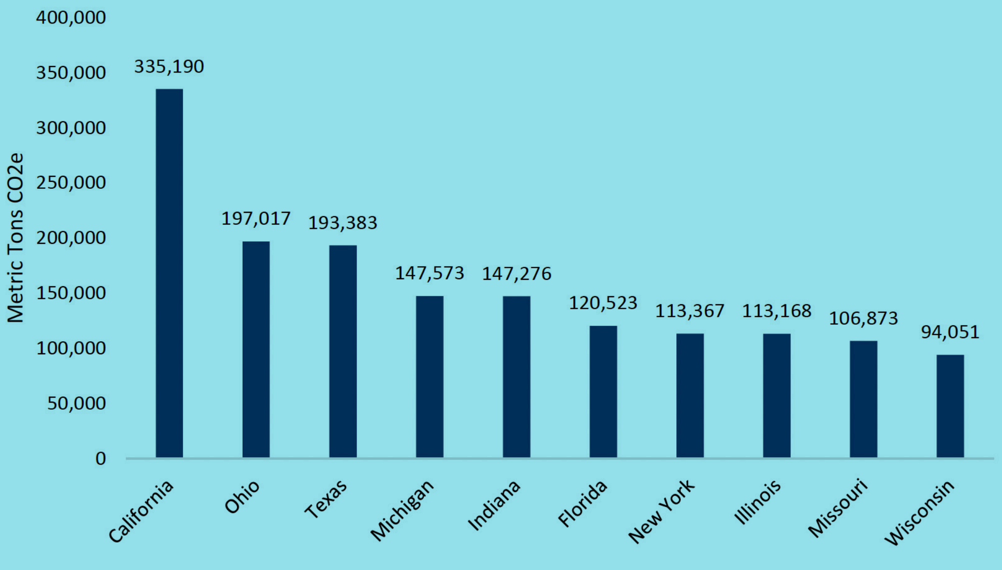
[68] Based on an average coal plant capacity of 332 MW (https://www.brattle.com/wp-content/uploads/2023/04/A-Review-of-Coal-Fired-Electricity-Generation-in-the-U.S..pdf) and a 2023 average coal plant capacity factor of 42.4%. (https://www.eia.gov/electricity/annual/html/epa_04_08_a.html).

As more equipment using alternative refrigerants is installed, incremental electricity consumption due to less efficient refrigerants grows to over 88 terawatt-hours ("TWh") in 2035, which is roughly the annual output of 71 average size coal-fired power plants.[69] In 2023, there were 1,390 TWh of electricity sold to commercial customers and 227 coal-fired power plants in operation, suggesting that commercial energy efficiency losses from the use of alternative refrigerants are significant.[70,71]

Emissions Impacts

The increased energy use associated with less efficient refrigerants in commercial heating and cooling equipment has a significant effect on emissions. Across all states, an incremental 2.8 million metric tons of carbon-dioxide equivalent ("CO2e") are expected to be generated in the first year of restrictions on fluorochemistries in commercial heating and cooling. This is equivalent to adding 663,000 passenger vehicles to the road. The state-level results highlighted in **Figure 25** show the most additional emissions would be produced in California, followed by Ohio and Texas. The amount of emissions generated depends on the volume of new heating and cooling equipment installed and the emissions intensity of the electric grid generation portfolio associated with each state.

Figure 25 – First-Year Incremental Emissions Impacts of Top 10 States, Commercial Heating and Cooling



Annual incremental emissions grow over the 2025–2035 analysis period as more equipment using alternative refrigerants is installed. In 2035, the annual incremental impact is nearly 30 million metric tons CO2e, equivalent to adding 6.9 million cars to the road. This brings cumulative emissions impact to almost 70 million additional metric tons CO2e over the time period.

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[69] 1 TWh = 1 million MWh

[70] https://www.eia.gov/energyexplained/electricity/use-of-electricity.php#

[71] https://www.eia.gov/electricity/annual/html/epa_04_01.html

Figure 26 – Incremental Emissions Impacts by Year, Commercial Heating and Cooling

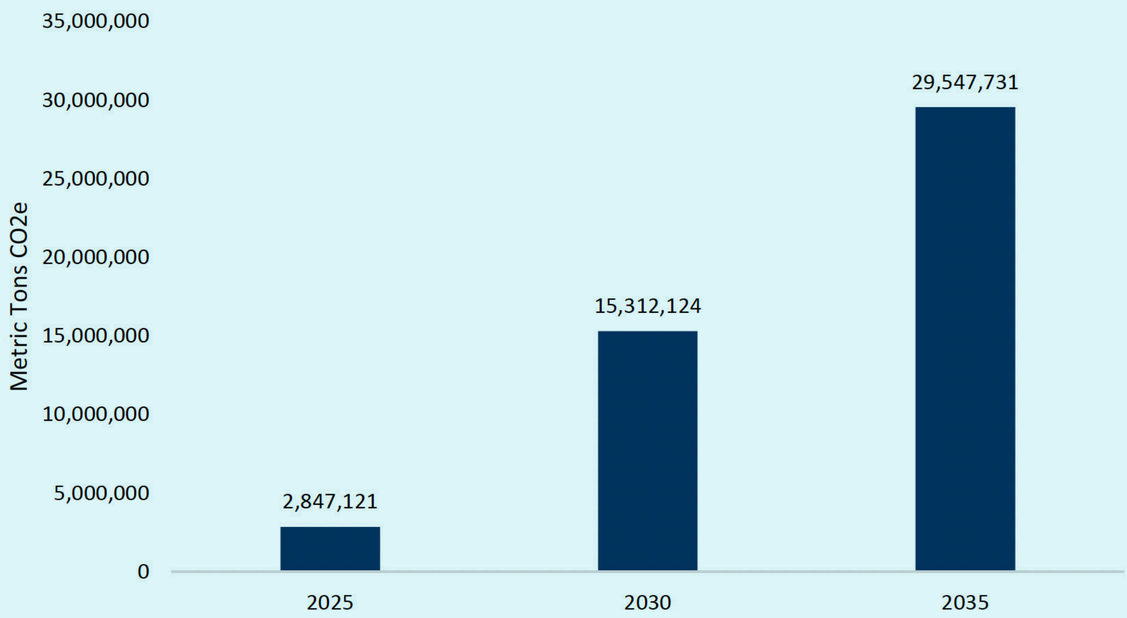
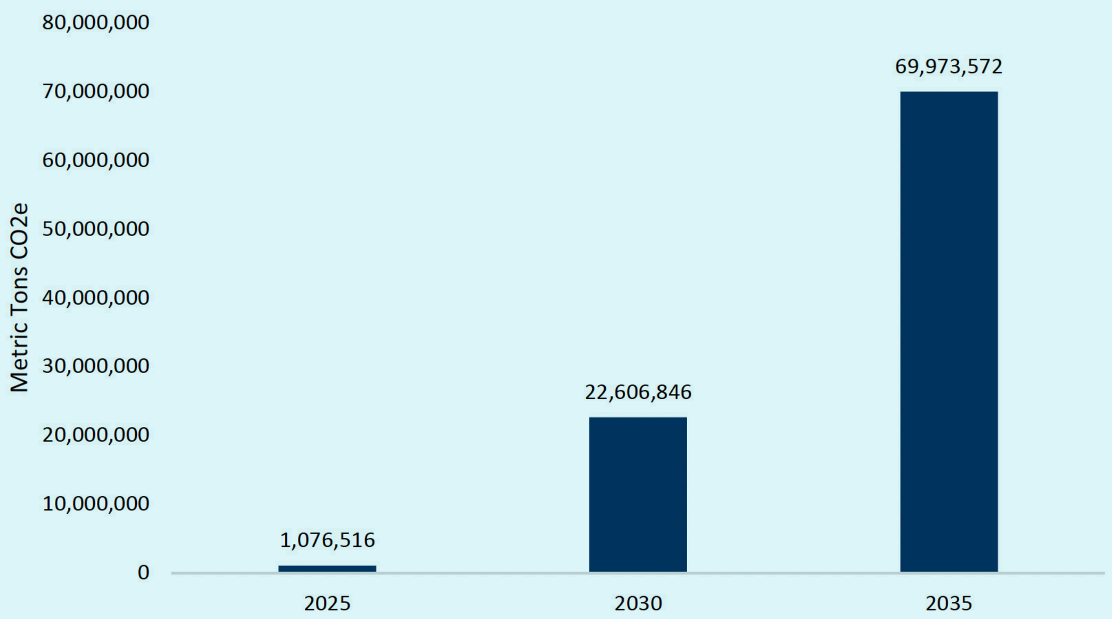


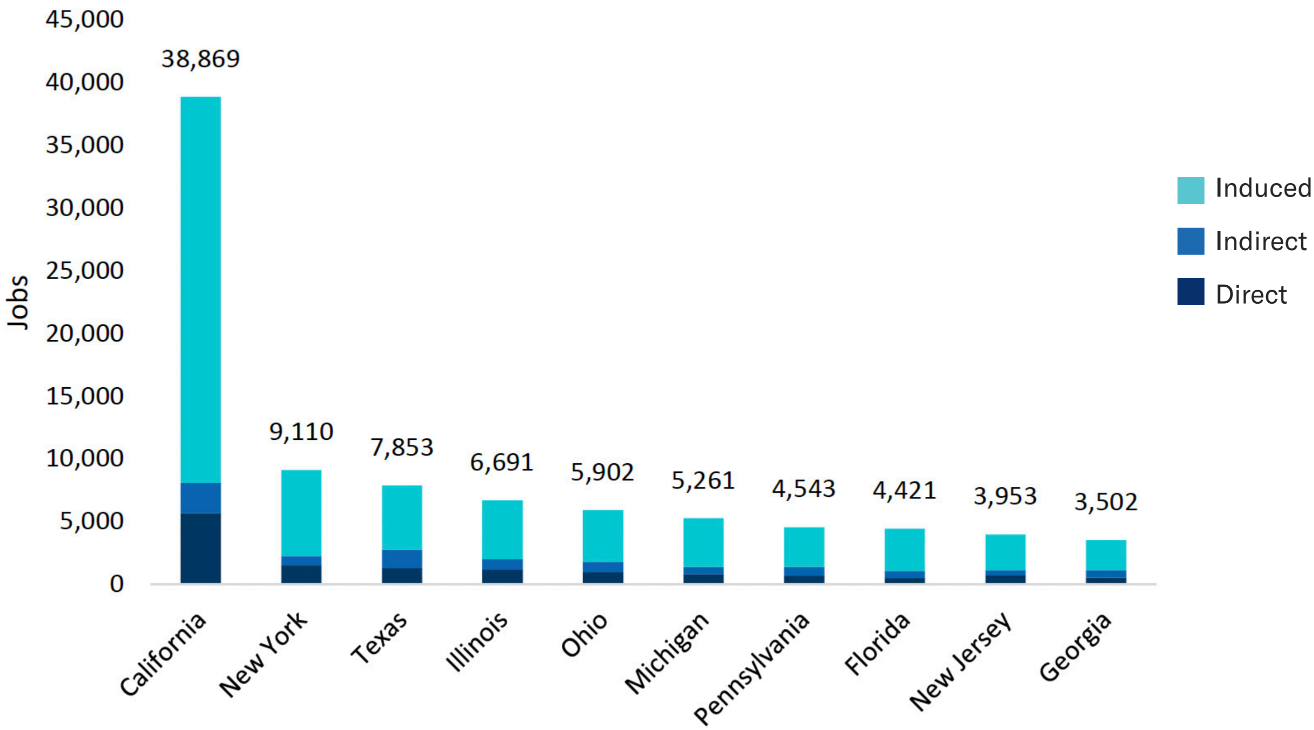
Figure 27 – Cumulative Emissions Impacts of Commercial Heating and Cooling



State-Level Impacts

Figure 28 ranks the top ten states by number of jobs at risk by 2035 due to restrictions on fluorochemistries in commercial heating and cooling. Of the nearly 39,000 jobs at risk in California, approximately 28,000 are the result of less efficient commercial heat pumps, refrigerators, and air conditioners reducing household disposable income.

Figure 28 – Employment Impacts of Commercial Heating and Cooling, Top 10 States



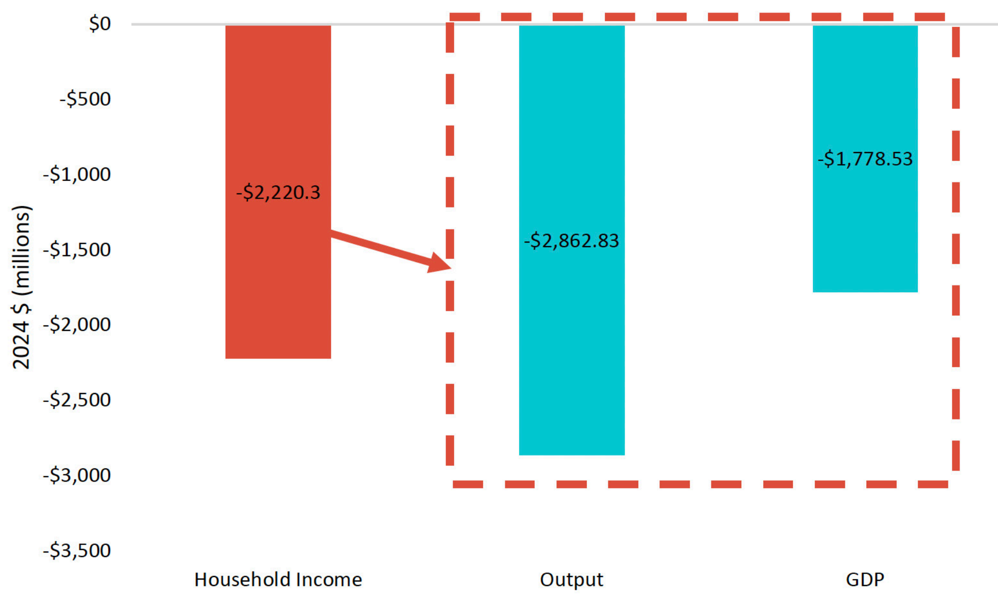
Building Materials

Higher energy bills from less energy efficient residential building materials reduces household disposable income. In total, nearly $222 million of national disposable income is placed at risk by potential restrictions on building materials in the first year. In following years, more new homes are built with alternative materials, increasing the number of homes spending more on energy bills due to less effective insulation. By 2035, increased spending on energy bills per year grows to $2,220 million, or $2.2 billion. The maximum annual effect of restrictions on building materials is considered below.

Output and GDP Impacts

The potential reduction in household income places more than $2.8 billion of economic output and over $1.7 billion of GDP at risk, as shown in **Figure 29.**

Figure 28 – Employment Impacts of Commercial Heating and Cooling, Top 10 States



IMPLAN relies on consumer spending patterns to estimate the economic impacts of reduced household income. **Table 4** lists economic sectors at risk in order of their share of total induced output at risk.

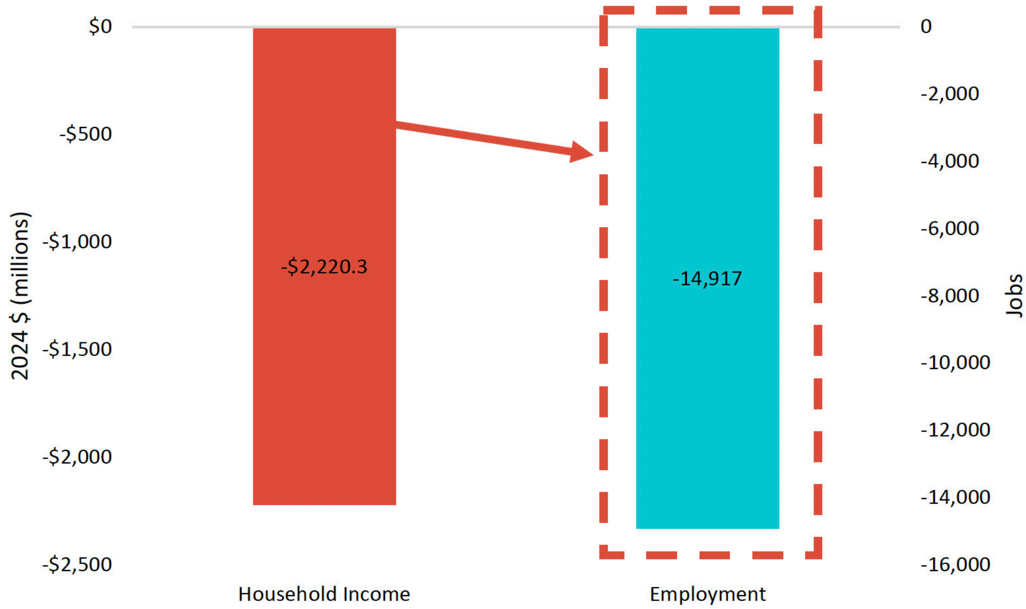
Table 4 – IMPLAN Consumer Spending Pattern

Sector	% of Total Output at Risk
Healthcare	23%
Retail	15%
Accommodation and Food Service	12%
Finance and Real Estate	12%
Personal Services	9%
Business Services	6%
Transportation and Logistics	4%
Professional Services	4%
Education	3%
Information	3%
All Other Sectors	9%

Employment and Labor Income Impacts

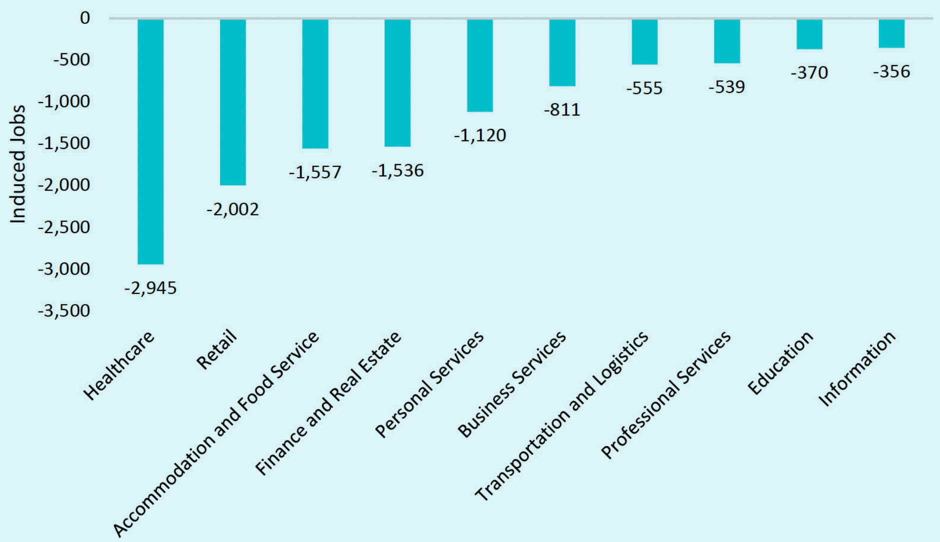
Figure 30 shows that nearly 15,000 jobs are at risk due to less efficient residential building materials.

Figure 30 – Jobs at Risk, Building Materials



The number of jobs at risk in the top 10 most affected economic sectors is shown in **Figure 31.**

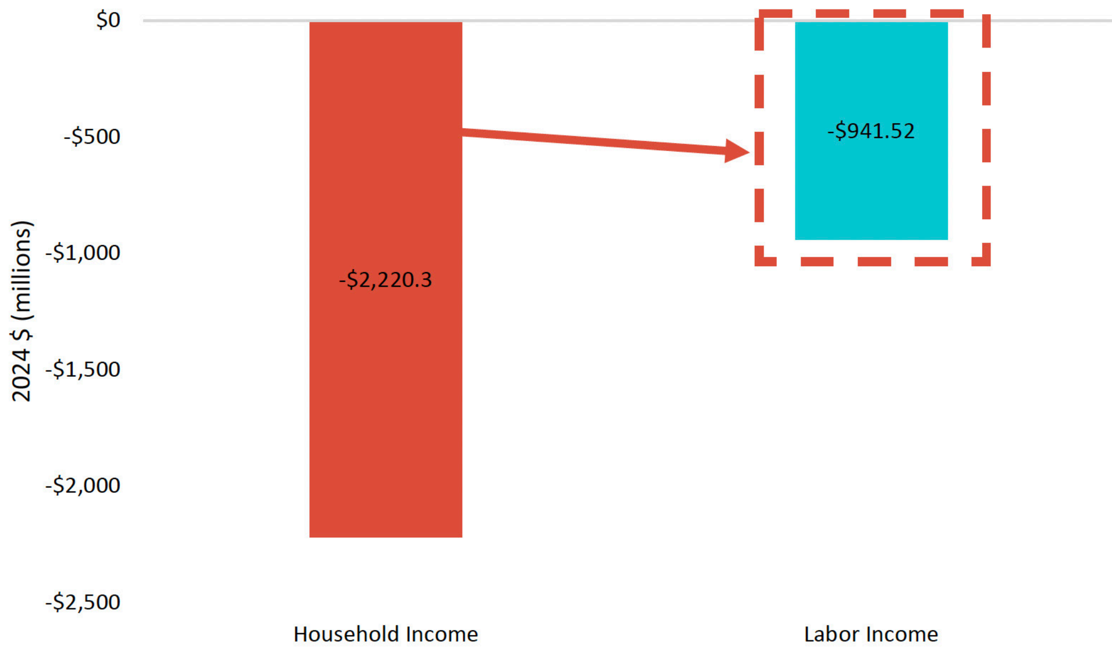
Figure 31 – Jobs at Risk, Building Materials, Top 10 Sectors



Jobs at risk due to reduced disposable income support an average annual salary of $63,082, according to the data in Figure 32, out of the $941 million labor income at risk across the economy.[72]

[72] $941 million divided by 14,917 jobs.

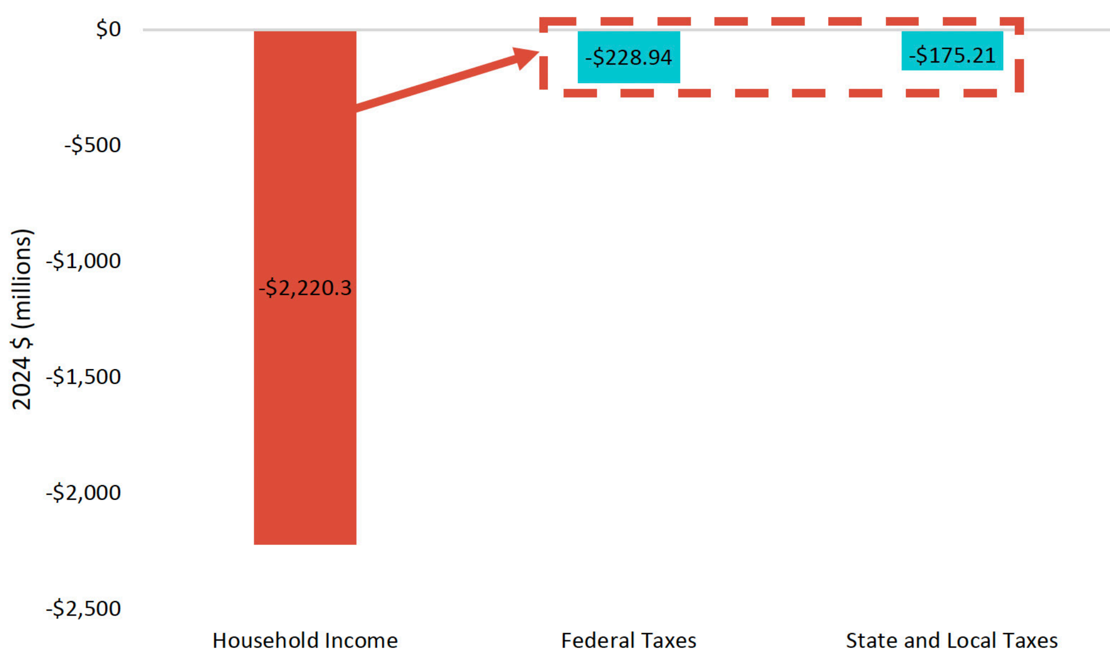
Figure 32 – Labor Income at Risk, Building Materials



Federal, State, and Local Tax Revenue Impacts

As shown in **Figure 33,** the disposable income at risk would have a significant effect on tax revenues. The federal government would see $228 million of tax revenues at risk, while state and local governments stand to lose more than $175 million.

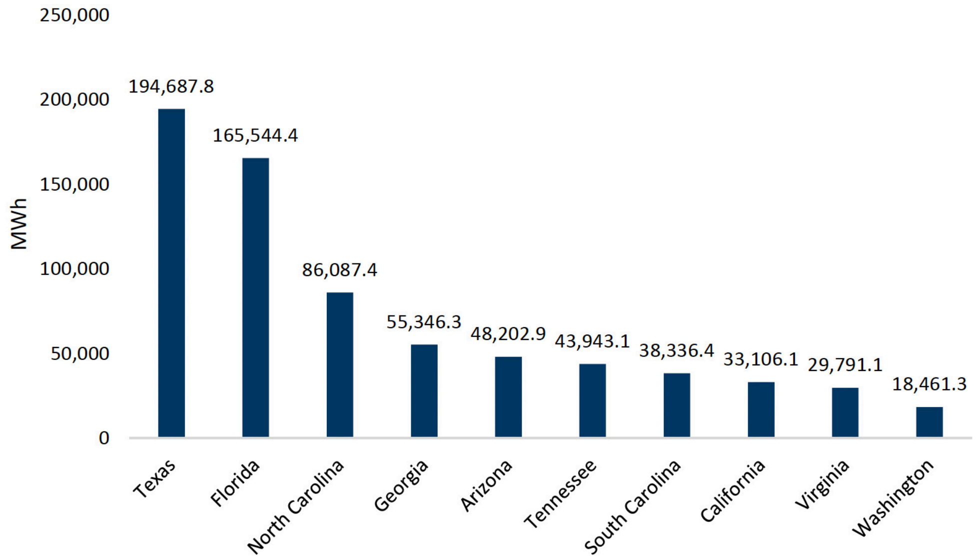
Figure 33 – Federal, State, and Local Tax Revenues at Risk, Building Materials



Electricity Consumption Impacts

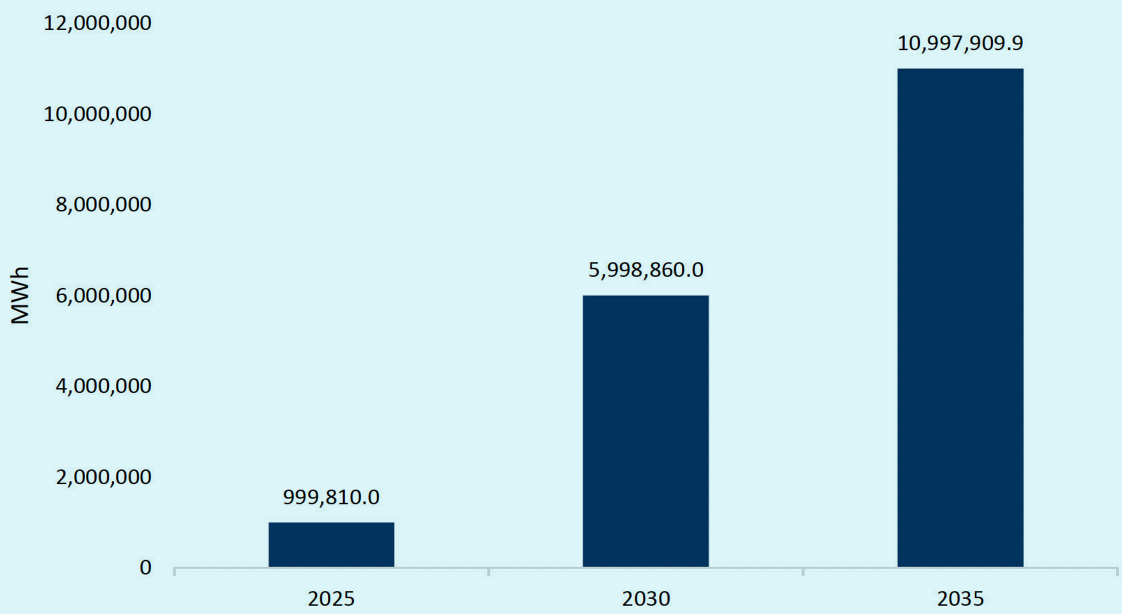
Less efficient building materials lead to higher energy bills for consumers due to a less insular building envelope. Texas is projected to build the most new homes with alternative building materials and therefore is estimated to consume the most additional electricity. An estimated total of 1 million additional MWh of electricity is consumed across all states in the first year.

Figure 34 – First-Year Incremental Electricity Consumption Impacts, Building Materials, Top 10 States



In each year from 2025–2035, it is assumed the same number of new homes will be built as 2023. The annual incremental effect of increased electricity consumption in new homes reaches nearly 11 TWh of electricity in 2035, roughly the equivalent generation of 9 average size coal-fired power plants.

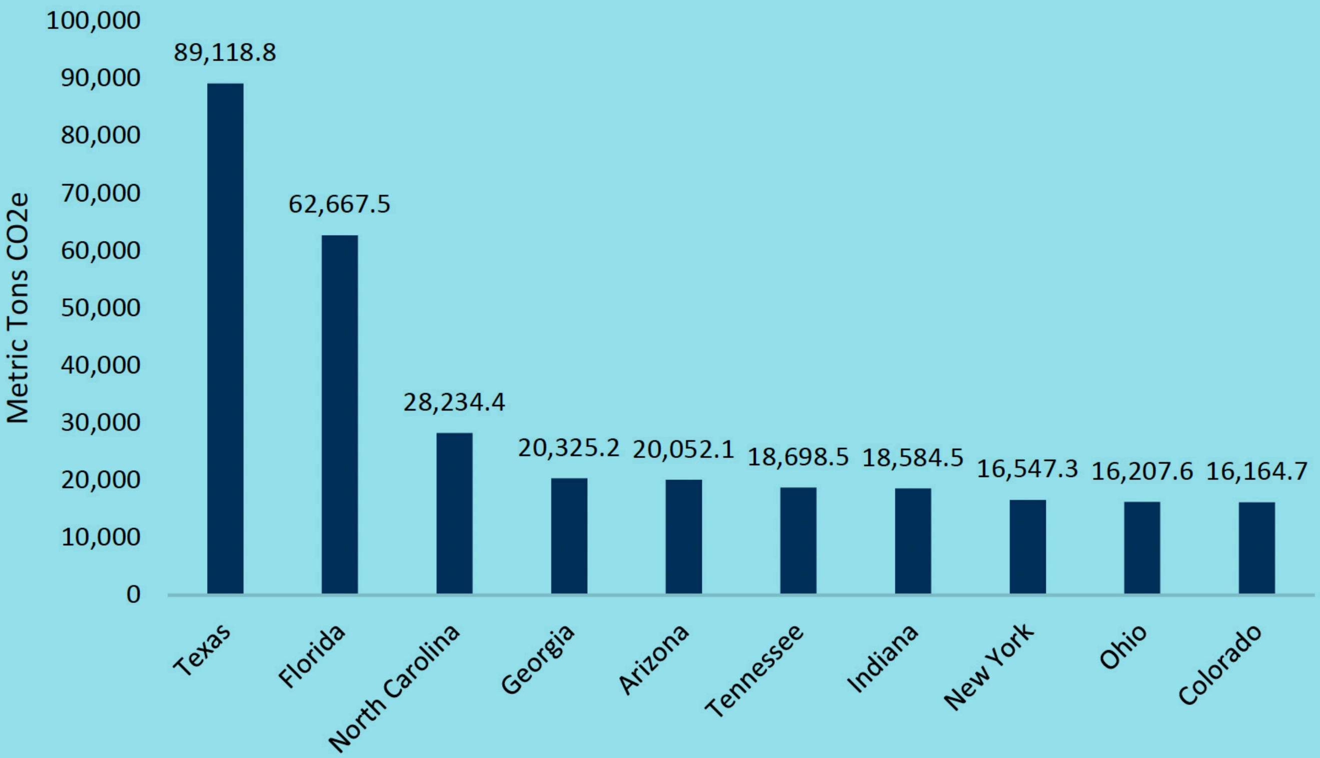
Figure 34 – First-Year Incremental Electricity Consumption Impacts, Building Materials, Top 10 States



Emissions Impacts

The increased energy use associated with less efficient building materials has a significant effect on emissions. Across all states, 557,000 metric tons of carbon-dioxide equivalent ("CO2e"), equal to adding 129,000 passenger vehicles to the road, are expected to be generated in the first year of restrictions on fluorochemistries in building materials. The state-level results highlighted in Figure 36 show that the most additional emissions would be produced in Texas, followed by Florida and North Carolina. The amount of emissions generated depends on the volume of new heating and cooling equipment installed and the emissions intensity of the electric grid generation portfolio associated with each state.

Figure 36 – First-Year Incremental Emissions Impacts, Building Materials, Top 10 States



Increased emissions grow over the 2025–2035 analysis period as new homes with alternative building materials make up an increasing share of the housing supply. The annual incremental emissions impact is 6.1 million additional metric tons CO2e in 2035, equivalent to the annual emissions of 1.4 million passenger vehicles, for a cumulative effect of 36 million additional metric tons CO2e across the time period.

Figure 37 – Incremental Emissions Impact by Year, Building Materials

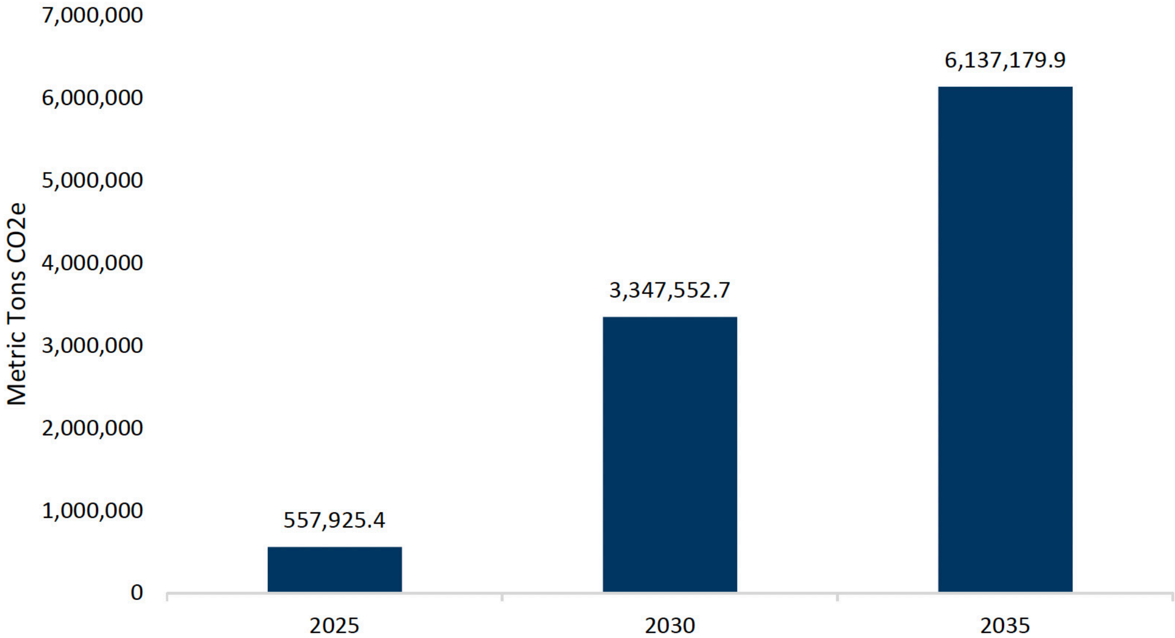
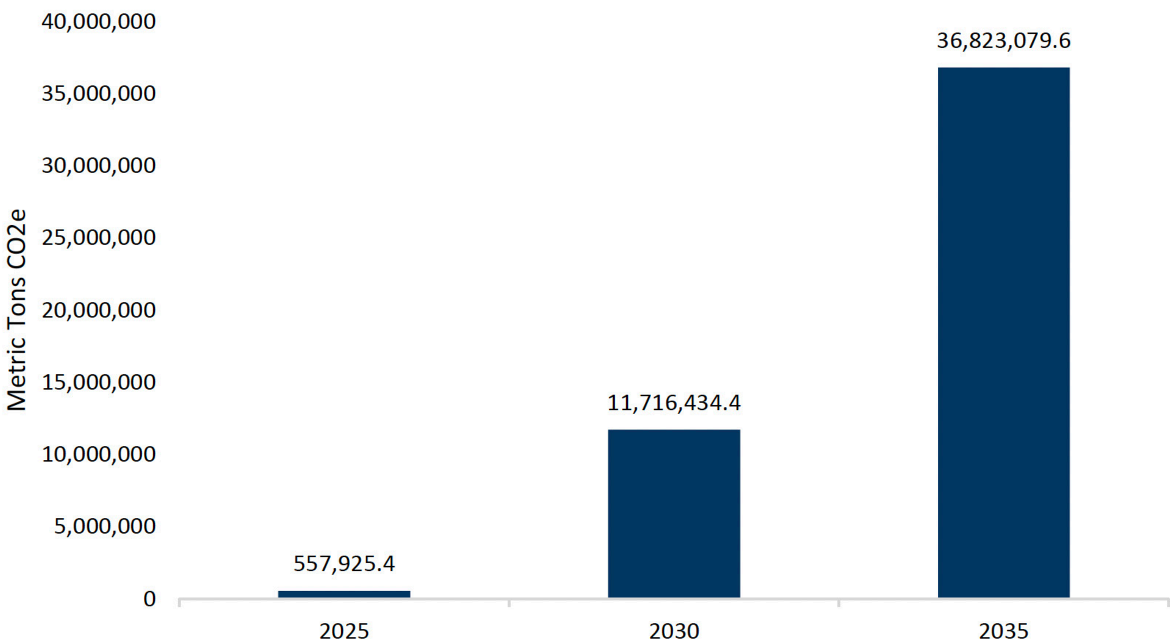


Figure 38 – Cumulative Emissions Impacts, Building Materials

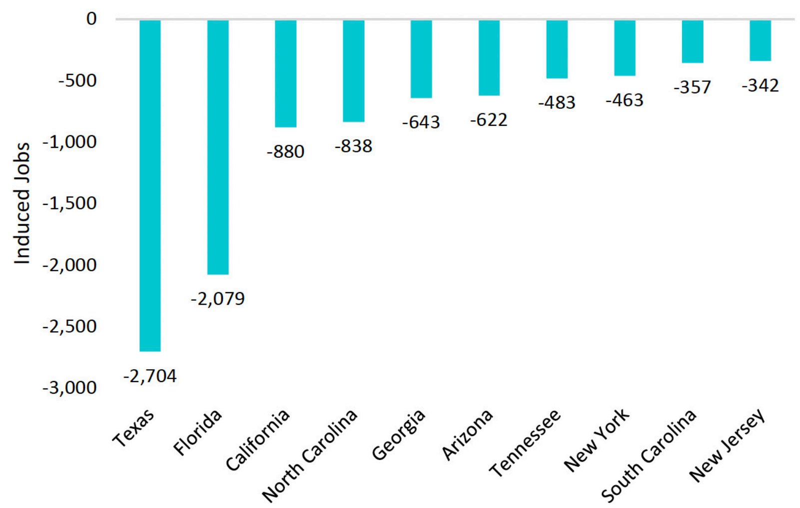


Total Impacts

Output and GDP Impacts

Restrictions on fluorochemistries used in residential heating and cooling, commercial heating and cooling, and building materials could place a combined $131 billion in output and $68 billion of GDP at risk. Total output at risk is divided between $40.3 billion (31%) of direct, $37.6 (29%) of indirect, and $53.8 (40%) of induced impacts.

Figure 39 – Total Output and GDP at Risk



Employment and Labor Income Impacts

Restrictions on fluorochemistries could place more than 519,000 jobs at risk across the economy. **Figure 42** shows that the healthcare sector is the most impacted, with more than 61,000 jobs at risk. Of the 128,308 jobs directly impacted, roughly 105,000 are in the residential heating and cooling sector, primarily manufacturing and installation jobs.

Figure 40 – Total Jobs at Risk

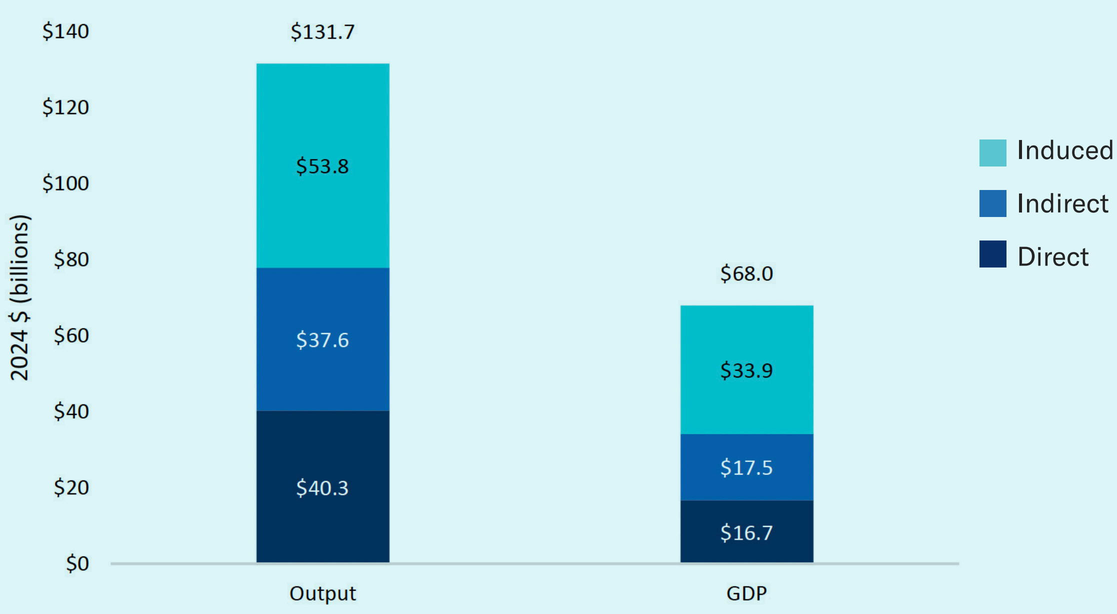


Figure 41 – Total Jobs at Risk, Top 10 Sectors

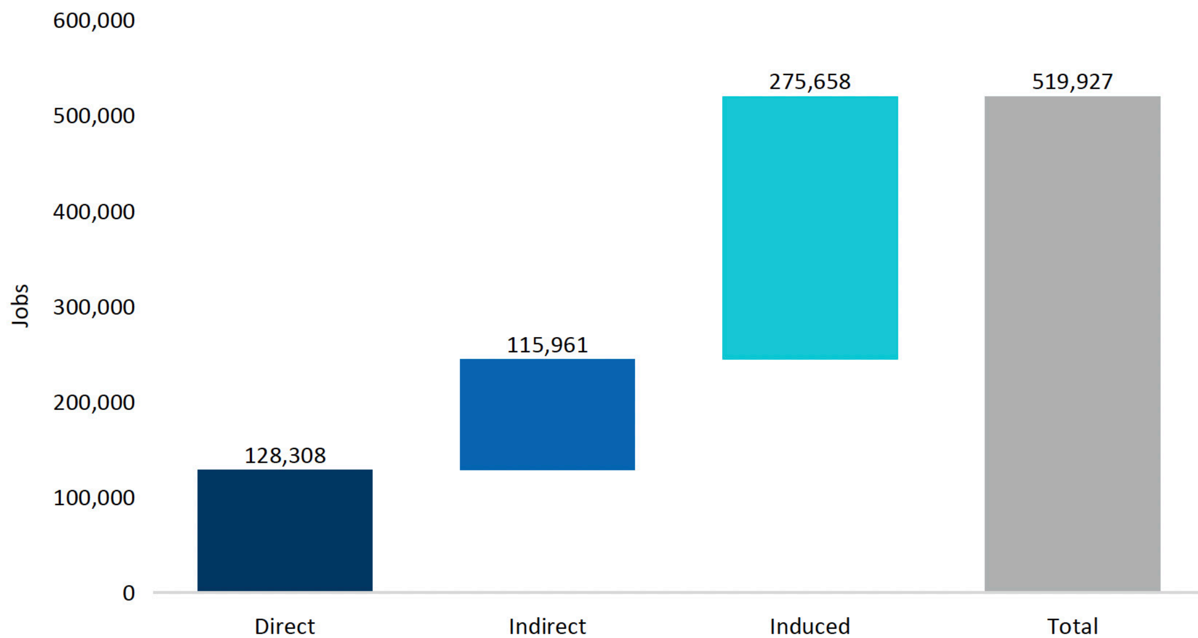
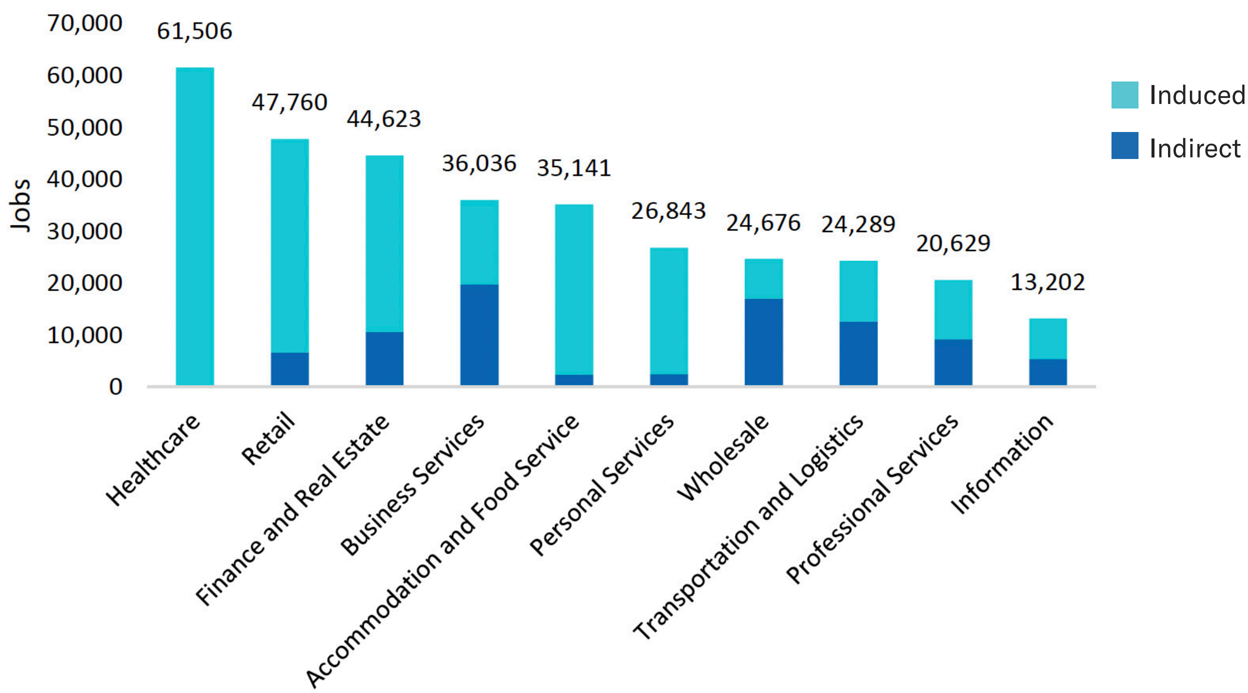


Figure 42 – Total Labor Income at Risk



[73] $38 billion divided by 519,927 jobs

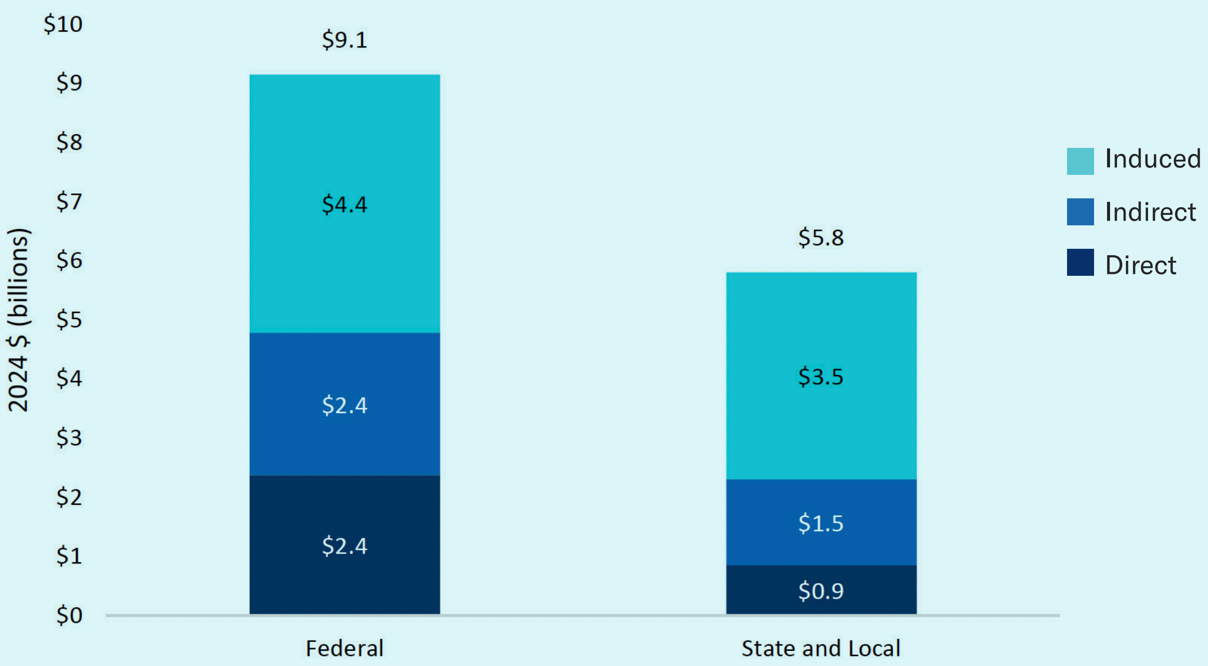
As shown in **Figure 43**, more than $38 billion in labor income is supported across all of the jobs at risk, which translates to an annual average salary of $73,000 across all occupations.[73]

Figure 43 – Total Labor Income at Risk

Federal, State, and Local Tax Revenue Impacts

The economic activity at risk supports significant tax revenues. A total of more than $9 billion in federal tax revenues and nearly $6 billion in state and local tax revenues may be lost if restrictions on the use of fluorochemistries for these applications are implemented.

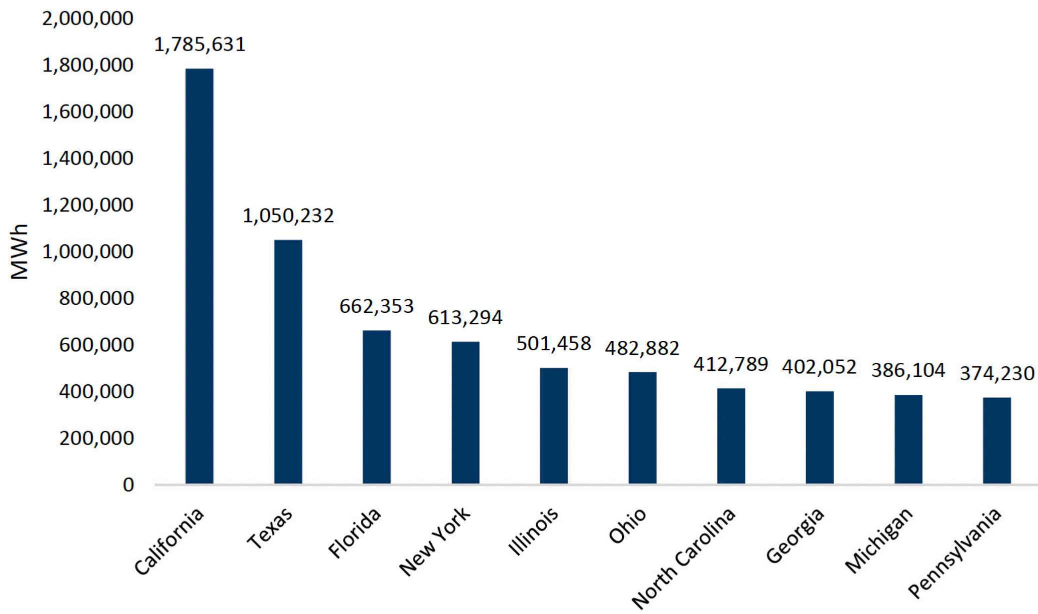
Figure 44 – Total Federal, State, and Local Tax Revenues at Risk



Electricity Consumption Impacts

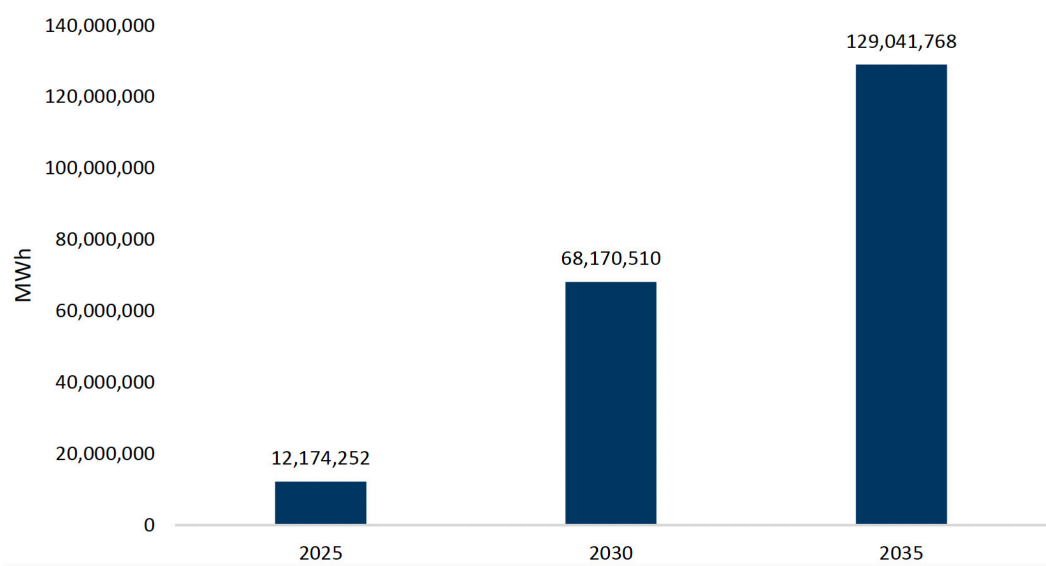
In the first year of restrictions, a total of over 12 million MWh of additional electricity is consumed across all applications, the equivalent output of 10 average-sized coal-fired power plants. California consumes the most additional electricity, followed by Texas and Florida. This difference is largely driven by California's adoption rate of commercial heat pumps.

Figure 45 – First-Year Incremental Electricity Consumption Impacts, Total, Top 10 States



In the following 10 years, as more heating and cooling equipment with less efficient refrigerants are installed and more new homes with alternative building materials are constructed, the annual effect of restrictions on electricity consumption increased to nearly 129 million MWh by 2035, or the output of roughly 107 average-sized coal-fired power plants.

Figure 46 – Incremental Electricity Consumption Impacts by Year, Total



Emissions Impacts

Increased energy use generates additional emissions. In the first year, nearly 4.3 million incremental metric tons of CO2e are generated across all heating, cooling, and building materials applications, equal to adding 1 million passenger vehicles to the road. As shown in **Figure 48**, by 2035, the annual impact grows to 48 million metric tons per year, or the equivalent of 11 million passenger vehicles.

Figure 47 – First-Year Incremental Emissions Impacts, Total, Top 10 States

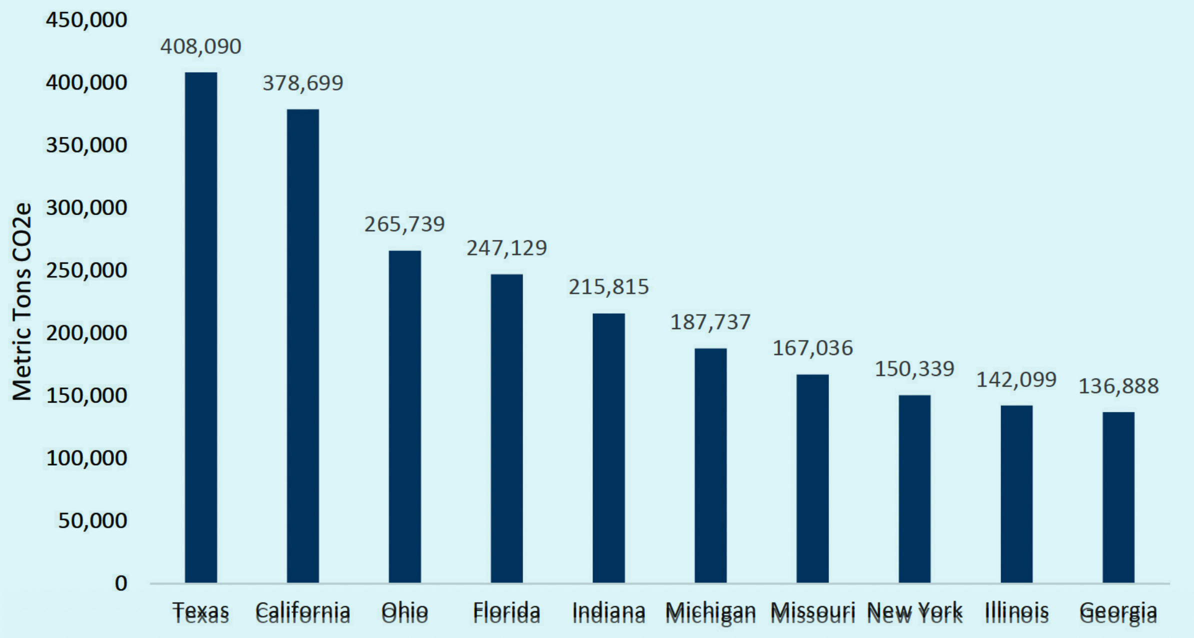
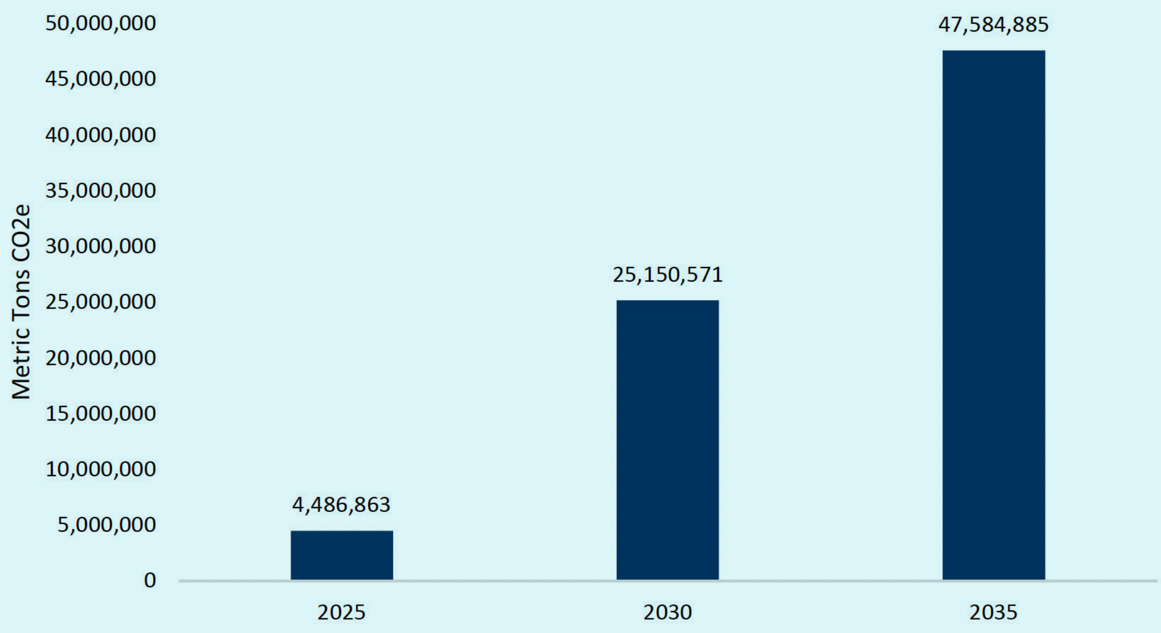
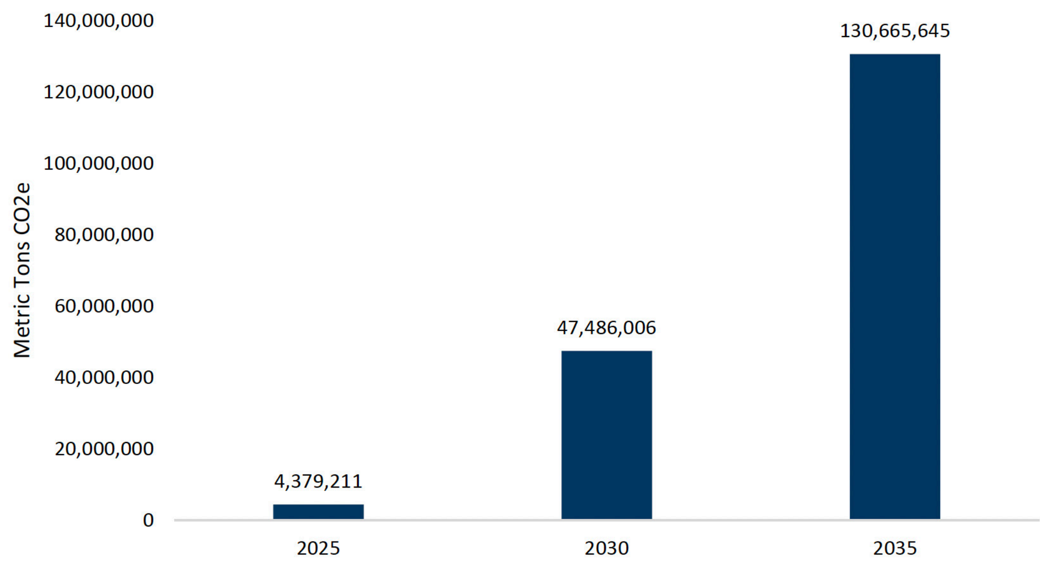


Figure 48 – Incremental Emissions Impact by Year, Total



The cumulative impact of increased energy use grows to over 130 million metric tons of CO2e over the period 2025–2035, highlighted by **Figure 49**. By 2030, the cumulative effect is already over 47 million metric tons CO2e.

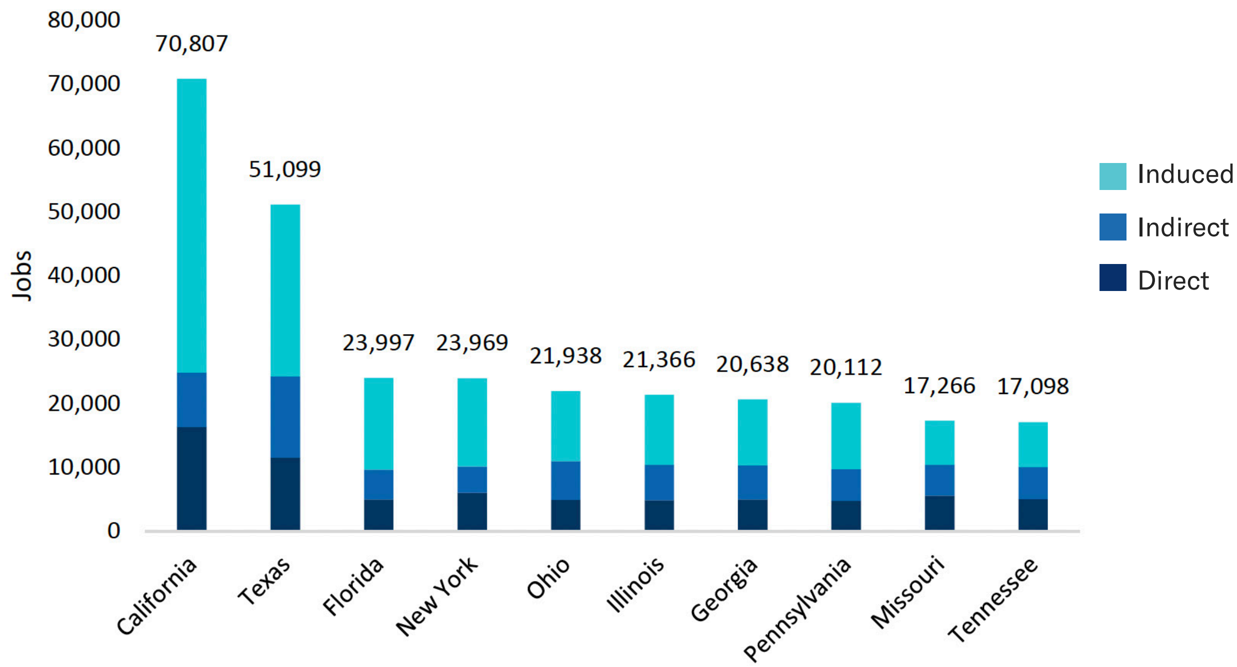
Figure 49 – Cumulative Emissions Impacts, Total



State-Level Impacts

Overall, **Figure 50** shows that restrictions on fluorochemistries could place a significant amount of jobs at risk in the top ten states affected. California and Texas make up nearly 122,000, or 23%, of all jobs at risk.

Figure 50 – Total Jobs at Risk, Top 10 States



Conclusions

Policymakers should consider the potential ramifications of restrictions on fluorochemistries in building materials and in residential and commercial heating and cooling applications. Restrictions on the use of fluorochemistries in the following applications could have significant economic, fiscal, and environmental impacts for the U.S.:

- As refrigerants used in in residential and commercial heat pumps and air conditioner systems
- In components of residential and commercial heating and cooling equipment such as O-rings, gaskets, and seals
- In commercial refrigeration system refrigerants and components
- In residential construction materials, such as blowing agents for spray-foam insulation or roofing

This report utilized estimates of equipment adoption and data on energy prices, regional equipment use, and equipment efficiencies to estimate increased costs and resulting economic activity at risk associated with fluorochemistries restrictions in residential and commercial applications. The analysis also examined the economic benefits of manufacturing and installing residential and commercial heating and cooling equipment that could face delays if the use of fluorochemistries was restricted.

The analysis found that the environmental impacts and combined economic activity at risk if restrictions on fluorochemistries in these applications were implemented include:

- Roughly $132 billion in economic output and over $68 billion in GDP annually by 2035
- Over half a million jobs across construction, manufacturing, and other key sectors
- Approximately $9 billion in federal tax revenues and $6 billion in state and local tax revenues
- More than 4 million metric tons in incremental additional CO2e emissions in the first year, growing to over 48 million metric tons by 2035, equivalent to adding 11 million vehicles to the road
- Cumulative emissions over the 2025-2035 time period total 131 million metric tons
- Incremental electricity demand of roughly 12 million MWh in the first year, growing to over 129 million MWh by 2035, equivalent to the output of 107 average-sized coal-fired power plants.

Appendix

Table 5 – Annual State-Level Impacts, Residential Heating and Cooling (2035)

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	1,688.7	6,064	710.5	406.7	94.7	55.8
Alaska	11.5	32	6.2	2.4	0.6	0.5
Arizona	1,365.7	5,917	722.5	411.1	99.0	58.6
Arkansas	1,633.7	5,592	702.6	367.1	92.4	51.8
California	7,457.5	31,059	4,405.7	2,546.1	625.6	457.7
Colorado	973.3	3,899	488.6	299.6	69.9	38.5
Connecticut	852.8	3,494	459.8	285.9	71.2	47.8
Delaware	215.2	968	124.5	68.6	15.1	8.5
District of Columbia	80.6	387	55.6	35.1	5.8	3.9
Florida	3,988.1	17,498	2,057.2	1,142.8	297.2	160.3
Georgia	4,421.9	16,493	2,197.1	1,154.2	280.0	162.1
Hawaii	7.3	33	4.4	2.3	0.5	0.6
Idaho	241.0	1,071	113.8	70.1	16.5	9.8
Illinois	3,962.5	14,465	2,005.1	1,153.8	272.9	181.8
Indiana	3,022.6	9,454	1,294.3	725.5	166.3	89.5
Iowa	1,215.9	4,100	514.9	284.9	65.0	36.8
Kansas	1,480.0	5,528	656.3	382.8	89.4	53.7
Kentucky	1,568.2	5,700	683.6	415.8	88.2	57.0
Louisiana	1,050.9	4,393	488.7	269.1	60.8	44.6
Maine	198.0	968	106.0	61.7	14.5	11.5
Maryland	1,299.0	5,755	718.2	413.3	95.3	72.8
Massachusetts	1,500.6	5,843	845.0	533.2	126.7	64.0
Michigan	2,619.4	9,945	1,209.8	728.7	172.1	92.0
Minnesota	2,202.1	7,529	1,082.7	653.9	149.2	88.8
Mississippi	1,033.1	3,792	404.5	207.9	49.9	34.8
Missouri	3,832.7	14,070	1,659.5	1,024.8	229.6	115.7
Montana	72.2	415	39.8	25.1	5.9	3.1
Nebraska	399.7	1,513	195.3	105.5	24.8	13.4
Nevada	674.4	2,807	362.5	189.7	51.0	29.7
New Hampshire	293.9	1,156	147.1	94.4	22.3	10.4
New Jersey	2,219.9	9,199	1,250.1	755.9	179.0	131.6
New Mexico	198.5	1,094	109.1	61.6	14.0	12.0
New York	3,579.4	14,396	2,136.6	1,258.8	300.4	243.1

North Carolina	3,264.4	11,832	1,714.9	917.8	220.0	111.5
North Dakota	108.2	397	49.2	27.0	6.2	3.0
Ohio	4,430.3	15,707	2,028.6	1,177.6	270.5	155.4
Oklahoma	2,658.3	9,682	1,061.7	652.5	140.9	72.8
Oregon	699.3	2,805	354.2	219.1	52.3	31.6
Pennsylvania	4,128.2	15,228	1,961.1	1,187.3	274.3	161.7
Rhode Island	289.9	1,079	140.9	81.1	19.3	12.7
South Carolina	2,034.8	7,408	848.5	484.4	118.4	74.7
South Dakota	220.6	817	90.8	57.6	12.7	5.1
Tennessee	4,187.2	14,149	1,903.1	1,097.2	257.7	128.3
Texas	11,325.0	40,542	5,578.2	2,988.9	691.7	332.2
Utah	453.8	1,821	232.5	125.1	30.4	17.9
Vermont	144.8	559	67.8	36.6	8.6	7.0
Virginia	2,110.8	8,515	1,091.4	621.3	145.6	97.7
Washington	1,204.0	4,059	650.4	370.0	94.2	55.1
West Virginia	299.5	1,033	122.8	66.7	14.8	12.2
Wisconsin	2,852.4	9,401	1,310.0	746.0	178.4	90.4
Wyoming	20.7	101	11.4	5.8	1.6	1.1

Table 6 – Annual State-Level Impacts, Commercial Heating and Cooling (2035)

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	305.5	1,295	146.3	79.8	18.8	13.1
Alaska	26.4	120	16.7	8.5	1.9	1.2
Arizona	485.6	2,249	281.2	152.1	37.1	23.8
Arkansas	243.6	981	114.3	59.2	14.9	9.7
California	8,883.3	38,869	5,595.4	3,008.4	754.8	596.5
Colorado	367.1	1,650	212.8	119.1	28.5	18.6
Connecticut	307.8	1,391	188.2	108.9	27.7	20.1
Delaware	125.8	599	77.8	41.5	9.2	5.7
District of Columbia	75.5	317	50.6	29.7	5.1	3.5
Florida	930.9	4,421	518.4	275.4	72.4	43.4
Georgia	810.4	3,502	442.2	227.9	55.5	36.0
Hawaii	82.0	401	52.4	26.2	6.1	6.6
Idaho	101.1	493	53.8	30.8	7.3	5.0
Illinois	1,506.0	6,691	873.4	488.4	116.0	87.6
Indiana	730.8	3,129	378.8	213.4	48.2	31.3

Iowa	266.0	1,165	133.2	73.5	16.6	10.9
Kansas	313.8	1,381	159.4	90.1	21.0	14.4
Kentucky	313.3	1,376	154.6	91.0	19.4	14.2
Louisiana	231.7	1,024	116.3	60.6	13.9	11.0
Maine	87.9	448	50.4	28.0	6.7	5.7
Maryland	577.5	2,768	353.3	184.2	43.8	37.2
Massachusetts	566.8	2,484	352.8	212.0	50.9	28.4
Michigan	1,084.4	5,261	595.5	344.5	81.5	51.4
Minnesota	600.5	2,559	335.6	196.2	44.8	30.8
Mississippi	171.0	753	75.6	38.7	9.2	7.6
Missouri	697.4	3,012	346.0	204.5	46.2	25.9
Montana	71.0	376	38.3	22.8	5.5	3.1
Nebraska	122.7	555	67.1	35.8	8.4	5.0
Nevada	257.7	1,171	153.3	76.6	20.8	13.3
New Hampshire	104.0	484	61.0	37.0	8.8	4.7
New Jersey	879.9	3,953	533.9	311.5	74.4	58.4
New Mexico	114.0	603	64.1	33.7	7.8	7.2
New York	2,095.6	9,110	1,360.3	747.4	182.3	157.9
North Carolina	653.9	2,829	361.0	193.8	46.2	27.4
North Dakota	33.7	145	17.3	9.9	2.2	1.2
Ohio	1,292.3	5,902	696.4	387.5	89.6	59.2
Oklahoma	373.3	1,523	165.7	97.9	21.2	12.7
Oregon	505.9	2,403	291.4	174.3	41.6	26.8
Pennsylvania	1,024.8	4,543	558.7	330.5	76.5	49.5
Rhode Island	86.6	407	49.8	27.8	6.6	5.1
South Carolina	333.0	1,421	161.0	85.6	21.3	15.5
South Dakota	57.7	270	28.9	17.6	3.9	1.8
Tennessee	627.4	2,465	313.9	184.8	42.6	24.0
Texas	1,970.5	7,853	1,033.8	553.9	127.7	72.3
Utah	221.1	1,001	126.5	63.2	15.7	10.4
Vermont	40.6	197	22.2	12.3	2.9	2.5
Virginia	589.2	2,695	341.9	180.9	43.3	33.0
Washington	821.9	3,192	507.6	270.8	69.6	46.6
West Virginia	117.4	560	61.0	33.5	7.4	5.9
Wisconsin	708.5	3,126	377.7	214.1	50.6	31.3
Wyoming	26.0	125	14.1	6.8	1.8	1.2

Table 7 – Annual State-Level Impacts, Building Materials (2035)

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	200	20.7	20.7	10.5	2.5	2.3
Alaska	11	1.4	1.4	0.8	0.2	0.1
Arizona	622	75.9	75.9	40.0	9.9	7.1
Arkansas	124	12.6	12.6	6.4	1.6	1.4
California	880	125.5	125.5	65.7	16.6	14.2
Colorado	282	35.9	35.9	18.9	4.6	3.5
Connecticut	82	11.3	11.3	6.1	1.6	1.3
Delaware	56	6.8	6.8	3.5	0.8	0.6
District of Columbia	12	2.0	2.0	1.1	0.2	0.2
Florida	2,079	236.4	236.4	123.0	32.5	21.9
Georgia	643	73.7	73.7	37.4	9.2	7.0
Hawaii	71	9.1	9.1	4.5	1.0	1.2
Idaho	117	12.8	12.8	6.8	1.7	1.3
Illinois	210	26.1	26.1	14.2	3.4	3.0
Indiana	269	29.6	29.6	16.6	3.7	2.9
Iowa	107	11.1	11.1	5.8	1.3	1.1
Kansas	106	11.6	11.6	6.2	1.5	1.2
Kentucky	169	17.8	17.8	10.0	2.2	1.9
Louisiana	126	12.7	12.7	6.6	1.5	1.4
Maine	75	8.8	8.8	4.6	1.1	1.0
Maryland	214	26.2	26.2	13.4	3.2	3.0
Massachusetts	185	26.0	26.0	15.0	3.7	2.2
Michigan	229	25.3	25.3	14.0	3.4	2.4
Minnesota	244	29.3	29.3	16.6	3.8	3.1
Mississippi	72	6.8	6.8	3.3	0.8	0.8
Missouri	184	20.1	20.1	10.9	2.5	1.8
Montana	36	3.6	3.6	2.1	0.5	0.3
Nebraska	76	8.5	8.5	4.4	1.0	0.7
Nevada	156	19.2	19.2	9.5	2.6	1.9
New Hampshire	49	6.4	6.4	3.5	0.9	0.5
New Jersey	342	45.6	45.6	25.2	6.1	5.4
New Mexico	51	5.4	5.4	2.7	0.6	0.6
New York	463	68.4	68.4	36.5	9.0	8.5
North Carolina	838	95.7	95.7	50.7	12.1	8.7
North Dakota	24	2.4	2.4	1.5	0.3	0.1

Ohio	59.7	329	36.6	19.4	4.6	3.5
Oklahoma	24.9	138	14.4	7.6	1.7	1.3
Oregon	24.0	129	15.2	8.6	2.1	1.5
Pennsylvania	63.7	341	39.9	22.7	5.3	3.9
Rhode Island	3.2	17	2.1	1.1	0.3	0.2
South Carolina	62.6	357	38.3	18.5	4.7	4.3
South Dakota	10.2	58	6.1	3.5	0.8	0.4
Tennessee	93.2	483	58.3	33.1	7.7	5.6
Texas	525.3	2,704	316.0	167.9	38.8	27.2
Utah	30.9	159	18.8	9.1	2.3	1.8
Vermont	3.7	21	2.3	1.2	0.3	0.3
Virginia	58.5	308	37.6	18.9	4.6	4.1
Washington	51.2	216	34.3	17.0	4.5	3.5
West Virginia	8.6	51	5.2	2.9	0.6	0.6
Wisconsin	35.2	192	21.6	11.6	2.8	2.1
Wyoming	1.6	10	0.9	0.4	0.1	0.1

Table 8 – Annual Incremental Costs, Residential Heating and Cooling (2025)

State	Installation Costs (millions $ 2024)	Energy Costs (millions $2024)	Total (millions $2024)
Alabama	128.9	8.8	137.7
Alaska	N/A	N/A	N/A
Arizona	176.6	11.6	188.3
Arkansas	91.5	5.6	97.1
California	903.3	45.8	949.1
Colorado	111.4	3.9	115.3
Connecticut	75.2	9.5	84.7
Delaware	23.2	1.6	24.8
District of Columbia	31.9	1.3	33.2
Florida	463.6	29.0	492.6
Georgia	325.7	19.2	344.9
Hawaii	0.2	0.1	0.3
Idaho	27.5	1.8	29.4
Illinois	211.4	13.4	224.8
Indiana	109.9	11.9	121.8
Iowa	49.3	5.3	54.6
Kansas	85.2	8.5	93.7

Kentucky	109.9	8.1	118.0
Louisiana	142.4	7.6	150.0
Maine	28.5	2.7	31.2
Maryland	192.7	15.5	208.3
Massachusetts	130.3	16.8	147.1
Michigan	147.3	12.9	160.3
Minnesota	75.4	3.5	79.0
Mississippi	74.9	4.6	79.5
Missouri	162.0	10.1	172.1
Montana	17.4	1.2	18.6
Nebraska	29.7	2.2	31.9
Nevada	89.8	5.6	95.4
New Hampshire	26.5	2.4	28.8
New Jersey	206.9	14.2	221.1
New Mexico	56.7	2.4	59.1
New York	406.8	23.3	430.1
North Carolina	274.8	15.3	290.1
North Dakota	6.6	0.7	7.3
Ohio	190.5	17.4	207.9
Oklahoma	133.1	8.1	141.2
Oregon	63.3	3.1	66.5
Pennsylvania	241.5	22.8	264.4
Rhode Island	21.7	1.5	23.2
South Carolina	134.3	7.9	142.2
South Dakota	11.1	0.9	12.0
Tennessee	170.8	10.7	181.6
Texas	820.8	54.9	875.7
Utah	58.4	2.1	60.5
Vermont	12.0	1.0	13.0
Virginia	236.5	14.2	250.7
Washington	98.7	4.1	102.8
West Virginia	22.6	2.2	24.7
Wisconsin	59.8	5.6	65.4
Wyoming	4.7	0.2	4.9

Table 9 – Annual Incremental Costs, Residential Heating and Cooling (2035)

State	Installation Costs (millions $ 2024)	Energy Costs (millions $2024)	Total (millions $2024)
Alabama	1,417.9	96.3	1,514.2
Alaska	N/A	N/A	N/A
Arizona	1,943.1	127.8	2,071.0
Arkansas	1,006.3	61.7	1,068.0
California	9,936.6	503.5	10,440.1
Colorado	1,225.2	42.8	1,268.0
Connecticut	827.6	104.4	932.0
Delaware	255.2	17.9	273.1
District of Columbia	351.0	13.8	364.9
Florida	5,100.0	318.8	5,418.9
Georgia	3,582.4	211.7	3,794.1
Hawaii	1.9	1.2	3.2
Idaho	302.8	20.3	323.1
Illinois	2,325.7	147.4	2,473.2
Indiana	1,209.0	130.6	1,339.6
Iowa	541.9	58.7	600.7
Kansas	937.2	93.1	1,030.4
Kentucky	1,208.4	89.4	1,297.8
Louisiana	1,566.5	83.2	1,649.7
Maine	313.6	29.8	343.4
Maryland	2,120.0	170.9	2,290.9
Massachusetts	1,432.8	184.8	1,617.6
Michigan	1,620.7	142.3	1,763.0
Minnesota	829.8	38.9	868.8
Mississippi	824.2	50.7	874.9
Missouri	1,782.2	111.3	1,893.5
Montana	191.1	13.7	204.8
Nebraska	327.1	24.1	351.2
Nevada	987.8	62.0	1,049.8
New Hampshire	291.2	26.0	317.1
New Jersey	2,276.4	156.0	2,432.4
New Mexico	623.9	26.0	650.0
New York	4,475.2	256.2	4,731.5
North Carolina	3,023.1	168.4	3,191.4
North Dakota	72.7	7.6	80.3

Ohio	2,095.0	191.7	2,286.7
Oklahoma	1,463.7	89.6	1,553.3
Oregon	696.8	34.3	731.1
Pennsylvania	2,656.7	251.2	2,907.9
Rhode Island	239.1	16.1	255.2
South Carolina	1,477.4	87.0	1,564.5
South Dakota	122.5	9.6	132.1
Tennessee	1,879.2	118.2	1,997.3
Texas	9,028.6	603.8	9,632.3
Utah	642.5	23.4	665.9
Vermont	132.5	10.7	143.1
Virginia	2,601.9	155.8	2,757.6
Washington	1,085.6	45.4	1,131.1
West Virginia	248.1	23.9	272.0
Wisconsin	657.8	61.4	719.2
Wyoming	52.2	2.2	54.4

Table 10 – Annual Incremental Costs, Commercial Heating and Cooling (2025)

State	Energy Costs (million $2024)
Alabama	11.0
Alaska	1.8
Arizona	20.9
Arkansas	6.6
California	451.3
Colorado	16.3
Connecticut	14.9
Delaware	6.5
District of Columbia	4.8
Florida	39.6
Georgia	26.2
Hawaii	6.5
Idaho	4.2
Illinois	54.5
Indiana	27.4
Iowa	8.7
Kansas	10.3

Kentucky	10.5
Louisiana	8.7
Maine	5.0
Maryland	30.8
Massachusetts	28.2
Michigan	49.0
Minnesota	17.7
Mississippi	6.1
Missouri	17.1
Montana	3.9
Nebraska	4.2
Nevada	12.1
New Hampshire	5.4
New Jersey	34.6
New Mexico	7.2
New York	102.8
North Carolina	24.1
North Dakota	1.0
Ohio	46.2
Oklahoma	8.3
Oregon	19.9
Pennsylvania	34.8
Rhode Island	4.1
South Carolina	11.5
South Dakota	2.0
Tennessee	14.3
Texas	50.5
Utah	9.1
Vermont	2.1
Virginia	25.4
Washington	30.5
West Virginia	5.7
Wisconsin	24.6
Wyoming	1.6

Table 11 – Annual Incremental Costs, Commercial Heating and Cooling (2035)

State	Energy Costs (million $2024)
Alabama	112.4
Alaska	17.8
Arizona	214.6
Arkansas	68.2
California	4,855.5
Colorado	167.7
Connecticut	153.6
Delaware	70.1
District of Columbia	51.8
Florida	399.6
Georgia	272.3
Hawaii	64.9
Idaho	43.7
Illinois	569.7
Indiana	283.1
Iowa	90.4
Kansas	108.2
Kentucky	108.6
Louisiana	88.9
Maine	51.3
Maryland	328.2
Massachusetts	290.7
Michigan	510.8
Minnesota	182.8
Mississippi	62.3
Missouri	178.3
Montana	40.2
Nebraska	43.9
Nevada	126.2
New Hampshire	56.0
New Jersey	363.8
New Mexico	75.8
New York	1,086.9
North Carolina	251.2
North Dakota	9.6

Ohio	481.4
Oklahoma	86.1
Oregon	213.6
Pennsylvania	364.9
Rhode Island	42.2
South Carolina	119.4
South Dakota	21.0
Tennessee	146.4
Texas	516.8
Utah	95.4
Vermont	21.7
Virginia	269.8
Washington	326.2
West Virginia	60.1
Wisconsin	255.4
Wyoming	16.3

Table 12 – Annual Incremental Costs, Building Materials (2025)

State	Energy Costs (million $2024)
Alabama	3.1
Alaska	0.2
Arizona	8.2
Arkansas	1.8
California	12.8
Colorado	4.0
Connecticut	1.2
Delaware	0.9
District of Columbia	0.3
Florida	25.7
Georgia	8.1
Hawaii	1.2
Idaho	1.7
Illinois	2.6
Indiana	3.9
Iowa	1.6
Kansas	1.5

Kentucky	2.4
Louisiana	1.7
Maine	1.1
Maryland	3.2
Massachusetts	2.6
Michigan	3.0
Minnesota	3.1
Mississippi	1.1
Missouri	2.5
Montana	0.5
Nebraska	1.1
Nevada	2.4
New Hampshire	0.8
New Jersey	4.9
New Mexico	0.8
New York	6.9
North Carolina	11.9
North Dakota	0.4
Ohio	4.1
Oklahoma	1.9
Oregon	1.8
Pennsylvania	4.3
Rhode Island	0.2
South Carolina	5.5
South Dakota	0.8
Tennessee	6.4
Texas	33.1
Utah	2.2
Vermont	0.3
Virginia	4.6
Washington	3.7
West Virginia	0.8
Wisconsin	2.6
Wyoming	0.2

Table 13 – Annual Incremental Costs, Building Materials (2035)

State	Energy Costs (million $2024)
Alabama	33.8
Alaska	2.2
Arizona	90.3
Arkansas	20.1
California	140.3
Colorado	43.6
Connecticut	12.9
Delaware	9.8
District of Columbia	2.8
Florida	283.2
Georgia	89.5
Hawaii	12.8
Idaho	18.8
Illinois	28.9
Indiana	42.9
Iowa	17.8
Kansas	16.6
Kentucky	26.7
Louisiana	18.7
Maine	11.7
Maryland	35.1
Massachusetts	29.1
Michigan	33.5
Minnesota	33.8
Mississippi	11.8
Missouri	27.1
Montana	5.5
Nebraska	11.9
Nevada	26.8
New Hampshire	8.3
New Jersey	54.1
New Mexico	9.1
New York	76.3
North Carolina	131.3
North Dakota	3.9

Ohio	45.3
Oklahoma	20.9
Oregon	20.3
Pennsylvania	47.1
Rhode Island	2.5
South Carolina	60.5
South Dakota	9.0
Tennessee	70.8
Texas	364.3
Utah	24.0
Vermont	3.4
Virginia	50.5
Washington	40.6
West Virginia	9.0
Wisconsin	29.1
Wyoming	2.2

Table 14 – Total Annual State-Level Economic Impacts (2035)

State	Output (million $2024)	Employment (thousand jobs)	GDP (millions $2024)	Labor Income (millions $2024)	Federal (millions $2024)	State and Local (millions $2024)
Alabama	2,028.8	7,559	877.5	497.0	116.0	71.2
Alaska	40.1	163	24.3	11.7	2.7	1.8
Arizona	1,973.4	8,788	1,079.7	603.1	146.0	89.5
Arkansas	1,898.6	6,697	829.5	432.7	108.9	62.9
California	16,532.7	70,807	10,126.6	5,620.2	1,397.0	1,068.4
Colorado	1,397.3	5,831	737.3	437.6	103.0	60.6
Connecticut	1,177.4	4,967	659.3	400.8	100.5	69.2
Delaware	351.4	1,623	209.1	113.6	25.1	14.8
District of Columbia	158.9	715	108.2	65.9	11.1	7.5
Florida	5,309.2	23,997	2,812.0	1,541.2	402.2	225.6
Georgia	5,350.9	20,638	2,713.0	1,419.5	344.7	205.2
Hawaii	103.4	504	65.9	33.0	7.6	8.4
Idaho	363.3	1,680	180.4	107.8	25.5	16.2
Illinois	5,509.7	21,366	2,904.7	1,656.3	392.3	272.4
Indiana	3,801.5	12,852	1,702.7	955.5	218.3	123.7

Iowa	1,500.3	5,372	659.3	364.2	82.9	48.8
Kansas	1,813.3	7,015	827.2	479.1	111.9	69.3
Kentucky	1,911.2	7,245	856.0	516.8	109.8	73.1
Louisiana	1,304.0	5,543	617.7	336.3	76.3	57.1
Maine	299.8	1,490	165.2	94.3	22.3	18.2
Maryland	1,917.0	8,737	1,097.7	610.9	142.3	113.0
Massachusetts	2,106.5	8,512	1,223.8	760.2	181.3	94.6
Michigan	3,745.7	15,436	1,830.6	1,087.2	257.0	145.8
Minnesota	2,849.9	10,332	1,447.7	866.7	197.8	122.7
Mississippi	1,215.9	4,617	486.8	249.8	59.9	43.2
Missouri	4,563.3	17,266	2,025.6	1,240.2	278.3	143.4
Montana	149.3	826	81.7	49.9	11.8	6.5
Nebraska	536.2	2,143	270.8	145.8	34.2	19.1
Nevada	962.2	4,134	534.9	275.8	74.4	44.9
New Hampshire	407.7	1,689	214.5	134.9	32.0	15.6
New Jersey	3,169.2	13,494	1,829.5	1,092.6	259.6	195.3
New Mexico	321.5	1,748	178.6	98.0	22.4	19.8
New York	5,774.1	23,969	3,565.3	2,042.8	491.6	409.5
North Carolina	4,074.0	15,498	2,171.6	1,162.3	278.3	147.6
North Dakota	146.1	566	68.9	38.4	8.7	4.3
Ohio	5,782.3	21,938	2,761.6	1,584.5	364.6	218.1
Oklahoma	3,056.5	11,343	1,241.7	758.1	163.8	86.8
Oregon	1,229.2	5,338	660.8	401.9	96.0	59.8
Pennsylvania	5,216.6	20,112	2,559.8	1,540.5	356.1	215.1
Rhode Island	379.8	1,503	192.8	110.0	26.2	18.0
South Carolina	2,430.4	9,186	1,047.8	588.5	144.5	94.5
South Dakota	288.6	1,146	125.8	78.7	17.3	7.3
Tennessee	4,907.8	17,098	2,275.3	1,315.0	307.9	158.0
Texas	13,820.7	51,099	6,928.0	3,710.7	858.2	431.6
Utah	705.8	2,982	377.8	197.4	48.4	30.1
Vermont	189.1	776	92.2	50.2	11.8	9.8
Virginia	2,758.5	11,518	1,470.9	821.1	193.5	134.9
Washington	2,077.2	7,468	1,192.4	657.8	168.3	105.1
West Virginia	425.5	1,644	189.0	103.0	22.9	18.7
Wisconsin	3,596.1	12,719	1,709.2	971.7	231.8	123.8
Wyoming	48.4	236	26.5	13.1	3.5	2.4

Table 15 – Increased Electricity Demand, 2025

State	Residential (MWh)	Commercial (MWh)	Building Materials (MWh)	Total (MWh)
Alabama	53,007	82,109	18,147	153,262
Alaska	N/A	8,515	536	9,051
Arizona	74,488	169,393	48,203	292,084
Arkansas	40,298	60,601	10,660	111,559
California	137,240	1,615,284	33,106	1,785,631
Colorado	24,013	132,825	11,802	168,641
Connecticut	27,735	66,212	1,696	95,643
Delaware	9,128	44,793	5,340	59,261
District of Columbia	6,720	29,185	1,433	37,338
Florida	172,205	324,604	165,544	662,353
Georgia	124,271	222,435	55,346	402,052
Hawaii	266	16,638	1,599	18,502
Idaho	14,602	45,322	9,711	69,635
Illinois	75,296	421,160	5,002	501,458
Indiana	69,853	205,942	11,229	287,024
Iowa	35,207	76,826	6,198	118,231
Kansas	55,519	85,873	6,288	147,681
Kentucky	56,519	88,955	16,019	161,494
Louisiana	58,125	81,296	12,468	151,890
Maine	8,603	24,749	1,159	34,511
Maryland	82,107	203,941	18,135	304,183
Massachusetts	49,565	127,631	3,659	180,855
Michigan	60,335	320,305	5,464	386,104
Minnesota	21,213	134,421	7,890	163,524
Mississippi	30,976	48,538	6,896	86,410
Missouri	70,868	155,238	9,222	235,327
Montana	8,657	31,471	2,111	42,239
Nebraska	17,206	44,793	4,627	66,625
Nevada	30,085	88,226	11,554	129,865
New Hampshire	7,312	24,598	944	32,854
New Jersey	70,387	219,631	12,293	302,310
New Mexico	15,023	60,549	3,387	78,959
New York	91,639	508,667	12,987	613,294

North Carolina	104,663	222,038	86,087	412,789
North Dakota	5,466	12,873	1,490	19,830
Ohio	99,622	373,753	9,507	482,882
Oklahoma	59,449	81,733	11,913	153,095
Oregon	21,486	166,854	8,699	197,039
Pennsylvania	110,578	253,145	10,507	374,230
Rhode Island	4,734	20,300	248	25,282
South Carolina	51,333	101,117	38,336	190,786
South Dakota	6,233	19,180	3,417	28,830
Tennessee	77,838	120,531	43,943	242,313
Texas	336,853	518,691	194,688	1,050,232
Utah	16,827	95,766	9,992	122,585
Vermont	4,047	11,353	465	15,865
Virginia	87,556	220,604	29,791	337,951
Washington	32,867	286,364	18,461	337,692
West Virginia	13,605	45,377	5,558	64,540
Wisconsin	29,061	175,955	5,375	210,391
Wyoming	1,549	15,844	679	18,073

Table 16 – Increased Electricity Demand, 2035

State	Residential (MWh)	Commercial (MWh)	Building Materials (MWh)	Total (MWh)
Alabama	583,079	835,945	199,612	1,685,887
Alaska	N/A	85,151	5,891	99,557
Arizona	819,369	1,734,964	530,232	3,212,919
Arkansas	443,279	623,653	117,257	1,227,145
California	1,509,643	17,314,477	364,168	19,188,288
Colorado	264,146	1,360,225	129,827	1,855,046
Connecticut	305,086	678,619	18,655	1,052,068
Delaware	100,409	479,213	58,738	651,867
District of Columbia	73,924	312,018	15,758	410,718
Florida	1,894,253	3,270,525	1,820,989	7,285,881
Georgia	1,366,985	2,303,210	608,810	4,422,575
Hawaii	2,921	166,377	17,586	203,522
Idaho	160,619	464,660	106,820	765,983
Illinois	828,254	4,370,926	55,019	5,516,035
Indiana	768,384	2,122,717	123,515	3,157,260

Iowa	387,281	793,785	68,174	1,300,541
Kansas	610,713	897,594	69,167	1,624,488
Kentucky	621,712	918,683	176,207	1,776,429
Louisiana	639,379	830,312	137,145	1,670,785
Maine	94,631	253,237	12,744	379,617
Maryland	903,180	2,162,930	199,482	3,346,016
Massachusetts	545,215	1,307,415	40,252	1,989,405
Michigan	663,687	3,314,454	60,109	4,247,149
Minnesota	233,340	1,386,948	86,794	1,798,768
Mississippi	340,740	495,539	75,857	950,510
Missouri	779,547	1,608,771	101,438	2,588,600
Montana	95,225	326,930	23,217	464,624
Nebraska	189,263	460,979	50,895	732,877
Nevada	330,936	915,179	127,090	1,428,516
New Hampshire	80,431	251,522	10,388	361,398
New Jersey	774,254	2,299,071	135,218	3,325,412
New Mexico	165,250	629,980	37,260	868,551
New York	1,008,034	5,350,955	142,858	6,746,230
North Carolina	1,151,295	2,300,582	946,962	4,540,677
North Dakota	60,126	128,997	16,395	218,125
Ohio	1,095,845	3,866,483	104,574	5,311,703
Oklahoma	653,940	842,097	131,047	1,684,046
Oregon	236,343	1,786,241	95,690	2,167,427
Pennsylvania	1,216,360	2,623,713	115,575	4,116,527
Rhode Island	52,077	208,257	2,726	278,105
South Carolina	564,667	1,041,933	421,700	2,098,651
South Dakota	68,565	196,341	37,586	317,127
Tennessee	856,223	1,231,602	483,374	2,665,441
Texas	3,705,387	5,270,384	2,141,566	11,117,337
Utah	185,097	994,116	109,916	1,348,439
Vermont	44,522	116,107	5,117	174,517
Virginia	963,116	2,313,501	327,702	3,717,460
Washington	361,535	3,058,450	203,074	3,714,616
West Virginia	149,654	476,419	61,140	709,941
Wisconsin	319,670	1,812,707	59,120	2,314,296
Wyoming	17,044	835,945	7,474	198,798

Table 17 – Incremental Emissions, 2025

State	Residential (Metric Tons CO2e)	Commercial (Metric Tons CO2e)	Building Materials (Metric Tons CO2e)	Total (Metric Tons CO2e)
Alabama	19,027	29,474	7,854	56,355
Alaska	N/A	3,544	590	4,134
Arizona	24,054	54,700	20,052	98,806
Arkansas	19,404	29,179	6,855	55,438
California	28,479	335,190	15,030	378,699
Colorado	12,778	70,680	16,165	99,623
Connecticut	6,583	15,716	2,395	24,694
Delaware	3,730	18,302	2,353	24,384
District of Columbia	1,691	7,346	424	9,462
Florida	63,938	120,523	62,668	247,129
Georgia	41,780	74,782	20,325	136,888
Hawaii	176	11,045	1,528	12,750
Idaho	1,645	5,107	5,461	12,214
Illinois	20,232	113,168	8,699	142,099
Indiana	49,954	147,276	18,584	215,815
Iowa	9,926	21,660	5,116	36,703
Kansas	20,807	32,183	4,912	57,902
Kentucky	44,409	69,896	14,114	128,419
Louisiana	21,637	30,262	5,538	57,437
Maine	1,337	3,847	2,164	7,349
Maryland	23,854	59,250	5,858	88,963
Massachusetts	19,317	49,742	5,632	74,692
Michigan	27,798	147,573	12,366	187,737
Minnesota	7,446	47,181	11,459	66,086
Mississippi	12,487	19,566	3,387	35,439
Missouri	48,789	106,873	11,374	167,036
Montana	4,050	14,723	2,230	21,002
Nebraska	8,629	22,464	4,730	35,824
Nevada	9,262	27,163	5,766	42,191
New Hampshire	1,016	3,419	1,436	5,872
New Jersey	15,599	48,673	14,774	79,045
New Mexico	6,757	27,235	3,094	37,086
New York	20,424	113,367	16,547	150,339

North Carolina	31,196	66,181	28,234	125,611
North Dakota	3,276	7,716	1,849	12,841
Ohio	52,514	197,017	16,208	265,739
Oklahoma	18,583	25,548	5,453	49,584
Oregon	2,915	22,634	4,352	29,901
Pennsylvania	35,824	82,011	12,173	130,008
Rhode Island	1,744	7,479	581	9,803
South Carolina	13,038	25,682	10,639	49,358
South Dakota	924	2,844	2,505	6,274
Tennessee	24,634	38,146	18,699	81,479
Texas	125,588	193,383	89,119	408,090
Utah	11,634	66,211	12,508	90,354
Vermont	78	219	762	1,060
Virginia	23,431	59,035	9,131	91,597
Washington	2,772	24,155	8,698	35,626
West Virginia	12,184	40,637	5,153	57,974
Wisconsin	15,534	94,051	11,314	120,899
Wyoming	1,277	13,062	1,065	15,405

Table 18 – Incremental Emissions, 2035

State	Residential (Metric Tons CO2e)	Commercial (Metric Tons CO2e)	Building Materials (Metric Tons CO2e)	Total (Metric Tons CO2e)
Alabama	209,301	283,361	86,399	595,770
Alaska	N/A	2,244	6,492	41,928
Arizona	264,590	628,387	220,573	1,045,416
Arkansas	213,440	242,310	75,407	589,137
California	313,268	3,592,954	165,330	4,071,552
Colorado	140,560	509,503	177,811	1,042,189
Connecticut	72,416	257,987	26,345	259,840
Delaware	41,026	161,079	25,879	262,709
District of Columbia	18,606	110,451	4,667	101,807
Florida	703,323	1,214,324	689,343	2,606,989
Georgia	459,580	968,921	223,577	1,457,495
Hawaii	1,939	39,366	16,813	129,204
Idaho	18,100	195,803	60,071	130,532
Illinois	222,556	1,527,054	95,689	1,492,736
Indiana	549,497	721,843	204,429	2,271,952

Iowa	109,189	263,225	56,279	389,266
Kansas	228,881	300,290	54,027	619,306
Kentucky	488,502	309,078	155,257	1,365,602
Louisiana	238,004	264,632	60,921	608,002
Maine	14,710	77,320	23,808	77,884
Maryland	262,397	687,320	64,442	955,226
Massachusetts	212,489	486,811	61,957	783,992
Michigan	305,778	1,192,575	136,027	1,968,859
Minnesota	81,901	509,545	126,050	694,762
Mississippi	137,355	223,798	37,255	374,365
Missouri	536,677	560,253	125,113	1,769,344
Montana	44,548	135,483	24,531	222,021
Nebraska	94,919	152,942	52,034	378,142
Nevada	101,886	300,070	63,422	447,067
New Hampshire	11,180	76,722	15,795	61,939
New Jersey	171,584	723,817	162,513	843,599
New Mexico	74,328	231,189	34,038	391,727
New York	224,662	1,964,947	182,021	1,599,258
North Carolina	343,155	850,000	310,579	1,339,446
North Dakota	36,039	34,963	20,337	133,696
Ohio	577,655	1,518,026	178,283	2,794,085
Oklahoma	204,410	281,759	59,982	527,617
Oregon	32,061	619,107	47,868	322,239
Pennsylvania	394,062	1,107,553	133,904	1,377,967
Rhode Island	19,185	78,534	6,387	102,294
South Carolina	143,415	389,779	117,025	525,072
South Dakota	10,168	52,361	27,555	66,840
Tennessee	270,979	426,651	205,684	866,441
Texas	1,381,472	2,038,147	980,307	4,326,727
Utah	127,974	336,398	137,591	952,886
Vermont	860	29,116	8,382	11,487
Virginia	257,736	774,339	100,443	977,286
Washington	30,496	1,174,490	95,679	384,163
West Virginia	134,021	199,755	56,683	617,356
Wisconsin	170,869	685,712	124,459	1,264,249
Wyoming	14,052	35,436	11,717	161,252

Table 19 – State-Level Impacts, Previous Report

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	372.4	180.9
California	341,194.6	788.0	171,931.5	94,387.8	24,921.4	15,674.9
Colorado	25,272.6	74.4	11,983.2	6,938.4	1,746.0	726.7
Connecticut	29,918.5	70.5	16,941.1	8,289.9	2,377.6	1,217.1
Delaware	855.6	2.4	422.5	175.7	45.3	27.9
District of Columbia	1,093.0	2.6	566.3	348.5	61.9	27.3
Florida	70,735.9	226.3	30,794.9	18,159.5	5,007.0	1,861.0
Georgia	58,328.3	164.2	24,341.6	13,762.9	3,352.7	1,620.5
Hawaii	531.7	1.7	229.1	130.3	30.6	18.9
Idaho	16,837.6	46.7	6,497.2	4,088.7	1,048.0	480.3
Illinois	76,957.6	181.7	29,403.0	16,659.1	4,067.1	2,446.1
Indiana	146,964.7	340.8	51,491.8	27,002.6	6,573.8	3,168.9
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	2,467.5	1,416.5
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	271.4	183.1
Maryland	7,906.9	21.0	3,728.9	1,948.2	500.3	306.4
Massachusetts	36,874.5	93.6	18,782.6	11,045.9	2,911.5	1,309.3
Michigan	228,180.5	537.2	79,458.5	43,636.3	10,949.4	4,987.3
Minnesota	19,750.2	57.7	8,603.1	5,130.9	1,246.9	703.4
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	388.2	183.8
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	362.0	162.5
New York	49,429.7	125.1	23,246.4	13,657.4	3,480.9	2,241.6

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	139.8	35.5
Ohio	155,706.2	431.7	53,221.2	32,990.7	7,614.0	4,093.4
Oklahoma	14,107.0	43.2	4,605.7	3,273.6	699.6	278.0
Oregon	88,973.6	238.7	42,497.2	23,686.5	6,114.4	3,472.8
Pennsylvania	41,702.7	115.9	18,015.6	10,681.9	2,584.6	1,316.8
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	3,682.5	1,796.8
Texas	216,927.9	574.5	95,444.2	51,085.1	12,781.1	4,582.9
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	305.8	189.0
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	5,597.4	1,939.4
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

U.S. Chamber of Commerce