NATIONAL RENEWABLE ENERGY LABORATORY

Economic Contribution on the Region, the State of Colorado, and the Nation in Fiscal Year 2023

A project for the Alliance for Sustainable Energy, LLC

Report by:

The Business Research Division
Leeds School of Business
University of Colorado Boulder

Final Report

August 2024

Leeds School of Business
UNIVERSITY OF COLORADO **BOULDER**

Business Research Division

The Business Research Division (BRD) of the Leeds School of Business at the University of Colorado Boulder has been serving Colorado since 1915. The BRD conducts economic impact studies and customized research projects that assist companies, associations, nonprofits, and government agencies with making informed business and policy decisions. Among the information offered to the public is the annual Colorado Business Economic Outlook Forum, which provides a forecast of the state's economy by sector. The BRD also publishes the quarterly Leeds Business Confidence Index, which gauges Colorado business leaders' opinions about the national and state economies and how their industries will perform in the upcoming quarter. The Colorado Business Review *is a quarterly publication that offers decision makers industry-focused analysis and information as it relates to the Colorado economy.*

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's (DOE's) primary national laboratory for renewable energy and energy efficiency research and development (R&D). Designated as a Federally funded research and development center, NREL's research ranges from basic sciences to systems engineering and analysis. Staff at NREL are focused on solving high-priority problems that result in market-ready solutions. NREL is managed by the Alliance for Sustainable Energy LLC (Alliance), a partnership between Battelle and MRIGlobal, on behalf of DOE's Office of Energy Efficiency and Renewable Energy.

In an effort to address the nation's energy, economic, environmental, and security goals, NREL's team of scientists, researchers, analysts, and other staff develop advanced technologies and work closely with commercial and noncommercial partners to provide technical expertise and capabilities to advance the innovations of its industry partners. NREL manages commercialization programs and works to accelerate deployment of technologies to the market.

NREL reported employment of 3,184 full-time, part-time, postdoctoral, and intern employees in fiscal year (FY) 2023, 99% of whom work for NREL in Colorado. The laboratory is a top-five employer in Jefferson County. NREL's employees continue to earn higher than average wages in the state and nationally. The laboratory contributes a multitude of research and operational jobs to the economy, which helps to diversify and strengthen the local workforce. Given the nature of the R&D conducted at NREL, employment and expenditures represent only a fraction of the economic benefits derived from NREL. The research and discovery that takes place at NREL leads to scientific innovations, tech transfer, and commercialization, which fall outside the scope of this economic impact study.

The economic impacts of NREL on the nation totaled $1.9 billion in FY 2023, with the federal laboratory directly employing or supporting more than 8,200 jobs across the country (Table 1). While every state in the nation recorded economic benefits associated with lab spending and employment, the top five impacted areas were Colorado, California, Virginia, Texas, and Minnesota. Given the laboratory's primary location in Colorado, the state also recorded the greatest economic benefits—$1.3 billion in output, 5,700 jobs, and $780 million in value added.

TABLE 1: NREL NATIONAL ECONOMIC CONTRIBUTION (DIRECT, INDIRECT, AND INDUCED), FY 2023

Total				
Impact	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
Direct	3,184	468	468	776
Indirect	2,618	239	351	625
Induced	2,418	145	280	454
Total	8,220	853	1,100	1,855

Economic impacts were quantified in this study using a 546-sector IMPLAN multiregional input-output model. The report details the economic impacts in terms of output, employment, and income using primary data collected from departments within NREL.

PURPOSE OF THE STUDY

The Business Research Division (BRD) at the Leeds School of Business was funded by the Alliance to objectively measure the economic and fiscal impacts of the NREL for FY 2023. The analysis includes the impact on the nation, states, Colorado counties, and Colorado congressional districts.

As DOE's primary laboratory for renewable energy and energy efficiency research and development, NREL develops renewable energy and energy-efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.

NREL has more than four decades of focused leadership in clean energy research, development, and deployment. Engaging in partnerships with forward-thinking commercial organizations; universities; foundations; and state, federal, and Tribal governments ensures NREL's work is relevant and applicable to today's energy problems.

To secure NREL's vision—a clean energy future for the world—the laboratory has set goals to address three primary threats facing humanity: climate change, pollution, and biodiversity loss. NREL is tackling these interconnected threats through research and development in three critical research areas: integrated energy pathways, electrons to molecules, and circular economy for energy materials.

NREL's 327-acre campus in Golden, Colorado, is the laboratory's primary location (South Table Mountain campus). The campus supports the laboratory's Energy Systems Integration Facility (ESIF), Integrated Biorefinery Research Facility, National Center for Photovoltaics, and National Bioenergy Center. NREL's Flatirons Campus is located 13 miles north of the South Table Mountain campus, situated on 305 acres near Boulder, Colorado.

The NREL campus is growing with many projects planned or currently under development. NREL recently completed its newest building on the South Table Mountain Campus, called the Research and Innovation Laboratory (RAIL). Research in this new laboratory will focus on plastics upcycling, next-generation batteries, and advanced energy materials. NREL is anticipating breaking ground on its Energy Materials and Processing at Scale (EMAPS) signature facility in late 2024, which will accelerate laboratory innovations for scale-up and industry adoption of the materials crucial for a clean energy economy.

A series of additions and improvements are also coming to NREL's South Table Mountain and Flatirons campuses made possible through $150 million in funding provided by the Inflation Reduction Act of 2022 (IRA). This includes modernizing research infrastructure, including new and expanded facilities to

advance technologies such as sustainable aviation fuels, and advancing NREL's Advanced Research on Integrated Energy Systems (ARIES) research platform that will support the administration's decarbonization goals in the grid, buildings, transportation, and industrial sectors. Funding will also support laboratory renovations and deferred maintenance to improve facilities for NREL researchers and allow NREL to lead by example by cutting overall emissions from lab operations. These planned additions and improvements are not considered in the 2023 analysis.

ECONOMIC OVERVIEW

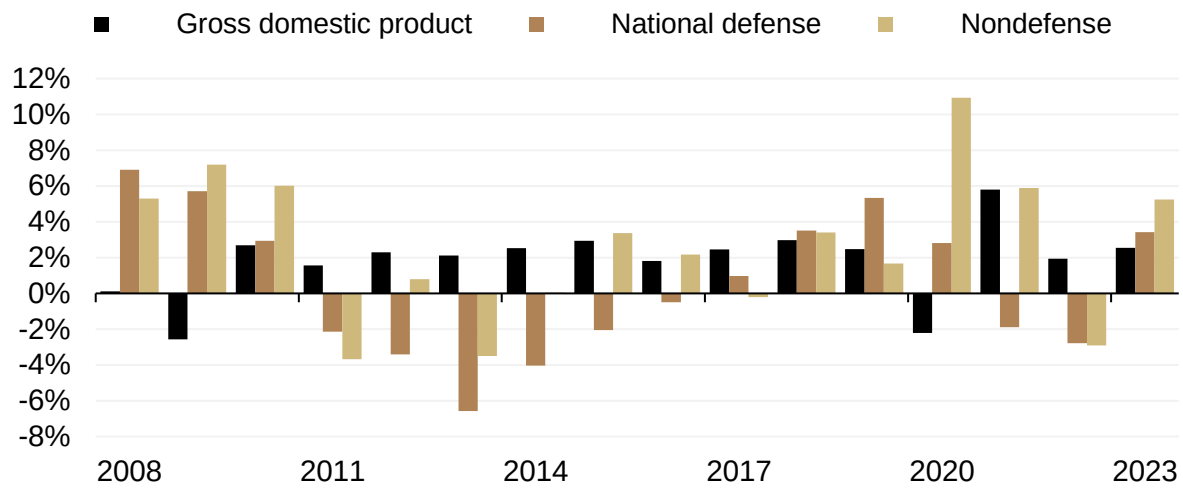
Data from the Bureau of Economic Analysis show that the domestic economy grew at real rates of 5.8% in 2021, 1.9% in 2022, and 2.5% in 2023 (Table 2, Figure 1). Total government consumption expenditures and gross investment grew 4.1% in 2023, which followed declines of 0.3% and 0.9% in 2021 and 2022, representing the only two decreases since the recession. *Federal* government consumption expenditures and gross investment posted strong growth over 2019–2021 (3.8%, 6.1%, and 1.4%, respectively), but fell 2.8% in 2022 before again increasing with 4.2% growth in 2023. The subsector of federal nondefense outpaced the growth in overall federal spending with 5.2% growth in 2023.

TABLE 2: GOVERNMENT SPENDING COMPONENTS OF REAL U.S. GDP, ANNUAL GROWTH RATES

Component of GDP	2019	2020	2021	2022	2023
Gross Domestic Product	2.5%	-2.2%	5.8%	1.9%	2.5%
Government Consumption Expenditures and Gross Investment	3.9%	3.2%	-0.3%	-0.9%	4.1%
Federal	3.8%	6.1%	1.4%	-2.8%	4.2%
National Defense	5.3%	2.8%	-1.9%	-2.8%	3.4%
Nondefense	1.7%	10.9%	5.9%	-2.9%	5.2%
State and Local	4.0%	1.4%	-1.3%	0.2%	4.0%

Source: Bureau of Economic Analysis.

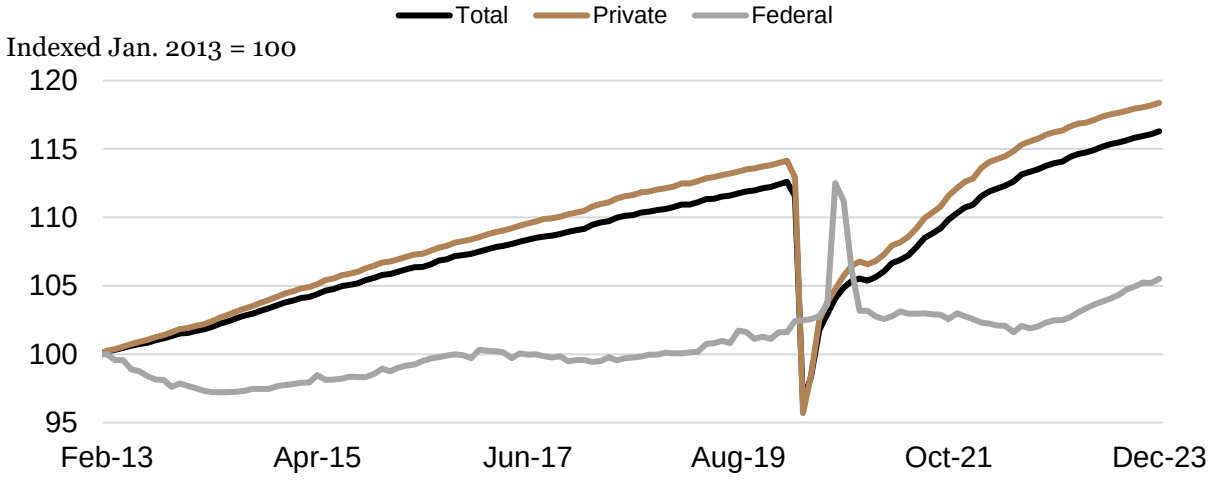
FIGURE 1: ANNUAL PERCENT CHANGE IN U.S. REAL GROSS DOMESTIC PRODUCT



Source: Bureau of Economic Analysis.

The pandemic-induced recession caused record job losses in 2020, with the United States losing 21.9 million jobs (14.4%) in a two-month span (March and April). The nation added back 26.7 million jobs from May 2020 through December 2023, rising above the peak employment level recorded in February 2020 by over 5 million jobs (3.3%). In comparison, Colorado lost 378,700 jobs (13.4%) from January to April 2020 but added back 518,800 jobs as of December 2023—up 5% from January 2020 levels.[1] Aside from employment spikes that coincide with the U.S. Census, federal government employment has underperformed total and private-sector employment over the past 10 years (Figure 2).[2]

FIGURE 2: INDEXED NATIONAL EMPLOYMENT GROWTH

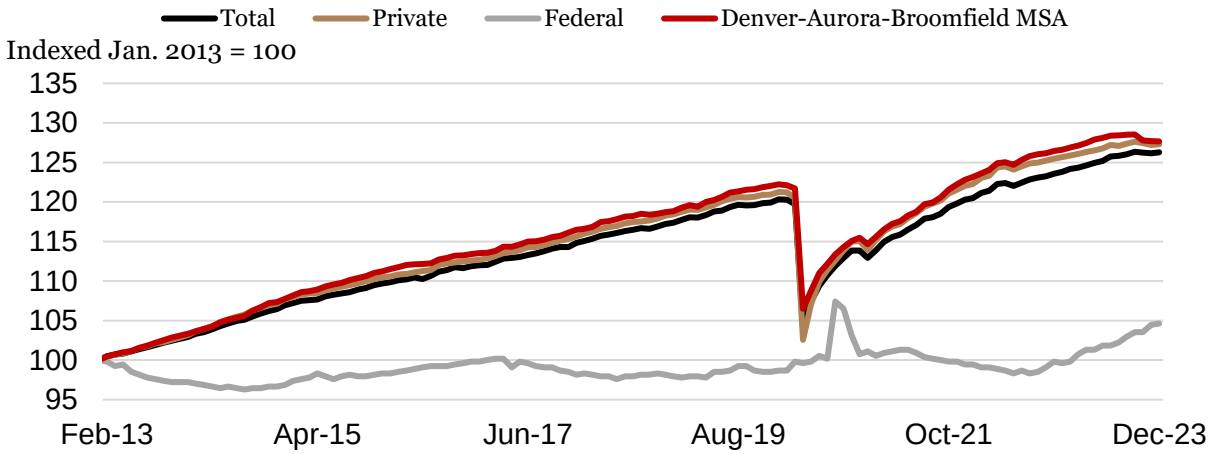


Source: Bureau of Labor Statistics, CES, Seasonally Adjusted.

[1] Colorado employment peaked one month prior to the U.S.
[2]NREL is managed by a private-sector entity, the Alliance for Sustainable Energy, LLC. Within the labor files, employees are counted in the private sector.

Colorado employment growth has outperformed national employment growth over the past 10 years, and private-sector employment growth has outperformed federal government employment growth (Figure 3). Employment in Colorado recorded a 10-year compound annual growth rate (CAGR) of 2.4% in December 2023 compared to 1.5% nationally. The Denver-Aurora-Lakewood metropolitan statistical area (MSA), where NREL's South Table Mountain campus resides, recorded an employment CAGR of 2.5% over the same period. While NREL is a federally funded laboratory, employment at the laboratory is considered private-sector employment because it is managed by the private-sector Alliance.

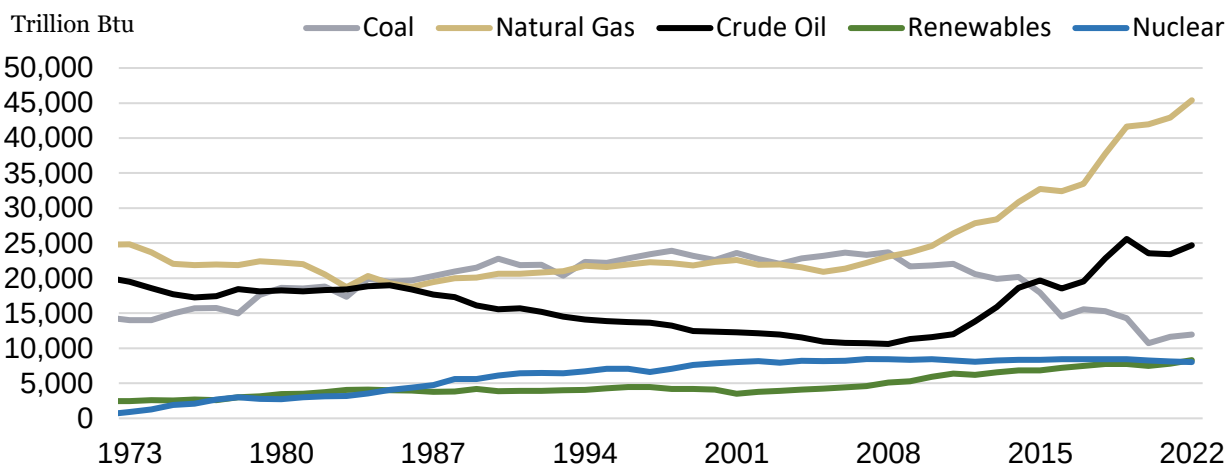
FIGURE 3: INDEXED COLORADO EMPLOYMENT GROWTH



Source: Bureau of Labor Statistics, CES, Seasonally Adjusted.

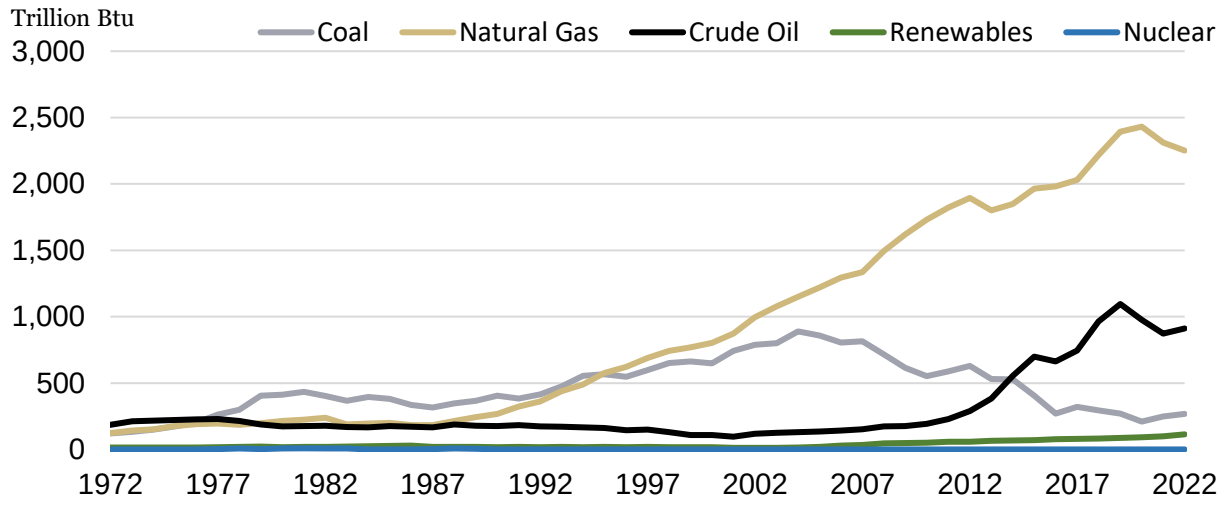
Since 2015, natural gas and crude oil have been the most produced energy sources at both national and state levels (Figure 4 and Figure 5). The rise in crude oil production over the past decade could be attributed to the decline of coal production, which has fallen toward levels that are comparable to renewable energy production. Between 2007 and 2022, coal production declined 49% nationally and 67% in Colorado.

FIGURE 4: ANNUAL NATIONAL ENERGY PRODUCTION BY SOURCE



Source: Energy Information Administration, Energy Overview.

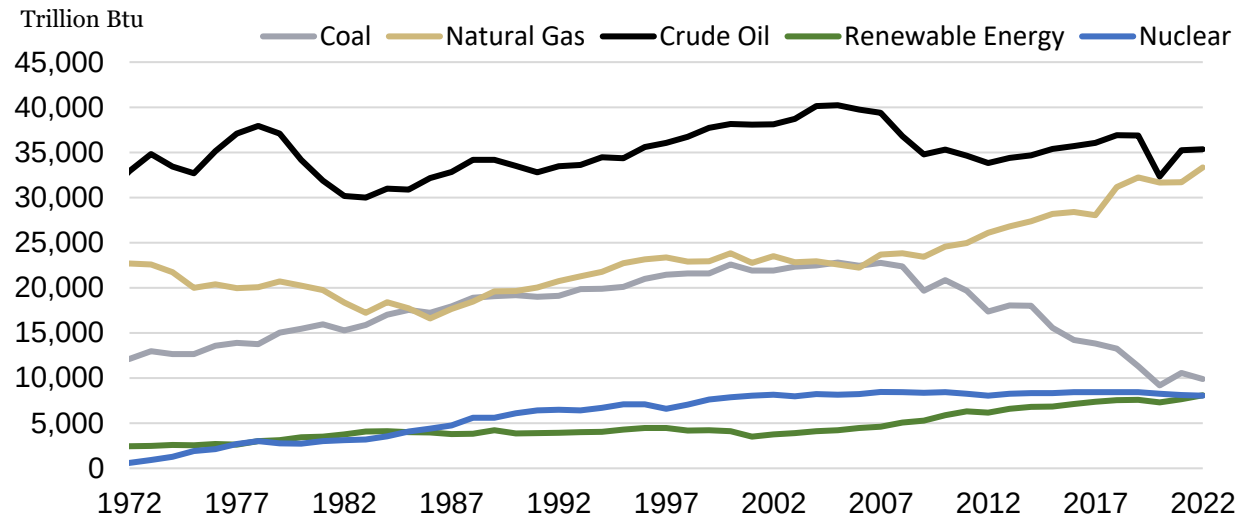
FIGURE 5: ANNUAL COLORADO ENERGY PRODUCTION BY SOURCE



Source: Energy Information Administration, State Energy Data System.

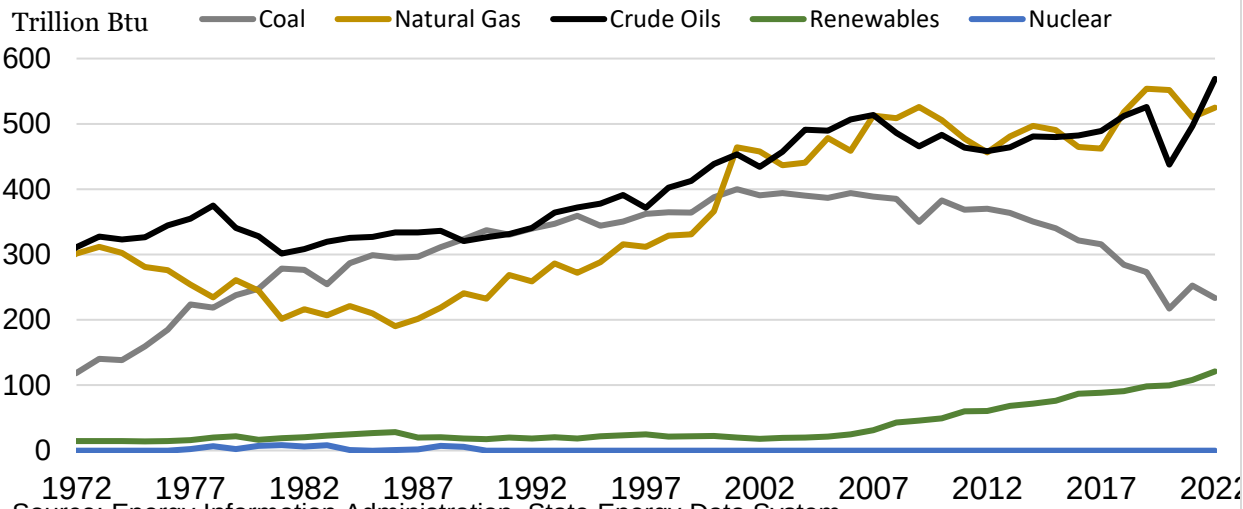
Mirroring the trends in energy production, energy consumption shows natural gas and crude oil as the primary energy sources in the United States and Colorado and the demand for coal on a steady decline (Figure 6 and Figure 7). The percentage decrease in coal consumption from 2007 to 2022 was 57% nationally and 40% in Colorado, placing coal just above renewable energy sources for consumption. Colorado has witnessed substantial growth in renewable energy consumption between 2004 and 2022 (Figure 6). A large part of this growth can be attributed to the rise in wind and solar energy in the state.

FIGURE 6: ANNUAL NATIONAL ENERGY CONSUMPTION BY SOURCE



Source: Energy Information Administration, Energy Overview.

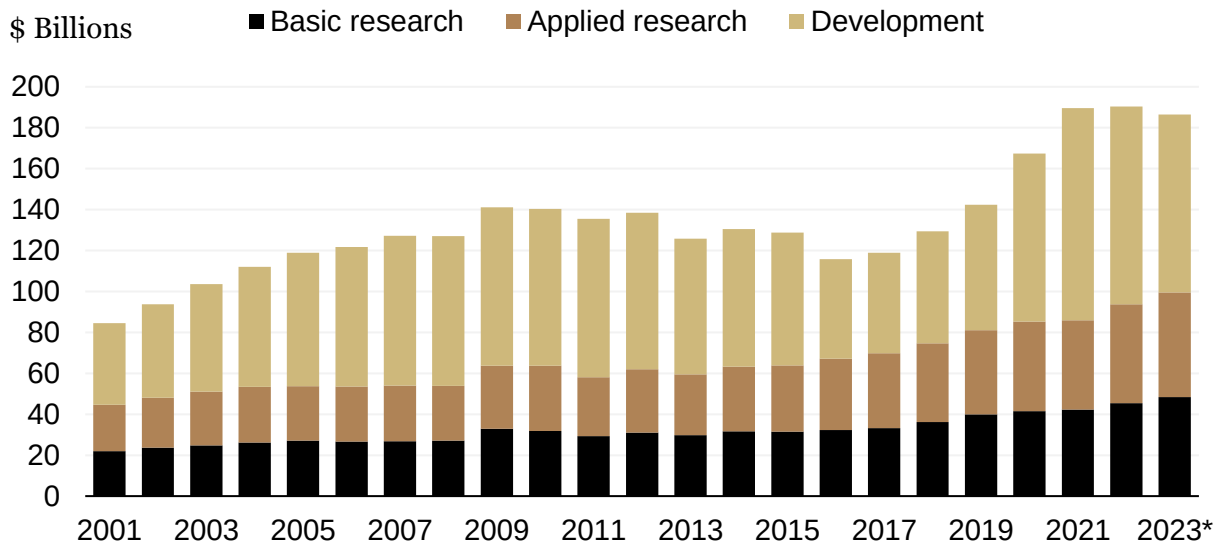
FIGURE 7: ANNUAL COLORDO ENERGY CONSUMPTION BY SOURCE



Source: Energy Information Administration, State Energy Data System.

Federal obligations for R&D decreased 1.8% in 2023 after reaching a record-high level in 2022 (Figure 8). Applied and basic research both increased to record levels, up 6.8% and 5.4% year-over-year, respectively. Of the preliminary $193 billion in federal obligations for R&D in 2023, $99.5 billion was for basic and applied research, $87 billion was for development, and $6.5 billion was for R&D plant.

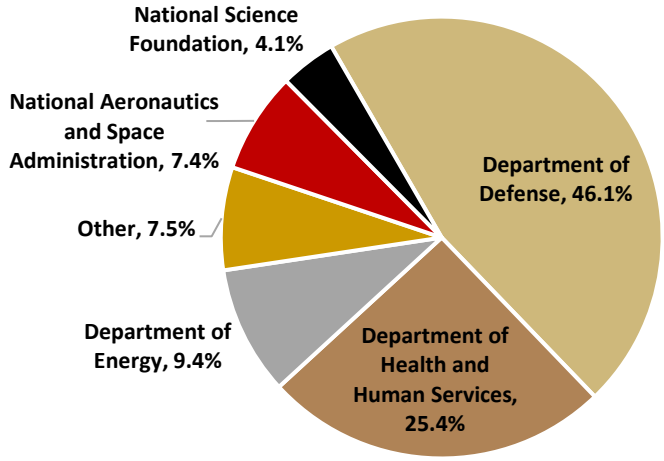
FIGURE 8: FEDERAL OBLIGATIONS FOR RESEARCH AND DEVELOPMENT



Source: National Science Foundation. * Preliminary.

In FY 2023, the federal agencies with the greatest percentage of outlays for research and development were the Department of Defense (46.1%) and the Department of Health and Human Services (25.4%) (Figure 9). DOE, the primary funder of NREL, ranked third in total funding outlays, accounting for 9.4% of federal outlays for R&D by agency in FY 2023.

FIGURE 9: ANNUAL FEDERAL OUTLAYS FOR RESEARCH AND DEVELOPMENT BY AGENCY, AVERAGE FY 20223



Source: National Science Foundation.

[3]

Basic research is defined as experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts. Basic research may include activities with broad or general applications in mind, such as the study of how plant genomes change, but should exclude research directed towards a specific application or requirement, such as the optimization of the genome of a specific crop species.

Applied research is defined as original investigation undertaken in order to acquire new knowledge. Applied research is, however, directed primarily towards a specific practical aim or objective.

Development is defined as creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge.

National Science Foundation[3]

METHODOLOGY

This study was conducted in cooperation with the NREL organization, replicating multiple prior studies with a comparable methodology that were conducted for NREL and for CO-LABS, a consortium of Colorado-based federally funded scientific laboratories, universities, businesses, local governments, and community leaders.

The research team queried NREL about its facility, employment, operating, and capital expenditures (including construction) for FY 2023. Data were reorganized by function and applied to a 546-sector IMPLAN input-output model that quantified the economic impacts of NREL by state, and by county in Colorado using IMPLAN's multiregional input-output (MRIO) model.[4] Contrasting with prior studies, the MRIO models NREL's activity in the state where the activity occurs (rather than a general national model), which produces estimates that reflect each state's economy (industry composition, wages, trade, etc.). This study uses the 2022 dataset from IMPLAN (most current available). The study also estimates impacts in Colorado's new congressional districts, which were approved in 2021. Impacts were modeled by congressional district, but the impacts presented in this report reflect the sum of the counties within each district rather than the district output (split counties were assigned to the district

[3] Source: National Science Foundation https://ncses.nsf.gov/surveys/federal-funds-research-development/2021-2022#survey-description. Retrieved February 28, 2024.
[4] Source: IMPLAN, MRIO: Introduction to Multi-Regional Input-Output Analysis, https://support.implan.com/hc/en-us/articles/115009713448-MRIO-Introduction-to-Multi-Regional-Input-Output-Analysis. Retrieved July 27, 2024.

with the highest population) because of the loss of industry and wage fidelity as data were modeled in a larger geographic district area versus the comparatively smaller counties.

Direct industry employment, wages, funding, and expenditures were the basis for economic impact estimates and for subsequent multiplier analysis to illustrate ripple effects of industry spending within the economy.

Direct industry employment refers to companies directly producing or delivering products—the vertical supply chain. There are also a number of firms supporting the industry, such as financial, legal, accounting, and consulting services firms.

Multipliers refer to the interindustry relationships within a study area in terms of input-output (I-O) economic impacts.[5] Multipliers are useful for analyzing project decisions to understand the incremental impacts that such activities have on the local economy. IMPLAN multipliers are static and thus do not consider large-scale disruptive impacts on the economic fabric without calculating specific infrastructure changes.

For the purpose of this study, all multipliers are comprised of direct, indirect, and induced effects. Direct refers to direct spending or employment in the study industry or firm. Indirect is the spending or employment in related industries impacted by spending or employment in the study industry or firm. Induced refers to changes in household expenditures impacted by spending or employment in the study industry or firm.

DEFINITIONS

Gross Domestic Product (GDP): A measure of economic activity, GDP is the total value added by resident producers of final goods and services.

Gross Output (Output): The total value of production is gross output. Unlike GDP, gross output includes intermediate goods and services. Gross output is closely synonymous with revenue or sales.

Value Added: The contribution of an industry or region to total GDP, value added equals gross output, net of intermediate input costs.

Labor Income: Total compensation of employees (wages and benefits) and sole proprietors (profits).

[5] Bureau of Economic Analysis, Regional Multipliers, https://apps.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf, retrieved June 11, 2024.

Employment: Full-time and part-time workers.

Direct Impact: Initial economic activity (e.g., sales, expenditures, employment, production, etc.) by a company or industry.

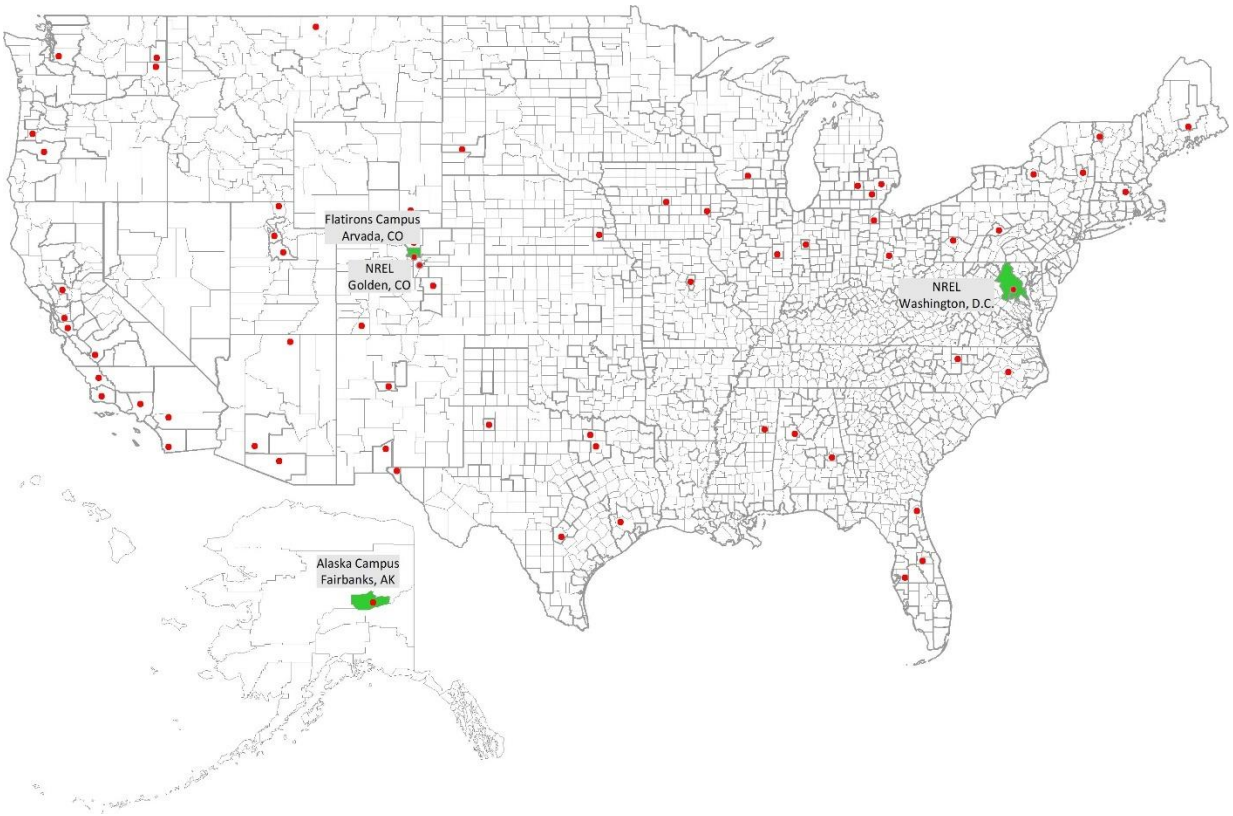
Indirect Impact: The upstream (backward) economic activity impacted by purchases along a company or industry supply chain.

Induced Impact: Economic activity derived from workers spending their earnings on goods and services in the economy.

NREL OPERATIONS

NREL's South Table Mountain campus, located at 15013 Denver West Parkway in Golden, Colorado, is within about an hour's proximity to numerous major research universities, federal laboratories, and private R&D companies throughout the state. NREL is located 36 miles (45 minutes) from Denver International Airport, 18 miles (24 minutes) from downtown Denver, 28 miles (40 minutes) from Boulder, 70 miles (1 hour 15 minutes) from Fort Collins, and 6 miles (12 minutes) from the Denver Federal Center. The Flatirons Campus, including the National Wind Technology Center, is located 20 miles (30 minutes) north of NREL'S South Table Mountain. The laboratory also has an administrative office in Washington, D.C., and a campus focused on extreme climate housing solutions in Fairbanks, Alaska (Alaska Campus in Fairbanks) (Figure 10).

FIGURE 10: NREL LOCATIONS AND UNIVERSITY PARTNERSHIPS



Note: Each red dot represents a partner university in FY 2023.

Expenditures

NREL reported a budget of $776 million in FY 2023, with most funding provided by the Department of Energy. NREL's nonlabor operating expenditures (e.g., maintenance, supplies, materials, equipment, computers, software, training, and subcontracted research) were provided by ZIP code, which allowed for spending analysis by state, by county in Colorado, and by congressional district in Colorado. Spending was recorded in every state nationally. Colorado, California, Virginia, Minnesota, and Texas recorded the greatest direct spending in terms of direct, nonlabor expenditures. Nearly all direct spending (98%) was domestic. NREL also funds universities to conduct research. These university partnerships accounted for $28.9 million in spending in FY 2023.

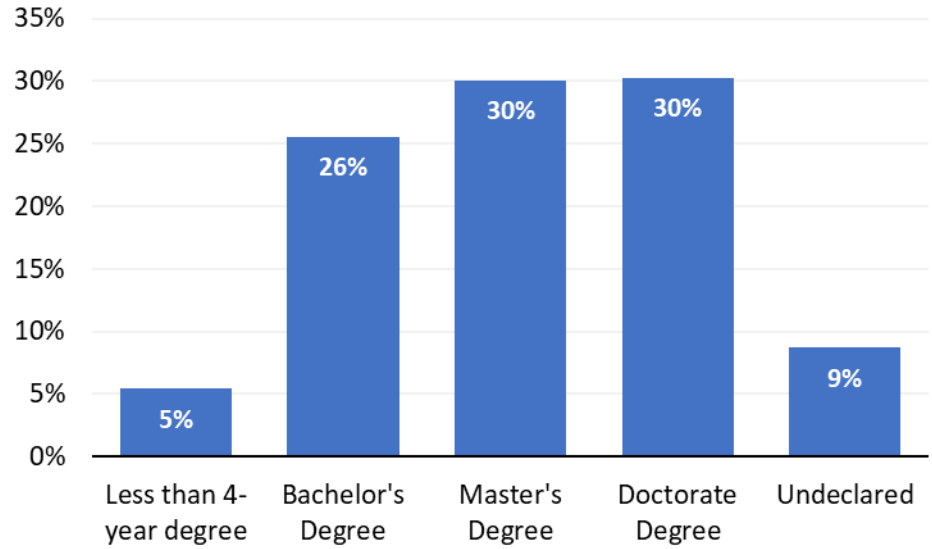
Employment

NREL's employment totaled 3,184 in FY 2023, including regular employees, limited term employees, postdoctoral researchers, and interns. Nearly 94% of workers (2,979) were full-time workers in FY 2023, earning an average salary of $120,200 per year. NREL recorded 205 part-time workers averaging $60,200 in salary in FY 2023. Benefits are assumed to add 26.3% to the employee costs. Additionally, NREL hires contract workers who are not estimated in the totals above but whose compensation was included in operating expenditures as a supplier to NREL.

NREL's offices are concentrated in Jefferson County in the cities of Golden, Lakewood, and Arvada. The largest employment footprint is in Colorado, recording 3,145 workers between the South Table Mountain campus and the Flatirons Campus, making NREL is one of the five largest employers in Jefferson County. The Alaska Campus in Fairbanks and the Washington, D.C., office account for a combined 1.2% of NREL's employment, or 39 employees (23 and 16, respectively). While the research facilities are concentrated in Jefferson County, employment is much more distributed across the state and the country, illustrating the impact of remote work. More than 91% of NREL's employees reported a Colorado home address, with a concentration of workers in Jefferson County (Figure 11). The Denver MSA accounted for 76% of national residences, and the metropolitan Front Range, from Larimer County to Pueblo, accounted for all but 0.7% of NREL's employees in Colorado. Nearly 14% of employees reside in 47 other states and the District of Columbia. The eight states recording the largest number of NREL employees as residents include Colorado, California, Texas, Virginia, New York, Florida, Alaska, and Washington, collectively representing 93% of the total.

Educational attainment represents the highest degree earned. The educational attainment of the NREL workforce exceeds that of Jefferson County, the laboratory's home county, and the state as a whole. Almost 86% of NREL's employees have a bachelor's degree or higher (26% have a bachelor's degree, 30% have a master's degree, and 30% have earned a doctoral degree) (Figure 11).[6]

FIGURE 11: NREL EMPLOYEE EDUCATIONAL ATTAINMENT

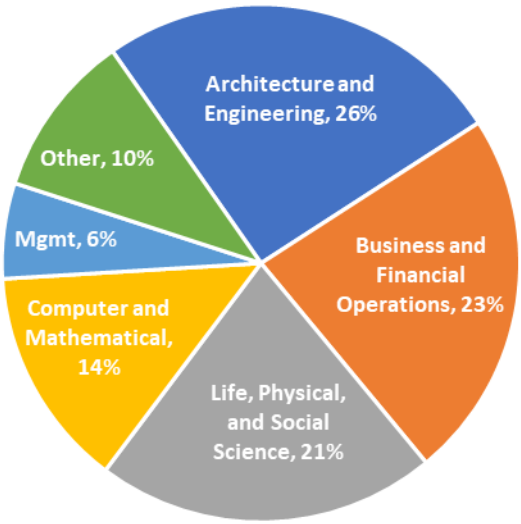


[6] Calculation includes the 9% of employees who have undeclared educational status.

Occupations

NREL's work is conducted by scientific researchers and support staff. More than 60% of employment is engaged in core research and development occupations (Architecture and Engineering, 26%; Life, Physical, and Social Science, 21%; Computer and Mathematical, 14%), while 39% is employed in business support operations (Business and Financial Operations, 23%; Management, 6%; and Other, 10%) (Figure 12). Core positions include engineers, scientists, postdoctoral researchers, IT professionals, and research analysts. Support positions include attorneys, human resources, budgeting, administration, and communications. In some instances, researchers are also in management roles, thus overstating business support operations and underestimating core research and development.

FIGURE 12: NREL OCCUPATIONS, FY 2023



ECONOMIC IMPACT

Total Impact

The economic impact of NREL operations on the nation totaled $1.9 billion in FY 2023 (Table 3). Total employment impacts summed to more than 8,200 jobs.[7] The impact on the state of Colorado totaled $1.3 billion with employment impacts of 5,700 direct and supported jobs (Table 4). The majority of the employment impacts are nested in the state due to the installations in Colorado. The impact of the facility on salaries and benefits totaled $654 million in Colorado, or $116,000 per worker, showing the positive spillover effects to other industries.

[7] Employment is presented as a headcount, not an FTE.

TABLE 3: NREL ECONOMIC CONTRIBUTION (DIRECT, INDIRECT, AND INDUCED), FY 2023

Total				
Impact	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
Direct	3,184	468	468	776
Indirect	2,618	239	351	625
Induced	2,418	145	280	454
Total	8,220	853	1,100	1,855

TABLE 4: NREL ECONOMIC CONTRIBUTION BY STATE (TOP 20), (DIRECT, INDIRECT, AND INDUCED), FY 2023

State Impacts				
State	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
Colorado	5,657	654	780	1,285
California	320	29	47	78
Virginia	278	21	34	60
Texas	156	11	18	34
Minnesota	136	10	16	29
New York	101	10	17	27
Illinois	116	10	15	26
Massachusetts	107	10	16	26
Washington, D.C.	71	9	12	22
Washington	78	7	12	20
North Carolina	100	7	11	20
Maryland	74	5	9	15
Pennsylvania	68	5	8	15
Florida	78	5	8	15
Missouri	62	4	7	13
New Jersey	55	5	7	13
Alaska	62	5	7	12
Ohio	56	4	6	12
Arizona	52	3	6	11
Connecticut	46	4	6	10
All Other	545	35	58	112
Total	8,220	853	1,100	1,855

Focusing on Jefferson County, the economic impact narrowed given worker commuting patterns and the limited supply chain that exists within a single county. The economic impact of NREL on Jefferson County totaled $889 million in FY 2023, which includes the total budget spend emanating from the NREL's two campus located within the county, as well as the local purchases (Table 5). The impact on labor totaled 3,859 jobs and $503 million in income (salary and benefits), including the workers on-site and the multiplicative impact associated with local spending.

TABLE 5: NREL ECONOMIC CONTRIBUTION BY COLORADO COUNTY (TOP 10), (DIRECT, INDIRECT, AND INDUCED), FY 2023

County Impacts				
County	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
Jefferson County	3,859	503	538	889
Denver County	822	88	131	204
Boulder County	239	18	29	51
Adams County	211	13	23	40
Arapahoe County	164	11	20	32
Douglas County	124	8	14	23
Broomfield County	50	4	7	11
Larimer County	56	3	5	10
Weld County	43	2	4	8
El Paso County	26	1	3	5
Rest of Colorado	61	3	6	11
Total	5,657	654	780	1,285

Congressional Districts

The majority of the economic impacts are nested in the Colorado's 7th Congressional District given the primary location of NREL activities—the district yields 70% of the economic impact and 69% of the employment impact (Table 6). All of the congressional districts in Colorado recorded economic benefits stemming from a remote labor force to purchases from companies residing in the other districts. The impact of the facility on salaries and benefits totaled $654 million in Colorado.

TABLE 6: NREL ECONOMIC CONTRIBUTION BY CONGRESSIONAL DISTRICT, (DIRECT, INDIRECT, AND INDUCED), FY 2023

District Impacts				
Congressional District	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
CO01	822	88	131	204
CO02	322	23	37	66
CO03	21	1	2	4
CO04	131	8	15	25
CO05	26	1	3	5
CO06	164	11	20	32
CO07	3,916	507	546	902
CO08	255	15	27	48
Total	5,657	654	780	1,285

CONCLUSION

NREL operations led to economic benefits exceeding $1.9 billion nationally in FY2023. The majority of economic benefits accrued to the state of Colorado, which is the home of the main NREL operating facility; however, economic benefits were recorded in every state nationally through direct and indirect spending. The economic contribution of NREL on the Colorado economy totaled $1.3 billion in FY 2023, and by district, the impacts ranged between $4 million and $900 million.

BIBLIOGRAPHY

IMPLAN Group, LLC. IMPLAN 2023. Huntersville, NC. IMPLAN.com.

IMPLAN, MRIO: Introduction to Multi-Regional Input-Output Analysis, https://support.implan.com/hc/en-us/articles/115009713448-MRIO-Introduction-to-Multi-Regional-Input-Output-Analysis. Retrieved July 27, 2024.

Colorado Independent Redistricting Commissions. All reports (.xlsx). https://redistricting.colorado.gov/content/congressional-final-approved (accessed April 20, 2022).

National Science Foundation. *Survey of Federal Funds for Research and Development: Fiscal Years 2021-22, Definitions,* https://ncses.nsf.gov/surveys/federal-funds-research-development/2021-2022#survey-description (accessed February 28, 2024).

National Science Foundation. *Federal obligations and outlays for research, experimental development, and R&D plant, by agency: FYs 2022–23, https://ncses.nsf.gov/surveys/federal-funds-research-development/2022-2023#data.* Retrieved July 28, 2024.

National Science Foundation. *Federal obligations for research and development, by type of R&D, and for R&D plant: FYs 1951–2023, https://ncses.nsf.gov/surveys/federal-funds-research-development/2022-2023#data.* Retrieved July 28, 2024.

U.S. Bureau of Economic Analysis. Gross Domestic Product (GDP) by State, Real GDP in Chained Dollars, www.bea.gov (accessed February 16, 2024).

U.S. Bureau of Economic Analysis. Percent Change from Preceding Period in Real Gross Domestic Product, www.bea.gov (accessed July 28, 2024).

U.S. Bureau of Labor Statistics. Current Employment Statistics, www.bls.gov (accessed February 15, 2024).

U.S. Bureau of Labor Statistics. Quarterly Census of Employment and Wages, www.bls.gov (accessed February 15, 2024).

U.S. Energy Information Administration, State Energy Data System (SEDS): 1960-2022, (Primary energy production in Btu – fossil fuels and nuclear, Primary energy production in Btu – renewable energy and total energy, All consumption estimates in BTU) https://www.eia.gov/state/seds/seds-data-complete.php?sid=US#Consumption, retrieved July 28, 2024.

APPENDIX 1: NREL'S ECONOMIC IMPACT BY STATE

TABLE 7: NREL'S ECONOMIC IMPACT BY STATE

State Impacts				
State	Employment	Labor Income ($Millions)	Value Added ($Millions)	Output ($Millions)
Alabama	14	1	1	3
Alaska	62	5	7	12
Arizona	52	3	6	11
Arkansas	5	0	0	1
California	320	29	47	78
Colorado	5,657	654	780	1,285
Connecticut	46	4	6	10
Delaware	8	1	1	2
District of Columbia	71	9	12	22
Florida	78	5	8	15
Georgia	35	2	4	7
Hawaii	12	1	1	2
Idaho	27	2	3	5
Illinois	116	10	15	26
Indiana	18	1	2	4
Iowa	4	0	0	1
Kansas	12	1	1	2
Kentucky	9	1	1	2
Louisiana	10	1	1	2
Maine	9	1	1	2
Maryland	74	5	9	15
Massachusetts	107	10	16	26
Michigan	43	3	5	9
Minnesota	136	10	16	29
Mississippi	8	0	1	1
Missouri	62	4	7	13
Montana	10	1	1	2
Nebraska	5	0	1	1
Nevada	19	1	2	4
New Hampshire	18	1	2	4
New Jersey	55	5	7	13
New Mexico	27	2	3	5
New York	101	10	17	27
North Carolina	100	7	11	20
North Dakota	4	0	0	1
Ohio	56	4	6	12
Oklahoma	19	1	2	4
Oregon	47	3	5	10
Pennsylvania	68	5	8	15
Rhode Island	2	0	0	0
South Carolina	24	1	2	5
South Dakota	3	0	0	1
Tennessee	39	3	4	8
Texas	156	11	18	34
Utah	50	3	5	10
Vermont	7	0	1	1
Virginia	278	21	34	60
Washington	78	7	12	20
West Virginia	7	0	1	1
Wisconsin	43	3	5	9
Wyoming	7	0	1	2

APPENDIX 2: NREL'S ECONOMIC IMPACT (OUTPUT) BY COLORADO COUNTY

TABLE 8: NREL'S ECONOMIC IMPACT (OUTPUT) BY COLORADO COUNTY

County Impacts			
County	**Output ($Thousands)**	**County**	**Output ($Thousands)**
Adams County	39,990	Kit Carson County	35
Alamosa County	7	La Plata County	333
Arapahoe County	32,435	Lake County	23
Archuleta County	2	Larimer County	10,218
Baca County	0	Las Animas County	4
Bent County	3	Lincoln County	23
Boulder County	50,894	Logan County	55
Broomfield County	11,437	Mesa County	1,729
Chaffee County	26	Mineral County	-
Cheyenne County	22	Moffat County	19
Clear Creek County	1,353	Montezuma County	22
Conejos County	3	Montrose County	129
Costilla County	2	Morgan County	293
Crowley County	4	Otero County	16
Custer County	4	Ouray County	30
Delta County	173	Park County	940
Denver County	203,816	Phillips County	29
Dolores County	0	Pitkin County	24
Douglas County	23,356	Prowers County	18
Eagle County	1,120	Pueblo County	485
El Paso County	4,642	Rio Blanco County	3
Elbert County	793	Rio Grande County	4
Fremont County	143	Routt County	580
Garfield County	164	Saguache County	108
Gilpin County	1,221	San Juan County	126
Grand County	128	San Miguel County	122
Gunnison County	152	Sedgwick County	10
Hinsdale County	-	Summit County	413
Huerfano County	12	Teller County	150
Jackson County	9	Washington County	30
Jefferson County	889,344	Weld County	8,013
Kiowa County	1	Yuma County	97

APPENDIX 3: NREL'S DIRECT EXPENDITURES BY COLORADO CONGRESSIONAL DISTRICT

TABLE 9: NREL'S DIRECT EXPENDITURES BY COLORADO CONGRESSIONAL DISTRICT

District Spending						
Congressional District	Residents	Total Wages ($M)	Average Wages	Est. Wages w/Benefits ($M)	Other Spending ($M)	Total Spending ($M)[a]
CO01	421	$46	$110,063	$59	$22	$69
CO02	246	$45	$182,777	$57	$17	$62
CO03	11	$1	$81,346	$1	$1	$2
CO04	127	$18	$144,615	$23	$2	$20
CO05	6	$2	$371,427	$3	$1	$3
CO06	227	$20	$86,656	$25	$2	$21
CO07	1,262	$172	$136,333	$217	$22	$194
CO08	131	$20	$149,897	$25	$2	$22
Total	2,431	$324	$133,340	$409	$69	$393

Note: Compensation includes salary and benefits. Table excludes total direct activity associated with the total budget, headcount, etc., at NREL offices. [a] Total spending of wages, benefits, and other spending may not equal the sum due to rounding.