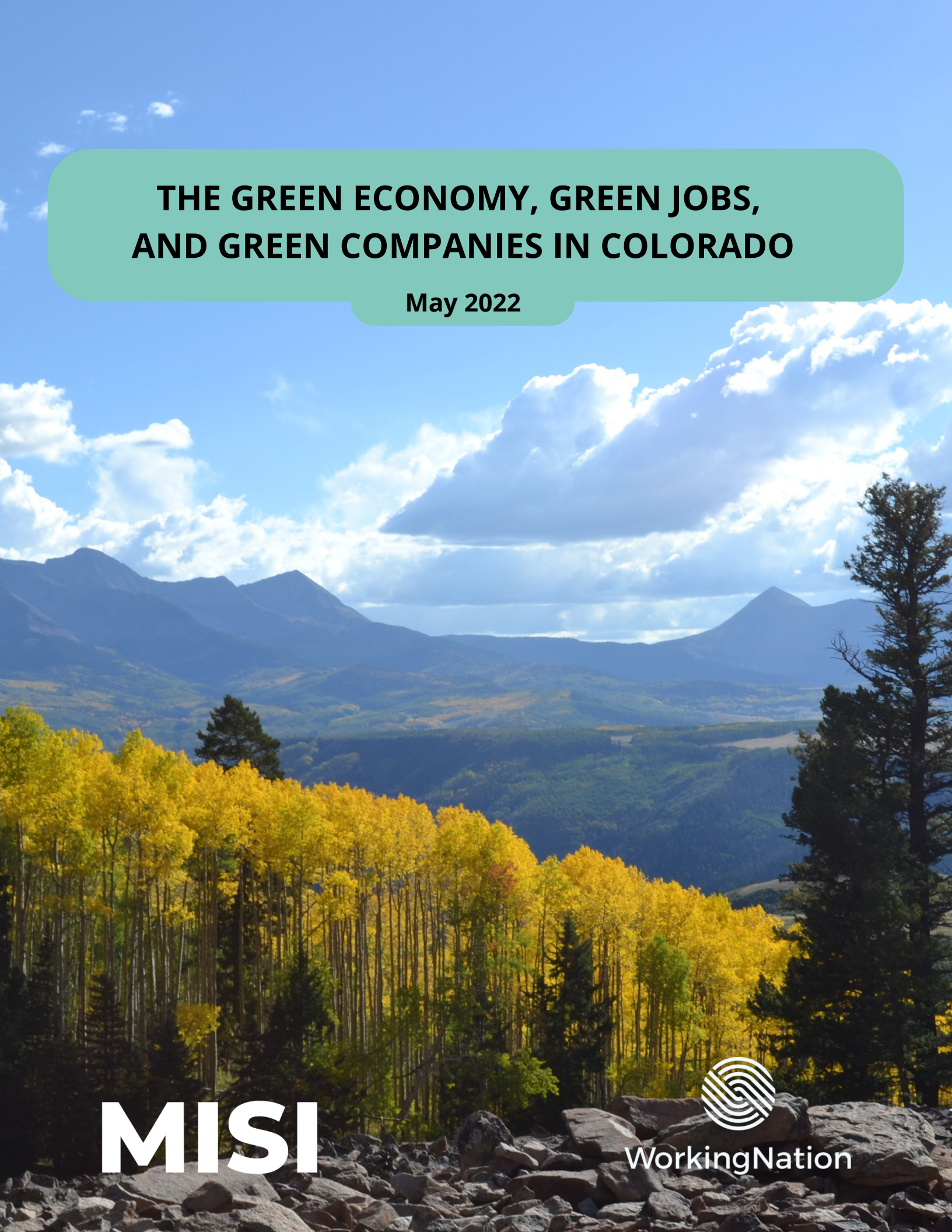
THE GREEN ECONOMY, GREEN JOBS, AND GREEN COMPANIES IN COLORADO

May 2022



MISI

WorkingNation

THE GREEN ECONOMY, GREEN JOBS, AND GREEN COMPANIES IN COLORADO

Prepared by Management Information Services, Inc.
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TABLE OF CONTENTS

BOTTOM LINE UP FRONT

In this report, MISI conducted statewide research for Colorado on green jobs and industries, with a further drill down on rehiring potential, identifying a sample of specific locales and employers. This research and the resultant database and IT capabilities also has relevance to other states and regions. This complements similar earlier research conducted for Pennsylvania. As in Pennsylvania, there is a growing skills gap and mismatch that is threatening to disrupt the labor market as it tries to recover from the impact of the Covid-19 pandemic, and also a growing mismatch between the skills that employers want and the skills that employees have and, as the economy struggles to fully reopen, that warning is more relevant than ever – especially for green industries and green jobs.

A major purpose of this report is to provide compelling empirical information that will facilitate WorkingNation (WN) initiatives to develop stories and narratives about the size, scope and impact of employment in the green industry and solutions to the jobs skills gap – especially as they relate to the emerging and rapidly growing green industries in Colorado (and how these compare to green jobs in Pennsylvania and eventually other states.)

The number of future green jobs in a state is determined by the increasing portion of total jobs in the state comprised of green jobs and the rate of growth of employment in the state, and these changes will alter the future distribution of U.S. green jobs among the states; the distribution of green jobs among industry sectors in the two states differs and will likely differ in other states; and there are substantial differences in the occupational distribution of green jobs in Colorado and Pennsylvania – and such difference are likely in other states.

An overview of data points and other findings and suggestions is presented below.

General Observations:

As in Pennsylvania, many companies, in Colorado and elsewhere whether they realize it or not, owe their profits – and in some cases their existence – to “green” expenditures. Many workers, in Colorado and elsewhere whether they realize it or not, would be unemployed were it not for these expenditures. Green jobs are not self-evident and exist in sectors not generally appreciated as green, such as construction for energy efficiency.

In many occupations not traditionally identified as green, a greater than proportionate share of the jobs is generated by the green economy. These findings are significant for they indicate that state investments in green initiatives will create jobs in greater than proportionate shares in two categories Colorado is eager to attract – college-educated professional workers, many with advanced degrees, and highly skilled, technical workers, with advanced training and technical expertise. Green industries thus generate jobs that are disproportionately for highly-skilled, well-paid, technical and professional

workers, who in turn underpin and provide a middle-class foundation for entrepreneurship and economic growth.

There exists relatively little rigorous and comprehensive research addressing the practical relationship between green industries and existing jobs or future job creation. Even some research in this area sponsored by environmental organizations is off the mark, in that it has tended to emphasize jobs creation in classically green activities, such as environmental lawyers, solar engineers, or workers in recycling plants. However, while these jobs count as green jobs, the classic green job constitutes only a small portion of the jobs created by the green economy. Rather, the vast majority of the jobs created are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. Green firms employ a wide range of workers at all educational and skills levels and at widely differing earnings levels, and in green companies most of the employees are not classified as “environmental specialists” or “green energy specialists.”

Colorado Specific Findings:

1) The concentration of green jobs in Colorado within certain economic sectors is significant. Green investments will provide a greater than proportionate assist to Colorado’s high-tech and manufacturing sectors, and green investments generate, proportionately, more than jobs in professional, scientific, and technical services than the state average and more than twice as many jobs in manufacturing as the state average. Similar findings were derived for Pennsylvania.

2) MISI forecasts that in 2030 Colorado green jobs will total 14.3% of all jobs in the state, and this implies that by 2030 green jobs in Colorado will increase as a total of all jobs in the state by about 70%. Between 2029 and 2030 green jobs in Colorado will increase about 6% – a total of about 29,000 jobs. The state of Colorado forecasts that total employment in the state over that period will increase by 40,000 jobs. Thus, green job growth in the state that year will equal over two-thirds of the total job growth in Colorado. With appropriate federal and state government policies in place, the number of green jobs in Colorado could increase even more substantially.

3) Clean energy jobs in Colorado will likely return to their pre-Covid level by the end of 2021. However, MISI estimates that the current number of green jobs in Colorado totals approximately 266,300, and is growing at a compound annual growth rate of 6%, which represents a total annual increase in green jobs in the state of about 16,000 – more than twice the cumulative loss in clean energy and energy efficiency (EE) jobs in the state. This indicates that total green job growth in the state could replace all of the estimated the clean energy and EE jobs lost in Colorado during 2020 by the third quarter of 2021.

4) Most of the green companies MISI surveyed were adversely affected by Covid during 2020. However, they were affected relatively less than many other types of companies in the state and by June 2021 they were recovering better than the state economy as a

whole – in part, due to the Payroll Protection Plan, which allowed them to avoid layoffs and retain staff.

5) Green jobs are increasing rapidly in Colorado and offer important opportunities for encouraging green industries in the state. However, they will continue for the foreseeable future to comprise only a small portion of total jobs in the state. Any ambitious employment and job creation programs must take such discrepancies into account.

6) Annual new job openings with high “green visibility” such as wind turbine technicians and solar photovoltaic installers will total only about 15 to 20 a year and so emphasis on these types of jobs could result in misguided and self-defeating jobs and jobs training programs. This report demonstrates that that many occupations contain many more workers, are growing rapidly, will continue to employ many more workers and, crucially, will provide many more annual job openings than will most green jobs in the state.

7) There is synergy between green companies/green jobs and other rapidly-growing sectors in Colorado. For example, many of the green companies profiled here are active in and obtain substantial revenues from the health care industry. These include, especially, American Energy Assets and Crusoe Energy. Since the health care industry is one of the largest and most rapidly-growing industries in the state, this implies that associated green jobs will also be growing substantially and rapidly. This provides the basis for an interesting narrative. This will also tend to increase the forecasts of future green jobs in the state.

8) Median hourly wages for clean energy jobs are about 25% higher than the national median wage. However, green jobs paying better than burger flippers or baristas is a low bar. Many green jobs pay substantially less than the jobs they are displacing, energy workers earn more than the typical U.S. worker, and the highest-paying positions are skewed heavily toward nuclear, utility, oil, natural gas, and coal industry workers. Wind, solar, and “green“ jobs pay well below them.

9) The Colorado AFL-CIO and eight other Colorado unions developed a plan for a transformative green jobs program for Colorado, and the centerpiece of the program is clean energy investments undertaken in combination by the public and private sectors with two fundamental goals: promoting global climate stabilization by reducing CO_2 emissions and expanding green job opportunities. This is significant, given the potential conflict between unions and green jobs programs, and can serve as the basis of a comprehensive green jobs program for Colorado that has union support and buy-in.

10) Green jobs will be created across a new continuum of employment, skills, responsibilities, and earnings. Training for new skills will be needed across a wide spectrum of industries. Some changes in skills are relatively well defined, but many likely changes remain difficult to forecast since the technologies are still evolving. Many job tasks currently remain unknown, and thus identification of training needs requires

interactive research combined with job definition. Many of these jobs do not currently exist and do not have occupational titles defined in federal or Colorado state government occupational handbooks and employment guides. Further, many of these new jobs require different skills and education than current jobs, and training needs must be determined to enable this rapidly growing green sector to have a sufficient supply of trained and qualified employees.

Implications for policy and public understanding:

Colorado is seeking to modernize and expand its manufacturing and its high-tech industrial and professional, scientific, and technical services industries, and the green economy can aid in this objective. The information presented here can educate state policymakers and assist them in devising appropriate post-Covid green jobs and skills training programs. It should be noted that many of the jobs in these sectors are the high-skilled, high-wage, technical, and professional jobs that Colorado and Pennsylvania (and other states) seek to attract and retain.

Green jobs in the state are being seriously under-estimated, and the potential implications of this for state jobs and training programs are serious. Further green jobs in the state are more resilient and have recovered more rapidly than most other jobs or total employment, and the potential implications of this for state jobs and training programs are important.

Over the next decade the number of annual new green jobs in Colorado will be increasing at a rate that is much greater than the rate of growth in total Colorado employment. The annual increase in Colorado green jobs post-Covid could be a substantial portion of jobs forecast by the state to be created annually over the next several years. This has profound implications for state economic, jobs, and education and training programs.

It is possible to develop meaningful green industry narratives for Colorado illustrating the potential of green jobs and green jobs initiatives and highlighting trends and individual companies. These narratives can be informative for corporations, thought leaders, NGOs, foundations, and local governments that seek to integrate environmental efforts with socio-economic progress, including and especially jobs creation and employment.

I. GREEN INDUSTRIES AND GREEN JOBS IN COLORADO

I.A. The Colorado Economy in 2019

The Colorado economy performed well in 2019, growing at real rate of 3.7%, compared to the national growth rate of 2.3% rate, and estimated state personal income grew 6.1 percent in 2019, compared to national rate of 6.1 percent.[1] Total Colorado gross domestic product (GDP) reached $393 billion and per capita income increased in 2019 to $68,242, as compared to U.S. per capita GDP of $65,240.[2] It ranks 16th in state per capita GDP and is 4.6% above the U.S, average.[3] Colorado State GDP accounts for 1.8% of the 2019 U.S. total of $21.43 trillion. If Colorado was an independent nation, in terms of GDP it would rank 46rd: Just above Israel, Ireland, and Malaysia.[4]

Colorado's 2019 population totaled 5.8 million, 1.8% of the U.S. total and was the nation's 22nd most populous. The state's population increased an estimated 14.5 percent since the 2010 decennial census, a rate more than twice that the nation's 6.3-percent growth rate over the same period.[5]

Table I-1 shows the earnings by industry of employment in Colorado and how these compare to the U.S. averages:

- Column 1 shows Colorado State earnings by industry.
- Column 2 shows Colorado State earnings by industry as a percent of the U.S. total for that industry.
- Column 3 shows Colorado State earnings by industry as a percent of the state total.
- Column 4 shows U.S. earnings by industry as a percent of the U.S. total.
- Column 5 gives the derived Colorado State Index: The weight of the state industry payroll vis-à-vis the national weight. 100 is the same proportion as the U.S. Thus, for example: 25 means that state industry lags the national importance; 150 means it is of 50% greater importance to the state than in the U.S. average; and so forth.[6]

[1]https://www.colorado.edu/business/sites/default/files/attached-files/cbr_2019_midyear_issue.pdf#:~:text=Real%20GDP%20grew%202.1%25%20in,nation's%20GDP%20growth%20of%202.9%25
[2]Ibid.
[3]https://balancingeverything.com/gdp-by-state/#:~:text=Colorado%20has%20the%2016th%20largest,it%20as%20a%20developed%20economy.
[4]https://fee.org/articles/us-state-gdps-compared-to-entire-countries/.
[5]https://www.census.gov/quickfacts/CO.
[6]Note that the Index is the product of column 3 and column 4.

Table I-1

Earnings by Industry of Employment in Colorado and the U.S. in 2019

	State (millions)	State Share of U.S.	State Share of Earnings	U.S. Share of Earnings	State Index
Personal income (adjusted for residence)	$356,411	1.9%	-	-	-
Farm	$1,403	1.6%	0.5%	0.7%	82
Forestry, fishing, and related activities	379	1.0%	0.1%	0.3%	51
Forestry and logging	17	0.2%	0.0%	0.1%	12
Fishing, hunting and trapping	3	0.1%	0.0%	0.0%	6
Support activities for agriculture and forestry	359	1.3%	0.1%	0.2%	65
Mining, quarrying, and oil and gas extraction	13,180	7.6%	5.1%	1.3%	389
Oil and gas extraction	10,934	10.1%	4.2%	0.8%	521
Mining (except oil and gas)	460	2.0%	0.2%	0.2%	101
Support activities for mining	1,785	4.1%	0.7%	0.3%	213
Utilities	1,396	1.2%	0.5%	0.9%	63
Construction	20,065	2.5%	7.8%	6.1%	127
Construction of buildings	5,499	2.5%	2.1%	1.6%	130
Heavy and civil engineering construction	2,563	2.3%	1.0%	0.8%	121
Specialty trade contractors	12,003	2.5%	4.7%	3.7%	127
Manufacturing	14,656	1.2%	5.7%	9.1%	63
Durable goods manufacturing	9,878	1.3%	3.8%	5.9%	66
Wood product manufacturing	222	0.8%	0.1%	0.2%	42
Nonmetallic mineral product manufacturing	731	2.2%	0.3%	0.3%	112
Primary metal manufacturing	205	0.6%	0.1%	0.3%	30
Fabricated metal product manufacturing	1,166	1.0%	0.5%	0.8%	53
Machinery manufacturing	1,178	1.1%	0.5%	0.8%	58
Computer and electronic product manufacturing	3,244	2.0%	1.3%	1.2%	103
Electrical equipment, appliance, and components	208	0.5%	0.1%	0.3%	27
Motor vehicles, bodies and trailers, and parts	(D)	-	-	0.6%	-
Other transportation equipment manufacturing	(D)	-	-	0.7%	-
Furniture and related product manufacturing	398	1.7%	0.2%	0.2%	85
Miscellaneous manufacturing	935	1.5%	0.4%	0.5%	76
Nondurable goods manufacturing	4,777	1.1%	1.9%	3.2%	58
Food manufacturing	1,581	1.5%	0.6%	0.8%	75
Beverage and tobacco product manufacturing	648	3.1%	0.3%	0.2%	158
Textile mills	2	0.0%	0.0%	0.0%	1
Textile product mills	78	1.2%	0.0%	0.0%	64
Apparel manufacturing	28	0.4%	0.0%	0.1%	21
Leather and allied product manufacturing	7	0.4%	0.0%	0.0%	21
Paper manufacturing	174	0.5%	0.1%	0.3%	26
Printing and related support activities	324	1.2%	0.1%	0.2%	59
Petroleum and coal products manufacturing	191	0.6%	0.1%	0.2%	33
Chemical manufacturing	1,252	1.0%	0.5%	1.0%	49
Plastics and rubber products manufacturing	492	0.9%	0.2%	0.4%	48

Table I-1 (continued)
Earnings by Industry of Employment in Colorado and the U.S. in 2019

	State (millions)	State Share of U.S.	State Share of Earnings	U.S. Share of Earnings	State Index
Wholesale trade	$12,320	2.0%	4.8%	4.6%	104
Retail trade	12,926	1.7%	5.0%	5.6%	90
Motor vehicle and parts dealers	2,686	1.9%	1.0%	1.1%	97
Furniture and home furnishings stores	486	1.9%	0.2%	0.2%	98
Electronics and appliance stores	479	1.6%	0.2%	0.2%	81
Building material and garden equipment and dealers	1,112	1.8%	0.4%	0.5%	93
Food and beverage stores	2,107	1.8%	0.8%	0.9%	93
Health and personal care stores	801	1.4%	0.3%	0.4%	72
Gasoline stations	563	1.4%	0.2%	0.3%	70
Clothing and clothing accessories stores	623	1.4%	0.2%	0.3%	71
Sporting goods, hobby, musical instrument, books	556	2.9%	0.2%	0.1%	151
General merchandise stores	1,782	1.8%	0.7%	0.7%	93
Miscellaneous store retailers	1,028	2.4%	0.4%	0.3%	126
Nonstore retailers	703	1.1%	0.3%	0.5%	58
Transportation and warehousing	10,483	2.0%	4.1%	4.0%	101
Air transportation	2,317	3.4%	0.9%	0.5%	175
Rail transportation	340	1.5%	0.1%	0.2%	75
Water transportation	1	0.0%	0.0%	0.1%	0
Truck transportation	2,324	1.4%	0.9%	1.2%	74
Transit and ground passenger transportation	538	1.1%	0.2%	0.4%	56
Pipeline transportation	2,692	6.2%	1.0%	0.3%	318
Scenic and sightseeing transportation	34	1.6%	0.0%	0.0%	82
Support activities for transportation	746	1.1%	0.3%	0.5%	56
Couriers and messengers	758	1.6%	0.3%	0.3%	84
Warehousing and storage	735	1.1%	0.3%	0.5%	58
Information	9,259	1.9%	3.6%	3.6%	99
Publishing industries (except Internet)	3,311	2.7%	1.3%	0.9%	136
Motion picture and sound recording industries	328	0.8%	0.1%	0.3%	39
Broadcasting (except Internet)	656	0.7%	0.3%	0.7%	37
Telecommunications	2,507	2.9%	1.0%	0.7%	147
Data processing, hosting, and related services	2,036	3.6%	0.8%	0.4%	187
Other information services	422	0.5%	0.2%	0.6%	28
Finance and insurance	15,157	1.7%	5.9%	6.9%	86
Monetary Authorities-central bank	(D)	-	-	0.0%	-
Credit intermediation and related activities	5,264	1.7%	2.0%	2.3%	89
Securities, commodities and other financials	4,452	1.6%	1.7%	2.1%	82
Insurance carriers and related activities	5,305	1.7%	2.1%	2.4%	88
Funds, trusts, and other financial vehicles	(D)	-	-	0.1%	-

Table I-1 (continued)
Earnings by Industry of Employment in Colorado and the U.S. in 2019

	State (millions)	State Share of U.S.	State Share of Earnings	U.S. Share of Earnings	State Index
Real estate and rental and leasing	$6,985	2.1%	2.7%	2.5%	106
Real estate	6,000	2.3%	2.3%	2.0%	118
Rental and leasing services	903	1.3%	0.4%	0.5%	65
Lessors of nonfinancial intangibles (except copyright)	82	2.6%	0.0%	0.0%	135
Professional, scientific, and technical services	33,736	2.4%	13.1%	10.6%	124
Management of companies and enterprises	7,459	2.1%	2.9%	2.7%	106
Administrative, support and waste/remediation services	10,469	1.9%	4.1%	4.2%	96
Administrative and support services	9,722	1.9%	3.8%	4.0%	95
Waste management and remediation services	746	2.1%	0.3%	0.3%	107
Educational services	2,940	1.3%	1.1%	1.7%	68
Health care and social assistance	22,460	1.5%	8.7%	11.0%	79
Ambulatory health care services	12,837	1.8%	5.0%	5.4%	93
Hospitals	5,141	1.2%	2.0%	3.4%	59
Nursing and residential care facilities	2,044	1.4%	0.8%	1.1%	70
Social assistance	2,438	1.6%	0.9%	1.1%	84
Arts, entertainment, and recreation	4,149	2.4%	1.6%	1.3%	124
Performing arts, spectator sports, and related	2,075	2.1%	0.8%	0.7%	108
Museums, historical sites, and similar institutions	158	2.0%	0.1%	0.1%	102
Amusement, gambling, and recreation industries	1,915	3.0%	0.7%	0.5%	152
Accommodation and food services	9,530	2.1%	3.7%	3.5%	106
Accommodation	2,232	2.1%	0.9%	0.8%	110
Food services and drinking places	7,298	2.0%	2.8%	2.7%	105
Other services (ex. government and govt. enterprises)	9,173	1.9%	3.6%	3.6%	99
Repair and maintenance	2,578	1.9%	1.0%	1.0%	99
Personal and laundry services	2,663	1.9%	1.0%	1.1%	97
Religious, grantmaking, civic, professional organizations	3,557	2.0%	1.4%	1.3%	103
Private households	376	1.6%	0.1%	0.2%	83
Government and government enterprises	39,247	1.9%	15.2%	15.7%	97
Federal civilian	6,697	1.9%	2.6%	2.7%	96
Military	4,332	3.0%	1.7%	1.1%	152
State and local	28,218	1.8%	11.0%	11.9%	92
State government	9,635	2.2%	3.7%	3.4%	111
Local government	18,583	1.6%	7.2%	8.5%	84

Notes: - (D) Not shown to avoid disclosure of confidential information; estimates are included in higher-level totals
- All data are based in constant 2020 dollars.

Source: *Personal Income*, U.S. Bureau of Economic Analysis; and Management Information Services, Inc., 2021

This table shows that Colorado ranks relatively low with respect to sectors such as agriculture, utilities, primary metal manufacturing, chemical manufacturing, motion pictures, data processing, and nursing and residential care facilities. However, this

table illustrates that the state ranks high with respect to several sectors: Specifically, with 1.8 percent of the nation's population:

- Employment earnings in the Colorado oil and gas extraction sector account for 10.1 percent of total earnings nationally in that sector.
- Employment earnings in the Colorado beverage and tobacco manufacturing sector account for 3.1 percent of total earnings nationally in that sector.
- Employment earnings in the Colorado air transportation trade sector account for 3.4 percent of total earnings nationally in that sector.
- Employment earnings in the Colorado pipeline transportation sector account for 6.2 percent of total earnings nationally in that sector.
- Employment earnings in the Colorado data processing sector account for 3.6 percent of total earnings nationally in that sector.
- Employment earnings in the Colorado amusement and recreation sector account for three percent of total earnings nationally in that sector.

I.B. Summary of the Green Industry and Jobs in Colorado

MISI estimates that in 2019:

- Sales generated by green industries in Colorado totaled $29.4 billion.
- The number of green jobs totaled over 266,000.
- The green industry in Colorado comprised 7.5% percent of gross state product.
- Colorado green industries accounted for 4.5% of the sales of the U.S. environmental industry.
- Green jobs comprised 8.9 percent of Colorado employment.
- Green jobs in Colorado comprised 3.3 percent of the total number of green jobs in the U.S.

MISI forecasts that, post COVID-19, green jobs will increase four to five times more rapidly than total employment in the state.

Table I-2 shows the industrial distribution of green jobs in Colorado in 2019.

Comparison of the industrial sector distribution of green jobs in Colorado with that of total employment in the state is instructive – Figure I-1. A significant portion of the green jobs is in the public administration sector which, given the public nature of green programs, is to be expected. However, most of the green jobs in Colorado are in the private sector, and focusing on these reveals that they are heavily concentrated in several sectors. Of particular note is that the private sector green industry in Colorado is more manufacturing intensive than other private sector activity in the state:

- Over 10 percent of private sector jobs in the green industry are in manufacturing, compared to less than five percent in manufacturing among all private sector industrial activities in Colorado.

- Over 17 percent of private sector green jobs are in professional, scientific, and technical services, compared to 14.7 percent of all private sector jobs in the state.
- Nearly 12 percent of private sector green jobs are in administrative, support, and waste management services, compared to less than four percent of all private sector jobs in the state.
- Over 11 percent of private sector green jobs are in construction, compared to less than six percent of all private sector jobs in the state.

Table I-2
Green Jobs in Colorado in 2019, by Industry

Industry	2017 NAICS Code	Green Jobs
Agriculture, Forestry, Fishing and Hunting	11	2,004
Mining	21	5,122
Utilities	22	6,607
Construction	23	29,860
Manufacturing	31-33	26,772
Wholesale Trade	42	7227
Retail Trade	44-45	9,148
Transportation and Warehousing	48-49	4,166
Information	51	1,557
Finance and Insurance	52	1,895
Real Estate and Rental and Leasing	53	2,532
Professional, Scientific, and Technical Services	54	46,372
Management of Companies and Enterprises	55	2,189
Administrative/Support/ Waste Management/ Remediation Services	56	31,754
Educational Services	61	2,133
Health Care and Social Assistance	62	624
Arts, Entertainment, and Recreation	71	2,507
Accommodation and Food Services	72	3,122
Other Services	81	39,174
Public Administration	92	41,555
State Total		266,321

Source: U.S. Bureau of Labor Statistics, Colorado Department of Employment and Labor, and Management Information Services, Inc.

Conversely, there are relatively few green jobs in other parts of the Colorado economy (Figure I-1):

- Less than four percent of green jobs are in the retail trade sector, compared to over five percent in retail trade among all jobs in the state.
- Less than one percent of green jobs are in the finance and insurance sector, compared to nearly six percent among all private sector jobs in the state.
- Less than one percent of green jobs are in the health care and social service sector, compared to over nine percent among all jobs in the state.
- Less than two percent of green jobs are in the transportation and warehousing sector, compared to over four percent among all jobs in the state.

Figure I-1
Comparison of the Industrial Distribution of Jobs in Colorado

Source: U.S. Bureau of Labor Statistics, Colorado Department of Employment and Labor, and Management Information Services, Inc.

Assessing the portion of total state employment in each industrial sector accounted for by green jobs indicates that the 266,300 green jobs accounted for nearly nine percent of the total 3.08 million jobs in Colorado in 2019. However, this distribution is uneven among industry sectors:

- Over 40 percent of employment in the utilities sector consists of green jobs, primarily water, waste treatment, sanitation, and related facilities.
- Nearly 10 percent of public administration employment (federal, state, and local) in the state consists of green jobs.
- Over 17 percent of Colorado jobs in the professional, scientific, and technical services are green jobs.
- Over 10 percent of the state's manufacturing employment is green-related
- Only very small portions of total state employment in sectors such as food services, entertainment, real estate, transportation, and retail trade are comprised of green jobs.

The concentration of green jobs within certain industrial sectors is instructive and interesting. While accounting for nearly five percent of total state employment, the industrial sector composition of green employment is highly skewed in favor of certain sectors. For example, more than 10 percent of private sector green jobs are in manufacturing, compared to less than five percent of all employment, and more than 17 percent of green jobs are in professional, scientific, and technical services, compared to less than 15 percent of all private sector jobs in the state.

This indicates that green investments will provide a greater than proportionate assist to Colorado's high-tech and manufacturing sectors. Colorado is seeking to modernize and expand its high-tech industrial and manufacturing base. Table I-2 and Figure I-1 indicate that the green industry can aid in this objective.

Similarly, green investments generate disproportionately more jobs in professional, scientific, and technical services as the state average. Jobs in this sector are the high-skilled, high-wage, technical and professional jobs that Colorado – and other states – seeks to attract and retain. Table I-2 and Figure I-1 indicate that investments in green protection can be of considerable assistance here.

I.C. Green Jobs in Colorado by Occupation and Skill

Green jobs in Colorado can be disaggregated by specific occupations and skills, and this information for 2019 for selected occupations is given in Table I-3. This table illustrates that green jobs in Colorado are widely distributed among all occupations and skill levels and, while the number of jobs created in different occupations differs substantially, employment in virtually all occupations is generated by green industries.

Table I-3
Green Jobs Generated in Colorado in 2019, by Selected Occupations

Occupation	Jobs
Accountants and Auditors	2,881
Biochemists and Biophysicists	279
Biological Technicians	421
Bookkeeping, Accounting, and Auditing Clerks	2,930
Budget Analysts	158
Chemists	321
Computer Programmers	551
Computer Systems Analysts	1,170
Cost Estimators	641
Electrical and Electronic Engineering Technicians	268
Database Administrators	443
Electricians	1,662
Environmental Engineering Technicians	244
Environmental Engineers	872
Environmental Scientists and Specialists, Including Health	1,218
Executive Secretaries and Administrative Assistants	997
Financial Managers	972
Geoscientists, Except Hydrologists and Geographers	318
Hazardous Materials Removal Workers	649
Health and Safety Engineers	142
Human Resources Specialists	1,450
Industrial Machinery Mechanics	575
Inspectors, Testers, Sorters, Samplers, and Weighers	640
Janitors and Cleaners, Except Maids and Housekeeping Cleaners	2,989
Landscape Architects	388
Machinists	591
Management Analysts	1,222
Mechanical Engineers	872
Office Clerks	3,480
Plumber, Pipefitters, and Steamfitters	1,011
Refuse and Recyclable Material Collectors	1,909
Security Guards	1,287
Septic Tank Services and Sewer Pipe Cleaners	403
Solar Photovoltaic Installers	160
Truck Drivers, Heavy and Tractor Trailer	2,101
Water and Liquid Waste Treatment Operators	1,741
Welders, Cutters, Solders, and Brazers	104
Wind Turbine Technicians	260

Source: Management Information Services, Inc.

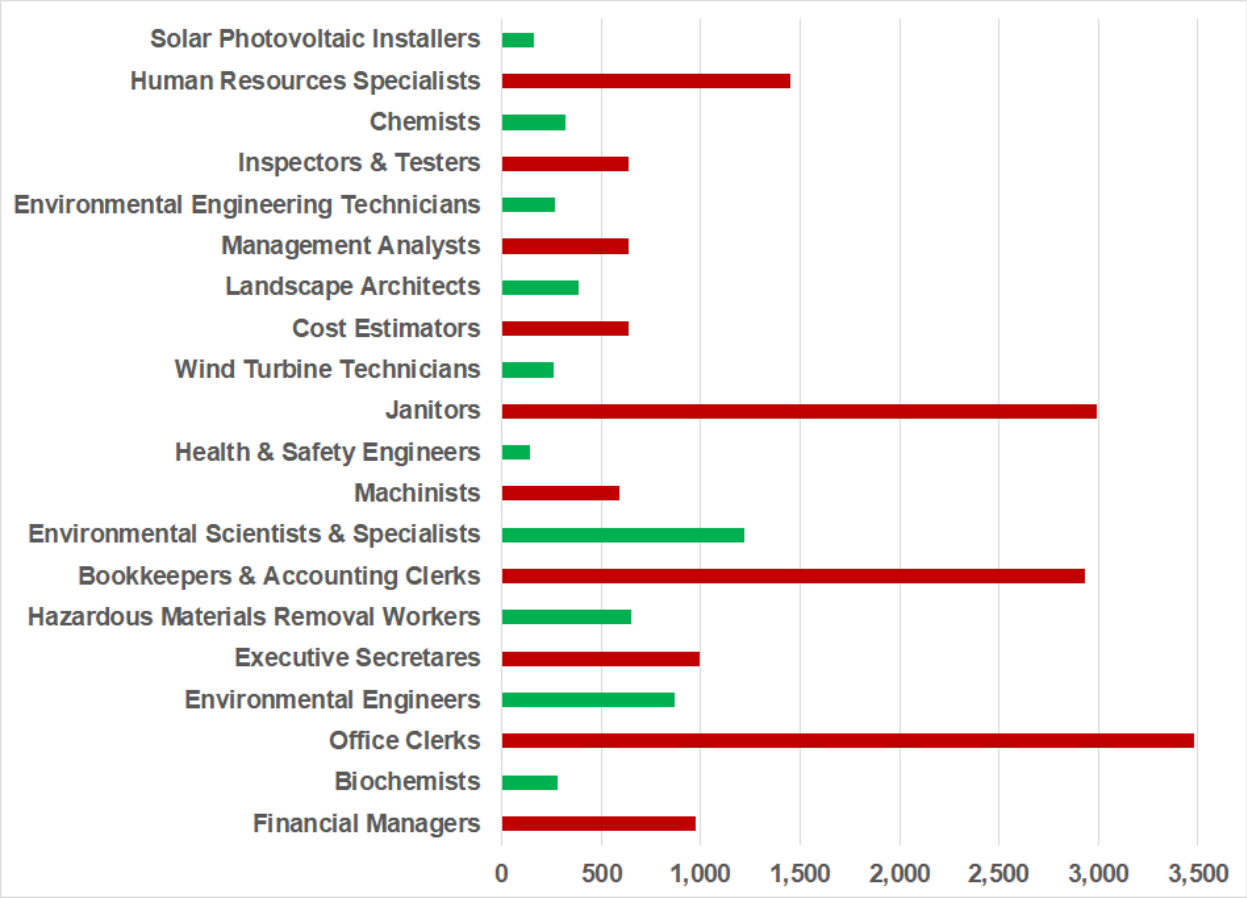
The vast majority of the green jobs created are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. and most of the persons employed in these jobs may not even realize that they owe their livelihood to the green economy. This is borne out in Table I-3 and Figure I-2, which list the jobs created by environmental protection in Colorado in 2019 within selected occupations. These show that in 2019 green industries in Colorado generated:

- More jobs for financial manager (972) than for biochemists (279)
- More jobs for office clerks (3,480) than for environmental engineers (872)
- More jobs for executive secretaries and administrative assistants (997) than for hazardous materials removal workers (649)
- More jobs for bookkeeping and accounting clerks (2,930) than for environmental scientists and specialists (1,218)
- More jobs for machinists (591) than for health and safety engineers (142)
- More jobs for janitors (2,989) than for wind turbine technicians (260)
- More jobs for cost estimators (641) than for landscape architects (388)
- More jobs for management analysts (641) than for environmental engineering technicians (268)
- More jobs for inspectors and testers (640) than for chemists (321)
- More jobs for human resources specialists (1,450) than for solar photovoltaic installers (160)

Thus, many workers in Colorado are dependent on the green economy for their employment, although they often would have no way of recognizing that connection unless it is brought to their attention.

The importance of green industries for jobs in some occupations is much greater than in others. For some occupations, such as environmental scientists and specialists, environmental engineers, hazardous materials workers, water and liquid waste treatment plant operators, environmental science protection technicians, wind turbine technicians, refuse and recyclable material collectors, and environmental engineering technicians, much of the demand in Colorado is created by green activities. This is hardly surprising, for most of these jobs are clearly identifiable as “green” jobs.

Figure I-2
Green Jobs Generated in Colorado in 2019, by Selected Occupations



Source: Management Information Services, Inc.

However, in many occupations not traditionally identified as green, a greater than proportionate share of the jobs are also generated by the green economy. Recalling that, on average, environment-related employment in Colorado comprises only about nine percent of total employment, in 2019 green expenditures generated jobs for a greater than proportionate share of many professional occupations in the state, including:

- Computer software applications engineers
- Electrical and electronics engineers
- Computer programmers
- Landscape architects
- Operations research analysts
- Biochemists and biophysicists
- Computer systems software engineers
- Network systems and data communications analysts
- Medical scientists (except epidemiologists)
- Chemical engineers

- Management analysts
- Civil engineers
- Chemical technicians
- Architecture and civil drafters
- Electrical and electronics engineering technicians
- Chemical plant and system operators
- Chemical technicians
- Mechanical engineering technicians
- Technical writers
- Electrical and electronics drafters
- Electrical and electronics repairers (powerhouse, substation and relay)
- Chemical plant and system operators
- Surveying and mapping technicians
- Operating engineers

The above findings are significant for they indicate that state investments in green initiatives and environmental protection will create jobs in greater than proportionate shares in two categories Colorado -- and other states -- are eager to attract:

- College-educated professional workers, many with advanced degrees
- Highly skilled, technical workers, with advanced training and technical expertise, many of them in the manufacturing sector.

Green industries thus generate jobs that are disproportionately for highly skilled, well paid, technical and professional workers, who in turn underpin and provide foundation for entrepreneurship and economic growth.

II. SUMMARY PROFILES OF SELECTED COLORADO GREEN COMPANIES

MISI conducted a survey of a representative sample existing green companies in Colorado, examining a functional, technological and geographic mix of companies. Our research revealed many firms, and they:

- Are located throughout the state, in major urban centers, suburbs, small towns, and rural areas.
- Range in size from small firms of 20 employees or less to large firms employing hundreds.
- Are engaged in a wide variety of activities, including remediation, construction, manufacturing, testing, monitoring, analysis, etc.
- Include some of the most sophisticated, high-tech firms in the state.

Summary descriptions of a representative sample of these firms are given in Table II-1 and are discussed below. The information presented is current as of April 2021.

Table II-1
Summary of the Select Colorado Green Companies Profiled

Company	Location	Products/Services	Jobs
American Energy Assets	Denver	American Energy Assets provides energy efficiency, conservation, and environmental programs for health care, education, and commercial facilities designed to control energy usage, reduce environment impacts, and save money.	15
AMP Robotics	Lousiville	AMP's pioneering AI platform, AMP Neuron™, applies deep learning to continuously improve the precise identification and categorization of paper, plastics, and metals by color, size, shape, opacity, form factor, brand, and more, contextualizing and storing data about each item it perceives to accurately recover recyclables, removing contamination and ultimately creating high-value raw material for resale into the global supply chain.	104
Ayuda Companies	Denver	Ayuda Companies provides environmental remediation, environmental consulting, and construction management services with in-house environmental engineers, chemists, civil engineers, chemical engineers, geologists, biologists, archaeologists, and construction managers.	24
Bolder Industries	Boulder	Bolder Industries provides innovative sustainable rubber and plastic solutions that address the global waste-tire problem by providing valuable new product outputs from recovered tire materials.	24

Crusoe Energy	Denver	Crusoe Energy provides solutions to eliminate routine flaring of natural gas, assist the oil industry operate more efficiently, achieve better relationships with communities and regulators, and improve environmental performance.	38
Eagle Environmental Consulting	Wheat Ridge	Eagle Environmental Consulting, Inc. (EAGLE) provides compliance and remedial environmental services to the petroleum marketing, oil and gas, commercial real estate, legal, and industrial sectors, as well as local, state and federal government.	48
EcoVapor Recovery Systems	Denver	EcoVapor Recovery Systems designs, engineers, and provides oil and gas producers the most technically advanced vapor recovery units in the industry which reduce on-site emissions by hundreds of tons annually.	15
Enbala	Denver	Enbala provides a platform for creating controllable and dispatchable energy resources and optimizes and dispatches these energy resources to respond to the real-time needs of the power system.	28
Geotech Environmental Equipment, Inc.	Denver	Geotech Environmental Equipment, Inc. is an international leader in the design, manufacture and distribution of equipment used for sampling, monitoring, and remediating groundwater and soil pollution.	77
Keystone Tower Systems	Denver	Keystone Tower Systems is developing a new manufacturing process for wind turbine towers, dramatically increasing production rates and unlocking new possibilities for welded steel towers.	31
Pivot Energy	Denver	Pivot Energy is a national leader in the development of onsite solar projects and small utility solar projects, including community solar.	62
Smith Environmental & Engineering	Dacono	Smith Environmental and Engineering (SMITH) provides comprehensive consulting & design-build services furnishing responsible solutions in environmental stewardship.	26

Source: Management Information Services, Inc.

II.A. American Energy Assets

American Energy Assets (AEA) provides energy efficiency, conservation, and environmental programs for health care, education, and commercial facilities designed to control energy usage, reduce environment impacts, and save money. AEA is a healthcare energy company that has helped hundreds of facilities find the most cost-effective and immediate ways to optimize their energy usage. It focuses on saving facilities money through non-capital projects. AEA is headquartered in Denver, where it employees seven people with another six employees located across the US. Its staff of experts include energy analysts and engineers.

Founded in Denver in 2003, AEA has more than 100 years of combined experience developing energy programs for health care, education, and commercial facilities. The majority of AEA's clients are children's hospitals, university medical centers, and acute care facilities of all sizes. AEA works closely with clients to make an economic impact in the immediate term by lowering their energy needs, then to continue the collaboration indefinitely as their business grows and the clients' needs evolve. AEA has completed a wide range of projects including installing building automation systems in Ohio hospitals and Wisconsin school systems, managing utility metering programs in the West, and notably, has helped hundreds of hospitals in 36+ states find the most cost-effective and immediate ways to optimize their operations.

While most facilities already have efficient equipment in place, AEA seeks opportunities in using these existing systems as efficiently as they were intended. AEA sends expert engineers to facilities to analyze their building automation systems. While onsite, they conduct detailed engineering surveys, expanded BAS trending, and data analysis to find savings. AEA's specialized tools allow clients to see exactly where their energy savings come from, and they are able to compare year to year savings and see how efficient they are compared to similar facilities.

AEA is able to save hospitals tens of thousands, perhaps hundreds of thousands, every year in energy costs. Ensuring that facilities reach their energy savings goal is AEA's main priority.

Core offerings include the following.

Services for Existing Infrastructure

- OnTrack Efficiency Program
- Benchmarking
- Baseline Management
- Measurement & Verification

System Upgrades

- Design/Construction
- Lighting Audits
- Capital Planning
- Central Plant Upgrades
- Solar Thermal & Renewables

Additional Services

- On-Site Energy Management
- Data Analytics Migration
- Parking Solutions
- Technology Adaptation
- Green Roof Ordinance

II.B. AMP Robotics

AMP Robotics is modernizing the world's recycling infrastructure by applying AI and robotics to economically recover commodities reclaimed as raw materials for the global supply chain. It builds and deploys technology that solves many of the central challenges of recycling and shifts the economics of the industry to make it more efficient, cost-effective, scalable, and sustainable. AMP's pioneering AI platform, AMP Neuron™, applies deep learning to continuously improve the precise identification and categorization of paper, plastics, and metals by color, size, shape, opacity, form factor, brand, and more, contextualizing and storing data about each item it perceives to accurately recover recyclables, removing contamination, and ultimately creating high-value raw material for resale into the global supply chain.

AMP is headquartered and has manufacturing operations in Louisville, Colorado. It currently employs 87 people out of headquarters and another 24 in the US outside of Colorado. Its staff is comprised of environmentalists, engineers, business development specialists, account managers, and administrative staff. AMP currently has 36 open positions it is looking to fill in the U.S. and another seven internationally.

AMP got started with the help of early-stage grant funding and the support of partners like the Carton Council and Denver's Alpine Waste and Recycle (now GFL Environmental), where the company tested its first robot prototype. Hard work and late nights in the materials recovery facility eventually paid off. Early venture funding allowed the team to double in size to 10 people and hone in and perfect the product. Fast-forward another year, and the systems were meeting performance and reliability expectations without issues, and the industry started to recognize the technology's value. In January 2021, AMP secured Series B funding of $55 million. AMP is currently deploying AI and robotics technology globally and scaling the organization rapidly to meet demand.

The global recycling industry has been in economic crisis over the last few years as China and other international importers of recyclables enacted stricter requirements on the purity of recycled materials. COVID-19 exacerbated the recycling crisis, forcing many businesses to suspend operations due to concerns for worker safety. At the same time, the pandemic increased demand for high-quality recycled feedstock to overcome supply chain interruptions and shifts in raw material availability.

AMP's intelligent automation helped the industry overcome the crisis by modernizing recycling -- keeping these businesses open, ensuring worker safety, increasing productivity, improving bale purity, overcoming labor shortages, lowering the costs to recycle, diverting materials from landfills, and increasing overall rates of recycling and resource recovery. Its technology is helping to provide a sustainable workforce for recycling jobs that have been chronically hard to fill. AMP is keeping an essential public service running and local businesses operating, while retaining and creating new jobs in manufacturing and other areas of the recycling industry.

With deployments across the United States, Canada, Japan, and now expanding into Europe, AMP's technology recovers recyclables from municipal waste, precious commodities from electronic waste, and high-value materials from construction and demolition debris.

II.C. Ayuda Companies

Ayuda Companies provides environmental remediation, environmental consulting, and construction management services and is a premier provider of environmental compliance and environmental consulting services; historical design services and related restoration/renovation; environmental investigation and environmental remediation; and construction management services. It services both the public and private sectors. Ayuda is headquartered in Denver, and employs 19 people in the Denver area and another five spread across the U.S. Employees include environmental engineers, chemists, civil engineers, chemical engineers, geologists, biologists, archaeologists, and construction managers.

Ayuda was founded in 2002 as Velez Management Corporation by Maria Velez. Maria built a successful business by providing consulting services to other small businesses in the areas of business development, capture plans/proposal support as well as providing project management on staff augmentation, environmental, and construction contracts. In May of 2006, the firm was accepted into the 8(a) program. In 2007, Sonya Yungeberg joined Maria Velez as partner and second employee. At that time, the company name was changed to Ayuda. Since 2006, Ayuda completed over $175M in contracts.

Ayuda is a client-focused organization that builds referral and repeat business from their existing client base while selectively taking on new clients. Clients include USACE: Tulsa, Omaha, Albuquerque, Huntsville, Kansas City, NASA Johnson Space Center, NIST, NOAA, City and County of Denver, Garfield County, City of Thornton, PFP Holdings, EnviroFinance Group, PCL, Horne LLC, Zurich National, Sewell School, and Denver Public Schools.

Ayuda services include the following.

Environmental Services

- Perfluorinated Chemicals (PFCs), an emerging contaminant, Preliminary Assessments (PA)/Site Inspections (SI)
- Risk Assessments
- Phase I and Phase II Environmental Site Assessment
- Property Condition Assessment
- Indoor Air Quality Assessment
- Asbestos and Lead Hazard Assessment, Risk Assessment, Abatement, and Air Monitoring

- Water Intrusion Investigation
- Mold Investigation and Remediation Oversight
- Natural and Cultural Resources Assessment and Permitting
- Site Remediation and Restoration
- Storage Tank Design, Management, and Remediation
- Stormwater Management Services
- Environmental Management Plan Preparation and Implementation Consulting
- Comprehensive Compliance Auditing
- Dredging Permitting
- Landfill Design
- Energy Management Support
- Historical Building Surveys
- Archaeological Historical Services
- Threatened & Endangered Species Studies
- Wetland Surveys

Construction Management Services

- Owner's Representative Services
- Secure Facility Construction
- Value Engineering
- Quality Assurance/Quality Control
- Safety Consulting
- Litigation Support Services

Other Services

- Homeland Defense/Vulnerability Assessments
- Disaster Recovery Consulting
- Home Maintenance Services
- Homeland Defense Continuity of Operations/Continuity of Government
- Staff Augmentation

II.D. Bolder Industries

Bolder Industries (BI), a certified B Corporation, provides innovative sustainable rubber and plastic solutions that address the global waste-tire problem by providing valuable new product outputs from recovered tire materials. The company is a pioneer in converting end-of-life tires into desirable carbon black alternatives and petrochemicals with minimal waste. Bolder Industries is headquartered in Boulder, where it employees 47 people. Staff includes engineers, manufacturing technicians, executives, business development, marketing and others.

BI was founded in 2011 with a mission to divert materials from landfills, offset greenhouse gas emissions, reduce water and electricity usage, and create local jobs. BI's flagship product is BolderBlack, which is derived from used tires and scrap rubber and serves as a replacement for traditional carbon black, a compound used to strengthen rubber and colorize plastics. Its U.S. production solves two major environmental problems with one elegant process: Resource extraction from waste tires and the creation of petrochemicals and BolderBlack that uses 90%+ less water and emits 90%+ fewer greenhouse gasses. BolderBlack has made its way into more than 300 products ranging from tires to construction materials to waste containers. Nearly anything that is black plastic or rubber can use BolderBlack as a sustainable alternative to virgin carbon black.

In June 2020, BI started construction of a manufacturing plant in Maryville, Missouri. The 24,000 square foot facility houses the proprietary systems necessary to recycle over two million scrap tires annually. In October 2020, BI entered into a letter of intent with special purpose acquisition firm GigCapital2 Inc. that would take BI public. According to the regulatory filing, Bolder Industries estimates that the firm will operate 15 plants and record as much as $530 million in annual revenue by 2026.

In Addition to BolderBlack, BI also produces steel. Tire steelcord and beadwire is made from very high quality high tensile strength steel. Prior to the pyrolysis stage of their process, BIs' process recovers clean steel that is 99% free of residual rubber making this material valuable in the recycled steel market. At the end of 2020, Bolder Industries was producing around 260 tons per month.

II.E. Crusoe Energy

Crusoe Energy provides solutions to eliminate routine flaring of natural gas, assist the oil industry operate more efficiently, achieve better relationships with communities and regulators, and improve environmental performance. Crusoe is on a mission to help the oil industry eliminate routine flaring of natural gas and reduce the cost of cloud computing. Crusoe repurposes otherwise wasted energy to fuel the growing demand for computational power in the expanding digital economy. Headquartered in Denver, Crusoe employs 23 people in Colorado and another 38 in the U.S. outside of Colorado. Employees include engineers, field operations, electricians, hardware techs, financial analysts, data center technicians, network architects, and software engineers.

In May 2021, Crusoe announced plans to grow its Denver headquarters, expanding their footprint and creating 286 new high-paying jobs in Colorado. Positions will include operations, engineering, safety, environmental, accounting, finance, legal, human resources, technology, business development, and sales and marketing.

Crusoe Energy was founded in 2018 by two Denver natives: Chase Lochmiller and Cully Cavness. They set out to address the massive waste associated with natural

gas. The ability to capture natural gas and harness it for computing operations suits the two men's interests in financial engineering and environmental preservation.

The company currently operates 40 modular data centers powered by otherwise wasted and flared natural gas throughout North Dakota, Montana, Wyoming, and Colorado. By 2022, that number should expand to 100 units as Crusoe enters new markets such as Texas and New Mexico. Since launch, Crusoe has emerged as a scalable solution to reduce flaring through energy intensive computing, such as bitcoin mining, graphical rendering, artificial intelligence model training, and even protein folding simulations for COVID-19 therapeutic research.

II.F. Eagle Environmental Consulting

Eagle Environmental Consulting, Inc. (EAGLE) provides compliance and remedial environmental services to the petroleum marketing, oil and gas, commercial real estate, legal, and industrial sectors, as well as local, state and federal governments. EAGLE undertakes a wide range of projects from the planning stages through implementation, from assessment through remediation. Headquartered in Wheat Ridge, Colorado, EAGLE employs 21 people in Colorado and another 26 elsewhere in the U.S. Employees include engineers, scientists, project managers, geologists, environmental consultants, and administrative staff. EAGLE is currently looking to hire one additional staff Scientist/Geologist.

Founded in 2005, EAGLE has provided environmental services for various clients within the public and private sector throughout Colorado and New Mexico. EAGLE provides technical and innovative approaches, as well as the economic solutions required to address each client's specific environmental liability.

Services offered are listed below.

Subsurface/Surface Investigations

- Soil and Groundwater Assessment
- Soil and Groundwater Remediation
- Risk Assessment
- Emergency Response
- Spill Prevention Control and Countermeasures (SPCC)
- Response Plans

Due Diligence and Compliance

- Phase I Environmental Site Assessments
- Phase II Subsurface Investigations
- Environmental Compliance Audits
- Tank Management Services
- Brownfields Redevelopment Support Services

- Legal Environmental Support Services
- Litigation Support
- Reimbursement Services

Air Permitting and Compliance

- GHG reporting
- New Stationary Sources (NSPS) and Standards of Performance for National Emission Standards for Hazardous Air Pollutants (NESHAP) Compliance
- Emission Inventories
- Regulatory Strategy and Compliance

II.G. EcoVapor Recovery Systems

EcoVapor Recovery Systems (ERS) designs, engineers, and provides oil and gas producers the most technically advanced vapor recovery units in the industry which reduce on-site emissions by hundreds of tons annually. ERS is dedicated to helping the oil and gas industry improve its environmental and financial sustainability with innovative technology. Its solutions help operators reduce routine flaring, minimizing emissions, and maximizing production. ERS employs seven people out of their headquarters in Denver, and another 10 people across the U.S. including field offices in Greely, Colorado, and Midland, Texas. Staff is composed of engineers, mechanics, programmers, marketers, account managers, executive staff, and others.

ERS was founded in 2010 to provide an innovative, reliable solution to economically control vapor emissions at oil and gas production sites. EcoVapor designs, engineers, and provides oil and gas producers the most technically advanced vapor recovery units in the industry and has over 120 installations in the major U.S. basins.

ERS's ZerO2 System allows operators to capture flash gas directly from the tanks (and/or VRT) allowing for 100% gas capture on site. This, in turn, reduces on-site emissions by hundreds of tons per year and makes the operator more money in the process. In conjunction with the ZerO2 System, ERS also provides a remote monitoring and operational control system giving operator personnel the ability to monitor and control ZerO2 units. Additionally, ERS provides field maintenance and repair of the units as needed.

II.H. Enbala

Enbala provides a platform for creating controllable and dispatchable energy resources and optimizes and dispatches these energy resources to respond to the real-time needs of the power system. It has a passion to make the world's power grids greener and more reliable, efficient, and predictable by harnessing the power of

distributed energy. It accomplishes this with a transformative real-time energy-balancing platform that can change the utility landscape.

Enbala is headquartered in Denver, and employs 15 staff. Enbala also has 15 more employees across the U.S. and an additional 30 internationally. Employees include software engineers, project managers, marketers, warehouse personnel, executive staff, and others. In April 2020, Enbala was approved for a $558,000 Paycheck Protection Program (PPP) loan to use towards payroll and avoid layoffs.

Founded in 2003, Enbala got its start aggregating pumps, motors, and other variable loads into frequency regulation markets run by mid-Atlantic grid operator PJM and Ontario's Independent Electricity System Operator, and coordinating chillers, refrigerators and other behind-the-meter flexibility as a partner in Canada's PowerShift Atlantic project. The company then shifted from a direct market participation model to focus on serving utilities via demand response and distributed energy resource (DER) integration programs. Its customers include Portland General Electric, Public Service New Mexico, Sacramento Municipal Utility District, Eversource, and Ontario, Canada utility Electra, as well as others. Enbala has expanded into managing behind-the-meter batteries and solar systems, with pilot projects in Hawaii using rooftop PV solar inverters and behind-the-meter batteries for Southern California Edison's Integrated Grid Project, and a major project with Australia's AGL to manage the country's largest solar-battery VPP project.

Enbala currently provides the advanced technology needed to ensure the operational stability of the world's power grids by harnessing the power of distributed energy. Concerto, Enbala's real-time energy-balancing platform, provides a highly flexible approach for creating controllable and dispatchable energy resources from flexible loads, energy storage, and renewable energy sources. The platform gives energy retailers and utilities the flexibility to operate in real-time and to better manage the escalating complexities of increasingly variable energy assets and evolving market opportunities.

In October 2020, it was announced Generac Power Systems was acquiring Enbala. The company continues aggregating DERs from multiple vendors and providers as a standalone business within Generac.

II.I. Geotech Environmental Equipment, Inc.

Geotech Environmental Equipment, Inc. is an international leader in the design, manufacture and distribution of equipment used for sampling, monitoring, and remediating groundwater and soil pollution. State-of-the-art manufacturing, machining, and extrusion capabilities enable Geotech to provide cost-effective solutions to tough environmental problems for its extensive list of international government, consulting and private industry customers.

Geotech is headquartered in Denver, where it employees 52 people. Outside Colorado, the company employs 69 people. In addition to its 125,000 square-foot Denver-based factory and headquarters, Geotech operates service centers in five states, a European Sales Center in Barcelona, Spain, and a representative office in Beijing China. Employees span operations, engineers, production managers, account managers, development, equipment technicians, sales and other specialties.

Originally formed in 1956, Geotech transitioned from a specialty machine shop to an environmental equipment manufacturer in 1978 when invited by the United States Geological Survey (USGS) to partner with them in developing products and technologies for the emerging U.S. Trace Metals Analysis Program. The resulting bladder pumps, peristaltic pumps, 0.45-micron sampling filters, and filter holders developed by Geotech for the program became the groundwater industry standards.

Geotech expanded its product lines by acquiring three companies: Oil Recovery Systems (ORS) in 1997, Keck Instruments, Inc. in 1999, and the Marschalk Corporation in 2005. In 2015 Geotech acquired Leptron Industrial Robotic Helicopters, Inc., a leader in the environmental aerial sensor platform industry since 2009. Geotech recognizes the value of unmanned aerial vehicles for environmental monitoring. Geotech currently offers one of the most extensive lines of equipment in the environmental field.

Geotech products and services include:

- Water sampling
- Groundwater level and flow measurements
- Water quality equipment
- Water sample filtration
- Geophysical measurements
- Handheld XRF analyzers
- Unmanned aircraft systems
- Air quality measurements
- Soil sampling equipment
- Remediation equipment
- Industry specific equipment
- Field equipment and supplies

II.J. Keystone Tower Systems

Keystone Tower Systems (KTS) has developed a new manufacturing process for wind turbine towers, dramatically increasing production rates and unlocking new possibilities for welded steel towers, and its automated tower production system brings modern manufacturing to the steel tower industry. Headquartered in Denver, Keystone employs 18 people in Colorado and another 14 elsewhere in the U.S. Employees include engineers, production managers, site operators, analysts, supply chain professionals and others. Keystone is currently seeking to hire two new engineers.

Keystone was founded in 2011 by Eric Smith and Rosalind Takata after meeting at MIT. They were searching for innovations that could dramatically increase the cost-effectiveness of wind power and they developed a way to tailor the spiral-welded technology already proven in the pipe industry to the wind industry.

Keystone's process can be operated at the wind project, enabling towers that are far larger than currently available transport constrained towers. It is currently working with leading wind turbine manufacturers to integrate large diameter, field-welded towers into their turbine offerings, enabling welded steel towers to reach hub-heights in excess of 140m. Keystone's tapered spiral-welded technology can significantly reduce the cost and time to build both onshore and offshore towers, adding strength and saving steel versus traditional can-welded towers.

KTS reduces the cost of wind energy by developing the advanced tower design and manufacturing technology needed to reach stronger winds at lower costs. Backed by over a decade of development, KTS' patented technology delivers the most advanced towers on the market. Designed in close collaboration with the world's leading turbine OEMs, KTS towers are fully certified for use in commercial projects, and with its automated manufacturing process it produces towers faster and to a higher quality standard than was previously possible.

KTS' patented tapered spiral welding combines all of the production steps for making large diameter steel tubes into one process, greatly reducing the manufacturing cost, footprint, and time required to produce steel towers. It has adapted spiral welding – a highly automated, proven process for producing cylindrical pipe and pilings – to accommodate the tapered diameter, variable wall thickness, and high manufacturing quality required for wind turbine towers. A single machine completes the joining, rolling, fit-up, welding and severing of a tower section, resulting in continuous production of steel tower shells. Because it is a high throughput, compact system, tapered spiral welding provides economic benefits when operated in a factory setting, and can also be readily mobilized for temporary operations on-site (for onshore supply) or port-side (for offshore supply). Keystone's patented breakthrough brings spiral welding into the wind industry with the introduction of variable diameters and wall thicknesses, and its custom manufacturing equipment is designed and built in Denver.

Keystone's patented breakthrough allows tapered towers with variable wall-thickness to be manufactured from constant width sheets of steel. As a result, Keystone can manufacture the lightest, lowest cost, and most structurally optimized towers in the industry. Keystone's manufacturing processes is covered by over 100 patents across more than 30 countries representing over 95% of the wind energy market.

II.K. Pivot Energy

Pivot Energy is a national solar provider that develops, finances, builds, and manages solar and energy storage projects and is leader in the development of onsite solar projects and small utility solar projects, including community solar. Pivot offers a distributed energy platform that includes a range of services and software aimed at serving the full solar ecosystem. Pivot Energy is headquartered in Denver, with satellite offices in Chicago, New York Metro Area, and St. Louis. The company employs 40 people out of headquarters and another 20 outside Colorado. Employees include marketers, strategists, business development, community developers, engineers, project developers and more. In 2020, despite COVID, Pivot hired 13 new positions (a 34% increase in staff).

Founded in 2009, Pivot is a B Corp that was conceived and continues to operate as a Triple Bottom Line (3BL) company. Their activities are oriented towards having a positive impact upon: People, Planet and Profit. The company assesses metrics for three bottom lines on a quarterly basis, with a goal of achieving balanced growth in all three areas. It believes this approach to doing business is the inevitable next evolutionary stage for the economic sector.

Pivot provides commercial and community solar solutions to a wide variety of sectors spanning Corporate portfolios, Businesses, Agriculture, K-12, Higher Education, Government, Military, Non-profits and Utilities. In 2020, Pivot completed 116 solar projects across six states, totaling 64 megawatts of commercial and community solar capacity.

In June 2021, ECP acquired Pivot. The acquisition will provide Pivot with increased access to capital to bolster its growth and leadership position within the community solar sector, which has become the fastest growing solar sub-segment. It will also enable Pivot to transition to a model of aggregating and managing attractive recurring cash flowing assets through in-house development, co-development partnerships, and acquisitions.

II.L. Smith Environmental & Engineering

Smith Environmental and Engineering is a woman-owned business providing comprehensive environmental engineering, design-build, and consulting services in Colorado and the western United States. It proactively addresses complex environmental issues for clients, furnishing responsible solutions in environmental stewardship. Headquartered in Dacono, Colorado, Smith employs 23 people in Colorado and another 12 elsewhere in the U.S. Employees include business development, project managers, project coordinators, engineers, environmental scientists, account managers and other specialties. In February 2020, the company was granted a PPP loan in the amount of $408,000 to retain employees.

Smith was originally founded in 2000 and services municipalities, government agencies, developers, private landowners, mining, oil and gas companies, and industry. Since it's inception, Smith has serviced over 1,400 clients.

Services offered are listed below.

Ecological Management

- Migratory bird clearance surveys
- Raptor surveys
- Special status species surveys
- Noxious weed surveys, management plans, & control
- Prairie dog management
- Mitigation & revegetation monitoring

Environmental Construction

- Planting & seeding
- Mulching & erosion control services
- BMP Inspections
- Erosion control supervisors
- Drainage structure installation
- Demolition & grading
- Silt fence & other BMP installation
- Boardwalk, trail, & small bridge installation
- Path construction
- Tree thinning, felling, wildfire fuel mitigation

Public Information

- Public outreach strategy
- Stakeholder mapping & engagement
- Public meeting organization & staffing
- Targeted messaging
- Media relations
- Content development
- Social media planning & development

Ecological Sciences

- Terrestrial & aquatic resource baseline studies
- Wetland delineations
- CWA Section 404 Permitting
- T/E/S species habitat assessments
- ESA Section 7 consultation

- ESA Section 10 permitting

Hazardous Materials

- Asbestos survey & abatement
- Groundwater/Surface water monitoring
- Vapor intrusion assessment
- Environmental construction monitoring
- Site remediation & closure
- Brownfield Assessment

Cultural Resources/Paleontology

- SH 106 Compliance
- Archeological Investigations and Excavations
- Historic Resources Investigations
- Historic Structures Assessments
- Historic District Assessments
- Historic Preservation

III. ILLUSTRATIVE GREEN INDUSTRY NARRATIVES FOR COLORADO

MISI developed three green industry narratives for Colorado illustrating the potential of green jobs and green jobs initiatives in the state. These are summarized below.

III.A. Green Energy Supports Family Values

Why this may be of interest to WorkingNation:

- This project literally touches all of the bases: A synergy between green energy, family unification, education, and successful health and substance abuse programs.
- The Baby Haven at Fort Logan provides housing, educational, and daycare facilities for women in substance abuse treatment and related programs.
- The Haven's success lies in its ability to keep families together and provide a safe and supportive environment.
- The program has had extraordinary success with its family based approach -- it provides the lowest substance abuse recidivism rate in Colorado.
- Extensive green energy and energy efficiency initiatives resulted in significant cost reductions in the Haven's new facility's utility bills – savings which are being invested in program services and child care.
- This experience and the job skills and expertise required can serve as a template for numerous facilities throughout Colorado and the U.S.
- The program supports a total of about 40 jobs (direct and indirect).

The Baby Haven Project

Founded in 1992, the Baby Haven at Fort Logan provides housing, educational, and daycare facilities for women in substance abuse treatment and related programs. The Haven's success lies in its ability to keep families together and provide a safe and supportive environment, and the Baby Haven program has had extraordinary success with its family based approach. With over a 90% success rate after two years, it provides the lowest substance abuse recidivism rate in Colorado. The success of this program has earned recognition from the mayor's and governor's offices.

The previous facility for the Haven was built in the late 1800's and could no longer meet the needs of the program. A new facility was designed with four classrooms, a multipurpose area, warming kitchen, dining area, and administrative offices. The challenge for the Haven project was to achieve the highest performance possible within a limited budget, while matching the historic character of the existing campus. The owner was committed to providing an energy efficient and healthy environment for the children and staff, while recognizing the long term value of high performance green building strategies. The owner and project team sought the

assistance of independent consultants early in the design process to assist with this commitment.

Aware of the project's high expectations and limited budget, the consultants worked with the project team to review and analyze the building envelope and proposed HVAC systems for efficiency and cost considerations. They analyzed the performance of the selected wall system and offered additional suggestions for appropriate insulation details. The wall system included a continuous layer of exterior insulation and fiberglass batts between 6" studs. In addition, under-slab and perimeter footing insulation help to optimize thermal performance and comfort. The team evaluated the proposed mechanical system for efficiency, first cost, and maintenance. The selected Variable Air Volume (VAV) HVAC system provides hydronic heating, DX cooling, and a digitally controlled economizer cycle for fresh air as needed.

Once the structural building envelope and mechanical systems were selected, the energy model helped the project team identify high performance glazing as a more cost effective strategy than additional insulation. This simple enhancement reduced energy use another 10 kBTU/sf/yr and enabled the project to exceed the 62 kBtu/sf/yr energy use benchmark.

With these primary high performance features in place, the owner followed a unique approach to additional strategies as the project moved forward. Rather than removing strategies from the project, the owner and project team worked to include them as alternates. As funding became available, these alternates could readily be included in the building if construction still allowed. This approach paid off when Xcel Energy awarded a grant that funded a radiant floor solar thermal system to be included in the infant and toddler rooms.

The Baby Haven project ultimately succeeded in providing an energy efficient, healthy, and safe environment for children. Many high performance features supported this mission. The radiant floor system in the infant and toddler classrooms not only provide efficient heat, but a warm surface for the children to play on. The high performance glazing was increased by 6" in height to bring the sill closer to the floor level so that toddlers could pull themselves up and see their mothers returning. Fiberglass window frames reduce thermal transfer while standing up to the rigors of a child care facility. Multi-level switching for the fluorescent lights with interior window shading help save energy and allow the child care supervisor to control the classroom environment for naps and quiet times. All of these resulted in significant cost reductions in the facility's utility bills – savings which are being invested in program services and child care.

Most important, the professional design and construction services and the determination to deliver a green and healthy facility will have substantial personal, health, and financial benefits for years to come. Notably, over 27 of the leading Colorado state foundations contributed financially to the new Baby Haven project. In

addition, many of the project team members donated a substantial portion of their time and professional services because this facility is such a community asset.

The green design features of the Haven project include:

- High performance building envelope with continuous exterior rigid insulation.
- Fiberglass frame, double pane, low-e windows.
- VAV HVAV system with economizer.
- Partial solar thermal radiant in-floor heating supplemented with high efficiency boiler hydronic heat.
- High efficiency water heater with ability, in the future, to add supplemental solar thermal radiant heat.
- Occupancy sensors for lighting with occupant controlled switching for light levels.
- Under slab vapor barrier for radon protection.
- Irrigation controlled by moisture sensors.
- Low flow plumbing fixtures.
- Energy star appliances.
- Fresh air brought into the building on a monitored basis.
- Natural daylight in all occupied spaces, with insulated skylights over internal meeting area.
- Internal shading on east, west, and south windows.
- Low VOC – finishes, carpet, and adhesives.

III.B. Renewable Energy Revitalizes The Eastern Plains

Why this may be of interest to WorkingNation:

- Urban and rural Colorado do not often see eye to eye politically, but this obscures how much they rely on each another. Green energy is a good example: Communities along the Front Range and all across the state want more green electricity and the jobs that come with it, and the Eastern Plains is providing. That was true before the recession caused by COVID-19 -- and it is doubly true now.
- The Eastern Plains have become the epicenter of the Colorado renewable energy sector and renewable energy has become the major economic driver in eastern Colorado.
- Renewable energy is creating 13,000 jobs and generates $5.9 billion in economic activity in eastern Colorado -- including renewable manufacturing plants along in the I-25 corridor in Windsor, Brighton, and Pueblo.
- Renewable energy property taxes on the Eastern Plains exceed $23 million per year, and in 2019 contributed 40% of the property tax revenues that supported county government operations in Kit Carson County.
- Ranchers and farmers who agree to build renewable energy projects on their properties receive lease payments, and those payments should exceed $15 million per year by 2024.

Description of Renewable Energy on the Eastern Plains

Moving the Colorado energy sector to green energy sources is a massive undertaking. To the average citizen or elected official, it can seem overwhelming. Nevertheless, this transformation is happening.

To really appreciate this, one has to get away from the office buildings of downtown Denver and the suburbs along I-25 and take a trip to Colorado's Eastern Plains. Over the past two decades, the counties of the Eastern Plains have become the epicenter of the Colorado renewable energy sector, hosting more than 95 percent of state's wind and solar generating capacity.

Starting from the construction of a single 30 MW wind farm in 2000, renewable development has surged and totaled more than 3,700 MW by the end of 2020. By 2024, the region's total renewable capacity is projected to accelerate even faster to more than 6,000 MW.

This 20-fold increase in renewable energy capacity amounts to a $9.4 billion investment in rural Colorado, and has supported more than 6,300 jobs and 360 businesses across eastern Colorado. Jobs and businesses are vital to the health of any community, but so is a strong local tax base to support essential services. And in this area, renewable energy has also become a mainstay in eastern Colorado.

By 2024, renewable energy property taxes on the Eastern Plains will exceed $23 million per year. According to Kit Carson County Commissioner Cory Wall, referring to almost $2 million per year in property taxes from renewable energy projects, "This makes a significant impact on our annual budget." To put that in perspective, $2 million is close to 40% of the property tax revenues that supported county government operations in Kit Carson County in 2019. Republican State Representative Rod Pelton stated "In several of the counties in my legislative district, taxes paid by wind farms make up nearly half the amount of the annual operating revenue for county government. This is a long-term and stable funding source which does not fluctuate with the market and it is enabling local governments to fund needed services without raising taxes."

In addition, ranchers and farmers who agree to build renewable energy projects on their properties receive lease payments, and those payments should exceed $15 million per year by 2024.

To be clear: Those are just the direct economic contributions of renewable energy development on the Eastern Plains. The expansion of wind and solar in this region over the next several years is expected to create nearly 13,000 jobs and generate $6 billion in total economic activity across all sectors – including renewable manufacturing plants along in the I-25 corridor in Windsor, Brighton, and Pueblo.

Urban and rural Colorado do not often see eye to eye politically, but too often this obscures how much urban Colorado and rural Colorado rely on each another. For generations, Colorado's farmers and ranchers have provided food and fuel to people in the cities and suburbs, who in turn provide a market for the goods they produce. Green energy is the next big chapter in this story. Communities along the Front Range and all across the state want more wind and solar electricity and the jobs that come with both, and the Eastern Plains is providing. That was true before the recession caused by COVID-19 -- and it is doubly true now.

III.C. Green Initiatives Facilitate Wastewater Treatment Facilities

Why this may be of interest to WorkingNation:

- Additional water and wastewater treatment facilities will be sorely needed in the U.S. over the coming decades – e.g., consider Flint, Michigan, etc.
- The Biden Infrastructure Plan includes over $110 billion in investments in water treatment facilities.
- Wastewater treatment facility energy savings can significantly impact the overall costs of the facilities as well as operating budgets and town finances.
- The small town of Nederland, Colorado had to build a new wastewater treatment facility for itself and adjoining communities, including Boulder.
- The project team embraced a new approach that focused on more efficient green waste water treatment equipment.
- While there were some up-front costs associated with purchasing the higher efficiency process equipment, the payback period was very short and the enhanced equipment was a valuable investment that is paying continuing returns.
- Nederland's experience can serve as a model for future U.S. investments in green, cost effective water and wastewater treatment infrastructure and for the job skills required to build the facilities.
- The facility supports about 15 jobs (direct and indirect).

Building a Green, Cost-Effective Wastewater Treatment Facility

The small town of Nederland, Colorado (population 1,400) and the adjacent Barker reservoir are within the Middle Boulder Creek watershed. In addition to being a water supply for the town and the adjoining communities, including Boulder – one of Colorado's wealthiest and most rapidly growing cities, the reservoir is also a recreational area. To help mitigate concerns about the quality of water flowing into the reservoir and downstream, Nederland had to build a new 4,000 sq. ft. wastewater treatment facility. This facility resides on the northwest (upstream) end of Barker Reservoir and is capable of treating 0.25 million gallons of wastewater per day (MGD).

In small towns such as Nederland, wastewater treatment facility energy savings can significantly impact operating budgets and town finances. At the early conceptual stages of this project, green energy strategies became a priority for the project team and town officials. An energy analysis for the project identified that nearly 90% of the building's energy use and cost was due to process equipment. A typical approach for a project of this size and scope would be to follow a traditional "this is the way it has always been done" path to the specifying of this equipment. However, armed with the results of the energy analysis, the project team embraced a new approach that started with a research effort focused on more efficient waste water treatment equipment.

As a result of this research, high speed turbine blowers were selected in place of the originally designed standard centrifugal and positive displacement (PD) blowers. Compared to the original design, the turbine blower for the digester is saving a minimum of 15% of the energy used annually and has a simple payback of less than three years. The turbine blower for the sequencing batch reactor (SBR) has a payback of just over one year. The combination of this equipment accounts for more than 60% of the overall electric load of the facility. By selecting high efficiency blowers, a minimum 14% electrical energy savings is being realized annually.

The headworks room is where wastewater first enters the treatment facility. This first stage of treatment, by code, requires 12 continuous air changes per hour for safe operations and occupancy. As a result, the makeup air unit normally would require supplemental heating, placing a significant energy load on the building. However, with this facility, the project team was able to design a heat recovery system with recovery coils around the discharges pipes of the high horsepower turbine blowers. The recovered heat from these coils is then transferred to the makeup air unit, nearly eliminating the need for heating in these rooms.

The project team helped to further optimize the energy efficiency of the Nederland wastewater treatment facility. This included incentive research, recommendations to reduce heating setpoints, and participation in conceptual design meetings with the owner. All together, this process resulted in substantial annual energy savings for the project – saving which are being utilized in Nederland's budgets. The energy analysis, short payback, and ongoing energy savings made it a simple decision for town officials to support the high performance green features of this project.

While there were some up-front costs associated with purchasing the higher efficiency process equipment, the payback period was very short and the enhanced equipment was a valuable investment that is paying continuing returns. The payback periods ranged between 1.1 and 2.5 years, which are extremely attractive.

IV. COMPARISON OF GREEN JOBS IN COLORADO AND PENNSYLVANIA

IV.A. Green Jobs in Colorado and Pennsylvania

It is instructive to compare green jobs in the two states where a rigorous comparison is now possible: Colorado and Pennsylvania. As discussed in the Pennsylvania report, green jobs in the state in 2019 comprised just over 6% of the total jobs in the state, and MISI forecast that this would gradually increase to nearly 9% by 2028.[7]

In comparison, here MISI estimates that green jobs in Colorado comprised about 9% in 2019 and would gradually increase to over 13% by 2028. Thus, as shown in Figure IV-1:

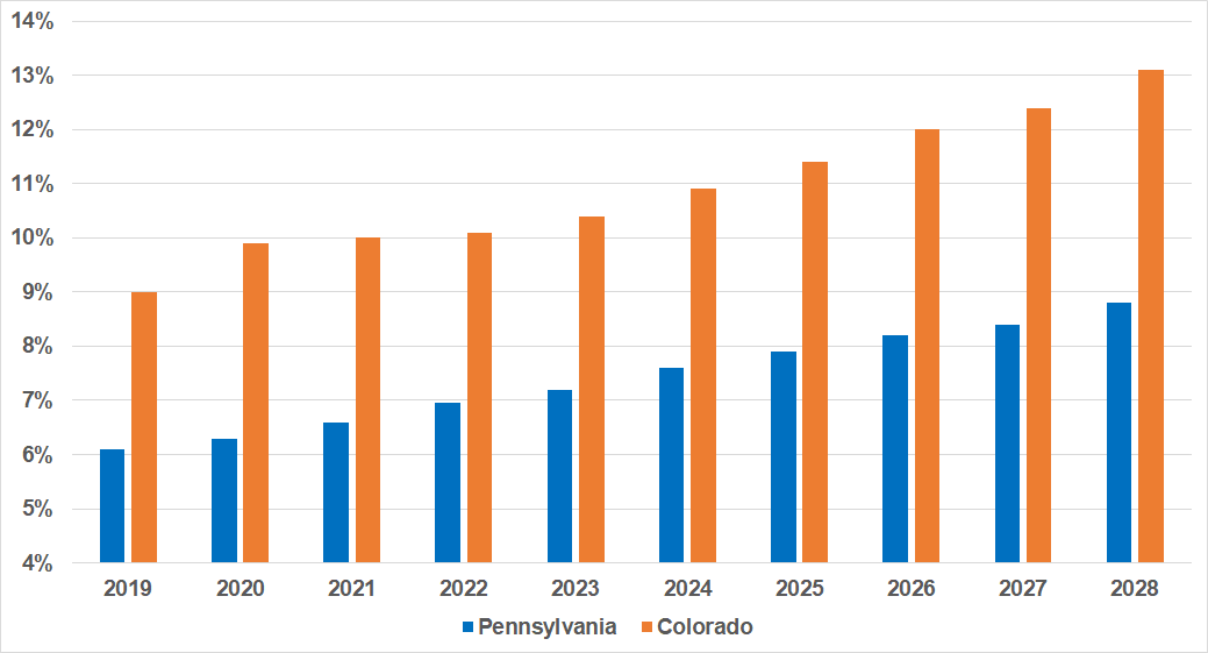
- In 2019, green jobs comprised 6.1% of total Pennsylvania employment and 9% of total Colorado employment.
- MISI forecasts that in 2023, green jobs will comprise 7.2% of total Pennsylvania employment and 10.4% of total Colorado employment.
- MISI forecasts that in 2025, green jobs will comprise 7.9% of total Pennsylvania employment and 11.4% of total Colorado employment.
- MISI forecasts that in 2028, green jobs will comprise 8.8% of total Pennsylvania employment and 13.1% of total Colorado employment.

Thus, in both states, the portion of jobs comprised of green jobs will increase by nearly 50% between 2019 and 2028. However, in 2028 green jobs in Colorado will comprise 50% more of total employment in the state than green jobs will in Pennsylvania.

It is important to note that both the portion of green jobs and the numbers of green jobs are increasing substantially in both states. However, since employment in Pennsylvania is forecast to increase very little, 2019 – 2028,[8] whereas employment in Colorado is forecast to increase markedly over this period,[9] the number of green jobs in Colorado will be increasing much more rapidly than in Pennsylvania – both in total and as a portion of total employment.

[7]Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," prepared by for WorkingNation, May 2021.
[8]Pennsylvania Department of Labor & Industry Center for Worforce Information & Analysis, "Pennsylvania Industry Employment 2018-2028 Long-Term Projections," https://www.workstats.dli.pa.gov/Documents/Projections/Industrial/PA/PA_LTIP.pdf.
[9]https://demography.dola.colorado.gov/economy-labor-force/economic-forecasts/.

Figure IV-1
Percent Employment Comprised of Green Jobs in Colorado and Pennsylvania



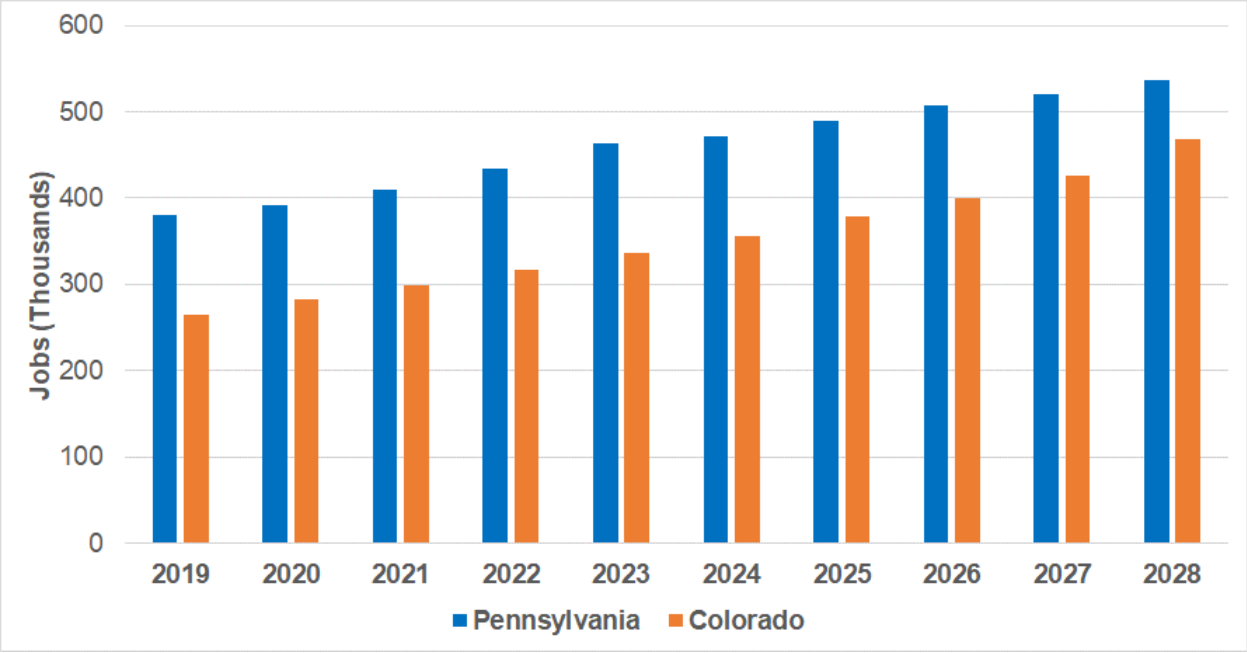
Source: Pennsylvania Department of Labor and Industry, State of Colorado, and Management Information Services, Inc.

This is illustrated in Figure IV-2, which shows the estimated green jobs in each state, 2019 – 2028. This figure shows that:[10]

- In 2019, there were about 380,000 green jobs in Pennsylvania and about 265,000 in Colorado.
- MISI Forecasts that in 2023, there will be about 465,000 green jobs in Pennsylvania and about 335,000 in Colorado.
- MISI Forecasts that in 2025, there will be about 490,000 green jobs in Pennsylvania and about 380,000 in Colorado.
- MISI Forecasts that in 2028, there will be about 535,000 green jobs in Pennsylvania and about 470,000 in Colorado.
- In 2019, there were about 120,000 more green jobs in Pennsylvania than in Colorado, whereas in 2028 there will be less than 70,000 more green jobs in Pennsylvania than in Colorado – even though total employment in Pennsylvania is about twice that in Colorado.

[10]Pennsylvania job forecasts are derived in Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," op. cit.

Figure IV-2
Green Jobs in Pennsylvania and Colorado



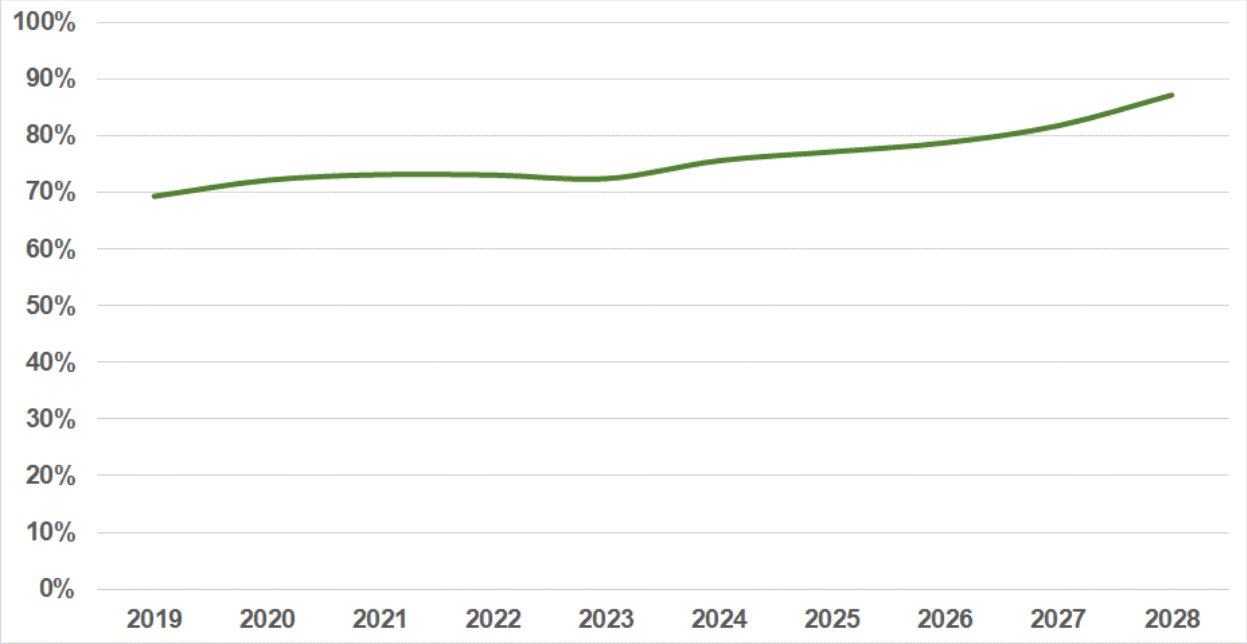
Source: Pennsylvania Department of Labor and Industry, State of Colorado, and Management Information Services, Inc.

In Colorado, both the total number of jobs and the portion of jobs comprised of green jobs are increasing rapidly, 2019 - 2028. However, in Pennsylvania, whereas the portion of jobs comprised of green jobs is increasing, 2029-2028, total employment in the state over that period is forecast to be nearly stagnant.[11] Thus, Colorado green jobs as a percent of Pennsylvania green jobs increase continuously. As shown in Figure IV-3:

- In 2019, the number of green jobs in Colorado were less than 70% of the green jobs in Pennsylvania.
- MISI forecasts than in 2024, the number of green jobs in Colorado will total more than 75% of the green jobs in Pennsylvania.
- MISI forecasts than in 2028, the number of green jobs in Colorado will total more than 87% of the green jobs in Pennsylvania.
- In 2019, the number of green jobs in Pennsylvania were 45% greater than those in Colorado.
- In 2028, the number of green jobs in Pennsylvania will be less than 15% greater than those in Colorado.

[11]Pennsylvania Department of Labor & Industry Center for Workforce Information & Analysis, op. cit.

Figure IV-3
Green Jobs in Pennsylvania and Colorado



Source: Pennsylvania Department of Labor and Industry, State of Colorado, and Management Information Services, Inc.

IV.B. Green Jobs by Industry and Occupation

Comparison of the distribution of green jobs among industry sectors in both states yields interesting results. As shown in Figure IV-4, in some sectors the percent distribution of green jobs is similar. These include:

- Construction
- Utilities
- Waste Management/Remediation Services
- Information

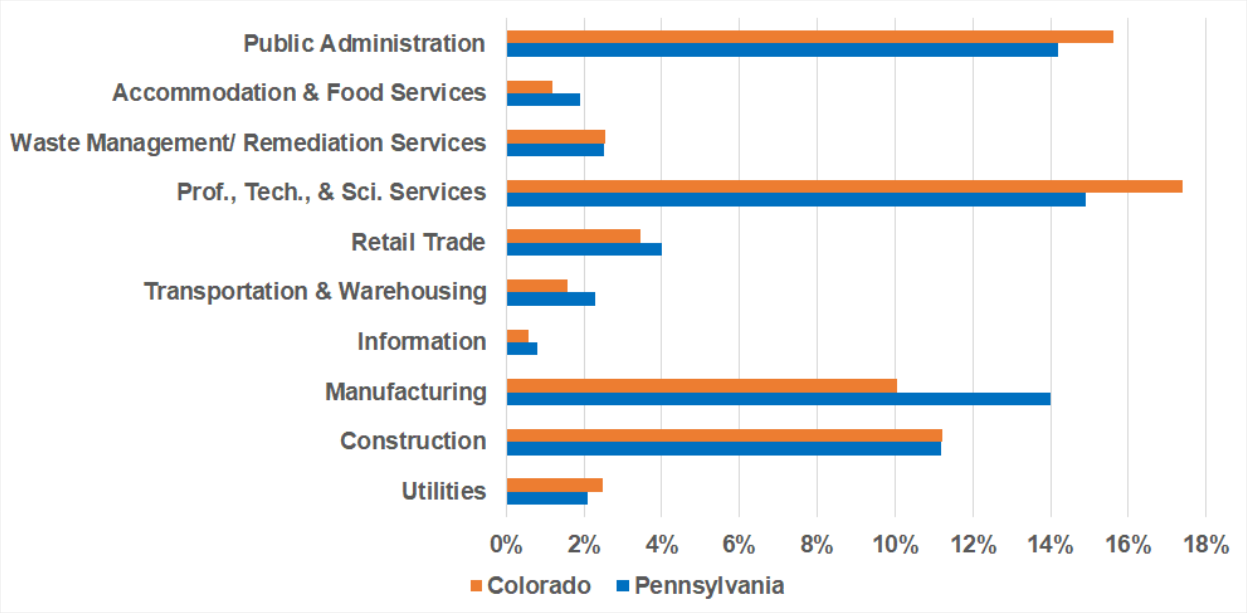
In some sectors, the percent of green jobs in Pennsylvania is substantially greater than in Colorado. These include:

- Manufacturing
- Accommodation and Food Services
- Retail Trade

In some sectors, the percent of green jobs in Colorado is substantially greater than in Pennsylvania. These include:

- Professional, Technical, and Scientific Services
- Public Administration

Figure IV-4
Industry Sector Distribution of Green Jobs, 2019



Source: Management Information Services, Inc.

There are substantial differences in the occupational distribution of green jobs in each state. While the total number of green jobs in Pennsylvania in 2019 was more than 30% larger than the number of green jobs in Colorado, green jobs by occupation differed much more.[12] As shown in Figure IV-5, for some occupations the green job differential between the two states is much greater than 30%. These include:

- Sewer and Pipe Cleaners
- Environmental Engineers
- Health and Safety Engineers
- Database Administrators

Figure IV-5 also shows that for some occupations the green job differential between the two states is about the average of 30%. These include:

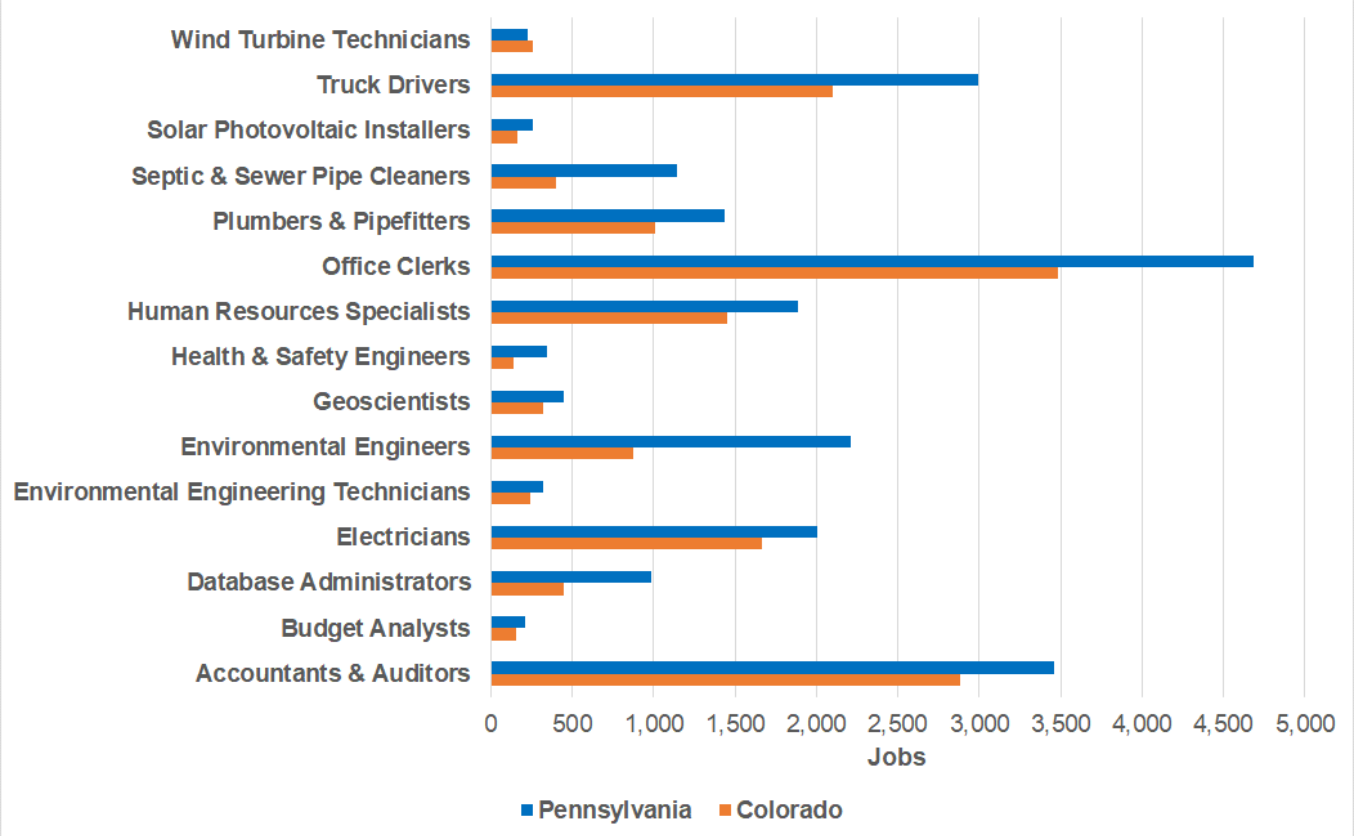
- Budget Analysts
- Environmental Engineering Technicians
- Human Resources Specialists
- Office Clerks
- Truck Drivers
- Plumbers and Pipefitters

[12]Pennsylvania green jobs by occupation are given in Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," op. cit.

Figure IV-5, also shows that for some occupations the green job differential between the two states is below the average of 30%. These include:

- Wind Turbine Technicians
- Accountants and Auditors
- Electricians

Figure IV-5
Green Jobs by Occupation in Pennsylvania and Colorado, 2019



Source: Management Information Services, Inc.

IV.C. Implications of the Comparative Findings

Comparison of green jobs in only two states cannot yield determinant findings.[13] However, such a comparison does provide some interesting findings and potential implications.

First, the number of future green jobs in a state is determined by the increasing portion of total jobs in the state comprised of green jobs and the rate of growth of

[13]However, these findings and their implications can be further assessed as additional state reports for WorkingNaion are completed.

employment in the state. Thus, green jobs in Colorado are forecast to increase more rapidly than in Pennsylvania because the portion of total employment in Colorado comprised of green jobs is increasing more than in Pennsylvania and, more important, because total employment in Colorado is increasing much more than in Pennsylvania.

Second, the changes mentioned above will alter the future distribution of U.S. green jobs among the states. Thus, for example, in 2019, green jobs in Pennsylvania accounted for about 4.7 percent of the total number of green jobs in the U.S. and green jobs in Colorado comprised about 3.3 percent of the total number of green jobs in the U.S. By 2028, the portion of U.S. green jobs in Pennsylvania will be less than in 2019, whereas the portion of U.S. green jobs in Colorado will be greater than in 2019. Similar comments apply to most other states. States where employment and the portion of green jobs are growing rapidly will increase their portion of U.S. green jobs; those states where employment and the portion of green jobs are growing slowly will decrease their portion of U.S. green jobs.

Third, the distribution of green jobs among industry sectors in states will differ. Here, for example, we found that in some sectors, the percent of green jobs in Pennsylvania is substantially greater than in Colorado. These include Manufacturing, Accommodation and Food Services, and Retail Trade. We also found that in some sectors, the percent of green jobs in Colorado is substantially greater than in Pennsylvania. These include Professional, Technical, and Scientific Services and Public Administration. Such differences in the industry sector distribution of green jobs are likely among most other states.

Finally, we found that there are substantial differences in the occupational distribution of green jobs in Colorado and Pennsylvania. While the total number of green jobs in Pennsylvania in 2019 was more than 30% larger than the number of green jobs in Colorado, green jobs by occupation differed much more. For some occupations the green job differential between the two states is much greater than 30%; for some occupations the green job differential between the two states is about the average of 30%; and for some occupations the green job differential between the two states is below the average of 30% -- in fact, we found that there were actually more Wind Turbine Technicians in Colorado than in Pennsylvania. Once again, similar occupational differences are likely among most other states.

V. UTILIZING GREEN INITIATIVES IN COLORADO TO FORM AN INTEGRAL PART OF A STATE JOBS DEVELOPMENT STRATEGY

V.A. Colorado Green Jobs Pre- and Post COVID

One objective of this research is to assess the Colorado green jobs situation pre- and post COVID and to assess how green job growth can assist state employment in recovering from COVID induced losses. A preliminary assessment of this potential can be gained by assessing the estimated job losses in a portion of the green industry, "clean energy," and energy efficiency jobs, and comparing these to total green jobs. Estimates available indicate that:[14]

- Colorado clean energy job gains in December 2020 totaled 402 (0.6%)
- This represents an annual clean energy job growth in the state of about 4,820.
- Colorado clean energy jobs losses since pre-COVID totaled 4,200 (6.2%)
- Colorado EE job growth in December 2020 totaled 222 (0.7%).
- This represents an annual EE job growth in the state of about 2,665.
- Colorado EE jobs losses since pre-COVID totaled 2,427 (6.7%).

This indicates that:

- The total number of clean energy jobs in Colorado pre-COVID totaled approximately 60,000.
- The total number of EE jobs in Colorado pre-COVID totaled approximately 36,100.

Based on 2020 estimates, the cumulative loss of clean energy jobs and of EE jobs in Colorado since 2019 (pre-COVID) totals about 6,625. However, MISI estimates that the current number of green jobs in Colorado totals approximately 266,300, and is growing at a compound annual growth rate (CAGR) of about 6%. This represents a total annual increase in green jobs in the state of about 16,000 – more than twice the cumulative loss in clean energy and EE jobs in the state. This indicates that total green job growth in the state could replace all of the estimated the clean energy and EE jobs lost in Colorado during 2020 by the third quarter of 2021.

V.B. The Significant Growth of Colorado Green Jobs

As noted, MISI forecasts that although the rate of growth in green expenditures will decline over the next decade, total expenditures will continue to increase substantially. The rate of growth declines because the total size of the industry continues to increase. In Colorado, MISI forecasts that, post COVID-19, green jobs will increase much more rapidly than total employment in the state.

[14]E2, E4TheFuture, and ACORE, "Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis," February 8, 2021.

In April 2021:[15]

- The Colorado civilian labor force was 3,197,000
- Colorado employment was 2,993,000
- Unemployment was 205,000
- The unemployment rate was 6.4%
- The five month change in employment through April 2021 was 1.5%

As noted, MISI estimates that green jobs in Colorado in 2019 totaled approximately 266,300. Based on past rates of growth, MISI estimates that green jobs increased at a CAGR of 6% since 2019. This implies that in 2021, green jobs total about 300,000 and comprise about 10% of total Colorado employment – compared to less than 9% in 2019.

The State of Colorado forecasts 2030 employment in the state will total 3,538,000 jobs.[16] This represents an increase in jobs of 18.2% since 2021.

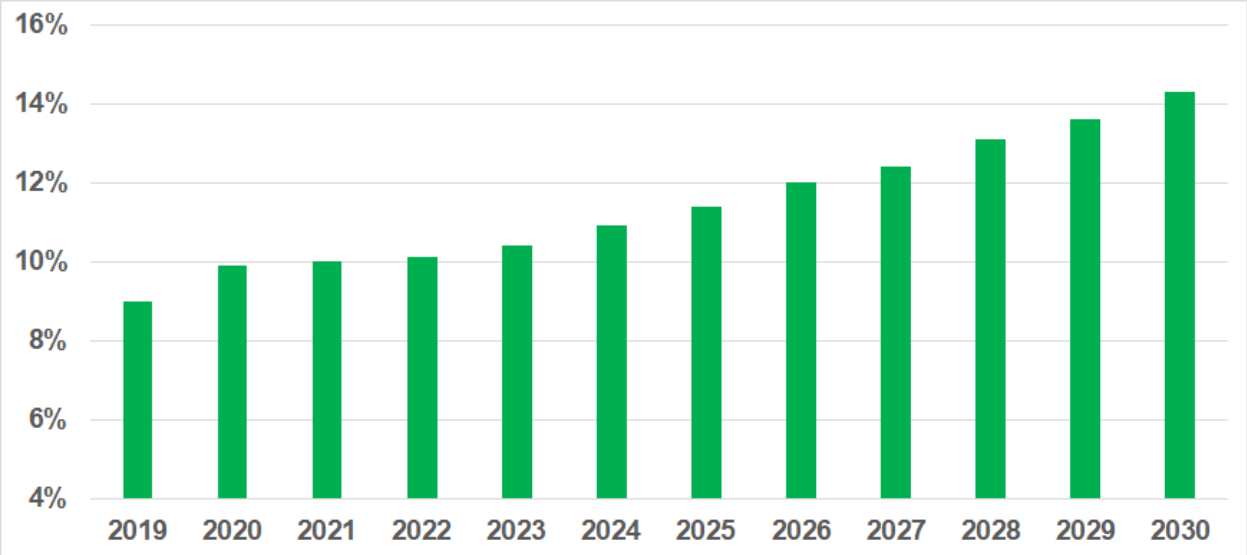
MISI forecasts that green jobs in Colorado are increasing and will continue to increase about 6% annually. Thus, assuming that 2021 green jobs total about 300,000, this implies that, if these growth rates continue, Colorado green jobs will be increasing annually by about 18,000 – 30,000. Thus, Colorado green jobs will be increasing at a rate that is three times greater than total Colorado employment. This implies that the annual increase in Colorado green jobs post-Covid could equal about one-third to one-half the total net number of jobs forecast by the state to be created annually over the next decade.

MISI estimates that Colorado green jobs totaled approximately 300,000 in 2021 and that they will increase at a CAGR of 6% through 2030. Thus, in 2030 Colorado green jobs will total approximately 506,000.

The State of Colorado forecasts that in 2030 total Colorado employment will be 3.538 million.[17] Therefore, in 2030 Colorado green jobs will total about 14.3% of all jobs in the state. Since in 2019 green jobs in Colorado totaled about 8.4% of all jobs in the state, this implies that by 2028 green jobs in Colorado will increase as a total of all jobs in the state by about 70% -- Figure V-1.

[15]https://www.bls.gov/eag/eag.pa.htm.
[16]https://demography.dola.colorado.gov/economy-labor-force/economic-forecasts/.
[17]Ibid.

Figure V-1
Percent of Colorado Employment Comprised of Green Jobs



Source: Management Information Services, Inc. and State of Colorado, Department of Local Affairs.

Further, assume that between 2029 and 2030 green jobs in Colorado increase at the MISI estimate of about 6% annually -- or a total of about 29,000. The State of Colorado forecasts that total employment in the state over that period will increase by about 40,000 jobs.[18] This implies that green job growth in the state that year will be equivalent to over 70% of the total net job growth in Colorado.

It is also important to note that with appropriate Federal and state government policies in place, the number of green jobs in Colorado could increase even more rapidly and substantially. For example, MISI has estimated that even a relatively modest version of the green new deal (GND) would create approximately 18.3 million jobs in the U.S.[19] In Section I.B, MISI estimated that in 2019 green jobs in Colorado comprised about 3.3% of the total number of green jobs in the U.S. Assuming that Colorado would receive approximately 3.3% of the total U.S. GND jobs, but also realizing that the state is heavily invested in fossil fuels and fossil fuel jobs,[20] the GND could generate between 600,000 and 700,000 new green jobs in the state. This would comprise about 20% of the total jobs in the state and would nearly double the number of green jobs that MISI has forecast for Colorado absent the GND.

Colorado state policies could also significantly affect the creation of new green jobs. For example:

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[18]Ibid.
[19]Roger H. Bezdek, "The Jobs Impact of the USA New Green Deal," *American Journal of Industrial and Business Management*, Vol. 10, No. 6 (June 2020), pp. 1085-1106; Roger H. Bezdek, "The USA New Green Deal Will Create Over 18 Million Jobs," *Journal of Environmental Science and Renewable Resources*, Vol. 2, No. 1 (June 2020).
[20]https://www.eia.gov/state/?sid=CO.

- In 2004, Colorado became the first state with a voter-approved renewable portfolio standard (RPS). The legislature increased the requirements several times, and the RPS now requires 30% of electricity sold by investor-owned utilities to come from renewable energy sources by 2020, with 3% from small-scale distributed generation. Separate requirements apply to municipal and cooperative electricity suppliers, depending on their size.[21]
- In 2019, Colorado Governor Jared Polis proposed a plan for 100% of the state's electricity generation to come from renewable resources by 2040.[22] Colorado is 1 of 12 states that have adopted the Zero Emission Vehicle (ZEV) program. Under this program, automakers are required to sell a specific number of no or low emissions vehicles and invest in clean technology.
- In 2020, Xcel Energy, Colorado's largest utility provider, generated 37% of electricity from in-state renewable resources, an increase from 30% the previous year. The utility stated that it would obtain 53% of electricity from in-state renewable sources by 2026, primarily by closing coal-fired power plants in Colorado.[23]
- Governor Polis in September 2020 signed seven climate and energy bills along with four electric vehicle (EV) bills, and unveiled a roadmap of the state's path to 100% renewable electricity by 2040.[24] The legislation is designed to decarbonize the state's economy 90% below 2005 levels by 2050, codify Xcel Energy's 100% carbon-free electricity by 2050 goal, and expand energy efficiency and EV programs in the state. Polis ran his campaign in part on reaching 100% renewable energy by 2040, and his first executive order focused on advancing transportation electrification in Colorado.
- In January 2021, Colorado released its Greenhouse Gas Pollution Reduction Roadmap. It details how Colorado will reach the goal of reducing greenhouse gas emissions by 26% of 2005 levels by 2025, and 50% by 2030.[25] The roadmap details policies to meet targets in Colorado's climate action plan, which calls for a 25% reduction in greenhouse gas emissions by 2025 and a 50% reduction by 2030.[26] Those goals are measured against Colorado's 2005 emissions levels. Governor Polis stated "We have taken historic steps towards our goals, and this roadmap will help guide the critical efforts necessary to reap the full benefits of boldly and equitably transitioning to a clean energy economy." However, environmental activists contend that the roadmap amounts to only a list

[21]NC Clean Energy Technology Center, DSIRE, "Renewable Portfolio Standard, Colorado," June 14, 2018.
[22]Colorado Governor Jared Polis, "Governor Polis Releases Roadmap to 100 Percent Renewable Energy and Bold Climate Action," (May 30, 2019).
[23]Kohler, Judith, "Xcel Energy, Partners to Close Northwest Colorado Coal-Fired Power Plants Years Ahead of Schedule," *The Denver Post*, (January 4, 2021.
[24]https://www.utilitydive.com/news/colorado-gov-polis-unveils-roadmap-to-100-carbon-free-by-2040-signs-11-cl/555975/.
[25]Colorado Energy Office, "GHG Pollution Reduction Roadmap," 2021.
[26]https://www.cpr.org/2020/09/30/colorado-climate-change-jared-polis-roadmap-to-meet-goals-some-environment-groups-oppose/.

of “goal and aspirations” and are suing the Polis administration for failing to propose clear rules to meet the climate rules.

- The Colorado AFL-CIO and several Colorado unions developed a plan for a transformative green growth program for Colorado. The centerpiece of the program is clean energy investments, undertaken in combination by the public and private sectors throughout the state, and has two fundamental goals: Promoting global climate stabilization by reducing carbon dioxide emissions in Colorado without increasing emissions outside of the state and expanding good green job opportunities throughout the state. The plan recommends investing $14.5 billion per year in clean energy projects in Colorado, which will generate about 100,000 jobs per year in the state. New job opportunities will be created in a wide range of areas, including construction, sales, management, production, engineering, and office support, and the program recommends a just transition for fossil fuel industry dependent workers and communities.[27]
- H.B. 19-1261, “Climate Action Plan to Reduce Pollution,” establishes a goal of reducing economy-wide carbon emissions 90% below 2005 levels by 2040.[28] It sets benchmark targets of 26% reduction by 2025 and 50% by 2030. It directs the AQCC to develop policy and incentives to reach those targets, but leaves retail electricity rulemaking to the PUC.
- HB21-1149, “Energy Sector Careen Pathway in Higher Education,” requires the Colorado work force development council, in collaboration with local work force boards, the department of education, superintendents of local school districts, the state board for community colleges and occupational education, and other postsecondary partners, to design a career pathway for students in the energy sector using an existing statutory model for the design and implementation of career pathways.[29]
- SB21-246, “Electric Utility Promote Beneficial Electrification,” directs the PUC to establish energy savings targets and approve plans under which investor-owned electric utilities will promote the use of energy-efficient electric equipment in place of less efficient fossil-fuel-based systems.[30] This directive would substantially follow the model of existing demand-side management (DSM) policies established by the PUC. It directs the PUC to apply current standards for measurement of the social cost of carbon emissions, including methane, in evaluating the cost, benefit, or net present value of utility plans and proposals for beneficial electrification.
- XB21-161, “Reduce Natural Gas Greenhouse Gas Emissions,” requires the PUC to adopt by rule, no later than July 31, 2022, greenhouse gas (GHG) emission reduction programs for natural gas utilities.[31] Municipally owned utilities may, but need not, participate in a reduction program. The rules must include reporting requirements and a process for utilities to fully recover qualified investments,

[27]https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.
[28]Climate Action Plan To Reduce Pollution | Colorado General Assembly.
[29]Energy Sector Career Pathway in Higher Education | Colorado General Assembly.
[30]Electric Utility Promote Beneficial Electrification | Colorado General Assembly.
[31]Voluntary Reduce Greenhouse Gas Natural Gas Utility | Colorado General Assembly.

which are prudently incurred costs associated with a reduction program. The bill establishes the following GHG emission reduction targets, using a utility's 2019 GHG emissions as a baseline: By January 1, 2025, at least 5%; by January 1, 2030, at least 10%; and on and after January 1, 2035, at least 15%.

- SB21-020, “Energy Facility Property Tax Valuation,” would ensure that clean energy resources and energy storage systems used to store electricity are assessed for valuation for the purpose of property taxation in a similar manner to renewable energy facility property used to generate and deliver electricity.[32] Currently, the property tax administrator is required to determine the actual value of a renewable energy facility using the income approach to valuation only. This valuation currently involves a "tax factor" based on a 20-year period. This bill extends this period by 10 years for a renewable energy facility that begins generating energy on or after January 1, 2021. It also specifies that after the 20- or 30-year period, as applicable, a tax factor is not applied and the taxable value shall not exceed the depreciated value floor calculated using the cost basis method.

V.C. Green Jobs and New Jobs in Perspective

Green jobs are increasing rapidly in Colorado, will continue to do so, and offer important opportunities for encouraging green/environmental and related industries in the state. These could form an integral part of state economic development strategy and innovative learning opportunities and solutions to the state/local jobs skills gap. However, it is important to be realistic with respect to the overall jobs situation in Colorado and to place green jobs and green jobs growth into perspective. While green jobs are important and are growing rapidly, they will continue for the foreseeable future to comprise only a small portion of total jobs and of new jobs in the state.

For example, in 2019 (pre-COVID), MISI estimates that there were approximately 266,000 green jobs in Colorado. To put this in perspective, in 2019 BLS estimates that in Colorado there were approximately:[33]

- 325,000 jobs in Administrative and Support occupations.
- 287,000 jobs in Sales occupations.
- 260,000 jobs in Food Preparation occupations.
- 241,000 jobs in Health Care occupations.

Thus, in these four occupations alone, there were more than four times as many jobs as all green jobs.

The discrepancies between the numbers of specific green jobs in Colorado and jobs in selected other occupations is illustrated in Figure V-2.

[32]Energy Equipment and Facility Property Tax Valuation | Colorado General Assembly.
[33]https://www.bls.gov/oes/2019/may/oes_co.htm.

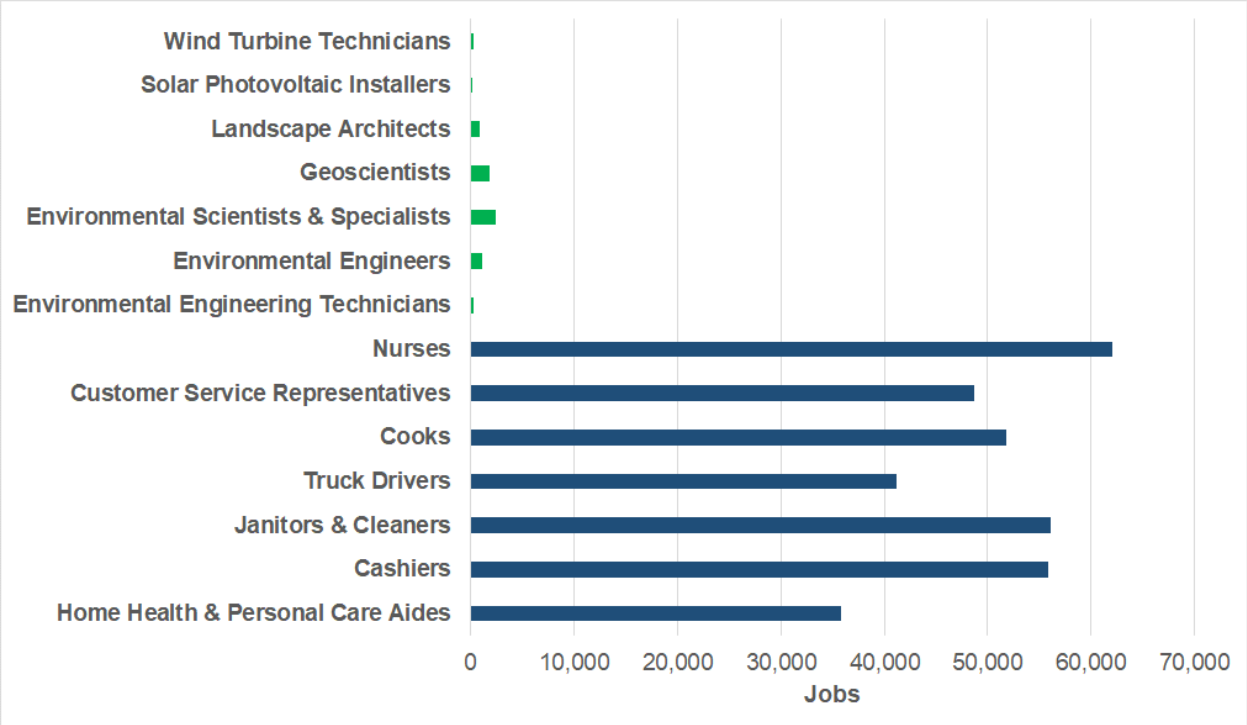
This figure shows that in 2019 the green jobs listed totaled:

- 360 Environmental Engineering Technicians
- 1,110 Environmental Scientists & Specialists
- 1,910 Geoscientists
- 920 Landscape Architects
- 160 Solar Photovoltaic Installers
- 290 Wind Turbine Technicians

However, this figure also shows that in 2019 there were many more jobs in Colorado in other occupations, including:

- 55,800 Home Health & Personal Care Aides
- 62,000 Nurses
- 48,700 Customer Service Representatives
- 51,800 Cooks
- 41,200 Truck Drivers
- 56,100 Janitors and Cleaners
- 35,800 Home and Personal Care Aides+

Figure V-2
Employment in Select Colorado Green and Other Jobs, 2019



Source: U.S. Bureau of labor Statistics and Management Information Services, Inc.

Thus, in Colorado in 2019, there were:

- 224 times as many jobs for Home and Personal Health Care Aides as jobs for Solar Photovoltaic Installers
- 215 times as many jobs for Nurses as jobs for jobs for Wind Turbine Technicians.
- 114 times as many jobs for Truck Drivers as jobs for Environmental Engineering Technicians
- 47 times as many jobs for Cooks as jobs for Environmental Engineers.

Further, it should be noted that, according to the Solar Energy Industries Association, in 2020 the total number of jobs in the entire solar industry in Colorado was about 6,770.[34] Thus, total number of jobs in the solar energy industry in Colorado is only about:

- 11% of the jobs for Nurses
- 12% of the jobs for Janitors and Cleaners
- 14% of the jobs for Customer Service Representatives

In other words, the numbers of most green jobs in Colorado are currently very small compared to the numbers of jobs in many other occupations in the state. Any ambitious and realistic employment and job creation programs must take such discrepancies into account.

The U.S. Bureau of Labor Statistics (BLS) forecast the most rapidly growing occupations in the U.S. through 2029.[35] As shown in Figure V-3, two of the most rapidly growing occupations are green jobs – wind turbine service technicians and solar photovoltaic installers, and eight are in the health care field.

Two of the most widely publicized green jobs in Colorado and, indeed, in the U.S. are wind turbine technicians and solar photovoltaic installers. These are widely identified as "ideal" green jobs of the future that are growing rapidly and are prime candidates for jobs programs and jobs training initiatives.[36] BLS confirms that these two occupations are among the most rapidly growing in the U.S.[37]

Figure V-3 shows that BLS forecasts that wind turbine technicians will be the most rapidly growing occupation in percent terms over the next decade, increasing 61% by 2029, and that solar photovoltaic installers will be the third most rapidly growing

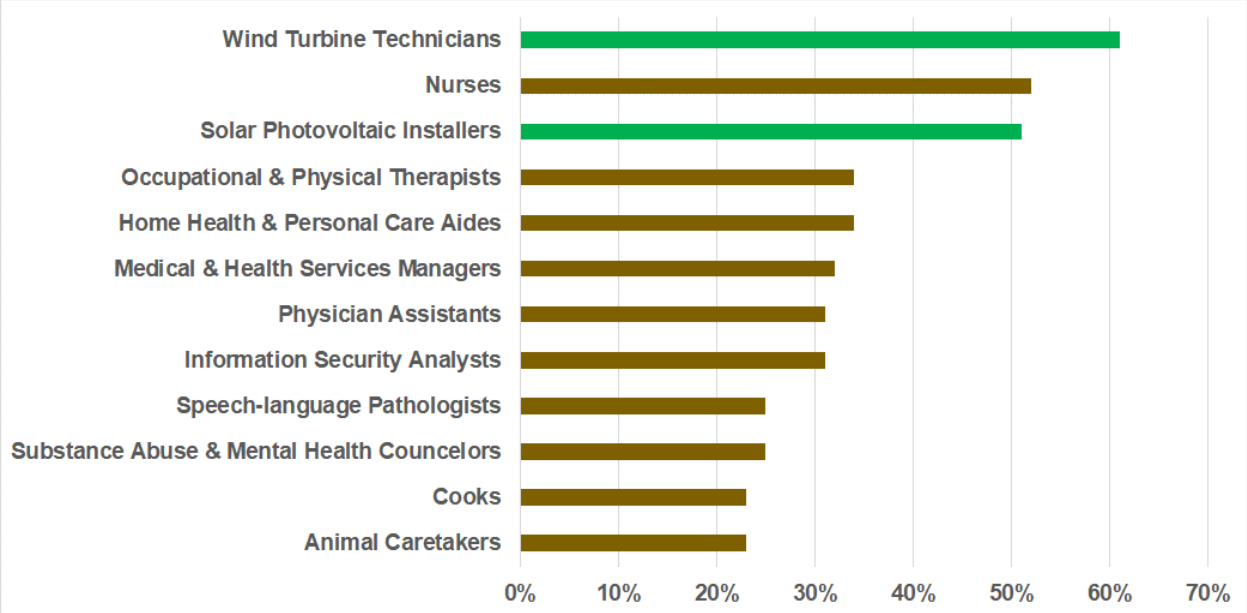
[34]Solar Energy Industries Association, "Colorado Solar," https://www.seia.org/state-solar-policy/colorado-solar.
[35]U.S. Bureau of Labor Statistics, "Fastest Growing Occupations: 20 Occupations With the Highest Percent Change of Employment Between 2019-29," https://www.bls.gov/ooh/fastest-growing.htm.
[36]See, for example, the discussion in https://e2.org/reports/clean-jobs-colorado-2019/; E2, American Council on Renewable Energy, Clean Energy Leadership Institute, and BW Research Partnership, "Clean Jobs, Better Jobs: An Examination of Clean Energy Job Wages and Benefits," October 2020.
[37]U.S. Bureau of Labor Statistics, "Fastest Growing Occupations: 20 Occupations With the Highest Percent Change of Employment Between 2019-29," op. cit.

occupation over the next decade, increasing 51% by 2029. Most of the other 20 most rapidly growing occupations are in the health care field.

However, it should be noted that in 2019 in Colorado, there were only approximately 290 wind turbine service technicians and about 160 solar photovoltaic installers.[38] Accordingly, in 2029, using the BLS forecasts, we estimate that there will be in Colorado requirements for about (Figure V-4):

- 465 wind turbine service technicians
- 240 solar photovoltaic installers

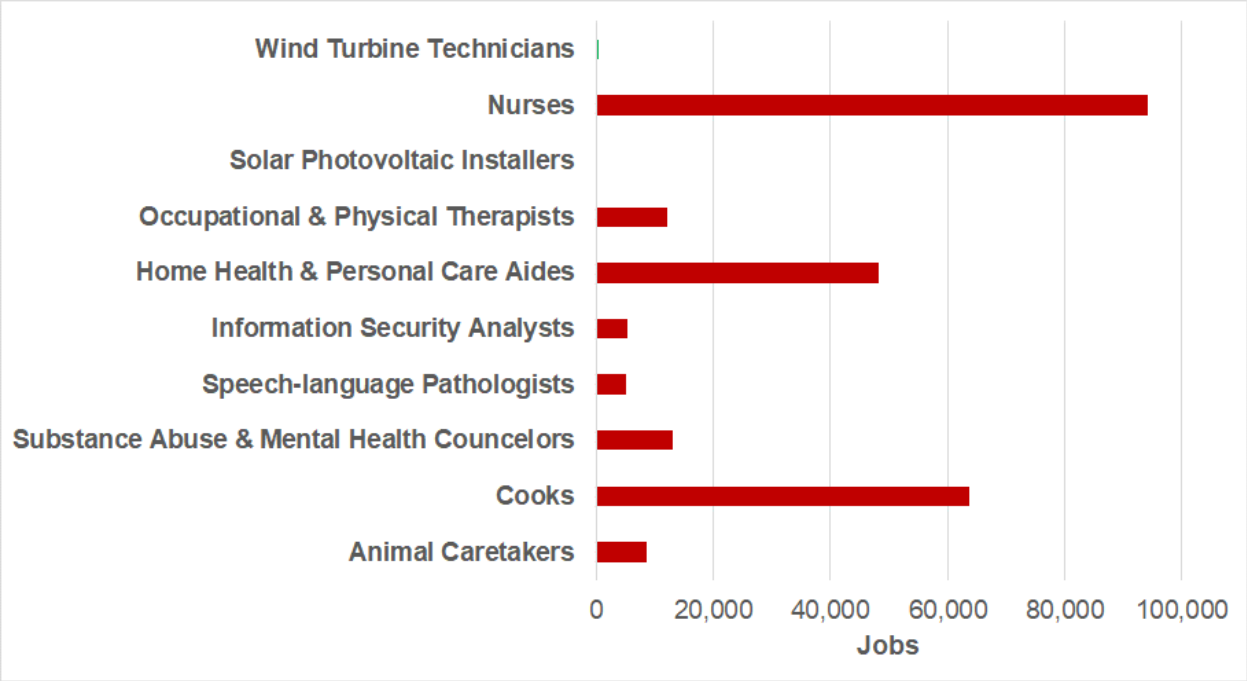
Figure V-3
Forecast Percent Change in Employment, 2019-2029



Source: U.S. Bureau of labor Statistics.

[38]U.S. Bureau of Labor Statistics, "May 2019 State Occupational Employment and Wage Estimates Colorado," https://www.bls.gov/oes/2019/may/oes_co.htm.

Figure V-4
Estimated Colorado 2029 Jobs, Select Occupations



Source: U.S. Bureau of labor Statistics and Management Information Services, Inc.

In comparison, using the BLS forecasts,[39] MISI estimates that in 2029 in Colorado there will be requirements for approximately (Figure VII-4):

- 48,240 Home Health and Personal Care Aides
- 94,200 Nurses
- 5,250 Information Security Analysts
- 63,700 Cooks
- 12,100 Occupational and Physical Therapists
- 5,000 Speech Language Pathologists
- 13,215 Substance Abuse and Mental Health Counselors
- 8,600 Animal Caretakers

Thus, the number of future jobs in the health care field and other occupations will simply swamp the number of most future green jobs in Colorado.

The same is true for some of the other most rapidly growing jobs. For example, among the 20 most rapidly growing jobs forecast by BLS, MISI estimates that in 2029 in Colorado:

[39]U.S. Bureau of Labor Statistics, "Fastest Growing Occupations: 20 Occupations With the Highest Percent Change of Employment Between 2019-29," op. cit.

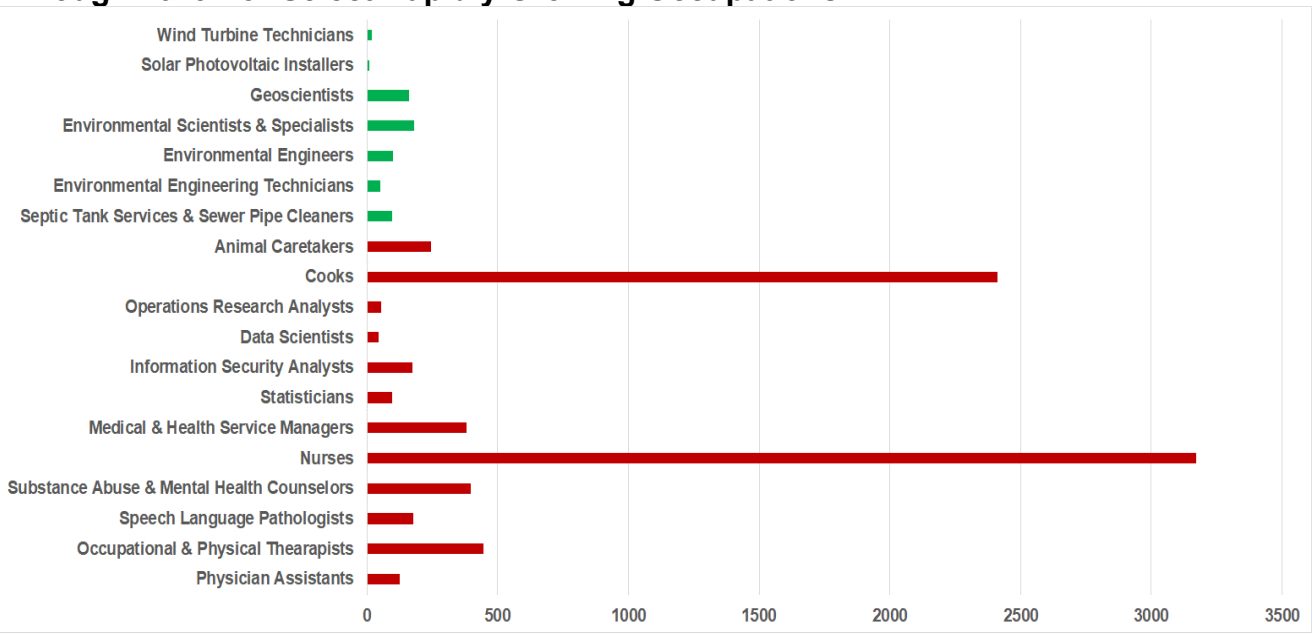
- The number of statisticians (increasing 35% through 2029) will total 1,500.
- The number of data scientists (increasing 31% through 2029) will total 1,000.
- The number of operations research analysts (increasing 25% through 2029) will total 1,050.
- The number of Medical and Health Service Managers (increasing 32% through 2029) will total 11,900.
- The number of Physician Assistants (increasing 31% through 2029) will total 4,100.

Once again, many occupations contain many more workers, are growing rapidly, will continue to employ many more workers and, crucially, will provide many more annual job openings in Colorado than will green jobs in the state.

This is illustrated in Figure V-5, which shows the average annual Colorado job openings through 2029 for select rapidly growing occupations. This figure demonstrates that when expressed as annual new job openings there are many occupations that annually create substantially more new jobs than do green occupations. For example, while BLS forecasts that wind turbine technicians will be the most rapidly growing occupation in percentage terms over the coming decade and that solar photovoltaic installers will be the third most rapidly growing occupation over the coming decade, through 2029 in Colorado MISI estimates that:

- Job openings for wind turbine technicians will total only about 18/yr.
- Job openings for solar photovoltaic installers will total only about 10/yr.

Figure V-5
Average Annual Colorado Job Openings
Through 2029 For Select Rapidly Growing Occupations



Source: U.S. Bureau of Labor Statistics and Management Information Services, Inc.

Further, through 2029 in Colorado MISI estimates that job openings for environmental engineering technicians will total only about 50/yr. The only green occupations in Figure V-5 that create more than 100 annual job openings in the state are environmental scientists and specialists – 180 job openings/yr., and environmental geoscientists – 160 job openings/yr.

The relative job situation in Colorado can also be illustrated by comparing the most rapidly growing green occupations with the most rapidly growing fossil fuel occupations. BLS forecasts that the four most rapidly growing fossil fuel occupations, 2019-2029, are:[40]

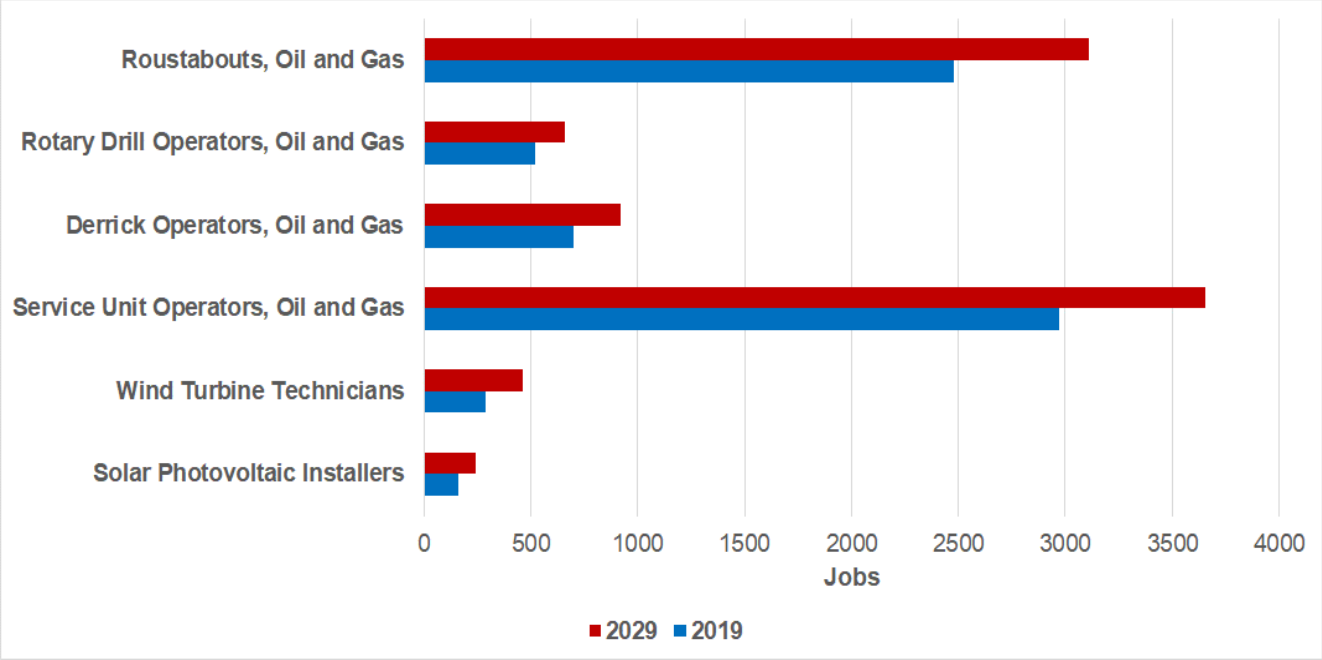
- Derrick Operators, Oil and Gas – 31%
- Rotary Drill Operators, Oil and Gas – 27%
- Roustabouts, Oil and Gas – 25%
- Service Unit Operators, Oil and Gas – 23%

The implications of this for at least some future green and non-green jobs is illustrated in Figure V-6, which compares the numbers of these fossil fuel jobs and green jobs in Colorado in 2019 and forecast 2029. This figure illustrates that, despite the fact that the two renewable energy jobs are increasing in percentage terms more rapidly than the four fossil fuel jobs, in 2029 there will be:

- More than 15 times as many jobs for Service Unit Operators, Oil and Gas, than for Solar Photovoltaic Installers
- Eight times as many jobs for Service Unit Operators, Oil and Gas, than for Wind Turbine Technicians
- 13 times as many jobs for Roustabouts, Oil and Gas, than for Solar Photovoltaic Installers
- Seven times as many jobs for Roustabouts, Oil and Gas, than for Wind Turbine Technicians
- Four times as many jobs for Derrick Operators, Oil and Gas, than for Solar Photovoltaic Installers
- Twice as many jobs for Derrick Operators, Oil and Gas, than for Wind Turbine Technicians
- Three times as many jobs for Rotary Drill Operators, than for Solar Photovoltaic Installers
- 40% more jobs for Rotary Drill Operators, than for Wind Turbine Technicians

[40]Ibid.

Figure V-6
Colorado Jobs: 2019 and Forecast 2029



Source: U.S. Bureau of Labor Statistics and Management Information Services, Inc.

V.D. Green Jobs Specifications and Controversies

It is also important to focus on the "green" jobs, skills, and occupations that are realistic for meaningful job creation. Several examples may suffice.

First, energy efficiency (EE) is recognized as a key area for green job creation in Colorado – and elsewhere.[41] The return on investment for EE initiatives is attractive, there are substantial numbers of EE jobs in the state, and they are increasing and will continue to increase. Further, President Biden's proposed Civilian Climate Corps would represent a huge expansion of energy efficiency jobs.[42]

But what is an "energy efficiency job?" What education, skills, training, and experience are required? These are almost certainly much more prosaic than environmentalists and energy efficiency advocates may prefer or even comprehend.

[41]See, for example, https://www.usenergyjobs.org/; https://acore.org/clean-energy-Covid-19-economic-crisis/; https://ases.org/wp-content/uploads/2019/01/CO_Jobs_Rpt_Jan2009_summary.pdf.
[42]https://www.npr.org/2021/05/07/994812209/bidens-civilian-climate-corps-would-tackle-climate-change-care-for-public-lands.

For example, there are millions of square feet of residential, commercial, and industry space in Colorado that require energy efficiency enhancements, and doing so will undoubtedly create many jobs. What types of job requirements would be created? What kind of green energy efficiency occupations would be in demand?

One of the most in-demand jobs will be Drywall Installers, who will be essential to most basic energy efficiency improvements. On the interior of buildings, drywall will have to first be removed. Then, structural improvements will have to be made, energy efficient windows and doors installed, and related energy efficient enhancements made, and insulation will have to be installed. Then, new drywall will have to be installed.

At present, there are approximately 3,500 drywall installers in Colorado with an annual mean wage of about $52,800.[43] Any ambitious energy efficiency initiatives in the state will require a large, rapid, continuing increase in the number of drywall installers. Training them would require a minimum of several months plus addition on the job training (OJT) and apprenticeship training. Such "green" jobs are an attractive target since they:

- Do not require advanced degrees.
- Are feasible for desired target populations, e.g., minorities, those with minimal formal education, persons with poor work histories, etc.[44]
- Are "good" jobs that pay well and support a middle class standard of living
- Are candidates for union labor.
- Will remain in demand indefinitely in the construction and remodeling industries.

Nevertheless, drywall installers may not be conventionally considered to be "green" jobs or occupations. They are not ecologists, solar energy engineers, environmental lawyers, etc. That is, they are not generally defined as sexy, exciting "green" jobs.

Another example is heating, ventilation, and air conditioning (HVAC) jobs. At present there are approximately 7,000 workers in Colorado classified as Heating, Air Conditioning, and Refrigeration Mechanics and Installers with an annual mean wage of about $55,700.[45] These will also be in continuing high demand, and such "green" jobs are an attractive target for many of the same reasons as drywall installers. However, the skills and job training requirements are much more rigorous and demanding than for drywall installers. Further, HVAC jobs are feasible for minorities, poor, and the disadvantaged in providing useful, marketable energy efficiency/renewable energy skills that can assist low-income persons in increasing the energy efficiency of their residences and reducing their HVAC bills. In addition, and critical, HVAC training provides students with portable, stackable credentials that allow them to successfully obtain full-time jobs and build careers.

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[43]U.S. Bureau of Labor Statistics, "May 2020 State Occupational Employment and Wage Estimates, Colorado," https://www.bls.gov/oes/current/oes_co.htm.

[44]https://www.ecasavesenergy.org/training-center.

[45]U.S. Bureau of Labor Statistics, "May 2020 State Occupational Employment and Wage Estimates, Colorado," op. cit.

However, there are at least two caveats. First, Heating, Air Conditioning, and Refrigeration Mechanics and Installers is not a unique “green” job classification. Much of the job function may not even be defined as being “green.”

Second, and more basic, in Colorado and elsewhere, much of what this job function entails is air conditioning (AC)/climate control, and this is increasingly a major portion of what the job entails. However, environmentalists and green advocates contend that AC is a serious and rapidly growing problem relating to energy consumption and the impacts on climate.[46] They contend that the goal should be to minimize, or even eliminate, the need for AC. This, of course, would minimize, or even eliminate, the need for Heating, Air Conditioning, and Refrigeration Mechanics and Installers and related jobs.

Green job definitions can be even more controversial. For example, in April 2021, Presidential climate adviser Gina McCarthy confirmed that White House plans for a clean electricity standard (CES) would allow for nuclear power and carbon capture technologies – carbon capture and sequestration (CCS) and direct air capture (DAC).[47] McCarthy stated that the Administration considers a clean energy standard to be an integral part of its effort to achieve zero carbon emissions: "We think it's one of the best methods to actually get the reductions we're looking for with a level of certainty, and the energy sector seems to understand that."

Nuclear power does not directly produce any CO_2, and many experts say it should be included in any net-zero plans because of its large existing generating capacity and its ability to consistently and reliably provide large amounts of base load power. Nuclear energy is controversial, and has been criticized by many environmentalists over its radioactive waste and safety concerns. Similarly, some environmentalists and green energy groups have also called on Biden to abandon CCS, contending that it prolongs the use of fossil fuels. However, McCarthy stated that the CES would be "fairly robust, and it's going to be inclusive. Clearly, we think a CES is appropriate and advisable, and we think the industry itself sees it as one of the most flexible and most effective tools."[48]

McCarthy did not provide details about how far a CES would go in supporting nuclear power. It is possible that the policy may only cover plants that are currently operating, but it may also extend to include new plants. The former is more likely than the latter, given the challenges and costs involved in building new nuclear capacity. In any case, as shown in Figure V-7, nuclear power is not a significant component of Colorado’s energy generation mix.[49]

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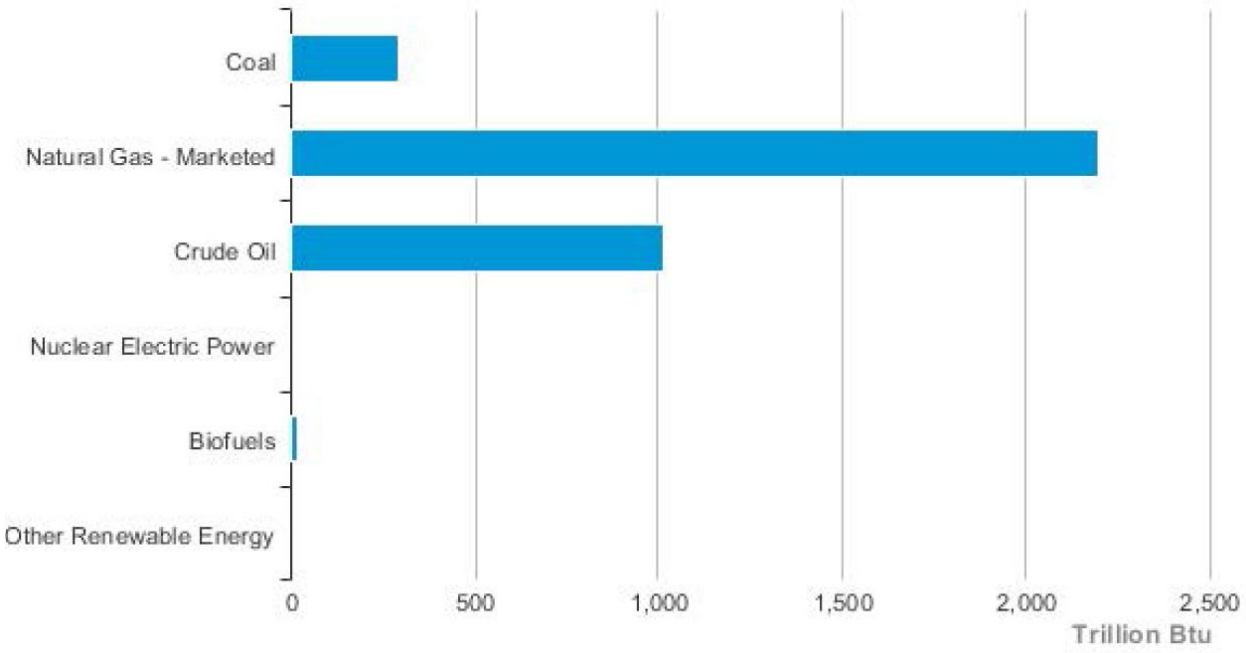
[46]See, for example, https://www.theguardian.com/environment/2019/aug/29/the-air-conditioning-trap-how-cold-air-is-heating-the-world.

[47]Lesley Clark, “Gina McCarthy: Clean Energy Standard to Include Nuclear, CCS,” *E&E News*, April 2, 2021; Ari Natter, “White House Wants Nuclear in Clean Energy Mandate, McCarthy Says,” Apr 02 2021, https://www.bloombergquint.com/business/white-house-wants-nuclear-in-clean-energy-mandate-mccarthy-says.

[48]Ibid.

[49]https://www.eia.gov/state/analysis.php?sid=CO.

Figure V-7
Colorado Energy Production, 2018



Source: U.S. Energy Information Administration.

However, as shown in Figure V-7, coal, oil, and natural gas are major components of the Colorado energy economy. Specifically:[50]

- Colorado is the fifth-largest crude oil-producing state, with 90% of production coming from one county.
- Colorado was the seventh-largest natural gas-producing state in 2020 and accounted for almost two-fifths of total U.S. coalbed methane production in 2019.
- In 2020, coal-fired power plants provided 36% of Colorado's net generation, a decrease from 68% in 2010, while electricity from natural gas increased.

Thus, CCS is destined to play a major role in Colorado's energy and environmental future.

CCS has long been proposed as a solution to fossil fuels' CO_2 emissions problems. The technology captures CO_2 from power plant exhaust streams and sequesters it underground. However, the technology has been criticized by

[50]Ibid.

environmental and green energy advocates for prolonging reliance on fossil fuels,[51] and no commercial power plant in the U.S. currently uses CCS, although there is an existing pilot-scale plant -- NRG's Petra Nova plant in Texas.[52]

There is much to recommend CCS:

- It is a proven GHG reduction technology.
- The White House CES would allow for CCS.
- The UN, IEA, and other organizations have concluded that ambitious GHG reduction goals are simply not feasible without massive CCS initiatives.[53]
- The National Academies of Science determined that CCS can be one of the critical strategies for reducing net carbon emissions.[54]
- Even advocates of the Green New Deal have acknowledged the necessity for CCS as a part of the program.[55]
- CCS enjoys strong bipartisan support from organized labor.[56]
- CCS enjoys strong bipartisan support in the state legislature and in the U.S. Congress.[57]
- It is a program that will likely continue to enjoy broad support for many years to come.
- When combined with enhanced oil recovery (EOR), CCS is economically viable.

At present, except for a small number of R&D jobs at the National Renewable Energy Laboratory in Golden, there are few CCS jobs in Colorado.[58] However, as the UN, the International Energy Agency (IEA), and numerous other organizations have concluded, to achieve the IPCCC GHG reduction goals massive amounts of CCS will be required not only for power plants but also for commercial and industrial facilities

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[51]For example, Greenpeace contends that "CCS is a false climate solution that bolsters big oil." Carbon-Capture-Scam.pdf (greenpeace.org).

[52]https://www.nrg.com/case-studies/petra-nova.html.

[53]"If the world is to succeed in constraining CO_2 emissions to levels consistent with a less than 2°C rise in global temperatures, then Carbon Capture and Storage (CCS) will need to contribute about one-sixth of needed CO_2 emission reductions in 2050, and 14 percent of the cumulative emissions reductions between 2015 and 2050." United Nations Commission for Europe, Carbon Capture and Storage: A Technological Challenge Already Solved," 2020.

[54]https://www.nap.edu/catalog/10922/the-hydrogen-economy-opportunities-costs-barriers-and-rd-needs.

[55]See, for example, "The Green New Deal and Carbon Dioxide Removal Approaches," https://energycentral.com/c/ec/green-new-deal-and-carbon-dioxide-removal-approaches#:~:text=In%202019%2C%20Representative%20Alexandria%20Ocasio,(D%2DNY)%20introduced%20H.R.&text=CDR%20processes%20achieve%20this%20by,away%20through%20sequestration%20or%20utilization; https://www.vox.com/energy-and-environment/2019/1/15/18181678/green-new-deal-100-percent-renewable-energy-nuclear-ccs; Jessica McDonald, "The Facts on the 'Green New Deal,'" https://www.factcheck.org/2019/02/the-facts-on-the-green-new-deal/.

[56]"Bracing For Life After Coal," *Bloomberg Businessweek*, May 10, 2021.

[57]For example, in the U.S. Congress, at the FY20 DOE Budget Hearing, Representative Greg Walden stated "I am encouraged by the work DOE is doing to support transformative breakthroughs in 'carbon free' fossil energy and carbon capture technologies." Opening Statement of Republican Leader Greg Walden, Subcommittee on Energy "The Fiscal Year 2020 DOE Budget," May 9, 2019. Further, presumptive Democrat Presidential nominee, Joe Biden, is on record as supporting CCUS.

[58]https://www.nrel.gov/docs/fy21osti/72330.pdf.

including steel, chemicals, cement, fertilizers, plastics, and others.[59] Further, this will have to be accomplished very rapidly, and the CCS industry will have to become at least as large as the current oil and gas industry in a very short time – 30 years or less, whereas it took the oil and gas industry 100 years to reach its current size.[60] According to Brad Page, CEO of the Global CCS Institute "We have an uncomfortable reality, quite frankly. It's very hard to get away from needing carbon capture and storage both to avoid emissions and also to be a significant part of carbon dioxide removal."[61]

Since Colorado is a fossil fuel energy intensive state, CCS may have to become a major industry and source of jobs in Colorado by 2030, and probably much sooner. Estimates have been made of the numbers and types of jobs created by a large CCS industry, and these are applicable to Colorado.[62] As noted, Colorado is the nation's fifth-largest crude oil-producing state and the seventh-largest natural gas-producing state.[63] Thus, Colorado would be required to create a disproportionately large share of the U.S. CCS industry and jobs. MISI estimates that by 2030, an ambitious U.S. CCS initiative could result in the creation of 40,000 – 60,000 jobs (direct and indirect) in the state. Many of these jobs would be relatively high-skilled and well-paying and a large portion would likely be union jobs. If these were classified as "green" jobs, they would represent a non-trivial portion of Colorado green jobs – and of energy jobs in general, in the state. For example, if there were 60,000 CCS jobs in Colorado in 2030, this would represent 12% of all green jobs in the state in that year.

Other states have already instituted ambitious CCS jobs training programs. For example, in June 2020 in New Mexico, the San Juan College School of Energy, the City of Farmington, the Farmington Electric Utility System, and Enchant Energy signed a memorandum of understanding (MOU) to develop programs that will result in the skilled CCS workforce required.[64]

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[59]United Nations Commission for Europe, op. cit.

[60]Jeff McMahon, "Carbon Capture Has to Get as Big As Oil Industry in Less Than 30 Years," *Forbes*, April 4, 2021.

[61]Brad Page, "Energy Seminar: Why CCS Matters in a Net Zero Emissions World," March 29, 2021, https://energy.stanford.edu/events/energy-seminar-brad-page-ceo-global-ccs-institute.

[62]https://www.nationalcoalcouncil.org/studies/2017/CO2-EOR-and-CTL-Economics.pdf.

[63]https://www.eia.gov/state/analysis.php?sid=CO.

[64]San Juan College School of Energy, the City of Farmington, Farmington Electric Utility System and Enchant Energy, "Memorandum of Understanding to Guide Collaboration For Development of Skilled Workforce at San Juan Generating Station, June 29, 2020. Under the MOU, the School of Energy will support professional development training for current and new employees at the plant. The school will also train a new workforce with the skills needed for the ongoing control, operation, and maintenance of the plant and future carbon capture facilities. In addition, the School of Energy plans to develop a one-year certification and a two-year Associate of Applied Science degree that will include the technical skills and training needed to work in coal-fired power plants equipped with carbon capture technology. The carbon capture contractor, Kiewit Power Constructors, estimates that the carbon capture island alone will require 2,000,000 worker-hours in direct construction, union labor to build.

MISI has conducted extensive research on the types of jobs, skills, and occupations that would be generated by CCS initiatives.[65] This research found that ambitious CCS initiatives would generate large numbers of jobs in the Utilities, Construction, O&M, Manufacturing, and related industries. These jobs would be disproportionately for technical, high-skilled occupations paying above average wages, and the employees would be unionized to a much greater extent than the average U.S. labor force. Thus, these jobs would be of the type advocated by green energy and green new deal advocates.

The question is, however, would these jobs be classified as "green?" According to the Biden White House, the answer is "yes." However, as noted, many environmentalists and green energy advocates would answer in the negative.

As noted, except for researchers at the National Renewable Energy Laboratory, there currently are relatively few CCS jobs in Colorado. However, major GHG reduction efforts will require widespread extensive CCS initiatives on power plants and industrial and commercial facilities. Thus, within a few years there could be many thousands of CCS-related jobs in the state – whether or not they are classified as being "green."

More generally, green jobs will be created across a new continuum of employment, skills, responsibilities, and earnings, and training for new skills will be needed across a wide spectrum of industries.[66] Some changes in skills are relatively well defined, but many likely changes remain difficult to forecast since the technologies are still evolving. Notably, many of these jobs do not currently exist and do not have occupational titles defined in federal and state government occupational handbooks and employment guides. Further, many of these new jobs require different skills and education than current jobs, and training needs must be determined to enable this rapidly growing sector of the U.S. economy and labor market to have a sufficient supply of trained and qualified employees. Eventually, most of these occupations will grow, the number of employees classified in the occupations will increase, and federal and state governments will add them to the employment classifications. Until then, labor market and employment analysis and forecasting will be performed using the current set of U.S. Labor Department occupational titles and job descriptions.[67]

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[65]See, for example Management Information Services, Inc., "Assessment of the Jobs Impacts of CCUS Retrofit of Four Coal Power Plants in Wyoming," prepared for the U.S. Department of Energy, July 2020; Management Information Services, Inc., "Analyzing the Economic and Job Impacts of the DOE R&D Program and CCS Tax Credits," prepared for the National Energy Technology Laboratory, December 2017; Management Information Services, Inc., "Employment Impact Analysis of Coal Carbon Capture and Sequestration Retrofits," prepared for National Energy Technology Laboratory, August 2015.

[66]See the discussion in Roger H. Bezdek, "The Hydrogen Economy and Jobs of the Future," *Electrochemical Society Transactions From the Fuel Cell Seminar & Energy Exposition 2019*, February 2020; Roger H. Bezdek, "The Hydrogen Economy and Jobs of the Future," *Renewable Energy and Environmental Sustainability*, Vol. 4, No. 1 (2019).

[67]These are listed in the U.S. Department of Labor, Bureau of Labor Statistics, Standard Occupational Classification. Available at https://www.bls.gov/soc/. Also see U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Outlook Handbook*. Available at https://www.bls.gov/ooh/.

V.E. Green Jobs and Unions

V.E.1. Green Jobs Salaries

Ideally, green energy advocates believe that green jobs should be relatively well paying, have generous benefits, and be unionized to the highest degree possible. However, there is substantial controversy over this issue.

On the one hand, E2's Clean Jobs America report derived three major findings concerning green energy jobs:[68]

- Median hourly wages for clean energy jobs overall are about 25 percent higher than the national median wage.
- Clean energy jobs are more likely to come with health care and retirement benefits than jobs across the rest of the private sector.
- Unionization rates for clean energy jobs are slightly higher than the rest of the private sector, with a few exceptions.

E2 defined job quality largely in terms of wages and the provision of employment benefits, such as health care and retirement contributions. However, additional metrics, including unionization rates, demographic distribution, and educational requirements were also included.

E2 found that overall, median salaries for clean energy jobs are much higher than for jobs in sectors such as retail, service, and accommodations, especially when it comes to entry-level wages and for workers just entering the workforce. Clean energy job salaries are also comparable – and in some cases higher -- than fossil fuel job salaries. For example, jobs in coal, natural gas, and petroleum fuels pay about $24.37 an hour while jobs in solar and wind pay about $24.85 an hour. Similarly, jobs in energy efficiency -- the largest part of the green energy sector – have median salaries of about $24.44. Clean energy occupations also had higher rates of health care coverage, and virtually all enjoyed comparable or better retirement benefits than the national average. Finally, the clean energy industries' nine percent unionization rate is higher than the six percent unionization rate across the rest of the private sector, but varies by occupation.

On the other hand, there is considerable evidence that many green jobs may pay substantially less than the jobs they are displacing and that unionization rates for green jobs are relatively low. Further, many labor union officials are concerned with potential discrepancies in green jobs salaries and those in the fossil fuel industries and the implications of a "just transition."

The USEER studies found that energy industry workers employed by solar and wind power companies earn significantly less than those who mine coal or drill for

[68]E2, American Council on Renewable Energy, Clean Energy Leadership Institute, and BW Research Partnership, "Clean Jobs, Better Jobs: An Examination of Clean Energy Job Wages and Benefits," October 2020.

natural gas.[69] For example, the median wage for solar workers is $24.48 an hour compared with $30.33 for those employed by the natural gas sector, which amounts to a roughly $12,000 annual wage gap.[70] Such wage disparities threaten to undermine green energy advocates' contention that the U.S. can initiate a multitrillion-dollar assault on climate change while growing its economy and transitioning workers to well-paying green jobs.

Energy workers on the whole earn more than the typical U.S. worker, but the highest-paying positions are skewed heavily toward nuclear, utility, natural gas, and coal industry workers. Wind, solar, and "green" jobs were well below them on the median pay scale. According to former DOE Secretary Ernest Moniz, "The big message is that the energy industry has a significantly higher median wage than does the economy as a whole. There's clearly a distribution of wages -- as there is in any other sector -- because of the level at which specialized skills are needed."[71]

The median hourly wage for all U.S. energy workers is $25.60 -- 34 percent higher than the national median hourly wage of $19.14. And, while the energy sector has suffered during the COVID-19 pandemic, it has lost fewer jobs than other parts of the economy. Utility employees were the highest paid among energy industry segments, with a median wage of $41.08 per hour, which would amount to nearly $85,500 per year, while mining and fossil fuel extraction workers followed at $36.32 per hour, or more than $75,500 a year. The high concentration of utility jobs in the electric power generation and transmission, distribution, and storage sectors also means that workers in those positions earn higher than average wages.

Jobs in energy-specific construction, which would increase significantly under green initiatives, pay about $25.53 per hour, or just above $53,000 annually. Manufacturing jobs earned a median wage of $23.02, or nearly $48,000 per year. However, note that in Colorado, Rotary Drill Operators, Oil and Gas, earn about 35.50 per hour, or $74,000 per year, and coal miners earn about $31.60 per hour, or $63,000 per year.[72]

It is difficult to compare wages across energy technology sectors because of factors such as accessibility, skill, experience, education and training requirements, and geographic distribution.[73] Jobs that pay significantly higher than the national median wage are also likely to require more experience, education, training, and certifications.

Workers in the nuclear industry received a median hourly wage of $39.19, equivalent to $81,515 a year -- more than double the national median, although the

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[69]https://www.usenergyjobs.org/.
[70]Kelsey Tamborrino, "The Wage Gap That Threatens Biden's Climate Plan, *Politico*, April 6, 2021; U.S. Energy Employment Report: Colorado Energy and Employment – 2019, op. cit.
[71]Ibid.
[72]U.S. Bureau of Labor Statistics, "May 2020 State Occupational Employment and Wage Estimates, Colorado," op. cit.
[73]https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/606d1178a0ee8f1a53e66206/1617760641036/Wage+Report.pdf.

industry accounts for less than one percent of total energy jobs. Nuclear industry workers tend to need advanced training and other requirements, increasing their earning power. However, they face a wave of nuclear plant retirements, with five nuclear reactors scheduled to close during 2021.[74] Shutdowns of nuclear plants could also threaten the U.S. effort to fight climate change: According to Moniz, "Without the nuclear fleet carrying on, our carbon goals just become all that much more difficult because nuclear remains the single highest zero-carbon electricity source."[75]

Energy efficiency workers, including those engaged in building efficiency improvements such as weatherization, comprised 28.4 percent of total energy employment in 2019. However, workers in that sector have a median wage of $24.44 an hour -- significantly lower than nuclear industry workers and nearly $6 lower per hour than natural gas workers, who make $30.33/hr. Fast-growing sectors in the renewable energy sector, solar and wind, also have median wages below that of fossil fuel workers: $24.48 for solar and $25.95 for wind.[76]

V.E.2. Unions and the Just Transition

The issues of the unionization level of green energy jobs and the implications for organized labor are contentious and controversial. For example, 18% of workers in the oil and gas industries are members of a union while only 4% of workers in renewable energy jobs are union members.[77] Also, the number of workers needed to keep a solar or wind farm operational after is it built is typically lower than the number needed to keep the oil and gas industry functioning. On the other hand, boom and bust cycles are the norm in the fossil fuel industry. Workers making a six figure income today often find themselves in the unemployment line tomorrow.[78]

And while solar installer and wind turbine technician jobs may be increasing rapidly, there are still far fewer of them than in competing energy fields and they are not necessarily in the same locations as displaced fossil-fuel workers. For example, Jeff Nobers, executive director of the Builders Guild of Western Pennsylvania, stated “These are the jobs you're going to have, but nobody can really tell us what they are. And then some other obvious questions. Will people have to move? Do I have to relocate my family?”[79]

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[74]Rebecca Rainey and Eric Wolff, “Biden's Green Energy Plans Clash With Pledge to Create Union Jobs,” *Politico*, April 2, 2021.
[75]Kelsey Tamborrino, op. cit.; U.S. Energy Employment Report: Colorado Energy and Employment – 2019, op. cit.
[76]Ibid.
[77]“Analysis: Biden’s Clean-Energy ‘Revolution’ Faces Challenge to Match Fossil-Fuel Jobs, Pay,” *Reuters*, https://www.reuters.com/article/usa-election-labor-renewables/analysis-bidens-clean-energy-revolution-faces-challenge-to-match-fossil-fuel-jobs-pay-idUSKBN27F1LX?edition-redirect=uk.
[78]Ibid.
[79]Kelsey Tamborrino, op. cit.

Organized labor abhors the term “just transition,” but most green energy advocates and their allies continue to use it. Too often, though, the message gets subsumed in a broader culture war that paints Washington-conceived solutions as at best fools’ gold, at worst a death sentence. According to Phil Smith, spokesman for the United Mine Workers, “They’ve got a long way to go to convince people that what could happen will actually be positive for them. Because right now, they don’t believe that. There's never been such a thing as a just transition. Now, at least people are talking about the need for it, which is which is a step in the right direction. But there's been no example in this country of how to do that.”[80] UMW president Cecil Roberts stated “We believe that the Second Coming of the Lord is gonna get here before a just transition makes it our way.”[81]

Similarly, Liz Shuler, secretary-treasurer of the AFL-CIO, stated “There's members saying, ‘If we're moving into this, if we're transitioning into all these new jobs, where's mine?’ So outline specifically how the transition will be laid out. Is it going to be a bridge for those who are close to retirement? Is it going to be wage replacement? Is it going to be training up folks into the next opportunity?”[82] Jeff Nobers warns that “The skills learned in one area are less transferable than policymakers imagine. Many clean-energy jobs are ‘at the margins,’ and tend to disappear once the solar panels and wind turbines are up and running.”[83]

Labor groups are concerned that a green transition will eliminate the kind of steady, fixed-location jobs provided by coal mines or fossil fuel power plants, and instead will lead to temporary construction jobs that require mobility. But labor groups worry that construction and installation jobs will be low paying and temporary. They contend that only manufacturing has traditionally offered higher pay and benefits and can sustain a work force for years.[84]

A second concern is that wind farms, solar plants, and other green and climate-friendly power sources will need few workers to maintain them and keep them operating.[85] The prospect that workers would also receive significantly less pay only adds to green energy advocates’ challenges in persuading workers that their strategy is also a jobs strategy. Brad Markell, executive director of the AFL-CIO Industrial Union Council, stated "For people that are in the fossil sector, the prospect of moving to the clean energy sector if you have to take a pay cut is not attractive."

Green energy advocates are not trusted messengers, given that many of them have long endorsed environmental policies that workers in fossil fuel-reliant sectors view as an assault on their employment and a danger to their communities. Green

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[80]Zack Colman and Anthony Adragna, “Biden Takes on Democrats’ ‘Mission Impossible’: Revitalizing Coal Country,” *Politico*, April 18, 2021.
[81]“Bracing For Life After Coal,” *Bloomberg Businessweek*, May 10, 2021.
[82]Kelsey Tamborrino, op. cit.
[83]Kelsey Tamborrino, op. cit.
[84]https://www.nytimes.com/2021/05/11/business/economy/clean-energy-biden.html?action=click&module=Top%20Stories&pgtype=Homepage.
[85]https://www.politico.com/news/2021/04/02/biden-green-jobs-plan-unions-478986.

energy advocate contend that clean energy is the future, and the jobs are there. However, the jobs often are not in the right places or with the right benefits. Obama and Hillary Clinton both had plans for a coal country transition, but they are best remembered for Clinton's campaign-trail gaffe that "We're going to put a lot of coal miners and coal companies out of business," which still resonates.[86]

According to Representative Andy Levin (D-Mich.), a former labor organizer and clean-energy consultant, "It's really maddening to me when people say to a boilermaker or a pipe-fitter or a laborer with a capital L who is an expert in pipeline work, 'Oh, don't worry, you can go install solar panels.' That is insulting, a) because it doesn't comprehend the incredible skill of their work and b) because it doesn't comprehend that they have really a whole culture around the work they do."[87]

The challenge of transitioning to a new green economy while still respecting and including workers is already being felt in West Virginia, a state that has seen its coal economy decline precipitously over the past decade while policymakers struggle to create new economic opportunities. The state is uniquely positioned to reap the benefits of federal green investments through its two senators: Perennial swing vote Joe Manchin (D-W. Va.), and Environment and Public Works ranking member Shelley Moore Capito (R-W. Va.). West Virginians contend that residents of the state now by-and-large accept the notion that the coal sector is not likely to rebound -- despite former President Trump's promises -- but many nonetheless remain skeptical of promises of new green jobs and investment. There still exists widespread resentment about the perception that environmental regulations from the Obama Administration hastened coal's decline.

Brandon Dennison, founder of Coalfield Development, which aims to foster new businesses in Appalachia, stated that "Promises of job retraining are a bit of a trigger that sets people off because such programs are difficult to pull off, require people to put any current employment on hold, and often yield jobs that don't pay as well as coal mining positions, which don't require a college education."[88]

Fairness is where workers, especially those involved in organized labor, find fault with the proposed green economic makeover. Some clean-energy companies lack the most basic of labor protections. Many categorize their workforce as contractors, denying them full benefits. Very few wind and solar companies have unions, and many opposed unionization efforts. Tesla CEO Elon Musk has taken a particularly strong stance against unions, with the National Labor Relations Board demanding he remove a tweet that allegedly threatened organizers. And making electric vehicles requires fewer parts than internal combustion engine-powered cars, translating to fewer workers.[89]

[86]Ibid.
[87]Ibid.
[88]Ibid.
[89]Ibid.

Labor groups contend that companies have either deterred or actively opposed unionization among workers employed in installation and construction, which in the U.S. represent most of the jobs in renewables. That has depressed wages while depriving workers of coveted health and retirement benefits. Terry O'Sullivan, general president of the Laborers' International Union of North America (LIUNA), stated "The new green economy has been heralded as a win-win for workers and the environment, but that's a big lie to working men and women when wind and solar developers discourage unionization efforts, which we are seeing on most of the large- scale utility projects."[90]

One major deterrent to labor organizing is that developers often rely on recruitment agencies to provide their workers. According to the North America's Building Trades Union (NABTU), less than a quarter of wind and solar projects that got under way in 2020 are using union labor.[91]

Joe Uehlein, president of the Labor Network for Sustainability, contends that solar companies often require installers to sign contracts stating they're independent contractors, making them ineligible to join unions. He states "They aren't good actors when it comes to treating their workers."[92]

V.E.3. A Union Developed Green Jobs Program For Colorado

Given the potential conflict between unions and green jobs programs, it is important to assess a green jobs program for Colorado developed by unions. As noted, the Colorado AFL-CIO and eight Colorado unions developed a plan for a transformative green jobs program for Colorado.[93] In addition to the Colorado AFL-CIO, the plan was sponsored by:

- The Colorado State Conference of Electrical Workers (CSCEW)
- United Association (UA) Local 208
- Colorado Building & Construction Trades Council
- Boilermakers Local 101
- Service Employees Industrial Union (SEIU) Local 105
- Laborers International Union of North America (LIUNA) Local 720
- Communications Workers of America (CWA) District 7
- The Denver Area Labor Federation.

The centerpiece of the program is clean energy investments, undertaken in combination by the public and private sectors throughout the state, and it has two fundamental goals:

[90]Saijel Kishan, "Not-so-Great Green Jobs," *Bloomberg Businessweek*, April 26, 2021.
[91]Ibid.
[92]Ibid.
[93]https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.

- Promoting global climate stabilization by reducing carbon dioxide emissions in Colorado without increasing emissions outside of the state.
- Expanding good green job opportunities throughout the state.

The plan recommends investing $14.5 billion per year in clean energy projects in Colorado, which the plan estimates will generate about 100,000 jobs per year in the state. New job opportunities will be created in a wide range of areas, including construction, sales, management, production, engineering, and office support, and the program recommends a just transition for fossil fuel industry dependent workers and communities.[94]

The first goal for clean energy investments will be to achieve, by 2030, a 50% reduction in CO_2 emissions in Colorado relative to the 2005 level of emissions. Emissions in Colorado as of 2005 were at 95.2 million metric tons. The emissions level as of 2030 will therefore need to be no more than 48 million tons.

The plan recommends major areas of clean energy investments:

- Energy Efficiency -- dramatically improving energy efficiency standards in Colorado's stock of buildings, vehicles, public transportation systems, and industrial production processes.
- Clean Renewable Energy -- dramatically expanding the supply of clean renewable energy sources -- primarily wind, solar, and geothermal power -- available at competitive prices to all sectors of Colorado's economy.

It estimates that the level of investment needed to achieve Colorado's energy goals will be approximately $14.5 billion per year between 2021 and 2030. This estimate assumes that Colorado's economic growth proceeds at an average rate of 2.4% per year, and clean energy investments will need to equal about 3.5% of Colorado's annual GDP. The average annual clean energy investment level of 3.5% of GDP implies that about 96% of Colorado's economic activity will be directly engaged in activities other than clean energy investments. The plan contends that increasing efficiency standards will enable consumers to spend less for a given amount of energy services. It estimates that the average Colorado household should be able to save about 36% on their overall annual energy bill, reducing spending from $4,600 to $2,900.[95]

The major thrust of the plan is job creation through clean energy investments, and it estimates that investing $14.5 billion per year in clean energy projects in Colorado will generate about 100,000 jobs per year in the state. Specifically:

- New job opportunities will be created in a wide range of areas, including construction, sales, management, production, engineering, and office support.

[94]https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.

[95]This would be after they have paid off their initial up-front efficiency investments over five years. DSIRE (2015): Local Option - Property Tax Exemption for Renewable Energy Systems. NC Clean Energy Technology Center. Available online at http://programs.dsireusa.org/system/program/detail/2501.

- Current average total compensation in these occupations ranges between about $60,000 and $100,000.
- Employment growth in these areas should create increased opportunities for women and minority workers to be employed and to raise unionization rates.
- Higher unionization rates should promote gains in compensation and better working conditions in the affected industries.
- Good-quality worker training programs will be needed to ensure that a wide range of workers will have access to the jobs created by clean energy investments and that the newly-employed workers can perform their jobs at high productivity levels.

The plan also contains recommendations for a "just transition for fossil fuel industry dependent workers and communities."[96] It notes that about 88% percent of all energy consumption in Colorado currently derives from burning oil, coal, and natural gas and estimates that consumption of oil and gas will need to decrease by about 40% as of 2030 while coal consumption will need to decline by 70%.

The plan estimates that about 34,000 workers in Colorado are currently employed in 10 industries that will be heavily affected by the implied reductions in statewide fossil fuel consumption. It estimates that total job losses will average 688 per year, 585 of which are non-managerial. This is after allowing that an average of 745 workers per year will voluntarily retire.

The plan's Just Transition program for all non-managerial workers presently employed in Colorado's fossil fuel related industries includes five components:

1. Pension guarantees for retired workers who are covered by employer-financed pensions.
2. Retraining to assist displaced workers to obtain the skills needed for a new job and 100 percent wage replacement while training.
3. Re-employment for displaced workers through an employment guarantee, with 100 percent wage insurance.
4. Relocation support for all workers who require this support.
5. Full Just Transition support for older workers who choose to continue working past the age of 65 rather than retiring.

The plan estimates that the average costs of supporting these workers will amount to about $234,000 per worker, or about $78,000 per year over three years. Overall costs will amount to about $114 million per year over the duration of the Just Transition program.

The plan builds on the existing Colorado Climate Plan, and the main recommended policy measures include:

- A carbon tax -- revenues from a carbon tax estimated at varying tax rates.

96https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado.

- A flat tax rate of $15 per ton of carbon, which will generate about $1 billion in revenues per year.
- A tax rate that increases from $25 to $75 per ton of carbon over 2021 – 2030, which will generate about $3 billion per year.

The revenues can be used to both rebate lower-income households and finance Colorado's clean energy investment programs.

The plan recommends strengthening existing energy efficiency and renewable energy portfolio standards:

- Strengthening existing procurement programs to support an expanding market for electric vehicles.
- Expanding subsidized financing policies currently available through the Colorado Climate Plan, including Property Assessed Clean Energy (PACE) financing, along with loan guarantees and tax incentives.

The plan recommends greatly expanding Colorado's current and recent worker training programs for clean energy employment opportunities. It recommends channeling new investment funds into communities that are significantly dependent on the state's fossil fuel related industries. These include Moffat, Weld, Cheyenne, Los Animas, Mesa, Gunnison and Yuma Counties. It states that support could be developed through expanding Colorado's Rural Response, Recovery and Resilience program (R4). It notes that Pueblo, Colorado, is already actively engaged in a green community transition. Pueblo's experiences underscore both the opportunities and challenges with green transition programs.

Finally, the plan's goal is to achieve a 90% percent CO_2 emissions reduction by 2050. It contends that Colorado can reduce its CO_2 emissions by 90 percent relative to its 2005 level, to nine million tons, by 2050 through continuing its clean energy investment program. Average clean energy investments would need to equal about 1.2% of state GDP per year over 2031 – 2050.

Our assessment of the plan is as follows.

It is encouraging that a consortium of Colorado unions has developed a detailed comprehensive green jobs plan that addresses most of the major issues involved in transitioning to green jobs and a more sustainable economy. It is notable because, as discussed, unions have often proven to be skeptical of green jobs initiatives and programs.[97] However, there are several problems with the plan.

First, while the plan development was sponsored by nine Colorado unions, it is notable and troubling that unions representing fossil fuel workers were not among the sponsors. These are the unions most opposed to transitioning from fossil fuels to alternative green energy,[98] and their buy-in to any green jobs plan is essential.

[97]See the discussion in Section V.E.2.
[98]https://www.politico.com/newsletters/the-long-game/2020/09/01/unions-fracture-over-climate-490237.

Second, the term "just transition" features prominently in the plan. As discussed in Section V.E.2, organized labor abhors the term "just transition," and the Colorado unions who developed the plan do not seem to be aware of this. According to Phil Smith, spokesman for the United Mine Workers, "They've got a long way to go to convince people that what could happen will actually be positive for them. Because right now, they don't believe that. There's never been such a thing as a just transition. Now, at least people are talking about the need for it, which is which is a step in the right direction. But there's been no example in this country of how to do that."[99] UMW president Cecil Roberts stated "We believe that the Second Coming of the Lord is gonna get here before a just transition makes it our way."[100]

Third, the plan estimate that total job losses resulting from the plan will average 688 per year is probably a gross under-estimate of the job loses likely to actually occur. As noted, Colorado is one of the largest fossil fuel producing states in the country.[101] Further, estimates of fossil-fuel related jobs in Colorado are in the range of 200,000 – or 20,000/yr, 2021 - 2030.[102] Thus any major transition away from fossil fuels is liable to create 20 to 30 times as many job losses as the plan estimates. This is significant for at least two reasons:

- It damages the credibility of the plan and its estimates and recommendations.
- The plan estimate that the average costs of supporting the displaced workers will amount to about $234,000 per worker. If the number of job losses is 20 to 30 times as large as this, the implications for the costs of supporting the displaced workers are obvious and ominous -- overall costs, instead of the plan estimate of about $114 million per year over the duration of the Just Transition program, could total as high as $3.4 billion per year.

Fourth, for displaced workers the plan recommends pension guarantees, retraining with 100 percent wage replacement, re-employment through an employment guarantee with 100 percent wage insurance, and relocation support. While laudable, such generous assistance is liable to be resented by the many thousands of Colorado workers excluded from such generous benefits.

Fifth, the plan recommends a substantial Colorado carbon tax to raise revenues. Such a tax on would put many Colorado businesses at a competitive disadvantage compared to firms in the other 49 states, and would be adamantly opposed by Colorado industry.

Finally, the plan estimates that new job opportunities will be created in a wide range of areas, and that the current average total compensation in these occupations

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[99]Zack Colman and Anthony Adragna, "Biden Takes on Democrats' 'Mission Impossible': Revitalizing Coal Country," *Politico*, April 18, 2021.
[100]"Bracing For Life After Coal," *Bloomberg Businessweek*, May 10, 2021.
[101]https://www.eia.gov/state/analysis.php?sid=CO.
[102]https://www.api.org/oil-and-natural-gas/energy-primers/hydraulic-fracturing/how-many-jobs-has-the-oil-and-natural-gas-industry-created.

ranges between about $60,000 and $100,000. However, the current average mean wage for all Colorado occupations is $60,800,[103] and it is not likely that the all or even most of the new jobs created would pay substantially more than this.

Nevertheless, these criticisms are not fatal and should not be interpreted as rendering the plan unreasonable or infeasible. More realistically, the plan represents a good starting point for negotiations with other interested parties for a union-endorsed green jobs initiative and should be evaluated as such. It thus represents a valuable contribution to the debate over green jobs and green jobs initiatives.

[103]U.S. Bureau of Labor Statistics, "May 2020 State Occupational Employment and Wage Estimates, Colorado," op. cit.

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