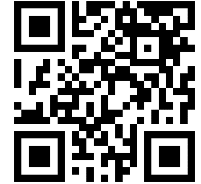


## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania



**Dr. Roger H. Bezdek**

Management Information Services Inc.

**ABSTRACT:** This paper estimates and forecasts the green economies and green jobs in the USA states of Colorado and Pennsylvania. The industry distribution of green jobs in each state is estimated by NAICS code. The occupational distribution of green jobs in each state is estimated by detailed occupational classification and skill levels. Green jobs for each state are forecast for the coming decade. We find substantial differences in the size, structure, distribution, and forecasts of green jobs in each state. We determine that 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 that green jobs in Colorado are forecast to increase much more rapidly than in Pennsylvania in both percentage and absolute terms. We determine that these changes will alter the future distribution of U.S. green jobs among the states. We also find that the distribution of green jobs among industry sectors in the two states differs significantly. Finally, we find that there are substantial differences in the industrial and occupational distributions of green jobs in Colorado and Pennsylvania. We discuss the implications for Colorado, Pennsylvania, and other states seeking to implement ambitious green initiatives.

**KEYWORDS:** Green jobs; green economies; state green economies; state green jobs, green jobs forecast; green occupations; state green jobs strategies.

### INTRODUCTION

Many states in the USA are aggressively implementing green industry and jobs initiatives to strengthen their economies and labor markets.<sup>1</sup> However, these initiatives are often misguided in that they fail to recognize the size, structure, and potential of the green industries and jobs in the states.

Here we address this issue by analyzing and forecasting the green economies and the jobs created by the green economies in the states of Colorado and Pennsylvania.<sup>2</sup> The two states represent excellent case studies: Colorado is a western state that is growing rapidly, whereas Pennsylvania is an eastern “rustbelt” state that is growing very slowly and has a labor force that is not expanding.

We estimate the size and industrial composition of the states’ green economies, analyze and forecast the jobs and occupations in each state created by the green economies, compare and contrast the green economies and jobs in the two states, and derive the implications for these two states and for other states seeking to increase their green economies and green jobs.

### I. SUMMARY OF THE GREEN INDUSTRY AND JOBS IN COLORADO

We estimate that in 2019:<sup>3</sup>

- Sales generated by green industries in Colorado totaled \$29.4 billion.
- The number of jobs (direct, indirect, and induced) generated in the state by the green economy totaled over 266,000.<sup>4</sup>
- The green economy in Colorado comprised 7.5% percent of gross state product.
- The Colorado green economy accounted for 4.5% of the U.S. green economy.
- Jobs generated by the green economy comprised 8.9 percent of Colorado employment.
- Jobs generated by the green economy in Colorado comprised 3.3 percent of the total number of green jobs in the U.S.

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

#### I.A. Industrial Distribution of Green Jobs

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

Table I-1 shows the industrial distribution of green jobs in Colorado in 2019 by NAICS code.<sup>5</sup>

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.

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.

**Table I-1 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	7,227
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

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

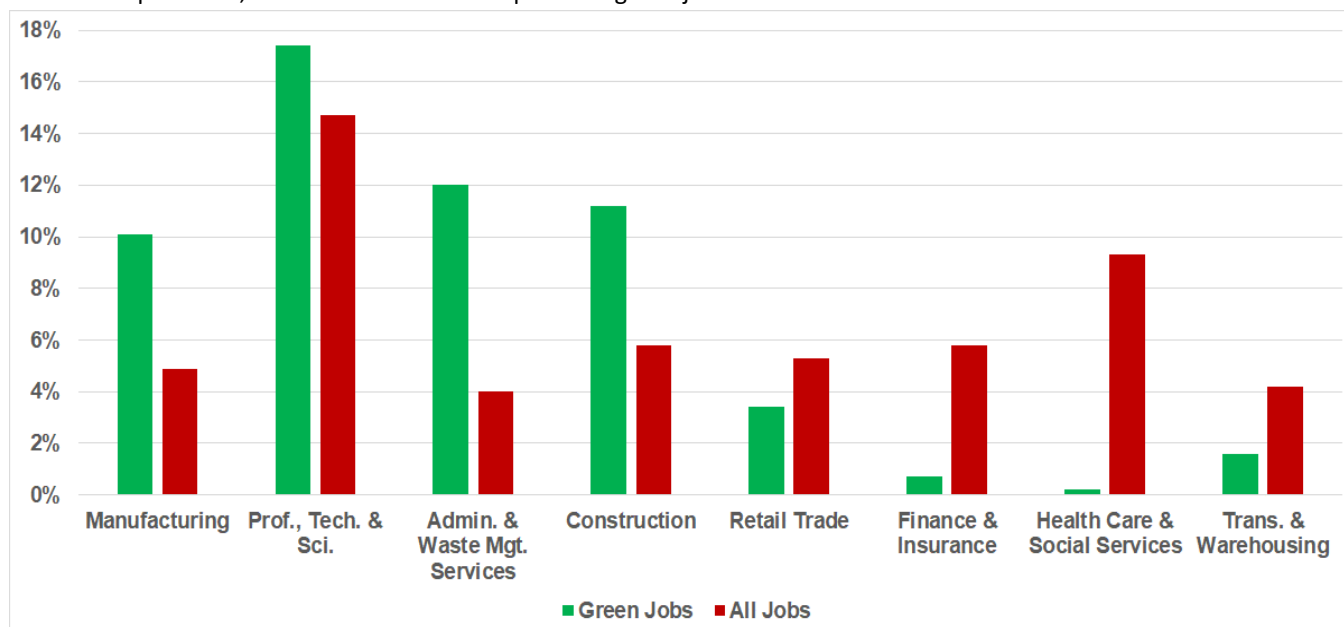
Other Services	81	39,174
Public Administration	92	41,555
<b>State Total</b>		<b>266,321</b>

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.



**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.

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-1 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-1 and Figure I-1 indicate that investments in green protection can be of considerable assistance here.

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

### I.B. 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-2. 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 varies substantially, employment in virtually all occupations is generated by the green economy.

**Table I-2 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.

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

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.<sup>6</sup> This is borne out in Table I-2 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.<sup>7</sup>

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.

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

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

- 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.

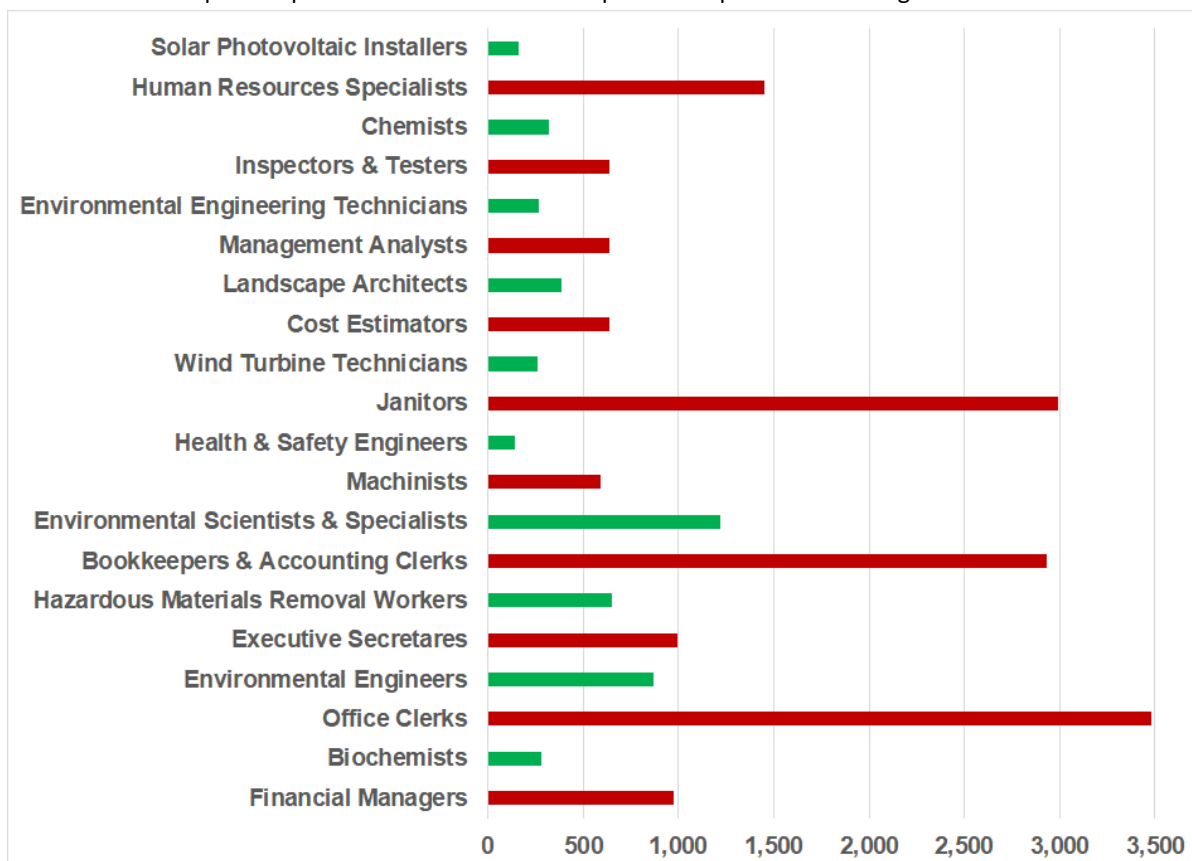


Figure I-2 Green Jobs Generated in Colorado in 2019, by Selected Occupations

Source: Management Information Services, Inc.

## II. GREEN INDUSTRIES AND GREEN JOBS IN PENNSYLVANIA

### II.A. Summary of the Green Industry and Jobs in Pennsylvania

We estimate that in 2019:<sup>8</sup>

- Sales generated by the green economy in Pennsylvania totaled \$42.9 billion.
- The number of green jobs totaled over 376,000.
- The green economy in Pennsylvania comprised 5.3% percent of gross state product.
- The Pennsylvania green economy accounted for 6.6% of the sales of the U.S. green economy.
- Green jobs comprised 6.1 percent of Pennsylvania employment.
- Green jobs in Pennsylvania comprised 4.7 percent of the total number of green jobs in the U.S.

We forecast that, post COVID-19, green jobs will increase three to four times more rapidly than total employment in the state.

Table II-1 shows the industrial distribution of green jobs in Pennsylvania in 2019.

Comparison of the industrial sector distribution of green jobs in Pennsylvania with that of total employment in the state is instructive. A significant portion of the green jobs is in the public administration sector which, given the public nature of green

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

programs, is to be expected. However, most of the green jobs in Pennsylvania 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 Pennsylvania is more manufacturing intensive than other average private sector activity in the state:

- Over 16 percent of private sector jobs in the green industry are in manufacturing, compared to nine percent in manufacturing among all private sector industrial activities in Pennsylvania.
- Over 17 percent of private sector green jobs are in professional, scientific, and technical services, compared to less than six percent of all private sector jobs in the state.
- Nearly 10 percent of private sector green jobs are in administrative, support, and waste management services, compared to less than six percent of all private sector jobs in the state.
- Less than three percent of private sector green jobs are in educational services, compared to over four percent of all private sector jobs in the state.

Conversely, there are relatively few private sector green jobs in other parts of the Pennsylvania economy:

- Less than five percent of private sector green jobs are in the retail trade sector, compared to over 10 percent in retail trade among all private sector jobs in the state.
- Less than one percent of green jobs are in the finance and insurance sector, compared to nearly five percent among all private sector jobs in the state.
- A little over one percent of green jobs are in the health care and social service sector, compared to over 17 percent among all private sector jobs in the state.
- Less than three percent of green jobs are in the transportation and warehousing sector, compared to four percent among all private sector jobs in the state.

Assessing the portion of total state employment in each industrial sector accounted for by green jobs indicates that the 376,700 green jobs accounted for about a little over six percent of the total 6.2 million jobs in Pennsylvania in 2019. However, this distribution is uneven among industry sectors:

- Over one-third of employment in the utilities sector consists of green jobs, primarily water, waste treatment, sanitation, and related facilities.
- Nearly ten percent of public administration employment (federal, state, and local) in the state consists of green jobs.
- Nearly 20 percent of Pennsylvania jobs in the professional, scientific, and technical services are green jobs.
- 11 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.

**Table II-1 Green Jobs in Pennsylvania in 2019, by Industry**

Industry	2017 NAICS code	Green Jobs
Agriculture, Forestry, Fishing and Hunting	11	3,041
Mining	21	4,189
Utilities	22	9,233
Construction	23	48,990
Manufacturing	31-33	61,505
Wholesale Trade	42	11,836
Retail Trade	44-45	17,393
Transportation and Warehousing	48-49	10,032
Information	51	3,715
Finance and Insurance	52	3,347
Real Estate and Rental and Leasing	53	3,257
Professional, Scientific, and Technical Services	54	65,361
Management of Companies and Enterprises	55	5,659
Administrative/Support/ Waste Management/ Remediation Services	56	37,212



## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

Educational Services	61	10,802
Health Care and Social Assistance	62	4,844
Arts, Entertainment, and Recreation	71	1,848
Accommodation and Food Services	72	3,438
Other Services	81	8,478
Public Administration	92	62,474
<b>State Total</b>		<b>376,655</b>

**Source:** U.S. Bureau of Labor Statistics, Pennsylvania Department of Labor, and Industry, and Management Information Services, Inc.

The concentration of green jobs within certain industrial sectors is instructive and interesting. While accounting for a little over six percent of total state employment, the industrial sector composition of green employment is highly skewed in favor of certain sectors. For example, more than 16 percent of private sector green jobs are in manufacturing, compared to nine percent of all private sector employment, and more than 17 percent of private sector green jobs are in professional, scientific, and technical services, compared to less than six percent of all private sector jobs in the state.

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

Similarly, green investments generate, proportionately, three times as many 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 Pennsylvania – and other states – seeks to attract and retain. Table II-1 indicates that investments in green protection can be of considerable assistance here.

### II.B. Green Jobs in Pennsylvania by Occupation and Skill

Green jobs in Pennsylvania can be disaggregated by specific occupations and skills, and this information for 2019 for selected occupations is given in Table II-2. This table illustrates that green jobs in Pennsylvania 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.

As noted, 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 II-2 and Figure II-1, which list the jobs created by environmental protection in Pennsylvania in 2019 within selected occupations. These show that in 2019 green industries in Pennsylvania generated:

- More jobs for welders (1,281) than for biochemists (481)
- More jobs for office clerks (4,686) than for environmental engineers (322)
- More jobs for executive secretaries and administrative assistants (1,933) than for hazardous materials removal workers (1,314)
- More jobs for bookkeeping and accounting clerks (4,622) than for environmental scientists and specialists (1,816)
- More jobs for machinists (1,186) than for health and safety engineers (341)
- More jobs for janitors (3,177) than for wind turbine technicians (224)
- More jobs for cost estimators (1,002) than for landscape architects (591)
- More jobs for management analysts (1,844) than for environmental engineering technicians (508)
- More jobs for inspectors and testers (1,502) than for chemists (566)
- More jobs for human resources specialists (1,882) than for solar photovoltaic installers (255)

Thus, many workers in Pennsylvania 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.<sup>9</sup>

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



## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

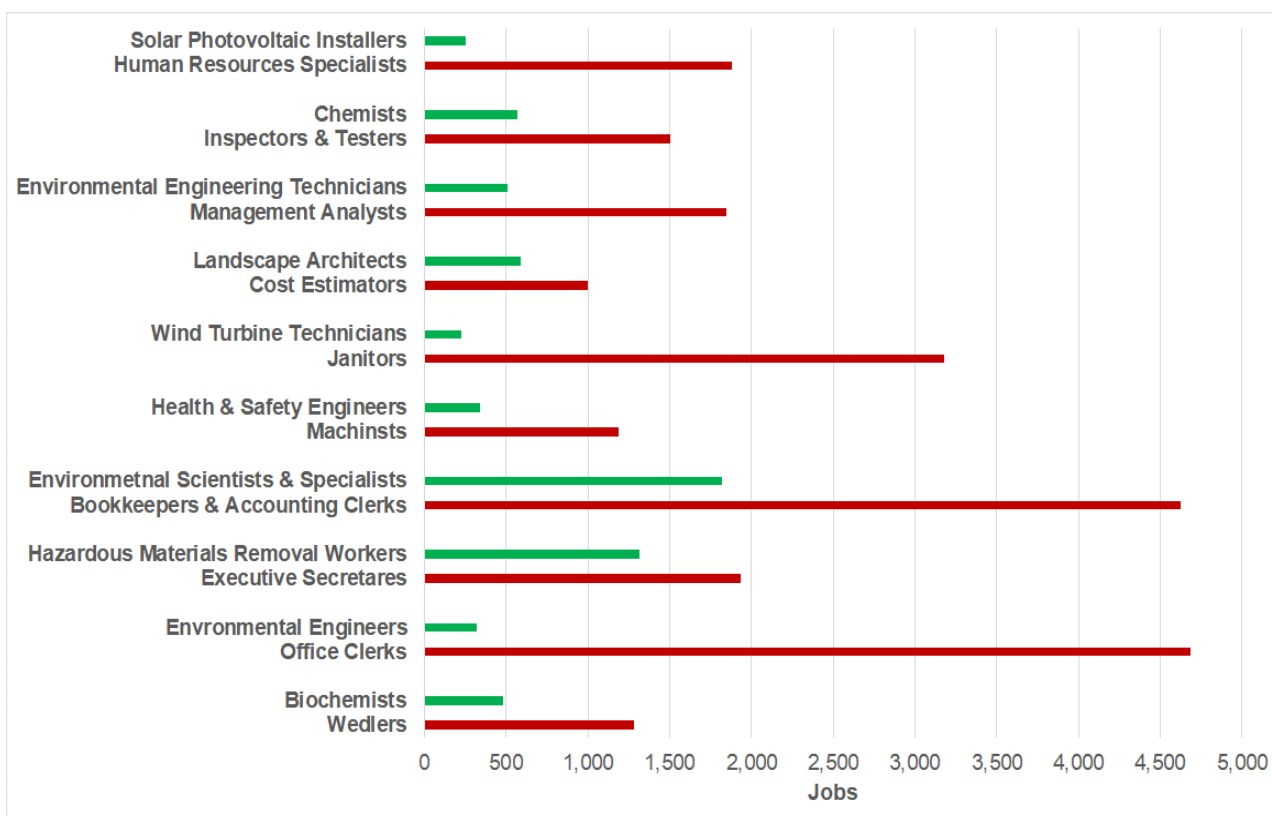
collectors, and environmental engineering technicians, much of the demand in Pennsylvania is created by green activities. This is hardly surprising, for most of these jobs are clearly identifiable as “green” jobs.

**Table II-2 Green Jobs Generated in Pennsylvania in 2019, by Selected Occupations**

Occupation	Jobs
Accountants and Auditors	3,462
Biochemists and Biophysicists	481
Biological Technicians	693
Bookkeeping, Accounting, and Auditing Clerks	4,622
Budget Analysts	207
Chemists	556
Computer Programmers	1,113
Computer Systems Analysts	1,948
Cost Estimators	1,002
Electrical and Electronic Engineering Technicians	508
Database Administrators	986
Electricians	2,001
Environmental Engineering Technicians	322
Environmental Engineers	2,212
Environmental Scientists and Specialists, Including Health	1,816
Executive Secretaries and Administrative Assistants	1,933
Financial Managers	1,898
Geoscientists, Except Hydrologists and Geographers	447
Hazardous Materials Removal Workers	1,314
Health and Safety Engineers	341
Human Resources Specialists	1,882
Industrial Machinery Mechanics	1,640
Inspectors, Testers, Sorters, Samplers, and Weighers	1,502
Janitors and Cleaners, Except Maids and Housekeeping Cleaners	3,177
Landscape Architects	591
Machinists	1,186
Management Analysts	1,844
Mechanical Engineers	1,662
Office Clerks	4,686
Plumber, Pipefitters, and Steamfitters	1,435
Refuse and Recyclable Material Collectors	3,122
Security Guards	1,872
Septic Tank Services and Sewer Pipe Cleaners	1,140
Solar Photovoltaic Installers	255
Truck Drivers, Heavy and Tractor Trailer	2,989
Water and Liquid Waste Treatment Operators	3,041
Welders, Cutters, Solders, and Brazers	1,211
Wind Turbine Technicians	224

**Source:** Management Information Services, Inc.

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania



**Figure II-1 Green Jobs Generated in Pennsylvania 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 Pennsylvania comprises only about six 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

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

- 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 Pennsylvania -- 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.

### III. COMPARISON OF GREEN JOBS IN COLORADO AND PENNSYLVANIA

#### III.A. Green Jobs in Colorado and Pennsylvania

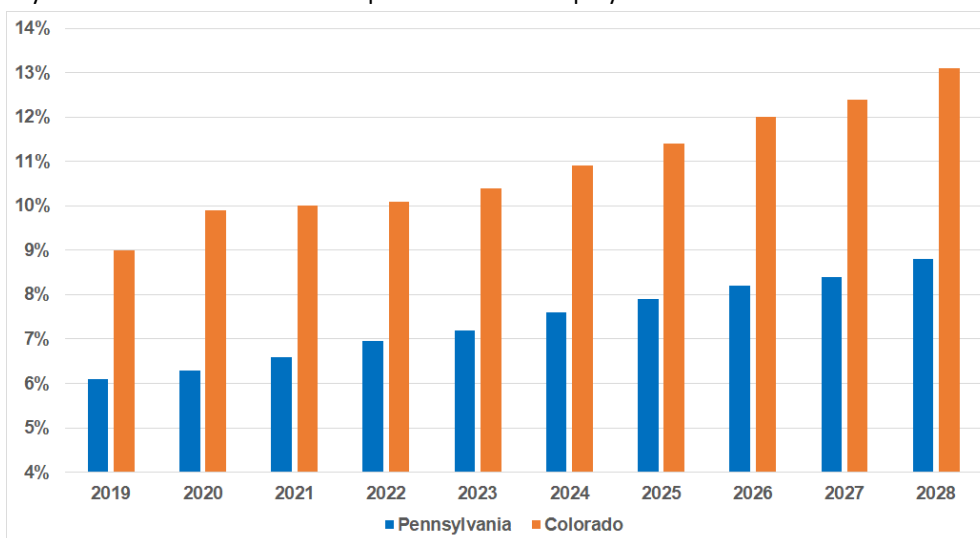
It is instructive to compare green jobs in the two states where a rigorous comparison is now possible: Colorado and Pennsylvania. As discussed, green jobs in Pennsylvania in 2019 comprised just over 6% of the total jobs in the state, and we forecast that this would gradually increase to nearly 9% by 2028.<sup>10</sup>

In comparison, we estimate that green jobs in Colorado comprised about 9% of the total jobs in the state in 2019 and will gradually increase to over 13% by 2028. Thus, as shown in Figure III-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,<sup>11</sup> whereas employment in Colorado is forecast to increase markedly over this period,<sup>12</sup> 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.



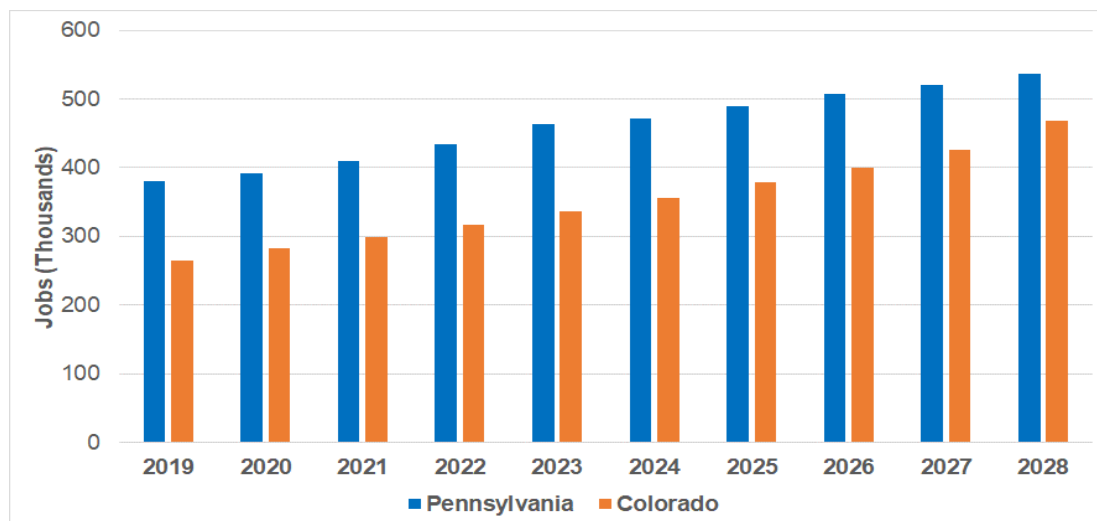
**Figure III-1 Percent Employment Comprised of Green Jobs in Colorado and Pennsylvania**

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

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

This is illustrated in Figure III-2, which shows the estimated green jobs in each state, 2019 – 2028. This figure shows that:<sup>13</sup>

- In 2019, there were about 380,000 green jobs in Pennsylvania and about 265,000 in Colorado.
- We forecast that in 2023, there will be about 465,000 green jobs in Pennsylvania and about 335,000 in Colorado.
- We forecast that in 2025, there will be about 490,000 green jobs in Pennsylvania and about 380,000 in Colorado.
- We forecast 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.

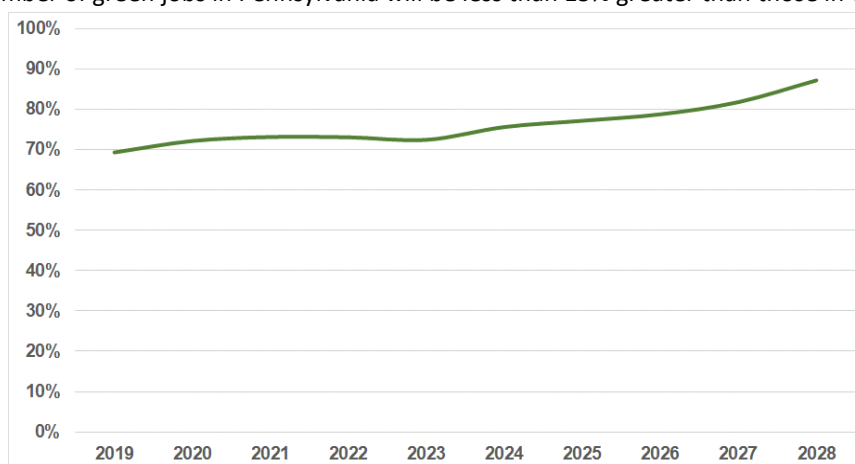


**Figure III-2 Green Jobs in Pennsylvania and Colorado**

**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, 2019-2028, total employment in the state over that period is forecast to be nearly stagnant.<sup>14</sup> Thus, Colorado green jobs as a percent of Pennsylvania green jobs increase continuously. As shown in Figure III-3:

- In 2019, the number of green jobs in Colorado were less than 70% of the green jobs in Pennsylvania.
- We forecast that in 2024, the number of green jobs in Colorado will total more than 75% of the green jobs in Pennsylvania.
- We forecast that 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.



**Figure III-3 Green Jobs in Colorado as a Percentage of Green Jobs in Pennsylvania**

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

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

### III.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 III-4, in some sectors the percent distribution of green jobs is similar. These include:

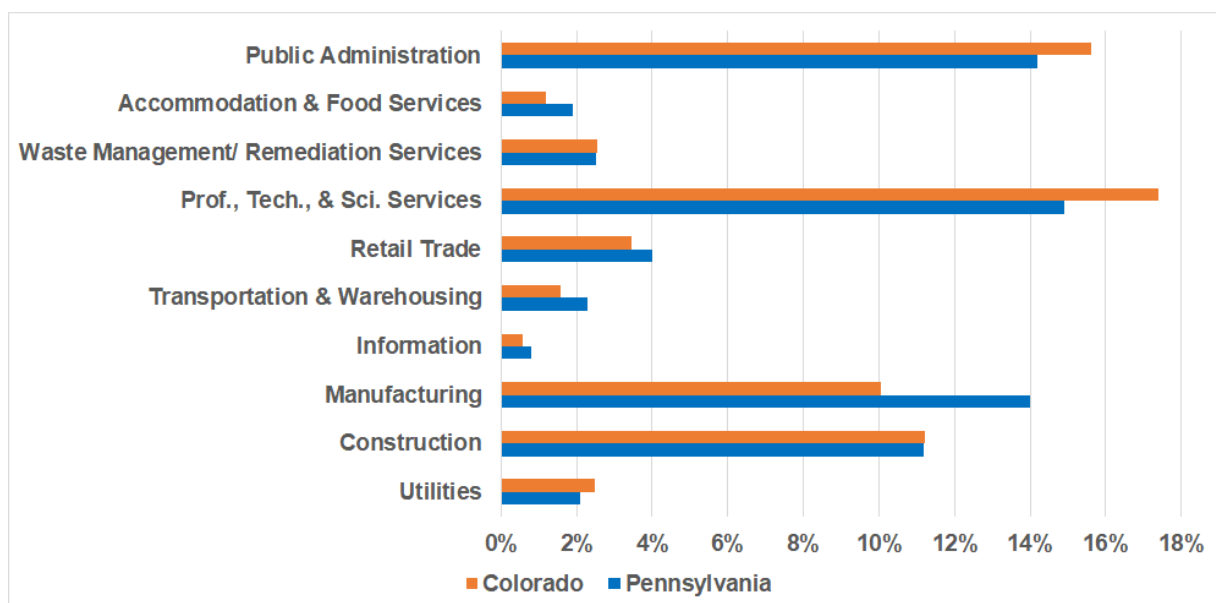
- Construction
- Utilities
- Waste Management/Remediation Services
- Information

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 III-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.<sup>15</sup> As shown in Figure III-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 III-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

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Figure III-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

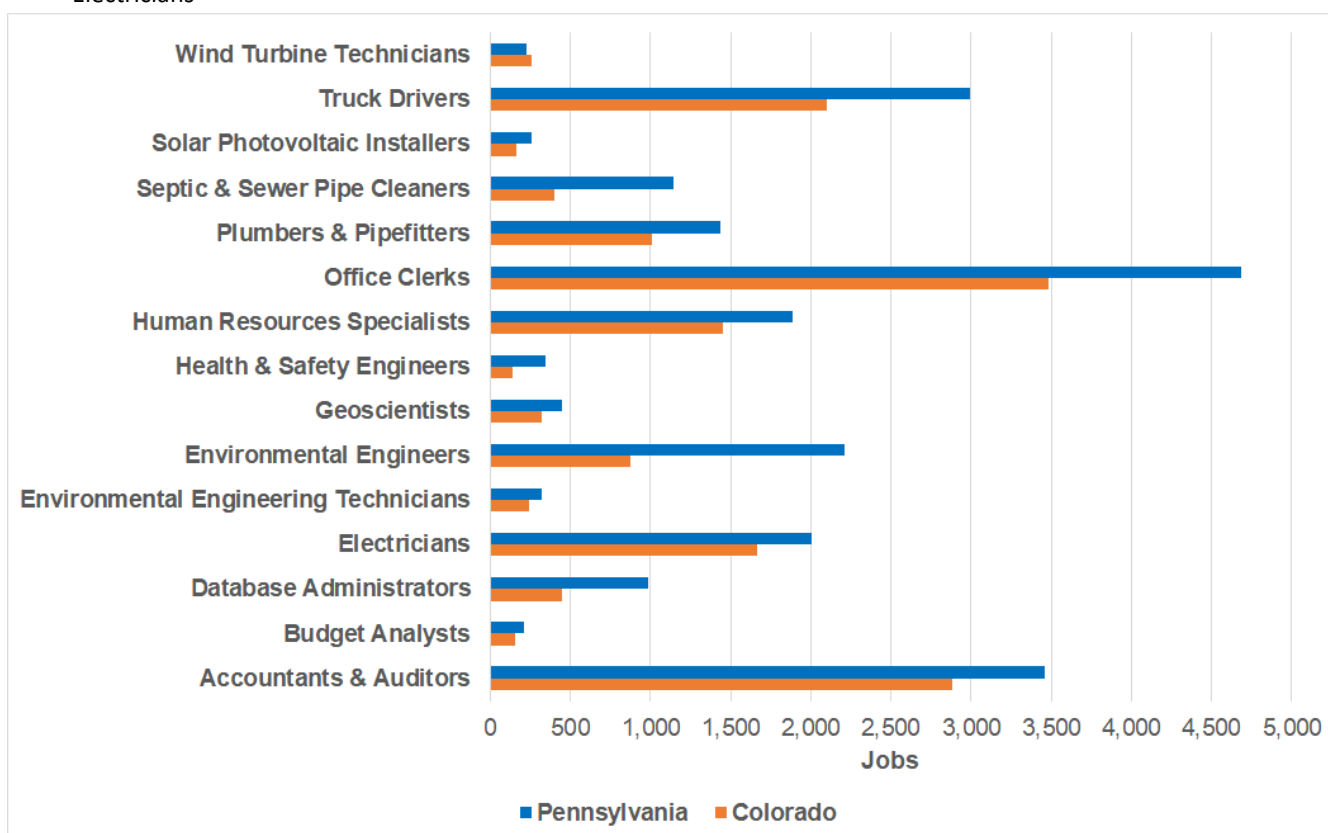


Figure III-5 Green Jobs by Occupation in Pennsylvania and Colorado, 2019

Source: Management Information Services, Inc.

### IV. IMPLICATIONS OF THE COMPARATIVE FINDINGS

Comparison of green jobs in only two states cannot yield determinant findings.<sup>16</sup> Further, the forecasts are subject to a considerable degree of uncertainty. While there is a high level of confidence that the number of green jobs will continue to increase in both absolute and percentage terms, the rate of increase of these jobs is subject to considerable uncertainty. For example:

- Following U.S. Energy Information (EIA) conventions, the forecasts are based on current, existing (as of August 2022) policies and enacted legislation.<sup>17</sup>
- The rate of green jobs growth could accelerate if additional environmental legislation and more aggressive renewable energy and climate change incentives and mandates – such as those outlined in COP26<sup>18</sup> -- are enacted at the national and state levels.
- The rate of green jobs job growth could decrease if there is a lessening of green awareness and a backlash against ambitious environmental and climate legislation and regulations.<sup>19</sup>
- Unforeseen circumstances, such as severe recessions, pandemics, war, political developments, etc., could materially affect the forecasts.<sup>20</sup>

Further, many emerging green jobs do not currently exist and do not have occupational titles defined in federal and state government occupational handbooks and employment guides.<sup>21</sup> In addition, 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, employment, and education and training analyses and forecasting will be performed using the current set of U.S. Labor Department occupational titles and job descriptions.<sup>22</sup>

## Comparative Analysis of USA Green Industries and Green Jobs in Colorado and Pennsylvania

Nevertheless, a comparison of the two states 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 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 rapidly 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 despite the fact that the total number of jobs in Pennsylvania is much larger than the total number of jobs in Colorado.<sup>23</sup> Once again, similar occupational differences are likely among most other states.

It is thus imperative that similar analyses be conducted for other states to measure and forecast state green economies and the jobs generated by these economies to expand and generalize the findings reported here.

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- 1) <https://thenext100.org/greenjobs/>.
- 2) The employment concept used here is a full time equivalent (FTE) job in the U.S. An FTE job is defined as 2,080 hours worked in a year's time, and adjusts for part time and seasonal employment and for labor turnover. The FTE concept normalizes job creation among full time, part time, and seasonal employment. Thus, for example, two workers each working six months of the year would be counted as one FTE job. An FTE job is the standard job concept used in these types of analyses and allows meaningful comparisons over time and across jurisdictions because it consistently measures the input of labor in the production process.
- 3) Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Colorado," prepared for WorkingNation, May 2022; <https://workingnation.com/wp-content/uploads/2022/08/Green-Economy-of-Colorado.pdf>.
- 4) Here, green jobs are defined as the total number of jobs generated by the green economy. We estimated the total (direct, indirect, and induced) jobs created by the green economies: i) Direct jobs are those created directly in the specific activity or process; ii) indirect jobs are those created throughout the required interindustry supply chain; iii) induced jobs are those created in supporting or peripheral activities; total jobs are the sum or all of the jobs created – direct, indirect, and induced. The total (direct, indirect, and induced) jobs concept is the accepted methodology widely used in studies of this



nature and in the peer-reviewed literature. See the discussion in Roger H. Bezdek, "Jobs Created by the Green Economy in the USA," *Environment and Pollution*, Vol. 11, No. 1, (March 2022), pp. 21-32.

- 5) <https://www.census.gov/naics/>.
- 6) See the discussion in Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," prepared by for WorkingNation, May 2022; <https://workingnation.com/wp-content/uploads/2022/08/Green-Economy-of-Pennsylvania.pdf>
- 7) See Roger H. Bezdek, Robert M. Wendling and Paula DiPerna, "Environmental Protection, the Economy, and Jobs: National and Regional Analyses," *Journal of Environmental Management*, Vol. 86, No. 1 (January 2008), pp. 63-79.
- 8) Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," op. cit.
- 9) Bezdek, Wendling, and Paula DiPerna, op. cit.
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- 11) Pennsylvania Department of Labor & Industry Center for Workforce Information & Analysis, "Pennsylvania Industry Employment 2018-2028 Long-Term Projections," [https://www.workstats.dli.pa.gov/Documents/Projections/Industrial/PA/PA\\_LTIP.pdf](https://www.workstats.dli.pa.gov/Documents/Projections/Industrial/PA/PA_LTIP.pdf).
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- 13) Pennsylvania job forecasts are derived in Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," op. cit.
- 14) Pennsylvania Department of Labor & Industry Center for Workforce Information & Analysis, op. cit.
- 15) Pennsylvania green jobs by occupation are given in Management Information Services, Inc., "The Green Economy, Green Jobs, and Green Companies in Pennsylvania," op. cit.
- 16) However, these findings and their implications can be further assessed as additional state reports are completed.
- 17) See U.S. Energy Information Administration, *Annual Energy Outlook 2022*, February 2022.
- 18) See <https://ukcop26.org/>.
- 19) For example, such as the "yellow vest" protests in France; <https://www.reuters.com/article/us-france-electricity/yellow-vests-put-french-government-on-spot-over-power-prices-idUSKCN1PO25Y>.
- 20) For example, since the Russian invasion of Ukraine worldwide interest in green technologies has increased greatly.
- 21) See the discussion in Management Information Services, Inc., See Management Information Services, Inc., "Defining and Estimating the U.S. the Green Economy and Green Jobs, prepared WorkingNation, 2022; <https://workingnation.com/the-green-economy-its-bigger-than-you-think-and-growing-rapidly/>.
- 22) These are listed in the U.S. Department of Labor, Bureau of Labor Statistics, *Standard Occupational Classification*, <https://www.bls.gov/soc/>. Also see U.S. Department of Labor, Bureau of Labor Statistics, *Occupational Outlook Handbook*, <https://www.bls.gov/ooh/>.
- 23) There are more than twice as many jobs in in Pennsylvania than in Colorado.



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