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How Many Green Jobs are There in the USA?

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Abstract

Green jobs are of intense interest in the USA but have not been rigorously estimated. While green jobs are desirable and are increasing rapidly, consistent time series estimates and forecasts of these jobs are not available. This has impeded research and policy development. We analyze and compare the estimates of USA green jobs currently available. We note that these estimates differ markedly, and summarize the reasons for the discrepancies. We then present an estimate of the jobs created by the USA green economy in 2020 and discuss why this estimate is the most viable. We note that most persons in jobs created by the green economy do not realize that they owe their livelihood to the green economy and that the number of jobs generated by the green economy are is least 3 or 4 times larger than realized. We conclude that the significance of green jobs is not appreciated and this has serious economic, environmental, and policy implications that must be remedied.

Key Words: green jobs; USA green jobs; green jobs estimates; green jobs concepts; green jobs significance

"Prior to determining whither we are tending, we must first know where we are."
A. Lincoln

I. Introduction

There is currently intense controversy concerning the definition of green jobs, their magnitude and distribution, the issue of net job creation, and the education, training, skills, and salary levels related to green jobs. These controversies are currently especially relevant due to, for example:

- The current lack of consistent definitions and estimates of green jobs and the green economy.
- The increasing prevalence of green jobs in the U.S. economy.
- The rapid growth of these jobs that is forecast.
- The increasing emphasis on environmental and climate concerns.
- The Biden Administration's infrastructure, Green New Deal, clean energy, and related initiatives. [1]

- The skepticism expressed by organized labor with respect to potential job displacement and salary differentials.

However, these and related concerns cannot be addressed unless and until we have an estimate of about how many "green" jobs there currently are in the USA. This paper assesses and compares current estimates of USA green jobs and presents an estimate of the jobs being created by the green economy.

METHOD AND MATERIAL

This paper summarizes the major estimates of green jobs in the USA currently available in the recent literature. It discusses the strengths and weaknesses of each estimate. It then presents estimates that are found to be more viable and consistent and explains why. It places these data in perspective and discusses their significance.

2. RECENT ESTIMATES OF U.S. GREEN JOBS

There are five recent estimates of U.S. green jobs available from:

- A. Bowen, K. Kuralbayeva, and E.L. Tipoec.
- E2/USEER.
- Environmental and Energy Study Institute.
- Lucien Georgeson and Mark Maslin.
- MISI.

These are summarized below.

In 2018, Bowen, Kuralbayeva, and Tipoec (BKT) estimated the share of U.S. jobs that would benefit from a transition to the green economy, and presented different measures for the ease with which workers are likely to be able to move from non-green to green jobs. They found that 19.4% of U.S. workers are currently part of the green economy in a broad sense, although a large proportion of green employment is indirectly green. [2] U.S. employment in 2018 was 155.8 million, and thus the BKT estimate implies that about 30.2 million of these jobs were green.

BKT contended that green jobs vary in "greenness," with few jobs consisting only of green tasks, suggesting that "green" should be considered a continuum rather than a binary characteristic. They found that while it is easier to transition to indirectly green rather than directly green jobs, greening is likely to involve transitions on a similar scale and scope of existing job transitions. Non-green jobs differ from their green counterparts in only a few skill-specific aspects, suggesting that most re-training can happen on-the-job. BKT found that the green economy offers a large potential for short-run growth. [3]

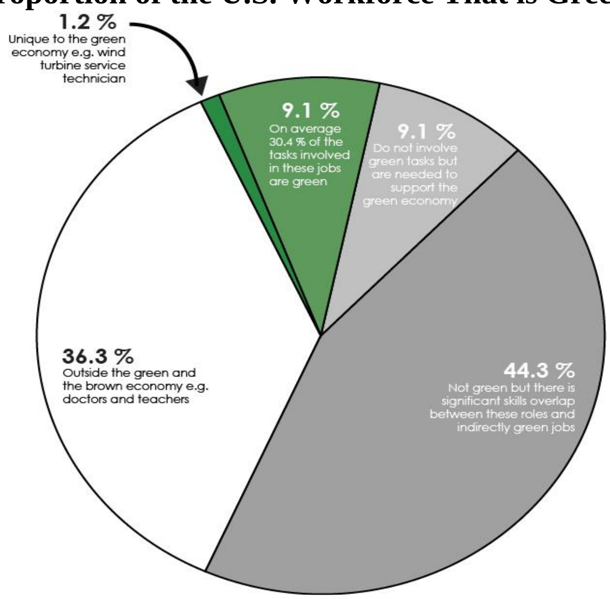
They used data on the U.S. job market to estimate how many green jobs there are in the U.S. workforce and, for those jobs which are not green, how the transition to a low-carbon economy could affect them. They noted that BLS estimated that in 2011 2.6% of the U.S.

workforce was employed in the production of green goods and services. These jobs reduce fossil fuel usage, decrease pollution and greenhouse gas emissions, involve recycling materials, increasing energy efficiency, or the development of renewable energy sources.

However, BKT estimated that the actual number of workers in jobs already supporting the green economy is much higher. Using BLS data from 2014 and from the U.S. department of Labor's Occupational Network Database (O*NET), they found that there is a spectrum of green jobs. Most estimates of green jobs only include occupations which are unique to the green economy, for example wind turbine service technicians or solar photovoltaic installers. BKT analyzed the O*NET [4] data and found that there are many occupations which involve some green tasks but are usually excluded from estimates of green jobs.

BKT estimated that 1.2% of U.S. jobs is unique to the green economy. On average, 59.4% of the tasks involved in these jobs are 'green tasks' as defined by data from the O*NET dataset, which assesses the types of tasks involved in 858 (out of 974) U.S. occupations and how often the tasks are carried out. An additional 9.1% of the workforce are performing green tasks in their jobs but less often: For example workers who are urban and regional planners or refuse and recyclable material collectors. On average, 30.4% of the tasks carried out in these jobs are green. When BKT included all jobs in which workers are currently undertaking at least one green task per year they estimated that 10.3% of current U.S. jobs are "green" – Figure 2-1. [5]

Figure 2-1
Proportion of the U.S. Workforce That is Green



Source: Bowen, Kuralbayeva, and Tipoec

Their analysis estimated that a further 9.1% of the U.S. workforce are in jobs which will be necessary to support the green economy but which do not directly support green tasks, and they labeled these "indirectly green jobs." For example, financial analysts might forecast or analyze financial costs of climate change, identify environmentally-sound financial investments, and recommend environmentally-related financial products. These jobs do the behind-the-scenes work that contributes to green economic activity.

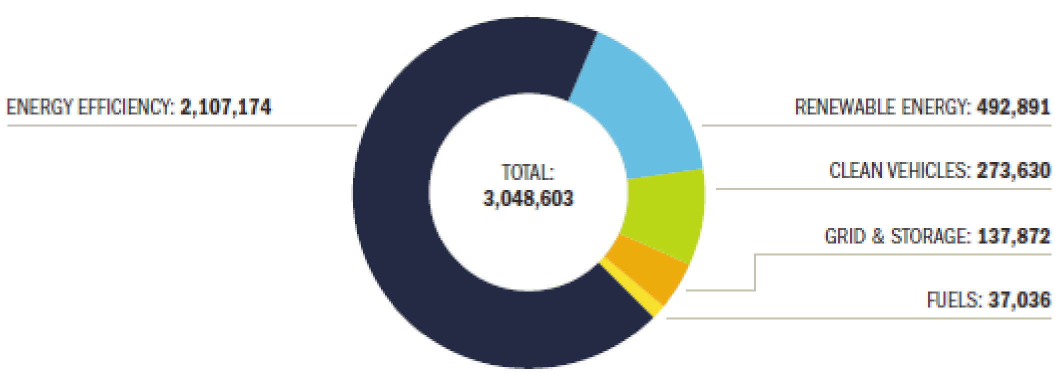
It is difficult to determine how many of the workers in this category are currently supporting the green economy. However, BKT concluded that these workers should be able to transition to working in jobs which support the green economy with little retraining since they will not need any new skills. [6]

E2, using primarily U.S. Energy Employment Report (USEER) data, [7] estimated that in 2020, the number of clean energy jobs in the U.S. declined for the first time since it began tracking nationwide employment across the entire clean energy sector in 2015. [8] Amid the COVID-19 pandemic and related economic contraction and the lingering impacts of policies from the previous administration that encouraged fossil fuels over clean energy, nearly 307,000 jobs were lost in wind, solar, energy efficiency and other clean energy sectors.

E2 estimated that about 3 million Americans worked in clean energy at the end of 2020, down from 3.36 million the year before – Figure 2-2. [9][1] Further:

- Jobs in energy efficiency, the largest part of the U.S. energy sector, decreased the most, falling more than 11 percent from 2019 as COVID-19 pandemic restrictions prevented energy efficiency workers from entering commercial and residential buildings.
- Wind energy employment increased slightly, while solar employment fell, driven by declines in residential solar sales and installation which were hit hard early in the pandemic and could not fully recover despite growth in the second part of the year.
- Overall, renewable energy jobs fell by nearly 6 percent.
- Jobs in grid modernization, battery, and storage occupations declined nearly 7 percent after two years of rapid growth driven by growing demand in batteries for electric vehicles and commercial and residential energy storage.
- Clean vehicle manufacturing jobs defied overall energy sector job loss patterns and grew nearly 3 percent as automakers increasingly shifted to cleaner and more efficient electric cars, trucks and buses. Electric and hybrid electric vehicle employment grew more than six percent adding over 12,000 new jobs in 2020, the largest increase of any clean energy category.

Figure 2-2
U.S. Clean Energy Employment by Sector 2020



Source: E2.

[1]Based on E2's analysis of BLS data and the findings of a national survey of more than 35,000 businesses across the U.S. economy.

Despite the overall decline, E2 found that clean energy remains the largest job creator across America's energy sector, employing nearly three times as many workers as work in fossil fuel extraction and generation. More Americans still work in clean energy than work as middle and elementary school teachers, bankers, farmers or real estate agents. Median hourly wages for clean energy jobs also are about 25 percent higher than the national median wage, and also pay better than most fossil fuel extraction jobs.

California, Texas, New York, and Florida remain the nation's leaders for clean energy jobs, but smaller states such as Illinois, Massachusetts, Michigan, and Ohio all employed more than 100,000 clean energy workers each at the end of 2020. [10]

E2 includes jobs in solar energy, wind energy, combined heat and power, bioenergy, non-woody biomass, low-impact hydro power, geothermal, clean vehicle technologies, clean energy storage, smart grid, micro grid, grid modernization, advanced biofuels, and energy efficiency including ENERGYSTAR and high efficiency appliances, efficient lighting, HVAC, renewable heating and cooling, and advanced building materials. The clean energy occupations covered in this report span economic sectors including construction, manufacturing, wholesale trade, transmission and distribution, and professional services.

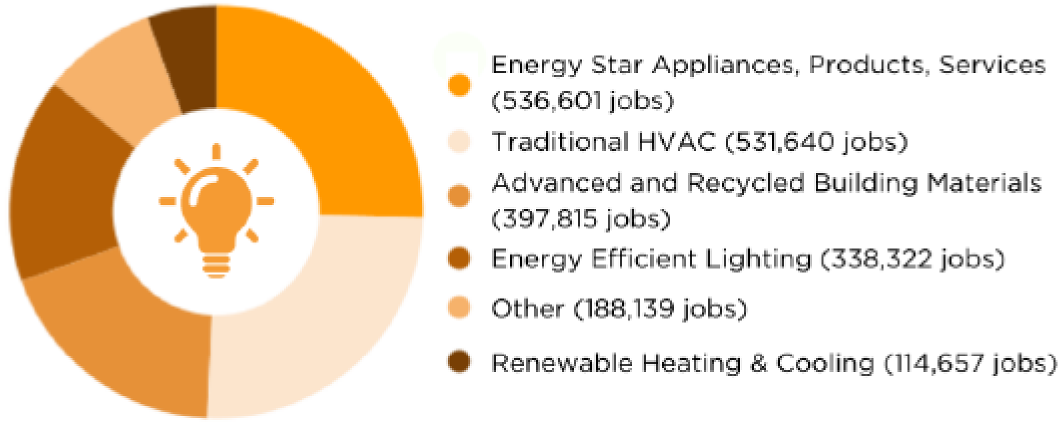
E2 excludes jobs of workers who may spend some of their time in clean energy but a plurality in another energy sector. For example, workers employed by an excavation business might spend the majority of their time grading and preparing drilling pads for oil or gas rigs, but they also might spend a portion of their time preparing sites for wind turbines or large solar installations. If clean energy does not account for a plurality of their work, those workers would not be counted as being employed in the clean energy economy but would instead be counted as part of another energy sector. E2 also does not include jobs in corn ethanol, woody biomass, large hydropower, and nuclear because of environmental issues associated with those industries. Jobs in retail trade, repair services, water or waste management, and indirect employment or induced employment are also not included.

The Environmental and Energy Study Institute (EESI) contends that responding to the climate crisis provides an immense opportunity for job creation and terms those jobs -- jobs that help mitigate and adapt to climate change -- are climate jobs. [11] It estimates that in recent years, climate jobs have been on the rise in the U.S. However, the economy-wide impacts of the COVID-19 pandemic affected climate employment and EESI estimated that 8% of climate jobs were lost in 2020.][2] Despite this, employment in some climate industries increased in 2020, and many climate jobs are expected to recover in 2021. ESSI estimates that, in total, there were over 4.1 million climate jobs in 2020. [12]

ESSI estimates that energy efficiency supported 2.1 million jobs in 2020 – Figure 2-3. This includes workers who design, install, distribute, and manufacture energy-efficient products and services. The states with the most energy efficiency jobs in 2020 were California (283,800 jobs), Texas (152,100), New York (121,000), and Florida (108,900). While energy efficiency jobs decreased 11.4 percent in 2020, they are forecast to increase 10% in 2021.

[2] ESSI relied on the USEER reports for most of the estimates.

Figure 2-3
Energy Efficiency Jobs



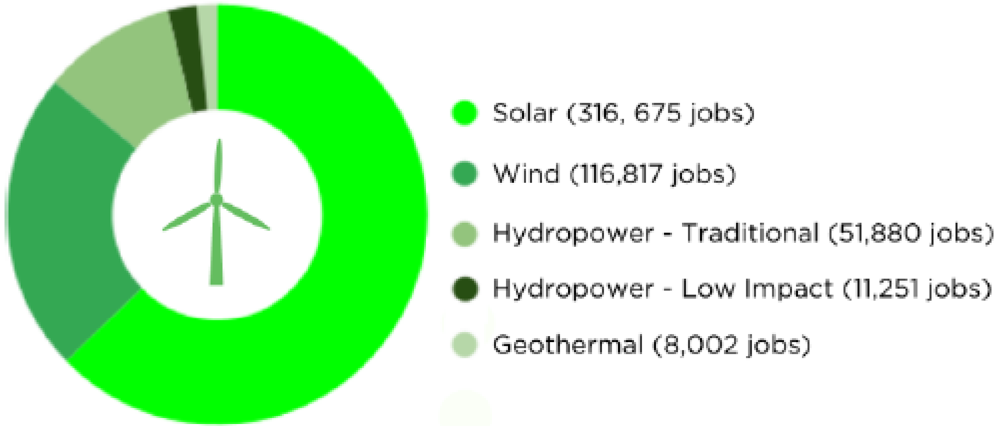
Source: Environmental and Energy Study Institute.

ESSI estimates that energy transmission, distribution, and storage supported 763,000 jobs in 2020. The sector overall lost three percent of its jobs in 2020, but battery storage added 800 jobs. California had the highest energy storage and grid employment (22,600 jobs), with Texas (12,400) and Nevada (9,200) following. In the coming years, transmission, distribution, and storage employment will likely grow to support increased renewable energy connecting to the electric grid.

ESSI estimates that renewable energy supported 504,600 jobs in 2020 – Figure 2-4. Employment in the sector decreased by six percent in 2020, but wind energy added 2,000 jobs. EESI contends that significant job growth in renewable energy is anticipated, noting that wind turbine service technicians and solar photovoltaic installers are projected to be the fastest and third-fastest growing occupations, respectively, across the entire economy in the coming decade.

ESSI estimates that clean vehicles supported 261,300 jobs in 2020. This includes about 119,700 jobs in hybrid electric vehicles, 83,700 jobs in electric vehicles, 47,800 jobs in plug-in hybrid vehicles, and 10,000 jobs in hydrogen/fuel cell vehicles. Despite the economic impacts of COVID-19, employment in the hybrid electric and electric vehicle industry increased six and eight percent, respectively, in 2020. Renewable fuels supported 103,000 jobs in 2020. This includes about 33,500 jobs in corn ethanol, 19,500 jobs in other ethanol fuels, 32,400 jobs in woody biomass, and 17,600 jobs in other biofuels. Public transportation agencies supported 435,000 direct jobs in 2018, and every $1 billion invested in public transportation can yield 50,000 jobs. [13]

Figure 2-4
Renewable Energy Jobs



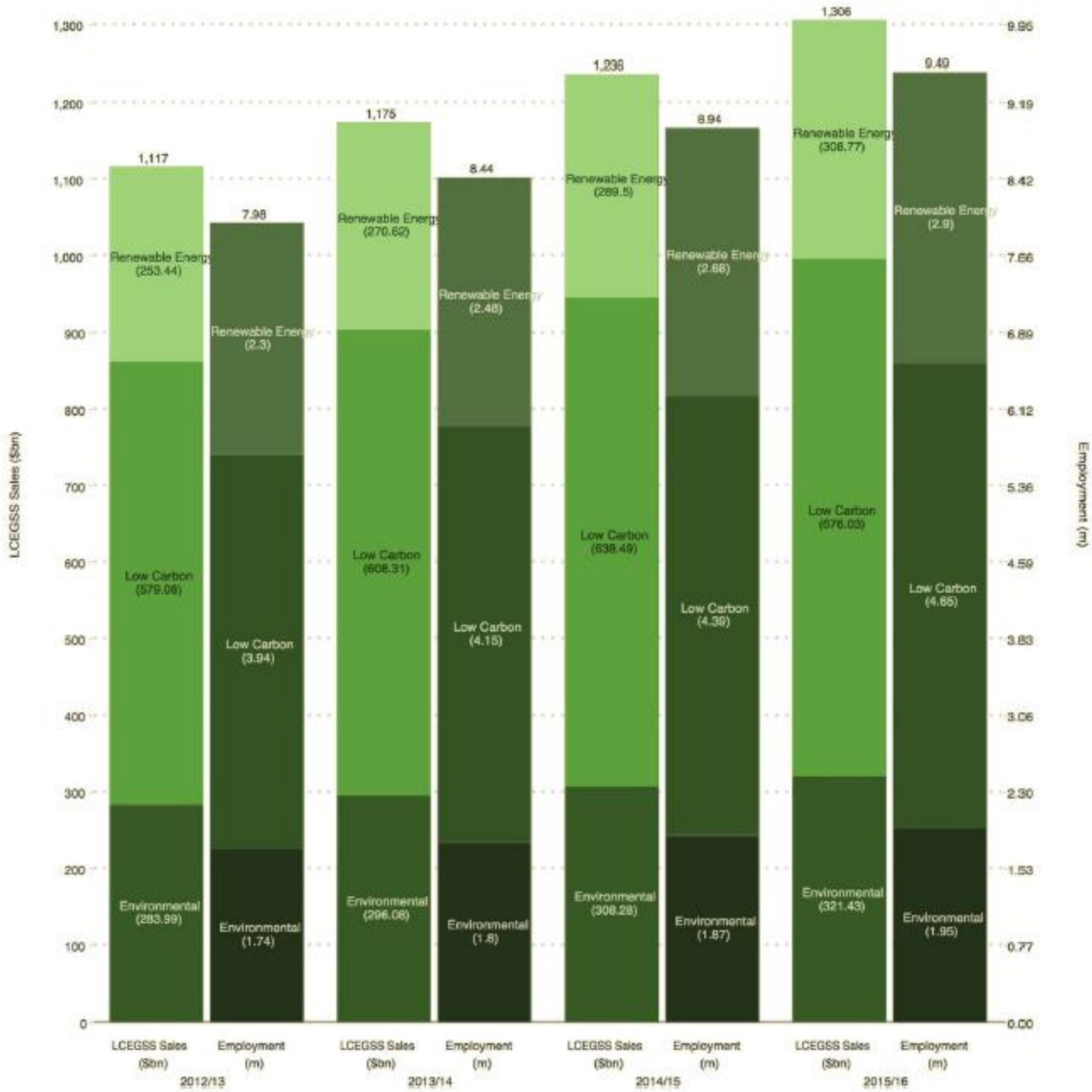
Source: Environmental and Energy Study Institute.

Lucien Georgeson and Mark Maslin (G&M) estimated the share of jobs in the U.S. that would benefit from a transition to the green economy, and developed different measures for the ease with which workers are likely to be able to move from non-green to green jobs. [14] Using what they termed "transactional triangulation" they measured supply chain activity and full economic impact, but this approach it is not directly comparable to national statistics.

G&M utilized the U.S. O*NET database and its definition of green jobs, and estimated that 19.4% of U.S. workers could currently be part of the green economy in a broad sense, although a large proportion of green employment would be "indirectly" green, comprising existing jobs that are expected to be in high demand due to greening, but do not require significant changes in tasks, skills, or knowledge. [15] Their analysis of task content showed that green jobs vary in "greenness," with very few jobs only consisting of green tasks, suggesting that the term green should be considered a continuum rather than a binary characteristic. While it is easier to transition to indirectly green rather than directly green jobs, greening is likely to involve transitions on a similar scale and scope of existing job transitions. Non-green jobs generally appear to differ from their green counterparts in only a few skill-specific aspects, suggesting that most re-training can happen on-the-job. Network analysis shows that the green economy offers a large potential for short-run growth if job transitions are strategically managed.

Using low carbon environmental goods and services sector (LCEGSS) data, G&M estimated that the 2015/2016 U.S. green economy represented $1.3 trillion in annual sales revenue and employed nearly 9.5 million FTEs (full time equivalent) and that both have grown by over 20% over three years – Figure 2-5. This figure shows the estimation of the U.S. green economy using the LCEGSS definitions, for both sales revenue, and jobs estimated in FTEs for the four financial years for which data are available. They estimated that a greater proportion of employment is taken up by Renewable Energy compared to Sales revenue, and this suggests that RE sectors are particularly important for green economy job creation. On the other hand, they concluded that the Environmental sectors, which may be more mature in many cases, deliver a greater amount of revenue per FTE. [16]

Figure 2-5
Sales ($ billions) and Employment (FTEs, m) in LCEGSS in the U.S. for Financial Years 2012/2013 to 2015/16



Source: Georgeson and Maslin.

Their comparison with China, OECD members, and the G20 countries indicated that the U.S. has a greater proportion of the working age population employed (4%) and higher sales revenue per capita in the green economy. It also demonstrates that other countries have huge potential to develop their green economy and the US needs to develop energy, environmental and educational policies to remain competitive.

G&M estimated that LCEGSS in the U.S. increased from $1.1 trillion and 8 million FTEs in 2012/13 to $1.3 trillion and 9.5 million FTEs in 2015/16. [17] This represented about 7% of the U.S. annual GDP. The estimated scale of the green economy ($1.3 trillion and employing over

4% of the working age population) strongly suggests that it is a significant contributor to U.S. economic development and the economic well-being of millions of people across the U.S. It was also a key contributor to the U.S. recovery after the 2007 financial crisis. [18] Existing federal policies to support the private sector (including clean energy initiatives) have assisted U.S. businesses to grow and create jobs, and the data herein suggests that growth in jobs in the green economy may be faster than growth in estimated sales value in some sectors of the green economy. economic initiatives and environmental regulations can, potentially, drive innovation and economic development, rather than inhibiting it. [19]

G&M's research indicated that many countries have huge potential to generate higher green employment and growth. Thus, "The economic case for driving economic growth and job creation through fossil fuels has weakened based on the employment estimates in fossil fuels, and there are genuine risks of stranded assets. To safeguard US economic development and job creation, we suggest that economic, environmental and education policies need to be developed to support the U.S. green economy in the context of global developments in the green economy." [20]

G&M contends that their research provides the basis to restart the previously fruitful and important debates regarding how to define and measure the green economy in the US, and the value of doing so to better assess claims made about the green economy and green jobs. They presented a newer, broader definition of the green economy, which includes data estimates of both sales and employment, which has data available for the various subsectors that are included in the LCEGSS taxonomy, and which measures value chain activities. The data therefore have a number of novel characteristics and benefits that give it significant potential to contribute to improving the understanding of how economies are changing and how economic policies could be designed based on alternative data collection processes such as this. [21]

Management Information Services, Inc. (MISI) estimated U.S. green jobs in 2019 and 2021 and estimated the jobs that would be created by the Green New Deal (GND). [22] The GND is a proposed package of U.S. legislation designed to address climate change, economic inequality, and other issues.[3] In recent years, various proposals for a "Green New Deal" have arisen both in the U.S. and internationally.

MISI noted that, contrary to general public perception and public policy understanding, in recent decades, green energy and environmental protection have grown rapidly to become a major sales-generating, profit-making, job-creating industry. The size and the job creating potential of the green industry is something that few people are aware of. MISI, estimated that in 2019, U.S. green jobs (direct plus indirect) totaled about 7.8 million and in 2021 totaled about 8.8 million. [23] MISI estimated that the green "industry" currently ranks above the top of the Fortune 500, and MISI estimates that in 2019 the green industry generated $640 billion in total industry sales (2019 dollars) and 7.8 million jobs. For perspective, compared the revenues generated by other industries, this is: About equal to all supermarkets and grocery stores; greater than the construction

[3]The name is derived from the New Deal, a set of social and economic reforms and public works projects undertaken by USA President Franklin Roosevelt in response to the Great Depression of the 1930s. The GND combines Roosevelt's economic approach with contemporary proposals involving environmental programs, renewable energy, and energy efficiency, and its estimated costs run well into the trillions of dollars.

industry; more than twice the size of the mining industry; 25% greater than Walmart; twice the size of ExxonMobil; more than 2.5 times the size of Apple; 2.75 times the size of Amazon; and four times the size of Ford. Thus, the green industry is currently a major factor in the USA economy and job market.

MISI noted that the GND is not well defined and there are many different versions, and the GND cost has been estimated at anywhere from $2 trillion to $6 trillion and higher. MISI estimates that the GND would cost about cost about $2.5 trillion in expenditures (2019 dollars) and would generate more than 18.3 million jobs (direct plus indirect).[4] Thus, here MISI is using a relatively modest version of the GND costing about $2.5 trillion that is concerned primarily with energy and environmental programs. As noted, some versions of the GND also include a variety of health, education, and other social policies. Of course, the economic and job impacts of the GND will differ depending on the size, structure, and duration of the GND specified.

MISI also estimated the jobs in the manufacturing sector that would be generated by the GND and found that of the 18.3 million jobs, about 2.25 million would be "green" manufacturing jobs. [24] Of the 18.3 million jobs, about 2.25 million would be "green" manufacturing jobs. A disaggregation of some of the major industrial components of these jobs -- by 2 and 3 digit North American Industrial Classification System (NAICS) Code -- is presented in Table 2-1.

[4]The 18.3 million jobs estimated is a very large number. However, it is sobering to note that in the eight week period from early March to early April 2020, about 36.5 million Americans filed for unemployment insurance, with weekly totals above three million a week. Thus, the 18.3 million jobs is only half as many jobs as were lost in an eight week period.

Table 2-1
Jobs by Select Industry Resulting From the GDN in 2030

Industry Title	Jobs (thousands)
Select Manufacturing Industries	
Electrical equipment, appliances, and components	230
Miscellaneous manufacturing	225
Fabricated metal products	200
Nonmetallic mineral products	195
Motor vehicles, bodies and trailers, and parts	115
Primary metals	95
Chemical products	90
Other transportation equipment	80
Computer and electronic products	50
Machinery	45
Plastics and rubber products	40
Wood products	35
Paper products	30
Textile mills and textile product mills	20
Other Select Industries	
Construction	960
Miscellaneous professional, scientific and technical services	350
Waste management and remediation services	230
Utilities	145
Information and data processing services	105
Computer systems design and related services	100
Total Jobs (including industries not listed separately)	**18,340**

Source: Management Information Services, Inc.

3. COMPARISON OF THE ESTIMATES

Table 3-1 and Figure 3-1 show the different estimates of U.S. green jobs available from a variety of government and non-government sources over the past two decades. They illustrate the wide range of green jobs estimates available depending on the green job definition and the source of the estimate. For example, the lowest estimate is 750,000 green jobs from USME for 2008 and the highest estimate is 30.2 million green jobs from BKT for 2018 – a 40X difference.

Even for similar years, the estimates can vary greatly. For example:

- BLS estimates 3.4 million green jobs in 2011.
- BI estimates 2.7 million green jobs in 2010.
- G&M estimates 8 million green jobs in 2012.
- MISI/J&EI estimates 5.9 million green jobs in 2010
- These estimates differ by 3X.

Table 3-1
U.S. Green Jobs Estimates

Source and Year of Estimate	Green Jobs (millions)
BI, 2010	2.7
BI, 2016	6.6
BLS, 2011	3.4
BKT, 2018	30.2
DOC, 2010	1.8 - 2.4
E2/USEER, 2015	2.5
E2/USEER, 2019	3.4
E2/USEER, 2020	3.0
EBI, 2017	1.73
EDF, 2017	4.0 – 4.5
EESI, 2020	4.1
EI, 2014	3.8
G&M: 2012	8.0
G&M: 2016	9.4
GI, 2006	0.8
MISI/J&EI, 2010	5.9
MISI, 2021	8.8
Pew, 2007	0.77
USME, 2008	0.75

Source: MISI.

Legend for Table IV-1:

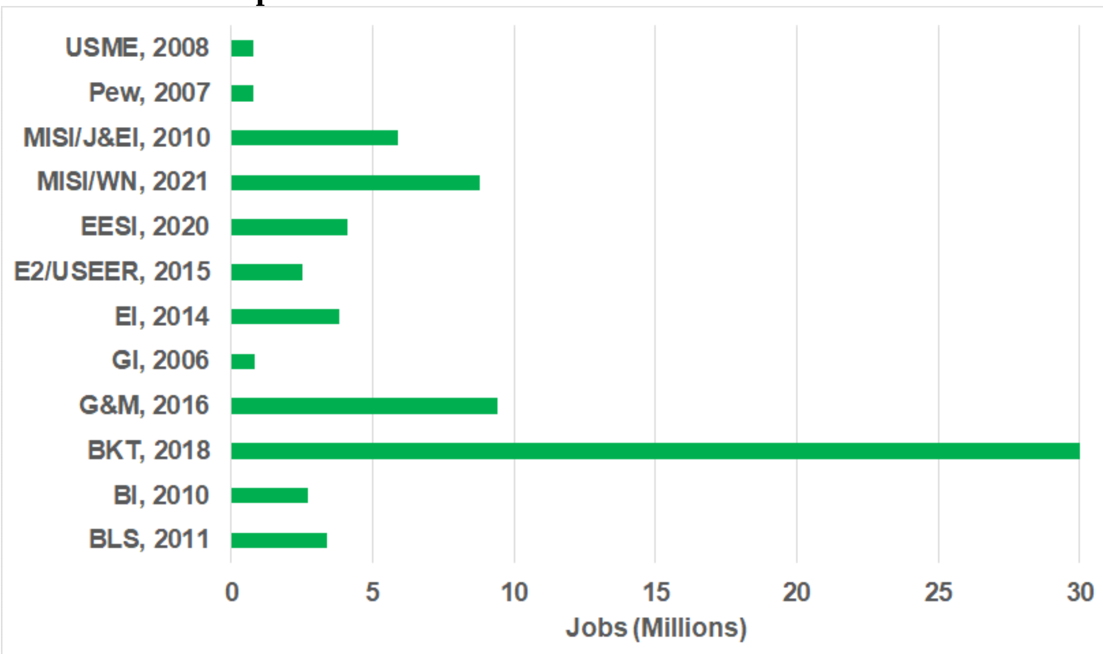
- BLS: U.S. Bureau of Labor Statistics
- BI: Brookings Institution
- BKT: Bowen, Kuralbayeva, & Tipoec
- E2: Environmental Entrepreneurs
- EBI: Environmental Business International, Inc.
- EDF: Environmental Defense Fund
- EESI: Environmental and Energy Study Institute
- EI: Echotech Institute
- DOC: U.S. Department of Commerce
- G&G: Georgeson and Maslin
- GI: Georgetown Institute
- J&EI: Jobs and Environment Initiative
- MISI: Management Information Services, Inc.
- Pew: Pew Charitable Trusts
- USEER: U.S. Energy Employment Report
- USME: U.S. Metro Economies

The most recent green jobs estimates also vary greatly:

- E2/USEER estimates 3.0 million green jobs in 2020.

- EESI estimates 4.1 million green jobs in 2020.
- BKT estimates 30.2 million green jobs in 2018.
- G&M estimates 9.4 million green jobs in 2016.
- MISI estimates 8.8 million green jobs in 2021.
- These estimates differ by a factor of 10.

Figure 3-1
Examples of the Variation in U.S. Green Jobs Estimates



Source: MISI.

Even estimates from the same organization can differ substantially. For example, BI estimated 2.7 million green jobs in 2010 and estimated 6.6 million green jobs in 2016 – a 2.5X difference. State green jobs estimates also differ markedly. Table 3-2 and Figures 3-2 and 3-3 show the different estimates of green jobs available for a number of states from a variety of government and non-government sources over the past two decades.

Table 3-2
Estimates of Green Jobs For Selected States

State, Source, and Year of Estimate	**Green Jobs Estimate** (thousands)
Arizona: MISI/J&EI, 2005	91
Arizona: E2/USEER, 2020	57
California: MISI/J&EI, 2005	599
California: E2/USEER, 2020	485
California: E2/USEER, 2019	537
California: LIMD, 2009	433
California: AEEI, 2015	508
California: CCJE, 2015	332
Colorado: MISI/WN, 2019	266
Colorado: E2/USEER, 2020	58
Colorado: MISI/ASEA, 2007	91
Connecticut: MISI/J&EI, 2005	66
Connecticut: ECSU, 2009	42
Connecticut: MISI, 2009	165
Connecticut: E2/USEER, 2020	40
Connecticut: EC, 2019	44
Florida: MISI/J&EI, 2005	220
Florida: E2/USEER, 2020	150
Louisiana: E2/USEER, 2020	26
Louisiana: LSU, 2009	98
Maine: MDL, 2006	2.5
Maine: E2/USEER, 2020	11.9
Michigan: MISI/J&EI, 2005	202
Michigan: E2/USEER, 2020	113
Michigan: BLMISI, 2008	109
Michigan: Pew, 2007	23
Minnesota: MISI/J&EI, 2005	92
Minnesota: E2/USEER, 2020	55
Minnesota: MNGAT, 2014	15
Minnesota: NRDC, 2008	252
New York: MISI/NYSERDA, 2007	9*
New York: E2/USEER, 2020	153
New York: NYSERDA, 2019	164
Missouri: MGJR, 2009	131
Missouri: E2/USEER, 2020	47
North Carolina: MISI/J&EI, 2005	112
North Carolina: E2/USEER, 2020	100
Ohio: MISI/J&EI, 2005	176
Ohio: E2/USEER, 2020	103

Ohio: MISI/ASES, 2006	503
Ohio: ODJFS, 2011	89
Oregon; OED, 2010	43
Oregon: E2/USEER, 2020	52
Pennsylvania: MISI/WN 2019	376
Pennsylvania: E2/USEER, 2020	87
Pennsylvania: PDEP, 2019	97
Pennsylvania: PDLI, 2010	183
Washington: WESED, 2010	99
Washington: E2/USEER, 2020	76
Washington: Pew, 2007	17
Wisconsin: MISI/J&EI, 2005	97
Wisconsin: E2/USEER, 2020	69

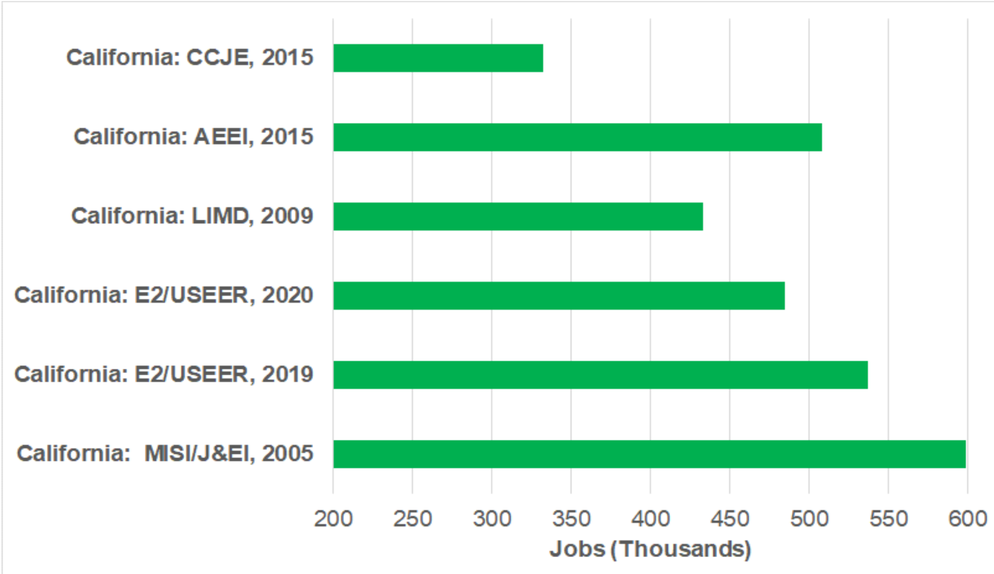
*RE jobs only

Source: MISI.

Legend for Table IV-2:

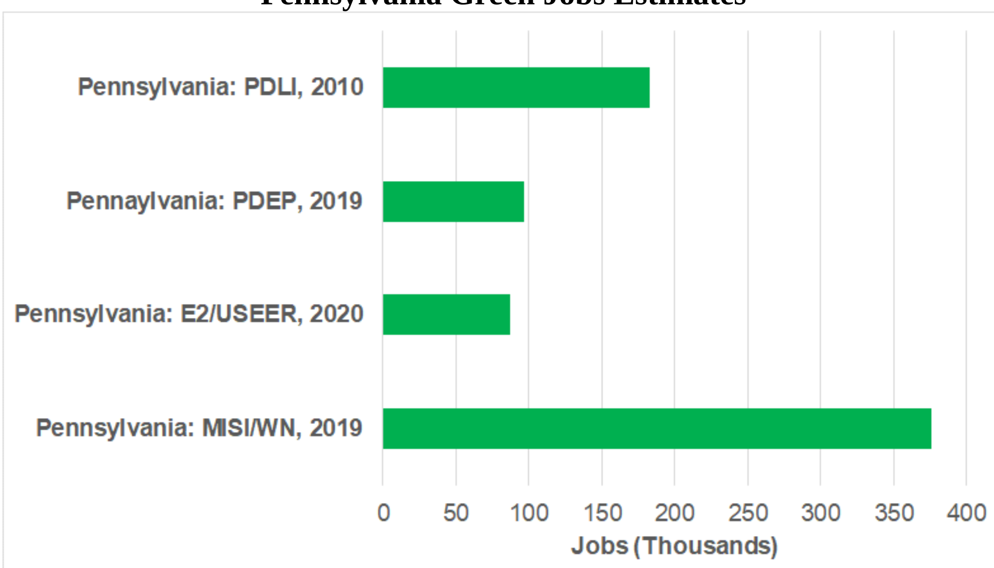
- AEEI: Advanced Energy Economy Institute
- ASEA: American Solar Energy Association
- BLMSI: Michigan Bureau of Labor Market Information and Strategic Initiatives
- CCJE: California Center for Jobs and the Economy
- E2: Environmental Entrepreneurs
- EC: Energize Connecticut
- ECSU: Eastern Connecticut State University
- J&EI: Jobs and Environment Initiative
- LIMD: California Employment Development Department's Labor Market Information Division
- LSU: Louisiana State University
- MDL: Maine Department of Labor
- MGJR: Missouri Green Jobs Report
- MNGAT: Minnesota NGA Policy Academy Team
- MISI: Management Information Services, Inc.
- NYSERDA: New York State Research and Development Authority
- NRDC: National Resources Defense Council
- ODJFS: Ohio Department of Jobs and Family Services
- OED: Oregon Employment Department
- PDEP: Pennsylvania Department of Environmental Protection
- PDLI: Pennsylvania Department of Labor & Industry
- Pew: Pew Charitable Trusts
- USEER: U.S. Energy Employment Report
- WESED: Washington State Employment Security Department
- WN: WorkingNation

Figure 3-2
California Green Jobs Estimates



Source: MISI.

Figure 3-3
Pennsylvania Green Jobs Estimates



Source: MISI.

They illustrate the enormous range of green jobs estimates among states and even for the same state depending on the green job definition and the source of the estimate. For example:

- For California, the green job estimates differ by a factor of nearly two.
- For Colorado, the green job estimates differ by a factor of nearly five.
- For Connecticut, the green job estimates differ by a factor of four.

- For Michigan, the green job estimates differ by a factor of nearly nine.
- For Minnesota, the green job estimates differ by a factor of 17.
- For Ohio, the green job estimates differ by a factor of nearly 12.
- For Pennsylvania, the green job estimates differ by a factor of more than four.
- For Washington, the green job estimates differ by a factor of nearly six.

4. ANALYSIS: WHY DO THE ESTIMATES DIFFER SO MARKEDLY?

It is thus clear that green jobs estimates for the U.S. and for individual states differ significantly. The national estimates differ by a factor of 40, and even the most recent estimates differ by a factor of 10.

To begin with, the differences cannot be attributed to any potential biases inherent in the source of the estimate. For example, EBI's estimate of 1.73 million green jobs in 2017 is among the lowest of the estimates. This is despite the fact the EBI is a for-profit corporation selling environmental data and consulting services, and it would seemingly be in EBI's interest to estimate a large number of green jobs. As another example, the Echotech Institute's estimate of 3.8 million green jobs in 2014 is far less than the larger estimates. This is despite the fact the EI was a for-profit college specializing in renewable energy and environmental programs, and it would seemingly have been in EI's interest to estimate a large number of green jobs.

Rather, the major cause of the enormous differences in green jobs estimates is the definition of green jobs and the data sources used. Thus, for example:

- EBI has a narrow proprietary data base and a focus on revenues to business, and classifies spending into services (analytical, hazardous waste, consulting & engineering, etc.) equipment (air pollution control, waste management, instruments & information, etc.), and resources (water utilities, resource recovery, and clean energy & power). It estimated 1.73 million U.S. green jobs in 2017.
- Pew used an industry output approach to categorize and estimate the number of U.S. green jobs and estimated 770,000 U.S. green jobs in 2007.
- The Department of Commerce (DOC) estimated private sector green employment in the U.S. based on publically-available Economic Census data, defined green products or services as those whose predominant function serves one or both of conserving energy and other natural resources or reducing pollution, and estimated 1.8 - 2.4 million U.S. green jobs in 2010.
- BLS defined green jobs as "jobs involved in economic activities that help protect or restore the environment or conserve natural resources" and estimated 3.4 million U.S. green jobs in 2010.
- E2 used USEER data, defined green jobs solely as clean energy jobs – thus excluding environmental and pollution abatement jobs, and estimated 3.0 million U.S. green energy jobs in 2020.

At the other extreme are very large estimates of U.S. green jobs:

- BKT used a very expansive definition of green jobs including not only those involving production of green goods and services but also jobs in any way somehow supposedly supporting the green economy, and estimated 30.2 million U.S. green jobs in 2018.
- G&M used what they termed "transactional triangulation" to measure supply chain activity and full economic impact, and estimated that in 2016 there were about 9.4 million U.S. workers who could be generously defined as being part of the green economy in a broad sense.

We conclude that the low estimates of U.S. green jobs are too low because of restrictive definitions. For example, EBI has a very narrow definition of green jobs that corresponds to its data base of environmental companies, and E2's definition of green jobs is deficient because it pertains only to clean energy jobs and excludes environmental jobs.

However, the high estimates of U.S. green jobs are too high because of overly expansive definitions. For example:

- BKT essentially counts any job even remotely connected to clean energy or environmental activities as green, even if only a small portion of the job relates to anything tenuously characterized as green. It ignores the FTE concept and likely overestimates the actual number of FTE green jobs by a factor or two or three, or more.
- G&M used what they termed "transactional triangulation" to measure supply chain activity and full economic impact and counted green jobs that vary in "greenness," with very few jobs consisting only of green tasks. Their approach also ignores the FTE concept, is overly broad, and is not directly comparable job estimates derived from available national statistical data bases.

Most of the comments made above apply to the state green jobs estimates. These vary enormously among the states and for individual states for the same reasons: Widely different green job concepts, definitions, estimation methods, and sources. It is unfortunate that no consistent databases of state green jobs estimates exist. E2 produces estimates of clean energy jobs by state, are available on a consistent basis for only three years, exclude environmental jobs, and suffer from the deficiencies of the USEER data. MISI has produced consistent estimates of jobs generated by the U.S. green economy for 11 states. [26] However, these are not available for all states and are not available on a time series basis.

5. CONCLUSION: GREEN JOBS CREATED BY THE USA ECONOMY

We utilize the MISI green job concept. [27] Basically, MISI does not attempt to develop a unique green job definition based on industrial or occupational characteristics. Rather, MISI defines green jobs as those full time equivalent (FTE) jobs generated – directly, indirectly, or induced – by the activities of the green economy. 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 and 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.[5]

This approach has at least five advantages:

1. It does not bog down into interminable debates over a specific green job definition.
2. It corresponds to interindustry job creation concepts that have been validated over the past half-century and utilized in many disparate economic and job impact analyses.
3. It provides a consistent national data base of estimates of jobs generated by the U.S. green economy over the past five decades.
4. It is viable and credible and produces neither the highest nor the lowest estimates of U.S. green jobs.
5. Importantly, it emphasizes that most of the jobs created by the green economy are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, etc., that the classic green job (solar energy engineer, ecologist, etc.) constitutes only a small portion of the jobs created, and that most of the persons employed in the jobs created may not even realize that they owe their livelihood to the green economy.

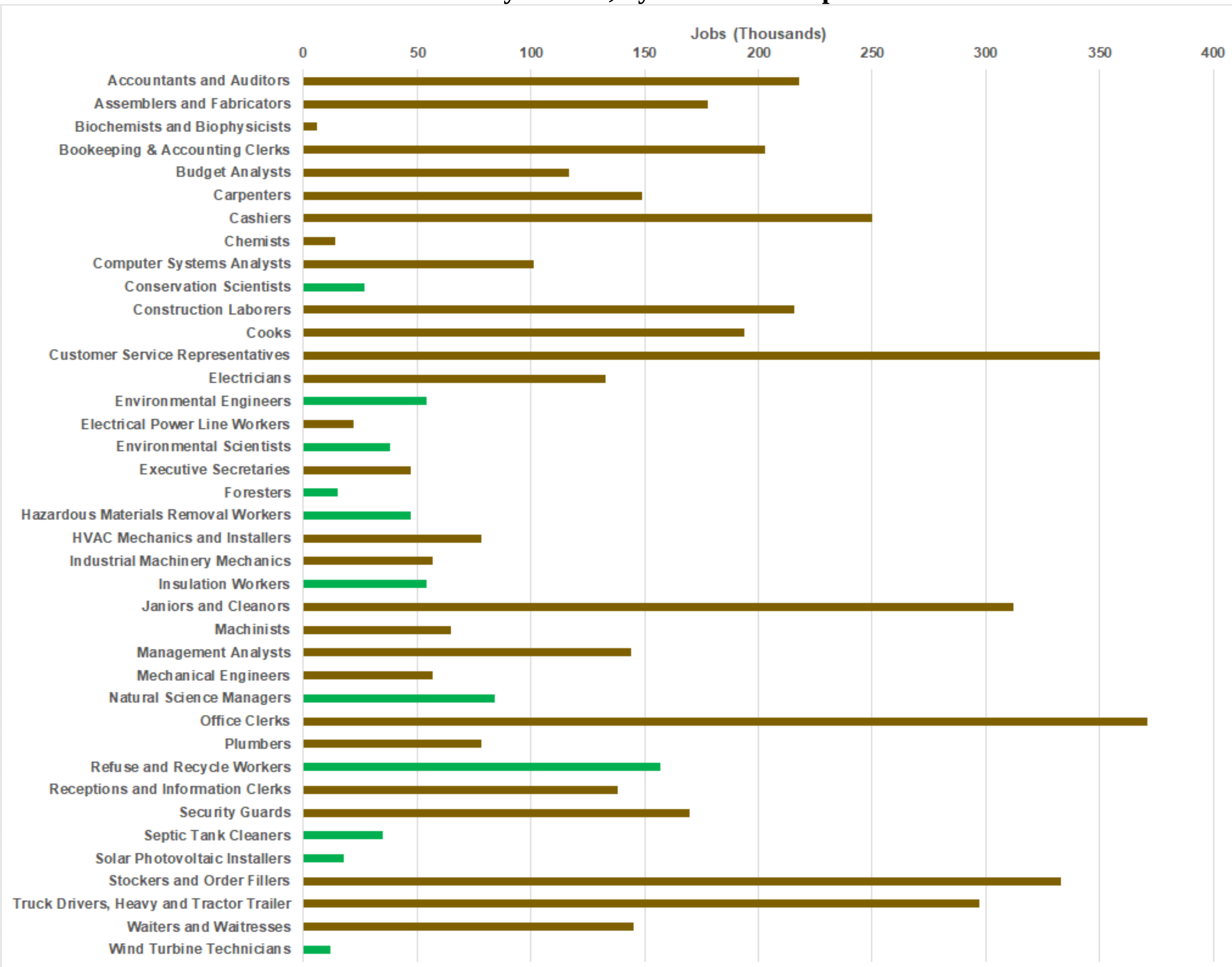
MISI estimated that the jobs generated in the U.S. green economy in 2020 totaled about 8.3 million and constituted less than 6% of total U.S. jobs. [28] However, these jobs should be assessed in perspective. For example, in 2020 these jobs:

- About equaled the total number of jobs in New York State.
- Totaled 40% more than the total number of jobs in Illinois.
- Totaled 65% more than the total number of jobs in Indiana.
- Totaled 75% more than the total number of jobs in Georgia.
- Totaled twice the total number of jobs in Virginia.
- Totaled 2.5 times the total number of jobs in Arizona.
- Totaled three times the total number of jobs in Missouri.

Further, most jobs generated by the U.S. green economy are not "green" (Figure 4-1). Rather, the vast majority of the jobs generated are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc., and most of the persons employed in these jobs do not realize that they owe their livelihood to the green economy.

[5]This is a nontrivial issue: FTE v non-FTE jobs estimates differ substantial among industries – especially at the more detailed level. The estimates for detailed industries can differ by 25%, and the variance among industries is very high and the ratios can change year over year.

**Figure 4-1: Jobs Generated by the U.S.
Green Economy in 2030, by Selected Occupations**



Source: U.S. Bureau of Labor Statistics, U.S. Energy Information Administration, and MISI.

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