

Research Article

The Reality and Policy Implications of U.S. Green Jobs

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Abstract:

Green jobs are of intense interest in the USA but heretofore 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 the importance of green jobs and estimate the green jobs created by the USA economy 1970 – 2030 by industry, occupation, skill, and salaries. Here we show that: 1) jobs generated by the USA green economy have increased from 1% of total jobs in 1970 to 6% 2020, and are forecast to comprise 14% of jobs in 2030; 2) most persons in these jobs do not realize that they owe their livelihood to the green economy; 3) jobs generated by the green economy are at least 3 or 4 times larger than realized; 4) most green jobs are not attractive, well paid, or unionized; 5) there about 25 times as many jobs currently being created by the U.S. green economy than by the U.S. coal industry; 6) advocates can be their own worst enemies by misrepresenting the reality of green jobs. The significance of green jobs is not appreciated and this has serious economic, environmental, and policy implications that must be remedied.

Keywords: green jobs; green jobs estimates; green jobs forecasts; green jobs significance; green jobs skills; green jobs vs. coal jobs; USA green jobs

Introduction

The crisis in Ukraine has greatly heightened the interest in green technologies, green energy, and green jobs. Further, green technologies and green jobs are relevant to many of the economic, environmental, and job issues currently being debated in the U.S., including infrastructure spending [<https://www.whitehouse.gov/bipartisan-infrastructure-law/>], climate mitigation policies in the wake of COP26 [<https://ukcop26.org/>], the Green New Deal [<https://www.misi-net.com/publications/JESRR-V2N1.pdf>], and green jobs, employment, and training policies. Here we correct disinformation being disseminated by analysts and interest groups who are opposed to green jobs programs and who minimize their potential significance. However, our findings also upend much conventional wisdom being propagated by environmentalists and green jobs advocates.

We derive recommendations for legislators, policy-makers, and educators: 1) the empirical reality of green jobs must be recognized; 2) the importance of green jobs for energy, environmental, and employment policies must be understood; 3) education and training for green jobs must recognize the reality that, contrary to much hype, most green jobs are not glamorous, well-paid, or unionized; 4) most jobs generated by the green economy are not necessarily “green.”

We estimated the jobs created by the U.S. green economy 1970 – 2030 by industry, occupation, skill, and salaries [[https://misi-net.com/publications/WN%20Green %20Jobs-0122.pdf](https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf)]. We found that:

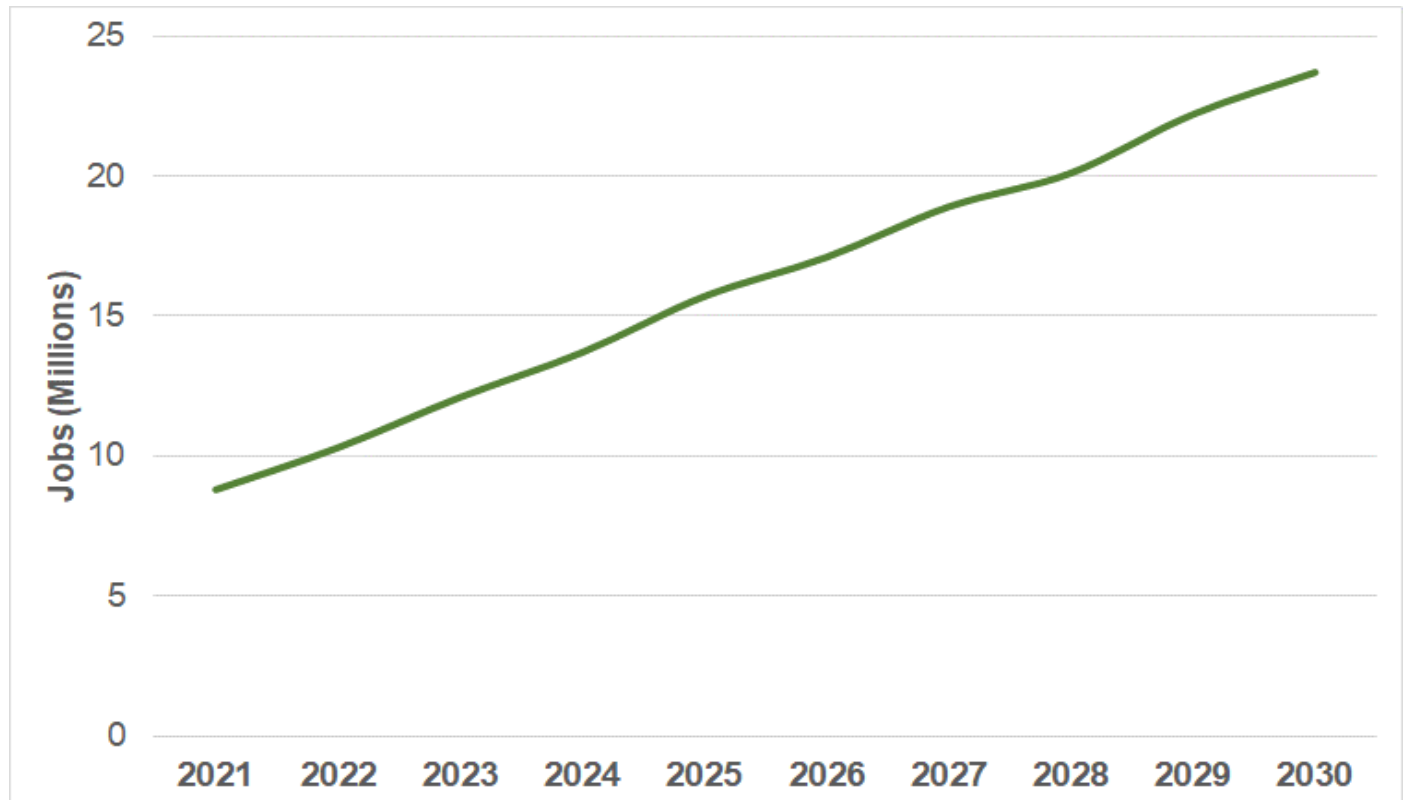
- Jobs generated by the U.S. green economy have increased from 1% of total jobs in 1970 to 6% in 2020, and are forecast to comprise 14% of jobs in 2030;
- Most persons in these jobs do not realize that they owe their livelihood to the green economy;
- Jobs generated by the green economy are at least three or four times larger than realized;
- there about 25 times as many jobs currently being created by the U.S. green economy than by the U.S. coal industry;
- Green energy investments have net positive economic and jobs benefits;
- Most green jobs are not attractive, well paid, or unionized;
- Green jobs salaries are not higher than average;
- Advocates can be their own worst enemies by misrepresenting green job realities;
- The significance and scale of green jobs is not appreciated.

Green Economy

The U.S. green economy is much larger than is realized, is growing rapidly, and will continue to increase rapidly. The current (2022) size of the U.S. green economy is approximately \$790 billion and this green economy creates over 10 million jobs. Jobs generated by the green economy increased from less than 1 million and 1% of U.S. jobs in 1970 to over 10 million jobs and 6.5%

by 2022. By 2030, they total 24 million and comprise nearly 14% of all jobs (Figure 1). Over 1970 - 2030, they are forecast to increase 16X as rapidly as total jobs. These estimates are much larger than most of those currently available [<https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf>, pp. 140-157] and emphasize that green jobs are being seriously underestimated.

Figure 1: Jobs Generated by the U.S. Green Economy Forecast, 2021 - 2030



Source: MISI.

Most jobs generated by the green economy are not “green” (Figure 2). Rather, the vast majority are standard jobs for accountants, engineers, analysts, clerks, factory workers, mechanics, etc., and most of the persons thus employed do not realize they owe their livelihood to the green economy. Many companies, whether they realize it or not, owe their profits – and in some cases their existence – to “green” expenditures.

Green Job Definition

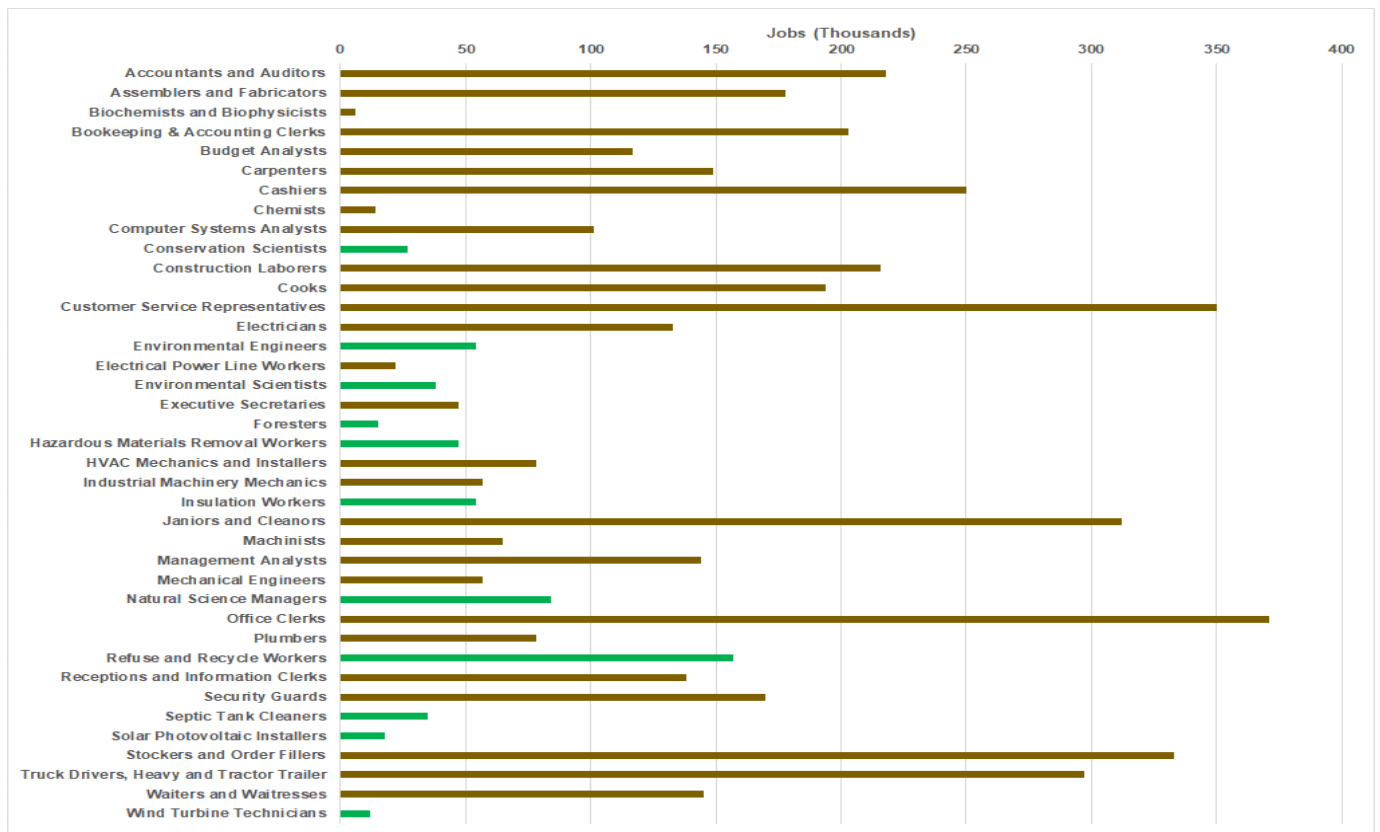
There is no consistent definition of a “green job.” Different estimates of U.S. green jobs are available from a variety of sources, and vary widely. National estimates differ by a factor of 40 and even recent estimates differ by a factor of 10, and state estimates also differ markedly [<https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf>, pp. 140-157].

Our green job concept is not based on industrial or occupational characteristics or on survey methods. Rather, we define green jobs as full time equivalent (FTE) jobs generated – directly, indirectly, or induced – by the green economy [<https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf>, pp. 169-177].

Green Economy Detail

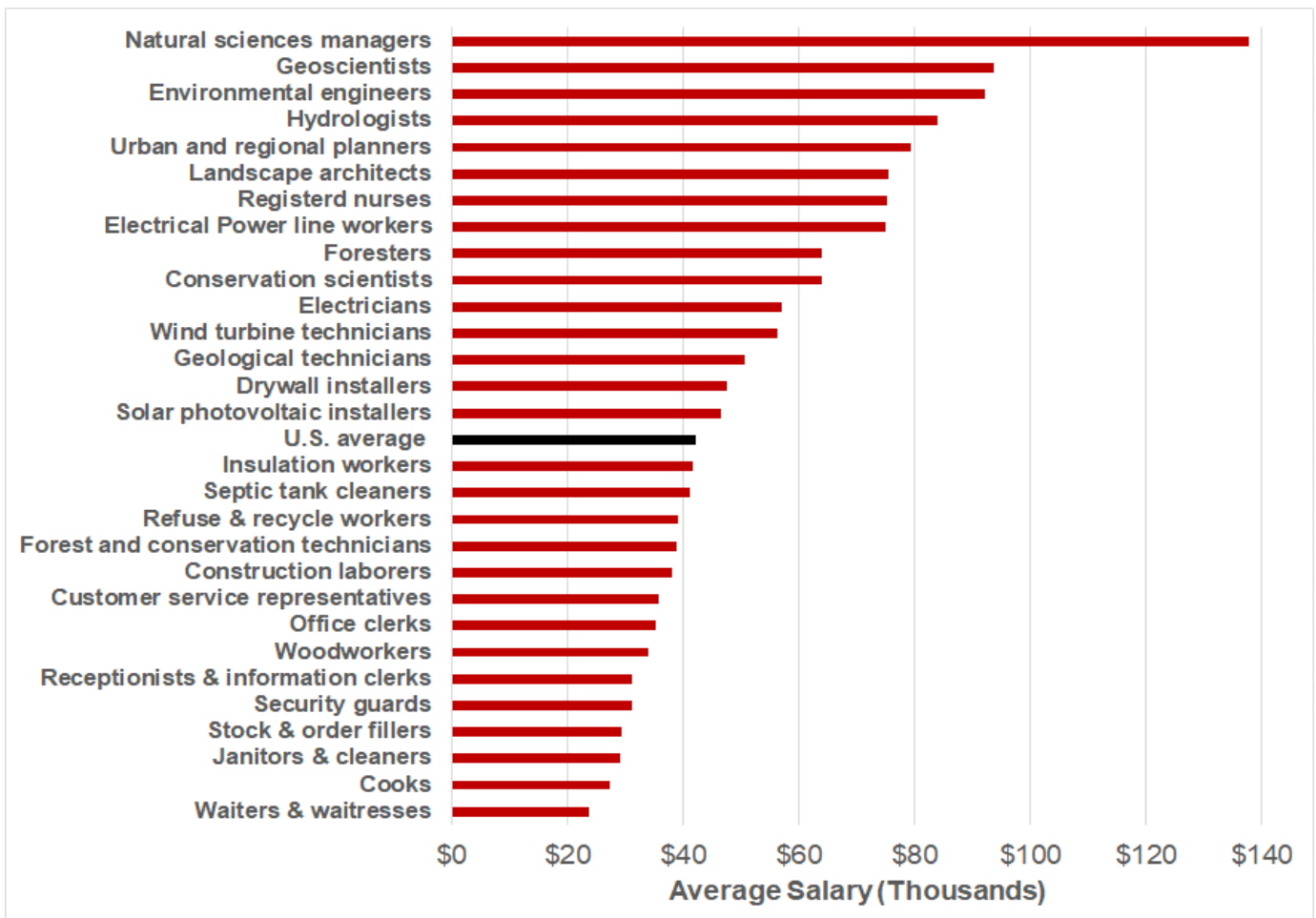
We resolve the contentious debate over the relative salaries of green jobs. Since the vast majority of jobs generated by the green economy are standard “non-green” jobs, the average salaries for these jobs must – due to the law of large numbers – be close to the U.S. average. While many of the jobs generated pay higher than average salaries, many others do not (Figure 3). For example, three types of the most numerous green jobs created – Refuse and Recycle Workers, Insulation Workers, and Septic Tank Cleaners – pay below average wages. Thus, it is not valid to contend that jobs generated by the green economy pay salaries that are significantly higher – or lower -- than average.

Figure 2: Jobs Generated by the U.S. Green Economy in 2030, by Selected Occupations



Source: U.S. Bureau of Labor Statistics.

Figure 3: Average 2020 Annual Salaries of Selected Jobs Generated by the Green Economy



Source: U.S. Bureau of Labor Statistics.

Most jobs in firms producing green products or services are not “green.” Specifically, in green companies, most of the employees are not classified as “environmental specialists” or “green energy specialists.” For example, in a wind turbine factory there are few if any classic green jobs; rather, the occupational job distribution of a typical wind turbine manufacturing company differs relatively little from that of a company that manufactures other products. This is illustrated in Table 1, which shows the 2019 occupational job distribution and employee earnings of a typical wind turbine manufacturing company. The job profile reflects that of a typical manufacturing facility with numerous jobs for Assemblers, Machinists, Engineers, Inspectors, Laborers, Clerks, etc. Nevertheless, these are green jobs due to the product being produced.

Table 1: Typical Employee Profile of a 250-person Wind Turbine Manufacturing Company, 2019

Occupation	Employees	Earnings
Engine and Other Machine Assemblers	31	\$33,359
Machinists	27	37,191
Team Assemblers	16	27,668
Computer-Controlled Machine Tool Operators	12	37,254
Mechanical Engineers	10	65,772
First-Line Supervisors/Managers of Production/Operating	10	54,705
Inspectors, Testers, Sorters, Samplers, and Weighers	8	37,202
Lathe and Turning Machine Tool Setters/Operators/Tenders	6	36,729
Drilling and Boring Machine Tool Setters/Operators/Tenders	4	36,509
Welders, Cutters, Solderers, and Brazers	4	36,530
Laborers and Freight, Stock, and Material Movers	4	28,466
Maintenance and Repair Workers	4	41,318
Tool and Die Makers	4	40,047
Grinding/Lapping/Polishing/Buffing Machine Tool Operators	4	31,899
Multiple Machine Tool Setters/Operators/Tenders	4	37,517
Industrial Engineers	3	64,659
Industrial Machinery Mechanics	3	42,315
Engineering Managers	3	99,404
Shipping, Receiving, and Traffic Clerks	3	29,516
General and Operations Managers	3	110,702
Industrial Production Managers	3	85,512
Industrial Truck and Tractor Operators	3	31,416
Purchasing Agents	3	51,702
Cutting/Punching/Press Machine Setters/Operators/Tenders	3	28,907
Production, Planning, and Expediting Clerks	3	41,601
Milling and Planing Machine Setters/Operators/Tenders	3	37,380
Mechanical Drafters	2	44,090
Customer Service Representatives	2	36,036
Bookkeeping, Accounting, and Auditing Clerks	2	32,760
Office Clerks, General	2	27,227
Sales Representatives, Wholesale and Manufacturing	2	50,757
Janitors and Cleaners	2	28,476
Sales Engineers	2	66,591

Accountants and Auditors	2	54,873
Tool Grinders, Filers, and Sharpeners	2	40,520
Executive Secretaries and Administrative Assistants	2	39,638
Mechanical Engineering Technicians	2	46,767
Electricians	2	45,570
Other employees	48	45,969
Employees, Total	250	\$57,680

Source: MISI.

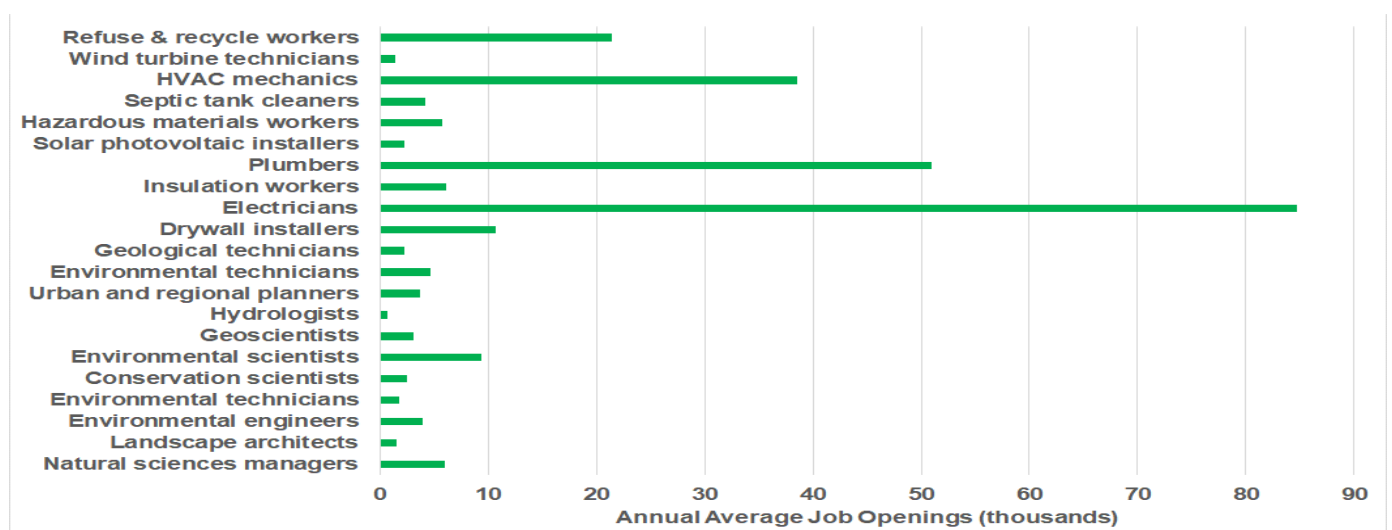
Green jobs advocates can be their own worst enemies. Advocates and politicians have greatly tightened the criteria for defining green jobs and have, paradoxically, greatly reduced the number of jobs that can, according to these criteria, be defined as “green.” The more stringent the criteria – high pay, good benefits, quality jobs, union jobs, favorable working conditions, etc., the fewer the jobs that are defined as green. [https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf, pp. 84-91]. The reality is that most jobs created by the green economy do not adhere to the stringent criteria. A very strict list of criteria greatly reduces estimates of the number of green jobs. Utilization of these criteria seriously underestimates the size and rates of growth of U.S. green jobs, and will hinder efforts to address pressing environmental, climate, and energy issues and to expand the green economy.

Contrary to green jobs advocates’ hype, many green jobs are not necessarily glamorous or desirable. Thus, forecast jobs openings for occupations such as Recycle Worker, Hazardous Materials Removal Worker, and Septic Tank Cleaner greatly exceed those for occupations generally promoted, such as Wind Turbine Technician, Solar Photovoltaic Installer, and Environmental Engineer – Figure 4. Advocates must be realistic as to the “green jobs of the future” and to relevant education and training policies. Thus, over the coming decade, annual total U.S job openings for Wind Turbine Service Technicians will total 1,400 and for Solar Photovoltaic Installers will total 2,300. It is not optimal educational or training policy to plan to produce many thousands of workers annually certified in these occupations given the relatively small number of annual job openings likely to be available.

There are numerous studies contending that green initiatives create substantial numbers of jobs and just the opposite – that they destroy jobs. Nevertheless, the balance of research indicates that investments in green energy programs have favorable net positive economic and jobs benefits [https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf, pp. 92-139].

The U.S. Bureau of Labor Statistics (BLS) occupational data have serious limitations for green jobs assessments for they do not include numerous designations that would be useful in green jobs analyses. [https://misi-net.com/publications/WN%20Green%20Jobs-0122.pdf, pp. 161-169]. Further, BLS occupational classifications will never be able to identify many distinct green occupations such as “Green Lawyer,” “Green Accountant,” “Green Welder,” “Green Programmer,” “Green Carpenter,” etc. In addition, how “green” an occupation is does not necessarily depend on the occupational definition. Rather, it is also determined by the product or service involved.

Figure 4: Average Annual Job Openings, 2020 – 2030, For Selected Green/Semi-green Occupations



Source: U.S. Bureau of Labor Statistics and MISI.

Identifying the job openings and the requisite skills, education, training, and experience required is especially important for education and training purposes [https://www.rees-journal.org/articles/rees/full_html/2019/01/rees180005s/rees180005s .html]. We estimated the average annual job openings for jobs generated by the green economy through 2030 (Figure 5). The vast majority of the annual job openings will not be for “green” or even “semi-green” occupations. For example, over the coming decade the average annual U.S. job openings generated by the green economy will total 30 times more Office Clerks (42,000) than Wind Turbine Service Technicians (1,400); 11 times more Assemblers and Fabricators (26,300) than Solar Photovoltaic Installers (2,300); 16 times more Construction Laborers (22,000) than Foresters (1,400); and 11 times more Customer Service Representative (44,000) than Environmental Engineers (4,000) [https://www.bls.gov/emp/tables/occupational-projections-and-characteristics. htm].

Through 2030, there will be relatively few annual job openings for Wind Turbine Service Technicians or for Solar Photovoltaic Installers [https://www.bls.gov/emp/tables/ occupational-projections-and-characteristics.htm.] Accordingly, it is not advisable to produce many thousands of workers annually in these occupations. The end result is likely to be disappointed workers trained in these skills functioning as baristas and fast-food workers.

Further, even for certifiable green occupations, over the coming decade most annual job openings generated by the green economy will not be for the types of glamorous green jobs that are the most publicized and hyped; e.g., Wind Turbine Service Technician, Solar Photovoltaic Installer, Environmental Scientist, etc. Rather, most of annual job openings will be for occupations such as Refuse and Recycle Workers – 21,400 annual job openings; Water and Waste Treatment Plant Operators – 10,500 annual openings; Hazardous Materials Removal Workers – 5,800 annual job openings; Septic Tank Cleaners – 4,200 annual openings; Insulation Workers – 3,300 annual openings.

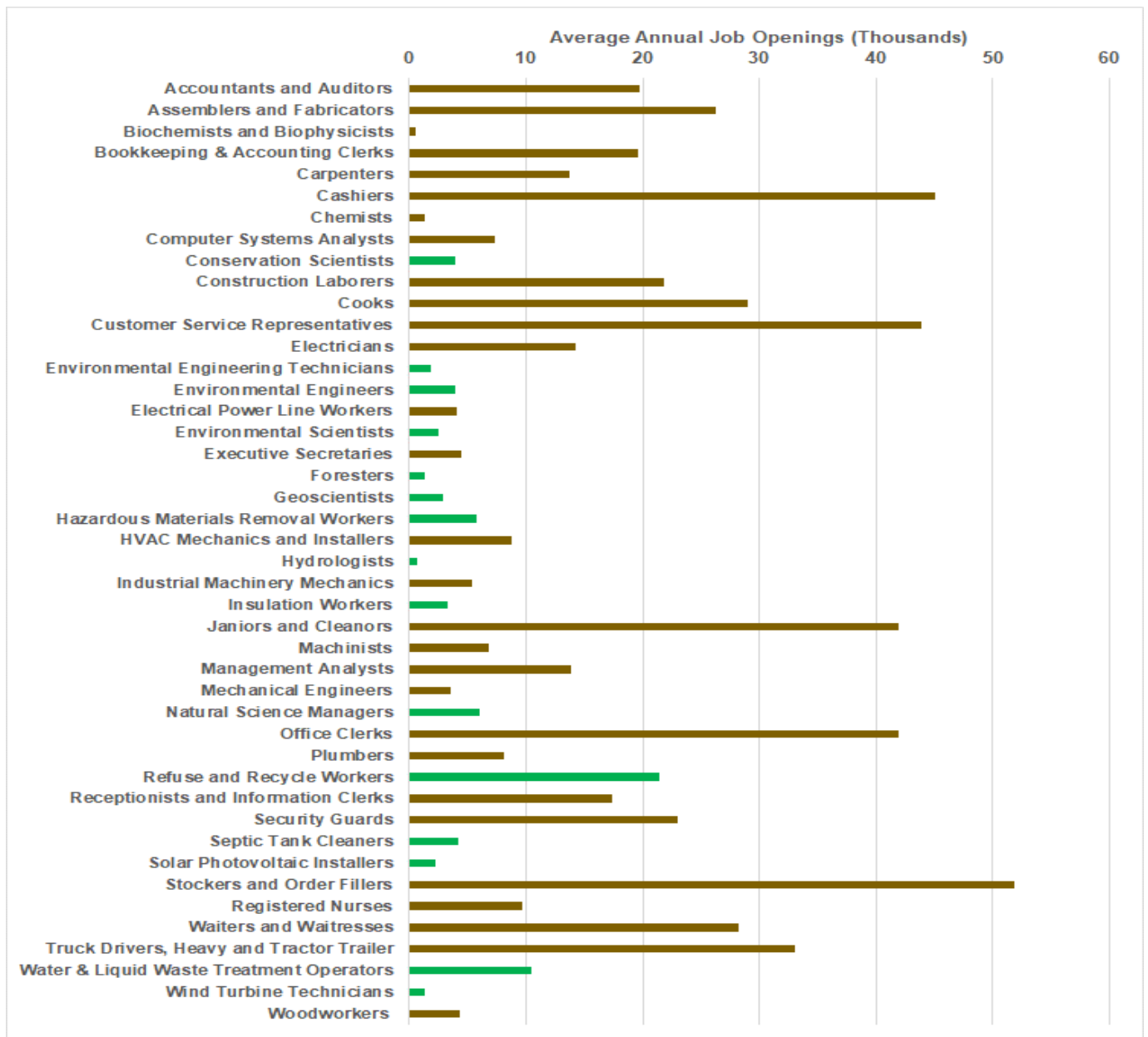
Green Jobs Relative to What?

We estimate that there are currently over 10 million jobs generated by the U.S. green economy. The question arises, “Relative to what?” How does this compare to job created by the energy industry or the fossil fuel industry?

Unfortunately, there are no comparable estimates for energy or fossil fuel jobs. The Department of Energy’s U.S. Energy and Employment Report (USEER) estimates that the **Energy, Energy Efficiency, and Motor Vehicles sectors in 2020 employed approximately 7.1 million persons** [https://www.energy.gov/sites/default/files/2021-07/USEER%202021%20Executive%20Summary.pdf]. **However, there are several problems with comparing this estimate to the green jobs estimate presented here. First, the USEER estimate includes renewable energy and energy efficiency, both of which are part of the green economy. Second, the USEER estimate refers only to direct jobs and excludes indirect and induced jobs. Third, there are serious empirical and theoretical problems with the USEER estimates** [https://misi-net.com/publications/WN %20Green%20Jobs-0122.pdf, pp. 47-49]

Similarly, there are no comparable estimates for jobs created by the fossil fuel industry. However, there is a recent comparable estimate for the total jobs created (direct, indirect, and induced) by the U.S. coal industry [https://misi-net.com/ publications/PUF-0620.pdf.] While there are currently about 82,700 active coal industry employees -- 55,400 active coal miners and that 27,300 contractors, in reality it was estimated that the total the number of coal dependent jobs is much larger than generally realized – as much as eight times larger, and totals approximately 420,000. It can thus be stated that there about 25 times as many jobs currently being created by the U.S. green economy than by the U.S. coal industry. Further, Figure 1 indicates that U.S. green jobs are growing rapidly, whereas U.S. coal industry jobs are decreasing and have been declining for the past century [https://misi-net.com/publications/PUF-0620.pdf].

Figure 5: Average Annual Job Openings Generated by the U.S. Green Economy, 2021-2030, Selected Occupations



Source: U.S. Bureau of Labor Statistics and MISI.

Policy Realities and Policy Imperatives

Identifying the job openings and the requisite skills, education, training, and experience required is especially important for education and training purposes [https://www.brookings.edu/wp-content/uploads/2020/11/20201120_BrookingsMetro_Work-based-learning_Final_Report.pdf]. Notably, for jobs requiring years of specialized education and training, planning has to be initiated years in advance of the anticipated demand for these jobs. Similarly, it is important to know which of the jobs being created can be filled with a limited amount of retraining or on-the-job training. For example, to increase the supply of some occupations may require nearly a decade, to increase the supply of workers in some occupations requires less time, but still substantial time, while the workers in other occupations can be increased much more rapidly. The information presented here can be used to develop optimal education, training, and retraining policies and to address the mismatch between the skills that employers want and the skills that employees have.

Importantly, policymakers must resist fixation on “sexy” green jobs such as Wind Turbine Technicians and Solar Photovoltaic Installers, for which there will be relatively few annual new job openings. This fixation could result in misguided and self-defeating jobs and jobs training programs. It must be emphasized 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.

Green investments will provide a greater than proportionate assist to the U.S. high-tech and manufacturing sectors, and green investments generate proportionately more jobs in professional, scientific, and technical services than the U.S. average

[https://www.researchgate.net/publication/344228366_Journal_of_Environmental_Science_and_Renewable_Resources_The_US_A_New_Green_Deal_Will_Create_Over_18_Million_Jobs]. This has important implications for economic, jobs, and education and training programs. Nevertheless, green jobs will continue for the foreseeable future to comprise only a small portion of total U.S. jobs. Employment and job creation programs must take such discrepancies into account.

Further, as noted, even for certifiable green occupations, over the coming decade most of annual job openings generated by the green economy will not be for the types of glamorous green jobs that are the most publicized and hyped; e.g., Wind Turbine Service Technician, Solar Photovoltaic Installer, Environmental Scientist, etc. Rather, most of annual job openings generated by the green economy will be for occupations such as, for example: Refuse and Recycle Workers – 21,400 annual job openings; Water and Waste Treatment Plant Operators – 10,500 annual job openings; Hazardous Materials Removal Workers – 5,800 annual job openings; Septic Tank Cleaners – 4,200 annual job openings; Insulation Workers – 3,300 average annual job openings. Nevertheless, it is unlikely that green job advocates will be publicizing Refuse and Recycle Workers or Septic Tank Cleaners as the glamorous “green jobs of the future.”

Jobs generated by the green economy will be created across a new continuum of employment, skills, training, responsibilities, and earnings [https://www.rees-journal.org/articles/rees/full_html/2019/01/rees180005s/rees180005s.html]. Training and retraining for new skills will be needed across a wide spectrum of industries. Some changes in skills are relatively well defined, but many remain difficult to forecast since the technologies are still evolving. Numerous 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 state government occupational handbooks [<https://www.bls.gov/ooh/>]. Further, many of these new jobs require different skills and education than current jobs, and training needs must be determined to enable the rapidly growing green economy to have a sufficient supply of qualified employees.

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