GEORGE MASON UNIVERSITY | Institute for Immigration Research

Foreign-Born Green Job Workers in the United States

By Ismail Nooraddini, MA and Kevin Nazar, MS

AUGUST 2021

August 2021

Table of Contents

Executive Summary and Key Findings

This report highlights the role foreign-born workers play in green jobs – those jobs that either benefit the environment directly or make their establishment's production more environmentally friendly. Environmental concerns, such as climate change and resource scarcity, call for a workforce that can create the resources and infrastructure necessary to implement effective approaches for prevention, mitigation, and resource conservation (European Environment Agency, 2019).

Americans are thinking about job growth, and some are connecting it to the green economy. Members of Congress reintroduced the "Green New Deal Resolution" (H. Res. 109, 2021) calling on the federal government to acknowledge the impact of climate change and take steps to reduce greenhouse gas emissions; invest in infrastructure; and ensure that future generations have clean air and water, healthy food, access to nature, and a sustainable environment. In March 2021, the Biden Administration released The American Jobs Plan, which envisions billions of dollars being spent to rebuild the country's infrastructure while creating millions of good jobs. The plan includes investments in the green economy such as developing and building electric vehicles, generating clean energy, retrofitting homes to be more energy efficient, and establishing the United States as a leader in climate science, innovation, and research and development (White House 2021). Both of these plans emphasize the creation of good, well-remunerated jobs that promote economic security for all workers. While there is much disagreement about the need to combat climate change as well as the details of these plans, as of July 2021, the White House and Congress are negotiating a deal on an infrastructure bill that would upgrade critical elements of the U.S.'s infrastructure and create jobs, many of which are likely to be "green."

The number of green jobs in the United States has been expanding. Prior to the COVID-19 pandemic and associated economic downturn, the two occupations projected to grow the most in the United States in the next ten years were not only green, but also had an overrepresentation of foreign-born workers. According to the Bureau of Labor Statistics (BLS), solar and photovoltaic installers had a projected growth of 63.3 percent, and wind turbine service technicians were projected to grow 56.9 percent. Nationwide, more than 15 percent of the workers in those occupations were foreign born. When examining the entire green sector, immigrant workers play an even larger role; 23 percent of all green job workers are foreign born.

Previous studies of jobs in the green energy economy examined workers at the industry or business level and did not examine the role of the foreign-born in these industries. However, we used occupation-level data to assess characteristics of individuals employed in four different sectors of the economy made up of related occupations: Cleaning, Installation, Business, and Science. By examining the role that immigrants play in green jobs and how they compare to native-born workers, we can better understand how and why immigrants are contributing to the green economy and determine how they may supplement the U.S. labor force to fill future green jobs.

The U.S. economy has begun to recover; as of May 2021, the unemployment rate is 5.8 percent, down from 13.3 percent in May 2020 (Bureau of Labor Statistics, 2021). But it is clear that the labor force has changed over the past year. Some businesses are reporting a "labor shortage" while others claim that it is a shortage of well-paying jobs, or a mismatch of skills and opportunities. There are currently

unresolved questions regarding the role of extended unemployment benefits and stimulus checks, a lack of child care, a preference for remote work, and changed personal priorities, and other factors on the U.S. labor force (Irwin, 2021; Long, 2021).

It may take a while for the United States to emerge from the miasma following the COVID-19 crisis. However, it appears to be clear that foreign-born workers will continue to be needed to supplement the U.S. workforce. This was true in the green economy prior to the pandemic, and will likely be true in the future. Foreign-born workers are not substitutes for American workers; rather, they complement U.S. workers (Ottaviano and Peri 2006; Peri and Sparber, 2008). Because immigrant and U.S. workers have different demographic profiles, they fill different niches in the workforce.

The data in this report comes from the 2013-17 Integrated Public Use Microdata Sample (IPUMS-USA) file based on the U.S. Census Bureau's American Community Survey. This data reflects the composition of the green workforce prior to the COVID-19 pandemic. We expect that the green sector will continue to grow, and that immigrants will continue to be important to rebuilding the economy and expanding the green sector.

Key Findings of the report

We organized green occupations into four sectors:

1. Building and grounds cleaning and maintenance occupations (Cleaning)
2. Installation, maintenance, transportation, and laborers (Installation)
3. Supervision and business operations (Business)
4. Environmental protection engineers and scientists (Science)

- **Immigrants were overrepresented in green jobs.** While immigrants comprise approximately 13 percent of the U.S. population and 16 percent of the labor force, they made up 23 percent of all green job workers. Of the estimated 15.4 million green job workers in the United States, approximately 3.6 million were immigrants. Immigrant green job workers made up larger shares in the Cleaning and Installation sectors.
- **Slightly more than one in three immigrant green job workers was a naturalized U.S. citizen.** Approximately 35 percent of all foreign-born green job workers were naturalized citizens. Immigrant green job workers in the Business and Science sectors (47 percent and 55 percent) were more likely to be naturalized citizens compared to immigrant green job workers in the Cleaning and Installation sectors (30 percent and 43 percent). In other words, the sectors with the highest concentrations of foreign-born workers also have the highest shares of noncitizens.
- **Immigrant green job workers in the Science sector came from different countries compared to all other green job workers.** The top countries of origin among immigrant green job workers in the aggregate of the Cleaning, Installation, and Business sectors were Mexico (45 percent), El Salvador (6.8 percent), Guatemala (4.9 percent), the Dominican Republic (3.3 percent), and Honduras (2.8 percent). On the other hand, the top five countries of origin among immigrants in the Science sector were India (9 percent), China (8 percent), Canada (6 percent), Mexico (3 percent), and Iran (3 percent).

- **Native- and foreign-born green job workers differed by demographic characteristics including gender, English proficiency, and education.** Immigrant green job workers were nearly twice as likely to be female compared to their native-born colleagues. Immigrant females made up notably larger proportions of the workforce among green job workers in the Cleaning and Science sectors. Immigrant green job workers in the Cleaning and Installation sectors were less likely to be proficient in English compared to the national average, while immigrant green job workers in the Business and Science sectors were more likely to be proficient in English. Foreign-born green job workers, in general, had lower rates of educational attainment relative to their native-born colleagues, but immigrant green job workers in the Science sector held higher levels of educational attainment at a greater rate, and were nearly twice as likely to have a master's degree or higher.
- **Foreign-born green job workers were twice as likely to be self-employed.** Immigrant workers were more likely to be self-employed than native-born workers in three out of the four sectors, including Business (22.3 percent versus 20.1 percent), Cleaning (21.6 percent versus 15.0 percent), and Installation (9.3 percent versus 6.4 percent). However, many of these immigrants were not incorporated, suggesting there were limited options for employment in established firms and self-employment was a necessity.
- **The two occupations that were projected to grow at the fastest rate in the U.S. between 2018 and 2028 are both green occupations.** These two occupations are Solar and photovoltaic installers and Wind turbine service technicians, and they were projected to grow 63.3 percent and 56.9 percent respectively according to the Bureau of Labor Statistics (BLS). Immigrant workers were overrepresented in both of these occupations.
- **Policymakers working on growing the green economy should consider immigrants and immigration policy as part of the solution**. As the economy recovers from the disruption of COVID-19 and the green economy expands, foreign-born workers can supplement the U.S. labor force in areas where it is needed.

Introduction

According to the United Nations Environment Programme, a "green economy" is defined by its low carbon dependency, resource efficiency, and low pollution levels, social inclusivity, and the prevention of the loss of biodiversity. "Green jobs" are those that either benefit the environment directly or make their establishment's production more environmentally friendly (Bureau of Labor Statistics, 201). Green jobs make up an increasingly substantial portion of the economy (Environmental Defense Fund, 2018). In fact, prior to the pandemic, solar and wind-industry jobs were growing at a rate of about 20 percent each year -- 12 times faster than the general economy. Environmental concerns, such as climate change and environmental resource scarcity, beckon a workforce that can create the resources and infrastructure necessary to implement effective approaches for the preservation of the environment (McClure et al., 2017).

Despite the thriving nature of the green industry prior to the pandemic, and expected continued growth of green jobs, it had been anticipated that the United States does not have enough workers to meet the demand for green jobs, resulting in labor market shortages (GETI, 2019). Indeed, prior to the pandemic labor shortages in green jobs had already be seen all over the United States, including in Vermont (Whitcomb, 2019), Iowa (Lawhon, 2018), and Wisconsin (Kirwan, 2019). For instance, according to the 2019 Vermont Clean Energy Report (Jordan et al., 2019), Vermont has the highest rate of per capita clean energy employment at 5.7 percent, but its workforce was stagnating. The disparity in the labor market hurt Vermont businesses who needed additional workers.

This paper highlights the important role that foreign-born* workers play in green jobs. This research builds on existing studies of green industries and jobs (Bureau of Labor Statistics 2014; Cuttino, 2009; U.S. Department of Energy, 2017; Muro et al., 2011, 2019), but focuses on the role of immigrants. Immigrants make up an increasingly larger share of the U.S. population and possess a variety of skills and aspirations beneficial to the U.S. economy. Today, immigrants represent 13 percent of the U.S. population and 16 percent of the labor force. Foreign-born green jobs workers are unevenly distributed across the county and across occupations, and fill both low- and high-skilled green jobs. While immigrants working in Science occupations tend to be highly educated and well remunerated, immigrants working in Cleaning and Installation occupations are generally not U.S. citizens, do not speak English well, are not well educated, and do not earn as much as their native-born counterparts. Many of the workers in the Cleaning occupations, in particular, have been "essential" workers during the COVID-19 pandemic. This crisis has made it clear than many of the U.S.'s essential workers are foreign-born, work in poor conditions, and have little access to health care and other benefits. As the United States and the world move forward with economic recovery, we have an opportunity to build a greener economy and ensure that the jobs created are good, decent jobs. There is likely to be greater demand for workers in green jobs at some point in the future, and immigrants may be important to filling those labor market needs.

*Please note that the terms "immigrant" and "foreign-born" are used interchangeably throughout this report. Foreign-born refers to individuals who are not a U.S. citizen at birth or who were born outside the U.S., Puerto Rico or other U.S. territories and whose parents are not U.S. citizens. The foreign-born may include naturalized U.S. citizens, Legal Permanent Residents, temporary residents, refugees and asylees, and others. Native born includes those who are U.S. citizens at birth, those born in the United States, Puerto Rico, or other U.S. territories, and those born abroad to a parent who is a U.S. citizen.

Identifying Green Occupations

Previous studies on jobs in the green economy relied on industry-level analysis (for example, see Solar Foundation 2017). The problem with this approach is that we are unable to discern characteristics of the individuals employed in these occupations. As such, these studies have not distinguished between native- and foreign-born workers.

In line with previous research, we use the Bureau of Labor Statistics' (BLS) definition of green jobs and rely on existing government reports to identify green occupations (Torpey, 2013; Warren, 2013; Watson, 2013). The BLS green jobs definition contains two components:

- Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; or,
- Jobs in which workers' duties involve making their establishments' production more environmentally friendly or use fewer resources.

Using this definition, BLS identified 19 occupations, which we then organized into four sectors. Table 1 includes the sectors and the occupations that fall within them as well as the number of workers in each sector and occupation.

1. Building and grounds cleaning and maintenance occupations (Cleaning)
2. Installation, maintenance, transportation, and laborers (Installation)
3. Supervision and business operations (Business)
4. Environmental protection engineers and scientists (Science)

Unless otherwise noted, data in this report was analyzed using the 2013-2017 5-year American Community Survey (ACS), via the Integrated Public Use Microdata Sample (IPUMS-USA) file (Ruggles et al 2020). Data regarding employment projections is based on the short-term and long-term estimates provided at the national and state level by the Bureau of Labor Statistics (BLS). These projection estimates are based on the Quarterly Census of Employment and Wages. See Appendix A for additional methodological notes.

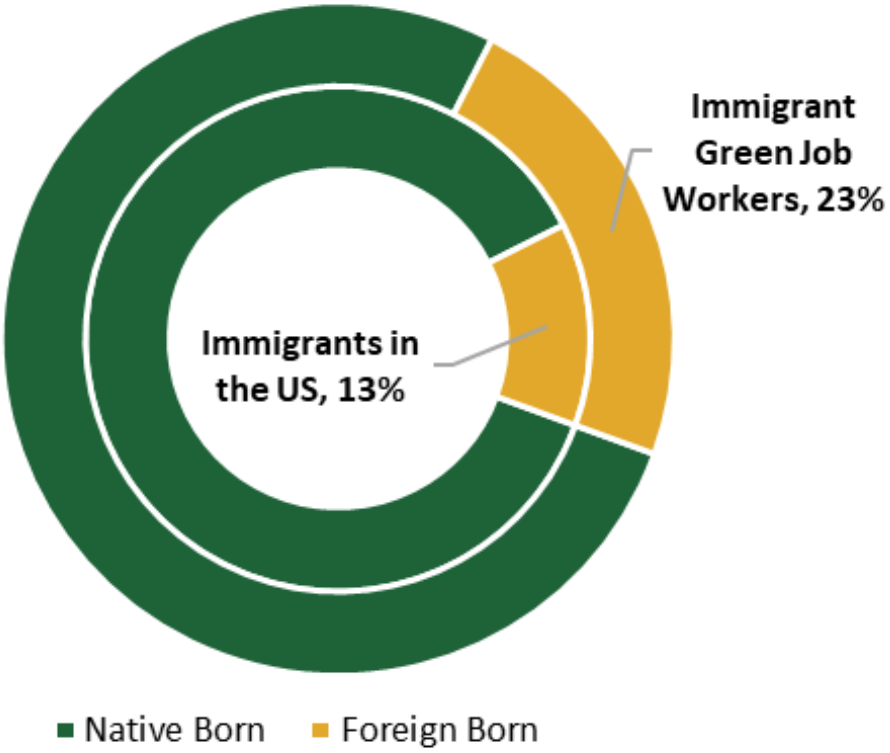
Table 1. Green Sectors and Occupations

	Total Number of Workers	% of All Individuals in Green Jobs
1. Cleaning	**7,518,503**	**48.7**
Grounds maintenance workers	1,888,198	12.2
Janitors and building cleaners	3,396,985	22.0
Maids and housekeeping cleaners	2,098,446	13.6
Refuse and recyclable materials collectors	134,874	0.9
2. Installation	**6,316,323**	**40.9**
Automotive service technicians and mechanics	1,008,730	6.5
Bus drivers	749,479	4.9
Forest and conservation workers	22,250	0.1
Heating, air conditioning, and refrigeration mechanics and installers	437,868	2.8
Laborers and freight, stock, and material movers, hand	3,041,359	19.7
Maintenance and repair workers, general	634,632	4.1
Miscellaneous installation, maintenance, and repair workers, including wind turbine service technicians	341,977	2.2
Miscellaneous construction workers including solar photovoltaic installers and others	80,028	0.5
3. Business	**1,446,259**	**9.4**
Business operations specialists, all other	341,299	2.2
First-line supervisors of landscaping, lawn service, and grounds keeping workers	182,394	1.2
First-line supervisors of construction trades and extraction workers	922,566	6.0
4. Science	**157,162**	**1.0**
Atmospheric and space scientists	13,628	0.1
Conservation scientists and foresters	24,302	0.2
Environmental engineers	33,115	0.2
Environmental scientists and geoscientists	86,117	0.6
TOTAL	**15,438,247**	**100.0**

A Portrait of Foreign-Born Individuals in Green Sectors and Occupations

The foreign born make up just over 13 percent of the population of the United States, but they comprised 23 percent of all workers in the four green sectors (Figure 1). Foreign-born workers are overrepresented in green jobs for a number of reasons, including differences in English speaking ability and educational attainment and job availability/ access to jobs.

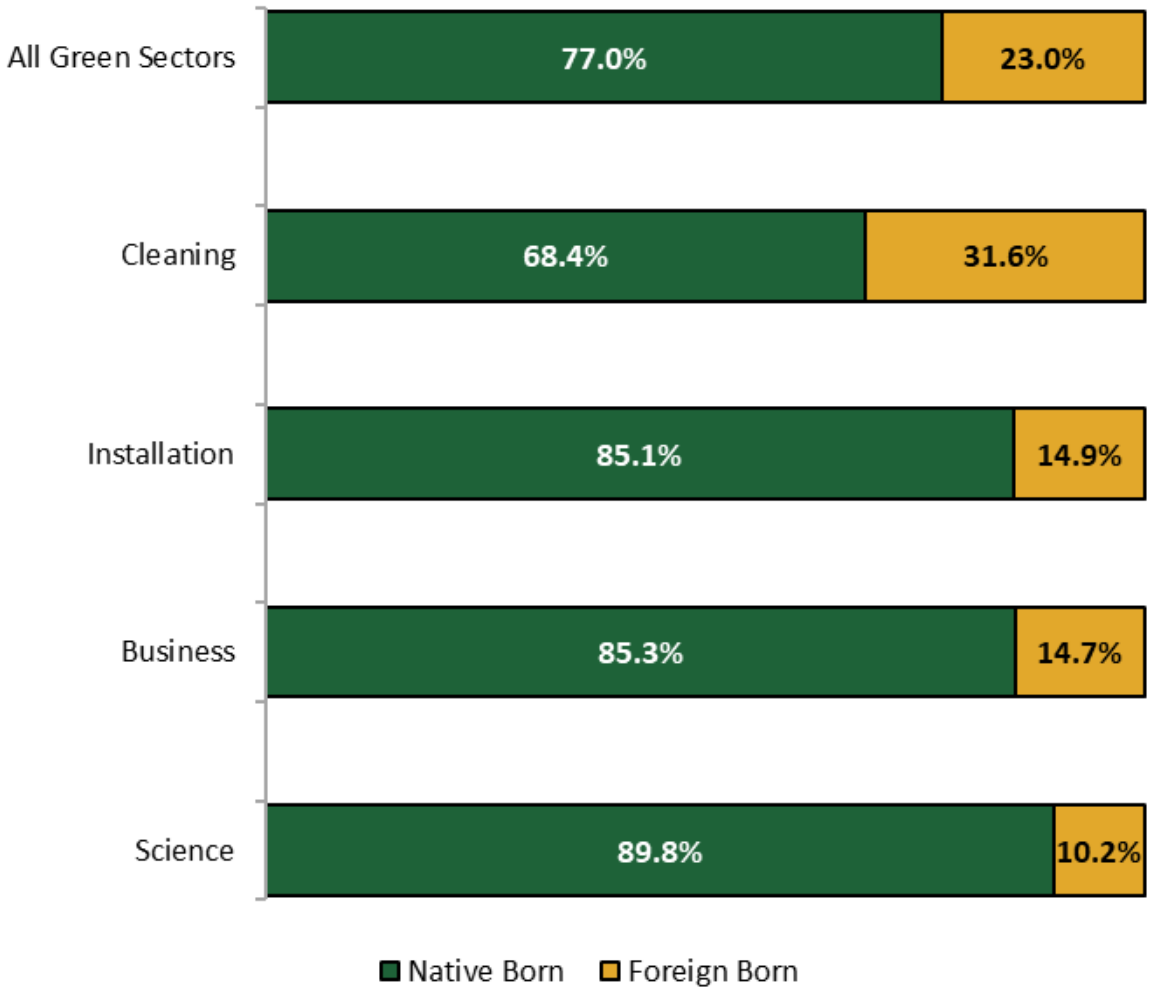
Figure 1. Share of Foreign-Born Individuals in All Green Sectors Compared to Share of Foreign-Born Individuals in the U.S. Population



Source: IIR analysis of American Community Survey (ACS) 2013-2017 5-year survey data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

The sector with the highest share of foreign-born individuals was the Cleaning sector, where 31.6 percent of workers were foreign born (Figure 2). This was more than twice the share as the Installation sector (14.9 percent) and the Business sector (14.7 percent). In these three sectors, the foreign born were overrepresented in comparison to their share within the general population. The green sector with the lowest share of foreign-born workers was Science, where 10.2 percent or workers were foreign born.

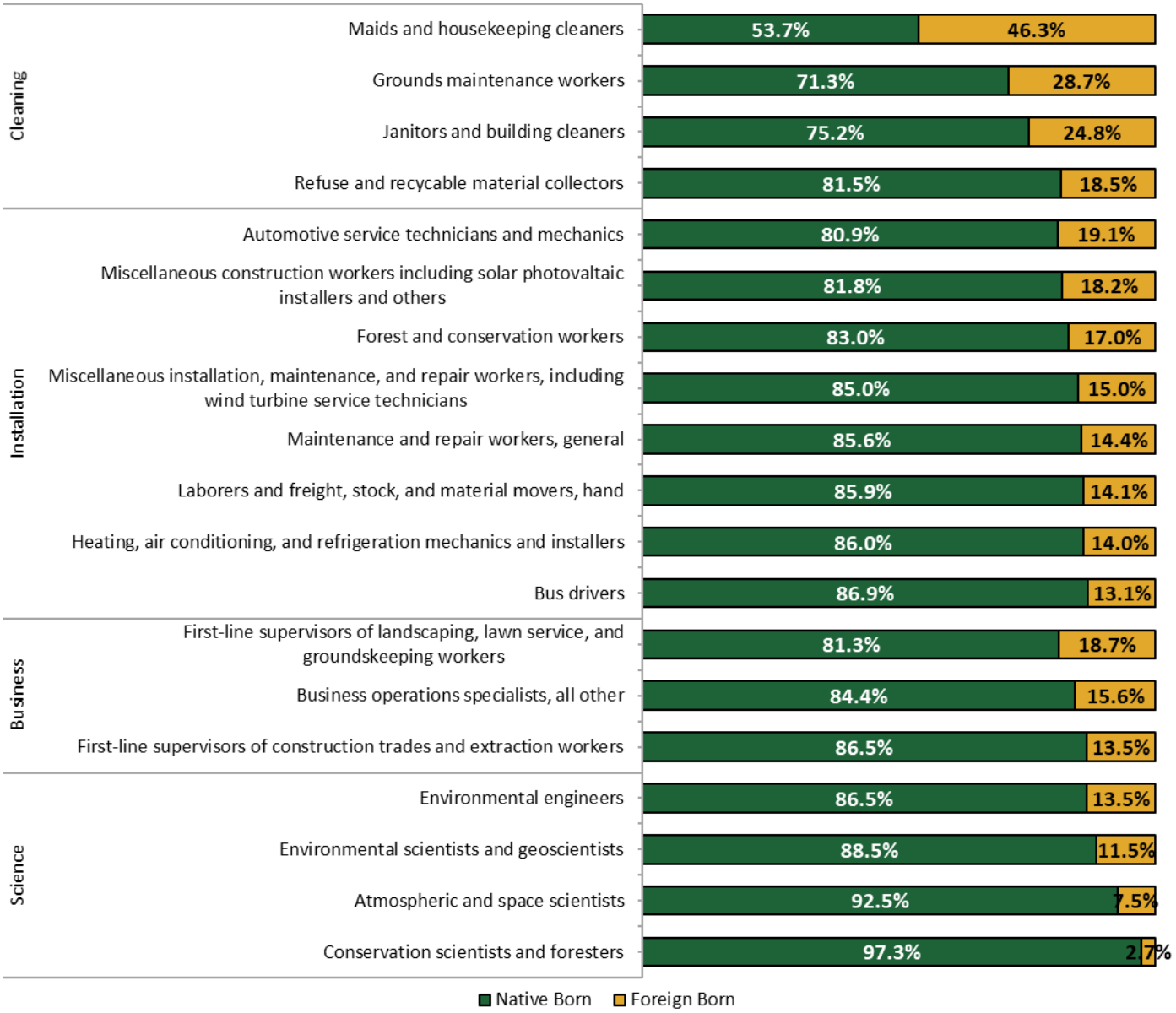
Figure 2. Share of Foreign-Born Workers in Green Sectors



Source: : IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Looking at the 19 green occupations separately, there was a great deal of variation in the share of foreign-born workers (Figure 3). The occupation with the highest share of foreign-born individuals was maids and housekeeping cleaners at 46.3 percent, followed by grounds maintenance workers with 28.7 percent; and janitors and building cleaners with 24.8 percent. The occupation with the smallest share of foreign-born individuals was conservation scientists and foresters at 2.7 percent. Generally, there were fewer foreign-born workers in the green occupations that require higher levels of education, while immigrants are overrepresented in occupations that require less education.

Figure 3. Shares of Foreign-Born Individuals in Green Occupations



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Geographic Distribution of Foreign-Born Green Job Workers

Foreign-born green job workers were unevenly distributed across the United States, with many of the areas hit hardest by the first wave of COVID-19 having larger proportions of immigrant green job workers (Muro et al., 2020). Table 2 shows the foreign born as a share of the total green job worker population relative to the foreign-born as a share of the total population, organized by U.S. Census Bureau Divisions (see Methodology for description). Foreign-born green jobs workers were overrepresented in all U.S. Census Bureau Divisions. That is, there were larger proportions of foreign-born green job workers in each region relative to the share of all foreign-born residents in each region. The Pacific region had the greatest share of immigrant green job workers (40.7 percent) and the greatest proportion of foreign born in the population. The West South Central and Middle Atlantic divisions were tied for second place; 27.0 percent of all green job workers were foreign born. The Mountain, South Atlantic, and New England divisions followed with 24.4 percent, 22.9 percent, and 21.2 percent of green jobs workers being foreign born, respectively.

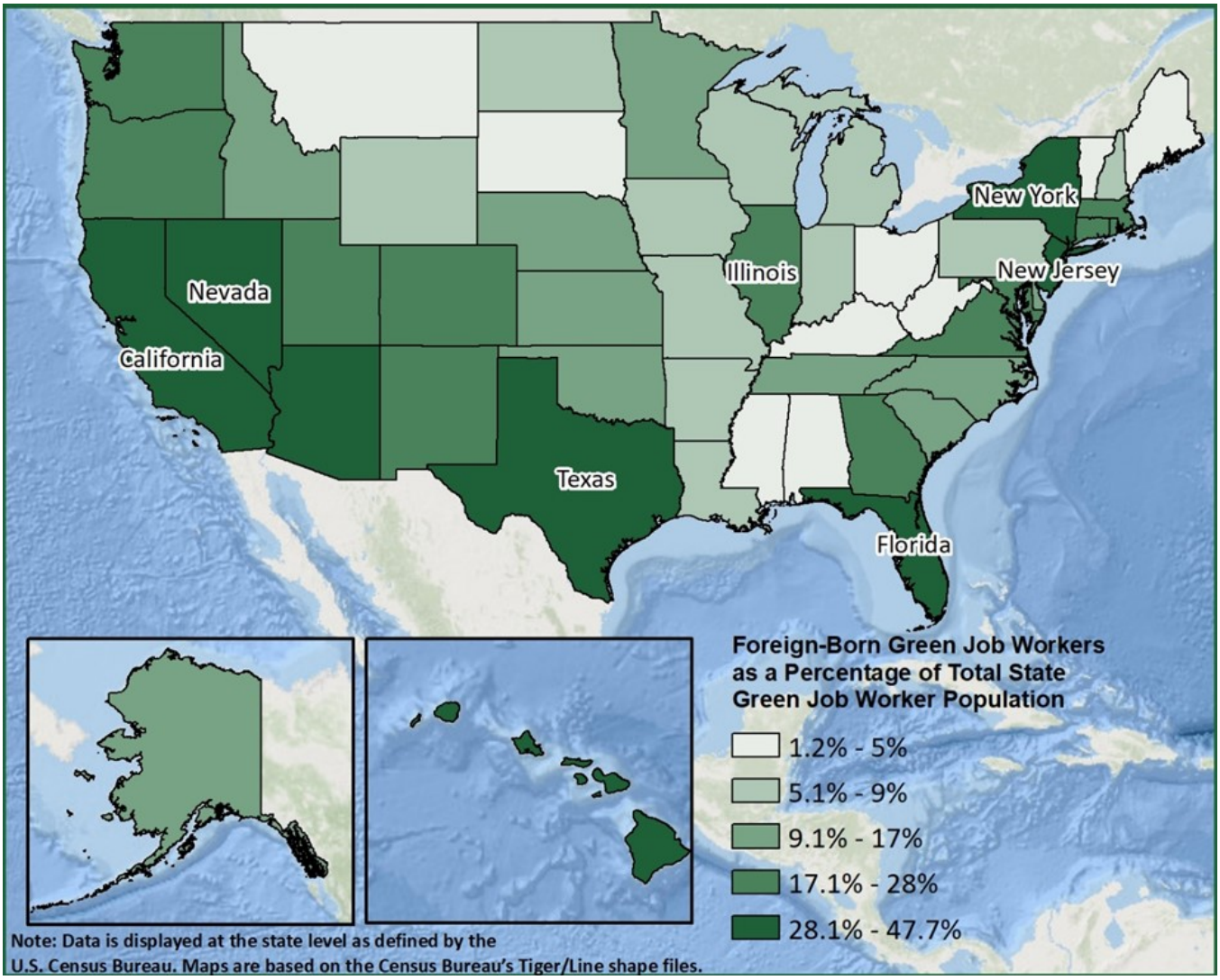
Table 2: Foreign-Born Green Job Workers Relative to Total Foreign-Born Population by U.S. Census Bureau Division

	Middle Atlantic	New England	East North Central	West North Central	South Atlantic	West South Central	East South Central	Pacific	Mountain
Foreign Born as Share of Total Population	17.6%	13.0%	7.7%	5.9%	13.1%	13.3%	3.8%	23.4%	11.1%
Foreign Born as Share of Green Job Worker Population	27.0%	21.2%	11.0%	8.7%	22.9%	27.0%	6.0%	40.7%	24.4%

Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Figure 4 shows that the share of foreign-born green job workers within each division was driven by particular states. Beginning with the **Northeast**, New Jersey (37.6 percent) and New York (36.0 percent), two of the states hit hardest by COVID-19, with New York being considered the epicenter of the American coronavirus outbreak, were responsible for the large share of foreign-born workers. Next, with regard to the **Midwest,** Illinois had the largest share of immigrant green job workers (25.3 percent) by far. In the **South,** Florida and Texas had the largest proportion of foreign-born green job workers. And finally, in the **West**, foreign-born green jobs workers in California (47.7 percent) and Nevada (42.5 percent) were responsible for the division's large proportions.

Figure 4: Foreign-Born Green Job Workers by State



Citizenship Status

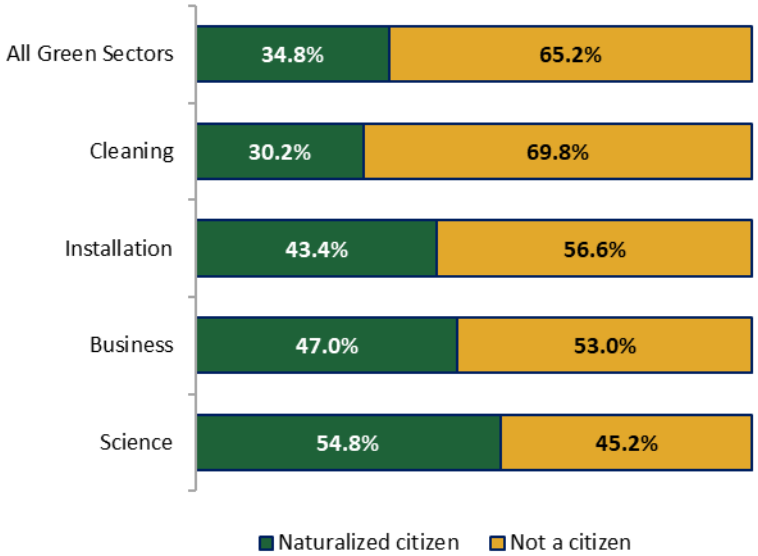
Unfortunately, Census data does not allow us to ascertain the specific immigration status of foreign-born workers. However, Figure 5 examines the citizenship status of foreign-born green job workers, distinguishing those who have become U.S. citizens from those who remain noncitizens. Noncitizens may be legal permanent residents (LPRs or green card holders), nonimmigrants (on temporary visas), or unauthorized immigrants. Nationwide, 48.1 percent of all immigrants in the United States are naturalized citizens, but among foreign-born green job workers, only 34.8 percent were naturalized.

Citizenship is a requirement for some jobs including certain people employed by the U.S. government. Figure 5 shows that the Cleaning sector had the smallest share of naturalized citizens (30.2 percent), while the Science sector had the largest share of naturalized citizens (54.8 percent). This was likely due to the fact that workers in the Cleaning sector were less likely to have an immigration status that can lead to U.S. citizenship. Foreign-born workers in the higher-skilled occupations were more likely to have been admitted as students or on employment-based visas that can lead to naturalization. Furthermore, scientists employed by the federal government may be required to be U.S. citizens.

At the occupational level, the largest share of naturalized citizens was in the bus driver occupation at 74.4 percent, perhaps because certain bus drivers may be required to be U.S. citizens. Environmental engineers followed at 70.3 percent, and business operations specialists were third at 57.4 percent.

Looking at those occupations that were hit by the economic downturn resulting from the COVID-19 pandemic (Gelatt, 2020), 62 percent of foreign-born janitors and building cleaners were non-citizens as well as 64.6 percent of laborers and freight, stock and material movers. Non-citizens comprised 70.3 percent of foreign-born maids and housekeeping cleaners.

Figure 5: Citizenship of Foreign-Born Green Job Workers by Sector



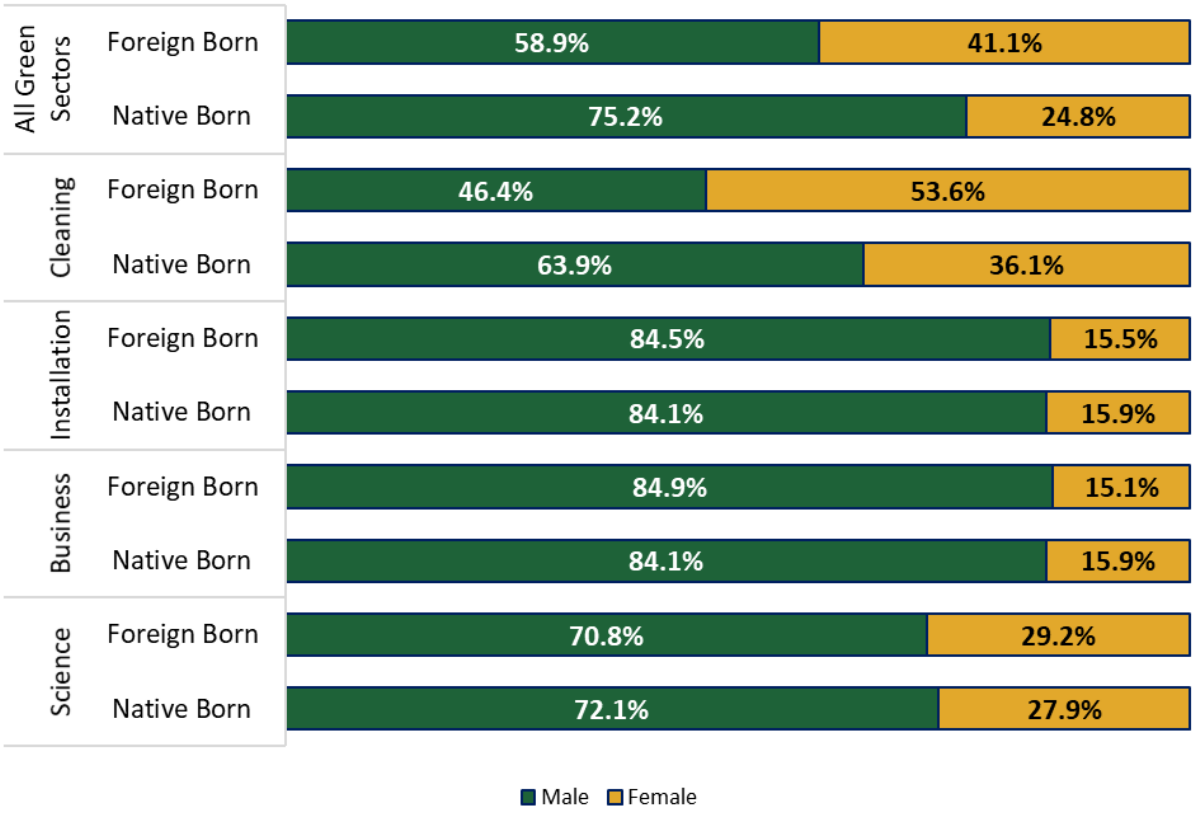
Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Gender

Foreign-born women tended to be overrepresented in green sectors when compared to native-born women. Overall, 41.1 percent of all foreign-born green job workers were female compared to only 24.8 percent of native-born green job workers (Figure 6). The largest shares of females for both foreign- and native-born workers were found in the Cleaning and Science sectors. In the Cleaning sector 53.6 percent of foreign-born workers and 36.1 percent native-born workers were women. Gender differences between native- and foreign-born green job workers in the Cleaning sector were largely driven by female maids and housecleaners and janitors and building cleaners. This is consistent with literature that finds immigrant women dominate cleaning occupations (Gelatt, 2020; Simon, 2018). This means that a large number of those responsible for cleaning during the pandemic were women who were not U.S. citizens. With respect to the Science sector, 29.2 percent of immigrant workers and 27.9 percent of native-born workers were women. Finally, women were very underrepresented in both the Installation and Business, sectors.

When analyzing the gender of foreign-born green job workers at the occupational level, unsurprisingly, the category of maids and housekeeping cleaners had the largest share of women. However, the biggest difference between native- and foreign-born women was in the conservation scientists and foresters occupation. Here foreign-born females comprised 59.6 percent of all foreign-born workers compared to a female share of only 21.4 percent among native-born workers. Conversely, foreign-born women were underrepresented in the atmospheric and space scientist occupation, where foreign-born females comprised only 5.4 percent of foreign -born workers while native-born females comprised 21 percent.

Figure 6. Native- and Foreign-Born Green Job Workers by Gender



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Countries of Origin of Foreign-Born Green Job Workers

Table 3 shows the top five countries of origin of foreign-born individuals in each green sector. Overall, the largest share of foreign-born individuals across all green sectors was from Mexico, followed by other Central or South American countries, including El Salvador, Guatemala, Dominican Republic, and Cuba. Mexico accounted for 47.3 percent of all workers in the Cleaning sector, 39.7 percent of all workers in the Installation sector, and 42.3 percent in the Business sector. Only in the Science sector did we see that India was the top country of origin for foreign-born individuals with 9.4 percent followed closely by China (7.9 percent) and then Canada (6 percent).

When analyzing country of origin by occupations, Mexico was the predominant country of origin across most of the low-skilled occupations. By contrast, India was the top country of origin of business operations specialists with 17.1 percent, and China was the top country of origin among environmental scientists; environmental engineers; and atmospheric scientists.

Table 3. Country of Origin of Foreign-Born Green Job Workers by Sector

Cleaning		Installation		Business		Science	
Mexico	47.3%	Mexico	39.7%	Mexico	42.3%	India	9.4%
El Salvador	7.8%	El Salvador	5.1%	India	4.8%	China	7.9%
Guatemala	5.7%	Dominican Republic	3.9%	El Salvador	4.4%	Canada	6.0%
Dominican Republic	3.3%	Guatemala	3.4%	Guatemala	2.5%	Mexico	3.0%
Honduras	3.2%	Cuba	3.4%	Cuba	2.5%	Iran	3.0%
All other	32.7%	All other	44.5%	All other	43.5%	All other	70.7%
Total Foreign-Born in Sector	**2,378,773**	**Total Foreign-Born in Sector**	**942,749**	**Total Foreign-Born in Sector**	**212,039**	**Total Foreign-Born in Sector**	**16,020**

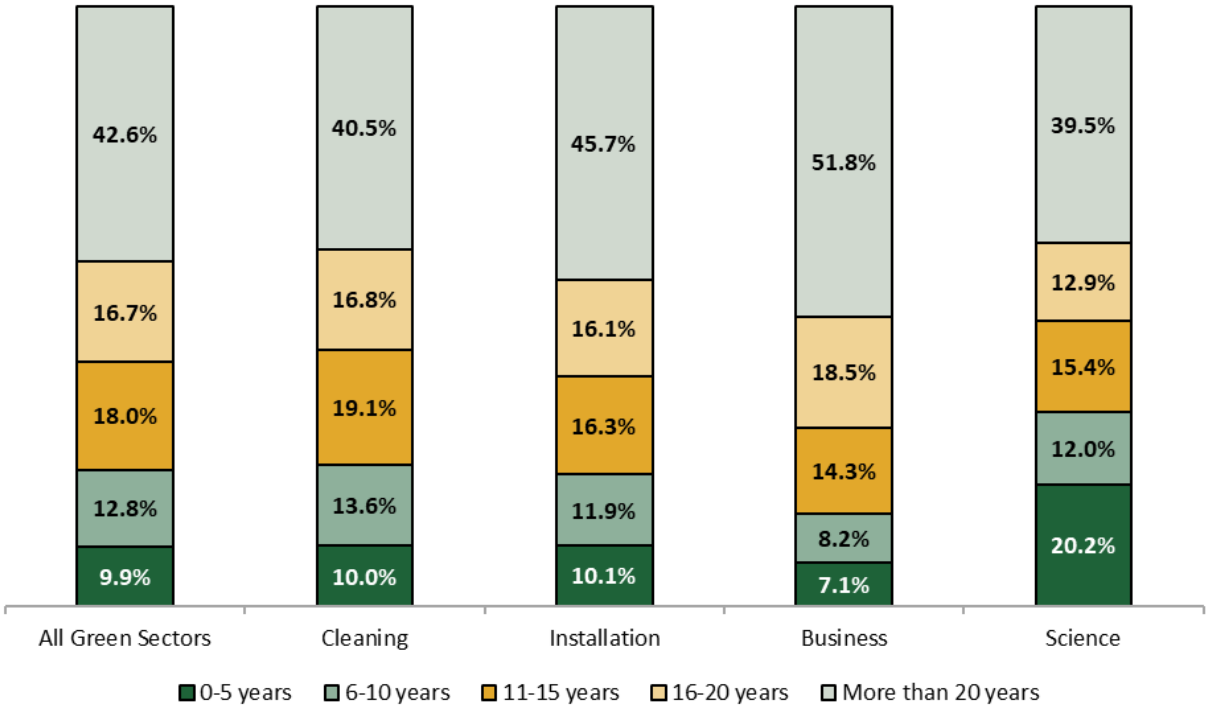
Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Years in the United States

Nationwide, 42.6 percent of foreign-born green job workers arrived in the United States more than 20 years ago (Figure 7), which is more recent compared to all foreign born in the United States (43.9 percent). There was some variation by green sector. Figure 7 shows that immigrant green job workers in the Business and Installation sectors had been in the United States the longest, followed by immigrant green job workers in the Cleaning and Science sectors. Approximately 51.8 percent of immigrant green job workers in the Business sector and 45.7 percent of foreign-born green job workers in the Installation sector had been in the United States for more than 20 years. Approximately two in five (40.5 percent) immigrant green job workers in the Cleaning sector arrived in the United States more than twenty years ago. Immigrant green job workers in the Science sector arrived most recently the United States, with more than 30 percent reporting having arrived to the United States in the past 10 years.

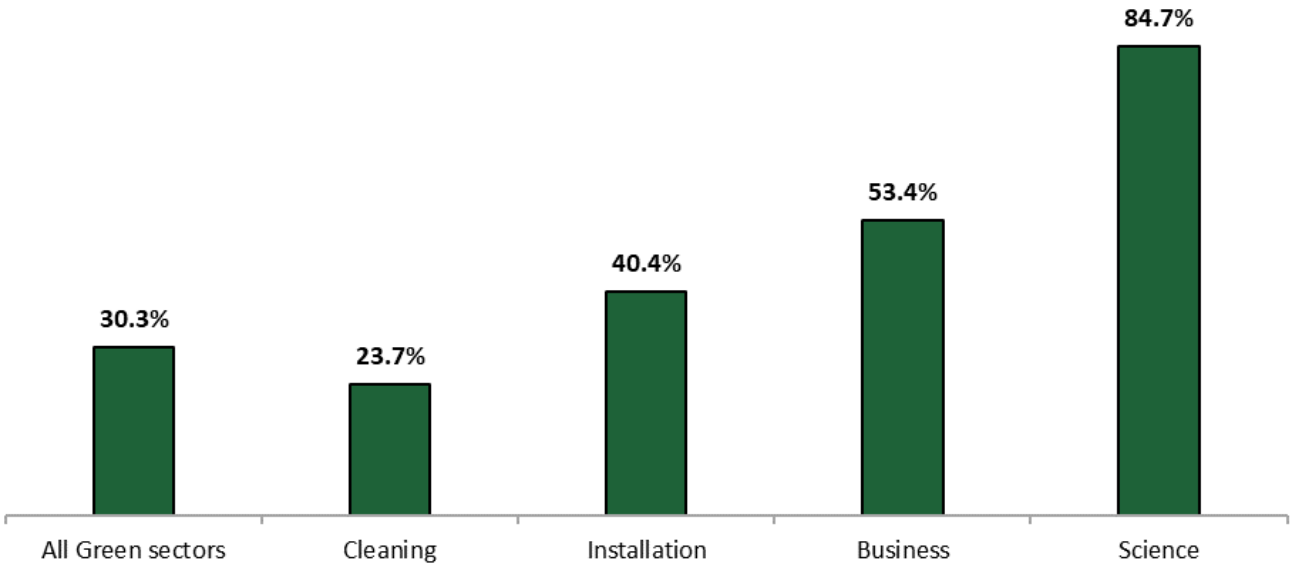
At the occupational level, immigrant green job workers who had been in the United States the longest were bus drivers (average of 26.9 years), which is consistent with the finding that they are very likely to be naturalized citizens. They were followed by first-line supervisors of landscaping, lawn service, and grounds keeping workers (average of 24.1 years), and first-line supervisors of construction trades and extraction workers (average of 23.8 years). Conversely, immigrant forest conservation workers (average of 17.5 years), environmental scientists and geoscientists (average of 17.7 years), and miscellaneous construction workers including solar photovoltaic installers (average of 18.2 years) had spent the least amount of time living in the United States.

Figure 7. Years in the United States Among All Foreign-Born Green Job Workers



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Figure 8. English Proficiency Among All Foreign-Born Green Job Workers



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

English Proficiency

In general, slightly less than one in three immigrant green job workers was proficient in English (speak only English or speak English very well). While this was below the national average of 50 percent, there were significant variations across green sectors (Figure 8). More than three quarters of foreign-born green job workers in the Science sector were proficient in English (84.7 percent), and more than half of immigrant green job workers involved in the Business sector were English proficient (53.4 percent). Workers in these two sectors spoke English proficiently at levels higher than the national average, and that finding was consistent with the higher levels of education required for many jobs in these sectors. English proficiency was considerably lower in the Installation sector (40.4 percent) and the Cleaning sector (23.7 percent).

Levels of English proficiency did not appear to align with duration of time spent in the United States, but rather, may have been a factor of educational attainment. The U.S. Census Bureau reported similar findings (Gambino et al., 2014), and reasoned that more recent migrants may have greater English-speaking abilities as a result of greater number of years in school. For instance, at the occupational level, immigrants who were most proficient in English, despite having arrived to the United States most recently, were conservation scientists and foresters (88.7 percent), environmental scientists and geoscientists (85 percent), and environmental engineers (81.4 percent). Conversely, despite having spent a similar amount of time in the United States, those in occupations who are least proficient in English were immigrant maids and housekeeping cleaners (21.7 percent) and grounds maintenance workers (22.2 percent).

Educational Attainment

When examining native- and foreign-born combined, levels of educational attainment varied across green sectors. Scientists (native- and foreign-born combined) had the highest rates of educational attainment, with 95 percent having reported that they had a bachelor's degree or higher. This was followed by those involved in the Business sector, where nearly one in four green job workers reported having a bachelor's degree or higher. Educational attainment was particularly low among those involved in Cleaning and Installation sectors. Slightly less than three in four individuals involved in Cleaning sectors had no more than a high school diploma (72.4 percent), while 59.7 percent of green job workers involved in the Installation sectors reported comparably low levels of education.

Foreign-born green job workers had lower rates of educational attainment relative to their native-born colleagues, but this varied by green sector (see Figure 9). In general, 7.8 percent of immigrant green jobs workers had a bachelor's degree or higher compared to 10.3 percent of native-born workers. Among Scientists, immigrant workers reported significantly higher rates of educational attainment compared to their native-born colleagues. Immigrant workers involved in the Business sector yielded bifurcated rates of educational attainment; they were more likely than the native born to have no more than a high school diploma and were more likely to have a bachelor's degree or higher. Conversely, foreign-born workers in the Cleaning sectors reported significantly lower rates of educational attainment compared to their native-born colleagues. Specifically, 82.2 percent of foreign -born green job workers involved in the Cleaning sector reported receiving a high school diploma or less, compared to 66.1 percent of their native-born colleagues.

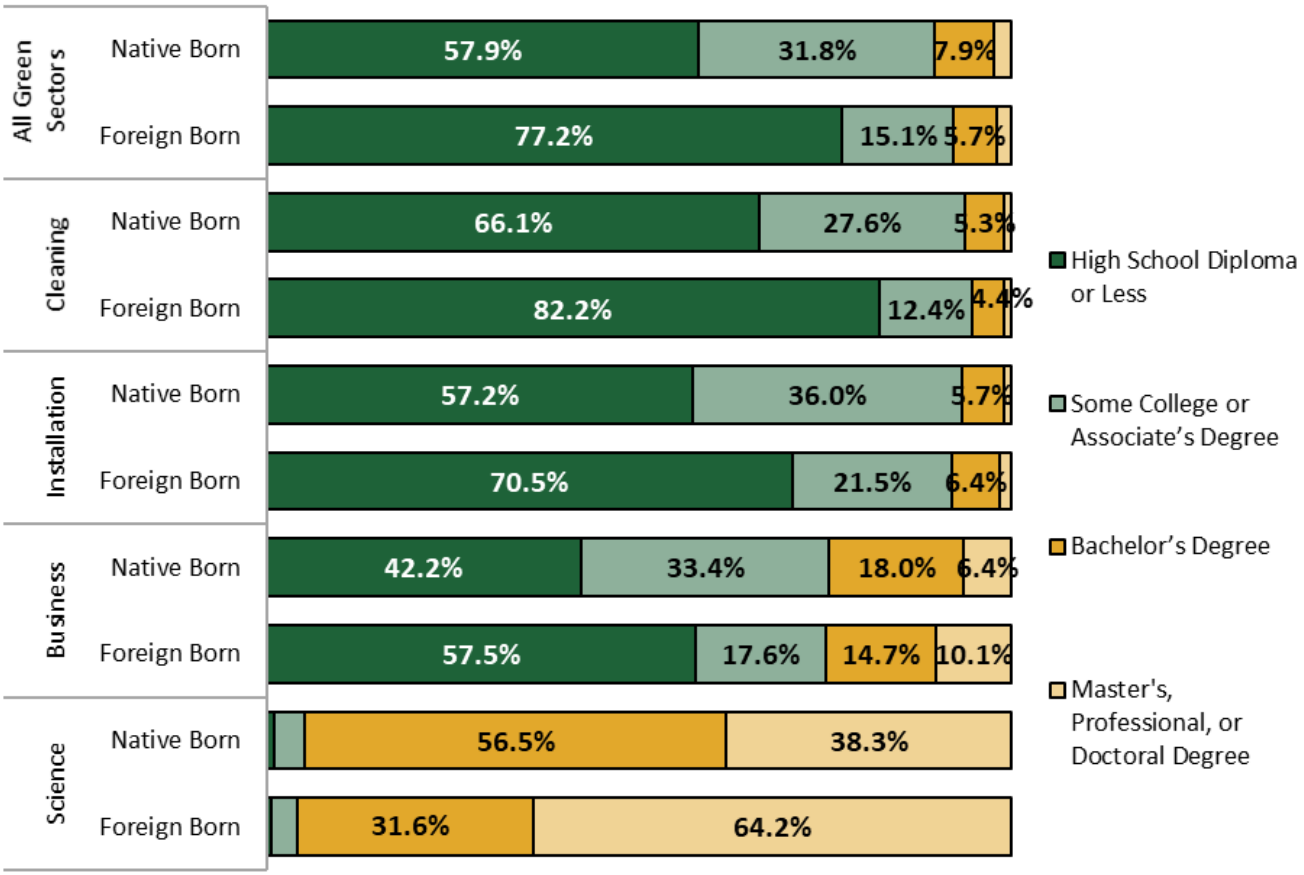
With regard to educational attainment at the occupational level, there was some variability within green sectors. Among those in the Cleaning sector, foreign-born maids and housekeeping cleaners; and janitors and building cleaners were more likely have a bachelor's degree or higher compared to their native-born counterparts. Within the Installation category, immigrant green job workers in six of the eight occupations were more likely to hold a bachelor's degree or higher than native-born workers. For instance, immigrant heating, air conditioning, and refrigeration mechanics and installers; and automotive service technicians and mechanics were nearly twice as likely to hold a bachelor's degree or higher compared to their native-born colleagues. With the exception of business operations specialists; and atmospheric and space scientists, where immigrants held slightly higher rates of education, immigrants in the Business and Science sectors held comparable rates of educational attainment with their native-born colleagues.

As evidenced in green jobs occupations, immigrants with high educational attainment must often work in jobs that do not require high levels of education – a phenomena known as brain waste or underemployment. Brain waste is not unique to the green economy, but our data show that foreign-born maids, housekeepers, janitors, and others often have more education than their job requires. This is often due to difficulties getting licensed or certified in the United States with foreign credentials, but may also be attributed to low levels of English proficiency or lack of U.S. citizenship. According to the Migration Policy Institute (MPI), one in four of the 7.6 million college educated immigrants in the United States during the 2009 to 2013 period experienced skill underutilization, meaning they were either working in low skilled jobs or unemployed (Batalova et al., 2016). This is problematic because if these high-skilled immigrants were working at their skill level, in the

profession in which they were trained and have experience, they would likely earn more and pay more in taxes (Batalova et al., 2016; Ruiz Soto et al., 2016; Nacamulli, 2017). For example, a report from the New American Economy in 2016 found that immigrant underemployment in Michigan resulted in more than $510 million in annual earnings losses and $48.6 million in forgone state and local taxes (Ruiz Soto et al., 2016).

Figure 9. Educational Attainment Among All Foreign-Born Green Job Workers

Age 25+



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Annual Income

The estimated personal median income of full-time green job workers varied by sector. Full-time is defined as employed 50 weeks or more out of the year and working 35 hours or more per week. With native- and foreign-born combined, the Science sector reported the highest personal median income ($72,393), followed by workers involved in the Business sector ($55,846), Installation sector ($35,162), and Cleaning sector ($25,533).

The personal median income of green job workers also varied across nativity (Figure 10). When looking at all workers employed full-time, foreign-born green job workers reported a lower personal median income than their native-born colleagues. However, this is likely due to the overrepresentation of immigrants in the Cleaning, Installation, and Business sectors, who earned less compared to immigrants in the Science sector who report higher personal incomes than their native counterparts. Foreign-born Scientists reported personal median incomes that were significantly higher – median difference of $14,394 – than their native-born colleagues, likely due to their higher levels of educational attainment. The Cleaning sector had the smallest differences in median personal incomes between native-born and immigrant workers, with native-born workers earning slightly more. Foreign-born workers in the Cleaning sector reported a personal median income that was $3,064 less than their native-born colleagues.

While there was a significant amount of variability among native and foreign-born green job workers by sector, the differences in annual salary were less apparent when we examined annual pay within individual occupations. Among the Cleaning sector, despite their greater likelihood of having a bachelor's degree or higher, immigrant maids and housekeeping cleaners and janitors earned slightly lower annual incomes compared to their native-born counterparts. Although immigrants were more likely to have a bachelor's degree or higher compared to their native-born colleagues in six out of the eight occupations within the installation sector, only among bus drivers did we see immigrants slightly out-earning their native-born peers. Among individuals employed in the Business sector, foreign-born business operations reported personal annual incomes that were slightly higher relative to their native-born counterparts. And finally, with respect to the Science sector, immigrant atmospheric and space scientists reported personal annual incomes that were slightly higher relative to their native-born counterparts.

Hourly Wage

Our analysis of annual personal earned income only considered individuals employed full time, thereby omitting from the analysis 34.9 percent of green job workers who were considered part time. Relative to native -born green job workers, foreign-born green job workers were slightly less likely to work part-time (33.8 percent versus 35.2 percent). To account for green job workers who may not work full time, we presented results on wages per hour.

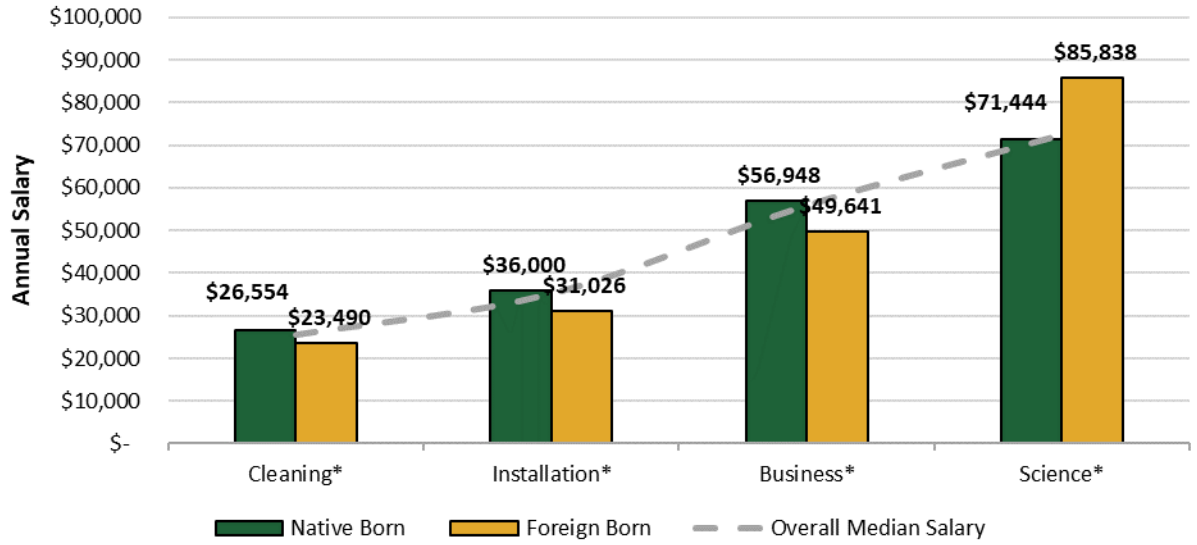
Green job workers reported patterns of hourly wages across sectors similar to workers employed full-time (Figure 11). The median hourly wage for immigrant green job workers was $12.18, while their native-born counterparts earned $14.28 per hour; a 15.9 percent disadvantage in hourly pay.[1] With the exception of the Science sector, foreign-born green job workers earned less per hour relative to their native-born counterparts; however, this difference was not found to be statistically significant. The difference in hourly pay was only found to be statistically significant in instances of green job workers in the Cleaning and Installation sectors. In short, while hourly differences exist in the former two sectors, differences in hourly wages fail to surface in the latter two sectors.[2]

[1] To calculate percentage differences, the following formula was used: Absolute (NB median income-FB median income)/AVERAGE(NB median income & FB median income).

[2] The significance of the relatively small difference in earnings in Cleaning and lack of significance for the other sectors where the difference between foreign-born and native-born workers is greater may be explained by the much larger samples upon the estimates for those in Cleaning compared to the other sectors.

Figure 10. Personal Earned Median Income of Full-Time Green Job Workers by Nativity and Sector

Individuals in the Labor Force and Employed Full-Time, Age 16+

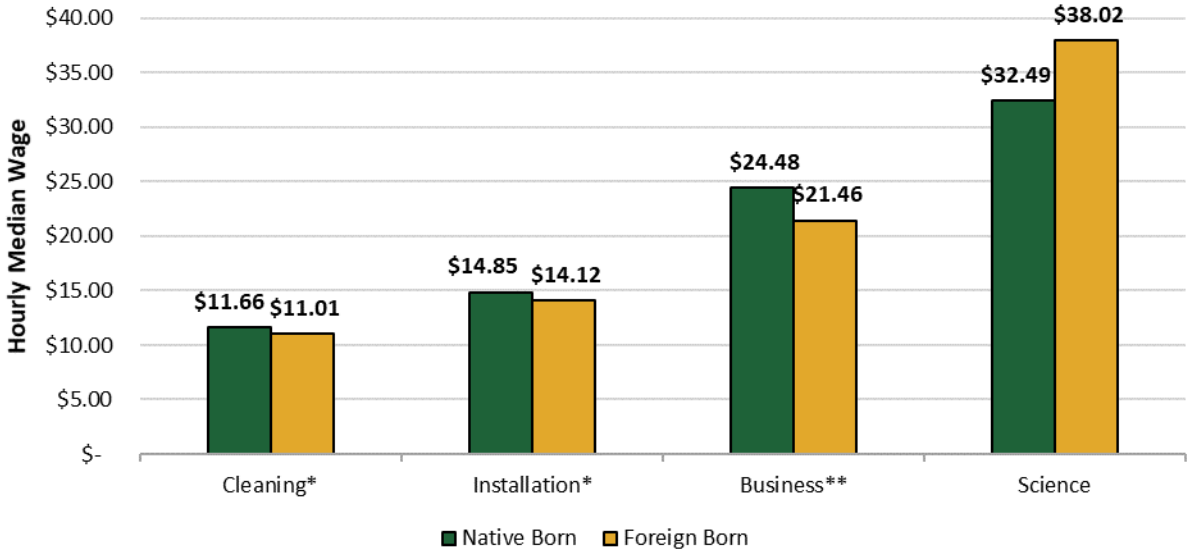


*Differences are statistically significant at the 0.05 level (independent t-test)

Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Figure 11. Median Hourly Wage Green Job Workers by Nativity and Sector

Individuals in the Labor Force and Employed Full-Time, Age 16+



*Differences are statistically significant at the 0.05 level (independent t-test)

**Differences are statistically significant at the 0.10 level (independent t-test)

Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Self-Employment

Overall, native- and foreign-born green job workers combined were more likely to be self-employed compared to the national rates of self-employment (13.7 percent versus 9.4 percent). However, rates of self-employment varied across green sectors. Foreign- and native-born green job workers were most likely to be self-employed in the Business and Cleaning sectors, and their rates of self-employment surpassed those of national averages. This was followed by green job workers in Installation and Science sectors, whose rates of self-employment fell slightly below national averages.

Self-employment can be divided into two types, and the differences are notable. Self-employed, incorporated includes individuals who work for themselves with businesses that are registered with a state's secretary of state. Self-employed, not incorporated includes individuals who work for themselves with businesses that are not registered with the secretary of state. Unincorporated self-employment is used as a proxy for "necessity entrepreneurship" and incorporated self-employment as a proxy for "opportunity entrepreneurship." Necessity entrepreneurship arises when individuals resort to self-employment when they are unable to find wage or salary employment with existing firms; opportunity entrepreneurship occurs when an individual innovates in response to a perceived opportunity to create new or greater value. The propensity towards necessity entrepreneurship may be high for certain groups, even in times of macroeconomic prosperity, if they face barriers to gain stable employment. Opportunity entrepreneurship is widely recognized as more beneficial for the economy as a whole – in terms of both innovation and job creation –because it is growth oriented.

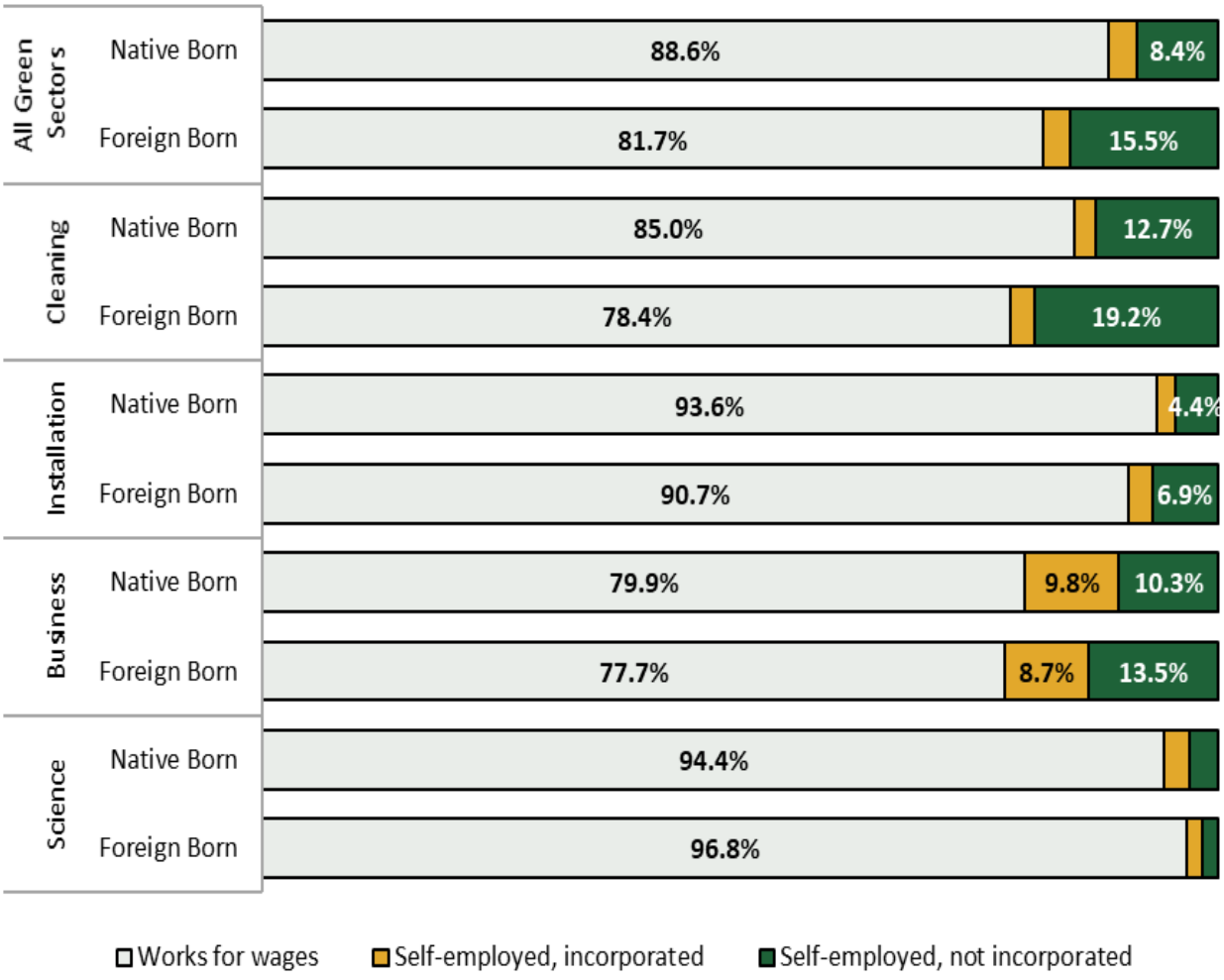
Overall, both native- and foreign-born green job workers in the Business sector were more likely to be self-employed, and incorporated compared to self-employed green job workers in all other green sectors. That is, green job workers in the Business sector were more likely to manage their own registered business, in many cases with their own employees, compared to workers in all other green sectors. The top three industries where self-employed, incorporated green job workers are employed were construction, landscape and horticultural services, and services to dwellings and other buildings.

Foreign-born green job workers were more likely to be self-employed compared to their native-born colleagues (Figure 12). However, there were minor differences across sectors. Immigrant workers were more likely to be self-employed in three out of the four sectors, including Business (22.3 percent versus 20.1 percent), Cleaning (21.6 percent versus 15.0 percent), and Installation (9.3 percent versus 6.4 percent). Science, on the other hand, was the only sector where native-born workers were more likely to be self-employed compared to their foreign-born colleagues (5.6 percent versus 3.2 percent).

While immigrant green job workers were more likely to be self-employed overall, native-born green job workers were slightly more likely to be self-employed, incorporated compared to their foreign-born colleagues. Immigrant green jobs workers are more likely to be self-employed and unincorporated. This is the case for immigrants working in the Cleaning sector where nearly 20 percent are self-employed and unincorporated. This may indicate that they are more likely to be independent contractors who are not counted as "employees" by any employer. Independent contractors are frequently not eligible for some of the same benefits as regular employees, including some COVID-19 economic relief.

Figure 12. Self-Employment Among Green Jobs Workers

In the Labor Force and Employed, Age 16+



Source: IIR Analysis of the American Community Survey (ACS) 2013 – 2017 5-year sample data from Integrated Public Use Microdata Sample (IPUMS-USA) file.

Rates of self-employment among native- and foreign-born workers varied at the occupational level. The occupations that had greatest rates of foreign-born self-employment compared to their native-born colleagues were refuse and recyclable material collectors (2.4 times more likely); atmospheric and space scientists (2.2 times more likely); maids and housekeeping cleaners (50 percent more likely); laborers and freight, stock, and material movers (40 percent more likely); and automotive service technicians and mechanics (40 percent more likely). Conversely, the occupations with the smallest shares of immigrant self-employment were forest and conservation workers (90 percent less likely); environmental engineers (40 percent less likely); and conservation scientists and foresters (20 percent less likely).

Creating a Culture for the Environment*

Patty (Colombia) and Ramiro (Ecuador)
Janitors and Building Cleaners
Fairfax, VA

Patty began her story as the owner of a school in the city of Cali, Colombia, where she was born. With post graduate studies in psychology and education, her school educated students from nursery school all the way to the fifth grade.

Upon arriving in the United States, Patty immediately began working in green jobs:

"I came in as a cleaning supervisor in a company where I worked about 10 years. After this I transitioned to selling ecological products. This was also a way to help people's health. Now we are still using ecologically friendly products. I've been here in the United States for 17 years." Like many immigrants who come to the United States, Patty holds graduate degrees that could have been put to good use in her country of origin. However, she had to come to the United States and work at a job where she is not applying her graduate expertise.

Patty met her husband, Ramiro, in the United States, and they both have a history of working in green jobs after their arrival. Ramiro emigrated from Ecuador to the United States. 43 years ago, when he was 20 years old, mostly due to the poor economic situation in his home country. He started off washing dishes at a restaurant and later became a chef. He then moved from Connecticut to Virginia where he started working in the cleaning business. He was a supervisor 17 years ago and now specializes in recycling and chemical products that are ecologically friendly.

Patty believes that their work not only helps the environment but also improves peoples' health. She has advice for everyone. "Create an ecological culture, because even though we still talk about ecological issues, there is no culture or consciousness for the environment."

*This interview was conducted in Spanish by Kevin Nazar and Ismail Nooraddini and was translated into English.

Immigrant Entrepreneurs in the Green Economy*

Anita Worden

England, Algeria
Co-owner of Multiple Solar Panel Companies
Boston, MA

Based on our analysis of American Community Survey data, today, there are more than 550,000 foreign-born owned green businesses in the United States who employ U.S. workers. One example is Anita Worden who is the co-owner of Yaskawa Solectria Solar, Solectria Renewables, LLC, Solectria Corporation, and Lightspeed Energy, LLC (ILC, 2015).

For Anita, family and aspirations to achieve drew her to a career in solar panels in the United States. Anita immigrated to the United States from Algeria, but was born in England. Her father, an Indian immigrant, worked as an engineer in Algeria before choosing to immigrate to the United States because he wanted the best life for his children.

Anita studied electrical engineering at MIT where she met her husband. Anita explains, "[H]e was driving around Massachusetts Ave, at MIT, with a solar racing car." Initially startled, she quickly grew interested and became "fully engaged" in the study of solar panels.

Their love and partnership lead them into a career of solar panels. For the next few years she worked closely with her husband and other students to build a fleet of solar panel cars. People showed interest on the side of the streets, and inquired with the team "When can I get a practical solar or electric car? This thing is a racing car; it isn't something I can drive."

These experiences prompted Anita and her husband to start their own solar energy business, Solectria Renewables. For nearly two decades they built electric cars, trucks, and vans. Today, nearly 250 people are employed with their business.

Anita and her husband occasionally take their children to India to show how fortunate they are to live in the United States. "Let's embrace everything that is offered here in the United States," Anita said.

*Interview adapted from YouTube video posted by the Immigrant Learning Center.

Projected Job Growth for Green Occupations 2018-2028

Green jobs are already an important part of the global economy, and experts predicted that a shift to a greener economy could create as many as 24 million new jobs globally by 2030 (Montt et al., 2018).

In the United States, prior to the pandemic, immigrant workers played an important role in green jobs, and were especially overrepresented in several occupations. Notably, **immigrant green workers are overrepresented in the two occupations that were projected to grow the most over the next eight years.**

According to the Bureau of Labor Statistics 2018-2028 Employment Projections, the occupations that were projected to grow the most in the United States between 2018 and 2028 were solar and photovoltaic installers, with a projected growth of 63.3 percent, and wind turbine service technicians, projected to grow 56.9 percent (Figure 13).

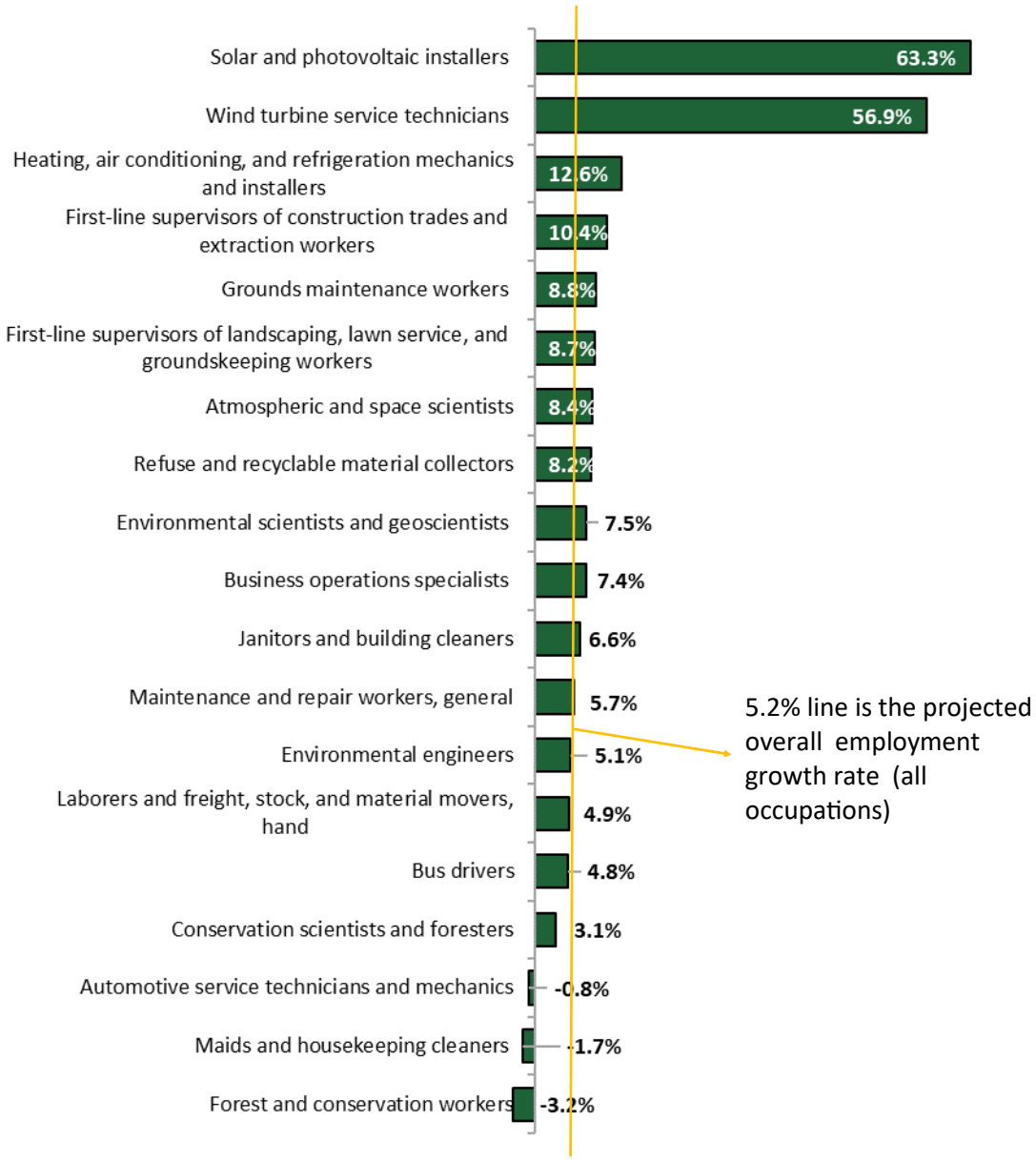
Foreign-born workers made up 18.2 percent of all miscellaneous construction workers including solar photovoltaic installers and 15.0 percent of miscellaneous installation, maintenance, and repair workers, including wind turbine service technicians. This meant that the two occupations projected to grow the most in the United States in the next ten years are not only green, but also saw overrepresentation of foreign-born workers.

All but two BLS occupations align exactly with the American Community Survey occupational classifications used in this analysis. Of the green occupations, 16 were expected to grow, ranging from 3.1 percent to 63.3 percent over the decade. Only automotive service technicians and mechanics and forest and conservation workers were projected to decrease in size between 2018-2028.

The American Community Survey five-year 2013-2017 dataset included the occupation of miscellaneous construction workers, including solar photovoltaic installers, septic tank servicers and sewer pipe cleaners, which is the closest to the occupation of solar photovoltaic installers included in the BLS projections. Nationwide, 18.2 percent of all workers in this occupation were foreign born. In some areas of the country, the share was much greater. Notably, in the District of Columbia, immigrants made up 55.6 percent of this occupation, and in Arizona immigrants were 33.3 percent.

Nationwide, 15 percent of all miscellaneous installation, maintenance, and repair workers, including wind turbine service technicians were foreign born. Again, geographically the proportion of foreign-born workers varied considerably. In California, 29.7 percent of all workers in this occupation were foreign born, followed by 28.4 percent in the state of New York. Foreign-born solar photovoltaic installers comprised a higher share than their native counterparts in the District of Columbia. Not surprisingly, foreign-born workers in these occupations were numerous in areas of the country with large immigrant populations. But if the green sector expands to all regions of the country, immigrant workers may be able to help fill the increasing demand, particularly as the native-born workforce ages.

Figure 13. Projected Job Growth Percentages of Green Occupations 2018-2028



Source: Long-term employment projections (2018-2028). Bureau of Labor Statistics, 2019.

Labor Shortages in the Wind Industry

The wind power industry is one of the fastest growing fields in the United States. In fact, the U.S. Department of Energy projects the wind industry to grow by 98 percent over the next 10 years (2017). According to the Bureau of Labor Statistics, wind-turbine technician is one of the fastest growing jobs in America, second to solar photovoltaic installers (2019).

Wind-powered energy is a clean, domestic source of energy that is sustainable and cost effective (U.S. Department of Energy, 2017). Additionally, wind turbines can be built on existing farms or ranches; both of which greatly benefit rural areas. It is no surprise that wind energy is a quickly-growing industry in many Midwestern and Southern states, such as Iowa and Texas (Douglas, 2019; Lawhon, 2018).

The industry is growing so rapidly in these areas that employers are struggling to find wind turbine technicians. According to Des Moines Area Community College professor James Fitzpatrick:

When wind companies come in and present, they're puzzled. We'll have five, 10, 20-year vets who say they don't know why the class isn't full. Some jobs you hear about could have 200 or 300 applicants. (These will get) five or 10… (Froese, 2018).

The United States has enough installed wind capacity to power over 30 million American homes (American Wind Energy Association, 2019). In the coming years, these existing wind turbines need to be maintained and new wind turbines installed. Immigrants account for nearly one in five individuals who are of prime working age (25-64) in the United States; one in two immigrants who are of prime working ages have an associate's degree or higher. Program Director at Colorado's Ecotech Institute, Auston Van Slyke, argued given the technological advancements, "Good training will be essential" (Froese, 2018). Given immigrants' existing education, they would be in a good position to assist with this growing industry.

Conclusion

Green jobs are already an important part of the global economy and, prior to the global pandemic, experts from the International Labour Organization (ILO) predicted that a shift to a greener economy could create as many as 24 million new jobs globally by 2030 (Montt et al., 2018). Furthermore, a shift to more sustainable policies could create better jobs that provide higher wages, and have a positive impact on the environment. The ILO found that, "the transition to a green economy is not only urgent for the sake of the planet, but is also compatible with improvements in decent work" (Montt et al.,2018:2). This is particularly true if policy changes and legal standards adapt to protect workers in green jobs. The COVID-19 pandemic has made it clear that many of the nation's essential workers are foreign-born, and many work in poor conditions and have little access to health care or other benefits. Furthermore, countries such as the United States need to plan to educate workers and develop the skills necessary to make the transition to a greener economy. Immigration policies can impact the way in which countries fill green jobs.

This profile has illustrated that foreign-born workers play important and varied roles within green occupations. Not surprisingly, immigrant workers are more predominant in areas of the country with large immigrant populations. However, as the green sector expands and green jobs increase in all regions of the country, opportunities will abound in these occupations for all workers.

In fact, the two occupations that were projected to grow the most, solar photovoltaic installers and wind turbine service technicians, employ large numbers of foreign-born individuals. The U.S. economy is rebuilding and the unemployment rate has fallen following the COVID-19 pandemic. If the number of workers needed in green occupations increases, U.S. workers may not be able to meet the demand, and foreign-born workers may be able to complement native-born workers and fill gaps in the labor market. Policymakers who are looking to make the United States a world leader in green jobs and green technologies should consider how immigrants and immigration policy can best serve the country's needs.

Methodology

Annual Income

Additional steps were taken in analyzing the data for personal income, which is defined as the total pre-tax personal income earned from wages or a person's own business or farm for the previous year. Prior to analyzing data on personal income, we further limited the dataset to green job workers who were in the labor force and employed full-time. Full-time employment is defined as working 35 hours or more per week for 50 weeks or more out of the year. We excluded all other respondents from our analysis because the reported personal median incomes varied drastically between full-time and part-time green job workers and were therefore not comparable. Additionally, outliers that fell outside the 99th percentile for green job workers, or outside the top one percent of pre-tax annual income, were removed from the final analysis.

Hourly wages

To discuss the income of green job workers who may not work full time, we also discussed results based on wages per hour. The following formula was used to calculate wages per hour:

(Annual Income / Weeks worked in the past 12 months) / Hours worked per week

We used the same annual income variable as described above, still having omitted outliers that fell outside the 99th percentile for green job workers, except in this instance we included part- and full-time green job workers. While information for weeks worked in the past year was available for single year ACS samples, it was not available in the same format for the 2013 – 2017 5-year ACS sample. Rather, there was information on ranges of weeks worked in the previous year. We converted this information into the median, or middle number, within each response category. For example, for the response option 1 to 13 weeks, we recoded this value to 7 weeks, for the response option 14 to 26 weeks, we recoded this response to 20 weeks, and so on. This value was then used as the denominator on the first half of the equation mentioned above. This strategy allowed us to estimate hourly wages in a way we would have otherwise been unable to calculate.

Employment Projections

Employment projections are based on the recently updated data for long-term employment projections by BLS. We are basing ourselves on percent change of employment from 2018 to the projected 2028 estimate. Counts for these same occupations in ACS data will vary but we are focusing on the percent change for the specific occupation. Even though the BLS and PMP Projections data uses the 2010 SOC code and ACS uses the 2010 Census Code for occupations a crosswalk is used to identify each. This allows for an employment projection for each of the green energy industry occupations being analyzed.

U.S. Census Bureau Divisions

Analysis of foreign-born green job workers as a share of total green job workers of the U.S. divisions is based off the U.S. Census Bureau Divisions. The U.S. Census Bureau considers there to be four regions of the United States- Northeast, Midwest, South, and West- with nine divisions. The regions and divisions are as follows:

Regions	Divisions
Northeast	• New England: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode island
	• Middle Atlantic: New York, Pennsylvania, and New Jersey
Midwest	• East North Central: Michigan, Wisconsin, Illinois, Indiana, and Ohio
	• West North Central: North Dakota, South Dakota, Minnesota, Iowa, Missouri, Nebraska, and Kansas
South	• South Atlantic: Maryland, District of Columbia, Delaware, West Virginia, Virginia, North Dakota, South Carolina, Georgia, and Florida
	• East South Central: Kentucky, Tennessee, Mississippi, and Alabama
	• West South Central: Oklahoma, Texas, Louisiana, and Arkansas
West	• Mountain: Montana, Idaho, Wyoming, Colorado, Utah, Nevada, Arizona, and New Mexico
	• Pacific: Washington, Oregon, California, Hawaii, and Alaska

Statistical Significance

When we refer to statistically significant relationships or statistical significance tests, we refer to the probability that the observed difference in a sample is likely to occur when in fact there is no difference in the larger population. Statistical significance is determined by a numerical indicator called a p-value. In social science research, a p-value of less than 0.05 is considered statistically significant. A p-value of less than 0.05 indicates that there is less than a five percent chance that the observed relationship in the sample is due to chance rather than a similar relationship in the entire population. Similarly, a p-value of less than 0.01 means that there is a less than one percent chance that the observed relationship in the sample is due to chance.

Dr. James C. Witte, *Director*
Dr. Michele Waslin, *Program Coordinator*
Dr. Wenjing Wang, *Postdoctoral Research Fellow*
Katharine Rupp, *Office Manager*
Fanni Farago, MA, *Graduate Research Assistant*
Eirini Giannaraki, MA, *Graduate Research Assistant*
Kevin Nazar, MS, *Graduate Research Assistant*
Ismail Nooraddini, MA, *former Graduate Research Assistant*

Acknowledgements

The authors thank Michele Waslin and James Witte for providing valuable feedback and edits, and Katharine Rupp for editing and production assistance. Thank you to The Immigrant Learning Center and The Public Education Institute for providing biographical information about Anita Worden.

About the Institute for Immigration Research

The Institute for Immigration Research (IIR) is a multidisciplinary research institute at George Mason University. The IIR's mission is to produce valid, reliable, and objective multidisciplinary research on immigrants and immigration to the United States and to disseminate this information through peer-reviewed academic journals, as well as in print and digital formats that make this research easily accessible to policy-makers, the media, the business community, and the general public. Our faculty affiliates, graduate students, and partners are at the forefront of research examining the economic contributions of all immigrant in the United States. The IIR produces high quality, timely research and analysis intended to promote informed action.

The IIR was founded in 2012 through the generous donation of Ms. Diane Portnoy and is a joint venture with The Immigrant Learning Center, Inc. of Malden, Massachusetts.

The IIR is located on the campus of George Mason University in Fairfax, Virginia, outside the nation's capital, Washington, DC. Its strategic location allows the IIR to draw on unparalleled academic, government, and private resources to advance its mission in research, education, and professional opportunities for current and future scholars of immigration studies. Through conferences, workshops, lectures, and other events, the IIR is able to engage in community outreach with one of the most diverse populations in the United States.

Works Cited

Anderson, Abigail, Richard Bowers. 2019. "Texas ranks first in U.S.- installed wind capacity and number of turbines." Washington, DC: U.S. Energy Information Administration. Retrieved April 30, 2020 (https://www.eia.gov/todayinenergy/detail.php?id=40252).

Batalova, Jeanne, Fix, Michael, and James D. Bachmeier. 2016. "Untapped Talent: The Costs of Brain Waste among Highly Skilled Immigrants in the United States". Washington, DC: *Migration Policy Institute*. Retrieved November 17, 2019 (https://www.migrationpolicy.org/research/untapped-talent-costs-brain-waste-among-highly-skilled-immigrants-united-states).

Bureau of Labor Statistics. 2014. "Green Jobs: U.S. Bureau of Labor Statistics." Washington, DC: U.S. Bureau of Labor Statistics. Retrieved November 17, 2019 (https://www.bls.gov/green/).

Bureau of Labor Statistics. 2019. "Employment Projections: Employment by detailed occupation 2018 and projected 2028." Washington, DC: U.S. Bureau of Labor Statistics. Retrieved May 5, 2020 (https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm).

Bureau of Labor Statistics. 2021. "The Employment Situation: May 2021." Washington, DC: U.S. Bureau of Labor Statistics. Retrieved June 9, 2021 (https://www.bls.gov/news.release/pdf/empsit.pdf).

Cuttino, Phyllis. 2009. "The Clean Energy Economy." Washington, D.C.: The Pew Charitable Trusts. June 10, 2009. Retrieved February 20, 2020 (https://globalurban.org/Clean_Energy_Economy.pdf).

Centers for Disease Control and Prevention. 2020. "Coronavirus Disease 2019 (COVID-19) in the U.S.: Cases in the U.S." Atlanta, GA: Centers for Disease Control and Prevention. Retrieved April 29, 2020 (https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html).

Douglas, Erin. 2019. "The fastest growing job in Texas us wind turbine technicians, data projects." *The Chronicle*. Retrieved February 25, 2020 (https://www.chron.com/business/bizfeed/article/The-fastest-growing-job-in-Texas-is-wind-turbine-13601522.php).

Environmental Defense Fund. 2018. "In Demand: Clean Energy, Sustainability and the New American Workforce." New York, NY: Environmental Defense Fund. Retrieved February 15, 2020 (http://edfclimatecorps.org/demand-clean-energy-sustainability-and-new-american-workforce).

European Environment Agency. 2020. *The European Environment State and Outlook 2020 Synthesis Report.* Denmark: European Environment Agency. Retrieved April 30, 2020 (https://www.eea.europa.eu//publications/soer-2020).

Froese, Michelle. 2018. "Gainful Employment in the Wind Industry." *Windpower Engineering & Development*. Retrieved February 25, 2020 (https://www.windpowerengineering.com/gainful-employment-in-the-wind-industry/).

Gambino, Christine, Yesenia Acosta, and Elizabeth Grieco. 2014. "English-Speaking Ability of the Foreign-Born Population in the United States: 2012." Washington, DC: U.S. Census Bureau. Retrieved April 7, 2020 (https://www2.census.gov/library/publications/2014/acs/acs-26.pdf).

Gamio, Lazaro. 2020. "The Workers Who Face the Greatest Coronavirus Risk." *The New York Times*. Retrieved April 28, 2020 (https://www.nytimes.com/interactive/2020/03/15/business/economy/coronavirus-worker-risk.html).

Gelatt, Julia. 2020. "Immigrant Workers: Vital to the U.S. COVID-19 response, Disproportionally Vulnerable." Washington, DC: Migration Policy Institute. Retrieved April 27, 2020 (https://www.migrationpolicy.org/research/immigrant-workers-us-covid-19-response).

Global Energy Talent Index. 2019. "The Global Energy Talent Index Report." Global Energy Talent Index. Retrieved March 20, 2020 (https://cdn2.hubspot.net/hubfs/3277184/Gated%20PDFS/Global%20Energy%20Talent%20Index%20-%20GETI%202019.pdf).

Immigrant Learning Center. 2015. "Immigrant Entrepreneur Anita Worden of Yaskawa – Solectria Solar." [Video]. Malden, MA: Immigrant Learning Center. Retrieved February 25, 2020 (https://www.youtube.com/watch?v=RkgSmEhkt-I).

Irwin, Neil. 2021. "Unemployment Is High. Why Are Businesses Struggling to Hire?" *The New York Times*. Retrieved June 8, 2021 (https://www.nytimes.com/2021/04/16/upshot/unemployment-pandemic-worker-shortages.html).

Jordan, Phillip, Ryan Young, Mitchell Schirch, Josh Williams, Veronica Williams, Nathaniel Hunt. 2019. "Vermont Clean Energy Industry Report." Vermont Clean Energy Development Fund. Montpelier, VT: State of Vermont Department of Public Service. Retrieved March 9, 2020 (https://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/CEDF/Reports/VCEIR%202019%20Final%20Signed.pdf).

Kirwan, Hope. 2019. "Renewable Energy, Energy Efficiency Companies Continue To Add Jobs In Wisconsin." Wisconsin Public Radio. Retrieved May 26, 2020 (https://www.wpr.org/renewable-energy-energy-efficiency-companies-continue-add-jobs-wisconsin).

Kosten, Dan. 2018. "Immigrants as Economic Contributors: Immigrant Entrepreneurs." Washington, DC: National Immigration Forum. Retrieved March 9, 2020. (https://immigrationforum.org/article/immigrants-as-economic-contributors-immigrant-entrepreneurs/)

Krogstad, Jens M., Ana Gonzalez-Barrera, and Luis Noe-Bustamente. 2020. "U.S. Latinos among Hardest Hit by Pay Cuts, Job Losses Due to Coronavirus." Washington, DC: Pew Research Center. Retrieved April 30, 2020 (https://www.pewresearch.org/fact-tank/2020/04/03/u-s-latinos-among-hardest-hit-by-pay-cuts-job-losses-due-to-coronavirus/).

Krogstad, Jens M., Jynnah Radford. 2018. "Education Levels of U.S. Immigrants Are on the Rise." Washington, DC: Pew Research Center. Retrieved March 9, 2020 (https://www.pewresearch.org/fact-tank/2018/09/14/education-levels-of-u-s-immigrants-are-on-the-rise/).

Lawhon, Danny. 2018. "Wind turbine technicians are hard to find. With rising pay and a thriving Iowa future, they should be." *Des Moines Register*. Retrieved February 25, 2020 (https://www.desmoinesregister.com/story/money/business/2018/04/24/wind-turbine-technician-jobs-iowa-high-demand/521139002/).

Long, Heather. 2021. "It's not a 'labor shortage.' It's a great reassessment of work in America." The Washington Post. Retrieved June 8, 2021 (https://www.washingtonpost.com/business/2021/05/07/jobs-report-labor-shortage-analysis/).

Mavletova, Aigul and James C. Witte. 2016. "Is the Willingness to Take Risks Contagious? A Comparison of Immigrants and Native-Born in the United States." *Journal of Risk Research* 20

(7): 827-845.

McClure, Laura A., William G. LeBlanc, Cristina A. Fernandez, Lora E. Fleming, David J. Lee, Kevin J. Moore, and Alberto J. Caban-Martinez. 2017. "Green Collar Workers: An Emerging Workforce in the Environmental Sector." *Journal of Occupational and Environmental Medicine* (595):440–45.

Montt, Guillermo, Tahmina Karimova, Elizabethe Echeverria Manrique, Nicola Maitre, Takaaki kizu, Tahmina Mahmud, Catherine Saget. 2018. *World Employment and Social Outlook 2018: Greening with Jobs.* Switzerland: International Labour Organization. Retrieved April 16, 2020 (https://www.ilo.org/global/publications/books/WCMS_628654/lang--en/index.htm).

Muro, Mark Jacob Whiton, and Robert Maxim. 2020. "COVID-19 Is Hitting the Nation's Largest Metros the Hardest, Making a 'Restart' of the Economy More Difficult." Washington, DC: The Brookings Institution. Retrieved April 29, 2020 (https://www.brookings.edu/blog/the-avenue/2020/04/01/why-it-will-be-difficult-to-restart-the-economy-after-covid-19/).

Muro, Mark, Jonathan Rothwell, and Devashree Saha. 2011. "Sizing the Clean Economy: A National and Regional Green Jobs Assessment." Washington, D.C.: The Brookings Institution. Retrieved October 10, 2019 (https://www.brookings.edu/research/sizing-the-clean-economy-a-national-and-regional-green-jobs-assessment/).

Muro, Mark, Adie Tomer, Ranjitha Shivaram, and Joseph Kane. 2019. "Advancing Inclusion Through Clean Energy Jobs." Washington, DC: The Brookings Institution. Retrieved April 30, 2020 (https://www.brookings.edu/wp-content/uploads/2019/04/2019.04_metro_Clean-Energy-Jobs_Report_Muro-Tomer-Shivaran-Kane.pdf).

Nacamulli, Nia. 2017. "$39.4 Billion: The Money We Miss by Under-Employing College-Educated Immigrants." New York, NY: World Education Services. Retrieved May 20, 2020 (https://wenr.wes.org/2017/05/39-4billion-the-money-we-miss-by-under-employing-college-educated-immigrants)

Orrenius, Pia M., Madeleine Zavodny. 2009. "Do Immigrants Work in Riskier Jobs?" *Demography* 46 (3): 535–51.

Ottaviano, Gianmarco and Giovanni Peri. 2006. "Rethinking the Gains from Immigration on Wages." NBER Working Paper #12497.

Peri, Giovanni and Chad Sparber. 2008. "Task Specialization, Immigration and Wages." NBER Discussion Paper #02/08.

Ruiz Soto, Ariel G., Jeanne Batalova, and Michael Fix. 2016. "The Costs of Brain Waste among Highly Skilled Immigrants in Michigan." Washington, DC: Migration Policy Institute. Retrieved March 3, 2020 (http://research.newamericaneconomy.org/wp-content/uploads/2016/12/BrainWaste-Michigan-FactSheet-FINAL.pdf).

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. 2020. IPUMS USA: Version 10.0 [dataset]. Minneapolis, MN: IPUMS, 2020. Retrieved March 10, 2020 **(**https://doi.org/10.18128/D010.V10.0**).**

Simon, Rita J. 2001. *Immigrant Women.* New York, NY: Transaction Publishers.

Stangler, Dane and Jason Wiens. 2014. "The Economic Case for Welcoming Immigrant Entrepreneurs." Kansas City, MO: Ewing Marion Kauffman Foundation. Retrieved March 9, 2020 (https://www.kauffman.org/resources/entrepreneurship-policy-digest/the-economic-case-for-welcoming-immigrant-entrepreneurs/).

The Solar Foundation. 2017. "National Solar Job Census 2017." Washington, DC: The Solar Foundation. Retrieved on May 20, 2020 (https://www.thesolarfoundation.org/solarjobscensusarchives/).

Torpey, Elka. 2018. "Green growth: Employment projections in environmentally focused occupations." Washington, DC: U.S. Bureau of Labor Statistics. Retrieved November 14, 2019 (https://www.bls.gov/careeroutlook/2018/data-on-display/green-growth.htm).

U.S. Department of Energy. 2017. "Wind Vision Detailed Roadmap Actions." Washington, DC: U.S. Department of Energy. Retrieved March 4, 2020 (https://www.energy.gov/sites/prod/files/2018/05/f51/WindVision-Update-052118-web_RMB.pdf).

U.S. Census Bureau. 2020. *"Census Regions and Divisions of the United States" Suitland, MD: U. S. Census Bureau.* Retrieved April 13, 2020 (https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf).

Wadhwa, Vivek, Anna Lee Saxenian, F. Daniel Siciliano. 2012. "America's New Immigrant Entrepreneurs: Then and Now." Kansas City, MO: Ewing Marion Kaufmann Foundation. Retrieved March 9, 2020 (https://www.kauffman.org/entrepreneurship/reports/immigration-and-the-american-economy/americas-new-immigrant-entrepreneurs-then-and-now/).

Watson, Audrey. 2013. "Green technologies and practices: a visual essay." *Monthly Labor Review*. Washington, DC: U.S. Bureau of Labor Statistics. 136(1): 36-48. Retrieved April 30, 2020 (https://www.bls.gov/opub/mlr/2013/01/art4full.pdf).

Warren, Zack. 2013. "The Green Goods and Services Occupational Survey: Initial Results." *Monthly Labor Review* Washington, DC: U.S. Bureau of Labor Statistics. 136(1): 26-35. Retrieved May 13, 2020. (https://www.bls.gov/opub/mlr/2013/01/art3full.pdf).

Waters, Mary C., and Tomás R. Jiménez. 2005."Assessing Immigrant Assimilation: New Empirical and Theoretical Challenges." *Annual Review of Sociology* 31(1): 105–25.

Whitcomb Jr., Keith. 2019. "Labor shortage affecting clean energy industry as well." *Rutland Herald*. Retrieved March 9, 2020 (https://www.rutlandherald.com/news/local/labor-shortage-affecting-clean-energy-industry-as-well/article_f7e83fb4-e81c-5400-994e-7154902aab02.html).

The White House. 2021. "Fact Sheet: The American Jobs Plan." Retrieved June 15, 2021 (https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/).

Wilmsen, Carl, Diane Bush, and Dinorah Barton-Antonio. 2015. "Working in the Shadows: Safety and Health in Forestry Services in Southern Oregon." *Journal of Forestry* 113(3):315–24.

GEORGE MASON UNIVERSITY | Institute for Immigration Research

Address: 4400 University Drive, MSN 1D7
Fairfax, VA 22030

Website: iir.gmu.edu

Phone: (703) 993-5833

Email: iir@gmu.edu

Facebook: facebook.com/GMUIIR

Twitter: @IIRGMU