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Finding the Right Fit: What Jobs Offer a Good Match for Fossil Fuel Workers' Skills?

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Abstract

The imperative to reduce greenhouse gas emissions necessitates major changes in the domestic and global energy sector. However, one concern is whether workers currently employed in the coal, oil, and natural gas industries will be able to access alternative employment opportunities with comparable levels of pay, inside or outside of the low-emissions energy sector. A related question is whether current educational programs are sufficient to train the large workforce that will be needed to rapidly deploy the range of technologies required to achieve deep reductions in greenhouse gas emissions. This analysis provides early evidence on these questions by analyzing data on occupational skills across the US economy. We find that a substantial number of occupations offer a good “skills match” for today’s fossil fuel workforce, but most of those occupations pay considerably less than jobs in fossil fuel extraction, refining, transportation, and power generation. Occupations that frequently offer a good-match with comparable pay are found mainly in transportation, construction, and rail industries. Several low-emissions sectors, particularly critical minerals mining, hydrogen, carbon capture, and energy-related civil engineering and construction, offer a substantial number of jobs with similar levels of pay and a good skills match for fossil fuel workers. We find that educational programs training workers to work with low-emissions technologies are fairly modest in scope, with the largest number in construction and heat pump installation and maintenance. We also find that in most cases, there is a positive correlation between where low-carbon technologies are being deployed and where workers are being trained to build and operate those technologies.

To better understand the variation in skills gaps across occupation, we have developed an interactive online data tool that allows users to examine skills gaps, earnings, and projected job growth for all 31 benchmark jobs. Explore the data via [**RFF’s Skills-Matching Data Tool**](#).

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1. Introduction

As the world seeks to reduce greenhouse gas emissions to limit the impacts of climate change, one substantial concern for policymakers, businesses, labor groups, communities, and other stakeholders is whether workers in the coal, oil, and natural gas industries can successfully transition to new employment opportunities. Over the last several decades, as coal production and use have declined in the United States, the local economic impacts have been substantial, particularly in Appalachian coal communities (Carley et al. 2018; Weber 2020; Colmer et al. 2024). In the oil and gas sector, although production is at an all-time high nationally, dramatic improvements in drilling and completion efficiencies have reduced direct employment in oil and gas extraction from roughly 200,000 in 2015 to 120,000 in 2023 (BLS 2024b, 211).

Modeling studies at a variety of geographic scales have estimated that a transition away from fossil fuels would likely increase energy sector employment overall, as the number of new jobs in low-emissions energy and associated infrastructure development would exceed the number of job losses in fossil energy (e.g., Pai et al. 2021; Mayfield et al. 2023; Xie et al. 2023). However, today's coal, oil, and gas workers will not necessarily benefit from this transition for several reasons.

First, new energy jobs will not necessarily grow fastest in fossil fuel-dependent regions (Lim et al. 2023; Xie et al. 2023), and limitations in labor mobility mean that workers will not necessarily relocate (Weber 2020; Castellanos and Heutel 2024). Second, common renewable energy jobs such as wind turbine technicians or solar installers may be unattractive for fossil fuel workers because they offer lower pay,¹ and empirical work has found that lower wages following job loss are a major issue for fossil fuel workers in various settings (Parks and Baran 2023; Colmer et al. 2024; Haywood et al. 2024). Third, because fossil fuel workers may not have the skill sets needed to work in growing sectors of the economy, they may face substantial retraining costs. Finally, fossil fuel workers may simply prefer to pursue employment outside of clean energy sectors. Reflecting these dynamics, Curtis et al. (2023) demonstrate that between 2005 and 2021, less than 1 percent of workers who left carbon-intensive jobs transitioned into “green” jobs (although this number grew during the study period). Surveys of workers at power plants scheduled for closure indicate that few had identified new employment and that most wanted to acquire new skills via training, assuming costs were covered (NM DWS 2023).

Some forward-looking research on the potential (and costs) for fossil fuel workers to transition to new jobs is limited by scope (i.e., focusing exclusively on renewable energy) and methodology. For example, Louie and Pearce (2016) estimate that retraining coal workers for solar jobs (across a variety of roles, including construction, installation, and operations) would cost roughly \$4,000 to \$21,000 per worker and

1 For example, in 2024, annual average earnings were roughly \$105,000 in the **fossil fuel electric power generation sector** and \$110,000 in the **oil and gas extraction** sector, compared with \$93,000 for **wind generation** and \$95,000 for **solar**. Common occupations such as wind turbine technicians and solar installers were considerably lower.

argue that a “relatively minor investment” in aggregate retraining costs could facilitate a complete transition of coal workers to the solar PV industry. However, the authors’ selection of solar occupations to which coal workers could most easily transition appears largely arbitrary, and little evidence is provided that workers could easily transition from one occupation to the other.² The results also indicate that training times range from several months up to nine years, an implausibly long period.

In addition to the needs of current fossil fuel workers, new training and skills requirements will be necessary in the United States and globally to innovate and deploy the energy technologies required to achieve long-term climate goals (IEA 2023; Popp et al. 2024). However, existing training programs may not be well suited to train the workforce that is essential to rapidly transform the world’s energy systems because they focus on educating students to work in today’s energy system. For example, Vakulchuk and Overland (2024) estimate that roughly two-thirds of global energy-focused degrees train students to work in fossil fuels through programs such as petroleum engineering or petroleum geology, whereas just one-third focus on renewable energy systems.

In this report, we carry out two main analyses. First, we assess which jobs offer the best match for the skill sets of workers in the coal, oil, and natural gas industries. We include, but do not limit the analysis to, low-emissions energy technologies such as wind, solar, geothermal, carbon capture, and others detailed in Section 2.³ This analysis builds on our previous work examining the extent to which fossil fuel job skills match the skills needed to take advantage of jobs in locally growing industries with similar rates of pay (Greenspon and Raimi 2024). Second, we analyze whether recent graduations from postsecondary education programs align with the workforce training needs of low-emissions technologies.

Section 2 describes our methodology for carrying out these analyses, followed by results and discussion in Section 3, including our analytical limitations. Section 4 concludes.

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- 2 For example, the authors posit that no retraining is necessary for a coal industry worker with the occupation Mobile Heavy Equipment Mechanics, Except Engines to become a Process Control Technician in the solar industry (Louie and Pearce 2016, Appendix 3) but provide no clear rationale or data to support such assumptions about occupational transitions. Subsequent work (e.g., Zhang et al. 2024) has followed the same general methodology but produces unsatisfying results because of the lack of detail when determining the best match between fossil fuel and low emissions energy jobs.
 - 3 We focus on a specific set of energy technologies that many modeling efforts (Jenkins et al. 2021; Mayfield et al. 2023; Raimi et al. 2024) suggest are needed for decarbonization.

2. Data and Methods

This analysis builds on our previous work (Greenspon and Raimi 2024), with several modifications. In that work, we analyzed fossil fuel workers' skills based on the skill set of a local fossil fuel workforce, which we calculated as a weighted average of skills across all occupations found within fossil fuel industries in each US commuting zone. That analysis, while informative, did not offer the level of granularity needed for workforce development professionals or individual workers to identify the jobs that offer the best skills matches with their current occupations.

In this report, we provide that level of analysis by looking at specific occupations that are concentrated within fossil fuel industries (details in Section 2.2) and assessing which alternative occupations offer the best matches in terms of job skills. We also examine whether these occupations offer similar pay and are projected to grow in the coming years. We perform this analysis for all jobs across the economy and for the subset of jobs associated with a suite of low-emissions energy technologies. The latter analysis is designed to identify the opportunities for fossil fuel workers to transition to jobs in parts of the energy industry that are likely to grow in the context of a transition to net-zero emissions. We complement this with an analysis of how well postsecondary education programs are preparing students for jobs in low-emissions energy industries. The remainder of this section details the data and methodology used in these analyses.

2.1. Data Assembly

We define fossil fuel industries as those based around the extraction, transportation, and refining of coal, oil, and natural gas, along with fossil-fueled electricity generation. These industries are listed in Table 1 with their corresponding North American Industry Classification System (NAICS) codes and employment levels as of 2023 (the most recent available year).

We use data on these industries from the Bureau of Labor Statistics' "Occupational Employment and Wage Statistics" (BLS-OEWS) for our analyses of current employment and job transition opportunities of fossil fuel workers. The BLS-OEWS provides the median annual salary and total employment count by occupation in each industry nationally, as well as the total employment by occupation in each state (across all industries).⁴ Occupations are defined using the BLS Standard Occupational Classification (SOC) system. The most recent BLS-OEWS data available were collected in May 2023, November 2022, May 2022, November 2021, May 2021, and November 2020 (BLS 2023).

4 Median annual salaries were not available for select occupations in certain states. In these cases, we used the national median salary for the occupation instead. In cases where this also was not available, we used the median salary of the broader occupation group. For details on these data, see BLS (2024a).

Table 1. Fossil fuel industries

Industry name	NAICS code	Total employment
Oil and Gas Extraction	211000	108,660
Coal Mining	212100	41,940
Support Activities for Mining	213000	278,870
Fossil Fuel Electric Power Generation	221112	74,410
Natural Gas Distribution	221200	112,540
Petroleum and Coal Products Manufacturing	324100	108,320
Pipeline Transportation	486000	53,160

Source: Employment statistics from Bureau of Labor Statistics (2023) for May 2023.

Notes: North American Industry Classification System (NAICS) code.

To determine which low-carbon energy technologies may offer a good fit for fossil fuel workers, we first identify a set of energy technologies that are projected to grow substantially in a transition to net-zero emissions. Based on analyses of medium- and long-term energy projections (e.g., Jenkins et al. 2021; Mayfield et al. 2023; Raimi et al. 2024) and input from experts at the US Department of Energy, we select 12 (occasionally overlapping) low- or no-emissions energy technologies that are at a variety of development stages. Where possible, we include both upstream (e.g., raw materials and equipment manufacturing) and downstream (e.g., electricity generation) subsectors for each technology.

In cases where low emissions energy technologies are mature, have been widely deployed, and have a specific industry associated with them (e.g., wind and solar), detailed data from BLS-OEWS exist on total employment by occupation in each industry. In cases where technologies are relatively nascent and have not been widely deployed (e.g., carbon capture and storage [CCS], biomass with carbon removal and storage [BiCRS]), sufficiently detailed BLS-OEWS data do not exist. When that is the case, we make judgments about which existing industries offer the best proxies for the types of occupations that will be in demand in each low-emissions energy sector.⁵ In addition to these energy-specific industries and associated occupations, we include a general construction category with subsectors for utilities construction and heavy/civil engineering. We do this because many of the energy technologies included in our analysis are highly capital-intensive, with a large proportion of employment generated by the construction of new facilities (e.g., wind farms, nuclear reactors) (IEA 2023).

5 We did not identify any proxy industries that were sufficiently similar to methane monitoring and abatement services. For this technology, we gathered information on job openings and employment at leading US companies and used this information to construct estimates of the overall share of employment in each occupation.

Table 2. Low-carbon energy technologies and occupational composition data sources

Technology	Subsector	Stage	Existing data	Proxy data
Biomass	Biomass electricity generation	Downstream	NAICS 221117	Not needed
Biomass	Biomass with carbon removal and storage (BiCRS)	Upstream	Not available	NAICS 113000
Carbon capture and storage	N/A	Downstream	Not available	NAICS 486200 (adjusted)
Critical minerals mining	Mining activities	Upstream	NAICS 212000	Not needed
	Production	Downstream	NAICS 327000 and 331400	Not needed
Geothermal generation	N/A	Downstream	NAICS 221116	Not needed
Heat pumps	Heat pump installation/maintenance	Downstream	Part of NAICS 238220	Not needed
Hydropower	Hydroelectric generation	Downstream	NAICS 221111	Not needed
Hydrogen	Hydrogen manufacturing	Upstream	Not available	NAICS 3250A1
	Hydrogen distribution	Downstream	Not available	NAICS 221200
Methane monitoring and abatement	Monitoring and abatement services	Downstream	Authors' calculations	Not available
Nuclear	Nuclear generation	Downstream	NAICS 221113	Not needed
Solar	Panel manufacturing	Upstream	Part of NAICS 334400	Not needed
	Solar generation	Downstream	NAICS 221114	Not needed
	Installation/maintenance	Downstream	Part of NAICS 238210	Not needed
Wind	Turbine manufacturing	Upstream	Part of NAICS 333600	Not needed
	Turbine installation and maintenance	Downstream	Part of NAICS 237130	Not needed
	Wind generation	Downstream	NAICS 221115	Not needed
Construction (general)	Utilities construction	Downstream	NAICS 237100	Not needed
	Heavy/civil engineering	Downstream	NAICS 237900	Not needed

Note: See the appendix for details of North American Industry Classification System (NAICS) codes and authors' calculations for methane monitoring and abatement.

This information is summarized in Table 2. In addition to data sources, the table reflects our best effort to distinguish between different stages of each energy technology. For example, the occupations required to operate a solar photovoltaic facility are likely very different from those required to design and build solar panels.

For the analyses that follow, we include occupations that account for at least 1 percent of total employment within industries for each low-emissions technology.⁶

2.2. Identifying Common Fossil Fuel Occupations

We use BLS data to determine which occupations are most concentrated in fossil fuel sectors and therefore most vulnerable to job reductions associated with decarbonization. This step is necessary because fossil fuel industries include a mix of some occupations predominant in these sectors (e.g., Derrick Operators) and others common across the economy (e.g., Accountants). We identify the former group of jobs by calculating the fossil fuel concentration (FFC) of each occupation, which we define as the percentage of total workers in each occupation that are employed in fossil fuel sectors. Calculating the FFC allows us to identify the set of workers with a high degree of specialization in coal, oil, and gas. For example, the FFC of workers with the occupational title Derrick Operators, Oil and Gas was 95.6 percent from 2021 to 2023 (meaning 4.4 percent of workers within this occupation were employed outside fossil fuel sectors), while the FFC of Accountants and Auditors was just 0.8 percent.

Because we cannot analyze each of the hundreds of occupations included in BLS data, and because our focus is on the workers who are most specialized in fossil fuels, we focus on occupations where the FFC exceeds 5 percent. This is an arbitrary threshold, and subsequent analysis could choose to broaden or narrow the focus of what can be considered a common fossil fuel job. However, we feel it is a reasonable benchmark because it results in a manageable number (31) of occupations to analyze and does not exclude any occupations that are essential to fossil fuel extraction (e.g., Extraction Workers, Roustabouts, Petroleum Engineers). The 31 occupations where the FFC exceeds 5 percent are listed in Table 3. The breakdown of each occupation's fossil fuel employment across industries is listed in Appendix Table A.1.

6 For methane monitoring and abatement, we relax this to 0.5 percent because the data we use to construct industry occupational profiles consist of current job openings (a subset of industry jobs) rather than current employment, a more holistic view of the industry. See Appendix A.4 for details.

Table 3. Occupations with the highest fossil fuel concentration

Occupation title	Average salary	Fossil fuel employment	Total employment	Fossil fuel concentration (%)
Wellhead Pumpers	\$71,830	17,640	18,230	96.8
Derrick Operators, Oil and Gas	\$58,210	11,000	11,510	95.6
Service Unit Operators, Oil and Gas	\$55,750	42,890	46,150	92.9
Rotary Drill Operators, Oil and Gas	\$61,770	11,280	12,180	92.6
Petroleum Pump System Operators, Refinery Operators, and Gaugers	\$94,580	29,830	33,360	89.4
Roustabouts, Oil and Gas	\$46,340	37,860	43,830	86.4
Petroleum Engineers	\$135,690	12,960	20,390	63.6
Loading and Moving Machine Operators, Underground Mining	\$64,070	2,980	5,160	57.8
Helpers—Extraction Workers	\$45,520	4,020	7,360	54.6
Pump Operators, Except Wellhead Pumpers	\$54,690	4,810	11,570	41.6
Power Plant Operators	\$97,010	12,880	31,490	40.9
Extraction Workers, All Other	\$49,580	2,890	7,120	40.6
Control and Valve Installers and Repairers, Except Mechanical Door	\$70,100	17,690	47,780	37.0
Underground Mining Machine Operators, All Other	\$68,910	680	2,560	26.6
Continuous Mining Machine Operators	\$61,420	3,930	15,700	25.0
Geological Technicians, Except Hydrologic Technicians	\$52,440	1,910	8,860	21.6
Mining and Geological Engineers, Including Mining Safety Engineers	\$100,640	1,150	7,040	16.3
Power Distributors and Dispatchers	\$104,750	1,430	9,040	15.8
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	\$96,600	3,810	24,790	15.4
Excavating and Loading Machine and Dragline Operators, Surface Mining	\$50,050	4,200	32,630	12.9
Geoscientists, Except Hydrologists and Geographers	\$92,580	3,070	24,620	12.5
Plant and System Operators, All Other	\$56,940	1,830	15,370	11.9
Earth Drillers, Except Oil and Gas	\$56,660	2,130	18,010	11.8
Calibration Technologists and Technicians	\$62,790	1,040	13,220	7.9
Riggers	\$56,220	1,860	23,870	7.8
Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$66,680	4,240	58,320	7.3
Chemical Engineers	\$112,100	1,370	21,140	6.5
Industrial Machinery Mechanics	\$61,420	25,660	412,650	6.2
Tank Car, Truck, and Ship Loaders	\$58,620	670	11,400	5.9
Mixing and Blending Machine Setters, Operators, and Tenders	\$46,100	6,100	105,740	5.8
Conveyor Operators and Tenders	\$39,260	1,300	24,660	5.3

Source: Employment and earnings statistics from Bureau of Labor Statistics (2023) for May 2023.

Note: See Appendix Table A.1 for employment by fossil fuel industry.

2.3. Calculating Skills Gaps

To determine the jobs where fossil fuel workers would be able to best apply their existing skill sets with minimal training, we calculate the degree to which the skills needed in occupations with a high FFC align with skills needed in other occupations. Data on these skills are available from the Occupational Information Network (O*NET), developed under the sponsorship of the US Department of Labor’s Employment and Training Administration (O*NET 2024). For each occupation, O*NET provides ratings of 35 job skills (e.g., Systems Evaluation, Reading), defined as the ability to perform a job task well and developed over time through training or experience. O*NET provides skill ratings across two dimensions: the importance of the skill to performing a specific job and the level of the skill required. For our analysis, we normalize these ratings from 0 (low) to 1 (high). O*NET ratings are based on surveys completed by trained occupational analysts, who consider job titles, descriptions, and other factors. A complete list and brief description of these skills are provided in the Appendix Table A.2.

We first calculate skills gaps as the difference in the level of skill s required to perform each job j and each fossil fuel job f , for every pair of fossil fuel and other jobs and for each of the 35 skills:

$$SkillGap_{s,f,j} = SkillLevel_{s,j} - SkillLevel_{s,f} \quad (1)$$

For example, according to O*NET, the occupation of Roustabout (SOC 47-5071) requires a level of 0.29 for the skill Systems Evaluation while the occupation of Logistician (SOC 13-1081) requires a level of 0.55.⁷ Therefore, in this case,

$$SkillGap_{Systems\ Evaluation, Roustabouts, Logisticians} = 0.55 - 0.29 = 0.26$$

To understand the total skills gap between jobs, we next calculate an overall skills gap for every pair of each fossil fuel job f and every other job j . This is calculated as a weighted average of all 35 values of $SkillGap_{s,f,j}$ for each skill s , where the weights are the relative importance of skill s for performing job j .⁸ This weighting means that

7 According to sample job skills rating questionnaires provided by O*Net, these skill level ratings align, respectively, with being able to “determine why estimates for the time to complete a task are overly optimistic” (rated 2/7, which we normalize as 0.29) and to “identify the reasons why a client might be unhappy with a product” (rated 3.9/7, normalized as 0.55).

8 The relative importance of skill s for job j is calculated as the importance rating of skill s as a fraction of the sum of the importance ratings for all 35 skills for job j .

the most important skills for a given a job play the largest roles in determining the overall skills gap (for example, the skill of mathematics is crucial for statisticians, while operation and control is particularly important for airline pilots). In cases where $SkillGap_{s,f,j} < 0$ (i.e., instances where a fossil fuel job has a higher skill rating than the comparison job), we replace $SkillGap_{s,f,j}$ with zero to focus only on skills gaps (rather than exceedances) and exclude it from the calculation of skill importance weights.

$$OverallSkillGap_{t,j} = \sum_s (SkillGap_{s,f,j} \times SkillImportance_{s,j}) \quad (2)$$

Continuing with the previous example, the overall skills gap between Roustabouts and Logisticians is calculated as 0.24, which represents the weighted average of the skills gap identified across all 35 skills. To understand our weighting process, consider the Systems Evaluation skill, which has a skills gap of 0.26. This skill is of medium importance for Logisticians, with a relative importance weight of 0.036 (it is the 17th most important out of 35 skills). For reference, the most important skill for Logisticians in the O*NET data is Critical Thinking (weighted at 0.048), while the least important skill is Installation (weighted at 0). Results from this analysis are presented in Sections 3.1, 3.2, and 3.3.

2.4. Job Projections

To assess future employment opportunities for fossil fuel workers transitioning to other sectors, we need information on which jobs are likely to grow and which are not. For this information, we turn to state-level forecasts of job growth by occupation from the US Department of Labor State Employment Projections Managing Partnership (PMP 2024). These employment projections are developed by each state under sponsorship of the US Department of Labor, with the most recent projections running from 2022 through 2032.

2.5. Postsecondary Education

Our analysis of training for labor requirements of low-emissions technologies relies on data on postsecondary education offerings and attainment by program. We use data from the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) for 2023. IPEDS collects program data from a wide range of postsecondary institutions, including research universities, state colleges and universities, private religious and liberal arts colleges, for-profit institutions, community and technical colleges, and non-degree-granting institutions (e.g., vocational schools). These data include the number of programs offered and number of awards or degrees conferred by each program. To identify the subject area for each of these programs, we use the Classification of Instructional Programs (CIP) (at the detailed [six-digit] level of standardized codes), which classifies each program into a subject area based on its pedagogical content. Developed by the US Department of Education, the CIP is "a taxonomic scheme that supports the accurate tracking and reporting of fields of study and program completions activity" (NCES 2024). We also use data available from IPEDS on the program award level (e.g., certificate, bachelor's degree, PhD).

To link postsecondary programs to each category of low-emissions technologies, we manually search for relatively specialized programs related to key aspects of each low-emissions technology.⁹ For example, we include programs that would clearly be appropriate for certain technologies, such as Geotechnical and Geoenvironmental Engineering for geothermal or Solar Energy System Installation and Repair Technology for solar. Using this process, we identify 40 types of postsecondary programs that are related to at least one technology (see Appendix Table A.4 for the complete list), with results presented in Section 3.4. We focus on programs that are relatively specific to a low-emissions technology to understand the amount of existing training, while recognizing that this excludes more general programs, such as Chemical Engineering, that have potential applications to these technologies. We further discuss limitations to this approach in Section 3.5.

3. Results and Discussion

3.1. Identifying Good-match Jobs

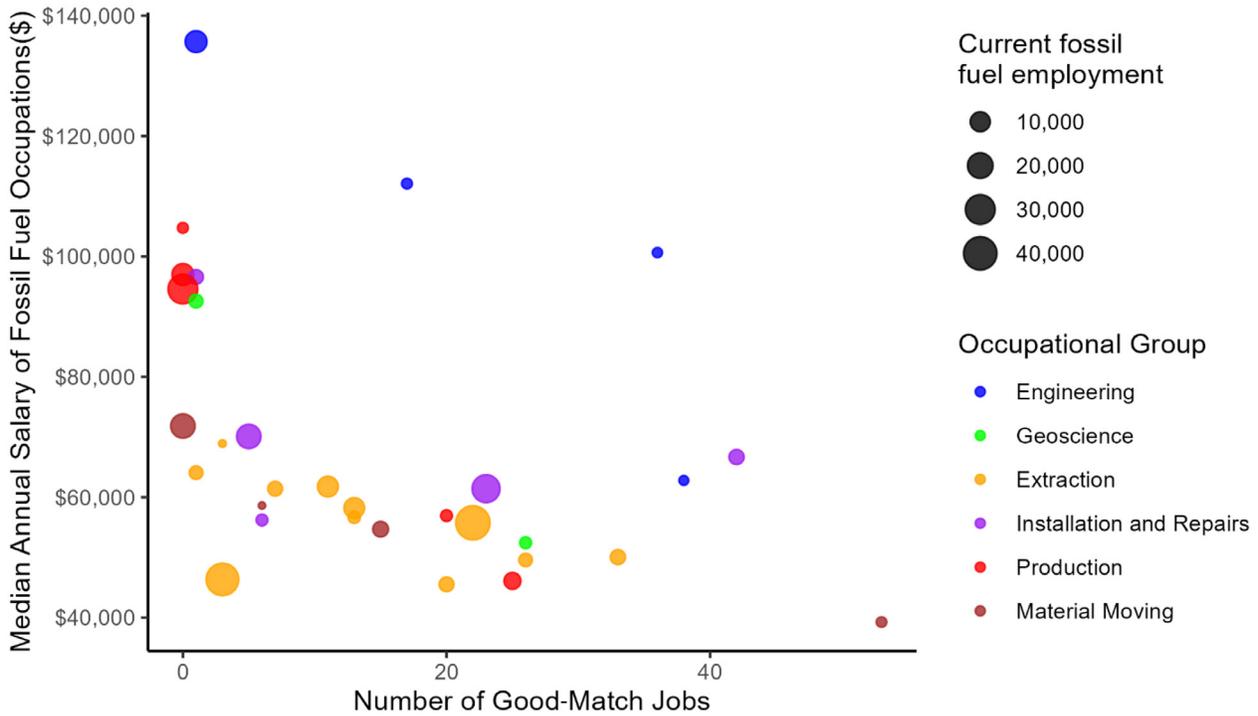
In most cases, workers in occupations with high concentrations in fossil fuels have the skills needed to move to many alternative occupations. However, most of these alternatives pay considerably less than what fossil fuel workers currently earn. For example, 30 alternative occupations offer a small skills gap for Wellhead Pumpers (SOC 47-5041, the occupation with the highest FFC in our sample).¹⁰ However, these occupations pay, on average, 43 percent less than Wellhead Pumpers. When we restrict the sample to occupations with this relatively small skills gap that pay 90 percent or higher relative to Wellhead Pumpers, no occupations remain (one occupation, Pile Drive Operators (SOC 47-2072), is the closest, with pay equal to 88.5 percent of that of Wellhead Pumpers). When we include occupations with a larger skills gap (less than 0.06, near the 50th percentile of skills gaps), several occupations emerge, including Rail-Track Laying and Maintenance Equipment Operators (SOC 47-4061); Underground Mining Machine Operators, all other (SOC 47-5049); Roof Bolters, Mining (SOC 47-5043); Control and Valve Installers and Repairers, Except Mechanical Doors (SOC 49-9012); and Power Plant Operators (SOC 51-8013). However, most of these occupations also have a high FFC, suggesting that they are also likely to decline in a net-zero transition.

A similar story emerges for most other occupations with high FFCs. Perhaps the starkest example comes from Petroleum Engineers (SOC 17-2171), a highly skilled occupation with a national average salary near \$150,000. There is a small skills gap between Petroleum Engineers and 283 alternative occupations. However, just one of those occupations (Optometrists) offers comparable pay. (We discuss the plausibility of such occupational transitions later in this section and in Section 3.5.)

9 An alternative approach is identifying postsecondary programs related to low-emissions technologies through crosswalks linking CIP codes and the SOC codes of occupations we estimate as important for each technology (listed in Appendix 5.4). However, this approach includes many high-enrollment programs that are of only marginal relevance to any specific technology (e.g., business and management studies) and therefore results in implausibly high estimates of postsecondary completions related to low-emissions technologies.

10 We use 0.017 as a benchmark to refer to occupations with a relatively small skills gap, which represents the 25th percentile of smallest skills gaps among all pairs of benchmark and comparison occupations. This is an arbitrary cutoff, as there is no standard metric to distinguish between small and large skills gaps.

Figure 1. Fossil fuel occupations by salary and number of good-match jobs



Source: Author calculations and employment and earnings statistics from Bureau of Labor Statistics (2023) for May 2023.

Other occupations with a high FFC appear to have a larger number of options. For example, there are 40 occupations with a small skills gap and similar pay to Mining and Geological Engineers, Including Mining Safety Engineers (SOC 17-2151), 38 of which are projected to grow in the next decade and 36 of which have a low FFC. This result suggests that certain occupations in the mining sector have a relatively bright outlook, particularly if the United States expands its mining operations related to critical minerals production (see Section 3.3), a sector where workforce shortages have worried experts (Johnson and Regier 2024).

Figure 1 illustrates the correlation between the number of good-match jobs for occupations with a high FFC and the salaries of those alternative jobs. It also represents the scale of current fossil fuel employment for each high-FFC job, roughly illustrating the number of workers who may be affected (see Appendix Table A.1 for detailed definitions).

With a small number of exceptions for select engineering occupations, higher-paying jobs with a high FFC have fewer good-match occupations with comparable pay than do lower-paying jobs with a high FFC. For example, Extraction Workers, All Other (SOC 47-5099) and Helpers-Extraction Workers (SOC 47-5081), each of which pays less than \$50,000 annually, have a relatively high number (27 and 20, respectively) of good-match jobs with similar levels of pay.¹¹ As noted in Section 2.1, many of these occupations are found frequently in the construction sector

¹¹ In fact, 8 of the 10 fossil fuel occupations with a typical salary less than \$60,000 had at least 14 good-match jobs. The only exceptions are Riggers (6 jobs) and Roustabouts, Oil and Gas (3 jobs).

(e.g., Construction Laborers, SOC 47-2061; Paperhangers, SOC 47-2142), the public sector (e.g., Bus Drivers, SOC 53-3052; Refuse and Recyclable Material Collectors, SOC 53-7081), and the transportation sector (e.g., Industrial Truck and Tractor Operators, SOC 53-7051).

Table 4 provides detail on these results for each occupation with an FFC above 5 percent. For each of these 31 benchmark occupations (1st column), the table reports the number of occupations across the economy with a small overall skills gap (less than or equal to 0.017; 2nd column), how many of those occupations pay at least 90 percent as much as the high-FFC job (3rd column), how many of those occupations are projected to grow through 2032 (4th column), and the number of those occupations with an FFC of 5 percent or less (5th column).¹² It also provides the projected number of openings across all occupations that meet all four criteria (6th column) to illustrate the sheer number of opportunities that could be open to fossil fuel workers in each occupation.

12 Note that each column is successively subsetting the set of occupations to which the fossil fuel job is compared by applying each criterion.

Table 4. Number of occupations with low skills gaps, comparable wages, projected growth, and low fossil fuel concentration

Occupations with high fossil fuel concentrations	Skills gap ≤0.017	... And salaries ≥90%	... And projected growth in jobs	... And FFC <5%	Projected annual openings*
Electrical and Electronics Repairers, Commercial and Industrial Equipment	378	67	43	42	283,500
Mining and Geological Engineers, Including Mining Safety Engineers	344	40	38	36	702,200
Calibration Technologists and Technicians	325	59	39	38	344,100
Chemical Engineers	309	19	18	17	108,000
Petroleum Engineers	283	1	1	1	1,700
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	267	2	1	1	2,400
Plant and System Operators, All Other	252	52	24	20	357,500
Petroleum Pump System Operators, Refinery Operators, and Gaugers	249	1	0	0	—
Industrial Machinery Mechanics	236	46	26	23	203,600
Service Unit Operators, Oil and Gas	233	50	26	22	435,600
Rotary Drill Operators, Oil and Gas	214	27	14	11	98,700

Power Plant Operators	207	0	0	0	—
Power Distributors and Dispatchers	199	0	0	0	—
Pump Operators, Except Wellhead Pumpers	187	35	16	15	345,400
Excavating and Loading Machine and Dragline Operators, Surface Mining	185	79	37	33	648,200
Derrick Operators, Oil and Gas	183	31	16	13	333,900
Geological Technicians, Except Hydrologic Technicians	167	48	26	26	215,600
Conveyor Operators and Tenders	155	121	56	53	2,111,100
Control and Valve Installers and Repairers, Except Mechanical Door	153	9	5	5	18,200
Extraction Workers, All Other	150	60	28	26	614,000
Earth Drillers, Except Oil and Gas	146	24	13	13	333,100
Geoscientists, Except Hydrologists and Geographers	138	2	1	1	9,400
Tank Car, Truck, and Ship Loaders	132	12	6	6	40,200
Mixing and Blending Machine Setters, Operators, and Tenders	117	55	26	25	780,000
Continuous Mining Machine Operators	103	13	7	7	74,500
Underground Mining Machine Operators, All Other	99	5	3	3	2,700
Riggers	94	14	6	6	40,600
Helpers—Extraction Workers	90	42	21	20	528,500
Loading and Moving Machine Operators, Underground Mining	48	2	1	1	21,200
Roustabouts, Oil and Gas	32	9	3	3	99,800
Wellhead Pumpers	30	0	0	0	—

Sources: Employment and earnings statistics from Bureau of Labor Statistics (2023) for May 2023, skills gap calculated from Occupational Information Network data, and job growth from Projections Managing Partnership data.

*Includes projected annual openings for all occupations that meet all criteria in each row of the table.

Which occupations offer the best match for fossil fuel workers? Across all 31 benchmark occupations, the most common good-match jobs that require similar skills to the benchmark job, offer at least 90 percent as high a typical salary, are growing, and have a low FFC are Bus Drivers (SOC 53-3052), Pile Driver Operators (SOC 47-2072), and Crane and Tower Operators (SOC 53-7021), along with occupations common in the rail industry (e.g., Railroad Brake, Signal, and Switch Operators and Locomotive Firers [SOC 53-4022]) and construction (e.g., Drywall and Ceiling Tile Installers [SOC 47-2081]).

For occupations with high FFCs and annual average wages above \$100,000, there is no clear concentration of occupations within a single industry. Instead, occupations with comparable wages represent a wide range of professional services, each of which requires significant domain-specific training. For example, there is a relatively small overall skills gap (0.02) between Geoscientists (SOC 19-2042), which have a high FFC, and Atmospheric and Space Scientists (SOC 19-2021), which have a low FFC. Although these occupations require similar high-level skills (e.g., math and science), they also involve years of specialized training that would require substantial investment for a Geoscientist to become an Atmospheric Scientist (or vice versa). When considering the potential for these highly specialized professionals to retrain, it is possible that higher-paid workers will have more savings and therefore more ability to pursue new skills. However, these workers will also have a higher opportunity cost of taking the time to retrain, which will tend to reduce their incentive to do so.

According to experts in the federal Interagency Working Group on Energy Communities, dislocated workers from coal-fired power plants or coal mines often find new employment in truck-driving occupations. Examining two major truck-driving occupations, Light Truck Drivers (SOC 53-3033) and Heavy and Tractor-Trailer Truck Drivers (SOC 53-3032), we find that these jobs often offer a good-match for our 31 high-FFC occupations but typically pay well below those jobs, with salaries averaging roughly \$43,000 to \$54,000 nationally. However, there are 9 high-FFC occupations for which Heavy and Tractor-Trailer Truck Drivers offers a good skills match and pays at least 90 percent of the salary.¹³

Because of limitations in the data, several occupations emerge as frequent “good-match” jobs that are implausible as likely replacement jobs for fossil fuel workers. For example, the occupation of Dancers, Models, and Musicians frequently shows a high level of overall skills match with our 31 benchmark occupations. This outcome highlights the fact that the skills necessary in some highly specialized occupations (e.g., musicianship) are not captured well in the O*NET data, while the skills that are captured in the data are not high priorities for these specialized occupations (we discuss these and other data limitations in more detail in Section 3.5). Although it is certainly possible that some fossil fuel workers could transition into these occupations, we exclude them from this analysis because of the highly specialized training they require.¹⁴

13 Those nine occupations are Conveyor Operators and Tenders; Derrick Operators, Oil and Gas; Service Unit Operators, Oil and Gas; Pump Operators, Except Wellhead Pumps; Extraction Workers, All Other; Excavating and Loading Machine and Dragline Operators, Surface Mining; Earth Drillers, Except Oil and Gas; Mixing and Blending Machine Setters, Operators, and Tenders; and Plant and System Operators, All Other.

14 The full list of occupations we exclude from our results and analysis is as follows: 27-2011, Actors; 27-2021, Athletes and Sports Competitors; 27-2042, Musicians and Singers; 27-2031, Dancers; 41-9012, Models; 27-2032, Choreographers; 27-2041, Music Directors and Composers; 27-3043, Writers and Authors; and 27-2012, Producers and Directors.

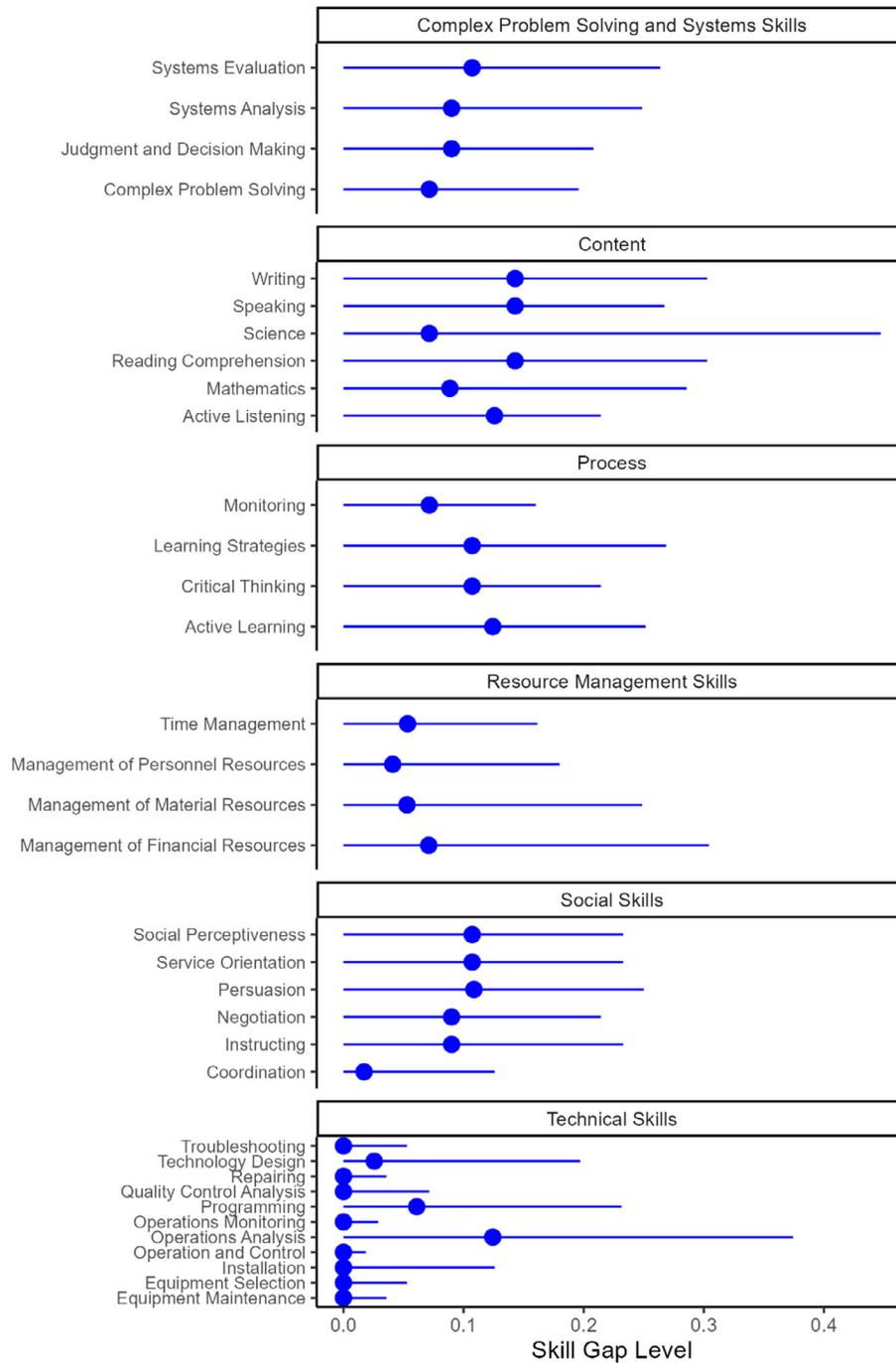
3.2. Assessing Skills Gaps

Next, we seek to understand which specific skills contribute to the overall skills gaps we observe in the data. To do so, we analyze the set of occupations with similar pay to fossil fuel jobs and assess which skills display the largest and smallest gaps. When we compare each of our 31 high-FFC occupations with occupations that pay 90 percent or more of each benchmark job (regardless of the size of the overall skills gap), the largest skills gaps emerge in the content category (e.g., Reading Comprehension, Speaking, Writing, Active Listening), followed by the process category (e.g., Active Learning, Critical Thinking). Gaps in other skill types are typically small, particularly in technical skills. These skills, such as Equipment Selection, Operations Monitoring, Quality Control Analysis, and Equipment Maintenance, show the smallest skills gaps (and often show skill exceedances) between our 31 high-FFC jobs and those with similar (or higher) pay.

Figure 2 illustrates the sizes and variations of these skills gaps. For each category, the dot represents the median skills gap between workers in 31 benchmark occupations with high (≥ 5 percent) fossil fuel concentration and other occupations that pay 90 percent or more relative to each benchmark job. The lines extend to the 10th and 90th percentile of the skills gaps observed across each job pairing.

As illustrated in Figure 2, there is wide variation across different occupations. For example, the largest skills gaps commonly appear in the content category, but for Geoscientists, this category shows the smallest gap, with larger differences in Resource Management and Technical Skills. In addition, the skills gaps are generally smaller for Geoscientists than they are for other occupations with a high FFC.

Figure 2. Skills Gap-Levels by Element Name



Note: N = 10,965.

3.3. Skill Matches and Gaps in Low-Emissions Energy Sectors

In this section, we analyze the extent to which occupations in low-emissions energy sectors may offer a good-match and similar earnings to occupations with a high FFC. We find a considerable number of occupations where these technologies offer a good-match with comparable pay for fossil fuel workers. One of the main reasons is that many low-emissions energy sectors involve significant construction activities, requiring the operation of heavy equipment (e.g., excavators, earth movers) that are widely used in coal, oil, and natural gas industries. Another factor is our inclusion of emerging industries such as hydrogen and carbon capture, which rely on many of the same engineering, construction, and monitoring practices seen in the oil and gas industry. Table 5 summarizes these results by showing the number of occupations in low-emissions energy sectors that offer a good-match and comparable pay for our 31 high-FFC jobs.

Table 5. Number of occupations in low-emissions energy sectors with low skills gaps and comparable salaries

Occupations with high fossil fuel concentrations	Skills gap ≤0.017	... And salaries ≥90%
Electrical and Electronics Repairers, Commercial and Industrial Equipment	74	19
Industrial Machinery Mechanics	55	16
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	54	1
Plant and System Operators, All Other	53	18
Service Unit Operators, Oil and Gas	50	18
Petroleum Pump System Operators, Refinery Operators, and Gaugers	49	1
Calibration Technologists and Technicians	46	7
Power Plant Operators	45	0
Rotary Drill Operators, Oil and Gas	44	9
Derrick Operators, Oil and Gas	38	10
Mining and Geological Engineers, Including Mining Safety Engineers	38	13
Pump Operators, Except Wellhead Pumpers	36	10
Excavating and Loading Machine and Dragline Operators, Surface Mining	35	21
Chemical Engineers	32	7
Earth Drillers, Except Oil and Gas	31	7
Extraction Workers, All Other	29	17
Control and Valve Installers and Repairers, Except Mechanical Door	29	4
Conveyor Operators and Tenders	28	28
Petroleum Engineers	22	0
Power Distributors and Dispatchers	21	0
Continuous Mining Machine Operators	20	4
Mixing and Blending Machine Setters, Operators, and Tenders	20	13

Geological Technicians, Except Hydrologic Technicians	18	5
Underground Mining Machine Operators, All Other	17	2
Tank Car, Truck, and Ship Loaders	17	1
Helpers—Extraction Workers	16	10
Riggers	14	3
Loading and Moving Machine Operators, Underground Mining	8	0
Geoscientists, Except Hydrologists and Geographers	8	0
Wellhead Pumpers	5	0
Roustabouts, Oil and Gas	4	1

Note: “Number of occupations” includes all those that account for 1 percent or more of the workforce in the sectors identified in Table 2.

As we have noted, the sectors that offer the best matches involve operation of heavy equipment (e.g., mining and construction) or use similar infrastructure to existing fossil fuel industries. For example, critical minerals mining requires the operation of some equipment that is used in coal mining. Carbon capture, utilization, and storage (CCUS) and hydrogen technologies require expertise widely found in the oil and gas sector, such as management of high-pressure fluids and gases, pipeline operations, and more. For construction-related occupations, many opportunities will likely be available, particularly if the nation accelerates its deployment of low-emissions energy technologies and associated infrastructure. However, workers in these fields may need to be highly mobile, moving from project to project, which may differ from what workers are used to in more fixed-location occupations such as coal mining or power plant operations. Table 6 summarizes which low-emissions technologies offer the largest number of good-match occupations for workers in the coal, oil, and natural gas industries.

Notably, the low-emissions technologies that have grown fastest in recent years offer relatively few good-match opportunities. Wind and solar, in particular, have a relatively small number of occupations that require similar skills and provide comparable wages.

Geothermal generation, perhaps surprisingly, offers the lowest number of matches in our dataset. This result reflects several limitations in the data. First, our data do not include geothermal exploration and technology development, which is a broader category than geothermal generation. This broader category, for which relevant occupational data are not available, involves characterizing the subsurface, drilling wells, and constructing infrastructure to generate power, all of which would likely offer good-matches for oil and gas industry workers. Second, our geothermal jobs data do not capture enhanced geothermal technologies that are starting to be deployed today and use many of the same technologies as the modern oil and gas industry (Ravikumar and Latimer 2022).

Table 6. Number of occupations in low-emissions energy sectors with low skills gap for at least one fossil fuel–intensive occupation

Energy sector	Related occupations	... And skills gap ≤ 0.017	... And wages $\geq 90\%$
Critical minerals	45	38	26
Heavy/civil engineering	19	17	12
Carbon capture, utilization, and storage	17	14	11
Utilities construction	18	14	11
Hydroelectric generation	20	16	11
Hydrogen manufacturing	23	17	11
Methane monitoring	30	16	11
Hydrogen distribution	19	15	10
Solar panel manufacturing	19	14	10
Wind turbine manufacturing	20	17	10
Biomass with carbon removal and storage	13	12	8
Solar generation	20	14	7
Biomass generation	12	8	6
Nuclear generation	17	9	6
Wind turbine installation/maintenance	13	9	6
Heat pump installation/maintenance	16	13	5
Solar panel installation/maintenance	14	11	5
Wind generation	13	8	5
Geothermal generation	3	2	2

Sources: Author calculations using earnings statistics from Bureau of Labor Statistics (2023) for May 2023 and skills data from Occupational Information Network.

3.4. Training the Low-Carbon Energy Workforce

Along with concerns over the fossil fuel workforce, an additional important question is whether current educational programs are producing workers who will have the skills to take advantage of employment opportunities in low-emissions energy sectors. Recent analysis from online employment data indicates that the supply of workers qualified to work in low-emissions energy sectors has not kept up with global demand growth (LinkedIn 2024). Anecdotal evidence also suggests that demand for certain low-emissions technologies, such as heat pumps for residential heating and cooling, may be outstripping the available supply of installers (Canny 2023; Simon 2024). Looking forward, demand for workers in a wide range of low-emissions technologies is projected to grow rapidly under deep decarbonization scenarios, reaching 4 to 8 million workers (2.5 to 5 percent of the total workforce) in the United States by the 2040s according to one analysis (Mayfield et al. 2023).

To determine whether existing educational programs are providing students with the skills necessary to take advantage of these opportunities, we examine the number of students receiving postsecondary certificates and degrees in programs closely related to each of the low-emissions technologies described in Section 2.1. (We describe the limitations of this analysis in Section 3.5.)

We find that in 2023, by far the largest number of students were graduating from community college and vocational programs (typically offering certificates or associate's degrees) in construction and heat pumps. For construction, programs often teach skills that can be applied in various types of utilities construction and heavy/civil engineering but are not necessarily specialized in low-emissions technologies. The large number of degrees related to heat pumps is driven by programs that train HVAC and refrigeration maintenance and engineering technicians.

Most students focused on emerging technologies such as CCUS, hydrogen, and critical minerals, as well as nuclear energy, are graduating with bachelor's or more advanced degrees. This result highlights the fact that most of these technologies are not widely deployed,¹⁵ so a relatively small number of jobs are available in construction, operations, or maintenance of the relevant infrastructure. For wind and solar, mature technologies that are now widely deployed, the opposite is true: most degrees come from community college and vocational programs that are training students to work in the field. Training provided by non-degree-granting institutions such as vocational schools is especially important for Composite Materials Technology/Technician programs (related to wind), Concrete Finishing programs (construction), Mining Technology/Technician programs (critical minerals), and HVAC Technology/Technician programs (heat pumps). Table 7 summarizes our results by energy technology and award level, with additional detail provided in Appendix Table A.4.

15 These sectors and their associated occupations may grow in the future. The job growth projections we rely on in this analysis do not provide detail on future energy pathways, nor do they provide data by industry, limiting our ability to interrogate this question here.

Table 7. Number of postsecondary degrees awarded in 2023 related to each low-emissions technology

Energy sector (aggregated)	Total completions	Community college/vocational*	Bachelor	Graduate
Construction	41,200	36,356	3,889	955
Heat pumps	30,143	30,135	8	—
Nuclear	1,260	203	619	438
CCUS	967	50	560	357
Hydrogen	941	15	627	299
Biomass	386	76	236	74
Critical minerals	314	19	177	118
Hydroelectric	290	—	165	125
Wind	264	264	—	—
Solar	240	233	—	7
Methane monitoring	35	—	25	10

Source: Certificate and degree completions from National Center for Education Statistics Integrated Postsecondary Education Data System.

*Includes completions for certificates, associate’s degrees, and where the award level is unknown.

To what extent are students graduating in the regions where these technologies are likely to be deployed at scale? We find substantial variation across the United States, but some results indicate that there is substantial alignment between where students are graduating and where technologies are being deployed. For example, we find the largest numbers of students completing postsecondary programs related to wind energy in California and Kansas, two states with substantial wind potential and generation. Similarly, the largest number of solar certificates and degrees are going to graduates in Texas and Georgia, two of the United States’ leading solar energy producers. In North Carolina, home to some of the nation’s largest biomass production facilities, more students are receiving biomass-related degrees than any other state.

For hydrogen, there is no standardized CIP program category. Instead, the closest analogue in our data is petroleum engineering programs. Unsurprisingly, the largest number of petroleum engineering degrees were awarded in Texas, where numerous companies are also pursuing hydrogen and where the US Department of Energy

(DOE) is supporting a hydrogen “hub” to be developed along the Texas-Louisiana gulf coast. Many hydrogen degrees are also being awarded in Pennsylvania, the nation’s second-largest natural gas-producing state and a participant in another DOE-supported hydrogen hub. Relatedly, Pennsylvania and Texas are also home to the largest number of graduates specializing in CCUS technologies. These results do not necessarily indicate that the hydrogen or CCUS workforces are being trained in Texas and Pennsylvania (although it does not preclude that possibility). Instead, it reflects the limitations in our data—that the closest proxies we have for degrees related to hydrogen and CCUS are concentrated in existing oil and gas educational programs.

For other technologies, it is more difficult to see clear patterns. For example, the largest number of degrees related to hydropower in 2023 were awarded in Florida and Texas, neither of which produces large amounts of electricity from hydropower. (This program is grouped together with ocean engineering degrees, which align more closely with those states’ substantial maritime economies.) Similarly, completions in degrees related to critical minerals do not appear to be correlated with the states where substantial resources of lithium and other metals have generated significant interest (e.g., Arkansas and Nevada).

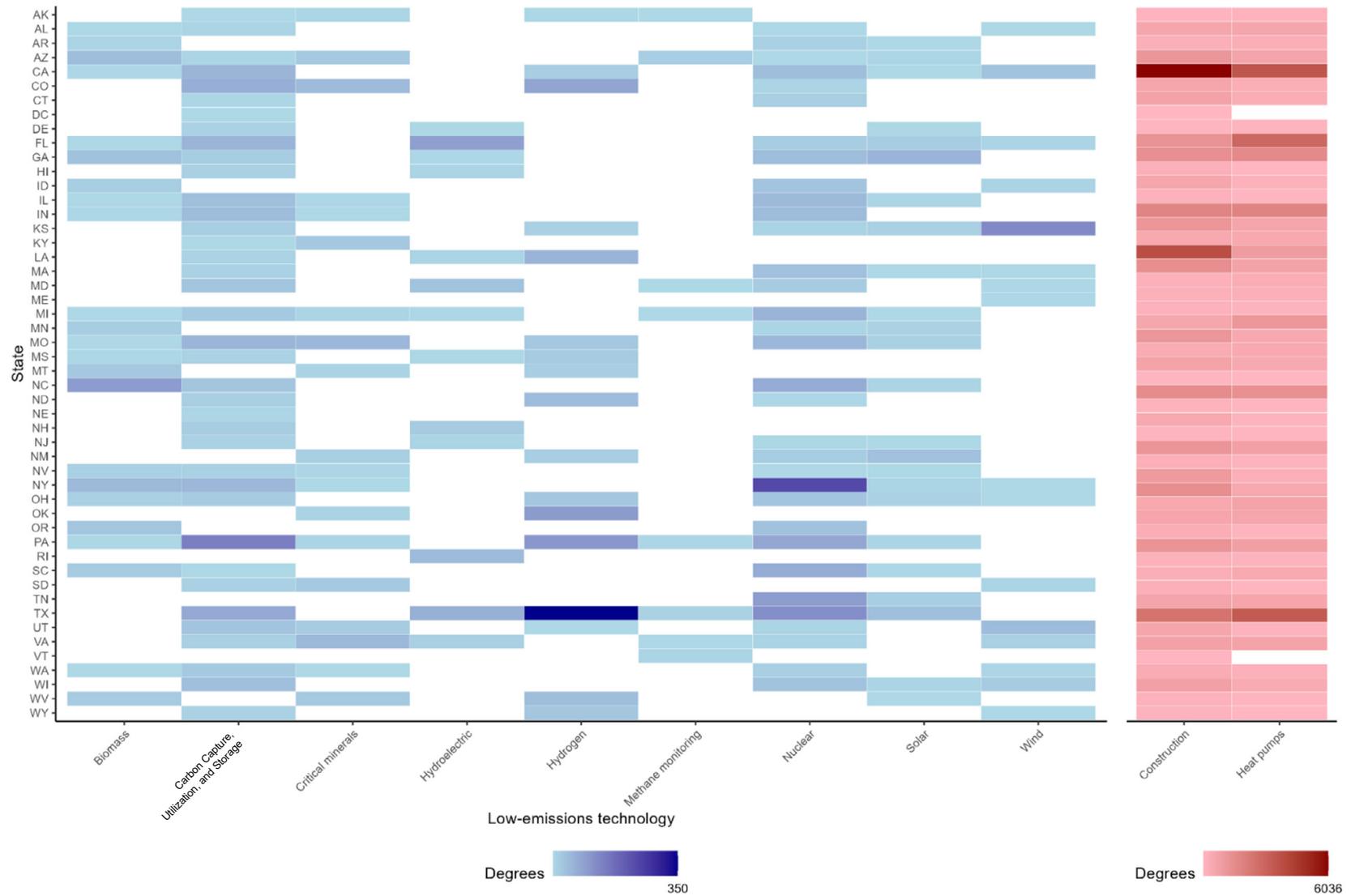
In the construction and heat pump industries, degrees are largely correlated with population. For example, Texas, California, and Florida, the three most populous US states, are among the top states for these graduates. Interestingly, a large number of construction graduates are in Louisiana, a relatively low-population state with a high degree of dependence on the oil and gas industry.

Figure 3 illustrates these state-level results using a heat map, with darker shades indicating states with a higher number of completions for a given technology or industry. The figure uses different scales for construction and heat pumps (in red) because these two sectors are at least an order of magnitude larger than the low-emissions energy sectors we examine (in blue).

3.5. Limitations

Our analysis has important limitations that can serve as the basis for additional inquiry. First, our data source on occupational skill requirements, O*NET, may not perfectly capture the skills needed for every occupation across the economy. One reason is that O*NET data are collected through surveys, which in some cases result in small sample sizes for certain occupations. When this is the case, any omissions or inaccuracies from survey respondents will distort the data, making these data less reliable than in cases where large numbers of surveys are administered.

Figure 3. Postsecondary degrees awarded in 2023 related to each low-emissions technology by state



Second, the skills data that we focus on are just one metric that measures whether an individual is well suited for an occupation. As stated on the O*NET website, “Every occupation requires a different mix of knowledge, skills, and abilities, and is performed using a variety of activities and tasks” (O*NET 2024). Each of these elements—knowledge, skills, abilities, activities, and tasks—is quantified in O*NET data. Future work can examine additional attributes of occupational characteristics to assess whether, and to what extent, they are similar to our results for skills. Future work could also empirically evaluate whether the metrics we have developed to identify good-match jobs accurately represent the types of occupational transitions that workers make in the real world.

In addition, certain aspects of what makes an individual well suited for a specific occupation are not quantified in O*NET data and may be impossible to quantify. For example, many fossil fuel occupations involve long work shifts under challenging conditions (e.g., 14 straight days of 12-hour shifts performing manual labor, sometimes in extreme heat or cold). Although the construction industry, where we find a substantial number of good-match jobs, may have similar work schedules, they can differ in many other occupations. Relatedly, the O*NET data do not capture behavioral and cultural dynamics, such as the willingness of workers to travel frequently or the fact that some sectors (e.g., coal mining) include generations of workers with a deep connection to their place of work.

Another limitation is the lack of information about the occupations required for deployment of some of the low-emissions technologies we examine. Although we use data from industries that serve as reasonable proxies for these technologies, differences may remain. In addition, our comparison of salaries by occupation looks only at median annual salary, which may mask important differences in the range of earnings for an occupation.

Finally, our data on postsecondary program completions also have limitations. In particular, our identification of postsecondary programs that align with low-emissions technologies may be limited because it relies on our manual search of titles and descriptions of these programs, which has the potential for errors or omissions.

In addition, we must make judgments about which training programs are most relevant for specific technologies. For example (as discussed in Section 3.4), we include programs that are not targeted at low-emissions technology but do provide relevant training, such as petroleum engineering degrees for hydrogen. We do this because certain emerging technologies do not have a clearly defined set of educational programs, requiring us to make judgments about what program content is most relevant for a specific technology. On the other hand, we exclude some general educational programs (e.g., chemical engineering) that provide training relevant for fossil fuels and low-emissions technologies.

Finally, we focus solely on postsecondary education. Many jobs related to low-emissions technologies require training beyond high school (Scott et al. 2024; JEC 2023). Our data from IPEDS capture this training by measuring completions of programs provided by community colleges and universities, as well as non-degree-

granting institutions. However, we do not include other training pathways, such as apprenticeships and on-the-job training. Future analysis can seek to incorporate these data sources to provide a broader understanding of the state of training the low-emissions energy workforce.

4. Conclusions

As the world pursues a transition to a low-emissions future, the size and composition of the energy workforce will change. New opportunities will arise in low-emissions sectors, while occupations in carbon-intensive sectors will decline. This analysis begins to assess which opportunities are likely to be most promising for workers in the coal, oil, and natural gas sector, as well as which training programs may need to be scaled up to provide the workforce necessary to build the energy system of the future.

We find that although there are large numbers of occupations that provide a good-match for the skills used in fossil fuel jobs, most of those occupations pay far less than jobs in coal, oil, and gas. This is particularly true for workers at the higher end of the income spectrum, who are often in highly specialized occupations such as petroleum engineering.

For fossil fuel workers in lower-paid occupations, the jobs that offer good skills matches and comparable pay are most often found in transportation, construction, and rail industries. Low-emissions energy technologies also offer promising opportunities, particularly in critical minerals, hydrogen, and CCUS, along with construction occupations essential to build energy infrastructure.

Existing education programs are producing large numbers of graduates who are well suited to build this infrastructure, along with individuals who can install and maintain heat pump systems. They are producing a smaller number of graduates in other low-emissions sectors, with the types and locations of degrees varying considerably.

Looking forward, substantial effort will be necessary to help individual fossil fuel workers identify which good-match occupations appeal to them, then support them in pursuing their desired career path. (This may include providing training in advance of a plant closure or other event that results in a loss of employment.) At the same time, existing education programs will likely need to expand to train the workforce required to build a low-emissions energy economy. This analysis begins to chart the course for both of these activities by providing foundational information that can guide policymakers, workforce development practitioners, labor unions, and others as they seek to ensure an equitable energy transition.

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Appendix

A.1. Benchmark Occupations Employment

Table A.1 lists all of the benchmark occupations with a fossil fuel concentration above 5 percent. It provides basic statistics on which fossil fuel industries those occupations are concentrated, along with the total level of employment.

Table A.1. Benchmark occupations employment by fossil fuel Industry

Standard Occupational Classification	Standard Occupational Classification title	Oil and gas extraction	Mining support activities	Pipelines	Coal mining	Natural gas distribution	Refining	Fossil fuel electric power generation	Total fossil fuel emp.	Total emp.	Fossil fuel concentration (%)
53-7073	Wellhead Pumpers	11,670	5,810	—	—	160	—	—	17,640	18,230	96.8
47-5011	Derrick Operators, Oil and Gas	1,040	9,960	—	—	—	—	—	11,000	11,510	95.6
47-5013	Service Unit Operators, Oil and Gas	8,760	33,770	230	—	130	—	—	42,890	46,150	92.9
47-5012	Rotary Drill Operators, Oil and Gas	2,110	9,170	—	—	—	—	—	11,280	12,180	92.6
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	2,190	1,090	9,020	—	130	17,310	90	29,830	33,360	89.4
47-5071	Roustabouts, Oil and Gas	4,620	33,240	—	—	—	—	—	37,860	43,830	86.4

Standard Occupational Classification	Standard Occupational Classification title	Oil and gas extraction	Mining support activities	Pipelines	Coal mining	Natural gas distribution	Refining	Fossil fuel electric power generation	Total fossil fuel emp.	Total emp.	Fossil fuel concentration (%)
17-2171	Petroleum Engineers	5,720	4,220	1,370	—	390	1,260	—	12,960	20,390	63.6
47-5044	Loading and Moving Machine Operators, Underground Mining	—	210	—	2,770	—	—	—	2,980	5,160	57.8
47-5081	Helpers—Extraction Workers	240	3,320	—	460	—	—	—	4,020	7,360	54.6
53-7072	Pump Operators, Except Wellhead Pumps	460	1,990	2,130	150	—	80	—	4,810	11,570	41.6
51-8013	Power Plant Operators	—	—	—	—	530	—	12,350	12,880	31,490	40.9
47-5099	Extraction Workers, All Other	330	1,750	—	810	—	—	—	2,890	7,120	40.6
49-9012	Control and Valve Installers and Repairers, Except Mechanical Door	1,070	950	840	—	12,990	30	1,810	17,690	47,780	37.0
47-5049	Underground Mining Machine Operators, All Other	—	90	—	590	—	—	—	680	2,560	26.6
47-5041	Continuous Mining Machine Operators	—	960	—	2,970	—	—	—	3,930	15,700	25.0
19-4043	Geological Technicians, Except Hydrologic Technicians	610	880	50	—	50	320	—	1,910	8,860	21.6

Standard Occupational Classification	Standard Occupational Classification title	Oil and gas extraction	Mining support activities	Pipelines	Coal mining	Natural gas distribution	Refining	Fossil fuel electric power generation	Total fossil fuel emp.	Total emp.	Fossil fuel concentration (%)
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers	140	380	—	630	—	—	—	1,150	7,040	16.3
51-8012	Power Distributors and Dispatchers	—	—	—	—	590	—	840	1,430	9,040	15.8
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	—	—	70	—	410	—	3,330	3,810	24,790	15.4
47-5022	Excavating and Loading Machine and Dragline Operators, Surface Mining	—	960	—	3,190	—	50	—	4,200	32,630	12.9
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	2,190	1,090	9,020	—	130	17,310	90	29,830	33,360	89.4
47-5071	Roustabouts, Oil and Gas	4,620	33,240	—	—	—	—	—	37,860	43,830	86.4
19-2042	Geoscientists, Except Hydrologists and Geographers	1,910	1,130	—	—	30	—	—	3,070	24,620	12.5
51-8099	Plant and System Operators, All Other	80	—	—	50	—	1,600	100	1,830	15,370	11.9
47-5023	Earth Drillers, Except Oil and Gas	—	1,970	—	160	—	—	—	2,130	18,010	11.8
17-3028	Calibration Technologists and Technicians	130	400	360	—	40	110	—	1,040	13,220	7.9

Standard Occupational Classification	Standard Occupational Classification title	Oil and gas extraction	Mining support activities	Pipelines	Coal mining	Natural gas distribution	Refining	Fossil fuel electric power generation	Total fossil fuel emp.	Total emp.	Fossil fuel concentration (%)
49-9096	Riggers	110	1,670	—	—	—	40	40	1,860	23,870	7.8
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	1,010	1,020	580	—	360	850	420	4,240	58,320	7.3
17-2041	Chemical Engineers	70	—	—	—	—	1,250	50	1,370	21,140	6.5
49-9041	Industrial Machinery Mechanics	2,510	9,780	3,730	1,440	1,960	3,780	2,460	25,660	412,650	6.2
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	2,190	1,090	9,020	—	130	17,310	90	29,830	33,360	89.4
47-5071	Roustabouts, Oil and Gas	4,620	33,240	—	—	—	—	—	37,860	43,830	86.4
19-2042	Geoscientists, Except Hydrologists and Geographers	1,910	1,130	—	—	30	—	—	3,070	24,620	12.5
51-8099	Plant and System Operators, All Other	80	—	—	50	—	1,600	100	1,830	15,370	11.9
47-5023	Earth Drillers, Except Oil and Gas	—	1,970	—	160	—	—	—	2,130	18,010	11.8
53-7121	Tank Car, Truck, and Ship Loaders	—	70	120	40	—	290	150	670	11,400	5.9
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders	—	1,280	—	—	—	4,820	—	6,100	105,740	5.8
53-7011	Conveyor Operators and Tenders	—	—	—	1,050	—	100	150	1,300	24,660	5.3

A.2. O*NET Skills

Table A.2 lists the 35 skills included in our analysis, along with brief descriptions of those skills.

Table A.2. Descriptions of skills from O*NET

2.A. Basic Skills: Developed capacities that facilitate learning or the more rapid acquisition of knowledge		
2.A.1. Content: Background structures needed to work with and acquire more specific skills in a variety of different domains		
2.A.1.a	Reading Comprehension	Understanding written sentences and paragraphs in work-related documents
2.A.1.b	Active Listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times
2.A.1.c	Writing	Communicating effectively in writing as appropriate for the needs of the audience
2.A.1.d	Speaking	Talking to others to convey information effectively
2.A.1.e	Mathematics	Using mathematics to solve problems
2.A.1.f	Science	Using scientific rules and methods to solve problems
2.A.2. Process: Procedures that contribute to the more rapid acquisition of knowledge and skill across a variety of domains		
2.A.2.a	Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems
2.A.2.b	Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making
2.A.2.c	Learning Strategies	Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things
2.A.2.d	Monitoring	Monitoring/assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action

2.B. Cross-Functional Skills: Developed capacities that facilitate performance of activities that occur across jobs

2.B.1. Social Skills: Developed capacities used to work with people to achieve goals

2.B.1.a Social Perceptiveness Being aware of others' reactions and understanding why they react as they do

2.B.1.b Coordination Adjusting actions in relation to others' actions

2.B.1.c Persuasion Persuading others to change their minds or behavior

2.B.1.d Negotiation Bringing others together and trying to reconcile differences

2.B.1.e Instructing Teaching others how to do something

2.B.1.f Service Orientation Actively looking for ways to help people

2.B.2. Complex Problem-Solving Skills: Developed capacities used to solve novel, ill-defined problems in complex, real-world settings

2.B.2.i Complex Problem-Solving Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions

2.B.3. Technical Skills: Developed capacities used to design, set-up, operate, and correct malfunctions involving application of machines or technological systems

2.B.3.a Operations Analysis Analyzing needs and product requirements to create a design

2.B.3.b Technology Design Generating or adapting equipment and technology to serve user needs

2.B.3.c Equipment Selection Determining the kind of tools and equipment needed to do a job

2.B.3.d Installation Installing equipment, machines, wiring, or programs to meet specifications

2.B.3.e Programming Writing computer programs for various purposes

2.B.3.g Operations Monitoring Watching gauges, dials, or other indicators to make sure a machine is working properly

2.B.3.h	Operation and Control	Controlling operations of equipment or systems
2.B.3.j	Equipment Maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance is needed
2.B.3.k	Troubleshooting	Determining causes of operating errors and deciding what to do about it
2.B.3.l	Repairing	Repairing machines or systems using the needed tools
2.B.3.m	Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance
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2.B.4. Systems Skills: Developed capacities used to understand, monitor, and improve socio-technical systems		
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2.B.4.e	Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one
2.B.4.g	Systems Analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes
2.B.4.h	Systems Evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system
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2.B.5. Resource Management Skills: Developed capacities used to allocate resources efficiently		
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2.B.5.a	Time Management	Managing one's own time and the time of others
2.B.5.b	Management of Financial Resources	Determining how money will be spent to get the work done, and accounting for these expenditures
2.B.5.c	Management of Material Resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work
2.B.5.d	Management of Personnel Resources	Motivating, developing, and directing people as they work, identifying the best people for the job

Source: O*NET Content Model Reference, https://www.onetcenter.org/dictionary/27.0/excel/content_model_reference.html.

A.3. List of Good-match Occupations for Fossil Fuel Occupations

Table A.3 provides detail on the number of good-match occupations listed in Table 4 for each benchmark occupation. It lists the occupations that, relative to each occupation with a high FFC, have a low skills gap (≤ 0.017), have a median salary of 90 percent or higher relative to the high-FFC job, are projected to grow in demand, and do not themselves have a high FFC (< 0.05).

Table A.3. Good-match occupations with low skills gaps, comparable pay, and growing demand for each occupation with a high fossil fuel concentration (FFC)

Benchmark occupation	Good-match occupations
Calibration Technologists and Technicians	Brickmasons and Blockmasons
Calibration Technologists and Technicians	Fine Artists, Including Painters, Sculptors, and Illustrators
Calibration Technologists and Technicians	Court Reporters and Simultaneous Captioners
Calibration Technologists and Technicians	Transportation Inspectors
Calibration Technologists and Technicians	Film and Video Editors
Calibration Technologists and Technicians	Cartographers and Photogrammetrists
Calibration Technologists and Technicians	Architectural and Civil Drafters
Calibration Technologists and Technicians	Electrical and Electronics Drafters
Calibration Technologists and Technicians	Bus Drivers, Transit and Intercity
Calibration Technologists and Technicians	Civil Engineering Technologists and Technicians
Calibration Technologists and Technicians	Structural Iron and Steel Workers
Calibration Technologists and Technicians	Dental Hygienists
Calibration Technologists and Technicians	Radiologic Technologists and Technicians

Benchmark occupation	Good-match occupations
Calibration Technologists and Technicians	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Calibration Technologists and Technicians	Special Effects Artists and Animators
Calibration Technologists and Technicians	Graphic Designers
Calibration Technologists and Technicians	Telecommunications Line Installers and Repairers
Calibration Technologists and Technicians	Camera Operators, Television, Video, and Film
Calibration Technologists and Technicians	Paralegals and Legal Assistants
Calibration Technologists and Technicians	Cardiovascular Technologists and Technicians
Calibration Technologists and Technicians	Magnetic Resonance Imaging Technologists
Calibration Technologists and Technicians	Surgical Technologists
Calibration Technologists and Technicians	Diagnostic Medical Sonographers
Calibration Technologists and Technicians	Crane and Tower Operators
Calibration Technologists and Technicians	Rail-Track Laying and Maintenance Equipment Operators
Calibration Technologists and Technicians	Surgical Assistants
Calibration Technologists and Technicians	Nuclear Medicine Technologists
Calibration Technologists and Technicians	Occupational Health and Safety Technicians
Calibration Technologists and Technicians	Archivists
Calibration Technologists and Technicians	Flight Attendants
Calibration Technologists and Technicians	Electrical and Electronics Installers and Repairers, Transportation Equipment

Benchmark occupation	Good-match occupations
Calibration Technologists and Technicians	Subway and Streetcar Operators
Calibration Technologists and Technicians	Hearing Aid Specialists
Calibration Technologists and Technicians	Librarians and Media Collections Specialists
Calibration Technologists and Technicians	Transit and Railroad Police
Calibration Technologists and Technicians	Computer User Support Specialists
Calibration Technologists and Technicians	Tax Examiners and Collectors, and Revenue Agents
Calibration Technologists and Technicians	Plumbers, Pipefitters, and Steamfitters
Chemical Engineers	Information Security Analysts
Chemical Engineers	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
Chemical Engineers	Database Administrators
Chemical Engineers	Database Architects
Chemical Engineers	Administrative Services Managers
Chemical Engineers	Software Quality Assurance Analysts and Testers
Chemical Engineers	Art Directors
Chemical Engineers	Economists
Chemical Engineers	Air Traffic Controllers
Chemical Engineers	Prosthodontists
Chemical Engineers	Materials Engineers

Benchmark occupation	Good-match occupations
Chemical Engineers	Electrical Engineers
Chemical Engineers	Orthodontists
Chemical Engineers	Materials Scientists
Chemical Engineers	Computer Hardware Engineers
Chemical Engineers	Economics Teachers, Postsecondary
Chemical Engineers	Veterinarians
Continuous Mining Machine Operators	Pile Driver Operators
Continuous Mining Machine Operators	Bus Drivers, Transit and Intercity
Continuous Mining Machine Operators	Rail-Track Laying and Maintenance Equipment Operators
Continuous Mining Machine Operators	Drywall and Ceiling Tile Installers
Continuous Mining Machine Operators	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Continuous Mining Machine Operators	Operating Engineers and Other Construction Equipment Operators
Continuous Mining Machine Operators	Crane and Tower Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Rail-Track Laying and Maintenance Equipment Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Telecommunications Line Installers and Repairers
Control and Valve Installers and Repairers, Except Mechanical Door	Railroad Brake, Signal, and Switch Operators and Locomotive Firers

Benchmark occupation	Good-match occupations
Control and Valve Installers and Repairers, Except Mechanical Door	Pile Driver Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Crane and Tower Operators
Conveyor Operators and Tenders	Refuse and Recyclable Material Collectors
Conveyor Operators and Tenders	Paperhangers
Conveyor Operators and Tenders	Landscaping and Groundskeeping Workers
Conveyor Operators and Tenders	Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders
Conveyor Operators and Tenders	Helpers—Painters, Paperhangers, Plasterers, and Stucco Masons
Conveyor Operators and Tenders	Laborers and Freight, Stock, and Material Movers, Hand
Conveyor Operators and Tenders	Food Cooking Machine Operators and Tenders
Conveyor Operators and Tenders	Machine Feeders and Offbearers
Conveyor Operators and Tenders	Industrial Truck and Tractor Operators
Conveyor Operators and Tenders	Packaging and Filling Machine Operators and Tenders
Conveyor Operators and Tenders	Light Truck Drivers
Conveyor Operators and Tenders	Insulation Workers, Floor, Ceiling, and Wall
Conveyor Operators and Tenders	Sawing Machine Setters, Operators, and Tenders, Wood
Conveyor Operators and Tenders	Crossing Guards and Flaggers
Conveyor Operators and Tenders	Meat, Poultry, and Fish Cutters and Trimmers

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Orderlies
Conveyor Operators and Tenders	Bus Drivers, Transit and Intercity
Conveyor Operators and Tenders	Painters, Construction and Maintenance
Conveyor Operators and Tenders	Couriers and Messengers
Conveyor Operators and Tenders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Conveyor Operators and Tenders	Reinforcing Iron and Rebar Workers
Conveyor Operators and Tenders	Pesticide Handlers, Sprayers, and Applicators, Vegetation
Conveyor Operators and Tenders	Floor Layers, Except Carpet, Wood, and Hard Tiles
Conveyor Operators and Tenders	Drywall and Ceiling Tile Installers
Conveyor Operators and Tenders	Stockers and Order Fillers
Conveyor Operators and Tenders	Food Batchmakers
Conveyor Operators and Tenders	Welders, Cutters, Solderers, and Brazers
Conveyor Operators and Tenders	Insulation Workers, Mechanical
Conveyor Operators and Tenders	Highway Maintenance Workers
Conveyor Operators and Tenders	Construction Laborers
Conveyor Operators and Tenders	Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders
Conveyor Operators and Tenders	Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters
Conveyor Operators and Tenders	Plasterers and Stucco Masons

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Tree Trimmers and Pruners
Conveyor Operators and Tenders	Agricultural Equipment Operators
Conveyor Operators and Tenders	Barbers
Conveyor Operators and Tenders	Heavy and Tractor-Trailer Truck Drivers
Conveyor Operators and Tenders	Tire Repairers and Changers
Conveyor Operators and Tenders	Glaziers
Conveyor Operators and Tenders	Pile Driver Operators
Conveyor Operators and Tenders	Crane and Tower Operators
Conveyor Operators and Tenders	Dredge Operators
Conveyor Operators and Tenders	Molders, Shapers, and Casters, Except Metal and Plastic
Conveyor Operators and Tenders	Roofers
Conveyor Operators and Tenders	Paving, Surfacing, and Tamping Equipment Operators
Conveyor Operators and Tenders	Tile and Stone Setters
Conveyor Operators and Tenders	Semiconductor Processing Technicians
Conveyor Operators and Tenders	Helpers—Roofers
Conveyor Operators and Tenders	Ophthalmic Laboratory Technicians
Conveyor Operators and Tenders	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Conveyor Operators and Tenders	Operating Engineers and Other Construction Equipment Operators

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Rail-Track Laying and Maintenance Equipment Operators
Conveyor Operators and Tenders	Brickmasons and Blockmasons
Derrick Operators, Oil and Gas	Pile Driver Operators
Derrick Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Derrick Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Derrick Operators, Oil and Gas	Reinforcing Iron and Rebar Workers
Derrick Operators, Oil and Gas	Crane and Tower Operators
Derrick Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Derrick Operators, Oil and Gas	Heavy and Tractor-Trailer Truck Drivers
Derrick Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Derrick Operators, Oil and Gas	Insulation Workers, Mechanical
Derrick Operators, Oil and Gas	Plasterers and Stucco Masons
Derrick Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Derrick Operators, Oil and Gas	Brickmasons and Blockmasons
Derrick Operators, Oil and Gas	Structural Iron and Steel Workers
Earth Drillers, Except Oil and Gas	Pile Driver Operators
Earth Drillers, Except Oil and Gas	Plasterers and Stucco Masons
Earth Drillers, Except Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators

Benchmark occupation	Good-match occupations
Earth Drillers, Except Oil and Gas	Reinforcing Iron and Rebar Workers
Earth Drillers, Except Oil and Gas	Drywall and Ceiling Tile Installers
Earth Drillers, Except Oil and Gas	Bus Drivers, Transit and Intercity
Earth Drillers, Except Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Earth Drillers, Except Oil and Gas	Crane and Tower Operators
Earth Drillers, Except Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Earth Drillers, Except Oil and Gas	Insulation Workers, Mechanical
Earth Drillers, Except Oil and Gas	Glaziers
Earth Drillers, Except Oil and Gas	Heavy and Tractor-Trailer Truck Drivers
Earth Drillers, Except Oil and Gas	Brickmasons and Blockmasons
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Telecommunications Line Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Bus Drivers, Transit and Intercity
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Crane and Tower Operators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Electrical and Electronics Installers and Repairers, Transportation Equipment
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Rail-Track Laying and Maintenance Equipment Operators

Benchmark occupation**Good-match occupations**

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Rail Car Repairers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Plumbers, Pipefitters, and Steamfitters

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Signal and Track Switch Repairers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Stationary Engineers and Boiler Operators

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Structural Iron and Steel Workers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Subway and Streetcar Operators

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Electrical Power-Line Installers and Repairers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Pile Driver Operators

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Medical Equipment Repairers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Wind Turbine Service Technicians

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Telecommunications Equipment Installers and Repairers, Except Line Installers

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Dental Hygienists

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Film and Video Editors

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Court Reporters and Simultaneous Captioners
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Elevator and Escalator Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Camera Operators, Television, Video, and Film
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Mobile Heavy Equipment Mechanics, Except Engines
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Commercial Divers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Radiologic Technologists and Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Radio, Cellular, and Tower Equipment Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Avionics Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Transportation Inspectors
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Millwrights
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Locomotive Engineers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Cartographers and Photogrammetrists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Ship Engineers

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Surgical Technologists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Electrical and Electronics Drafters
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Magnetic Resonance Imaging Technologists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Aerospace Engineering and Operations Technologists and Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Special Effects Artists and Animators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Aircraft Mechanics and Service Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Architectural and Civil Drafters
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Diagnostic Medical Sonographers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Computer Network Support Specialists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Flight Attendants
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	Transportation Inspectors
Excavating and Loading Machine and Dragline Operators, Surface Mining	Refuse and Recyclable Material Collectors
Excavating and Loading Machine and Dragline Operators, Surface Mining	Paperhangers

Benchmark occupation	Good-match occupations
Excavating and Loading Machine and Dragline Operators, Surface Mining	Insulation Workers, Floor, Ceiling, and Wall
Excavating and Loading Machine and Dragline Operators, Surface Mining	Reinforcing Iron and Rebar Workers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Paving, Surfacing, and Tamping Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Drywall and Ceiling Tile Installers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Crane and Tower Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Floor Layers, Except Carpet, Wood, and Hard Tiles
Excavating and Loading Machine and Dragline Operators, Surface Mining	Bus Drivers, Transit and Intercity
Excavating and Loading Machine and Dragline Operators, Surface Mining	Highway Maintenance Workers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Rail-Track Laying and Maintenance Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Painters, Construction and Maintenance
Excavating and Loading Machine and Dragline Operators, Surface Mining	Insulation Workers, Mechanical
Excavating and Loading Machine and Dragline Operators, Surface Mining	Construction Laborers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Welders, Cutters, Solderers, and Brazers

Benchmark occupation	Good-match occupations
Excavating and Loading Machine and Dragline Operators, Surface Mining	Pile Driver Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Glaziers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Plasterers and Stucco Masons
Excavating and Loading Machine and Dragline Operators, Surface Mining	Heavy and Tractor-Trailer Truck Drivers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Operating Engineers and Other Construction Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Excavating and Loading Machine and Dragline Operators, Surface Mining	Roofers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Dredge Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Tree Trimmers and Pruners
Excavating and Loading Machine and Dragline Operators, Surface Mining	Septic Tank Servicers and Sewer Pipe Cleaners
Excavating and Loading Machine and Dragline Operators, Surface Mining	Tile and Stone Setters
Excavating and Loading Machine and Dragline Operators, Surface Mining	Brickmasons and Blockmasons

Benchmark occupation	Good-match occupations
Excavating and Loading Machine and Dragline Operators, Surface Mining	Semiconductor Processing Technicians
Excavating and Loading Machine and Dragline Operators, Surface Mining	Costume Attendants
Excavating and Loading Machine and Dragline Operators, Surface Mining	Automotive Body and Related Repairers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Structural Iron and Steel Workers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Automotive Glass Installers and Repairers
Extraction Workers, All Other	Paperhangers
Extraction Workers, All Other	Refuse and Recyclable Material Collectors
Extraction Workers, All Other	Paving, Surfacing, and Tamping Equipment Operators
Extraction Workers, All Other	Insulation Workers, Floor, Ceiling, and Wall
Extraction Workers, All Other	Painters, Construction and Maintenance
Extraction Workers, All Other	Bus Drivers, Transit and Intercity
Extraction Workers, All Other	Reinforcing Iron and Rebar Workers
Extraction Workers, All Other	Drywall and Ceiling Tile Installers
Extraction Workers, All Other	Construction Laborers
Extraction Workers, All Other	Welders, Cutters, Solderers, and Brazers
Extraction Workers, All Other	Rail-Track Laying and Maintenance Equipment Operators
Extraction Workers, All Other	Highway Maintenance Workers

Benchmark occupation	Good-match occupations
Extraction Workers, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Extraction Workers, All Other	Insulation Workers, Mechanical
Extraction Workers, All Other	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Extraction Workers, All Other	Floor Layers, Except Carpet, Wood, and Hard Tiles
Extraction Workers, All Other	Plasterers and Stucco Masons
Extraction Workers, All Other	Pile Driver Operators
Extraction Workers, All Other	Dredge Operators
Extraction Workers, All Other	Crane and Tower Operators
Extraction Workers, All Other	Tree Trimmers and Pruners
Extraction Workers, All Other	Roofers
Extraction Workers, All Other	Glaziers
Extraction Workers, All Other	Heavy and Tractor-Trailer Truck Drivers
Extraction Workers, All Other	Operating Engineers and Other Construction Equipment Operators
Extraction Workers, All Other	Brickmasons and Blockmasons
Geological Technicians, Except Hydrologic Technicians	Painters, Construction, and Maintenance
Geological Technicians, Except Hydrologic Technicians	Paperhangers
Geological Technicians, Except Hydrologic Technicians	Reinforcing Iron and Rebar Workers
Geological Technicians, Except Hydrologic Technicians	Animal Breeders

Benchmark occupation	Good-match occupations
Geological Technicians, Except Hydrologic Technicians	Floor Layers, Except Carpet, Wood, and Hard Tiles
Geological Technicians, Except Hydrologic Technicians	Plasterers and Stucco Masons
Geological Technicians, Except Hydrologic Technicians	Insulation Workers, Mechanical
Geological Technicians, Except Hydrologic Technicians	Drywall and Ceiling Tile Installers
Geological Technicians, Except Hydrologic Technicians	Welders, Cutters, Solderers, and Brazers
Geological Technicians, Except Hydrologic Technicians	Insulation Workers, Floor, Ceiling, and Wall
Geological Technicians, Except Hydrologic Technicians	Bus Drivers, Transit, and Intercity
Geological Technicians, Except Hydrologic Technicians	Glaziers
Geological Technicians, Except Hydrologic Technicians	Court Reporters and Simultaneous Captioners
Geological Technicians, Except Hydrologic Technicians	Costume Attendants
Geological Technicians, Except Hydrologic Technicians	Tile and Stone Setters
Geological Technicians, Except Hydrologic Technicians	Roofers
Geological Technicians, Except Hydrologic Technicians	Fine Artists, Including Painters, Sculptors, and Illustrators
Geological Technicians, Except Hydrologic Technicians	Brickmasons and Blockmasons
Geological Technicians, Except Hydrologic Technicians	Transportation Inspectors
Geological Technicians, Except Hydrologic Technicians	Food Science Technicians
Geological Technicians, Except Hydrologic Technicians	Surveying and Mapping Technicians
Geological Technicians, Except Hydrologic Technicians	Railroad Brake, Signal, and Switch Operators and Locomotive Firers

Benchmark occupation	Good-match occupations
Geological Technicians, Except Hydrologic Technicians	Structural Iron and Steel Workers
Geological Technicians, Except Hydrologic Technicians	Massage Therapists
Geological Technicians, Except Hydrologic Technicians	Tree Trimmers and Pruners
Geological Technicians, Except Hydrologic Technicians	Highway Maintenance Workers
Geoscientists, Except Hydrologists and Geographers	Special Effects Artists and Animators
Helpers—Extraction Workers	Refuse and Recyclable Material Collectors
Helpers—Extraction Workers	Industrial Truck and Tractor Operators
Helpers—Extraction Workers	Paperhangers
Helpers—Extraction Workers	Paving, Surfacing, and Tamping Equipment Operators
Helpers—Extraction Workers	Reinforcing Iron and Rebar Workers
Helpers—Extraction Workers	Insulation Workers, Floor, Ceiling, and Wall
Helpers—Extraction Workers	Welders, Cutters, Solderers, and Brazers
Helpers—Extraction Workers	Bus Drivers, Transit and Intercity
Helpers—Extraction Workers	Drywall and Ceiling Tile Installers
Helpers—Extraction Workers	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Helpers—Extraction Workers	Construction Laborers
Helpers—Extraction Workers	Painters, Construction and Maintenance
Helpers—Extraction Workers	Rail-Track Laying and Maintenance Equipment Operators

Benchmark occupation	Good-match occupations
Helpers—Extraction Workers	Light Truck Drivers
Helpers—Extraction Workers	Pile Driver Operators
Helpers—Extraction Workers	Plasterers and Stucco Masons
Helpers—Extraction Workers	Dredge Operators
Helpers—Extraction Workers	Insulation Workers, Mechanical
Helpers—Extraction Workers	Highway Maintenance Workers
Helpers—Extraction Workers	Roofers
Industrial Machinery Mechanics	Pile Driver Operators
Industrial Machinery Mechanics	Rail-Track Laying and Maintenance Equipment Operators
Industrial Machinery Mechanics	Drywall and Ceiling Tile Installers
Industrial Machinery Mechanics	Crane and Tower Operators
Industrial Machinery Mechanics	Maintenance Workers, Machinery
Industrial Machinery Mechanics	Rail Car Repairers
Industrial Machinery Mechanics	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Industrial Machinery Mechanics	Signal and Track Switch Repairers
Industrial Machinery Mechanics	Bus Drivers, Transit and Intercity
Industrial Machinery Mechanics	Bus and Truck Mechanics and Diesel Engine Specialists
Industrial Machinery Mechanics	Operating Engineers and Other Construction Equipment Operators

Benchmark occupation	Good-match occupations
Industrial Machinery Mechanics	Plumbers, Pipefitters, and Steamfitters
Industrial Machinery Mechanics	Elevator and Escalator Installers and Repairers
Industrial Machinery Mechanics	Telecommunications Line Installers and Repairers
Industrial Machinery Mechanics	Security and Fire Alarm Systems Installers
Industrial Machinery Mechanics	Brickmasons and Blockmasons
Industrial Machinery Mechanics	Stationary Engineers and Boiler Operators
Industrial Machinery Mechanics	Structural Iron and Steel Workers
Industrial Machinery Mechanics	Subway and Streetcar Operators
Industrial Machinery Mechanics	Wind Turbine Service Technicians
Industrial Machinery Mechanics	Electrical Power-Line Installers and Repairers
Industrial Machinery Mechanics	Locomotive Engineers
Industrial Machinery Mechanics	Electrical and Electronics Installers and Repairers, Transportation Equipment
Loading and Moving Machine Operators, Underground Mining	Bus Drivers, Transit and Intercity
Mining and Geological Engineers, Including Mining Safety Engineers	Special Effects Artists and Animators
Mining and Geological Engineers, Including Mining Safety Engineers	Industrial Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Information Security Analysts
Mining and Geological Engineers, Including Mining Safety Engineers	Environmental Engineers

Benchmark occupation	Good-match occupations
Mining and Geological Engineers, Including Mining Safety Engineers	Economists
Mining and Geological Engineers, Including Mining Safety Engineers	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
Mining and Geological Engineers, Including Mining Safety Engineers	Art Directors
Mining and Geological Engineers, Including Mining Safety Engineers	Air Traffic Controllers
Mining and Geological Engineers, Including Mining Safety Engineers	Administrative Services Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Compensation and Benefits Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Genetic Counselors
Mining and Geological Engineers, Including Mining Safety Engineers	Architects, Except Landscape and Naval
Mining and Geological Engineers, Including Mining Safety Engineers	Orthodontists
Mining and Geological Engineers, Including Mining Safety Engineers	Transportation, Storage, and Distribution Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Database Administrators
Mining and Geological Engineers, Including Mining Safety Engineers	Database Architects
Mining and Geological Engineers, Including Mining Safety Engineers	Detectives and Criminal Investigators

Benchmark occupation	Good-match occupations
Mining and Geological Engineers, Including Mining Safety Engineers	Personal Financial Advisors
Mining and Geological Engineers, Including Mining Safety Engineers	Computer and Information Systems Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Atmospheric and Space Scientists
Mining and Geological Engineers, Including Mining Safety Engineers	Electrical Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Optometrists
Mining and Geological Engineers, Including Mining Safety Engineers	Materials Scientists
Mining and Geological Engineers, Including Mining Safety Engineers	Prosthodontists
Mining and Geological Engineers, Including Mining Safety Engineers	Economics Teachers, Postsecondary
Mining and Geological Engineers, Including Mining Safety Engineers	Software Quality Assurance Analysts and Testers
Mining and Geological Engineers, Including Mining Safety Engineers	Management Analysts
Mining and Geological Engineers, Including Mining Safety Engineers	Architectural and Engineering Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Materials Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Veterinarians

Benchmark occupation	Good-match occupations
Mining and Geological Engineers, Including Mining Safety Engineers	Pharmacists
Mining and Geological Engineers, Including Mining Safety Engineers	General and Operations Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Civil Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Physical Therapists
Mining and Geological Engineers, Including Mining Safety Engineers	Actuaries
Mining and Geological Engineers, Including Mining Safety Engineers	Marine Engineers and Naval Architects
Mixing and Blending Machine Setters, Operators, and Tenders	Refuse and Recyclable Material Collectors
Mixing and Blending Machine Setters, Operators, and Tenders	Paperhangers
Mixing and Blending Machine Setters, Operators, and Tenders	Light Truck Drivers
Mixing and Blending Machine Setters, Operators, and Tenders	Industrial Truck and Tractor Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Paving, Surfacing, and Tamping Equipment Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Bus Drivers, Transit and Intercity
Mixing and Blending Machine Setters, Operators, and Tenders	Welders, Cutters, Solderers, and Brazers
Mixing and Blending Machine Setters, Operators, and Tenders	Reinforcing Iron and Rebar Workers
Mixing and Blending Machine Setters, Operators, and Tenders	Drywall and Ceiling Tile Installers
Mixing and Blending Machine Setters, Operators, and Tenders	Rail-Track Laying and Maintenance Equipment Operators

Benchmark occupation	Good-match occupations
Mixing and Blending Machine Setters, Operators, and Tenders	Painters, Construction and Maintenance
Mixing and Blending Machine Setters, Operators, and Tenders	Insulation Workers, Mechanical
Mixing and Blending Machine Setters, Operators, and Tenders	Insulation Workers, Floor, Ceiling, and Wall
Mixing and Blending Machine Setters, Operators, and Tenders	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Mixing and Blending Machine Setters, Operators, and Tenders	Highway Maintenance Workers
Mixing and Blending Machine Setters, Operators, and Tenders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Mixing and Blending Machine Setters, Operators, and Tenders	Construction Laborers
Mixing and Blending Machine Setters, Operators, and Tenders	Crane and Tower Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Pile Driver Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Molders, Shapers, and Casters, Except Metal and Plastic
Mixing and Blending Machine Setters, Operators, and Tenders	Pesticide Handlers, Sprayers, and Applicators, Vegetation
Mixing and Blending Machine Setters, Operators, and Tenders	Heavy and Tractor-Trailer Truck Drivers
Mixing and Blending Machine Setters, Operators, and Tenders	Glaziers
Mixing and Blending Machine Setters, Operators, and Tenders	Floor Layers, Except Carpet, Wood, and Hard Tiles
Mixing and Blending Machine Setters, Operators, and Tenders	Plasterers and Stucco Masons
Petroleum Engineers	Optometrists
Plant and System Operators, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Plant and System Operators, All Other	Crane and Tower Operators

Benchmark occupation	Good-match occupations
Plant and System Operators, All Other	Heavy and Tractor-Trailer Truck Drivers
Plant and System Operators, All Other	Reinforcing Iron and Rebar Workers
Plant and System Operators, All Other	Bus Drivers, Transit and Intercity
Plant and System Operators, All Other	Pile Driver Operators
Plant and System Operators, All Other	Drywall and Ceiling Tile Installers
Plant and System Operators, All Other	Locomotive Engineers
Plant and System Operators, All Other	Insulation Workers, Mechanical
Plant and System Operators, All Other	Plasterers and Stucco Masons
Plant and System Operators, All Other	Rail-Track Laying and Maintenance Equipment Operators
Plant and System Operators, All Other	Brickmasons and Blockmasons
Plant and System Operators, All Other	Subway and Streetcar Operators
Plant and System Operators, All Other	Operating Engineers and Other Construction Equipment Operators
Plant and System Operators, All Other	Costume Attendants
Plant and System Operators, All Other	Structural Iron and Steel Workers
Plant and System Operators, All Other	Telecommunications Line Installers and Repairers
Plant and System Operators, All Other	Court Reporters and Simultaneous Captioners
Plant and System Operators, All Other	Fine Artists, Including Painters, Sculptors, and Illustrators
Plant and System Operators, All Other	Transportation Inspectors

Benchmark occupation	Good-match occupations
Pump Operators, Except Wellhead Pumpers	Reinforcing Iron and Rebar Workers
Pump Operators, Except Wellhead Pumpers	Bus Drivers, Transit and Intercity
Pump Operators, Except Wellhead Pumpers	Plasterers and Stucco Masons
Pump Operators, Except Wellhead Pumpers	Drywall and Ceiling Tile Installers
Pump Operators, Except Wellhead Pumpers	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Pump Operators, Except Wellhead Pumpers	Crane and Tower Operators
Pump Operators, Except Wellhead Pumpers	Insulation Workers, Mechanical
Pump Operators, Except Wellhead Pumpers	Heavy and Tractor-Trailer Truck Drivers
Pump Operators, Except Wellhead Pumpers	Rail-Track Laying and Maintenance Equipment Operators
Pump Operators, Except Wellhead Pumpers	Dredge Operators
Pump Operators, Except Wellhead Pumpers	Brickmasons and Blockmasons
Pump Operators, Except Wellhead Pumpers	Glaziers
Pump Operators, Except Wellhead Pumpers	Pile Driver Operators
Pump Operators, Except Wellhead Pumpers	Roofers
Pump Operators, Except Wellhead Pumpers	Operating Engineers and Other Construction Equipment Operators
Riggers	Bus Drivers, Transit and Intercity
Riggers	Drywall and Ceiling Tile Installers
Riggers	Reinforcing Iron and Rebar Workers

Benchmark occupation	Good-match occupations
Riggers	Insulation Workers, Mechanical
Riggers	Plasterers and Stucco Masons
Riggers	Glaziers
Rotary Drill Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Rotary Drill Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Rotary Drill Operators, Oil and Gas	Pile Driver Operators
Rotary Drill Operators, Oil and Gas	Crane and Tower Operators
Rotary Drill Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Rotary Drill Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Rotary Drill Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Rotary Drill Operators, Oil and Gas	Structural Iron and Steel Workers
Rotary Drill Operators, Oil and Gas	Subway and Streetcar Operators
Rotary Drill Operators, Oil and Gas	Brickmasons and Blockmasons
Rotary Drill Operators, Oil and Gas	Telecommunications Line Installers and Repairers
Roustabouts, Oil and Gas	Refuse and Recyclable Material Collectors
Roustabouts, Oil and Gas	Industrial Truck and Tractor Operators
Roustabouts, Oil and Gas	Paperhangers
Service Unit Operators, Oil and Gas	Crane and Tower Operators

Benchmark occupation	Good-match occupations
Service Unit Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Service Unit Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Service Unit Operators, Oil and Gas	Insulation Workers, Mechanical
Service Unit Operators, Oil and Gas	Glaziers
Service Unit Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Service Unit Operators, Oil and Gas	Plasterers and Stucco Masons
Service Unit Operators, Oil and Gas	Heavy and Tractor-Trailer Truck Drivers
Service Unit Operators, Oil and Gas	Pile Driver Operators
Service Unit Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Service Unit Operators, Oil and Gas	Reinforcing Iron and Rebar Workers
Service Unit Operators, Oil and Gas	Dredge Operators
Service Unit Operators, Oil and Gas	Telecommunications Line Installers and Repairers
Service Unit Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Service Unit Operators, Oil and Gas	Brickmasons and Blockmasons
Service Unit Operators, Oil and Gas	Machinists
Service Unit Operators, Oil and Gas	Costume Attendants
Service Unit Operators, Oil and Gas	Subway and Streetcar Operators
Service Unit Operators, Oil and Gas	Structural Iron and Steel Workers

Benchmark occupation	Good-match occupations
Service Unit Operators, Oil and Gas	Maintenance Workers, Machinery
Service Unit Operators, Oil and Gas	Plumbers, Pipefitters, and Steamfitters
Service Unit Operators, Oil and Gas	Electrical and Electronics Installers and Repairers, Transportation Equipment
Tank Car, Truck, and Ship Loaders	Bus Drivers, Transit and Intercity
Tank Car, Truck, and Ship Loaders	Reinforcing Iron and Rebar Workers
Tank Car, Truck, and Ship Loaders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Tank Car, Truck, and Ship Loaders	Drywall and Ceiling Tile Installers
Tank Car, Truck, and Ship Loaders	Insulation Workers, Mechanical
Tank Car, Truck, and Ship Loaders	Brickmasons and Blockmasons
Underground Mining Machine Operators, All Other	Pile Driver Operators
Underground Mining Machine Operators, All Other	Rail-Track Laying and Maintenance Equipment Operators
Underground Mining Machine Operators, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Calibration Technologists and Technicians	Brickmasons and Blockmasons
Calibration Technologists and Technicians	Fine Artists, Including Painters, Sculptors, and Illustrators
Calibration Technologists and Technicians	Court Reporters and Simultaneous Captioners
Calibration Technologists and Technicians	Transportation Inspectors
Calibration Technologists and Technicians	Film and Video Editors
Calibration Technologists and Technicians	Cartographers and Photogrammetrists

Benchmark occupation	Good-match occupations
Calibration Technologists and Technicians	Architectural and Civil Drafters
Calibration Technologists and Technicians	Electrical and Electronics Drafters
Calibration Technologists and Technicians	Bus Drivers, Transit and Intercity
Calibration Technologists and Technicians	Civil Engineering Technologists and Technicians
Calibration Technologists and Technicians	Structural Iron and Steel Workers
Calibration Technologists and Technicians	Dental Hygienists
Calibration Technologists and Technicians	Radiologic Technologists and Technicians
Calibration Technologists and Technicians	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Calibration Technologists and Technicians	Special Effects Artists and Animators
Calibration Technologists and Technicians	Graphic Designers
Calibration Technologists and Technicians	Telecommunications Line Installers and Repairers
Calibration Technologists and Technicians	Camera Operators, Television, Video, and Film
Calibration Technologists and Technicians	Paralegals and Legal Assistants
Calibration Technologists and Technicians	Cardiovascular Technologists and Technicians
Calibration Technologists and Technicians	Magnetic Resonance Imaging Technologists
Calibration Technologists and Technicians	Surgical Technologists
Calibration Technologists and Technicians	Diagnostic Medical Sonographers
Calibration Technologists and Technicians	Crane and Tower Operators

Benchmark occupation	Good-match occupations
Calibration Technologists and Technicians	Rail-Track Laying and Maintenance Equipment Operators
Calibration Technologists and Technicians	Surgical Assistants
Calibration Technologists and Technicians	Nuclear Medicine Technologists
Calibration Technologists and Technicians	Occupational Health and Safety Technicians
Calibration Technologists and Technicians	Archivists
Calibration Technologists and Technicians	Flight Attendants
Calibration Technologists and Technicians	Electrical and Electronics Installers and Repairers, Transportation Equipment
Calibration Technologists and Technicians	Subway and Streetcar Operators
Calibration Technologists and Technicians	Hearing Aid Specialists
Calibration Technologists and Technicians	Librarians and Media Collections Specialists
Calibration Technologists and Technicians	Transit and Railroad Police
Calibration Technologists and Technicians	Computer User Support Specialists
Calibration Technologists and Technicians	Tax Examiners and Collectors, and Revenue Agents
Calibration Technologists and Technicians	Plumbers, Pipefitters, and Steamfitters
Chemical Engineers	Information Security Analysts
Chemical Engineers	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
Chemical Engineers	Database Administrators
Chemical Engineers	Database Architects

Benchmark occupation	Good-match occupations
Chemical Engineers	Administrative Services Managers
Chemical Engineers	Software Quality Assurance Analysts and Testers
Chemical Engineers	Art Directors
Chemical Engineers	Economists
Chemical Engineers	Air Traffic Controllers
Chemical Engineers	Prosthodontists
Chemical Engineers	Materials Engineers
Chemical Engineers	Electrical Engineers
Chemical Engineers	Orthodontists
Chemical Engineers	Materials Scientists
Chemical Engineers	Computer Hardware Engineers
Chemical Engineers	Economics Teachers, Postsecondary
Chemical Engineers	Veterinarians
Continuous Mining Machine Operators	Pile Driver Operators
Continuous Mining Machine Operators	Bus Drivers, Transit and Intercity
Continuous Mining Machine Operators	Rail-Track Laying and Maintenance Equipment Operators
Continuous Mining Machine Operators	Drywall and Ceiling Tile Installers
Continuous Mining Machine Operators	Railroad Brake, Signal, and Switch Operators and Locomotive Firers

Benchmark occupation	Good-match occupations
Continuous Mining Machine Operators	Operating Engineers and Other Construction Equipment Operators
Continuous Mining Machine Operators	Crane and Tower Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Rail-Track Laying and Maintenance Equipment Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Telecommunications Line Installers and Repairers
Control and Valve Installers and Repairers, Except Mechanical Door	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Control and Valve Installers and Repairers, Except Mechanical Door	Pile Driver Operators
Control and Valve Installers and Repairers, Except Mechanical Door	Crane and Tower Operators
Conveyor Operators and Tenders	Refuse and Recyclable Material Collectors
Conveyor Operators and Tenders	Paperhangers
Conveyor Operators and Tenders	Landscaping and Groundskeeping Workers
Conveyor Operators and Tenders	Cleaning, Washing, and Metal Pickling Equipment Operators and Tenders
Conveyor Operators and Tenders	Helpers—Painters, Paperhangers, Plasterers, and Stucco Masons
Conveyor Operators and Tenders	Laborers and Freight, Stock, and Material Movers, Hand
Conveyor Operators and Tenders	Food Cooking Machine Operators and Tenders
Conveyor Operators and Tenders	Machine Feeders and Offbearers
Conveyor Operators and Tenders	Industrial Truck and Tractor Operators

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Packaging and Filling Machine Operators and Tenders
Conveyor Operators and Tenders	Light Truck Drivers
Conveyor Operators and Tenders	Insulation Workers, Floor, Ceiling, and Wall
Conveyor Operators and Tenders	Sawing Machine Setters, Operators, and Tenders, Wood
Conveyor Operators and Tenders	Crossing Guards and Flaggers
Conveyor Operators and Tenders	Meat, Poultry, and Fish Cutters and Trimmers
Conveyor Operators and Tenders	Orderlies
Conveyor Operators and Tenders	Bus Drivers, Transit and Intercity
Conveyor Operators and Tenders	Painters, Construction and Maintenance
Conveyor Operators and Tenders	Couriers and Messengers
Conveyor Operators and Tenders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Conveyor Operators and Tenders	Reinforcing Iron and Rebar Workers
Conveyor Operators and Tenders	Pesticide Handlers, Sprayers, and Applicators, Vegetation
Conveyor Operators and Tenders	Floor Layers, Except Carpet, Wood, and Hard Tiles
Conveyor Operators and Tenders	Drywall and Ceiling Tile Installers
Conveyor Operators and Tenders	Stockers and Order Fillers
Conveyor Operators and Tenders	Food Batchmakers
Conveyor Operators and Tenders	Welders, Cutters, Solderers, and Brazers

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Insulation Workers, Mechanical
Conveyor Operators and Tenders	Highway Maintenance Workers
Conveyor Operators and Tenders	Construction Laborers
Conveyor Operators and Tenders	Food and Tobacco Roasting, Baking, and Drying Machine Operators and Tenders
Conveyor Operators and Tenders	Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters
Conveyor Operators and Tenders	Plasterers and Stucco Masons
Conveyor Operators and Tenders	Tree Trimmers and Pruners
Conveyor Operators and Tenders	Agricultural Equipment Operators
Conveyor Operators and Tenders	Barbers
Conveyor Operators and Tenders	Heavy and Tractor-Trailer Truck Drivers
Conveyor Operators and Tenders	Tire Repairers and Changers
Conveyor Operators and Tenders	Glaziers
Conveyor Operators and Tenders	Pile Driver Operators
Conveyor Operators and Tenders	Crane and Tower Operators
Conveyor Operators and Tenders	Dredge Operators
Conveyor Operators and Tenders	Molders, Shapers, and Casters, Except Metal and Plastic
Conveyor Operators and Tenders	Roofers
Conveyor Operators and Tenders	Paving, Surfacing, and Tamping Equipment Operators

Benchmark occupation	Good-match occupations
Conveyor Operators and Tenders	Tile and Stone Setters
Conveyor Operators and Tenders	Semiconductor Processing Technicians
Conveyor Operators and Tenders	Helpers—Roofers
Conveyor Operators and Tenders	Ophthalmic Laboratory Technicians
Conveyor Operators and Tenders	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Conveyor Operators and Tenders	Operating Engineers and Other Construction Equipment Operators
Conveyor Operators and Tenders	Rail-Track Laying and Maintenance Equipment Operators
Conveyor Operators and Tenders	Brickmasons and Blockmasons
Derrick Operators, Oil and Gas	Pile Driver Operators
Derrick Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Derrick Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Derrick Operators, Oil and Gas	Reinforcing Iron and Rebar Workers
Derrick Operators, Oil and Gas	Crane and Tower Operators
Derrick Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Derrick Operators, Oil and Gas	Heavy and Tractor-Trailer Truck Drivers
Derrick Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Derrick Operators, Oil and Gas	Insulation Workers, Mechanical
Derrick Operators, Oil and Gas	Plasterers and Stucco Masons

Benchmark occupation	Good-match occupations
Derrick Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Derrick Operators, Oil and Gas	Brickmasons and Blockmasons
Derrick Operators, Oil and Gas	Structural Iron and Steel Workers
Earth Drillers, Except Oil and Gas	Pile Driver Operators
Earth Drillers, Except Oil and Gas	Plasterers and Stucco Masons
Earth Drillers, Except Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Earth Drillers, Except Oil and Gas	Reinforcing Iron and Rebar Workers
Earth Drillers, Except Oil and Gas	Drywall and Ceiling Tile Installers
Earth Drillers, Except Oil and Gas	Bus Drivers, Transit and Intercity
Earth Drillers, Except Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Earth Drillers, Except Oil and Gas	Crane and Tower Operators
Earth Drillers, Except Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Earth Drillers, Except Oil and Gas	Insulation Workers, Mechanical
Earth Drillers, Except Oil and Gas	Glaziers
Earth Drillers, Except Oil and Gas	Heavy and Tractor-Trailer Truck Drivers
Earth Drillers, Except Oil and Gas	Brickmasons and Blockmasons
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Telecommunications Line Installers and Repairers

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Bus Drivers, Transit and Intercity
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Crane and Tower Operators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Electrical and Electronics Installers and Repairers, Transportation Equipment
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Rail-Track Laying and Maintenance Equipment Operators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Rail Car Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Plumbers, Pipefitters, and Steamfitters
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Signal and Track Switch Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Stationary Engineers and Boiler Operators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Structural Iron and Steel Workers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Subway and Streetcar Operators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Electrical Power-Line Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Pile Driver Operators

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Medical Equipment Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Wind Turbine Service Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Telecommunications Equipment Installers and Repairers, Except Line Installers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Dental Hygienists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Film and Video Editors
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Court Reporters and Simultaneous Captioners
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Elevator and Escalator Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Camera Operators, Television, Video, and Film
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Mobile Heavy Equipment Mechanics, Except Engines
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Commercial Divers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Radiologic Technologists and Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Radio, Cellular, and Tower Equipment Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Avionics Technicians

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Transportation Inspectors
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Millwrights
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Locomotive Engineers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Cartographers and Photogrammetrists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Ship Engineers
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Surgical Technologists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Electrical and Electronics Drafters
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Magnetic Resonance Imaging Technologists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Aerospace Engineering and Operations Technologists and Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Special Effects Artists and Animators
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Aircraft Mechanics and Service Technicians
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Architectural and Civil Drafters
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Diagnostic Medical Sonographers

Benchmark occupation	Good-match occupations
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Computer Network Support Specialists
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Flight Attendants
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	Transportation Inspectors
Excavating and Loading Machine and Dragline Operators, Surface Mining	Refuse and Recyclable Material Collectors
Excavating and Loading Machine and Dragline Operators, Surface Mining	Paperhangers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Insulation Workers, Floor, Ceiling, and Wall
Excavating and Loading Machine and Dragline Operators, Surface Mining	Reinforcing Iron and Rebar Workers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Paving, Surfacing, and Tamping Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Drywall and Ceiling Tile Installers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Crane and Tower Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Floor Layers, Except Carpet, Wood, and Hard Tiles
Excavating and Loading Machine and Dragline Operators, Surface Mining	Bus Drivers, Transit and Intercity
Excavating and Loading Machine and Dragline Operators, Surface Mining	Highway Maintenance Workers

Benchmark occupation	Good-match occupations
Excavating and Loading Machine and Dragline Operators, Surface Mining	Rail-Track Laying and Maintenance Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Painters, Construction and Maintenance
Excavating and Loading Machine and Dragline Operators, Surface Mining	Insulation Workers, Mechanical
Excavating and Loading Machine and Dragline Operators, Surface Mining	Construction Laborers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Welders, Cutters, Solderers, and Brazers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Pile Driver Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Glaziers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Plasterers and Stucco Masons
Excavating and Loading Machine and Dragline Operators, Surface Mining	Heavy and Tractor-Trailer Truck Drivers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Operating Engineers and Other Construction Equipment Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Excavating and Loading Machine and Dragline Operators, Surface Mining	Roofers

Benchmark occupation	Good-match occupations
Excavating and Loading Machine and Dragline Operators, Surface Mining	Dredge Operators
Excavating and Loading Machine and Dragline Operators, Surface Mining	Tree Trimmers and Pruners
Excavating and Loading Machine and Dragline Operators, Surface Mining	Septic Tank Servicers and Sewer Pipe Cleaners
Excavating and Loading Machine and Dragline Operators, Surface Mining	Tile and Stone Setters
Excavating and Loading Machine and Dragline Operators, Surface Mining	Brickmasons and Blockmasons
Excavating and Loading Machine and Dragline Operators, Surface Mining	Semiconductor Processing Technicians
Excavating and Loading Machine and Dragline Operators, Surface Mining	Costume Attendants
Excavating and Loading Machine and Dragline Operators, Surface Mining	Automotive Body and Related Repairers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Structural Iron and Steel Workers
Excavating and Loading Machine and Dragline Operators, Surface Mining	Automotive Glass Installers and Repairers
Extraction Workers, All Other	Paperhangers
Extraction Workers, All Other	Refuse and Recyclable Material Collectors
Extraction Workers, All Other	Paving, Surfacing, and Tamping Equipment Operators
Extraction Workers, All Other	Insulation Workers, Floor, Ceiling, and Wall

Benchmark occupation	Good-match occupations
Extraction Workers, All Other	Painters, Construction and Maintenance
Extraction Workers, All Other	Bus Drivers, Transit and Intercity
Extraction Workers, All Other	Reinforcing Iron and Rebar Workers
Extraction Workers, All Other	Drywall and Ceiling Tile Installers
Extraction Workers, All Other	Construction Laborers
Extraction Workers, All Other	Welders, Cutters, Solderers, and Brazers
Extraction Workers, All Other	Rail-Track Laying and Maintenance Equipment Operators
Extraction Workers, All Other	Highway Maintenance Workers
Extraction Workers, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Extraction Workers, All Other	Insulation Workers, Mechanical
Extraction Workers, All Other	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Extraction Workers, All Other	Floor Layers, Except Carpet, Wood, and Hard Tiles
Extraction Workers, All Other	Plasterers and Stucco Masons
Extraction Workers, All Other	Pile Driver Operators
Extraction Workers, All Other	Dredge Operators
Extraction Workers, All Other	Crane and Tower Operators
Extraction Workers, All Other	Tree Trimmers and Pruners
Extraction Workers, All Other	Roofers

Benchmark occupation	Good-match occupations
Extraction Workers, All Other	Glaziers
Extraction Workers, All Other	Heavy and Tractor-Trailer Truck Drivers
Extraction Workers, All Other	Operating Engineers and Other Construction Equipment Operators
Extraction Workers, All Other	Brickmasons and Blockmasons
Geological Technicians, Except Hydrologic Technicians	Painters, Construction and Maintenance
Geological Technicians, Except Hydrologic Technicians	Paperhangers
Geological Technicians, Except Hydrologic Technicians	Reinforcing Iron and Rebar Workers
Geological Technicians, Except Hydrologic Technicians	Animal Breeders
Geological Technicians, Except Hydrologic Technicians	Floor Layers, Except Carpet, Wood, and Hard Tiles
Geological Technicians, Except Hydrologic Technicians	Plasterers and Stucco Masons
Geological Technicians, Except Hydrologic Technicians	Insulation Workers, Mechanical
Geological Technicians, Except Hydrologic Technicians	Drywall and Ceiling Tile Installers
Geological Technicians, Except Hydrologic Technicians	Welders, Cutters, Solderers, and Brazers
Geological Technicians, Except Hydrologic Technicians	Insulation Workers, Floor, Ceiling, and Wall
Geological Technicians, Except Hydrologic Technicians	Bus Drivers, Transit and Intercity
Geological Technicians, Except Hydrologic Technicians	Glaziers
Geological Technicians, Except Hydrologic Technicians	Court Reporters and Simultaneous Captioners
Geological Technicians, Except Hydrologic Technicians	Costume Attendants

Benchmark occupation	Good-match occupations
Geological Technicians, Except Hydrologic Technicians	Tile and Stone Setters
Geological Technicians, Except Hydrologic Technicians	Roofers
Geological Technicians, Except Hydrologic Technicians	Fine Artists, Including Painters, Sculptors, and Illustrators
Geological Technicians, Except Hydrologic Technicians	Brickmasons and Blockmasons
Geological Technicians, Except Hydrologic Technicians	Transportation Inspectors
Geological Technicians, Except Hydrologic Technicians	Food Science Technicians
Geological Technicians, Except Hydrologic Technicians	Surveying and Mapping Technicians
Geological Technicians, Except Hydrologic Technicians	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Geological Technicians, Except Hydrologic Technicians	Structural Iron and Steel Workers
Geological Technicians, Except Hydrologic Technicians	Massage Therapists
Geological Technicians, Except Hydrologic Technicians	Tree Trimmers and Pruners
Geological Technicians, Except Hydrologic Technicians	Highway Maintenance Workers
Geoscientists, Except Hydrologists and Geographers	Special Effects Artists and Animators
Helpers—Extraction Workers	Refuse and Recyclable Material Collectors
Helpers—Extraction Workers	Industrial Truck and Tractor Operators
Helpers—Extraction Workers	Paperhangers
Helpers—Extraction Workers	Paving, Surfacing, and Tamping Equipment Operators
Helpers—Extraction Workers	Reinforcing Iron and Rebar Workers

Benchmark occupation	Good-match occupations
Helpers—Extraction Workers	Insulation Workers, Floor, Ceiling, and Wall
Helpers—Extraction Workers	Welders, Cutters, Solderers, and Brazers
Helpers—Extraction Workers	Bus Drivers, Transit and Intercity
Helpers—Extraction Workers	Drywall and Ceiling Tile Installers
Helpers—Extraction Workers	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Helpers—Extraction Workers	Construction Laborers
Helpers—Extraction Workers	Painters, Construction and Maintenance
Helpers—Extraction Workers	Rail-Track Laying and Maintenance Equipment Operators
Helpers—Extraction Workers	Light Truck Drivers
Helpers—Extraction Workers	Pile Driver Operators
Helpers—Extraction Workers	Plasterers and Stucco Masons
Helpers—Extraction Workers	Dredge Operators
Helpers—Extraction Workers	Insulation Workers, Mechanical
Helpers—Extraction Workers	Highway Maintenance Workers
Helpers—Extraction Workers	Roofers
Industrial Machinery Mechanics	Pile Driver Operators
Industrial Machinery Mechanics	Rail-Track Laying and Maintenance Equipment Operators
Industrial Machinery Mechanics	Drywall and Ceiling Tile Installers

Benchmark occupation	Good-match occupations
Industrial Machinery Mechanics	Crane and Tower Operators
Industrial Machinery Mechanics	Maintenance Workers, Machinery
Industrial Machinery Mechanics	Rail Car Repairers
Industrial Machinery Mechanics	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Industrial Machinery Mechanics	Signal and Track Switch Repairers
Industrial Machinery Mechanics	Bus Drivers, Transit and Intercity
Industrial Machinery Mechanics	Bus and Truck Mechanics and Diesel Engine Specialists
Industrial Machinery Mechanics	Operating Engineers and Other Construction Equipment Operators
Industrial Machinery Mechanics	Plumbers, Pipefitters, and Steamfitters
Industrial Machinery Mechanics	Elevator and Escalator Installers and Repairers
Industrial Machinery Mechanics	Telecommunications Line Installers and Repairers
Industrial Machinery Mechanics	Security and Fire Alarm Systems Installers
Industrial Machinery Mechanics	Brickmasons and Blockmasons
Industrial Machinery Mechanics	Stationary Engineers and Boiler Operators
Industrial Machinery Mechanics	Structural Iron and Steel Workers
Industrial Machinery Mechanics	Subway and Streetcar Operators
Industrial Machinery Mechanics	Wind Turbine Service Technicians
Industrial Machinery Mechanics	Electrical Power-Line Installers and Repairers

Benchmark occupation	Good-match occupations
Industrial Machinery Mechanics	Locomotive Engineers
Industrial Machinery Mechanics	Electrical and Electronics Installers and Repairers, Transportation Equipment
Loading and Moving Machine Operators, Underground Mining	Bus Drivers, Transit and Intercity
Mining and Geological Engineers, Including Mining Safety Engineers	Special Effects Artists and Animators
Mining and Geological Engineers, Including Mining Safety Engineers	Industrial Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Information Security Analysts
Mining and Geological Engineers, Including Mining Safety Engineers	Environmental Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Economists
Mining and Geological Engineers, Including Mining Safety Engineers	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
Mining and Geological Engineers, Including Mining Safety Engineers	Art Directors
Mining and Geological Engineers, Including Mining Safety Engineers	Air Traffic Controllers
Mining and Geological Engineers, Including Mining Safety Engineers	Administrative Services Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Compensation and Benefits Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Genetic Counselors

Benchmark occupation	Good-match occupations
Mining and Geological Engineers, Including Mining Safety Engineers	Architects, Except Landscape and Naval
Mining and Geological Engineers, Including Mining Safety Engineers	Orthodontists
Mining and Geological Engineers, Including Mining Safety Engineers	Transportation, Storage, and Distribution Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Database Administrators
Mining and Geological Engineers, Including Mining Safety Engineers	Database Architects
Mining and Geological Engineers, Including Mining Safety Engineers	Detectives and Criminal Investigators
Mining and Geological Engineers, Including Mining Safety Engineers	Personal Financial Advisors
Mining and Geological Engineers, Including Mining Safety Engineers	Computer and Information Systems Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Atmospheric and Space Scientists
Mining and Geological Engineers, Including Mining Safety Engineers	Electrical Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Optometrists
Mining and Geological Engineers, Including Mining Safety Engineers	Materials Scientists
Mining and Geological Engineers, Including Mining Safety Engineers	Prosthodontists

Benchmark occupation	Good-match occupations
Mining and Geological Engineers, Including Mining Safety Engineers	Economics Teachers, Postsecondary
Mining and Geological Engineers, Including Mining Safety Engineers	Software Quality Assurance Analysts and Testers
Mining and Geological Engineers, Including Mining Safety Engineers	Management Analysts
Mining and Geological Engineers, Including Mining Safety Engineers	Architectural and Engineering Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Materials Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Veterinarians
Mining and Geological Engineers, Including Mining Safety Engineers	Pharmacists
Mining and Geological Engineers, Including Mining Safety Engineers	General and Operations Managers
Mining and Geological Engineers, Including Mining Safety Engineers	Civil Engineers
Mining and Geological Engineers, Including Mining Safety Engineers	Physical Therapists
Mining and Geological Engineers, Including Mining Safety Engineers	Actuaries
Mining and Geological Engineers, Including Mining Safety Engineers	Marine Engineers and Naval Architects
Mixing and Blending Machine Setters, Operators, and Tenders	Refuse and Recyclable Material Collectors
Mixing and Blending Machine Setters, Operators, and Tenders	Paperhangers

Benchmark occupation	Good-match occupations
Mixing and Blending Machine Setters, Operators, and Tenders	Light Truck Drivers
Mixing and Blending Machine Setters, Operators, and Tenders	Industrial Truck and Tractor Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Paving, Surfacing, and Tamping Equipment Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Bus Drivers, Transit and Intercity
Mixing and Blending Machine Setters, Operators, and Tenders	Welders, Cutters, Solderers, and Brazers
Mixing and Blending Machine Setters, Operators, and Tenders	Reinforcing Iron and Rebar Workers
Mixing and Blending Machine Setters, Operators, and Tenders	Drywall and Ceiling Tile Installers
Mixing and Blending Machine Setters, Operators, and Tenders	Rail-Track Laying and Maintenance Equipment Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Painters, Construction and Maintenance
Mixing and Blending Machine Setters, Operators, and Tenders	Insulation Workers, Mechanical
Mixing and Blending Machine Setters, Operators, and Tenders	Insulation Workers, Floor, Ceiling, and Wall
Mixing and Blending Machine Setters, Operators, and Tenders	Coating, Painting, and Spraying Machine Setters, Operators, and Tenders
Mixing and Blending Machine Setters, Operators, and Tenders	Highway Maintenance Workers
Mixing and Blending Machine Setters, Operators, and Tenders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Mixing and Blending Machine Setters, Operators, and Tenders	Construction Laborers
Mixing and Blending Machine Setters, Operators, and Tenders	Crane and Tower Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Pile Driver Operators
Mixing and Blending Machine Setters, Operators, and Tenders	Molders, Shapers, and Casters, Except Metal and Plastic

Benchmark occupation	Good-match occupations
Mixing and Blending Machine Setters, Operators, and Tenders	Pesticide Handlers, Sprayers, and Applicators, Vegetation
Mixing and Blending Machine Setters, Operators, and Tenders	Heavy and Tractor-Trailer Truck Drivers
Mixing and Blending Machine Setters, Operators, and Tenders	Glaziers
Mixing and Blending Machine Setters, Operators, and Tenders	Floor Layers, Except Carpet, Wood, and Hard Tiles
Mixing and Blending Machine Setters, Operators, and Tenders	Plasterers and Stucco Masons
Petroleum Engineers	Optometrists
Petroleum Pump System Operators, Refinery Operators, and Gaugers	None
Plant and System Operators, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Plant and System Operators, All Other	Crane and Tower Operators
Plant and System Operators, All Other	Heavy and Tractor-Trailer Truck Drivers
Plant and System Operators, All Other	Reinforcing Iron and Rebar Workers
Plant and System Operators, All Other	Bus Drivers, Transit and Intercity
Plant and System Operators, All Other	Pile Driver Operators
Plant and System Operators, All Other	Drywall and Ceiling Tile Installers
Plant and System Operators, All Other	Locomotive Engineers
Plant and System Operators, All Other	Insulation Workers, Mechanical
Plant and System Operators, All Other	Plasterers and Stucco Masons
Plant and System Operators, All Other	Rail-Track Laying and Maintenance Equipment Operators

Benchmark occupation	Good-match occupations
Plant and System Operators, All Other	Brickmasons and Blockmasons
Plant and System Operators, All Other	Subway and Streetcar Operators
Plant and System Operators, All Other	Operating Engineers and Other Construction Equipment Operators
Plant and System Operators, All Other	Costume Attendants
Plant and System Operators, All Other	Structural Iron and Steel Workers
Plant and System Operators, All Other	Telecommunications Line Installers and Repairers
Plant and System Operators, All Other	Court Reporters and Simultaneous Captioners
Plant and System Operators, All Other	Fine Artists, Including Painters, Sculptors, and Illustrators
Plant and System Operators, All Other	Transportation Inspectors
Power Distributors and Dispatchers	None
Power Plant Operators	None
Pump Operators, Except Wellhead Pumpers	Reinforcing Iron and Rebar Workers
Pump Operators, Except Wellhead Pumpers	Bus Drivers, Transit and Intercity
Pump Operators, Except Wellhead Pumpers	Plasterers and Stucco Masons
Pump Operators, Except Wellhead Pumpers	Drywall and Ceiling Tile Installers
Pump Operators, Except Wellhead Pumpers	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Pump Operators, Except Wellhead Pumpers	Crane and Tower Operators
Pump Operators, Except Wellhead Pumpers	Insulation Workers, Mechanical

Benchmark occupation	Good-match occupations
Pump Operators, Except Wellhead Pumpers	Heavy and Tractor-Trailer Truck Drivers
Pump Operators, Except Wellhead Pumpers	Rail-Track Laying and Maintenance Equipment Operators
Pump Operators, Except Wellhead Pumpers	Dredge Operators
Pump Operators, Except Wellhead Pumpers	Brickmasons and Blockmasons
Pump Operators, Except Wellhead Pumpers	Glaziers
Pump Operators, Except Wellhead Pumpers	Pile Driver Operators
Pump Operators, Except Wellhead Pumpers	Roofers
Pump Operators, Except Wellhead Pumpers	Operating Engineers and Other Construction Equipment Operators
Riggers	Bus Drivers, Transit and Intercity
Riggers	Drywall and Ceiling Tile Installers
Riggers	Reinforcing Iron and Rebar Workers
Riggers	Insulation Workers, Mechanical
Riggers	Plasterers and Stucco Masons
Riggers	Glaziers
Rotary Drill Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Rotary Drill Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Rotary Drill Operators, Oil and Gas	Pile Driver Operators
Rotary Drill Operators, Oil and Gas	Crane and Tower Operators

Benchmark occupation	Good-match occupations
Rotary Drill Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Rotary Drill Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Rotary Drill Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Rotary Drill Operators, Oil and Gas	Structural Iron and Steel Workers
Rotary Drill Operators, Oil and Gas	Subway and Streetcar Operators
Rotary Drill Operators, Oil and Gas	Brickmasons and Blockmasons
Rotary Drill Operators, Oil and Gas	Telecommunications Line Installers and Repairers
Roustabouts, Oil and Gas	Refuse and Recyclable Material Collectors
Roustabouts, Oil and Gas	Industrial Truck and Tractor Operators
Roustabouts, Oil and Gas	Paperhangers
Service Unit Operators, Oil and Gas	Crane and Tower Operators
Service Unit Operators, Oil and Gas	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Service Unit Operators, Oil and Gas	Bus Drivers, Transit and Intercity
Service Unit Operators, Oil and Gas	Insulation Workers, Mechanical
Service Unit Operators, Oil and Gas	Glaziers
Service Unit Operators, Oil and Gas	Rail-Track Laying and Maintenance Equipment Operators
Service Unit Operators, Oil and Gas	Plasterers and Stucco Masons
Service Unit Operators, Oil and Gas	Heavy and Tractor-Trailer Truck Drivers

Benchmark occupation	Good-match occupations
Service Unit Operators, Oil and Gas	Pile Driver Operators
Service Unit Operators, Oil and Gas	Drywall and Ceiling Tile Installers
Service Unit Operators, Oil and Gas	Reinforcing Iron and Rebar Workers
Service Unit Operators, Oil and Gas	Dredge Operators
Service Unit Operators, Oil and Gas	Telecommunications Line Installers and Repairers
Service Unit Operators, Oil and Gas	Operating Engineers and Other Construction Equipment Operators
Service Unit Operators, Oil and Gas	Brickmasons and Blockmasons
Service Unit Operators, Oil and Gas	Machinists
Service Unit Operators, Oil and Gas	Costume Attendants
Service Unit Operators, Oil and Gas	Subway and Streetcar Operators
Service Unit Operators, Oil and Gas	Structural Iron and Steel Workers
Service Unit Operators, Oil and Gas	Maintenance Workers, Machinery
Service Unit Operators, Oil and Gas	Plumbers, Pipefitters, and Steamfitters
Service Unit Operators, Oil and Gas	Electrical and Electronics Installers and Repairers, Transportation Equipment
Tank Car, Truck, and Ship Loaders	Bus Drivers, Transit and Intercity
Tank Car, Truck, and Ship Loaders	Reinforcing Iron and Rebar Workers
Tank Car, Truck, and Ship Loaders	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Tank Car, Truck, and Ship Loaders	Drywall and Ceiling Tile Installers

Benchmark occupation	Good-match occupations
Tank Car, Truck, and Ship Loaders	Insulation Workers, Mechanical
Tank Car, Truck, and Ship Loaders	Brickmasons and Blockmasons
Underground Mining Machine Operators, All Other	Pile Driver Operators
Underground Mining Machine Operators, All Other	Rail-Track Laying and Maintenance Equipment Operators
Underground Mining Machine Operators, All Other	Railroad Brake, Signal, and Switch Operators and Locomotive Firers
Wellhead Pumpers	None

A.4. Postsecondary Completions and Number of Training Programs Related to Low-Emissions Technologies

Table A.4 provides a list of postsecondary completions and training programs that we have identified as being relevant to the low-emissions technologies examined in this analysis.

Table A.4. Postsecondary completions and training programs

Category	Classification of Instructional Programs code	Classification of Instructional Programs title	Completions	Programs
Construction	460302	Electrician	24,547	855
Heat pumps	470201	Heating, Air Conditioning, Ventilation and Refrigeration Maintenance Technology/Technician	21,228	1,107
Heat pumps	150501	Heating, Ventilation, Air Conditioning and Refrigeration Engineering Technology/Technician	6,820	294
Construction	522001	Construction Management, General	4,154	271
Construction	460000	Construction Trades, General	2,589	175

Construction	460303	Lineworker	2,181	117
Construction	460301	Electrical and Power Transmission Installation/Installer, General	1,856	146
Construction	460415	Building Construction Technology/Technician	1,710	247
Heat pumps	460401	Building/Property Maintenance	1,569	186
Construction	460412	Building/Construction Site Management/Manager	1,420	131
Construction	143301	Construction Engineering	1,284	73
CCUS	400401	Atmospheric Sciences and Meteorology, General	955	151
Hydrogen	142501	Petroleum Engineering	941	77
Nuclear	142301	Nuclear Engineering	885	96
Construction	460499	Building/Construction Finishing, Management, and Inspection, Other	587	91
Heat pumps	460502	Pipefitting/Pipefitter and Sprinkler Fitter	526	67
Construction	460101	Mason/Masonry	370	68
Critical minerals	142101	Mining and Mineral Engineering	300	47
Biomass	30506	Forest Management/Forest Resources Management	299	37
Hydroelectric	142401	Ocean Engineering	290	34
Construction	460403	Building/Home/Construction Inspection/Inspector	286	75
Nuclear	151401	Nuclear Engineering Technology/Technician	261	22
Solar	151703	Solar Energy Technology/Technician	228	80

Nuclear	410205	Nuclear/Nuclear Power Technology/Technician	114	14
Construction	460402	Concrete Finishing/Concrete Finisher	113	10
Construction	460399	Electrical and Power Transmission Installers, Other	99	33
Wind	470704	Wind Energy System Installation and Repair Technology/Technician	92	6
Wind	150617	Composite Materials Technology/Technician	88	10
Biomass	30509	Wood Science and Wood Products/Pulp and Paper Technology/Technician	87	17
Wind	151704	Wind Energy Technology/Technician	84	14
Methane monitoring	303801	Earth Systems Science	25	9
Critical minerals	150901	Mining Technology/Technician	14	16
Solar	470703	Solar Energy System Installation and Repair Technology/Technician	12	4
CCUS	140802	Geotechnical and Geoenvironmental Engineering	11	13
Methane monitoring	140202	Astronautical Engineering	10	2
Construction	522002	Construction Project Management	4	1
CCUS	460504	Well Drilling/Driller	1	1
CCUS	400403	Atmospheric Physics and Dynamics	—	2
Construction	460505	Blasting/Blaster	—	2
Methane monitoring	400403	Atmospheric Physics and Dynamics	—	2

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