



**Maryland**  
Department of  
the Environment

# Appendix I

**Just Transition**

**2019 GGRA Draft Plan**

## Chapter 17: Just Transition

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*Commissioned by*  
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## 17.0 Executive Summary

As Maryland considers transitioning its energy mix away from fossil fuels and towards less carbon-intensive fuel sources, it is important to consider the impact of this transition on workers in fossil-fuel reliant industries. Some workers involved in aspects of the fossil fuel supply chain may lose their job and find it difficult to switch industries or occupations. The Maryland Department of the Environment (MDE) tasked the Regional Economic Studies Institute of Towson University (RESI) with evaluating economic dislocations resulting from potential carbon mitigation strategies. These economic dislocations included direct impacts to fossil-fuel-reliant workers, fiscal impacts resulting from industry changes at the local level, and other related disparities associated with the State’s efforts to reduce GHG emissions. Additionally, to meet objectives set in the State’s 40 by 30 Plan, MDE requested strategies for transitioning impacted fossil-fuel-reliant workers and mitigating other economic dislocations resulting associated with greenhouse gas reduction efforts. To meet the project objectives, RESI utilized a five-fold methodology:

- Identified major fossil-fuel-reliant industries within the state, focusing on industries related to the fossil-fuel supply chain;
- Estimated fiscal impacts to state and local governments resulting from a single firm closure within each major industry of focus;
- Determined key threatened occupations within the industries of focus;
- Analyzed related job opportunities for displaced employees; and
- Researched typical employment requirements and training opportunities within the state.

Major findings for each aspect are summarized below.

The fossil-fuel-reliant industries of focus identified through the analysis are illustrated in Figure 1 below. Data reflect 2017 annual averages.

**Figure 1: Industries of Focus**

NAICS	Industry	Maryland Employment	Total Wages
221112	Fossil Fuel Electric Power Generation	2,298	\$388,125,553
4471	Gasoline Stations	11,476	\$261,048,950
3241	Petroleum and Coal Products Manufacturing	848	\$70,113,044
2212	Natural Gas Distribution	587	\$50,083,767
3312	Steel Product Manufacturing from Purchased Steel	169	\$10,645,755
2121	Coal Mining	80	\$5,145,469

Sources: RESI, U.S. Bureau of Labor Statistics

As shown above, total Maryland employment in the industries of focus ranged from 80 to 11,476 workers. In sum, these six industries employ over 15,000 Maryland residents who earn just over \$397 million in wages each year. However, as a proportion of total employment in the state, these six industries are relatively small, constituting 0.7 percent of the state’s workforce.

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Figure 2 below shows a summary of annual fiscal revenue losses estimated if a single Maryland firm in each industry of focus were to close. Inputs were based on the most recently available 2017 data, while impacts are shown in 2019 dollars.

**Figure 2: Summary of Fiscal Impacts per Average Industry Firm**

Industry	State Taxes	Local Taxes	Total
Fossil Fuel Electric Power Generation	\$7,203,040	\$6,288,787	\$13,491,826
Gasoline Stations	\$57,020	\$47,939	\$104,959
Petroleum and Coal Products Manufacturing	\$147,973	\$116,210	\$264,181
Natural Gas Distribution	\$1,036,774	\$906,343	\$1,943,118
Steel Product Manufacturing from Purchased Steel	\$314,372	\$249,786	\$564,160
Coal Mining	\$1,123,723	\$988,172	\$2,111,896

Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

Estimated total annual fiscal losses to state and local governments had a considerable range, with a low of \$104,959/year per Gasoline Station to \$13,491,826/year per Fossil Fuel Electric Power Generation firm.

Figure 3 below shows five key threatened occupations identified within the six industries of focus. Threatened occupations are those with the most workers in fossil-fuel-reliant industries. Employment figures include both total Maryland employment and the proportion of workers in these occupations who work in fossil-fuel-reliant industries. For example, of the 79,000 cashiers employed across Maryland, an estimated 10 percent work in fossil fuel reliant industries.

**Figure 3: Key Threatened Occupations in Maryland**

Occupation	SOC Code	Total Maryland Employment	Employment in Fossil-Fuel-Reliant Industries
Cashiers	41-2011	79,000	7,545
Machinists	51-4041	2,820	626
First-Line Supervisors of Production and Operating Workers	51-1011	6,780	257
Petroleum Pump System Operators, Refinery Operators, and Gaugers	51-8093	140	140
Inspectors, Testers, Sorters, Samplers, and Weighers	51-9061	4,060	168

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, the occupation with greatest number of workers in fossil-fuel-reliant industries are cashiers, with 7,545 workers. The greatest proportion of potentially affected employees were in the petroleum pump system operators, refinery operators, and gaugers occupation with all employees working in fossil-fuel-reliant industries.

For each threatened occupation, related occupations were identified based on skill transfers, existing patterns of employment changes, growth projections, and salary expectations. The related occupations identified are listed in Figure 4 below.

**Figure 4: Related Occupations**

Related Occupation	Associated Threatened Occupation
Nursing Assistants	Cashiers
Receptionists and Information Clerks	Cashiers
Computer Numerically Controlled Machine Tool Programmers of Metal and Plastic	Machinists
Heavy and Tractor-trailer Truck Drivers	Machinists; Petroleum Pump System Operators, Refinery Operators, and Gaugers
First-line Supervisors of Construction Trades and Extraction Workers	First-Line Supervisors of Production and Operating Workers
First-line Supervisors of Mechanics, Installers, and Repairers	First-Line Supervisors of Production and Operating Workers
Engineering Technicians, Except Drafters	First-Line Supervisors of Production and Operating Workers and Machinists; Petroleum Pump System Operators, Refinery Operators, and Gaugers
Operating Engineers and Other Construction Equipment	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Life, Physical, and Social Science Technicians, All Other	Inspectors, Testers, Sorters, Samplers, and Weighers
Stationary Engineers and Boiler Operators	Inspectors, Testers, Sorters, Samplers, and Weighers; Petroleum Pump System Operators, Refinery Operators, and Gaugers

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

For each related occupation above, typical requirements for entry into the profession were researched including educational attainment and on-the-job training needed. Additionally, a survey of available training opportunities within the state was conducted.

For example, cashiers, the occupation with the most jobs within a fossil-fuel-reliant industry, could be transitioned to become nursing assistants or receptionists and information clerks. Both alternative occupations have strong projected growth and higher median wages than cashiers. Becoming a nursing assistant typically requires a postsecondary nondegree award, and there are over 100 certified CNA (certified nursing assistant) training programs offered in colleges, nursing homes, and freestanding institutions in the state.

Certification and degree opportunities exist at Maryland’s colleges and universities for most of the occupations examined in greater detail in this report. Additionally, apprenticeship and less formal training programs exist to help prepare workers for new careers in the absence of

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formal programs. Partnering with local institutions and private employers can help to ensure workers in fossil-fuel-reliant occupations statewide find high-quality, high-paying jobs to help support their families and their communities.

While the industries and occupations evaluated do not represent an exhaustive list of all those that may be affected by the State's 40 by 30 Plan, they provide a solid framework for evaluating potential economic and regional dislocations that may be incurred. Given the flexibility of job training and certification programs, scaling initiatives to respond to economic conditions is viable. Understanding the impacts and challenges related to greenhouse gas reduction policies enables the State to be better equipped when addressing these changes and taking steps to ensure an equitable and fair outcome for those affected.

## 17.1 Introduction

As Maryland considers transitioning its energy mix away from fossil fuels and towards less carbon-intensive fuel sources, it is important to consider the impact of this transition on workers in fossil-fuel reliant industries. Some workers involved in aspects of the fossil fuel supply chain may lose their job and find it difficult to switch industries or occupations. The Maryland Department of the Environment (MDE) tasked the Regional Economic Studies Institute of Towson University (RESI) with evaluating economic dislocations resulting from potential carbon mitigation strategies. These economic dislocations included direct impacts to fossil-fuel-reliant workers, fiscal impacts resulting from industry changes at the local level, and other related disparities associated with the State's efforts to reduce GHG emissions. Additionally, to meet objectives set in the State's 40 by 30 Plan, MDE requested strategies for transitioning impacted fossil-fuel-reliant workers and mitigating other economic dislocations resulting associated with greenhouse gas reduction efforts. To meet the project objectives, RESI utilized a five-fold methodology:

- Identified major fossil-fuel-reliant industries within the state, focusing on industries related to the fossil-fuel supply chain;
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- Analyzed related job opportunities for displaced employees; and
- Researched typical employment requirements and training opportunities within the state.

This report will continue as follows. Section 17.2 provides a brief overview of Just Transition models and best practices observed in other regions. Section 17.3 outlines the methodology used to determine the industries of focus, threatened occupations, related occupations, estimated fiscal impacts, and available training opportunities in the state. Section 17.4 provides an overview of each industry of focus and a summary of the estimated fiscal losses that would be incurred by state and local governments resulting from a single firm closure in each industry. Section 17.5 highlights the threatened occupations identified within the industries of focus. This section also provides information on more stable positions related to the threatened occupations into which workers could transfer, typical employment requirements, and available job training opportunities in the state. Additionally, this section presents anecdotal evidence of alternative employment strategies that have been pursued to transition workers from fossil-fuel-reliant industries (primary coal mining) into alternative occupations. Section 17.6 concludes the report.

## 17.2 Just Transition Overview and Best Practices

The following section will provide an overview of the Just Transition framework, including how the model has been implemented in several countries as they move away from reliance on fossil-fuel-reliant power generation. Additionally, this section will outline several best practice strategies that have emerged from evaluations of transition efforts in other areas.

### 17.2.1 Overview of Just Transition

Just Transition is a developmental model that is intended to guide the phasing out of high-pollutant industries, while simultaneously introducing and utilizing new and alternative sources (i.e., green/clean/renewable) of energy production.<sup>1</sup> Just Transition approaches are also expected to provide job opportunities and job security to those workers affected by new environmental strategies and policies. In the United States, a transition to alternative energy sources has the potential to significantly impact traditional energy sector workers. The Just Transition framework stresses that that policies should be implemented in advance of major transitions to cushion the impacts and support these workers by providing them with new skills and job opportunities.<sup>2</sup>

The term Just Transition was first used in the late 1990s when North American unions began developing a program to support workers that had lost their jobs due to environmental protection policies.<sup>3</sup> Over time, the meaning of the term has broadened and is used to describe a “deliberate effort to plan for and invest in a transition to environmentally and socially sustainable jobs, sectors and economies.”<sup>4</sup> Later, the phrase Just Transition was used again, this time by the International Trade Union Confederation (ITUC) during the 2015 Paris Climate Agreement Conference.<sup>5</sup>

After the Paris Agreement, the UN’s International Labor Organization (ILO) produced a definitive definition and implementation plan for Just Transition. According to the ILO, Just Transition is a “bridge from where we are today to a future where all jobs are green and decent, poverty is eradicated, and communities are thriving and resilient.”<sup>6</sup> Their approach to Just Transition includes “measures to reduce the impact of job losses and industry phase-out on workers and communities, and measure to produce new, green and decent jobs, sectors and healthy communities.”<sup>7</sup>

The Just Transition model will be a crucial component in supporting both existing and developing industries as a new, cleaner energy future is realized. However, these adjustments in energy production will inevitably have an impact on existing industries. In 2017 there were 1.1 million U.S. workers directly employed in the traditional (i.e. coal, oil, gas) Electric Power

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<sup>1</sup> Samantha Smith, “Just Transition: A Report for the OECD,” Just Transition Centre (May 2017): 1, accessed October 25, 2018, <https://www.oecd.org/environment/cc/g20-climate/collapsecontents/Just-Transition-Centre-report-just-transition.pdf>.

<sup>2</sup> Robert Pollin and Brian Callaci, “A Just Transition for U.S. Fossil Fuel Industry Workers,” *American Prospect*, July 6, 2016, accessed October 25, 2018, <http://prospect.org/article/just-transition-us-fossil-fuel-industry-workers>.

<sup>3</sup> Smith, “Just Transition: A Report for the OECD,” 2.

<sup>4</sup> Ibid.

<sup>5</sup> Sean Sweeney and John Treat, “Trade Unions and Just Transition,” Trade Unions for Energy Democracy (April 2018): 1, accessed October 25, 2018, [http://www.rosalux-nyc.org/wp-content/files\\_mf/tuedworkingpaper11\\_web.pdf](http://www.rosalux-nyc.org/wp-content/files_mf/tuedworkingpaper11_web.pdf).

<sup>6</sup> Smith, “Just Transition: A Report for the OECD,” 3.

<sup>7</sup> Ibid.

Generation and Fuels technologies.<sup>8</sup> The cost for the Just Transition framework in the U.S. has been estimated to be around \$500 million per year—only about 1 percent of the total annual investment needed to support climate stabilization policies.<sup>9</sup> The costs includes income subsidies, retraining, and relocation support for fossil-fuel impacted workers and should coincide with the growth of the clean energy industry.<sup>10</sup> Two major components of the Just Transition framework will be the guarantee of clean energy-related jobs for younger workers in affected industries and an expansion of employment opportunities through clean energy investments for individuals and communities that will face the brunt of the transition.<sup>11</sup>

### 17.2.2 Just Transition Best Practices

As countries around the world have begun to transition away from reliance on fossil fuels, examples of Just Transition models have emerged. These transitions vary in size and scope, depending upon the degree to which fossil fuels are integrated into the economy and the size of the industry. In a review of multiple case studies from economies transitioning away from coal, the IDDRI, an independent policy institute, noted several best practices when undertaking Just Transition initiatives.<sup>12</sup> These insights included aspects involving employee transitions, building successful policies to support Just Transition, and regional strategies for areas that are heavily fossil-fuel reliant. The following subsection highlights several best practice suggestions for each of these factors.

Employees of fossil-fuel-reliant industries are a central focus of Just Transition efforts. A fair transition into new employment opportunities for individuals and their families is crucial to a successful Just Transition effort. The IDDRI notes several aspects that should be considered when formulating a transition effort, including:

- Receiving input from workers early in planning stages,<sup>13</sup>
- Responding to questions from workers,
- Providing a timeline for the phase-out of activities, and
- Creating worker training programs that facilitate the transfer of employees to new jobs.<sup>14</sup>

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<sup>8</sup> National Association of State Energy Officials and Energy Futures Initiative, “2018 U.S. Energy and Employment Report,” 13, accessed February 8, 2019, <https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5afb0ce4575d1f3cdf9ebe36/1526402279839/2018+U.S.+Energy+and+Employment+Report.pdf>.

<sup>9</sup> Pollin and Callaci, “A Just Transition for U.S. Fossil Industry Workers.”

<sup>10</sup> Ibid.

<sup>11</sup> Ibid.

<sup>12</sup> “IDDRI, A Think Tank to Facilitate the Transition Towards Sustainable Development,” IDDRI, accessed January 12, 2019, <https://www.iddri.org/en/about-iddri>.

<sup>13</sup> O. Sartor, “Insights from Case Studies of Major Coal-Consuming Economies,” IDDRI and Climate Strategies (2018): 27, accessed January 4, 2019,

[https://coaltransitions.files.wordpress.com/2018/09/coal\\_synthesis\\_final.pdf](https://coaltransitions.files.wordpress.com/2018/09/coal_synthesis_final.pdf).

<sup>14</sup> Ibid., 27-29.

The actions listed above help to ensure that employees are heard during the planning and transition, and also provide a framework for expectations around the process. Questions that should be addressed from workers include how they will be ensured a transition to a new career or retirement, how their compensation will be impacted during this transition period, and how the efforts will be funded.<sup>15</sup> Additionally, it is important to gain input through social dialogue from community members who are also impacted by the transition process.<sup>16,17</sup> The provision of a timeline surrounding activities allows workers to determine whether they will likely be transferring to a new career, or whether they are close enough to retirement that they would be exiting the workforce.<sup>18</sup> For those who will be seeking new employment, job retraining programs should match the existing skills of workers with local employment alternatives.<sup>19</sup> Additionally, job training programs with a focus on direct job placement have been found to be more effective than more general retraining initiatives.<sup>20</sup>

Policies surrounding Just Transition plans should also be designed to consider the needs of a successful program. These factors include:

- Providing a transition oversight body,
- Funding of the transition, and
- Facilitating the creating of a job retraining program.<sup>21</sup>

To ensure that the Just Transition framework is implemented more smoothly, a dedicated oversight body should be created that contains stakeholders in the process.<sup>22</sup> This group would be involved in outlining the timeline associated with the transition, creating plans for the implementation and monitoring of the transition, and providing policy suggestions to support a successful transition.<sup>23</sup> Plans to adequately finance the Just Transition effort should also be considered when developing supporting policies.<sup>24,25,26</sup> These may include the creation of a dedicated fund to provide workforce retraining or transition out of the labor force, or potentially involving companies directly involved in the funding of a labor transition.<sup>27</sup> The structure of the job retraining program should be considered in conjunction with how the program would be funded.<sup>28</sup> As previously mentioned, ideally, the program will focus on direct

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<sup>15</sup> Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 27.

<sup>16</sup> Smith, "Just Transition A Report for the OECD," 7.

<sup>17</sup> United Nations, "Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs," 50, accessed January 11, 2019, <https://unfccc.int/sites/default/files/resource/Just%20transition.pdf>.

<sup>18</sup> Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 28.

<sup>19</sup> Ibid., 29.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid., 29-30.

<sup>22</sup> Ibid., 29.

<sup>23</sup> Ibid.

<sup>24</sup> Ibid., 30.

<sup>25</sup> United Nations, "Just Transition of the Workforce, and the Creation of Decent Work and Quality Jobs," 55.

<sup>26</sup> Smith, "Just Transition A Report for the OECD," 17-18.

<sup>27</sup> Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 30.

<sup>28</sup> Ibid.

worker placement into alternative industries rather than providing a more generic or general skill training program.<sup>29</sup> This may involve providing subsidies for on-the-job (OTJ) training once an appropriate employment opportunity is found for affected workers.<sup>30</sup>

The economies of areas in which Just Transition strategies are implemented can vary significantly. For this reason, the unique attributes of the regional economy should be considered when designing a plan for transitioning away from fossil-fuel reliance. According to findings from the IDDRI, these regional strategies should include:

- Expanding regional industries that are not fossil-fuel reliant,
- Leveraging the area’s advantages when diversifying industries,
- Supporting local entrepreneurial networks, and
- Strengthening regional expansion of alternative clean energy.<sup>31</sup>

Economic planning for Just Transition efforts should evaluate the area’s existing related activities which are not directly reliant upon fossil-fuel industries, known as “related diversification.”<sup>32</sup> Similarly, these diversification efforts should consider the region’s unique strengths and leverage these attributes when determining which industries to expand upon.<sup>33</sup> This concept of “smart [specialization]” could include aspects of infrastructure, skills of the existing workforce, local growth industries, property availability, or other comparative advantages within the affected region.<sup>34</sup> If the strengths of an area affected by the transition away from fossil fuels are not clear, partnerships with regional higher educational institutions can be used to help identify these attributes.<sup>35</sup> Entrepreneurial networks can also be a useful tool to start or expand industries with growth potential, and can be facilitated and supported through higher education institutions and their partners, including local businesses and governmental organizations.<sup>36</sup> Through these measures, existing industries in the area with growth potential, or industries that could utilize the region’s unique attributes to their advantage, can be identified and bolstered to diversify the local economy.

For regions with significant ties to energy production, and that also have the required infrastructure to support these projects, the expansion of renewable energy in the area may be a strong option in a Just Transition plan.<sup>3738</sup> The nature of the project—wind, solar, hydropower, or other pilot projects—would depend in part upon the region’s available

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<sup>29</sup> Sartor, “Insights from Case Studies of Major Coal-Consuming Economies,” 30.

<sup>30</sup> Ibid., 30.

<sup>31</sup> Ibid, 31.

<sup>32</sup> Ibid.

<sup>33</sup> Ibid.

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

<sup>36</sup> Ibid.

<sup>37</sup> Anna Zinecker, et al., “Real People, Real Change: Strategies for Just Energy Transitions,” International Institute for Sustainable Development and Global Subsidies Initiative (December 2018): 7, accessed January 11, 2019, <https://www.iisd.org/sites/default/files/publications/real-people-change-strategies-just-energy-transitions.pdf>.

<sup>38</sup> Sartor, “Insights from Case Studies of Major Coal-Consuming Economies,” 31.

resources.<sup>39</sup> Additionally, these projects would require a business plan that shows a sustainable model for long-term and commercial-scale activity to be used as a substitute for fossil-fuel-reliant power generation.<sup>40</sup>

The best practices outlined above provide multiple examples of how Just Transition models can be designed to bolster a successful shift away from fossil-fuel-reliant industries. While the transition to cleaner energy has numerous societal, economic, and environmental benefits, the impact to existing industries and communities must not be overlooked.<sup>41</sup> By incorporating affected employees and stakeholders into program planning, providing clear policy guidance and funding, and considering unique regional and economic attributes that impact a program's success, Just Transition framework can be strengthened and increase the likelihood of a smooth transition. Successful execution of a Just Transition model can be an integral step in not only mitigating climate change opposition, but also ensuring that all share in the economic benefits of the transition.<sup>42</sup>

## 17.3 Methodology

This section will outline the methodology used to identify industries that would likely be impacted by the State's plan to reduce GHG emissions, as well as the identification of the specific threatened occupations within these industries. The process of identifying alternative occupations related to these threatened occupations is also discussed, as well as the methods of estimating potential fiscal impacts resulting from reduced activity in fossil-fuel-reliant industries. Lastly, the process by which training opportunities in the state were obtained is also reviewed.

### 17.3.1 Identification of Industries of Focus

To determine which industries would be most impacted by the State's GHG reduction strategies, RESI first identified industries related to the supply chain for energy derived from coal, oil, and gas. Broadly, these core industries were coal mining, power plant operation, heavy manufacturing, pipeline transport, coal transport (rail), and gas stations. RESI defined these industries using North American Industry Classification System (NAICS) codes. For two industries of interest—Pipeline Transportation of Crude Oil (NAICS 4861) and Pipeline Transportation of Natural Gas (NAICS 4862)—industry data were suppressed and unavailable at the state level. Data suppression often occurs when there are a limited number of establishments in the industry and data disclosure could enable identification of unique companies. For Rail Transportation (NAICS 4821), data were not available due to reporting

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<sup>39</sup> Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 31.

<sup>40</sup> Ibid.

<sup>41</sup> Arjin Makhijani, "Beyond a Band-Aid: A Discussion Paper on Protecting Workers and Communities in the Great Energy Transition," Institute for Energy and Environmental Research (June 10, 2016): 2-3, accessed October 2, 2018, [https://ieer.org/wp/wp-content/uploads/2016/06/beyond-a-band-aid-just-energy-transition\\_2016\\_LNS-IEER.pdf](https://ieer.org/wp/wp-content/uploads/2016/06/beyond-a-band-aid-just-energy-transition_2016_LNS-IEER.pdf).

<sup>42</sup> Makhijani, "Beyond a Band-Aid: A Discussion Paper on Protecting Workers and Communities in the Great Energy Transition," 2-3.

limitations related to the railroad unemployment insurance system.<sup>43</sup> After evaluating data availability and relevance for detailed industries within the broader coal supply chain industries, six industries for further evaluation were determined:

- Fossil Fuel Electric Power Generation,
- Gasoline Stations,
- Petroleum and Coal Products Manufacturing,
- Natural Gas Distribution,
- Steel Product Manufacturing from Purchased Steel, and
- Coal Mining.

In addition to the six core industries of focus that were identified, RESI also utilized 2016 input-output tables from the U.S. Bureau of Economic Analysis (BEA) to identify additional related industries. The BEA's input-output tables show the interactions of industries through the inputs to, and outputs from, one another.<sup>44</sup> RESI used these tables to consider additional industries that would likely be negatively impacted by decreased operations. After evaluating these relationships, detailed NAICS within the industries of nonmetallic mineral products, primary metals, fabricated metal products, and chemical products were also included in the data analysis to identify threatened occupations.

### 17.3.2 Identification of Threatened Occupations

RESI then utilized an industry to occupation crosswalk obtained from the U.S. Bureau of Labor Statistics (BLS).<sup>45</sup> This file shows the national-level distribution of specific occupations by industry, allowing for an estimation of an approximate industry-specific occupational proportion. Because standard occupational codes (SOCs) are spread across numerous industries in varying concentrations, RESI needed to more specifically identify the proportion of employees in each occupation that work in the identified threatened industries. As a hypothetical example, although there may be a total of 100 workers within the human resources managers occupation for a specific geographical area, these managers could be spread throughout a number of industries such as retail trade, manufacturing, or healthcare.

Using these national-level proportions, RESI then applied the estimated employment percentage for each occupation to 2017 Maryland-level industry data from the BLS Quarterly Census of Employment of Wages (QCEW).<sup>46</sup> This resulted in a file that estimated the number of employees by occupation for each industry within Maryland. The file was subsequently restricted to those industries which were identified to be fossil-fuel dependent. Employment

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<sup>43</sup> "QCEW Overview," U.S. Bureau of Labor Statistics, last modified July 18, 2018, accessed October 15, 2018, <https://www.bls.gov/cew/cewover.htm>.

<sup>44</sup> "Input-Output Accounts Data," U.S. Bureau of Economic Analysis, accessed October 15, 2018, <https://www.bea.gov/industry/input-output-accounts-data>.

<sup>45</sup> "May 2017 National Industry-Specific Occupational Employment and Wage Estimates," U.S. Bureau of Labor Statistics, accessed October 15, 2018, <https://www.bls.gov/oes/2017/may/oessrci.htm#00>.

<sup>46</sup> "Quarterly Census of Employment and Wages: Private, All Industry Aggregations, Maryland," U.S. Bureau of Labor Statistics, accessed October 15, 2018, <http://www.bls.gov/cew/data/api/2017/a/area/24000.csv>.

figures relevant to each threatened industry of focus were then aggregated and sorted, which produced a list of key threatened occupations in the state. To avoid only focusing on only a small subgroup of occupations, jobs with common three-and four-digit SOCs were grouped together. Occupations of focus were selected from these groups based on the number of employees within the profession, relevance to the threatened industry, and to represent a broad mix of occupations. A full list of considered occupations can be found in Appendix A.

### 17.3.3 Identification of Related Occupations

After identifying the threatened occupations of focus, RESI evaluated alternative options for individuals currently working in these jobs. The related occupations were chosen based on several factors, including skill transfers, existing patterns of employment changes, growth projections, and salary expectations.

RESI created an occupational matrix that included employment changes obtained from resume and occupational data through Maryland Workforce Exchange (MWE).<sup>47</sup> Resume data included jobs which workers had moved to or from, and the number of individuals making this job change. In addition to identifying related occupations through resume data, the Occupational Information Network (O\*Net) database was also utilized to determine related jobs based on employment characteristics.<sup>48</sup> Occupational data through MWE included skills, certifications, and technologies associated with job postings. These data were merged with occupational growth projections from the BLS, as well as typical education and training requirements needed for entry into the occupation.<sup>49,50</sup> State-level wage data were also obtained from the BLS; for most occupations the most recent year available was 2017.<sup>51</sup> For several occupations, however, 2016 figures were the most recently available at the state level.<sup>52</sup>

For each threatened occupation, the related professions were sorted based on projected growth levels. Those jobs with projected negative growth were eliminated, as well as those with significantly lower median annual wages compared to the threatened occupation or that were also in fossil-fuel-reliant industries. Education and training requirements were considered, with those jobs requiring education levels close to that of the threatened occupation, or slightly above, being the most desirable. Using these criteria, the most relevant jobs were retained and

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<sup>47</sup> "Occupational Summary," Maryland Workforce Exchange, accessed November 19, 2018, <https://mwejobs.maryland.gov/vosnet/lmi/default.aspx?pu=1&plang=E>.

<sup>48</sup> "About O\*Net," O\*Net Resource Center, accessed November 19, 2018, <https://www.onetcenter.org/overview.html>.

<sup>49</sup> "Employment Projections," U.S. Bureau of Labor Statistics, last modified January 30, 2018, accessed October 16, 2018, <https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm>.

<sup>50</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics, last modified October 24, 2017, accessed October 16, 2018, <https://www.bls.gov/emp/tables/education-and-training-by-occupation.htm>.

<sup>51</sup> "May 2017 State Occupational Employment and Wage Estimates: Maryland," U.S. Bureau of Labor Statistics, last modified March 30, 2018, accessed October 16, 2018, [https://www.bls.gov/oes/current/oes\\_md.htm](https://www.bls.gov/oes/current/oes_md.htm).

<sup>52</sup> "May 2016 State Occupational Employment and Wage Estimates: Maryland," U.S. Bureau of Labor Statistics, last modified March 31, 2017, accessed October 16, 2018, [https://www.bls.gov/oes/2016/may/oes\\_md.htm#19-0000](https://www.bls.gov/oes/2016/may/oes_md.htm#19-0000).

focused on as potential alternative employment opportunities for each threatened occupation.

### 17.3.4 Estimating Fiscal Impacts

In order to estimate the potential fiscal impacts resulting from industry closures, RESI first collected data on each industry of interest within the state of Maryland. Using 2017 annual averages from BLS QCEW, RESI evaluated the number of firms in each industry of focus, as well as the number of employees and total wages.<sup>53</sup> The average figures per firm were then calculated to provide an approximate reference for the size of each establishment.

The IMPLAN input/output model was then used to calculate the expected fiscal impacts resulting from a closure of an ‘average’ firm for each industry type within the state of Maryland. The IMPLAN model has the ability to enumerate the economic and fiscal impact of each dollar earned and spent by the following: employees of the firm, other supporting vendors (business services, retail, etc.), each dollar spent by these vendors on other firms, and each dollar spent by the households of the firm’s employees, other vendors’ employees, and other businesses’ economic impacts that result from households increasing their purchases at local businesses.

Economists measure three types of economic impacts: direct, indirect, and induced impacts. The direct economic effects are generated as the event creates jobs and hires workers to support the event’s activities. The indirect economic impacts occur as vendors purchase goods and services from other firms. In either case, the increases in employment generate an increase in household income, as new job opportunities are created and income levels rise. This drives the induced economic impacts that result from households increasing their purchases at local businesses.

The fiscal impacts generated by IMPLAN include direct, indirect, and induced impacts. As noted in Section 17.4, fiscal impacts for each standalone industry cannot be combined due to the potential for double counting.<sup>54</sup> To more clearly differentiate state and local taxes, beyond the categories provided (e.g., property taxes, payroll taxes, etc.) RESI evaluated tax structures from the U.S. Census, to obtain approximate breakdowns between state and local tax revenues.<sup>55</sup> Using these approximations, RESI applied ratios to the fiscal impacts estimated by IMPLAN for each industry.

RESI’s analysis includes the following modeling assumptions.

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<sup>53</sup> “Quarterly Census of Employment and Wages: 2017, Annual Averages,” U.S. Bureau of Labor Statistics, last modified March 7, 2017, accessed December 19, 2018,

[https://data.bls.gov/cew/apps/data\\_views/data\\_views.htm#tab=Tables](https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables).

<sup>54</sup> Fiscal impacts include not only direct effects, but also indirect and induced effects which often overlap over different industries. For example, a coal mining firm may be considered an input or supplier to a fossil fuel electric power generation firm. The fiscal impacts resulting from the closure of a fossil fuel electric power generation firm would include impacts from the coal mining firm. Because of this, fiscal impacts should be interpreted independently by industry and not combined, because doing so could show impacts that are artificially large.

<sup>55</sup> “State and Local Government Finances by Level of Government and by State: 2015,” U.S. Census Bureau, American Factfinder, last updated October 19, 2017, accessed January 10, 2019,

<https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>.

- Economic impact multipliers are developed from IMPLAN input/output software.
- IMPLAN data are based on the North American Industrial Classification System (NAICS).
- IMPLAN employment multipliers are adjusted for inflation using the Bureau of Labor Statistic’s CPI-U.
- Impacts are based on 2016 IMPLAN data for the state of Maryland.
- Impacts are represented in 2019 dollars.

**17.3.5 Training Opportunities**

RESI utilized a number of sources to gain information on job training for related occupations. Sources included career planning websites, local training finder websites, industry group information pages, and occupational databases such as O\*Net. More specific information on programs and courses was obtained through college or training institution websites. For some occupations, such as nursing assistants, State requirements were also considered in training research. To provide additional employment context, data were also obtained on the number of job postings through Maryland Workforce Exchange to specify the areas within the state where positions were available as of November 2018.

**17.4 Industries of Focus**

As described in Section 17.3, six fossil-fuel-reliant industries were chosen for further analysis, based on relevance to the coal, oil, and gas supply chains. The following section will briefly describe each industry within Maryland and the estimated state and local fiscal impacts associated with potential firm reductions. Note that fiscal impacts presented for each industry include direct, indirect, and induced impacts. Because of this, fiscal impacts for standalone industries cannot be combined due to the potential for double counting.<sup>56</sup>

A summary of each fossil-fuel-reliant industry of focus is shown below in Figure 5 below. Data reflect 2017 annual averages.

**Figure 5: Industries of Focus**

NAICS	Industry	Maryland Employment	Total Wages
221112	Fossil Fuel Electric Power Generation	2,298	\$388,125,553
4471	Gasoline Stations	11,476	\$261,048,950
3241	Petroleum and Coal Products Manufacturing	848	\$70,113,044
2212	Natural Gas Distribution	587	\$50,083,767
3312	Steel Product Manufacturing from Purchased Steel	169	\$10,645,755
2121	Coal Mining	80	\$5,145,469

<sup>56</sup> Fiscal impacts include not only direct effects, but also indirect and induced effects which often overlap over different industries. For example, a coal mining firm may be considered an input or supplier to a fossil fuel electric power generation firm. The fiscal impacts resulting from the closure of a fossil fuel electric power generation firm would include impacts from the coal mining firm. Because of this, fiscal impacts should be interpreted independently by industry and not combined, because doing so could show impacts that are artificially large.

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, the six industries of focus vary considerably in both employment and total wages. The following subsections provide a more detailed breakdown of each industry, including the total number of firms, average employment per firm, and wages per firm. Additionally, estimated fiscal losses associated with the closure of an average firm are shown for each industry.

**17.4.1 Fossil Fuel Electric Power Generation**

Figure 6 below shows the industry summary for Fossil Fuel Electric Power Generation in Maryland during 2017.

**Figure 6: Fossil Fuel Electric Power Generation, 2017 Maryland Industry Summary**

Metric	Total
Total Firms	27 Firms
Total Workers	2,298 Employees
Total Wages	\$388,125,553
Average Workers Per Firm	85 Employees
Average Wages Per Firm	\$14,375,020

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, a total of 2,298 employees worked in the industry in 2017 with total Maryland wages of \$388.1 million. There were approximately 27 firms in the state within the Fossil Fuel Electric Power Generation industry, having an average of 85 employees per firm. Of the six industries evaluated, fossil fuel electric power plants have the most average employees per firm. This reflects the nature of modern power plants (and utility companies in general) which possess economies of scale—larger facilities with high entry costs and a relatively limited number of firms.

Figure 7 below provides an estimated fiscal impact summary for a Fossil Fuel Electric Power Generation firm in Maryland. These figures provide a hypothetical example of fiscal losses that would be attributed to the closing of a single firm within the industry. While input data reflects the most recently available 2017 figures from the BLS, impact dollars are represented in 2019 dollars.

**Figure 7: Fossil Fuel Electric Power Generation – Fiscal Impacts, Average Firm**

Type	State	Local	Total
Property	\$426,054	\$4,966,037	\$5,392,091
Income	\$548,419	\$320,046	\$868,465
Sales	\$5,092,518	\$517,129	\$5,609,647
Payroll	\$32,027	\$6,589	\$38,616
Other	\$1,104,023	\$478,985	\$1,583,007

<b>Total</b>	<b>\$7,203,040</b>	<b>\$6,288,787</b>	<b>\$13,491,826</b>
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Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

Of the total \$13.5 million in estimated annual taxes paid by each firm, approximately \$7.2 million would be allocated to the State while \$6.3 million would be paid to local governments. Combined, State sales tax and Local property tax account for \$10.1 million—roughly 75 percent of all taxes paid by each Maryland Fossil Fuel Electric Power Generation firm. Individual plant closures would have the most significant effect on tax revenue of any of the industries evaluated—total fiscal impacts from the closing of one Fossil Fuel Electric Power Generation plant are equivalent to the closure of roughly 133 gas stations for example.

**17.4.2 Gasoline Stations**

Figure 8 below shows the industry summary for Gasoline Stations in Maryland during 2017.

**Figure 8: Gasoline Stations, 2017 Maryland Industry Summary**

<b>Metric</b>	<b>Total</b>
Total Firms	1,397 Firms
Total Workers	11,476 Employees
Total Wages	\$261,048,950
Average Workers Per Firm	8 Employees
Average Wages Per Firm	\$186,864

Sources: RESI, U.S. Bureau of Labor Statistics

As illustrated above, a total of 11,476 employees worked in Gasoline Stations in 2017 with total Maryland wages of \$261.0 million. There were approximately 1,397 firms in the state within the industry, having an average of eight employees per firm. Of the six industries evaluated, Gasoline Stations had the fewest average employees and, by far, the lowest average wages per firm. Further, while the five other industries evaluated each had less than 100 firms each, there were 1,397 Gasoline Stations within the state.

Figure 9 below provides an estimated fiscal impact summary for an average Gasoline Station in Maryland. These figures represent the estimated revenue losses to state and local governments resulting from the closure of a single station.

**Figure 9: Gasoline Stations – Fiscal Impacts, Average Firm**

<b>Type</b>	<b>State</b>	<b>Local</b>	<b>Total</b>
Property	\$2,831	\$32,999	\$35,830
Income	\$12,280	\$7,166	\$19,446
Sales	\$33,689	\$3,421	\$37,110
Payroll	\$469	\$97	\$566
Other	\$7,751	\$4,256	\$12,007
<b>Total</b>	<b>\$57,020</b>	<b>\$47,939</b>	<b>\$104,959</b>

Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

Of the total \$0.1 million in estimated annual taxes paid by each firm, approximately \$57,020 would be allocated to the State while \$47,939 would be paid to local governments. Sales and property taxes comprise the largest components of total fiscal revenues, at \$37,110 and \$35,830, respectively. Although an individual firm closure will have notably less-pronounced economic consequences with regard to taxes compared to the other industries examined, there are significantly more total firms across the state.

### 17.4.3 Petroleum and Coal Products Manufacturing

Figure 10 below illustrates the industry summary for Petroleum and Coal Products Manufacturing in Maryland during 2017.

**Figure 10: Petroleum and Coal Products Manufacturing, 2017 Maryland Industry Summary**

Metric	Total
Total Firms	55 Firms
Total Workers	848 Employees
Total Wages	\$70,113,044
Average Workers Per Firm	15 Employees
Average Wages Per Firm	\$1,274,783

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, a total of 848 employees worked in the industry in 2017 with total Maryland wages of \$70.1 million. There were approximately 55 firms in the state within the Petroleum and Coal Products Manufacturing industry, having an average of 15 employees per firm. Compared to the other five industries examined, this industry had both the second-lowest wages per firm and second-lowest average workers per firm.

Figure 11 below shows an estimated fiscal impact summary for the average Petroleum and Coal Products Manufacturing firm in Maryland.

**Figure 11: Petroleum and Coal Products Manufacturing – Fiscal Impacts, Average Firm**

Type	State	Local	Total
Property	\$6,005	\$69,999	\$76,004
Income	\$46,028	\$26,861	\$72,889
Sales	\$71,112	\$7,221	\$78,333
Payroll	\$2,749	\$566	\$3,315
Other	\$22,078	\$11,564	\$33,640
<b>Total</b>	<b>\$147,973</b>	<b>\$116,210</b>	<b>\$264,181</b>

Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

Of the nearly \$0.3 million in total estimated annual taxes paid by an average firm, over \$0.1

million each would be allocated to both the state and local governments, respectively. Sales, property, and income taxes comprise the largest components of total fiscal revenues, respectively. Overall, the Petroleum and Coal Products Manufacturing industry would represent the second-lowest revenue losses to state and local governments, per firm, compared to the other industries evaluated.

#### 17.4.4 Natural Gas Distribution

Figure 12 below details the industry summary for Natural Gas Distribution in Maryland during 2017.

**Figure 12: Natural Gas Distribution, 2017 Maryland Industry Summary**

Metric	Total
Total Firms	19 Firms
Total Workers	587 Employees
Total Wages	\$50,083,767
Average Workers Per Firm	31 Employees
Average Wages Per Firm	\$2,635,988

Sources: RESI, U.S. Bureau of Labor Statistics

As shown above, a total of 587 employees worked in the industry in 2017 with total Maryland wages of \$50.1 million. There were approximately 19 firms in the state within the Natural Gas Distribution industry, having an average of 31 employees per firm.

Figure 13 below provides an estimated fiscal impact summary for an average Natural Gas Distribution firm in Maryland. These figures represent the estimated losses that would be incurred by state and local governments resulting from the closure of a single firm.

**Figure 13: Natural Gas Distribution – Fiscal Impacts, Average Firm**

Type	State	Local	Total
Property	\$58,270	\$679,195	\$737,465
Income	\$139,992	\$81,697	\$221,689
Sales	\$695,357	\$70,611	\$765,968
Payroll	\$7,009	\$1,442	\$8,451
Other	\$136,146	\$73,398	\$209,545
<b>Total</b>	<b>\$1,036,774</b>	<b>\$906,343</b>	<b>\$1,943,118</b>

Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

Of the more than \$1.9 million in total estimated annual taxes paid by each firm, approximately \$1.0 million would be received by the State while \$0.9 million would be paid to local governments. Sales and property taxes comprise the largest components of total fiscal revenues, at approximately \$0.8 million and \$0.7 million, respectively.

### 17.4.5 Steel Product Manufacturing from Purchased Steel

Figure 14 below shows the industry summary for Steel Product Manufacturing from Purchased Steel in Maryland during 2017.

**Figure 14: Steel Product Manufacturing, 2017 Maryland Industry Summary**

Metric	Total
Total Firms	5 Firms
Total Workers	169 Employees
Total Wages	\$10,645,755
Average Workers Per Firm	34 Employees
Average Wages Per Firm	\$2,129,151

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, a total of 169 employees worked in the industry in 2017 with total Maryland wages of \$10.7 million. There were approximately five firms in the state within the Steel Product Manufacturing industry, having an average of 34 employees per firm. This industry accounted for the second-lowest total wages of those industries evaluated and was tied with the Coal Mining industry as having the fewest number of firms in the state.

Figure 15 below shows a summary of the estimated fiscal losses from the closure of an average Steel Product Manufacturing firm in Maryland.

**Figure 15: Steel Product Manufacturing – Fiscal Impacts, Average Firm**

Type	State	Local	Total
Property	\$13,691	\$159,579	\$173,270
Income	\$83,773	\$48,888	\$132,661
Sales	\$162,486	\$16,500	\$178,986
Payroll	\$5,300	\$1,091	\$6,391
Other	\$49,122	\$23,728	\$72,852
<b>Total</b>	<b>\$314,372</b>	<b>\$249,786</b>	<b>\$564,160</b>

Sources: IMPLAN, RESI, U.S. Census

Of the nearly \$0.6 million in total estimated annual taxes paid by each firm, over \$0.3 million would be allocated to the State while more than \$0.2 million would be paid to local governments. Sales and property taxes comprise the largest components of total fiscal revenues, at roughly \$0.2 million each.

### 17.4.6 Coal Mining

Figure 16 below shows the industry summary for Coal Mining in Maryland during 2017.

**Figure 16: Coal Mining, 2017 Maryland Industry Summary**

<b>Metric</b>	<b>Total</b>
Total Firms	5 Firms
Total Workers	80 Employees
Total Wages	\$5,145,469
Average Workers Per Firm	16 Employees
Average Wages Per Firm	\$1,029,094

Sources: RESI, U.S. Bureau of Labor Statistics

In 2017, a total of 80 employees worked in the Coal Mining industry in Maryland with combined wages of \$5.1 million. There were approximately five firms in the state within this industry, having an average of 16 employees per firm. Among the six industries evaluated, the Coal Mining industry in Maryland had the lowest total wages, and was tied with Steel Product Manufacturing as having the fewest number of firms.

Figure 17 below shows the estimated fiscal impact summary for an average Coal Mining firm in Maryland. These results represent the estimated revenue losses to state and local governments resulting from the closure of a single firm.

**Figure 17: Coal Mining – State and Local Fiscal Impacts, Average Firm**

<b>Type</b>	<b>State</b>	<b>Local</b>	<b>Total</b>
Property	\$68,110	\$793,886	\$861,996
Income	\$63,832	\$37,251	\$101,083
Sales	\$814,523	\$82,712	\$897,235
Payroll	\$3,560	\$733	\$4,293
Other	\$173,698	\$73,590	\$247,289
<b>Total</b>	<b>\$1,123,723</b>	<b>\$988,172</b>	<b>\$2,111,896</b>

Sources: IMPLAN, RESI, U.S. Bureau of Labor Statistics, U.S. Census

A total of \$2.1 million in estimated annual taxes is generated by each firm, with approximately \$1.1 million allocated to the State and \$1.0 million paid to local governments. Sales and property taxes comprise the largest components of total fiscal revenues, at approximately \$0.9 million each. The revenue losses from a single coal mining firm represent the second-highest of the industries evaluated.

As shown throughout this section, the size and scope of the evaluated industries vary substantially, with total Maryland employment ranging from 80 to 11,476. Estimated fiscal losses to state and local governments also had a considerable range, with a low of \$0.1 million per Gasoline Station to \$13.5 million per Fossil Fuel Electric Power Generation firm. These figures provide an estimate of the employment and fiscal impacts that would result from decreased operations within these industries of focus.

## 17.5 Occupational Transitions

RESI evaluated key threatened occupations resulting from State climate change mitigation strategies, as determined in the methodology outlined in Section 17.3. This section will provide a summary of these occupations, as well as related professions to each threatened occupation. For several of these related occupations, the requirements and opportunities for entry are discussed in greater detail. In addition, alternative strategies for transitioning fossil-fuel-reliant workers that have been explored are also described.

These five key threatened occupations are summarized in Figure 18 below.

**Figure 18: Key Threatened Occupations**

Occupation	SOC Code	Total Maryland Employment	Employment in Fossil-Fuel-Reliant Industries
Cashiers	41-2011	79,000	7,545
Machinists	51-4041	2,820	626
First-Line Supervisors of Production and Operating Workers	51-1011	6,780	257
Petroleum Pump System Operators, Refinery Operators, and Gaugers	51-8093	140	140
Inspectors, Testers, Sorters, Samplers, and Weighers	51-9061	4,060	168

Sources: RESI, U.S. Bureau of Labor Statistics

As detailed above, of the five key threatened occupations, four fall under major SOC code 51, Production Occupations. The most-heavily impacted of these professions is petroleum pump system operators, refinery operators, and gaugers, for which all Maryland positions are estimated to be affected. While the greatest number of employees potentially displaced from fossil-fuel-reliant occupations are cashiers, the number of affected workers represents approximately 9.6 percent of all workers in Maryland within this position.

The following subsection will detail occupations that are related to each of the threatened occupations shown in Figure 18 above.

### 17.5.1 Related Occupations

In 2017, there were approximately 79,000 cashiers in Maryland; of these, an estimated 7,545 would potentially be impacted by State climate change mitigation strategies. Figure 19 below outlines occupations related to cashiers, as well as entry requirements, growth projections, and 2017 median wages. Please note that in the following tables abbreviations are used for high school diploma or equivalent (HS/Equivalent) and on-the-job (OTJ) training.



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**Figure 19: Related Occupations, Cashiers**

Occupation	Code	Minimum Education	On-the-Job Training	Projected Growth 2016-2026	Maryland Employment	Median Maryland Wage
<b>Cashiers</b>	<b>41-2011</b>	<b>No formal credential</b>	<b>Short-term OTJ</b>	<b>-0.9%</b>	<b>79,000</b>	<b>\$20,363</b>
Combined food preparation and serving workers, including fast food	35-3021	No formal credential	Short-term OTJ	16.8%	53,330	\$20,738
<b>Nursing assistants</b>	<b>31-1014</b>	<b>Postsecondary non-degree award</b>	<b>None</b>	<b>11.5%</b>	<b>28,250</b>	<b>\$29,640</b>
<b>Receptionists and information clerks</b>	<b>43-4171</b>	<b>HS/Equivalent</b>	<b>Short-term OTJ</b>	<b>9.1%</b>	<b>18,640</b>	<b>\$35,984</b>
Laborers and freight, stock, and material movers, hand	53-7062	No formal credential	Short-term OTJ	7.6%	42,370	\$27,456
Waiters and waitresses	35-3031	No formal credential	Short-term OTJ	7.0%	41,630	\$19,843
Maids and housekeeping cleaners	37-2012	No formal credential	Short-term OTJ	6.1%	16,640	\$23,483
Counter and rental clerks	41-2021	No formal credential	Short-term OTJ	5.5%	10,260	\$30,326
Stock clerks and order fillers	43-5081	HS/Equivalent	Short-term OTJ	5.0%	38,150	\$23,962

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

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As shown above, the majority of positions related to cashiers require a limited amount of education and training, such as short-term on-the job and a high school diploma or less. One of the highlighted occupations, nursing assistants, does require a postsecondary non-degree award. This position also has a significantly higher median wage than cashiers (\$29,738 for nursing assistants vs. \$20,363 for cashiers), and a high projected growth rate of 11.5 percent. The other highlighted occupation, receptionists and information clerks, has significant projected growth of 9.1 percent and a median wage in 2017 of \$35,984. Training opportunities for each of these professions are discussed in Section 17.5.2.

Figure 20 below details several occupations related to machinists, as well as entry requirements, growth projections, and 2017 median wages. Of the 2,820 machinists in the state, 626 are estimated to be potentially impacted by State climate change mitigation strategies.

Figure 20: Related Occupations, Machinists

Occupation	Code	Minimum Education	On-the-Job Training	Projected Growth 2016-2026	Maryland Employment	Median Maryland Wage
<b>Machinists</b>	<b>51-4041</b>	<b>HS/Equivalent</b>	<b>Long-term OTJ</b>	<b>2.0%</b>	<b>2,820</b>	<b>\$43,306</b>
<b>Computer numerically controlled machine tool programmers, metal and plastic</b>	<b>51-4012</b>	<b>Postsecondary non-degree award</b>	<b>Moderate-term OTJ</b>	<b>16.3%</b>	<b>270</b>	<b>\$54,829</b>
Construction laborers	47-2061	No formal credential	Short-term OTJ	12.4%	19,640	\$32,822
Maintenance and repair workers, general	49-9071	HS/Equivalent	Moderate-term OTJ	7.9%	21,590	\$41,101
<b>Heavy and tractor-trailer truck drivers</b>	<b>53-3032</b>	<b>Postsecondary non-degree award</b>	<b>Short-term OTJ</b>	<b>5.8%</b>	<b>23,640</b>	<b>\$45,594</b>
Computer-controlled machine tool operators, metal and plastic	51-4011	HS/Equivalent	Moderate-term OTJ	1.1%	1,060	\$43,306

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

Educational requirements for occupations related to machinists have more variation, ranging from no formal education to postsecondary non-degree awards. Similarly, on-the-job training needed for these positions range from short-term to moderate-term. The first highlighted occupation, computer numerically controlled machine tool programmers, metal and plastic, typically requires a postsecondary non-degree award and moderate-term on-the-job training. This position has a substantially higher median wage compared to machinists (\$43,306 for machinists vs. \$54,829 for computer numerically controlled machine tool programmers), and projected growth of 16.3 percent. The second highlighted occupation, heavy and tractor-trailer truck drivers, also requires a postsecondary non-degree award but only short-term on-the-job training. This occupation has projected growth of 5.8 percent and a median wage in 2017 of \$45,594. Training opportunities for each of these professions are discussed in Section 17.5.2.

Figure 21 below details several occupations related to first-line supervisors of production and operating workers. Of the 6,780 individuals employed in this occupation within the state, 257 are estimated to be potentially impacted by State climate change mitigation strategies.

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**Figure 21: Related Occupations, First-Line Supervisors of Production and Operating Workers<sup>57</sup>**

Occupation	Code	Minimum Education	On-the-Job Training	Projected Growth 2016-2026	Maryland Employment	Median Maryland Wage
<b>First-line supervisors of production and operating workers</b>	<b>51-1011</b>	<b>HS/Equivalent</b>	<b>None</b>	<b>-0.30%</b>	<b>6,780</b>	<b>\$59,946</b>
<b>First-line supervisors of construction trades and extraction workers</b>	<b>47-1011</b>	<b>HS/Equivalent</b>	<b>None</b>	<b>12.6%</b>	<b>15,520</b>	<b>\$67,330</b>
General and operations managers	11-1021	Bachelor's degree	None	9.1%	47,360	\$119,434
First-line supervisors of helpers, laborers, and material movers, hand	53-1021	HS/Equivalent	None	8.5%	3,720*	\$47,278*
<b>First-line supervisors of mechanics, installers, and repairers</b>	<b>49-1011</b>	<b>HS/Equivalent</b>	<b>None</b>	<b>7.1%</b>	<b>10,180</b>	<b>\$65,728</b>
First-line supervisors of transportation and material-moving machine and vehicle operators	53-1031	HS/Equivalent	None	6.6%	4,790*	\$60,674*
Aircraft cargo handling supervisors	53-1011	HS/Equivalent	None	5.9%	190	\$42,827
<b>Engineering technicians, except drafters, all other</b>	<b>17-3029</b>	<b>Associate degree</b>	<b>None</b>	<b>5.2%</b>	<b>1,730</b>	<b>\$86,445</b>

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

<sup>57</sup> Note that figures marked with an asterisk (\*) represent employment and wage estimates from 2016, the most recent available at the state level.

For the occupations related to first-line supervisors of production and operating workers, all are estimated by the BLS to require no on-the-job training. This is likely because supervisors will have knowledge of the requirements for their supervisees due to prior experience. Educational requirements for these positions vary, however, ranging from a high school diploma to bachelor's degree. Two highlighted occupations, first-line supervisors of construction trades and extraction workers, and first-line supervisors of mechanics, installers, and repairers, typically require a high school diploma or equivalent and no on-the-job training. These positions both have higher median wages compared to first-line supervisors of production and operating workers (\$67,330 and \$65,728 vs. \$59,946 for first-line supervisors of production and operating workers), and have projected growth rates of 12.6 percent and 7.1 percent, respectively. The third highlighted occupation, engineering technicians, except drafters, typically requires an associate degree yet has a substantially higher median wage of \$86,445. Moderate growth is projected for engineering technicians at 5.2 percent. Training opportunities for each of these professions are discussed in Section 17.5.2.

Figure 22 outlines several occupations related to petroleum pump system operators, refinery operators, and gaugers. This occupation is estimated to have the greatest proportion of workers potentially impacted by State climate change mitigation strategies, with all 140 individuals in the position potentially affected.

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**Figure 22: Related Occupations, Petroleum Pump System Operators, Refinery Operators, and Gaugers**

Occupation	Code	Minimum Education	On-the-Job Training	Projected Growth 2016-2026	Maryland Employment	Median Maryland Wage
<b>Petroleum pump system operators, refinery operators, and gaugers</b>	<b>51-8093</b>	<b>HS/Equivalent</b>	<b>Moderate-term OTJ</b>	<b>2.8%</b>	<b>140</b>	<b>\$48,838</b>
Pile-driver operators	47-2072	HS/Equivalent	Moderate-term OTJ	14.6%	90	\$49,317
<b>Operating engineers and other construction equipment operators</b>	<b>47-2073</b>	<b>HS/Equivalent</b>	<b>Moderate-term OTJ</b>	<b>12.3%</b>	<b>4,610</b>	<b>\$47,070</b>
Transportation vehicle, equipment and systems inspectors, except aviation	53-6051	HS/Equivalent	Moderate-term OTJ	5.9%	290	\$53,102
<b>Heavy and tractor-trailer truck drivers</b>	<b>53-3032</b>	<b>Postsecondary non-degree award</b>	<b>Short-term OTJ</b>	<b>5.8%</b>	<b>23,640</b>	<b>\$45,594</b>
<b>Engineering technicians, except drafters, all other</b>	<b>17-3029</b>	<b>Associate degree</b>	<b>None</b>	<b>5.2%</b>	<b>1,730</b>	<b>\$86,445</b>
Mechanical engineering technicians	17-3027	Associate degree	None	5.0%	670	\$57,366
<b>Stationary engineers and boiler operators</b>	<b>51-8021</b>	<b>HS/Equivalent</b>	<b>Long-term OTJ</b>	<b>5.0%</b>	<b>1,160</b>	<b>\$56,410</b>
Control and valve installers and repairers, except mechanical door	49-9012	HS/Equivalent	Moderate-term OTJ	4.9%	1,280	\$56,035

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

Occupations related to petroleum pump system operators, refinery operators, and gaugers show significant variation in estimated training and educational requirements for entry. The first highlighted occupation, Operating engineers and other construction equipment operators, generally requires a high school diploma or equivalent for entry and moderate-term on-the-job training. This profession has the highest projected growth rate of the three highlighted positions, at 12.3 percent, and a median wage comparable to that of petroleum pump system operators, refinery operators, and gaugers. Heavy and tractor-trailer truck drivers is again highlighted, requiring a postsecondary non-degree award and short-term on-the-job training. This occupation had a slightly lower median wage than petroleum pump system operators in 2017 (\$45,594 and \$48,838, respectively), though also has substantial employment opportunities in the state with 23,640 workers in 2017. Engineering technicians, except drafters are also highlighted again, which typically requires an associate degree. This position does offer a substantially higher median wage compared to petroleum pump system operators. Moderate growth is projected for both heavy and tractor-trailer truck drivers and engineering technicians at 5.8 percent and 5.2 percent, respectively. The final highlighted occupation, stationary engineers and boiler operators, most often requires a high school diploma only but long-term on-the-job training. This occupation has projected growth of 4.8 percent and had a median wage of \$56,410 in 2017. Training opportunities for each of these highlighted professions are discussed in Section 17.5.2.

Positions related to the final threatened occupation, inspectors, testers, sorters, samplers, and weighers, are shown in Figure 23. Of the 4,060 individuals employed in this profession in Maryland, 168 workers are estimated to potentially be impacted by State climate change mitigation strategies.

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**Figure 23: Related Occupations, Inspectors, Testers, Sorters, Samplers, and Weighers**

Occupation	Code	Minimum Education	On-the-Job Training	Projected Growth 2016-2026	Maryland Employment	Median Maryland Wage
<b>Inspectors, Testers, Sorters, Samplers, and Weighers</b>	<b>51-9061</b>	<b>HS/Equivalent</b>	<b>Moderate-term OTJ training</b>	<b>-10.7%</b>	<b>4,060</b>	<b>\$46,363</b>
<b>Life, physical, and social science technicians, all other</b>	<b>19-4099</b>	<b>Associate degree</b>	<b>None</b>	<b>9.7%</b>	<b>3,150</b>	<b>\$55,598</b>
Aviation/Transportation Inspectors	53-6051	HS/Equivalent	Moderate-term OTJ training	5.9%	290	\$53,102
Welders, cutters, solderers, and brazers	51-4121	HS/Equivalent	Moderate-term OTJ training	5.6%	2,080	\$45,885
<b>Stationary engineers and boiler operators</b>	<b>51-8021</b>	<b>HS/Equivalent</b>	<b>Long-term OTJ training</b>	<b>4.8%</b>	<b>1,160</b>	<b>\$56,410</b>

Sources: Maryland Workforce Exchange, O\*Net, RESI, U.S. Bureau of Labor Statistics

For most of the occupations related to inspectors, testers, sorters, samplers, and weighers, a high school diploma plus moderate-term to long-term on-the-job training is required for entry. However, for the first highlighted occupation, life, physical, and social science technicians (all other), an associate degree is typically needed. Jobs in this field include quality control analysts, precision agriculture technicians, and remote sensing technicians.<sup>58</sup> These occupations have strong projected growth of 9.7 percent and a median annual wage of \$55,598, higher than that of inspectors, testers, sorters, samplers, and weighers (\$46,363). The second highlighted occupation, stationary engineers and boiler operators, requires a high school diploma only but long-term on-the-job training. This occupation has projected growth of 4.8 percent and had a median wage of \$56,410 in 2017. Training opportunities for each of these professions are discussed in Section 17.5.2.

While the threatened occupations discussed in this subsection represent a cross section of those likely to be affected by the State's climate change mitigation strategies, they are not an exhaustive list. Rather, identifying these threatened occupations and related occupations into which workers could transition show examples of how displaced individuals could transfer skills and knowledge into new occupations with a more positive outlook. Often, these transitions could be facilitated with very feasible training, such as obtaining a postsecondary non-degree award or associate degree, and result in higher wages.

The following subsection will detail specific training and apprenticeship programs within the state for each of the related occupations that have been highlighted.

### 17.5.2 Job Training Programs

The following subsection outlines training requirements and opportunities in Maryland for the highlighted occupations in Section 17.5.4. These career preparation opportunities include apprenticeships, training programs, and formal degree programs. While other pathways to these professions exist, this section offers potential entry strategies for those seeking to transition from fossil-fuel-dependent jobs.

#### Nursing Assistants (31-1014)

Becoming a nursing assistant typically requires a postsecondary nondegree award.<sup>59</sup> To obtain this position in Maryland, the State requires a minimum of 100 training hours and 40 clinical hours for certified nursing assistant (CNA) certification.<sup>60</sup> In general, most CNA programs take approximately four to twelve weeks to complete.<sup>61</sup> Courses typically cover a broad range of patient care including taking vital signs, personal care, nutrition requirements, promotion of exercise and activity, identification of respiratory issues, basic diabetes management, and

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<sup>58</sup> "19-4099," My Next Move, accessed December 27, 2018, <https://www.mynextmove.org/find/search?s=19-4099>.

<sup>59</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>60</sup> "Nursing Assistant Training Requirements by State," PHI, accessed December 27, 2018, <https://phinational.org/advocacy/nurse-aide-training-requirements-state-2016/>.

<sup>61</sup> "Here's What You'll Study in a CNA Degree Program," All Nursing Schools, accessed February 7, 2019, <https://www.allnursingschools.com/certified-nursing-assistant/degrees/>.

caring for individuals with cognitive impairment.<sup>62</sup> Over 100 certified CNA training programs are offered in colleges, nursing homes, and freestanding institutions in the state.<sup>63</sup> These include community colleges located in 16 Maryland counties, serving a broad area within Maryland.<sup>64</sup>

Advertised skills for individuals in this profession include customer service, providing personal care, flexibility, and recording vital signs.<sup>65</sup> The most-common certifications requested in job postings on Maryland Workforce Exchange (MWE) for nursing assistants include Certification in Cardiopulmonary Resuscitation (CPR), CNA, Basic Life Support (CPR), Emergency Medical Technician (EMT), and Advanced Cardiac Life Support Certification (ACLS). There are also a number of certifications beyond a CNA certification. Some of these require a CNA certification as a base, but others, such as the Certified Patient Care Technician certificate, do not have this prerequisite. These additional certifications include Certified Wound Care Associate, National Nurse Aide Assessment Program, Certified Hospice and Palliative Nursing Assistant, and Certified Alzheimer Caregiver.<sup>66</sup>

In November of 2018, the Maryland counties with the highest numbers of job postings for nursing assistants were Baltimore City (107), Anne Arundel County (100), Montgomery County (84), Howard County (53), Baltimore County (52), and Prince George's County (52).<sup>67</sup>

### Receptionists and Information Clerks (43-4171)

Entry into the profession of receptionists and information clerks usually requires short-term on-the-job (OTJ) training and possessing a high school diploma or equivalent.<sup>68</sup> To further education, an associate degree in administrative assistant or secretarial science may be obtained.<sup>69</sup> These degree programs typically require one to two years of academic coursework.<sup>70</sup> Maryland has a wide range of degree programs that offer specialty options dependent on occupational field. Program curriculum can be field specific in areas such as healthcare, legal and business, or general for positions in corporate or government offices.<sup>71</sup> These options include but are not limited to software application specialist, executive

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<sup>62</sup> "Online CNA Classes: What You'll Need to Know," All Nursing Schools, accessed February 7, 2019, <https://www.allnursingschools.com/certified-nursing-assistant/cna-classes/>.

<sup>63</sup> Maryland Board of Nursing, "2018 Approved CNA Training Programs," 1-5, accessed December 27, 2018, <https://mbon.maryland.gov/Documents/approved-na-training-programs.pdf>.

<sup>64</sup> Maryland Board of Nursing, "2018 Approved CNA Training Programs," 2.

<sup>65</sup> "Occupational Summary," Maryland Workforce Exchange.

<sup>66</sup> "Find Training," CareerOneStop, accessed January 23, 2018, <https://www.careeronestop.org/FindTraining/find-training.aspx>.

<sup>67</sup> "Job Search," Maryland Workforce Exchange, accessed December 20, 2018, <https://mwjobs.maryland.gov/jobbanks/default.asp?p=0&session=jobsearch&geo=> .

<sup>68</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>69</sup> "Local Training Finder – Secretaries and Administrative Assistants," My Next Move, accessed December 27, 2018, <https://www.mynextmove.org/profile/ext/training/43-6014.00?s=MD>.

<sup>70</sup> Ibid.

<sup>71</sup> "Administrative Professional – A.A.S. Degree (Career), Howard Community College, accessed February 8, 2019, <http://howardcc.smartcatalogiq.com/2018-2019/Catalog/Areas-of-Study-By-Academic-Division/Business-and-Computer-Systems-Division-Areas-of-Study/Administrative-Professional-AAS-Degree-Career>.

administrative assistant, medical office administration, and legal office administration.<sup>72</sup> Programs may also be located at a local community college or university.<sup>73</sup>

Receptionists must possess strong customer service and time management skills.<sup>74</sup> In addition, knowledge of Microsoft Office programs are typically required.<sup>75</sup> Skills needed for this profession can be built by local courses in office administration and online training for office software.<sup>76</sup> Software skills learned are also dependent upon occupation field. Jobs in the medical field may require skills in medical coding software while jobs in business may require bookkeeping software skills.<sup>77</sup> The Maryland counties with the highest numbers of job postings for receptionist and information clerks in November 2018 were Montgomery County (70), Prince George's County (48) and Anne Arundel County (38).<sup>78</sup>

### **Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic (51-4012)**

Positions as a computer numerically controlled machine tool programmers of metal and plastic typically require a postsecondary non-degree award and moderate OTJ training.<sup>79</sup> Training for this profession can generally be completed in under two years.<sup>80</sup>

The Community College of Baltimore County offers a short-term training program that combines both manual and computer numerical control technology.<sup>81</sup> This program is certified through the National Institute of Metalworking skills (NIMS) and requires six months of educational training.<sup>82</sup> The Community College of Baltimore County also offers two other computer numerical control (CNC) certifications that differ in length and requirements. The CNC machinist certification prepares students for roles as a machine operator, machinist and/or a set-up person and requires 35 credit hours.<sup>83</sup> The CNC programming certificate is the shortest

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<sup>72</sup> "Office Administration (Executive Administrative Assistant Option)," Community College of Baltimore County, accessed February 8, 2019, [http://catalog.ccbcmd.edu/preview\\_program.php?catoid=16&poid=7859&returnto=984](http://catalog.ccbcmd.edu/preview_program.php?catoid=16&poid=7859&returnto=984).

<sup>73</sup> "Local Training Finder – Secretaries and Administrative Assistants," My Next Move.

<sup>74</sup> "Occupational Summary," Maryland Workforce Exchange.

<sup>75</sup> Ibid.

<sup>76</sup> "Become a Receptionist: Educations and Career Roadmap," Study.com, accessed December 27, 2018, [https://study.com/become\\_a\\_receptionist.html](https://study.com/become_a_receptionist.html).

<sup>77</sup> "Summary Report for: 43-4171.00," O\*Net Online, accessed December 27, 2018, <https://www.onetonline.org/link/summary/43-4171.00>.

<sup>78</sup> "Job Search," Maryland Workforce Exchange.

<sup>79</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>80</sup> "Local Training Finder – Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic," My Next Move, accessed December 27, 2018, <https://www.mynextmove.org/profile/ext/training/51-4012.00?s=MD&g=Go>.

<sup>81</sup> "CNC Machine Tool, Continuing Education Certificate," Community College of Baltimore County, accessed December 27, 2018, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/ConED-Program/cnc-machine-tool>.

<sup>82</sup> Ibid.

<sup>83</sup> "CNC Machinist Certificate, Credit Certificate," Community College of Baltimore County, accessed December 27, 2018, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/program/cnc-machinist-certificate>.

in length as it only requires 24 credit hours.<sup>84</sup> This certification is designed to prepare students for employment as a CNC programmer.<sup>85</sup>

Essential skills for this position include programming, operation monitoring, and complex problem solving.<sup>86</sup> Software programs used by computer numerically controlled machine tool programmers include computer-aided design (CAD), computer-aided manufacturing (CAM), object- or component-oriented software, and Microsoft Excel.<sup>87</sup>

### **Heavy and Tractor Trailer Truck Drivers (53-3032)**

Becoming a heavy and tractor-trailer truck driver typically requires a postsecondary nondegree award and short-term OTJ training.<sup>88</sup> Potential truck drivers may attend a professional truck driving school to gain experience operating large vehicles, learn about federal regulations and laws, and earn the required commercial driver's license (CDL).<sup>89</sup> Additionally, drivers can add endorsements to their CDLs, such as the hazardous materials endorsement, which will enable them to drive a specialized type of vehicle.<sup>90</sup>

In Maryland, CDL programs provide instruction for both the written exam and driving training, and typically take between six to eight weeks for completion.<sup>91</sup> Currently, there are 16 programs in the state with an average tuition of \$4,966, though individuals seeking this training may be eligible for federal financial aid.<sup>92</sup> Local schools offering this training include Anne Arundel Community College, College of Southern Maryland, Hagerstown Community College, All-State Career, and North American Trade Schools.<sup>93</sup> Classes are often held on both weekdays and weekends, enabling more flexible training schedules.<sup>94,95,96</sup> Some programs, such as the one offered through Hagerstown Community College, provide students with both job

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<sup>84</sup> "CNC Machinist Certificate, Credit Certificate," Community College of Baltimore County.

<sup>85</sup> Ibid.

<sup>86</sup> "Summary Report for 51-4012.00," O\*Net Online, accessed January 4, 2019, <https://www.onetonline.org/link/summary/51-4012.00>.

<sup>87</sup> "Summary Report for 51-4012.00," O\*Net Online.

<sup>88</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>89</sup> "Occupational Outlook Handbook: Heavy and Tractor-trailer Truck Drivers," U.S. Bureau of Labor Statistics, last modified April 13, 2018, accessed February 7, 2019, <https://www.bls.gov/ooh/transportation-and-material-moving/heavy-and-tractor-trailer-truck-drivers.htm>.

<sup>90</sup> "Occupational Outlook Handbook: Heavy and Tractor-trailer Truck Drivers," U.S. Bureau of Labor Statistics.

<sup>91</sup> "Truck Driving Schools in Maryland," All Trucking.com, accessed December 27, 2018, <http://www.alltrucking.com/schools/maryland/truck-driving/>.

<sup>92</sup> Ibid.

<sup>93</sup> Ibid. .

<sup>94</sup> Hagerstown Community College, "Commercial Vehicle Transportation: Truck Driver Training at HCC," 1-2, accessed February 7, 2019, <http://www.hagerstowncc.edu/sites/default/files/documents/13619%20B%20Lyle%20CVT%20brochure%20UPDA%20TE.PDF>.

<sup>95</sup> "Truck Driving: Commercial Driver's License," Anne Arundel Community College, accessed February 8, 2019, <https://www.aacc.edu/programs-and-courses/job-training/truck-driving/>.

<sup>96</sup> "Commercial Driver's License (CDL) Class A," College of Southern Maryland, accessed February 8, 2019, <https://www.csmd.edu/programs-courses/non-credit/career-development/transportation/CDL-Class-A>.

placement assistance through local and national employers.<sup>97</sup>

Heavy and tractor trailer truck drivers must be in good health.<sup>98</sup> Federal regulations can prohibit those with medical conditions such as high blood pressure or epilepsy from becoming truck drivers.<sup>99</sup> Potential truck drivers will also need to pass vision and hearing tests.<sup>100</sup> Additionally, CDL drivers must have a clean driving record and be willing to take random drug tests.<sup>101</sup>

In Maryland, the number of heavy and tractor-trailer truck driver jobs is expected to grow with an average of 2,440 annual job openings.<sup>102</sup> In November of 2018, the Maryland counties with the highest numbers of job postings for heavy and tractor-trailer truck drivers were Baltimore City (188), Howard County (137), Prince George’s County (108), Baltimore County (101), and Anne Arundel County (91).<sup>103</sup>

### **First-line Supervisors of Construction Trades and Extraction Workers (47-1011)**

Jobs for first-line supervisors of construction trades and extraction workers most-often require a high school diploma or equivalent.<sup>104</sup> Many positions also require training from a vocational school, related work experience, or an associate degree.<sup>105</sup> Training is offered in building and construction site management at multiple Maryland colleges, including Community College of Baltimore County, Prince George’s Community College, and Frederick Community College.<sup>106</sup> Community College of Baltimore offer programs of varying lengths and required credit hours, such as the Construction Project Controls Certificate (12 credits), Construction Management Certificate (39 credits), First-Line Supervisor Continuing Education Certificate (six months), and an associate of applied science in construction management (60 credits).<sup>107,108,109,110</sup>

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<sup>97</sup> Hagerstown Community College, “Commercial Vehicle Transportation: Truck Driver Training at HCC,” 1-2.

<sup>98</sup> “Occupational Outlook Handbook: Heavy and Tractor-trailer Truck Drivers,” U.S. Bureau of Labor Statistics, last modified April 13, 2018, accessed February 7, 2019, <https://www.bls.gov/ooh/transportation-and-material-moving/heavy-and-tractor-trailer-truck-drivers.htm>.

<sup>99</sup> “Occupational Outlook Handbook: Heavy and Tractor-trailer Truck Drivers,” U.S. Bureau of Labor Statistics.

<sup>100</sup> Ibid.

<sup>101</sup> Ibid.

<sup>102</sup> “Long Term Occupational Projections (2016-2026): Maryland, Heavy and Tractor-Trailer Truck Drivers,” Projections Central - State Occupational Projections, accessed February 7, 2019, <http://www.projectionscentral.com/Projections/LongTerm>.

<sup>103</sup> “Job Search,” Maryland Workforce Exchange.

<sup>104</sup> “Education and Training Assignments by Detailed Occupation,” U.S. Bureau of Labor Statistics.

<sup>105</sup> “Summary Report for: 47-1011.00,” My Next Move, accessed February 7, 2019, <https://www.mynextmove.org/profile/ext/online/47-1011.00>.

<sup>106</sup> “Local Training Finder – First-Line Supervisors of Construction Trades and Extraction Workers,” My Next Move, accessed December 27, 2018, <https://www.mynextmove.org/profile/ext/training/47-1011.00?s=MD&g=Go>.

<sup>107</sup> “Construction Project Controls Certificate, Credit Certificate,” Community College of Baltimore County, accessed February 7, 2019, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/program/construction-project-controls-certificate>.

<sup>108</sup> “Construction Management Certificate, Credit Certificate,” Community College of Baltimore County, accessed February 7, 2019, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/Program/construction-management-certificate>.

Advertised job skills for this profession include customer service, problem solving, and the ability to stand for long periods of time.<sup>111</sup> Proficiency in project management software, data base user interface and query software, and calendar and scheduling software may be required in this role.<sup>112</sup> Specific programs cited for this profession include Microsoft Project and Oracle Primavera Enterprise Project Portfolio Management.<sup>113</sup> Job postings were most plentiful in November 2018 in Baltimore City (11), Prince George’s County (7), Allegany County (4), Howard County (4), and Montgomery County (4).<sup>114</sup>

### **First-line Supervisors of Mechanics, Installers, and Repairers (49-1011)**

To become a first-line supervisor of mechanics, installers, and repairers, individuals typically need a high school diploma or equivalent.<sup>115</sup> According to MWE, employees also typically need about two years of training, consisting of both on the job and informal training.<sup>116,117</sup> Operations management and supervision programs are offered by Johns Hopkins University, Morgan State University, and the University of Maryland-University College.<sup>118</sup> These programs can be completed in less than one year.<sup>119</sup> Other job titles associated with this occupation include facilities manager, facility maintenance supervisor, and maintenance manager.<sup>120</sup> The International Facility Management Association (IFMA) is an association of facility management professionals which offers a number of facility-related credential and professional

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<sup>109</sup> “First-Line Supervisor, Continuing Education Certificate,” Community College of Baltimore County, accessed February 7, 2019, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/program/first-line-supervisor>.

<sup>110</sup> “Construction Management, Associate of Applied Science,” Community College of Baltimore County, accessed February 7, 2019, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/Program/construction-management>.

<sup>111</sup> “First-Line Supervisors of Construction Trades and Extraction Workers,” Maryland Workforce Exchange, accessed February 7, 2019, <https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileSummary.aspx?session=occdetail&valueName=occupation>.

<sup>112</sup> “First-Line Supervisors of Construction Trades & Extraction Workers,” My Next Move, accessed February 7, 2019, <https://www.mynextmove.org/profile/summary/47-1011.00>.

<sup>113</sup> Ibid.

<sup>114</sup> “Job Search,” Maryland Workforce Exchange.

<sup>115</sup> “Education and Training Assignments by Detailed Occupation,” U.S. Bureau of Labor Statistics.

<sup>116</sup> “First-Line Supervisors of Mechanics, Installers, and Repairers: Description,” Maryland Workforce Exchange, accessed February 7, 2019, <https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileDetails.aspx?session=occdetail&valueName=occupation&section=description>.

<sup>117</sup> This OTJ varies from the minimum requirements provided by the U.S. BLS, which indicates that no OTJ training is required.

<sup>118</sup> “Local Training Finder: First-Line Supervisors of Mechanics, Installers, and Repairers, Maryland,” CareerOneStop, accessed on February 8, 2019, <https://www.careeronestop.org/Credentials/Toolkit/find-local-training.aspx?keyword=First-Line%20Supervisors%20of%20Mechanics%2C%20Installers%2C%20and%20Repairers&location=maryland&ajax=oc&post=y>.

<sup>119</sup> “Local Training Finder: First-Line Supervisors of Mechanics, Installers, and Repairers, Maryland,” CareerOneStop.

<sup>120</sup> “Summary Report for: 49-1011.00,” O\*Net Online, accessed February 8, 2019, <https://www.onetonline.org/link/summary/49-1011.00>.

qualifications, and may be useful in obtaining training.<sup>121,122</sup> In Maryland, Prince George's Community College and Community College of Baltimore County have partnered with the Chesapeake chapter of IFMA to offer the Facilities Management Professional certification program.<sup>123,124</sup> At Community College of Baltimore, it is a four-month program with day classes that are typically held on Fridays and Saturdays.<sup>125</sup>

These positions may utilize project management software, data base user interface and query software, and enterprise resource planning software.<sup>126</sup> Advertised job skills include (but are not limited to) customer service, welding, and preventative, general, building, and grounds maintenance.<sup>127</sup>

As recently as November 2018, Baltimore City (31), Prince George's County (21), Montgomery County (19), Howard County (14), and Baltimore County (13) were among the leaders in the most positions offered.<sup>128</sup>

### **Engineering Technicians, Except Drafters, All Other (17-3029)**

Those seeking positions as engineering technicians, except drafters, would typically need to acquire an associate degree.<sup>129</sup> Associate degree programs in engineering are offered through multiple Maryland community colleges including Carroll Community College, College of Southern Maryland, Community College of Baltimore County, Howard Community College, and Prince George's Community College.<sup>130,131,132</sup> Along with others, Howard Community College

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<sup>121</sup> "Empowering Facility Professionals Worldwide," International Facility Management Association, accessed February 8, 2019, <http://www.ifma.org/>.

<sup>122</sup> "Credentials and Continuing Education," International Facility Management Association, accessed February 7, 2019, <https://www.ifma.org/professional-development/credentials>.

<sup>123</sup> "Facility Management Credential Programs (FMP)," Prince George's Community College, accessed February 7, 2019, [http://www.pgcc.edu/Programs\\_and\\_Courses/Noncredit/Continuing\\_Education\\_Program\\_Detail.aspx?id=6442462730](http://www.pgcc.edu/Programs_and_Courses/Noncredit/Continuing_Education_Program_Detail.aspx?id=6442462730).

<sup>124</sup> "Facility Management Professional, Continuing Education Certificate," Community College of Baltimore County, accessed February 7, 2019, <http://www.ccbcmd.edu/Programs-and-Courses-Finder/ConED-Program/facility-management-professional>.

<sup>125</sup> "Facility Management Professional, Continuing Education Certificate," Community College of Baltimore County.

<sup>126</sup> "First-Line Supervisors of Mechanics, Installers, & Repairers," Federal Student Aid, accessed February 7, 2019, <https://studentaid.ed.gov/sa/prepare-for-college/students/career-search/profile/summary/49-1011.00>.

<sup>127</sup> "First-Line Supervisors of Mechanics, Installers, and Repairers: Skills," Maryland Workforce Exchange, accessed February 7, 2019,

<https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileDetails.aspx?session=occdetail&valueName=occupation&section=skillstools>.

<sup>128</sup> "Job Search," Maryland Workforce Exchange.

<sup>129</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>130</sup> "Electronic Engineering Technology Courses in Maryland," Study.com, accessed December 27, 2018, [https://study.com/electronic\\_engineering\\_technology\\_courses\\_in\\_maryland.html](https://study.com/electronic_engineering_technology_courses_in_maryland.html).

<sup>131</sup> "Engineering Technology," Community College of Baltimore County, accessed December 27, 2018, <http://www.ccbcmd.edu/Programs-and-Courses/Schools-and-Academic-Departments/School-of-Technology-Art-and-Design/Engineering-Department/Engineering-Technology.aspx>.

offers engineering degrees with various specializations, such as computer, electrical, and biomedical.<sup>133</sup> Additionally, programs in energy management and systems technology; hydraulics and fluid power technology; and heating, ventilation, air conditioning, and refrigeration engineering offer technician career preparation and are available at Maryland colleges.<sup>134</sup> Vocational and technical schools also offer programs for engineering technicians, such as the Lincoln College of Technology in Columbia, MD.<sup>135,136</sup> A certification through the National Institute for Certification in Engineering Technologies, though not required, may make prospective employees more competitive.<sup>137</sup>

It may be important to learn C++ programming, either through coursework or a certificate program.<sup>138</sup> Since many employers look for candidates with previous work experience, when starting off in the field individuals often pursue entry-level jobs.<sup>139</sup> If a candidate has difficulty obtaining one, he or she may consider a job involving electrical equipment, programming, or power systems to gain the experience they need to break into the field.<sup>140</sup> Counties hiring the most engineering technicians in late 2018 were St. Mary's County (15), Montgomery County (3), Harford County (2), and Washington County (2).<sup>141</sup>

### **Operating Engineers and Other Construction Equipment Operators (47-2073)**

Entry into the profession of operating engineers and other construction equipment operators typically requires a high school diploma or equivalent and moderate-term OTJ training.<sup>142</sup> OTJ training can be facilitated through apprenticeships, which typically take several years to complete.<sup>143</sup> Many apprenticeship programs take four years to complete and include 6,000 hours of on the job training.<sup>144</sup> Local apprenticeship programs include Operating Engineers

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<sup>132</sup> "Engineering Associate of Science," Prince George's Community College, accessed February 8, 2019, [https://www.pgcc.edu/Programs\\_and\\_Courses/Program\\_Detail.aspx?programID=6442462394](https://www.pgcc.edu/Programs_and_Courses/Program_Detail.aspx?programID=6442462394).

<sup>133</sup> "Search Results: Engineering," Howard Community College, accessed February 8, 2019, <https://www.howardcc.edu/search-results.html?q=engineering>.

<sup>134</sup> "Local Training Finder: 17-3029.00, MD," CareerOneStop, accessed February 8, 2019, <https://www.careeronestop.org/Credentials/Toolkit/find-local-training.aspx?keyword=17-3029.00&persist=true&location=MD&ajax=0&post=y>.

<sup>135</sup> Beatrice Harrison, "How To Become an Engineering Technician," College Mouse, August 4, 2014, accessed February 8, 2019, <https://www.collegemouse.com/how-to-become-an-engineering-technician/>.

<sup>136</sup> "Local Training Finder: 17-3029.00, MD," CareerOneStop.

<sup>137</sup> Dawn Rosenberg McKay, "Engineering Technician Career," The Balance Careers, updated February 6, 2019, accessed February 8, 2019, <https://www.thebalancecareers.com/engineering-technician-526012>.

<sup>138</sup> "How To Become an Electronics Engineering Technician: Career Roadmap," Study.com, accessed February 8, 2019,

[https://study.com/articles/How\\_to\\_Become\\_an\\_Electronics\\_Engineering\\_Technician\\_Career\\_Roadmap.html](https://study.com/articles/How_to_Become_an_Electronics_Engineering_Technician_Career_Roadmap.html).

<sup>139</sup> "How To Become an Electronics Engineering Technician: Career Roadmap," Study.com.

<sup>140</sup> Ibid.

<sup>141</sup> "Job Search," Maryland Workforce Exchange.

<sup>142</sup> "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.

<sup>143</sup> "Be an Operating Engineer: Education and Career Roadmap," Study.com, accessed December 27, 2018, [https://study.com/be\\_an\\_operating\\_engineer.html](https://study.com/be_an_operating_engineer.html).

<sup>144</sup> "Operating Engineer Training Programs and Requirements," Study.com, accessed February 8, 2019, [https://study.com/operating\\_engineer\\_training.html](https://study.com/operating_engineer_training.html).

Local 37 Apprentice Training School and International Union of Operating Engineers Local 99.<sup>145,146</sup> The Operating Engineers Local 37 Apprenticeship is approximately a two-year program, comprised of 40-hour work weeks for a total length of 4,500 hours.<sup>147</sup> This apprenticeship is based in Sparrows Point, requires a high school diploma or GED, and offers a starting wage of \$14.38 per hour.<sup>148,149</sup> The apprenticeship offered by Miller & Long lasts 8,000 hours, also requires a high school diploma or GED, and has a starting wage of \$24.86 an hour.<sup>150</sup>

The International Union of Operating Engineers offers a four-year apprenticeship program consisting of 8,000 hours of OTJ experience and 576 classroom hours.<sup>151</sup> The Maryland Apprenticeship and Training Program (MATP) also lists operating engineers on their website, and directs applicants to available apprenticeship opportunities.<sup>152</sup> For individuals seeking jobs with certain skills such as operation of heavy construction equipment, certifications are offered.<sup>153</sup> For example, numerous crane certifications are offered through the National Commission for the Certification of Crane Operators.<sup>154,155</sup>

License requirements vary by state, but may be required to operate large machinery such as cranes and bulldozers.<sup>156</sup> Knowledge of Microsoft Office is frequently mentioned in job postings.<sup>157</sup> Facilities management software may also be necessary.<sup>158</sup>

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<sup>145</sup> "Operating Engineer Apprenticeship," Train Baltimore, accessed December 27, 2018, <http://trainbaltimore.org/Training/Program-Details.aspx?pid=89&pn=0>.

<sup>146</sup> "Welcome," International Union of Operating Engineers Local 99, accessed December 27, 2018, <http://www.iuolocal99.org/>.

<sup>147</sup> "Maryland Apprenticeship Locator: Operating Engineers: Operating Engineer Details," Maryland Department of Labor, Licensing and Regulation, accessed February 8, 2019, <http://www.dlir.state.md.us/Apprenticeship/Details.aspx?user=A&access=1&results=1&details=1&sessionGUID=94cd4cd4-cda2-405e-8b80-687c8f61146a>.

<sup>148</sup> "Maryland Apprenticeship Locator: Operating Engineers: Operating Engineer Details," Maryland Department of Labor, Licensing and Regulation.

<sup>149</sup> "Operating Engineer Apprenticeship," Train Baltimore.

<sup>150</sup> "Maryland Apprenticeship Locator: Miller & Long Concrete Construction: Operating Engineer Details," Maryland Department of Labor, Licensing and Regulation, accessed February 8, 2019, <http://www.dlir.state.md.us/Apprenticeship/Details.aspx?user=A&access=1&results=1&details=1&sessionGUID=94cd4cd4-cda2-405e-8b80-687c8f61146a>.

<sup>151</sup> "Our Apprenticeship Program," International Union of Operating Engineers, accessed February 8, 2019, <http://www.iuolocal99.org/apprenticeships.htm#one>.

<sup>152</sup> "Explore Registered Occupations - Maryland Apprenticeship and Training Program (MATP)," Maryland Department of Labor, Licensing, and Regulation, accessed December 27, 2018, <https://www.dlir.state.md.us/employment/approcc/approcc.shtml>.

<sup>153</sup> "Be an Operating Engineer: Education and Career Roadmap," Study.com, accessed December 27, 2018, [https://study.com/be\\_an\\_operating\\_engineer.html](https://study.com/be_an_operating_engineer.html).

<sup>154</sup> "Be an Operating Engineer: Education and Career Roadmap," Study.com.

<sup>155</sup> "News Headlines," National Commission for the Certification of Crane Operators (NCCCO), accessed February 8, 2019, <http://nccco.org/>.

<sup>156</sup> "Be an Operating Engineer: Education and Career Roadmap," Study.com.

<sup>157</sup> "Summary Report for: 47-2073.00," O\*Net Online, accessed February 8, 2019, <https://www.onetonline.org/link/summary/47-2073.00>.

The best Maryland counties for operating engineers and other construction equipment operators opportunities are Prince George’s County, which posted 19 job openings in November 2018, followed by eight in Baltimore City and seven in Anne Arundel County.<sup>159</sup>

### **Life, Physical, and Social Science Technicians, All Other (19-4099)**

Jobs falling under life, physical, and social science technicians, all other, most often require obtaining an associate degree.<sup>160</sup> As noted in the previous subsection, occupations in this field include quality control analysts, precision agriculture technicians, and remote sensing technicians.<sup>161</sup> Several Maryland community colleges offer related associate degrees, including Baltimore City Community College, Community College of Baltimore County, and Harford Community College.<sup>162</sup>

Life, physical, and social science technicians positions usually require knowledge of analytical or scientific software.<sup>163,164,165</sup> Specifically, quality control analyst positions may use additional program testing software and data base user interface and query software such as Selenium and Structured Query Language (SQL).<sup>166</sup> Precision agriculture technicians and remote sensing technicians may also need knowledge of map creation software such as ESRI ArcGIS software.<sup>167,168</sup>

The counties offering the most job postings in November of 2018 were Montgomery County (116), Frederick County (37), Howard County (31), and Baltimore City (13).<sup>169</sup>

### **Stationary Engineers and Boiler Operators (51-8021)**

To become a stationary engineers and boiler operator, individuals typically need a high school diploma or equivalent combined with long-term OTJ training.<sup>170</sup> Training for becoming a stationary engineer or boiler operator is often completed through an apprenticeship

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<sup>158</sup> “Operating Engineers & Other Construction Equipment Operators,” My Next Move, accessed February 8, 2019, <https://www.mynextmove.org/profile/summary/47-2073.00>.

<sup>159</sup> “Job Search,” Maryland Workforce Exchange.

<sup>160</sup> “Education and Training Assignments by Detailed Occupation,” U.S. Bureau of Labor Statistics.

<sup>161</sup> “19-4099,” My Next Move, accessed December 27, 2018, <https://www.mynextmove.org/find/search?s=19-4099>.

<sup>162</sup> “Local Training Finder – Life, Physical, and Social Science Technicians, All Other,” My Next Move, accessed December 27, 2018, <https://www.mynextmove.org>.

<sup>163</sup> “Quality Control Analysts,” My Next Move, accessed February 8, 2019, <https://www.mynextmove.org/profile/summary/19-4099.01>.

<sup>164</sup> “Precision Agriculture Technicians,” My Next Move, accessed February 8, 2019, <https://www.mynextmove.org/profile/summary/19-4099.02>.

<sup>165</sup> “Remote Sensing Technicians,” My Next Move, accessed February 8, 2019, <https://www.mynextmove.org/profile/summary/19-4099.03>.

<sup>166</sup> “Quality Control Analysts,” My Next Move.

<sup>167</sup> “Precision Agriculture Technicians,” My Next Move.

<sup>168</sup> “Remote Sensing Technicians,” My Next Move.

<sup>169</sup> “Job Search,” Maryland Workforce Exchange.

<sup>170</sup> “Education and Training Assignments by Detailed Occupation,” U.S. Bureau of Labor Statistics.

program.<sup>171</sup> These apprenticeship programs are typically completed over a four-year period though work with experienced operators, as well as supplemental classroom instruction.<sup>172</sup> Certification preparation courses are offered through Maryland community colleges including Anne Arundel Community College, College of Southern Maryland, Community College of Baltimore County, and Prince George's Community College.<sup>173,174,175,176</sup>

At Anne Arundel Community College (AACC), a Maryland Stationary Engineer Certification consists of two courses and in addition to earning an AACC certificate, it will prepare students for the Maryland Board of Stationary Engineers licensing exam.<sup>177</sup> Courses include training in boiler construction, care, and operations; hydronic heating systems; refrigeration and HVAC systems, and basic electrical knowledge.<sup>178</sup>

Commonly cited skills for this occupation include preventative maintenance, customer service, building maintenance, maintenance mechanics, and problem solving.<sup>179</sup> Use of technologies such as facilities management software or database user interface and query software may also be required in this role.<sup>180</sup> Baltimore City had the most job openings posted for stationary engineers and boiler operators in November of 2018 (11), followed by Harford and Prince George's County (three each).<sup>181</sup> Anne Arundel County, Dorchester County, Frederick County, Howard County, and Montgomery County also each had two positions listed during this time.<sup>182</sup>

### 17.5.3 Alternative Strategies

While this report has largely focused on retraining efforts through matching of education and skills between occupations through occupational crosswalks, alternative strategies have been pursued in other areas. A significant number of these efforts have focused on teaching former

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<sup>171</sup> "Stationary Engineer Training," International Union of Operating Engineers, accessed December 27, 2018, <https://www.iuoe.org/training/stationary-engineer-training>.

<sup>172</sup> Ibid.

<sup>173</sup> "Maryland Stationary Engineer Certification," Anne Arundel Community College, accessed December 27, 2018, <https://www.aacc.edu/programs-and-courses/job-training/stationary-engineer/>.

<sup>174</sup> "Stationary Engineer," College of Southern Maryland, accessed December 27, 2018, <https://www.csmd.edu/programs-courses/non-credit/career-development/construction-and-skilled-trades/Stationary-Engineer>.

<sup>175</sup> "VOC 042 – Preparation for Maryland Stationary Engineer's Certificate," Community College of Baltimore County, accessed December 27, 2018, <https://www.ccbcmd.edu/Migrate/ceed/syllabus/voc.html>.

<sup>176</sup> "OCU-359-Stationary Engineering I," Prince George's Community College, accessed December 27, 2018, [http://www.pgcc.edu/Programs\\_and\\_Courses/course\\_detail.aspx?courseID=644245530&programID=644246235](http://www.pgcc.edu/Programs_and_Courses/course_detail.aspx?courseID=644245530&programID=644246235).

<sup>177</sup> "Maryland Stationary Engineer Certification," Anne Arundel Community College, accessed February 8, 2019, <https://www.aacc.edu/programs-and-courses/job-training/stationary-engineer/>.

<sup>178</sup> Ibid.

<sup>179</sup> "Occupational Summary," Maryland Workforce Exchange.

<sup>180</sup> "Summary Report for 51-8021.00," O\*Net Online, accessed February 8, 2019, <https://www.onetonline.org/link/summary/51-8021.00>.

<sup>181</sup> "Job Search," Maryland Workforce Exchange.

<sup>182</sup> "Job Search," Maryland Workforce Exchange.

fossil-fuel-reliant workers to write code, for applications including software and web design, in order to gain employment in the technology field.<sup>183</sup> These programs are more prominent in states including West Virginia and Kentucky, which have historically had substantial coal mining industries.<sup>184,185</sup> Although this transition may initially seem incongruent with mining skillsets, some individuals leading transition efforts have stated that technologies used in mining, such as robotics, facilitate entry into the coding field.<sup>186</sup>

In eastern Kentucky, a startup company called Bit Source offered 22-week training in coding to laid-off coal miners.<sup>187</sup> Although the company hired only a fraction of the applicants for the training positions, local leaders have stressed the importance of small companies in diversifying the area's economic landscape.<sup>188</sup> One significant challenge the project has encountered is internet infrastructure, though there is a project currently underway to increase broadband availability in the state.<sup>189</sup> Internet speeds in the area lower than many other regions, with a 2017 ranking placing the state 47th in the nation for broadband speed and capacity.<sup>190</sup>

The Louisville, Kentucky-based startup Interapt provides another example of an organization that was created to increase economic activity through 'insourcing' of technology jobs.<sup>191</sup> The company initially trained 35 of 800 applicants to program completion, with plans to expand training over the next two sessions to 90 and over 150 individuals, respectively.<sup>192</sup> Interapt received funding from the Appalachia Regional Commission to launch the training program, which also provides trainees with a \$400 weekly stipend.<sup>193</sup> Additionally, the company's founder currently investing \$4 million in a local warehouse renovation to house the organization.<sup>194</sup>

While none of the programs listed above are sufficient to completely offset the impacts from fossil-fuel industry employment losses, they do offer examples of alternative strategies to

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<sup>183</sup> ABC Radio, "Coal Miners in West Virginia Learn HTML Coding as Second Career," *WTOP*, May 7, 2018, accessed November 15, 2018, <https://wtop.com/national/2018/05/coal-miners-being-taught-html-coding-as-a-second-career/>.

<sup>184</sup> ABC Radio, "Coal Miners in West Virginia Learn HTML Coding as Second Career."

<sup>185</sup> Sheryl Gay Stolberg, "Beyond Coal: Imagining Appalachia's Future," *New York Times*, August 17, 2016, accessed November 16, 2018, <https://www.nytimes.com/2016/08/18/us/beyond-coal-imagining-appalachias-future.html>.

<sup>186</sup> Erica Peterson, "From Coal to Code: A New Path for Laid-off Miners in Kentucky," *NPR*, May 6, 2016, accessed November 15, 2018, <https://www.npr.org/sections/alltechconsidered/2016/05/06/477033781/from-coal-to-code-a-new-path-for-laid-off-miners-in-kentucky>.

<sup>187</sup> Peterson, "From Coal to Code: A New Path for Laid-off Miners in Kentucky."

<sup>188</sup> *Ibid.*

<sup>189</sup> *Ibid.*

<sup>190</sup> "KentuckyWired FAQs," Kentucky Communications Network Authority, accessed February 8, 2019, <https://kentuckywired.ky.gov/about/Pages/faq.aspx>.

<sup>191</sup> Arlie Hochschild, "The Coders of Kentucky," *New York Times*, September 21, 2018, accessed November 15, 2018, <https://www.nytimes.com/2018/09/21/opinion/sunday/silicon-valley-tech.html>.

<sup>192</sup> Hochschild, "The Coders of Kentucky."

<sup>193</sup> *Ibid.*

<sup>194</sup> *Ibid.*

create economic opportunities for displaced workers. Software and application positions often have the benefit of being amenable to working remotely, enabling these displaced employees to work in a new profession yet stay in their current geographic location and generate economic activity. In addition to the related occupations generated through the occupational crosswalks, these in-demand technology jobs can also be considered as potential alternatives to fossil-fuel reliant positions as the State plans Just Transition strategies.

### 17.6 Conclusion

Throughout this report, RESI has addressed a broad range of topics related to the State's climate change mitigation strategies. These efforts include providing an overview of Just Transition models and how they have been successfully implemented in other regions, and a comprehensive evaluation of the predicted effects to Maryland's workforce and economy resulting from the State's 40 by 30 Plan. RESI completed this analysis by studying the industries of focus and their economic and fiscal footprints within the state, identifying key occupations likely to be impacted, and determining related occupations that provide alternative employment opportunities as the State transitions from fossil-fuel-reliant industries. The educational requirements for highlighted related occupations and training opportunities within the state of Maryland were also explored to provide greater transitional guidance. Additionally, the report provides strategies for mitigating these impacts through Just Transition models that have been successfully implemented in other regions, as well as alternative strategies that have been used in areas with declining coal mining industries.

While the industries and occupations evaluated throughout this report do not represent an exhaustive list of all those that may be affected by the State's 40 by 30 Plan, they provide a solid framework for evaluating potential economic and regional dislocations that may be incurred with this effort. Understanding the impacts and challenges related to greenhouse gas reduction policies enables the State to be better equipped when addressing these changes and taking steps to ensure an equitable and fair outcome for those affected.

It is clear that the transition to cleaner energy has numerous societal, economic, and environmental benefits—but it is also crucial to anticipate the impacts to existing industries, employees, communities, and regions that will be affected through this process. Through the information provided in this report, the State can take actions to build and strengthen policies that increase the likelihood of a smoother transition to Maryland's future of increased clean energy.

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## Chapter 17: Just Transition Analysis

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## Appendix A—Industries of Consideration

Figure 24: Occupations within Fossil-Fuel-Reliant Industries

Six-Digit SOC Code	Six-Digit SOC Title	Maryland Jobs in Fossil Fuel Dependent Industries	Occupation of Focus
41-2011	Cashiers	7,545	X
41-1011	First-Line Supervisors of Retail Sales Workers	1,127	
51-4041	Machinists	626	X
35-3021	Combined Food Preparation and Serving Workers, Including Fast Food	586	
11-1021	General and Operations Managers	314	
53-6031	Automotive and Watercraft Service Attendants	275	
41-2031	Retail Salespersons	258	
51-1011	First-Line Supervisors of Production and Operating Workers	257	X
43-9061	Office Clerks, General	199	
49-3023	Automotive Service Technicians and Mechanics	191	
51-4011	Computer-Controlled Machine Tool Operators, Metal and Plastic	186	
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	168	X
43-5081	Stock Clerks and Order Fillers	167	
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	162	X
35-2021	Food Preparation Workers	148	
51-9011	Chemical Equipment Operators and Tenders	141	
49-9071	Maintenance and Repair Workers, General	134	
49-9041	Industrial Machinery Mechanics	132	
51-4121	Welders, Cutters, Solderers, and Brazers	115	
43-3031	Bookkeeping, Accounting, and Auditing Clerks	114	

Sources: RESI, U.S. Bureau of Labor Statistics

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