Maryland
Department of the Environment

Supplemental Information

Just Transition Study Update

2030 GGRA Plan

Just Transition 2021 Analysis

Commissioned by
Maryland Department of the Environment

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October 28, 2021

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1.0 Executive Summary

In 2019, the Maryland Department of the Environment (MDE) requested an evaluation of economic dislocations resulting from potential carbon mitigation strategies as part of the State's 2030 Greenhouse Gas Emissions Reduction Act (GGRA) Plan. Accordingly, the Regional Economic Studies Institute of Towson University (RESI) evaluated economic dislocations that could result from potential carbon mitigation strategies, and identified related occupations into which displaced workers could shift during a Just Transition effort. These economic dislocations included direct impacts to fossil-fuel-reliant workers, and other related disparities associated with the State's efforts to reduce greenhouse gas (GHG) emissions.

The current report serves as an update to the previous analysis, and utilizes new data obtained from RESI's GGRA Plan Analysis that was conducted for the State. Through this new analysis, RESI was able to more clearly focus the study on expected impacts from the State's GHG-reduction strategies using results from REMI PI+ (REMI), a dynamic modeling tool used for economic policy modeling analysis. Utilization of this model allowed the project team to evaluate both baseline employment trends in Maryland's fossil-fuel-reliant industries, as well as additional industry impacts resulting from policy implementation. The objectives outlined for the current study once again included identification of alternative employment strategies for displaced workers, in addition to a closer evaluation of the effects on fossil-fuel-impacted communities. To meet the project objectives, RESI utilized the following methodology:

- Identified major fossil-fuel-reliant industries within the state, focusing on industries related to Maryland's fossil-fuel supply chain and those significantly impacted by changes to State environmental policies;
- Estimated the proportion of employment impacted by State environmental policies in each negatively affected industry of focus;
- Determined key threatened occupations within the industries of focus and the size of affected employment;
- Analyzed related job opportunities for displaced employees;
- Researched typical employment requirements and training opportunities within the state for related occupations as well as for clean energy jobs; and
- Provided a summary of potential impacts to communities impacted by transitions away from fossil-fuel reliance, and strategies to provide restorative environmental and social justice.

Major findings for each aspect of the analysis are summarized below.

Four fossil-fuel-reliant industries were chosen for further analysis based on their relevance to the coal, oil, and gas supply chains; industry size; and the likelihood of being negatively impacted by environmental policies between 2021 and 2050. Two additional indirectly related industries, Truck Transportation and Construction, were also identified as affected industries and were further explored. The natural employment trends, not accounting for policy impacts, are summarized in Figure 1 below. Please note that totals may not sum due to rounding.

Figure 1: Natural Employment Trend Projections in Focus Industries, No Policy Impacts

Industries	Maryland Employment 2019	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Oil and Gas Extraction[1]	1,241	35	63	85	1,819
Mining (Except Oil and Gas)	1,308	-26	-12	-9	-458
Utilities	10,308	-89	-5	-4	-980
Petroleum and Coal Products Manufacturing	901	-9	-7	-6	-227
Construction	245,466	-2,466	587	1,272	-6,072
Truck Transportation	26,347	-250	9	53	-1,875

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

As shown above, total 2019 Maryland employment in the four fossil-fuel-reliant industries of focus ranged from 901 to 10,308 workers. Construction and Truck Transportation are significantly larger industries in Maryland and employ a combined total of 271,813 workers. Of these four fossil-fuel-reliant industries, Utilities has the largest natural loss of 980 jobs, with Oil and Gas Extraction being the only industry projected to have positive gains between 2021 and 2050. For the Construction and Transportation industries, a total of 7,967 workers are projected to lose their jobs between 2021 and 2050, with an average of around 266 job losses every year. In sum, a net average of 260 workers in all six industries of focus are projected to lose their jobs every year between 2021 and 2050 due to general natural trends that dominantly impact the first decade (2021-2030) and that do not include GHG-reduction policies. The natural trend observed here is both affected by national and regional industry-specific dynamics and policies, as well as by existing Maryland policies pertaining to the different sectors.

Figure 2 below reflects projections of employment changes solely attributable to environmental policies using REMI, and do not include the natural industry employment changes previously described. In other words, the figures show the annual average difference in employment between baseline projections (no environmental policies) and those of the reference forecast with environmental policies in effect. Again, please note that totals may not sum due to rounding.

[1] Employment data from the U.S. Bureau of Economic Analysis for the Oil and Gas extraction sector is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.

Figure 2: Policy Impact Projections in Focus Industries

Industries	Maryland Employment 2019	Average Annual Policy Impact 2021-2030	Average Annual Policy Impact 2031-2040	Average Annual Policy Impact 2041-2050	Total Policy Impact 2021-2050
Oil and Gas Extraction[2]	1,241	-3	-6	-5	-142
Mining (Except Oil and Gas)	1,308	1	-2	0	-9
Utilities	10,308	1	-1	-6	-60
Petroleum and Coal Products Manufacturing	901	-4	-3	-3	-97
Construction	245,466	1,330	-667	-192	4,705
Truck Transportation	26,347	-56	-152	-81	-2,879

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

GHG-reduction policies are likely to be responsible for the slowing down of employment growth in the Oil and Gas Extraction industry by 7 percent, and an acceleration of the decline in the Petroleum and Coal Products Manufacturing industry by approximately 43 percent between 2021 and 2050. Declining employment in Mining and Utilities are not likely to be significantly accelerated by GGRA environmental policies. While these policies are likely to be causing losses in fossil-fuel-reliant industry employment, the impact is still small compared to their natural decline. As GGRA policies are expected to boost employment in the clean energy sector, the decline in the Utilities and Construction sectors show that the losses in fossil-fuel-reliant sectors caused by the GGRA policies in these industries are still higher than the gains made in renewable sectors.

It is notable to clarify that the REMI model aggregates all firms generating electric power into a single Utilities sector. That is, employees working in renewable energy electric power generation, such as wind or solar, are included in the total employment figures projected by REMI for the Utilities sector. Notably, however, only 5 percent of the industry's workers were employed in renewable energy electric power generation in Maryland by 2018, and accordingly, renewable energy only constitutes a small portion of the energy transmission, storage and distribution.[3] Since the analysis focuses on the net effect of environment policies on the sector, the overall negative impact on the Utilities sector indicates that the positive environmental

[2] Employment data for the Oil and Gas Extraction sector from the U.S. Bureau of Economic Analysis is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.
[3] Ibid.

policy impacts on clean energy jobs are not enough to compensate for the losses generated by the same policies.

In the Construction industry, GHG-reduction policies are projected to cause a boom in employment between 2021 and 2030, reducing the declining natural trend of the industry by half. However, 65 percent of these gains in employment are expected to be lost in the following two decades. Finally, GHG-reduction policies are expected to cause an acceleration in the overall decline of the Truck Transportation industry in the first decade evaluated, and a slow-down of growth in the following two decades.

For total net effects, Figure 3 combines natural trend projections with policy impact projections for each of the focus industries during each decade evaluated.

Figure 3: Net Effect on Focus Industries

Industries	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Oil and Gas Extraction[4]	28	48	72	1,473
Mining (Except Oil and Gas)	-25	-13	-9	-467
Utilities	-88	-6	-10	-1,040
Petroleum and Coal Products Manufacturing	-13	-11	-9	-323
Construction	-1,137	-80	1,080	-1,367
Truck Transportation	-305	-142	-28	-4,753

Sources: REMI, RESI

According to Figure 3, there will likely be an overall decline in all focus industries in a period of 30 years, except for the Oil and Gas Extraction industry. A total net loss of 6,477 workers is expected in the declining industries between 2021 and 2050. The only industry that experiences a slower decline because of the GGRA plan is the Construction industry. Part of this observation could be due to the expected boost in clean energy job employment in the Construction industry. For Truck Transportation, which is estimated to lose approximately 4,753 workers between combined natural trends and policy impacts, there are likely multiple industry-specific dynamics affecting this figure. These include the existing worker shortage for the industry, an aging workforce, and technological advances and increasing number of fulfillment centers that decrease total miles traveled.

[4] Employment data for the Oil and Gas Extraction sector from the U.S. Bureau of Economic Analysis is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.

Figure 4 below shows five key threatened occupations identified within the six industries of focus. Threatened occupations are those with the most workers in the industries of focus and that are projected to experience a decline throughout the following three decades due to GHG-reduction policies. Employment figures represent the estimated proportion of workers in these occupations who work specifically within the six industries of focus, rather than total employment in all industries. Please note that totals may not sum due to rounding.

Figure 4: Policy Impact Projections for Detailed Threatened Industry-Specific Occupations

Occupation	Employment in Threatened Industries 2019	Average Annual Impact 2021-2030	Average Annual Impact 2031-2040	Average Annual Impact 2041-2050	Total Impact 2021-2050
Heavy and Tractor-Trailer Truck Drivers	17,820	-12	-98	-50	-1593
Laborers and Freight, Stock, and Material Movers, Hand	3,260	3	-17	-8	-217
Bus and Truck Mechanics and Diesel Engine Specialists	1,210	-1	-6	-3	-102
Dispatchers, Except Police, Fire, and Ambulance	1,046	1	-5	-2	-63
Petroleum Pump System Operators, Refinery Operators, and Gaugers	219	-1	-1	-1	-23

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

As detailed above, the occupation with the greatest number of workers in the industries of focus are Heavy and Tractor-Trailer Truck Drivers, with 17,820 workers, out of which a total of 1,593 are expected to be threatened between 2021 and 2050 due to GHG-reduction policies. Although all of the Petroleum Pump System Operators work in fossil-fuel industries, the estimated number of job losses due to GHG-reduction policies is modest.

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 5 below.

Figure 5: Related Occupations

Related Occupation	Associated Threatened Occupation
Automotive Glass Installers and Repairers	Bus and Truck Mechanics and Diesel Engine Specialists
Billing and Posting Clerks	Dispatchers, Except Police, Fire, and Ambulance
Brokerage Clerks	Dispatchers, Except Police, Fire, and Ambulance
Captains, Mates, and Pilots of Water Vessels	Heavy and Tractor-Trailer Truck Drivers
Civil Engineering Technologists and Technicians	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Computer User Support Specialists	Dispatchers, Except Police, Fire, and Ambulance
Control and Valve Installers and Repairers	Bus and Truck Mechanics and Diesel Engine Specialists
Electrical and Electronic Engineering Technologists and Technicians	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Electro-Mechanical and Mechatronics Technologists and Technicians	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Environmental Engineering Technologists and Technicians	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Fence Erectors	Laborers and Freight, Stock, and Material Movers
Human Resources Assistants, Except Payroll and Timekeeping	Dispatchers, Except Police, Fire, and Ambulance
Janitors and Cleaners	Laborers and Freight, Stock, and Material Movers
Mobile Heavy Equipment Mechanics	Bus and Truck Mechanics and Diesel Engine Specialists
Packaging and Filling Machine Operators and Tenders	Laborers and Freight, Stock, and Material Movers, hand
Rail-Track Laying and Maintenance Equipment Operators	Laborers and Freight, Stock, and Material Movers
Reservation and Transportation Ticket Agents and Travel Clerks	Dispatchers, Except Police, Fire, and Ambulance
Sailors and Marine Oilers	Heavy and Tractor-Trailer Truck Drivers
Sawing Machine Setters, Operators, and Tenders, Wood	Laborers and Freight, Stock, and Material Movers
Security Guards	Laborers and Freight, Stock, and Material Movers
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	Petroleum Pump System Operators, Refinery Operators, and Gaugers
Transportation Inspectors	Heavy and Tractor-Trailer Truck Drivers
Welders, Cutters, Solderers, and Brazers	Bus and Truck Mechanics and Diesel Engine Specialists

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*Net, REMI, 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, Petroleum Pump System Operators, Refinery Operators, and Gaugers could be transitioned to become Environmental Engineering Technologists and Technicians with minimal additional preparation. Of the related occupations shown above, several were highlighted and described further due to factors that made them particularly strong options for a career transition, such as high average wage or strong expected growth rate.

When evaluating renewable energy job opportunities, it is important to note that many occupations in fossil-fuel-reliant industries are the same occupations in the clean energy sector. For instance, an Electrical Engineer may work in fossil-fuel electricity generation, or they can work in solar energy electricity generation. This also applies to Plant and System Operators and many other occupations. Thus, skills transfer from a job in fossil-fuel-reliant industry to another job in the same occupation in the clean energy sector will likely cause skill transfers to be smoother.

Certification and degree opportunities exist at Maryland's colleges and universities for several 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 formal programs. In addition to training programs for related occupations, clean energy training programs can provide additional opportunities for displaced workers, and also help the State in achieving its green employment and industry objectives. Several training opportunities for programs within Maryland are discussed, including requirements for entry, nature, and length of these programs.

When constructing a Just Transition plan, it is also important to consider the negative effects experienced by "fence-line communities," that are often low-income and/or communities of color that have borne a significant amount of the pollution and other negative environmental effects resulting from fossil-fuel and industrial activities.[5] Providing restorative justice through environmental remediation can help these communities recover, with findings that show these efforts increase local property values. Policies at the federal, state, and potentially local level can also assist communities in an economic recovery. These include funding infrastructure projects, investing in new and innovative businesses that capitalize on local assets, and encouraging utilization of local workers for new clean energy employment opportunities.

Recently, more federal attention has been placed identifying and assisting communities that are most vulnerable to changes in fossil-fuel reliance with an executive order in January 2021, which included the creation of an Interagency Working Group on Coal and Power Plant

[5] "Life at the Fenceline: Understanding Cumulative Health Hazards in Environmental Justice Communities," Environmental Justice for All, accessed August 9, 2021, https://ej4all.org/life-at-the-fenceline.

Communities and Economic Revitalization (IWG).[6] In their first report from April 2021, the IWG identified the California-Lexington Park region in St. Mary's County as 15th in the top 25 coal-dependent areas nationally, based on the proportion of direct coal-related jobs.[7] Additionally, the Maryland nonmetropolitan region was identified as being in the top 70 coal-reliant communities evaluated by metropolitan statistical area (MSA), which includes Garrett, Dorchester, Talbot, Caroline, and Kent Counties.[8,9]

While the industries and occupations evaluated do not represent an exhaustive list of all those that may be affected by the State's 2030 GGRA Plan, they provide an updated framework for evaluating potential economic and regional dislocations that may be incurred. 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 by this transition.

[6] "Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government," The White House, January 27, 2021, accessed August 2, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/.

[7] Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization, "Initial Report to the President on Empowering Workers Through Revitalizing Communities," 10, accessed August 2, 2021, https://netl.doe.gov/sites/default/files/2021-04/Initial%20Report%20on%20Energy%20Communities_Apr2021.pdf.

[8] Ibid, 9.

[9] The IWG report did not specify ranking for the Maryland nonmetropolitan area within the top 70 coal-reliant communities.

2.0 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. In 2019 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, and other related disparities associated with the State's efforts to reduce Greenhouse Gas (GHG) emissions. In 2021 and for the current analysis, MDE tasked RESI to update the 2019 study.

To meet objectives set in the State's 2030 GGRA Plan, MDE requested strategies for transitioning impacted fossil-fuel-reliant workers and mitigating other economic dislocations associated with greenhouse gas reduction efforts. To meet the project objectives, RESI utilized the following methodology:

- Identified major fossil-fuel-reliant industries within the state, focusing on industries related to Maryland's fossil-fuel supply chain and those significantly impacted by changes to State environmental policies;
- Estimated the proportion of employment impacted by State environmental policies in each negatively affected industry of focus;
- Determined key threatened occupations within the industries of focus and the size of affected employment;
- Analyzed related job opportunities for displaced employees;
- Researched typical employment requirements and training opportunities within the state for related occupations as well as for clean energy jobs; and
- Provided a summary of potential impacts to communities impacted by transitions away from fossil-fuel reliance, and strategies to provide restorative environmental and social justice.

This report will continue as follows: Section 3 provides a brief overview of Just Transition models and best practices observed in other regions. Section 4 outlines the methodology used to determine the industries of focus, threatened occupations, related occupations, and available training opportunities for related occupations as well as clean energy jobs in the state. Section 5 provides an overview of natural trend projections for each industry of focus as well as their estimated average annual employment changes resulting from GHG-reduction strategies. Section 6 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. Section 7 provides a summary of potential impacts to communities affected by transitions away from fossil-fuel reliance, and strategies to provide restorative environmental and social justice. Section 8 concludes the report.

3.0 Just Transition Overview and Best Practices

The following section will provide an overview of the Just Transition framework, including best practice strategies that have emerged as more regions embrace a shift away from fossil fuels. While the basic framework of Just Transition has remained relatively consistent, components of successful plans have grown clearer as more initiatives have been undertaken. Best practices considerations for workers, community members, and policy makers are outlined, and also highlight some of the challenges that have been faced during planning and executing Just Transition efforts. Two areas are highlighted as case studies, Holyoke, Massachusetts and the State of Colorado, which provide Just Transition efforts of varying scope and scale.

3.1 Overview of Just Transition

Just Transition is a developmental effort that is intended to transition away from extractive and high-pollutant industries, while simultaneously utilizing and investing in sustainable sources of energy production.[10] The Just Transition framework provides strategies for offering training and job opportunities to workers affected by new environmental initiatives and policies, while also ensuring equitable solutions for communities that have been impacted by fossil fuels.[11] A transition to alternative energy sources has the potential to significantly impact traditional energy sector workers, stressing the importance of planning for these challenges before changes are enacted.

The term Just Transition was first used in the late 1990s as North American unions began developing a support program for workers that had lost their jobs due to environmental protection policies.[12] 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."[13] The use of Just Transition language has been increasing in international, national, and local plans and agreements that focus on climate change initiatives and a transition to sustainable energy. For example, the 2016 Paris Climate Agreement explicitly noted the need for a Just Transition for workers and "the creation of decent work and quality jobs."[14] In 2017, the Organization for Economic Co-operation and Development (OECD) distributed a report from the Just Transition Center that included principles of Just Transition, stakeholder roles, case studies, and recommendations.[15] In the

[10] Samantha Smith, "Just Transition: A Report for the OECD," Just Transition Centre (May 2017): 1-3, accessed May 24, 2021, https://www.oecd.org/environment/cc/g20-climate/collapsecontents/Just-Transition-Centre-report-just-transition.pdf.
[11] Brian Palmer, "This Is What a Just Transition Looks Like," Natural Resources Defense Council, March 2, 2020, accessed May 24, 2021, https://www.nrdc.org/stories/what-just-transition-looks.
[12] Smith, "Just Transition: A Report for the OECD,"2.
[13] Ibid.
[14] "Paris Agreement," (United Nations, Paris, France, 2015), 4, accessed May 24, 2021, https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
[15] Smith, "Just Transition: A Report for the OECD," 1.

U.S., Green New Deal congressional proposals in 2019 and 2021 also included the need for a "fair and just transition for all communities and workers."[16,17]

Following the Paris Climate Agreement Conference in 2015, the United Nation's International Labor Organization (ILO) produced a definitive definition and implementation plan for Just Transition.[18] 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."[19] 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."[20] Some organizations, including the National Resources Defense Council (NRDC), have begun using the phrase Just and Equitable Transition.[21] This language is used to emphasize the need not only to support workers as they transition, but also to invest in marginalized communities who have experienced negative environmental impacts from reliance on fossil fuel facilities.[22]

The Just Transition model is a crucial component of supporting both existing and developing industries as a new, cleaner energy future is realized. In the U.S., coal consumption was overtaken by renewable energy for the first time in 2019.[23] In the same year, there were approximately 6.8 million U.S. workers employed in traditional energy and energy efficiency industries, with 1.2 million directly employed in traditional (i.e. coal, oil, natural gas) electric power generation and fuel technologies.[24] While employment in renewable and energy efficient jobs has increased, and with renewable energy jobs representing two of the top three fastest-growing occupations in the U.S., many workers will require assistance to transition away from fossil-fuel-reliant roles.[25]

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[16] U.S. Congress, House, *Green New Deals for Cities Act of 2021*, 117th Congress, 1st Session, 3, accessed May 24, 2021, https://bush.house.gov/sites/evo-subsites/bush.house.gov/files/evo-media-document/Bush.GND4Cities.FINAL_.pdf.
[17] U.S. Congress, House, *Recognizing the Duty of the Federal Government to Create a Green New Deal,* HR 109, 116th Congress, 1st Session, introduced in House February 7, 2019, 5, accessed May 24, 2021, https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf.
[18] International Labour Organization, "Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All," accessed May 24, 2021, https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf.
[19] Smith, "Just Transition: A Report for the OECD,"3.
[20] Ibid.
[21] Palmer, "This Is What A Just Transition Looks Like."
[22] Ibid.
[23] Ceres, "Practices for Just, Equitable and Sustainable Development of Clean Energy," 4, accessed June 1, 2021, https://www.ceres.org/sites/default/files/reports/2021-02/Ceres%20Clean%20Energy%20Design%202020%20FINAL%20update%20Feb21.pdf.
[24] National Association of State Energy Officials and Energy Futures Initiative, "2020 U.S. Energy and Employment Report," x-xvii, accessed May 24, 2021, https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5e78b3c756e8367abbd47ab0/1584968660321/USEER+2020+0323.pdf.
[25] "Fastest Growing Occupations," U.S. Bureau of Labor Statistics, April 9, 2021, accessed June 1, 2021, https://www.bls.gov/ooh/fastest-growing.htm.

The cost for a Just Transition framework in the U.S. has been projected to be around $500 million per year—about 1 percent of the estimated $50 billion in total annual investment needed to support climate stabilization policies.[26] These costs includes income subsidies, retraining, and relocation support for impacted fossil-fuel workers and should coincide with the growth of the clean energy industry.[27] The Biden Administration's recently proposed American Jobs Plan (AJP) includes spending on components of a Just Transition, including $100 billion on worker protections and workforce development, and $40 billion for a Dislocated Workers Program.[28] The Center for Strategic & International Studies estimates that of the estimated $2 trillion in spending, Just Transition policies would comprise 4 percent of the total plan's cost.[29]

While details are still emerging on the specific plan proposals, and a final version of the bill has yet to be passed, the original version of the AJP addressed several Just Transition factors on a federal level. These included expansion of clean energy jobs, investment in low- and zero-emissions transportation, and support for workers as they develop skills and transition to new jobs, and addressed inequality and social justice issues.[30] For example, the AJP proposed a new $40 billion Dislocated Workers Program to help individuals find new employment in clean energy and other growing industries.[31] Although the program would not be specific to energy workers, it would aid those who have lost their position "through no fault of their own," and provide career services and skills training.[32] The AJP also proposed an immediate $16 million investment to plug orphan oil and gas wells and clean up abandoned mines.[33] This initiative would create jobs in communities that have been negatively impacted from fossil fuels, while also reducing greenhouse gas leaks from these sources.[34] Another proposal within the original AJP was a push for expansion of the electric vehicle (EV) market with $174 billion in investment to bolster domestic supply chains, tax incentives for EV purchases, and work to electrify transit vehicles and school buses.[35]

3.2 Just Transition Best Practices

As the costs of renewable energy have declined and concerns over climate change have grown, countries, regions, and companies have increasingly taken steps towards a transition from fossil-fuel reliance. The 2015 ILO report provided a basic framework for regions as they proceeded with a Just Transition plan, with general policies and procedures becoming common

[26] Robert Pollin and Brian Callaci, "A Just Transition for U.S. Fossil Fuel Industry Workers," *American Prospect*, July 6, 2016, accessed May 24, 2021, http://prospect.org/article/just-transition-us-fossil-fuel-industry-workers.
[27] Ibid.
[28] Lachlan Carey, Stephen J. Naimoli, and Morgan Higman, "The American Jobs Plan Gets Serious About Infrastructure and Climate Change," Center for Strategic & International Studies (April 2, 2021), accessed May 24, 2021, https://www.csis.org/analysis/american-jobs-plan-gets-serious-about-infrastructure-and-climate-change.
[29] Ibid.
[30] Smith, "Just Transition: A Report for the OECD," 2.
[31] Carey, Naimoli, and Higman, "The American Jobs Plan Gets Serious About Infrastructure and Climate Change."
[32] "Fact Sheet: The American Jobs Plan," The White House, March 31, 2021, accessed June 1, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/.
[33] Ibid.
[34] "Fact Sheet: The American Jobs Plan," The White House.
[35] Ibid.

practices.[36,37] While plans should be tailored to meet the specific needs of a region, including how dependent an area is on fossil fuels, there are recommendations that are consistently seen for Just Transition implementation. The following subsection outlines best practice recommendations related to workers, communities, and policy makers, and how they are important to a successful transition.

Transitioning workers from fossil-fuel-reliant jobs is a central component of a Just Transition plan. These efforts can include an effective transfer into new employment opportunities for individuals, or potentially a shift to retirement for older workers. Additionally, community members in which fossil-fuel-reliant workers are stakeholders in a Just Transition plan, particularly those who have experienced negative health or environmental impacts of fossil-fuel reliance. Plan efforts should anticipate challenges and seek to:

- Understand which groups and communities will be most-heavily impacted by the transition;
- Obtain input from both workers and community members and respond to their questions early in planning stages;[38]
- Provide a phase-out timeline; and
- Create worker training programs that facilitate the transfer of employees to new jobs.[39]

The above points help to ensure that impacted employees and community members are heard during the planning and transition, and also provide a framework for expectations around the Just Transition process. It is critical that individuals are offered opportunities to provide feedback and voice concerns early and consistently throughout the transition to ensure that important issues can be raised at key stages.[40] This is particularly important in situations where workers may have negative feelings towards the transition due to past experiences, and trust needs to be gained or re-established.[41] Questions from workers may include how they will be ensured a fair transition to a new career or possibly retirement, how their compensation will be impacted during this transition period, and how the efforts will be funded.[42]

Providing a timeline for the process 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

[36] International Labour Organization, "Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for All."
[37] Mark Conway, "Developing and Implementing Just Transition Policies," Long-term Climate Strategies, accessed June 7, 2021, https://www.wri.org/climate/expert-perspective/developing-and-implementing-just-transition-policies.
[38] Ibid.
[39] O. Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," IDDRI and Climate Strategies (2018): 27-29, accessed July 5, 2021, https://coaltransitions.files.wordpress.com/2018/09/coal_synthesis_final.pdf.
[40] Conway, "Developing and Implementing Just Transition Policies."
[41] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 27.
[42] Ibid.

be exiting the workforce.[43] For those who will be seeking new employment, job retraining programs should attempt to match the existing skills of workers with new job options, focusing on local opportunities when possible.[44] If plant closing are staggered, regional worker transfer programs can be a useful tool to shift workers who may have difficultly retraining to an alternative work site.[45] Input from those affected is critically important in this aspect of a Just Transition plan to ensure that incorrect assumptions are not made regarding the options that workers prefer.[46]

In addition to facilitating the points outlined above, policy makers are also responsible for the structural, logistical, and equity aspects of a Just Transition. The following plan components should be considered by these individuals when planning and implementing Just Transition strategies:

- Provide a transition oversight body;
- Plan for funding needs of the transition early in the transition process;
- Facilitate the creation of a job retraining program;[47]
- Anticipate skills transfer and geographic challenges;
- Ensure new jobs in sustainable energy are high-quality positions and inclusive to displaced and marginalized workers; and
- Supporting regional industry diversification for areas that are particularly reliant on fossil fuel industries.[48]

Policy makers should help to ensure that the Just Transition framework is implemented effectively by creating a dedicated oversight body for the process that includes stakeholders.[49] This group would likely be involved in outlining the transition timeline, creating plans for implementation and monitoring, and providing policy suggestions to support a successful transition.[50] The funding needs of a Just Transition plan can represent a substantial barrier to implementation, particularly if they are not adequately planned for far in advance.[51] Dedicated funding pools may be created to support workforce retraining or help individuals transition out of the labor force, and may involve moving fossil-fuel subsidies to Just Transition funds.[52]

In addition to required funding, job retraining brings a number of challenges including skill gaps, job quality, and geographic considerations. Policy makers can focus on the structure of job retraining programs—ideally focusing on direct placement into new positions or job transfers—

[43] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 28.
[44] Ibid, 29.
[45] Ibid.
[46] Conway, "Developing and Implementing Just Transition Policies."
[47] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 29-30.
[48] Conway, "Developing and Implementing Just Transition Policies."
[49] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 29.
[50] Ibid.
[51] Conway, "Developing and Implementing Just Transition Policies."
[52] Ibid.

as research has shown these methods are more effective than general skills training.[53] Providing subsidies for on-the-job (OTJ) training once affected workers find an appropriate employment opportunity, and potentially relocation funds if employment opportunities are in a new area, are additional tools that can be used to increase the success of transition efforts.[54]

Policy makers also play a role in shaping and supporting both nascent and existing green industries in areas that have historically been dependent upon fossil-fuel jobs. In an effort to make green industries competitive, jobs have at times been low-paying or temporary positions or relied solely on outside contractors.[55,56] Comparatively, these jobs are less attractive to workers who previously worked in more stable and higher-paying fossil-fuel-reliant positions. One example from Minnesota's Public Utilities Commission showed that after a local-hire reporting requirement was implemented for wind and solar projects, local employment in wind energy construction rose from under 20 percent to above 50 percent in the span of one year.[57] As environmentally sustainable industries grow, encouraging strong labor standards such as fair wages and benefits, opportunities to unionize, and prioritization of local workers can help ensure these are high-quality jobs for employees.[58]

For specific regions that are heavily reliant upon fossil-fuel industries, stakeholders and policy makers can leverage the area's strengths when diversifying industries.[59] These efforts may include identification of comparative advantages and alternative industries, as well as supporting local entrepreneurial networks.[60] Expansion of renewable energy may be possible for regions with significant ties to energy production that also have the required infrastructure or conditions to support these projects.[61,62] One analysis found that approximately 25 percent of counties in the U.S. with the greatest potential for renewable energy industries currently have significant fossil-fuel industries.[63] In these "Goldilocks" communities, the nature of the project (e.g. wind, solar, hydropower) would depend in largely in part upon the region's available resources.[64] Several legislative efforts to bolster renewable energy projects and

[53] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 29.
[54] Conway, "Developing and Implementing Just Transition Policies."
[55] Ibid.
[56] Ceres, "Practices for Just, Equitable and Sustainable Development of Clean Energy," 7.
[57] Ibid.
[58] Wesley Look et al., "Labor Policies to Enable Fairness for Workers and Communities in Transition," Resources for the Future and Environmental Defense Fund (March 2021): 2, accessed July 5, 2021, https://media.rff.org/documents/Workforce-Final_v4.pdf.
[59] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 31.
[60] Ibid.
[61] 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 July 5, 2021, https://www.iisd.org/sites/default/files/publications/real-people-change-strategies-just-energy-transitions.pdf.
[62] Sartor, "Insights from Case Studies of Major Coal-Consuming Economies," 31.
[63] Adie Tomer, Joseph W. Kane, and Caroline George, "How Renewable Energy Jobs Can Uplift Fossil Fuel Communities and Remake Climate Politics," Brookings Institute (February 23, 2021), accessed August 3, 2021, https://www.brookings.edu/research/how-renewable-energy-jobs-can-uplift-fossil-fuel-communities-and-remake-climate-politics/.
[64] Ibid.

advanced manufacturing in coal-reliant communities are being considered by policymakers. For example, measures such as increasing available tax credits for firms locating to these regions, can be powerful tools for incentivizing the growth of green energy jobs.[65,66]

The best practices detailed above provide examples of how Just Transition models can be designed to bolster a successful shift away from fossil-fuel-reliant industries. While there are clear societal, economic, and environmental benefits to clean energy production, the impact to existing industries and communities must not be overlooked. 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, a Just Transition framework can be strengthened and increase the likelihood of a smooth transition. A carefully considered and implemented Just Transition strategy is an integral step in not only reducing climate change opposition, but also ensuring that all share in the economic benefits of the transition.

3.3 Just Transition Case Studies

To further illustrate how Just Transitions can be implemented, the following subsection will outline two examples—one statewide and one at the local level—of places moving away from fossil-fuel reliance. These programs highlight some of the planning strategies that were undertaken by each respective area, and also challenges that were faced during the Just Transition process.

Holyoke, Massachusetts

The closure of Mt. Tom Power Plant, the last coal-fired power plant in Massachusetts, provides an example of a multi-year Just Transition campaign on the east coast. Between 2010 and 2014, the community in Holyoke, Massachusetts launched and executed a community-driven campaign to push for the closure of the facility, helped workers transition into new careers or retirement, and developed a clean alternative energy generation project to replace the plant.[67] Today, Holyoke is home to the largest solar farm in the state, built on the grounds of the former coal plant site that permanently closed in 2014.[68]

Between 2010 and 2012, asthma rates among children in Holyoke were more than twice as high as the rest of the state, primarily attributed to the air pollution caused by the Mt. Tom coal

[65] "Climate and Clean Energy Policy State of Play," Holland and Knight, July 21, 2021, accessed August 10, 2021, https://www.hklaw.com/en/insights/publications/2021/07/climate-and-clean-energy-policy-state-of-play.
[66] Amber Todoroff, "Infrastructure Policy and Programs: Workforce Development," Environmental and Energy Study Institute, July 20, 2021, accessed August 10, 2021, https://www.eesi.org/articles/view/infrastructure-policy-and-programs-workforce-development.
[67] Marie Donahue and John Farrell, "A Massachusetts Town Realizes a Community Vision to Transition from Coal to Sol - Episode 73 of Local Energy Rules Podcast," Institute for Local Self-Reliance, June 12, 2019, accessed June 9, 2021, https://ilsr.org/community-vision-transition-coal-sol-holyoke-mass-lena-entin-ler-73/.
[68] Ibid.

plant.[69,70] This health disparity prompted local activists to initiate a campaign to push for the plant's closure. An environmental organization called Toxics Action Center partnered with the community-led Neighbor to Neighbor group around 2011, and built a strong coalition of labor union allies to pressure the coal plant's parent company to shut down Mt. Tom and help workers make an equitable transition.[71] The Sierra Club's campaign, "Beyond Coal," also became involved to offer expertise acquired from their former initiative efforts.[72] The owner and the operator of Mt. Tom coal plant was the multinational GDF Suez (now named ENGIE), which at the time was the second-largest utility company worldwide. The pressure prompted discussions between the company and campaign leaders, and led to the conclusion that renewable energy would be the best use of the 50-year-old coal plant site.[73]

After listening to employees' demands, initiative leaders and ENGIE agreed that older workers should be able to access retirement when the plant closed through a bridge retirement plan, and younger workers should be able to get training in new fields in addition to severance packages.[74] The Mt. Tom workers' union negotiated termination benefits with ENGIE, including a lump sum of pay, so that workers could immediately get unemployment benefits.[75] When operating at peak employment, there were 80 workers at the Mt. Tom plant, however by the time it closed in 2014 there were only 28 employees.[76] Of these remaining workers, seven received a defined benefit pension plan while others received job retraining with support from federal programs.[77] Notably, however, none of the former coal plant workers were offered positions to work on the newly constructed solar farm.[78]

Community leaders' support enabled ENGIE to receive a $100,000 grant to fund research on repurposing the site as a solar power plant, as well as state solar subsidies for new site construction.[79,80] As a provision of the solar subsidies, ENGIE was also ordered to remediate the

[69] Donahue and Farrell, "A Massachusetts Town Realizes a Community Vision to Transition from Coal to Sol."
[70] "Pediatric Asthma," Massachusetts Department of Public Health-Bureau of Environmental Health, accessed June 21, 2021, https://matracking.ehs.state.ma.us/Health-Data/Asthma/pediatric.html.
[71] Donahue and Farrell, "A Massachusetts Town Realizes a Community Vision to Transition from Coal to Sol."
[72] Rachel Layne, "How One Small City Sowed the Seeds for Its Own Green New Deal," *CBC News*, March 8, 2019, accessed June 14, 2021, https://www.cbsnews.com/news/climate-change-how-one-small-city-sowed-the-seeds-for-its-own-green-new-deal/.
[73] Donahue and Farrell, "A Massachusetts Town Realizes a Community Vision to Transition from Coal to Sol."
[74] Adele Peters, "This Old Coal Plant is Now a Solar Farm Thanks to Pressure from Local Activists," Fast Company, January 3, 2019, accessed June 09, 2021, https://www.fastcompany.com/90286009/this-old-coal-plant-is-now-a-solar-farm-thanks-to-pressure-from-local-activists.
[75] Cyatharine Alias, "Just Energy: Generating Community Power in Holyoke, MA," (Master's Thesis, Tufts University, 2020), 64, https://www.proquest.com/openview/05f1ae4dbd9719d562f353d424e24b97/1?pq-origsite=gscholar&cbl=2026366&diss=y.
[76] Ed Burke, "Holyoke's Path Away from Coal," Oil & Energy Online, accessed June 14, 2021, https://oilandenergyonline.com/articles/all/holyokes-path-away-coal/.
[77] Alias, "Just Energy: Generating Community Power in Holyoke, MA," 64.
[78] Ibid, 4.
[79] Ibid, 40.
[80] Peters, "This Old Coal Plant is Now a Solar Farm Thanks to Pressure from Local Activists."

site to prevent river contamination.[81] According to the reuse study, Mt. Tom was providing Holyoke with $315,000 in annual tax revenue which needed to be covered through new and alternative industries.[82] Towards this end, Holyoke's mayor decided to pursue new ways to bring in revenue for Holyoke, including embracing Massachusetts' newly legal cannabis industry.[83]

By 2017, 17,000 solar panels were installed and running in Holyoke, with a battery storage facility to help optimize energy distribution also in place by 2018.[84] The battery storage facility was funded in part by a state grant that is also being used to schedule, measure, and analyze the performance of the facility.[85] The solar farm has aided the city in recouping some of the lost tax revenue from the coal plant, however the city is still working on developing the rest of the industrial site for other uses.[86]

In December 2019, the Barr Foundation —a non-profit organization focuses on supporting projects that drive positive impacts to the community, including climate initiatives—granted $275,000 to the city of Holyoke.[87,88] These funds were provided to facilitate planning for a transition away from fossil fuels by converting city buildings to use renewable energy, and are expected to cover the costs of project management, technical consulting, capacity building, as well as technical support for Holyoke Gas and Electric.[89] The Barr Foundation also awarded the Neighbor to Neighbor organization $125,000 to work on resident engagement.[90] As of May 2019, approximately 90 percent of the power generated by Holyoke Gas and Electric is from carbon-free sources, two-thirds of which comes from renewable sources such as solar, hydroelectric, and wind energy.[91] The clean energy industry has grown substantially in Massachusetts, with employment increasing by 84 percent since 2010.[92] The sector now employs more than 110,000 workers, representing 3 percent of the state's total workforce.[93]

State of Colorado

Colorado has become a state with one of the most organized Just Transition efforts to date. As of 2019, the state had six coal mines and eight coal-fired electrical plants employing

[81] Alias, "Just Energy: Generating Community Power in Holyoke, MA," 4.
[82] Layne, "How One Small City Sowed the Seeds for Its Own Green New Deal."
[83] Ibid.
[84] Burke, "Holyoke's Path Away from Coal."
[85] Ibid.
[86] Lilli Ambort, "Coal Plant Communities Seek a Just Economic Transition," Institute for Local Self-Reliance, August 7, 2020, accessed June 14, 2021, https://ilsr.org/coal-closure-communities-just-transition/.
[87] "About Us," Barr Foundation, accessed October 18, 2021, https://www.barrfoundation.org/about#core-values.
[88] Dusty Christensen, "Holyoke Nets $275K Grant for Planning Transition to Net-zero Future," *Daily Hampshire Gazette*, December 18, 2019, accessed June 9, 2021, https://www.gazettenet.com/Holyoke-wins-Barr-Foundation-grant-to-study-clean-energy-transition-31419881.
[89] Ibid.
[90] Ibid.
[91] Layne, "How One Small City Sowed the Seeds for Its Own Green New Deal."
[92] Burke, "Holyoke's Path Away from Coal."
[93] Ibid.

approximately 2,000 workers.[94] Since late 2019 one of these electrical plants closed, with an additional four closures scheduled between 2023 and 2030, and another plant shutting down two-thirds of their operations by 2025.[95] With similar futures expected for the surrounding mines, the State has taken action to help workers and affected communities as Colorado transitions away from coal and coal-generated power.[96] Colorado has also made a commitment to tracking performance metrics related to the adoption of renewable energy, as well as Just Transitions and creation and retention of jobs in coal communities.[97]

Colorado's Just Transition plan and strategy is multi-faceted. In 2019, the state signed into law *HB19-1314 Just Transition From Coal-based Electrical Energy Economy*, with "a moral commitment to assist the workers and communities that have powered Colorado for a generation."[98,99] The bill defined a "coal transition community" as a "a municipality, county, or region that has been affected in the previous twelve months, or that demonstrates it will be impacted in the next thirty-six months, by the loss of fifty or more jobs in total from a coal mine, a coal-fueled electrical power generating plant, or the manufacturing and transportation supply chain of either."[100] The definition is important because according to these specifications, all of Colorado's counties contain coal transition communities.[101]

The legislation was also responsible for creating the Just Transition office within the State's Department of Labor and Employment, as well as a Just Transition advisory committee.[102] The advisory committee is comprised of policy and government representatives, coal workers, and coal community representatives.[103] The bill also specified that the advisory committee will be responsible for proposing benefits for transitioning coal workers, distributing grants for communities moving away from coal, and identifying sources of funding.[104]

Colorado's Just Transition Plan, released in December 2020, was a collaborative effort and "reflects input from a wide range of stakeholders, issue experts, state agencies, and members

[94] "About the Office of Just Transition," Colorado Department of Labor and Employment, accessed July 6, 2021, https://cdle.colorado.gov/about-the-office-of-just-transition.
[95] "Coal in Colorado," Colorado Department of Labor and Employment, accessed July 6, 2021, https://cdle.colorado.gov/coal-in-colorado.
[96] Ibid.
[97] "Environment & Renewables," Colorado.gov, accessed July 6, 2021, https://dashboard.colorado.gov/key-issues-performance/environment-renewables.
[98] "HB19-1314 Just Transition From Coal-based Electrical Energy Economy," Colorado General Assembly, accessed July 6, 2021, https://leg.colorado.gov/bills/hb19-1314.
[99] "Learn About the Legislation," Colorado Department of Labor and Employment, accessed July 6, 2021, https://cdle.colorado.gov/learn-about-the-legislation.
[100] "HB19-1314 Just Transition From Coal-based Electrical Energy Economy," Colorado General Assembly.
[101] Colorado Department of Labor and Employment, "Colorado Just Transition Action Plan," 3, accessed July 6, 2021, https://cdle.colorado.gov/sites/cdle/files/documents/Colorado%20Just%20Transition%20Action%20Plan.pdf.
[102] "About the Office of Just Transition," Colorado Department of Labor and Employment.
[103] "About the Just Transition Advisory Committee," Colorado Department of Labor and Employment, accessed July 12, 2021, https://cdle.colorado.gov/about-the-just-transition-advisory-committee.
[104] "HB19-1314 Just Transition From Coal-based Electrical Energy Economy," Colorado General Assembly.

of the public."[105] The initial plan developed by the commission focused on costly infrastructure spending and income support programs for affected communities.[106] However, as a result of the COVID-19 pandemic and the uncertainty around state revenues, the final plan was focused on simpler and lower cost ways to mitigate the effects of the loss of industry.[107] The plan also places emphasis on the "Tier One Transition Communities" that are likely to experience significant impacts as they move away from coal reliance. [108]

The plan has three specific areas of focus: community, workforce, and funding. Most of the community strategies outlined in the plan do not require large monetary support. Instead, efforts focus on how to best utilize resources and incentives from federal, state, and local sources so that communities can capitalize on existing funding sources in a more strategic and beneficial way.[109]

One community strategy outlined in Colorado's plan is centered on empowering communities to be the catalyst for their own Just Transition action plan. In advance of statewide initiatives, some towns around the state have begun to take matters into their own hands.[110] Craig, a rural town just west of Steamboat Springs, is already setting into motion support for workers impacted by the impending closure of the local coal power plant.[111] The town's local community college is integral to their plan, and town leaders are hoping that it can plan a key role in both reskilling and retaining the current workforce. Training programs in cybersecurity, paleontology, and nursing are some of the new offerings that have attracted transitioning coal workers.[112] Even with its proactive approach, the town will still need to obtain adequate funding for the programs and ensure that these jobs align with local demand.[113]

Colorado's plan also places particular attention on the "coal transition worker," defined as an individual who has been laid off from a coal-related job.[114] As with the community strategies, the workforce-related strategies also focus on existing funding sources and programs. These efforts focus on empowering workers and families to plan early, lobbying the federal government to prioritize a federal strategy to assist displaced workers, and preparing a detailed state program to help workers achieve transition goals.[115] One of the final things that the plan recognizes is the need for a long-term commitment of a Just Transition strategy, with a responsibility to make updates as needed to meet changing circumstances.[116]

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[105] Colorado Department of Labor and Employment, "Colorado Just Transition Action Plan," 1.
[106] Ibid, 3.
[107] Ibid.
[108] Ibid.
[109] Ibid, 5-6.
[110] Colorado Department of Labor and Employment, "Colorado Just Transition Action Plan," 8.
[111] Jason Gonzales, "In Rural Colorado, One Town is Looking to Its Community College to Help Survive the End of Coal," Chalkbeat, February 11, 2021, accessed July 6, 2021, https://co.chalkbeat.org/2021/2/11/22278204/community-college-craig-coal-sunset-just-transitions.
[112] Ibid.
[113] Ibid.
[114] Colorado Department of Labor and Employment, "Colorado Just Transition Action Plan," 11.
[115] Ibid, 15.
[116] Ibid, 3.

4.0 Methodology

This section will outline the methodology used to identify industries that would likely be impacted by the 2030 GGRA Plan, as well as the identification of the specific threatened occupations within these industries. The process of identifying alternative occupations related to these threatened occupations as well as alternative clean energy jobs is also discussed. Lastly, the process by which training opportunities in the state were obtained is reviewed.

4.1 Identification of Industries of Focus

To determine which industries would be most impacted by the State's GHG reduction strategies, RESI used the results of the economic modeling completed by the project team using REMI PI+ (REMI). The REMI model is a dynamic modeling tool used by various federal and state government agencies in economic policy modeling analysis. REMI contains a baseline model of the Maryland economy that is calibrated to the state's unique demographic and economic characteristics. Scenarios can then be built to estimate the impacts of various economic changes, such as those resulting from new or proposed environmental policies. When a scenario is evaluated, REMI calculates the direct impact of the economic event (for example, the sales made to a new business), as well as secondary effects (such as the new business' payments to vendors and the money spent in the local economy by workers in the new business).

The effects of these changes on the baseline REMI forecast are estimated, allowing researchers to see both the impacts on their own but also in the context of the state's economy. Due to dynamic features of the REMI model, the economic and demographic shifts between regions (within Maryland and across state lines) in response to the economic scenario are also considered. REMI also has the ability to forecast changes over time, which makes it particularly useful in evaluating the long-term impacts of policies in the future.

After evaluating REMI results, four industries within the broader fossil-fuel supply chain were identified for further evaluation:

- Oil and gas extraction;
- Mining (except oil and gas);
- Utilities; and
- Petroleum and coal products manufacturing.

In addition to these four core industries, RESI also used the REMI model to determine whether any additional industries showed a significant change based on the State's plan to reduce GHG emissions. Subsequently, RESI identified Truck Transportation and Construction as two other related and large-scaled industries to be further evaluated.

4.2 Identification of Threatened Occupations

RESI then utilized two different methods to identify occupations that are likely to experience job losses as a result of the State's environmental policies. The first method was to use REMI's employment results to identify general occupations, rather than industry-specific occupations, which are likely to be threatened by the State's GHG reduction strategies. After identifying these occupations, baseline employment projections (before any environmental policy

scenarios were implemented) were evaluated to better understand occupational trends. These baseline trends were then compared to the scenario with environmental policies in effect, and allowed RESI to determine how these policies would impact the rate of employment growth or decline between 2021 and 2050.

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 within the six identified threatened industries. As a hypothetical example, although human resources managers occupation could be experiencing an average decline of 100 employees each year caused by the environmental policies, these managers could be spread throughout several industries, such as retail trade or other industries that are not considered to be threatened. Consequently, RESI utilized a second method of identifying threatened industry-specific occupations using the national industry-to-occupation crosswalk obtained from the U.S. Bureau of Labor Statistics (BLS) on REMI industry data.[117] This file shows the national-level distribution of specific occupations by industry, allowing for an estimation of an approximate industry-specific occupational proportions.

Using these national-level proportions, RESI then applied the estimated employment percentage for each occupation on industry-specific impacted employment results generated by REMI. This resulted in a file that estimated the number of employees by occupation for each threatened industry within Maryland that are likely to be impacted by the State's GHG reduction strategies. To avoid focusing on only a small subgroup of occupations, jobs with common 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.

4.3 Identification of Related and Alternative Occupations

After identifying the threatened occupations of focus, RESI evaluated two alternative options for individuals currently working in these jobs: related occupations and fastest-growing occupations. Related occupations were chosen based on several factors including skill transfers, existing patterns of employment changes, growth projections, and salary expectations. These are occupations that individuals seeking to change careers could pursue with minimal additional preparation. The fastest-growing occupations identified using REMI, accounting for environmental policy impacts, were also suggested as alternative occupations.

To select related occupations, RESI created an occupational matrix for threatened occupations that included employment changes obtained from resume and occupational data through Maryland Workforce Exchange (MWE).[118] Resume data included jobs into which workers had

[117] "May 2020 National Industry-Specific Occupational Employment and Wage Estimates," U.S. Bureau of Labor Statistics, last modified September 28, 2020, accessed July 8, 2021, https://www.bls.gov/OES/Current/oessrci.htm.
[118] "Occupation Profile," Maryland Workforce Exchange, accessed July 12, 2021, https://mwejobs.maryland.gov/vosnet/lmi/default.aspx.

moved to or from, and the number of individuals making this job change. In addition to identifying related jobs through resume data, the Occupational Information Network (O*Net) database was utilized to determine related jobs based on employment characteristics, such as ease of skill transfer between occupations.[119,120] These data were merged with occupational growth projections released by the Maryland Department of Labor,[121] as well as typical education and training requirements needed for entry into the occupation.[122] State-level wage data for 2019 were also obtained from the BLS.[123]

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 in fossil-fuel-reliant industries. Education and training requirements were also considered, with those jobs requiring education levels close to that of the threatened occupation, or slightly above, being the most desirable. Using these criteria, RESI retained the most relevant jobs and focused on these as potential alternative employment opportunities for each threatened occupation.

4.4 Training Opportunities

RESI utilized several sources to gain information on job training for related occupations. These 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. Local clean energy job training opportunities were also explored in several industries including energy efficiency, energy storage, resource conservation, and advanced transportation. To provide additional employment context, data were also obtained on the number of job postings through MWE to specify the areas within the state where positions were available as of August 2021.

5.0 Industries of Focus

According to figures for Maryland from the 2019 U.S. Energy and Employment Report, 18,326 workers were estimated to have fossil-fuel-related jobs in the state, accounting for roughly 0.6 percent of Maryland's total employment.[124] As described in Section 4, four fossil-fuel-reliant

[119] "Career Changers Matrix," O*Net Resource Center, accessed July 10, 2021, https://www.onetcenter.org/dictionary/20.3/excel/career_changers_matrix.html.
[120] "Career Starters Matrix," O*Net Resource Center, accessed July 10, 2021, https://www.onetcenter.org/dictionary/20.2/excel/career_starters_matrix.html.
[121] "Maryland Occupational Projections 2018-2028, Workforce Information and Performance," Maryland Department of Labor, accessed July 20, 2021, https://www.dllr.state.md.us/lmi/iandoproj/maryland.shtml.
[122] "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics, last modified April 9, 2021, accessed July 16, 2021, https://www.bls.gov/emp/tables/education-and-training-by-occupation.htm.
[123] "May 2019 State Occupational Employment and Wage Estimates: Maryland," U.S. Bureau of Labor Statistics, last modified March 31, 2020, accessed June 25, 2021, https://www.bls.gov/oes/2019/may/oes_md.htm.
[124] Energy Futures Initiatives (EFI) and National Association of State Energy Officials (NASEO), "Maryland State Fact Sheet: US Energy and Employment Report 2019 (USEER)," 1-4, accessed July 25, 2021,

industries were chosen for further analysis based on their relevance to the coal, oil, and gas supply chains; industry size; and the likelihood of being negatively impacted by environmental policies between 2021 and 2050.[125] Two additional indirectly related industries, Truck Transportation and Construction, were also identified as impacted industries and were chosen for further analysis. The following section will first show the natural employment trend projections of the industry without GGRA policy impacts, and then show changes in employment attributed solely to the policy impacts. This distinction helps to understand how policies impact natural employment changes and trends over time.

5.1 Overview of Employment Trends in Threatened Industries

A summary of each core fossil-fuel-reliant industry of focus is shown in Figure 6**.** The data represents the average annual losses or gains in REMI's annual employment projections for each time period before policy impacts are considered. For context, 2019 Maryland employment figures are also presented to better understand projected changes within each specified industry. Please note that totals may not sum due to rounding.

Figure 6: Natural Employment Trend Projections in Core Industries, No Policy Impacts

Industries	Maryland Employment 2019	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Oil and Gas Extraction[126]	1,241	35	63	85	1,819
Mining (Except Oil and Gas)	1,308	-26	-12	-9	-458
Utilities	10,308	-89	-5	-4	-980
Petroleum and Coal Products Manufacturing	901	-9	-7	-6	-227

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

As shown in Figure 6, the Mining, Utilities, and Petroleum and Coal Products Manufacturing sectors are expected to experience losses between 2021 and 2050, representing 13 percent of

https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/5c7f412eeef1a1d1dc9afaec/1551843630914/Maryland.pdf.

[125] Other than the five industries of focus, the 2019 U.S. Energy and Employment Report for Maryland also counts employment in Agriculture and Forestry and Trade and Professional Services. These are not included in the current study due to either not being a fossil-fuel-reliant industry, not declining in aggregate terms, or because fossil-fuel-reliant jobs in these industries only constitute a small percentage of employment. Because of this, totals from the 2019 U.S. Energy and Employment Report will be greater than those reported for the core industries of the current analysis.

[126] Employment data for the Oil and Gas Extraction sector from the U.S. Bureau of Economic Analysis is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.

the industry's employment in 2019. These changes are referred to as the natural losses, or those occurring without accounting for the effects from Maryland GHG-reduction policies. Conversely, the Oil and Gas Extraction Industry is projected to increase natural employment by 47 percent above 2019 figures. The three declining sectors also show greater anticipated losses between 2021 and 2030 compared to changes in the following two decades.

Two sectors that are expected to be indirectly and significantly affected by changes in Maryland's GHG-reduction policies are Truck Transportation and Construction. For a baseline comparison, Figure 7 below shows the projected changes in natural employment for each time period evaluated. Once again, 2019 Maryland employment figures are presented for context on the size of these changes in relation to total industry employment.

Figure 7: Natural Employment Trend Projections in Related Industries, No Policy Impacts

Industries	Maryland Employment 2019	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Construction	245,466	-2,466	587	1,272	-6,072
Truck Transportation	26,347	-250	9	53	-1,875

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

Construction and Truck Transportation are expected to experience natural losses in the first decade that are greater than the natural gains in the following two decades. Local and national trends may be responsible for the projected employment decline between 2021 and 2030 of roughly 9.5 percent and 10 percent, respectively, for the Truck Transportation and Construction industries. In Maryland and nationwide, both industries have been experiencing a continuous shortage of workers. The shortage of truck drivers began around 2011 and increased substantially in 2017, with large freight volumes exacerbating shortages in the labor market by 2018.[127] In the Construction industry, labor shortages in Maryland started appearing in 2014, which have consistently driven construction projects' prices up significantly.[128]

One of the main reasons for the shortage in both industries is their aging workforce. The national average age of truckers is 46 years and 42.5 years for construction workers.[129] The industries have been challenged by frequent retirements while concurrently facing difficulty attracting qualified drivers who will abide by the carrier's safety and professionalism

[127] American Trucking Associations (ATA), "Truck Driver Shortage Analysis 2019," 2, accessed August 17, 2021, https://www.trucking.org/sites/default/files/2020-01/ATAs%20Driver%20Shortage%20Report%202019%20with%20cover.pdf.
[128] Teresa Johnson, "Labor Shortage Makes Maryland Construction Projects More Costly," December 15, 2019, accessed August 17, 2021, https://www.baltimoresun.com/business/bs-bz-maryland-labor-shortage-20191215-owedj4ww5rf2dkvfkezpexhtze-story.html.
[129] "Household Data Annual Averages," U.S. Bureau of Labor Statistics, accessed August 17, 2021, https://www.bls.gov/oes/current/oes_md.htm.

standards.[130,131] These issues have driven the market shortages in both industries, and hence, in their declining industry employment trends. Another possible cause for the declining trend in Truck Transportation and Construction is the rising cost of fuel.[132] Fuels constitute the largest expense that trucking companies must incur, and is a required material for most construction projects. [133,134] Other materials used in construction projects have also experienced increasing costs, such as lumber, steel, and iron.[135]

The following subsection will briefly describe each industry and the estimated employment loss due to potential firm reductions and downsizings solely caused by Maryland GHG-reduction policies.

5.2 Policy Impact Projections for Threatened Industries

Data in Figure 8 and Figure 9 reflect projections of employment changes solely attributable to GGRA environmental policies using REMI, and do not include the natural industry employment changes previously described in Section 5.1. In other words, the figures show the annual average difference in employment between baseline projections (no environmental policies) and those of the reference forecast with environmental policies in effect. For instance, if the average annual policy impact for the Utilities sector is equal to '-1' for the period 2031-2040, it means that there will be a total net loss of ten jobs during this decade-long period solely attributed to the GGRA policies, and not as an overall natural trend of the industry. Please note that totals may not sum due to rounding.

[130] American Trucking Associations (ATA), "Truck Driver Shortage Analysis 2019," 2.
[131] Johnson, "Labor Shortage Makes Maryland Construction Projects More Costly."
[132] "Trends Transforming the Trucking Industry Outlook in 2021," Linchpin, July 13, 2021, accessed August 17, 2021, https://linchpinseo.com/trends-trucking-and-transportation-industry/.
[133] Ibid.
[134] "Rising Cost in the Construction Industry," Michael Page, accessed August 17, 2021, https://www.michaelpage.com/advice/management-advice/development-and-retention/rising-costs-construction-industry.
[135] Ibid.

Figure 8: Policy Impact Projections in Core Fossil-Fuel-Reliant Industries

Industries	Maryland Employment 2019	Average Annual Policy Impact 2021-2030	Average Annual Policy Impact 2031-2040	Average Annual Policy Impact 2041-2050	Total Policy Impact 2021-2050
Oil and Gas Extraction[136]	1,241	-3	-6	-5	-142
Mining (Except Oil and Gas)	1,308	1	-2	0	-9
Utilities	10,308	1	-1	-6	-60
Petroleum and Coal Products Manufacturing	901	-4	-3	-3	-97

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

Environmental policies are expected to be responsible for the slowing down of employment growth in the Oil and Gas Extraction industry and an acceleration of the decline in the Petroleum and Coal Products Manufacturing industry. Declining employment in Mining and Utilities is not likely to be significantly accelerated by GGRA environmental policies. Thus, it can be concluded that Maryland's environmental policies are not likely to be causing additional significant losses in fossil-fuel-reliant industry employment.

Although Fossil Fuel Power Generation is the largest industry in the Utilities sector, it only employs 13 percent of the sector's workers, which could explain the small size of net losses attributable to environmental policies.[137] The REMI model aggregates all firms generating electric power into a single Utilities sector. That is, employees working in renewable energy electric power generation, such as wind or solar, are included in the total employment figures projected by REMI for the Utilities sector. Notably, however, only 5 percent of the industry's workers were employed in renewable energy electric power generation in Maryland by 2018, and accordingly, renewable energy only constitutes a small portion of the energy transmission, storage and distribution.[138] Since the analysis focuses on the net effect of environment policies on the industry, the overall negative impact on the Utilities sector indicates that the positive environmental policy impacts on clean energy jobs are not enough to compensate for the losses generated by the same policies.

[136] Employment data for the Oil and Gas Extraction sector from the U.S. Bureau of Economic Analysis is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.

[137] "2018 SUSB Annual Data Tables by Established Industry," U.S. Census Bureau, accessed October 6, 2021, https://www.census.gov/data/tables/2018/econ/susb/2018-susb-annual.html.

[138] Ibid.

Figure 9 below shows the change in average annual projected employment for the Truck Transportation and Construction industries with Maryland GGRA policies in place. Once again, please note that totals may not sum due to rounding.

Figure 9: Policy Impact Projections in Related Industries

Industries	Maryland Employment 2019	Average Annual Policy Impact 2021-2030	Average Annual Policy Impact 2031-2040	Average Annual Policy Impact 2041-2050	Total Policy Impact 2021-2050
Construction	245,466	1,330	-667	-192	4,705
Truck Transportation	26,347	-56	-152	-81	-2,879

Sources: REMI, RESI, U.S. Bureau of Economic Analysis

In Maryland, 90 percent of petroleum is consumed by the transportation industry.[139] Additionally, transportation is also considered the largest source of GHG emissions in the state.[140] Trucks are also used to carry and deliver several different forms of petroleum products from oilfields to refineries. Therefore, it is intuitive for emission reduction strategies to have negative continuous effects on transportation employment, including the Truck Transportation industry. As illustrated in Figure 9 above, Truck Transportation employment is likely to be negatively impacted by GHG-reduction strategies. Based on data from REMI, Maryland's GHG-reduction policies are expected to cause an acceleration in the overall decline of the industry in the first decade evaluated, and a reverse of growth into a decline in the following two decades.

In the Construction industry, GHG-reduction policies are projected to cause a boom in employment between 2021 and 2030, largely due to planned transportation projects to reduce vehicle emissions. Due to this jump in employment, the declining natural trend of the industry is reduced by half. With the completion of these projects around 2030, large losses are expected in the following two decades. While the net effect of the policies after three decades is still positive, a total of approximately 8,500 employees are short-term employees in the first decade and would need to find other job opportunities in subsequent years.

For total net effects, Figure 10 combines natural trend projections with policy impact projections for each of the focus industries during each decade evaluated.

[139] "Maryland: State Profile and Energy Estimates," U.S. Energy Information Administration, last updated October 15, 2020, accessed August 11, 2021, https://www.eia.gov/state/analysis.php?sid=MD.
[140] Maryland Department of the Environment, "State of Maryland 2017 Greenhouse Gas Emission Inventory Documentation," 149, accessed August 17, 2021, https://mde.maryland.gov/programs/Air/ClimateChange/Documents/MD%202017%20Periodic%20GHG%20Emissions%20Inventory%20Documentation.pdf.

Figure 10: Net Effect on Focus Industries

Industries	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Oil and Gas Extraction[141]	28	48	72	1,473
Mining (Except Oil and Gas)	-25	-13	-9	-467
Utilities	-88	-6	-10	-1,040
Petroleum and Coal Products Manufacturing	-13	-11	-9	-323
Construction	-1,137	-80	1,080	-1,367
Truck Transportation	-305	-142	-28	-4,753

Sources: REMI, RESI

As shown in Figure 10, there will likely be an overall decline in all focus industries in a period of 30 years, except for the Oil and Gas Extraction industry. A total net loss of 7,950 workers is expected in the declining industries between 2021 and 2050. The only industry that experiences a slower decline because of the GGRA plan is the Construction industry. Part of this observation could be due to the expected boost in clean energy job employment in the Construction industry. For Truck Transportation, which is estimated to lose approximately 4,753 workers between combined natural trends and policy impacts, the previously discussed industry-specific dynamics are likely affecting this figure.

6.0 Occupational Transitions

RESI evaluated key threatened occupations resulting from State climate change mitigation strategies, as determined in the methodology outlined in Section 4. This section will provide a summary of the natural employment trends of these occupations, show impacts of environmental policy on employment, and highlight related professions to each threatened occupation. For several of these related occupations, the requirements and opportunities for entry are discussed in greater detail.

6.1 Overview of Employment Trends and Policy Impact Projections for Threatened Occupations

Figure 11 shows the projected change in average annual employment for broad affected occupations before accounting for policy impacts. Employment figures represent those working in all industries, and are not isolated to any specific sector. These figures illustrate the baseline employment levels and trends to which the impacts from the GHG-reduction policies will be compared.

[141] Employment data for the Oil and Gas Extraction sector from the U.S. Bureau of Economic Analysis is suppressed for years 2017, 2018, and 2020 for confidentiality reasons. Since REMI's projections' reference year is 2017, projections are not accurate and are likely overestimating the figure. Therefore, policy impacts for this sector were scaled to 2019 data for this sector.

Figure 11: Employment Projections for Threatened Broad Occupations, No Policy Impacts

Occupation	Maryland Employment 2019	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050	Total Change 2021-2050
Motor Vehicle Operators	74,980	-445	497	653	7,056
Material Moving Workers	108,180	-204	620	823	12,400
Material Recording, Scheduling, Dispatching, and Distributing Workers	31,880	-478	247	373	1,421
Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	27,470	-214	120	183	885

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

As evident in Figure 11, the employment losses experienced in the first decade for the four identified occupations will be more than offset by gains in the following decades. For example, Material Recording, Scheduling, Dispatching, and Distributing workers are expected to lose 478 jobs annually between 2021 and 2030, yet positive employment growth between 2031 and 2040 eliminates and exceeds these impacts. As was discussed in Section 5, Transportation as well as Construction industries are declining industries for the near future in Maryland and nationwide. For this reason, occupations within these industries, such as Motor Vehicle Operators and Material Moving Workers, are also experiencing declines. The following subsection will show how environmental policies affect these natural employment trends.

Figure 12 details how environmental policies affect average annual employment levels and trends for each of the ten-year periods evaluated. Please note that totals may not sum due to rounding.

Figure 12: Policy Impact Projections for Threatened Broad Occupations

Occupation	Maryland Employment 2019	Average Annual Policy Impact 2021-2030	Average Annual Policy Impact 2031-2040	Average Annual Policy Impact 2041-2050	Total Impact 2021-2050
Motor Vehicle Operators	74,980	5	-112	-58	-1,648
Material Moving Workers	108,180	30	-32	-21	-221
Material Recording, Scheduling, Dispatching, and Distributing Workers	31,880	21	-18	-17	-146
Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	27,470	15	-11	-9	-250

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

When comparing Figure 12 to Figure 11, it can be inferred that policy impacts drive employment in the opposite direction of their natural trends. Therefore, while the four occupations are experiencing losses in the first decade, the environmental policies are slowing down these losses by their positive impact on employment. The impact on the following two decades is larger, negative, and slows down the overall growth of the four broad occupations. Notably however, the impacts on employment resulting from the Maryland's GHG-reduction strategies are significantly smaller than impacts from natural employment trends. For example, while Motor Vehicle Operators are expected to decline by an average of 58 employees annually between 2041 and 2050, natural trends show an average annual increase of 653 worker during this same time period.

The second method of identifying threatened occupations, as outlined is Section 4, was to further explore broad occupations and identify the most-impacted jobs within Maryland's threatened industries. This was completed by estimating the proportions of detailed occupations for each industry using a national employment-to-industry crosswalk. These estimates were then applied to REMI's Maryland industry employment projections, resulting in the impacts shown in Figure 13 below. Please note that totals may not sum due to rounding. A full list of occupations evaluated within Maryland's threatened industries can be found in Appendix A.

Figure 13: Policy Impact Projections for Detailed Threatened Industry-Specific Occupations

Occupation	Employment in Threatened Industries, 2019	Average Annual Impact 2021-2030	Average Annual Impact 2031-2040	Average Annual Impact 2041-2050	Total Impact 2021-2050
Heavy and Tractor-Trailer Truck Drivers	17,820	-12	-98	-50	-1593
Laborers and Freight, Stock, and Material Movers, hand	3,260	3	-17	-8	-217
Bus and Truck Mechanics and Diesel Engine Specialists	1,210	-1	-6	-3	-102
Dispatchers, Except Police, Fire, and Ambulance	1,046	1	-5	-2	-63
Petroleum Pump System Operators, Refinery Operators, and Gaugers	219	-1	-1	-1	-23

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

Heavy and Tractor-Trailer Truck Drivers, Bus and Truck Mechanics and Diesel Engine Specialists as well as Petroleum Pump System Operators and Gaugers are expected to experience a continuous decline from 2021 to 2050. However, Dispatchers, Laborers, Freight, Stock and Material Movers will only start experiencing negative policy impacts starting 2031. The largest impacts are expected in Heavy and Tractor-Trailer Truck Drivers, with average losses of 98 jobs annually between 2031 and 2040 and 50 jobs between 2041 and 2050. Petroleum Pump System Operators and Gaugers show the smallest impacts from GHG-reduction policies, declining by an average of one position annually for each decade evaluated.

6.2 Related Occupations

As Maryland moves forward with GHG-reduction strategies and a Just Transition plan away from fossil-fuel reliance, impacted workers may need to shift to alternative occupations. To gain a greater understanding of what these transitions may look like, RESI evaluated the threatened occupations outlined in Figure 13 to provide examples of potential employment opportunities for these workers. While additional factors such as individual preferences and local geographic demand will also impact employment decisions, this subsection will highlight potential occupations for workers potentially displaced from previously identified threatened occupations. Notably, the lists of related occupations that are provided constitute several selected jobs based on the filtering criteria described in Section 4, and is not an exhaustive list of all occupational transfer options.

In 2019, there were 23,270 Heavy and Tractor-Trailer Truck Drivers in Maryland, out of which

an estimated of 1,593 would potentially be impacted by State GGRA strategies between 2030 and 2050. Figure 14 below outlines occupations related to Heavy and Tractor-Trailer Truck Drivers, as well as entry requirements, growth projections, and 2019 average 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.

Additionally, the projected Maryland employment growth from 2018 to 2028 provided in the tables below are rates published by the Maryland Department of Labor and are based on economic factors and employment dynamics, rather than environmental policies. Therefore, even though the projected growth column could show positive percent changes for threatened occupations, they are still expected to be negatively impacted by emission reduction strategies. Since one of the criteria for a related occupation is that it does not fall into one of the threatened industries and since REMI data do not show negative impacts to the employment levels of other occupations, RESI does not expect a significant discrepancy between Maryland Department of Labor's growth rates and growth rates after environmental policy implementation. It is worth noting that as of October 2021, the published employment projections stop at year 2028, and do not extend until 2050 as REMI projections do for industries and broad occupations.

Figure 14: Alternative Occupations to Heavy and Tractor-Trailer Truck Drivers

Occupation	Maryland Employment 2019	Maryland Average Annual Wage	Minimum Education	On-the-Job Training	Projected Growth 2018-2028
Heavy and Tractor-Trailer Truck Drivers	**23,270**	**$50,090**	**Postsecondary nondegree award**	**Short-term OTJ**	**10.9%**
Maintenance and Repair Workers	**19,480**	**$46,340**	**HS/Equivalent**	**Moderate-term OTJ**	**13.8%**
Sailors and Marine Oilers	540	$58,050	No formal educational credential	Moderate-term OTJ	15.2%
Captains, Mates, and Pilots of Water Vessels	**570**	**$80,460**	**Postsecondary nondegree award**	**None**	**14.5%**
Transportation Inspectors	490	$62,080	HS/Equivalent	Moderate-term OTJ	8.6%

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*NET, REMI, RESI, U.S. Bureau of Labor Statistics

As shown above, most positions related to Heavy and Tractor-Trailer Truck Drivers require a limited amount of education and training for entry, such as short- or moderate-term OTJ training and a postsecondary nondegree award or less. The highlighted occupation—Captains, Mates, and Pilots of Water Vessels—does not typically require OTJ training and has a significantly higher average wage than Heavy and Tractor-Trailer Truck Drivers ($80,460 vs. $50,090, respectively). Additionally, this occupation has a high projected growth rate of 15.2 percent through 2028. The other highlighted occupation, Maintenance and Repair Workers, has a larger employment base in Maryland and a potential growth rate of 13.8 percent in Maryland, with a slightly lower but comparable average annual wage rate. Training opportunities for these two related occupations are discussed further in Section 6.3.

Figure 15 below details several occupations related to Laborers and Freight, Stock, and Material Movers, as well as entry requirements, growth projections, and 2019 mean wages. Of the 33,840 Laborers and Freight, Stock and Material Movers in the state, 217 are estimated to incur job losses because of the State's climate change mitigation strategies over the time periods evaluated.

Figure 15: Alternative Occupations to Laborers and Freight, Stock, and Material Movers, Hand

Occupation	Maryland Employment, 2019	Maryland Average Annual Wage	Minimum Education	On-the-Job Training	Projected Growth 2018-2028
Laborers and Freight, Stock, and Material Movers, Hand	**38,050**	**$33,940**	**No formal educational credential**	**Short-term OTJ**	**10.4%**
Sawing Machine Setters, Operators, and Tenders, Wood	280	$32,080	HS/Equivalent	Moderate-term OTJ	20.6%
Janitors and Cleaners	39,730	$30,500	No formal educational credential	Short-term OTJ	15.9%
Security Guards	**23,700**	**$37,930**	**HS/Equivalent**	**Short-term OTJ**	**12.3%**
Fence Erectors	840	$34,630	No formal educational credential	Moderate-term OTJ	9.4%
Rail-Track Laying and Maintenance Equipment Operators	**350**	**$62,980**	**HS/Equivalent**	**Moderate-term OTJ**	**6.5%**
Packaging and Filling Machine Operators and Tenders	3,790	$34,500	HS/Equivalent	Moderate-term OTJ	6.3%

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*NET, REMI, RESI, U.S. Bureau of Labor Statistics

While Laborers and Freight, Stock and Material Movers are not generally required to have formal educational credentials, most related occupations require a high school diploma or equivalent. Two exceptions are for Janitors and Cleaners, which is a lower-paying occupation but is in high demand, and Fence Erectors, which has a slightly higher average wage compared to Laborers and Freight, Stock and Material Movers. OTJ training typically needed for related positions range from short- to moderate-term levels. One of the highlighted occupations, Rail-Track Laying and Maintenance Equipment Operators usually requires a high school diploma and moderate-term OTJ training. This position has a substantially higher mean wage compared to Laborers and Freight, Stock and Material Movers ($62,980 vs. $33,940, respectively), and projected employment growth of 6.5 percent. The other highlighted occupation of Security Guards has a slightly higher average wage than Laborers and Freight, Stock and Material Movers at $37,930. This occupation also has a significant level of employment in the state with 23,700 workers, and typically requires a high school diploma and short-term OTJ training. Training opportunities for this profession are discussed in Section 6.3.

Figure 16 below details several occupations related to Bus and Truck Mechanics and Diesel Engine Specialists. Of the 4,350 individuals employed in this occupation within the state, 102 job losses are estimated from the policies changes between 2021 and 2050.

Figure 16: Alternative Occupations to Bus and Truck Mechanics and Diesel Engine Specialists

Occupation	Maryland Employment, 2019	Maryland Average Annual Wage	Minimum Education	On-the-Job Training	Projected Growth 2018-2028
Bus and Truck Mechanics and Diesel Engine Specialists	**4,350**	**$54,740**	**HS/Equivalent**	**Long-term OTJ**	**8.3%**
Welders, Cutters, Solderers, and Brazers	**2,720**	**$55,310**	**HS/Equivalent**	**Moderate-term OTJ**	**7.0%**
Automotive Glass Installers and Repairers	620	$54,880	HS/Equivalent	Moderate-term OTJ	6.3%
Mobile Heavy Equipment Mechanics	2,780	$59,130	HS/Equivalent	Moderate-term OTJ	4.0%
Control and Valve Installers and Repairers	830	$58,400	HS/Equivalent	Moderate-term OTJ	3.9%

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*NET, REMI, RESI, U.S. Bureau of Labor Statistics

Each selected occupation related to Bus and Truck Mechanics and Diesel Engine Specialists is estimated by the BLS to require moderate-term OTJ training. This likely related to the need to use specialized equipment or acquire hand skills. The related positions all require a high school diploma, which is the same level of education typically obtained by Bus and Truck Mechanics and Diesel Engine Specialists. The highlighted occupation—Welders, Cutters, Solderers and Brazers—is projected to grow faster than the national rate (7 percent in Maryland from 2018-2028 vs. 3 percent nationally from 2019 to 2029) and has a slightly higher mean wage of $55,310.[142] Training opportunities for this profession are detailed in Section 6.3.

Figure 17 outlines several occupations related to Dispatchers, Except Police, Fire, and Ambulance. The State's climate mitigation policies are estimated to impact 63 jobs out of the 3,370 individuals employed in Maryland over the time period evaluated.

[142] "Occupational Outlook Handbook: Welders, Cutters , Solderers, and Brazers," U.S. Bureau of Labor Statistics, accessed August 18, 2021, https://www.bls.gov/ooh/production/welders-cutters-solderers-and-brazers.htm.

Figure 17: Alternative Occupations to Dispatchers, Except Police, Fire, and Ambulance

Occupation	Maryland Employment, 2019	Maryland Average Annual Wage	Minimum Education	On-the-Job Training	Projected Growth 2018-2028
Dispatchers, Except Police, Fire, and Ambulance	**3,370**	**$45,790**	**HS/Equivalent**	**Moderate-term OTJ**	**5.8%**
Billing and Posting Clerks	7,000	$43,060	HS/Equivalent	Moderate-term OTJ	17.8%
Reservation and Transportation Ticket Agents and Travel Clerks	1,210	$43,930	HS/Equivalent	Short-term OTJ	7.2%
Brokerage Clerks	1,320	$59,780	HS/Equivalent	Moderate-term OTJ	4.9%
Human Resources Assistants, Except Payroll and Timekeeping	3,080	$46,510	Associate degree	None	1.9%
Computer User Support Specialists	**11,180**	**$58,470**	**Some college, no degree**	**None**	**6.7%[143]**

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*NET, REMI, RESI, U.S. Bureau of Labor Statistics

[143] Maryland projected growth from 2018-2028 is not available for this occupation. Data represent 2016-2026 MWE projected growth.

The typical educational and training requirements for occupations related to Dispatchers vary considerably. Educational attainment levels vary from a high school diploma to some college with no degree, and from no OTJ training to short- and medium-term OTJ training. The highlighted occupation, Computer User Support Specialists, is growing fast nationally and has a higher average wage than Dispatchers ($58,470 vs. $45,790, respectively). Although Computer User Support Specialists do not typically require OTJ training, they do have a higher educational requirement (some college, no degree) for entry than Dispatchers. Training opportunities for Computer User Support Specialist occupations are further discussed in Section 6.3.

Positions related to the final threatened occupation evaluated—Petroleum Pump System Operators, Refinery Operators, and Gaugers—are shown in Figure 18. Of the approximately 219 individuals employed in this profession in Maryland, 23 workers are estimated to be displaced due to State climate change mitigation strategies.

Figure 18: Alternative Occupations to Petroleum Pump System Operators, Refinery Operators, and Gaugers

Occupation	Maryland Employment, 2019	Maryland Average Annual Wage	Minimum Education	On-the-Job Training	Projected Growth 2018-2028
Petroleum Pump System Operators, Refinery Operators, and Gaugers	**219**[144]	**$50,710**	**HS/Equivalent**	**Moderate-term OTJ**	**2.8%**[145]
Environmental Engineering Technologists and Technicians	**360**	**$57,800**	**Associate degree**	**None**	**10.6%**
Civil Engineering Technologists and Technicians	1,240	$57,810	Associate degree	None	7.9%
Electro-Mechanical and Mechatronics Technologists and Technicians	530	$65,040	Associate degree	None	7.2%
Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders	380	$47,670	HS/Equivalent	Moderate-term OTJ	7.2%
Electrical and Electronic Engineering Technologists and Technicians	3,110	$76,250	Associate degree	None	5.6%
Mechanical Engineering Technologists and Technicians	470	$64,410	Associate degree	None	4.6%

Sources: Maryland Department of Labor, Maryland Workforce Exchange, O*NET, REMI, RESI, U.S. Bureau of Labor Statistics

[144] 2019 Maryland employment data not available for this occupation. Employment figure is based on national proportions applied to REMI's Maryland industry employment levels.

[145] Maryland projected growth from 2018-2028 is not available for this occupation. Data represent 2016-2026 MWE projected growth.

Most occupations related to Petroleum Pump System Operators require at least an associate degree for entry and no OTJ training. One exception is for the Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders occupation, which typically requires a high school diploma but also usually requires moderate-term OTJ training. The highlighted occupation, Environmental Engineering Technologists and Technicians, has a higher average wage of $57,800 compared to $50,710 for Petroleum Pump and System Operators. This occupation also typically requires an associate degree, compared to a high school diploma for Petroleum Pump System Operators. Environmental Engineering Technologists and Technicians usually do not require any OTJ training, and the occupation has a projected growth rate of 10.6 percent between 2018 and 2028—higher rate than most other related occupations evaluated. Training opportunities for Environmental Engineering Technologists are further discussed in Section 6.3.

In addition to analyzing related occupations, REMI also explored the fastest-growing occupations in Maryland as potential opportunities for displaced workers. Figure 19 shows the average annual growth rates of broad occupations as projected by REMI, and includes the combined net impact of both natural employment trends and changes from environmental policies that are expected to be in effect for the time periods evaluated.

Figure 19: Fastest Growing Broad Occupations with Environmental Policies in Effect

Occupation	Average Annual Percent Change 2021-2030	Average Annual Change 2021-2030	Average Annual Percent Change 2031-2040	Average Annual Change 2031-2040	Average Annual Percent Change 2041-2050	Average Annual Change 2041-2050
Computer Occupations	0.4%	463	1.1%	1,536	1.2%	1,908
Mathematical Science Occupations	1.2%	71	1.5%	100	1.5%	120
Nursing, Psychiatric, and Home Health Aides	0.6%	389	1.4%	21	1.4%	23
Occupational Therapy and Physical Therapist Assistants and Aides	1.3%	69	2.0%	248	1.8%	334

Sources: REMI, RESI

As shown in Figure 19, Maryland is projected to gain an estimate of 9,920 jobs between 2021 and 2030 in the four occupations outlined, with an additional 19,050 jobs between 2031 and 2040, and 23,850 jobs between 2041 and 2050. Nursing, Psychiatric and Home Health Aides as well as Occupational Therapy and Physical Therapist Assistants and Aides typically require lower levels of preparations for job market entry compared to Computer and Mathematical Science Occupations. Training opportunities for one component of the highlighted job, Occupational Therapy Assistants, will be further discussed in Section 6.3.

Many occupations in fossil-fuel-reliant industries are the same occupations in the clean energy sector. For instance, an Electrical Engineer may work in fossil-fuel electricity generation, or they can work in solar energy electricity generation. This also applies to Plant and System Operators and many other occupations. Thus, skills transfer from a job in fossil-fuel-reliant industry to another job in the same occupation in the clean energy sector will likely cause skill transfers to be smoother. Section 6.4 further explores clean energy job training opportunities in Maryland for those beginning or changing their career.

There are, however, a small number of occupations that can be considered as exclusively related to the clean energy sector. These occupations are listed in Figure 20 along with their required skills, education, and on-the-job training. It is important to note that wage, employment, and growth projection data for most of these detailed occupations are not available at either the Maryland or national level. Often this is due to the relatively small number of employees or employment firms in the state, resulting in data suppression. Nonetheless, data is available for the immediately broader occupation, which is labeled as "Occupation Family" in Figure 20. Accordingly, the last three columns represent Maryland data for wages employment and growth projections for the broader occupation family listed and not for the detailed occupation, except for Wind Turbine Service Technician occupations, for which data was only available at the national level.

Figure 20: Alternative Clean Energy Occupations

Occupation	Minimum Education	On-the-Job Training	Skills Needed	Occupation Family	Maryland Employment 2018	Maryland Average Annual Wage	Maryland Projected Growth 2018-2028
Solar Photovoltaic Installers	HS/Equivalent	Moderate-term OTJ	Installation, Mechanical Knowledge, Building & Construction	Solar Photovoltaic Installers	160	$49,470	54%
Wind Turbine Service Technicians	Postsecondary nondegree award	Long-term OTJ	Engineering & Technology, Mechanical Knowledge, Equipment Maintenance	Wind Turbine Service Technicians	*Unavailable*	$56,230*	68%*
Solar Thermal Installers and Repairers	HS/Equivalent	Apprenticeship	Engineering & Technology, Mechanical Knowledge, Building & Construction	Plumbers, Pipefitters, and Steamfitters	8,920	$57,520	11%
Solar Energy Systems Engineers/ Wind Energy Engineers	Bachelor's degree	None	Engineering & Technology, Physics, Design, Building & Construction,	Engineers, All Other	5,900	$69,422	5%
Water/ Wastewater Engineers	Bachelor's degree	None	Engineering & Technology, Design, Building & Construction	Civil Engineers	1,960	$81,210	12%
Solar Energy Installation Managers	HS/Equivalent	None	Engineering & Technology, Physics, Design, Building & Construction	First-Line Supvr. of Construction Trades/ Extraction Workers	15,850	$72,189	5%

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

Figure 20 shows a variety of clean energy jobs such as solar, wind and hydro-related occupations. While some careers require at least a bachelor's degree, such as Engineers, others including Wind Turbine Service Technicians and Solar Thermal Installers and Repairers can be attained with a post-secondary nondegree award or high school degree. Of these clean energy occupations, Solar Photovoltaic Installer is the fastest growing in Maryland, while Wind Turbine Service Technician is the fastest growing nationally, with growth rates of 54 percent and 68 percent, respectively. Most occupations require skills in engineering and technology as well as building and construction. Section 6.4 will further explore the training opportunities in Maryland as a preparation to work in the clean energy sector.

6.3 Training Opportunities

The following subsection outlines training requirements and opportunities in Maryland for the highlighted occupations in Section 6.2. The career preparation opportunities discussed 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 shift from fossil-fuel-dependent jobs during a Just Transition.

Maintenance and Repair Workers

Maintenance and Repair Workers typically perform tasks to keep machinery, mechanical equipment, or establishment structures in working order. Common duties involve but are not limited to pipe fitting, carpentry, repairing electrical or mechanical equipment, and installing new equipment.[146] To start a career in Maintenance and repair, a post-secondary certificate or a high school diploma is typically required along with a one to two years of on-the-job training or the completion of a recognized apprenticeship program.[147] With a projected growth rate of 8 percent from 2020 to 2030 nationally and 14 percent from 2018 to 2028 in Maryland, this occupation is expected to continue having a large number of job openings.[148]

Harford Community College offers a Building Maintenance certificate that requires 175 hours over six to eight months to complete and costs approximately $2,800. Candidates in this certification program learn about basic carpentry, plumbing, electricity, refrigeration, and refrigerant recovery.[149] Advertised skills for this occupation, including job postings from Maryland Workforce Exchange, include general, preventive, or equipment maintenance; repairing; troubleshooting; active learning; critical thinking; and customer service. As of October 20, 2021, there were 325 job openings in Maryland, including 48 in Baltimore County,

[146] "Occupation Profile: Maintenance and Repair Workers, General," CareerOnestop, accessed October 21, 2021, https://www.careeronestop.org/Toolkit/Careers/Occupations/occupation-profile.aspx?keyword=Maintenance%20and%20Repair%20Workers,%20General&onetcode=49907100&location=Maryland&onet=49907100.
[147] "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.
[148] "Maryland Occupational Projections 2018-2028," Maryland Department of Labor.
[149] "Building Maintenance," Harford Community College, accessed October 20, 2021, https://www.harford.edu/academics/workforce-career-training/building-maintenance.php.

43 in Montgomery County, 37 in Prince George's County, and 18 in Anne Arundel County.[150]

Captains, Mates, and Pilots of Water Vessels

Captains, Mates and Pilots typically command and supervise operations of ships and water vessels, such as tugboats and ferryboats. Individuals starting this career usually need a postsecondary certificate, less than five years of work experience in related positions, and are required to hold a license issued by the US. Coast Guard.[151] Although this occupation is not projected to grow substantially on the national level, it has a stable outlook in Maryland, with projected growth of 14 percent between 2018 and 2028.[152] The Baltimore-Columbia-Towson metropolitan area is ranked 8th nationally in employment levels for this occupation.[153] Additionally, there is currently a shortage of candidates for this occupation in the Maryland labor market.

While getting a certificate in Commercial Fishing or in Merchant Marine Officing can be a lengthy process, succeeding in licensing courses could be enough to prepare individuals for the U.S. Coast Guard License.[154] Captain's Licensing Courses (100 hours of instruction and testing) are offered at the Community College of Baltimore County as well as at the Annapolis School of Seamanship.[155,156] One of the most important requirements needed to obtain the US. Coast Guard license is to be able to document one year of experience on a vessel within the past three years.[157]

Advertised skills for this occupation, including job postings on Maryland Workforce Exchange (MWE), include operation and control, operation monitoring, critical thinking, flexibility, critical path analysis, program planning, and customer service.[158,159] Microsoft Project, Microsoft Excel, Git and Structured query language are some of the advertised tools and technology skills

[150] "Occupation Profile: Captains, Mates, and Pilots of Water Vessels," Careeronestop, accessed August 11, 2021, https://www.careeronestop.org/Toolkit/Careers/Occupations/occupation-profile.aspx?keyword=Captains,%20Mates,%20and%20Pilots%20of%20Water%20Vessels&onetcode=53502100&location=MARYLAND.
[151] Ibid.
[152] "Maryland Occupational Projections 2018-2028," Maryland Department of Labor.
[153] "Geographic Profile for Captains, Mates, and Pilots of Water Vessels, May 2020," U.S. Bureau of Labor Statistics, accessed August 11, 2021, https://www.bls.gov/oes/current/oes535021.htm#st.
[154] "U.S. Coast Guard Captain's License Credential Requirements," U.S. Coast Guard, accessed August 11, 2021, https://trlmi.com/u-s-coast-guard-captains-license-credential-requirements-oupv-up-to-100-gt/.
[155] "Captain's License," Community College of Baltimore County, accessed August 11, 2021, https://www.ccbcmd.edu/Programs-and-Courses/Life-Enrichment/Boating-and-Water-Activities/Captain-License.aspx.
[156] "The USCG Captain's License," Annapolis School of Seamanship, accessed August 11, 2021, https://www.annapolisschoolofseamanship.com/captainslicense.
[157] "U.S. Coast Guard Captain's License Credential Requirements," U.S. Coast Guard.
[158] "Occupation Profile: Ship and Boat Captains," Maryland Workforce Exchange, accessed August 11, 2021, https://mwejobs.maryland.gov/vosnet/lmi/default.aspx.
[159] "Summary Report for: 53-5021.00 Captains, Mates, Pilots of Water Vessels," O*Net OnLine, accessed August 11, 2021, https://www.onetonline.org/link/summary/53-5021.00.

needed for current position openings in Maryland.[160]

Security Guards

Security Guards can work in numerous roles including Campus Security Officers, Custom Protection Officers, Customer Service Security Officers, Hotel Security Officers, Loss Prevention Officers, Safety and Security Officers, and Security Agents. These individuals typically guard, patrol, or monitor premises to prevent theft, violence, or rule infractions.[161] To become a Security Guard no extensive training is needed either prior to job application or on the job, however, a high school diploma is typically required for entry.[162] There continues to be a high demand for the Security Guard occupation with a projected growth rate of 12 percent in Maryland between 2018 and 2028.[163]

There are two types of Security Guard jobs: armed and unarmed. To become an armed security guard in Maryland, there are additional requirements such as obtaining a Maryland Wear and Carry permit and completing a 16-hour, state-approved firearm training course. [164] Depending on the position, security guard training requirements may include additional firearm and video surveillance preparation.[165]

As of October 21, 2021 there were 982 job openings for Security Guards on MWE, with most jobs found in Montgomery (187), Anne Arundel (166), and Howard (157) counties.[166] Many of these advertised positions in Maryland required an Information Security/Cybersecurity Certification $(ISC)^2$ or CPR/First Aid Certification. Security Guards need to also have risk management skills, attention to detail, and professional fitness.[167]

Rail-Track Laying and Maintenance Equipment Operators

Rail-Track Laying and Maintenance Equipment Operator jobs can also be found under titles including Rail Maintenance Worker, Track Equipment Operator (TEO), Track Inspector, Track Laborer, Track Maintainer, and Track Repairer. Entering into these professions typically requires

[160] "Occupation Summary: Ship and Boat Captains," Maryland Workforce Exchange, accessed August 11, 2021, https://mwejobs.maryland.gov/vosnet/lmi/default.aspx.
[161] "Occupation Profile: Security Guards," Careeronestop, accessed October 21, 2021, https://www.careeronestop.org/Toolkit/Careers/Occupations/occupation-profile.aspx?keyword=Security%20Guards&onetcode=33903200&location=Maryland&onet=33903200.
[162] "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.
[163] "Maryland Occupational Projections 2018-2028," Maryland Department of Labor.
[164] "Unarmed and Unarmed Security Guard Requirements in Maryland," Security Resources, accessed October 21, 2021, https://www.securityresources.net/security-guard-requirements-by-state/security-guard-requirements-in-maryland.
[165] "Security Guard Training Requirements," Chron, accessed October 21, 2021, https://work.chron.com/security-guard-training-requirements-17761.html.
[166] "Occupation Summary: Security Guards," Maryland Workforce Exchange, accessed October 21, 2021, https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileSummary.aspx?session=occdetail&valueName=occupation.
[167] Ibid.

a high school diploma or equivalent and one month to a year of OTJ training.[168] This occupation is projected to grow 7 percent in Maryland between 2018 and 2028, faster than the anticipated growth rate of 3 percent across the U.S.[169] Nationally, Maryland is listed as one of the top-five paying states for Rail-Track Laying and Maintenance Equipment Operators, with an annual mean wage of $62,980.[170]

An apprenticeship program would be a typical preparation for entry into a Rail-Track Laying and Maintenance Equipment Operator position.[171] Machinery maintenance workers and maintenance machine repairers are registered occupations in the Maryland Apprenticeship and Training Program (MATP), where employers offer apprenticeship placement opportunities. Apprentices are paid while learning to lubricate machinery, change parts, or perform other routine machinery maintenance. The average program length of currently advertised opportunities as of August 2021 is 6,000 hours for an hourly wage rate ranging from $10 to $20. Apprenticeship programs sponsors include Baltimore City Community College, Washington County Public Schools, and Frederick County Public Schools.[172]

Individuals in these positions perform a variety of tasks involving physical labor to build, repair, and maintain railroad track.[173] They use a variety of hand and power tools and other construction equipment. Software skills are also sometimes needed such as the ability to utilize data base user interface and query software, enterprise resource planning (ERP) software, Microsoft Office software, spreadsheet software and time accounting software.[174]

Welders, Cutters, Solderers, and Brazers

To become a Welder, Cutters, Solderer, or Brazer, a high school diploma or equivalent is often required, as well as one month to a year of OTJ training.[175] This occupation is projected to grow faster in Maryland between 2018 and 2028 than on the national level, at 7 percent growth vs. 3 percent, respectively.[176] Although not always considered a green job, welders will be essential to the creation of the renewable energy infrastructure in the coming years for manufacturing of windfarms, bio-diesel plants, and turbine components.[177]

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[168] "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.
[169] "Maryland Occupational Projections 2018-2028," Maryland Department of Labor.
[170] "Geographic Profile for Rail-Track Laying and Maintenance Equipment Operators, May 2020," U.S. Bureau of Labor Statistics, accessed August 12, 2021, https://www.bls.gov/oes/current/oes474061.htm.
[171] "Summary Report for: 47-4061.00 - Rail-Track Laying and Maintenance Equipment Operators," O*Net, accessed August 12, 2021, https://www.onetonline.org/link/summary/47-4061.00.
[172] "Maryland Apprenticeship Locator," Maryland Department of Labor, accessed August 12, 2021, http://www.dllr.state.md.us/Apprenticeship/Results.aspx.
[173] "Occupation Profile: Rail-Track Laying and Maintenance Equipment Operators," Maryland Workforce Exchange, accessed August 18, 2021, https://mwejobs.maryland.gov/vosnet/jobbanks/joblist.aspx.
[174] "Summary Report for: 47-4061.00 - Rail-Track Laying and Maintenance Equipment Operators," O*Net.
[175] "Education and Training Assignments by Detailed Occupation," U.S. Bureau of Labor Statistics.
[176] Maryland Occupational Projections 2018-2028," Maryland Department of Labor.
[177] "Welders Play an Important Role in Green Technology," Tulsa Welding School, accessed August 12, 2021, https://www.tws.edu/articles/welders-play-an-important-role-in-green-technology/.

Apprenticeships or trade programs are typically suitable as market entry preparation for these occupations. North American Trade Schools in Baltimore offers a combination welding trade program which lasts for less than a year. This program consists of a series of comprehensive courses to provide individuals with knowledge and training in various welding applications and techniques and prepares students for certification tests.[178] Certifications are an important component of job preparation, as employers typically require this credential from job candidates. The Maryland Department of Transportation State Highway Administration (MDOT SHA) has adopted a regional welder's certification program for testing and certifying welders.[179] The certification is administered and issued by the American Welding Society (AWS).[180]

Most welders in Maryland work in the Specialty Trade Contractors and Fabricated Metal Product Manufacturing subsectors.[181] Welding is the most-frequent skill sought by Maryland employers, followed by preventive maintenance.[182] Additional skills and abilities that can be beneficial for entrants into Welders, Cutters, Solderers, or Brazers positions include analytical or scientific software skills, data base user interface and query software skills, and Microsoft Office suite experience.[183]

Computer User Support Specialists

Computer User Support Specialists are highly demanded in Maryland, where 664 jobs were open as of August 2021.[184] Most Computer User Support Specialist jobs require training in vocational schools, related OTJ training experience, or an associate degree.[185] An Information Technology Associate Degree is also offered at Prince George's Community College that covers a wide array of the computing discipline including technical support, networking, operating systems, and related subjects.[186] This degree prepares students for either entry-level employment in networking, security, information systems, and programming; or for transferring to a four-year degree program institution.[187] Strayer University in Suitland is another university that offers a Computer Support Specialist's Associate Degree program. The

[178] "Combination Welding Program," North American Trade Schools, accessed August 12, 2021, https://www.natradeschools.edu/combination-welding.
[179] "Welder Certification Program," Maryland Department of Labor, accessed August 18, 2021, https://roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=54.
[180] Ibid.
[181] "Occupation Profile: Welders, Cutters, Welder Fitters," Maryland Workforce Exchange, accessed August 18, 2021, https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileSummary.aspx.
[182] Ibid.
[183] "Summary Report for: 47-4061.00 - Rail-Track Laying and Maintenance Equipment Operators," O*Net.
[184] "Occupation Summary: Computer User Support Specialist," Maryland Workforce Exchange, accessed August 12, 2021, https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileSummary.aspx.
[185] "Summary Report for: 15-1232.00 – Computer User Support Specialists," O*Net Online, accessed August 12, 2021, https://www.onetonline.org/link/summary/15-1232.00.
[186] "Information Technology, A.S.," Prince George's Community College, accessed August 12, 2021. https://www.pgcc.edu/programs-courses/program-finder/information-technology-as/.
[187] Ibid.

program consists of 20 courses lasting 11 weeks each, and can also be completed online.[188] Other universities that offer similar two- to four-year computer and information technology associate degrees include Washington Adventist University, Capitol Technology University, Bowie State University, Chesapeake College, Baltimore City Community College and Garrett College.[189]

In August of 2021, the Maryland counties with the highest numbers of job postings for Computer User Support Specialists were Montgomery County (123), Howard County (93), Baltimore County (75), and Anne Arundel County (73).[190] Advertised certifications for these Maryland job openings include CompTIA, Help Desk Institute (HDI), Cisco Associate, ISC, and Apple macOS certifications.[191] Frequently included technology skills in employer job postings for this occupation were data base management system and user interface software, development environment software, operating software, and web platform development software.[192]

Environmental Engineering Technologists and Technicians

Environmental Engineering Technicians, also known as Environmental Protection Technicians, are expected to be in high demand in the future due to their potentially substantial role in a greener environment and economy. In Maryland, these jobs are projected to grow by 10 percent between 2018 and 2028, faster than the anticipated growth of 8 percent between 2019 and 2029 across the U.S.[193] Nationally, the Washington-Arlington-Alexandria metropolitan area in Washington, D.C.; Virginia; Maryland; and West Virginia is ranked second in highest employment levels for Environmental Engineering Technologists and Technicians.[194]

Jobs in this occupation often require an associate degree, a considerable amount of experience through years in related work, and/or vocational training.[195] In many cases, a bachelor's degree is also preferred.[196] Associate degree programs for this occupation generally include, but are not limited to, courses in trigonometry, geology, ecology, and geographic information systems

[188] "Online Associate in Arts in Information Technology," Strayer University, accessed August 12, 2021, https://www.strayer.edu/online-degrees/associate/information-technology.
[189] "Local Training Finder: Computer Support Specialist," Careeronestop, accessed August 12, 2021, https://www.careeronestop.org/Toolkit/Training/find-local-training.aspx.
[190] "Occupation Summary: Computer User Support Specialist," Maryland Workforce Exchange.
[191] Ibid.
[192] "Summary Report for: 15-1232.00 – Computer User Support Specialists," O*Net Online.
[193] "Projected Employment: Environmental Engineering Technologists and Technicians," Careeronestop, accessed August 13, 2021, https://www.careeronestop.org/Toolkit/Careers/Occupations/occupation-profile.aspx.
[194] "Geographic Profile for Environmental Engineering Technologists and Technicians," U.S. Bureau of Labor Statistics, accessed August 13, 2021, https://www.bls.gov/oes/current/oes173025.htm.
[195] "Summary Report for: 17-3025.00 – Environmental Engineering Technologists and Technicians," O*Net Online, accessed August 13, 2021, https://www.onetonline.org/link/summary/17-3025.00.
[196] Ibid.

that help candidates learn to map landscapes, locations, and buildings.[197] Such a program is offered at Wor-Wic Community College in Salisbury and takes less than a year to complete.[198] Harford Community College also offers science degrees that prepare students to transfer to a four-year institution or to enter the environmental industry workforce and work as Environmental Technicians.[199] Advanced environmental science technology and environmental health engineering degrees and certificates, such as bachelor's and master's degrees as well as graduate certificates, are available at Johns Hopkins University and the University of Maryland.[200,201]

Strong candidates for this job would have a considerable amount of knowledge in chemistry, engineering and technology, customer and personal services, and mathematics.[202] According to Maryland's current advertised jobs skills, they should also be able to perform sample collection, industrial maintenance, as well as building maintenance.[203] Prince George's County, Montgomery County and Frederick County had the most positions posted on MWE in August 2021 for Environmental Engineering Technicians.[204]

Occupational Therapy Assistants

In Maryland, the Occupational Therapy Assistant profession is one of the fastest-growing careers in the state, with an expected growth rate of 52 percent between 2018 and 2028.[205] This figure significantly exceeds anticipated average growth of 33 percent between 2019 and 2029 across the U.S.[206] Occupational Therapy Assistants need at least an associate degree from an accredited therapy assistant program to obtain the required state license.[207] Maryland has two schools with the required accreditation: Community College of Baltimore County and

[197] "Become an Environmental Engineering Technician," Study.com, accessed August 13, 2021, https://study.com/articles/Become_an_Environmental_Engineering_Technician_Career_Roadmap.html.
[198] "Local Training Finder: Environmental Engineering Technologists and Technicians," Careeronestop, accessed August 13, 2021, https://www.careeronestop.org/Toolkit/Training/find-local-training.aspx.
[199] "Environmental Science," Harford Community College, accessed August 13, 2021, https://www.harford.edu/academics/programs-courses/environmental-science.php.
[200] "Environmental Engineering and Science," Johns Hopkins Whiting School of Engineering, accessed August 13, 2021, https://ep.jhu.edu/programs/environmental-engineering-and-science/.
[201] "Environmental Science and Technology Major," University of Maryland, accessed August 13, 2021, https://academiccatalog.umd.edu/undergraduate/colleges-schools/agriculture-natural-resources/environmental-science-technology/environmental-science-technology-major/.
[202] "Summary Report for: 17-3025.00 – Environmental Engineering Technologists and Technicians," O*Net Online.
[203] "Occupation Profile: Environmental Engineering Technicians," Maryland Workforce Exchange, accessed August 18, 2021, https://mwejobs.maryland.gov/vosnet/lmi/profiles/profileSummary.aspx.
[204] Ibid.
[205] "Maryland Occupation Profile: Occupation Therapy Assistants," Careeronestop, accessed August 13, 2021, https://www.careeronestop.org/Toolkit/Careers/Occupations/occupation-profile.aspx.
[206] Ibid.
[207] "Occupational Outlook Handbook: Occupational Therapy Assistants," U.S. Bureau of Labor Statistics, accessed August 13, 2021, bls.gov/ooh/healthcare/occupational-therapy-assistants-and-aides.htm.

Alleghany College of Maryland.[208] The general education requirements before the clinical phase of the degree can be completed in one year. Upon completion of the program in two to three years, students will have accumulated over 500 hours of clinical training.[209] Students may then complete a required two-month clinical internship before they are eligible to take the Certified Occupational Therapy exam (COTA) offered by the National Board for Certification in Occupational Therapy.[210] Scoring at least in the 70th percentile allows candidates to be nationally certified and eligible to apply for the state license.[211]

Of the 121 MWE job openings in Maryland in August of 2021, most are concentrated in Montgomery County (22 postings) and Prince George's County (23 postings).[212] Employers' most-advertised tools and technologies included the ability to assist patients in using canes and crutches, as well as proficiency with data base user interface and query software.[213]

6.4 Clean Energy Jobs Training Opportunities

Clean energy jobs can be found in both traditional and new fields, including but not limited to environmental planning and engineering, water resources management, landscaping, renewable energy, and energy efficiency. Legislation passed in 2019 established a Clean Energy Workforce Account within the Maryland Department of Labor to fund clean energy job training related to renewable energy, energy efficiency, energy storage, resource conservation, and advanced transportation.[214] Starting in fiscal year (FY) 2021, a maximum of $8 million in grants will be provided to fund apprenticeship programs that prepare candidates for careers in clean energy industry jobs.[215] In addition, the Maryland Offshore Wind Energy Act of 2013 provides support for offshore-wind-related workforce training by funding their capital expenditure investments and operating expenditures.[216] A total budget of $1.2 million is allocated for FY 2021 and are permitted to cover 75 percent of participating programs' costs.[217]

As the clean energy industry grows, training programs for jobs in these careers represent another opportunity for displaced workers to transition into environmentally sustainable and

[208] "Occupational Therapist Certification Maryland," Occupational Therapy License.org, accessed August 13, 2021, https://www.occupationaltherapylicense.org/maryland-occupational-therapy.htm.
[209] "Occupation Therapy Assistant," Allegany College, accessed August 13, 2021, https://www.allegany.edu/occupational-therapy-assistant/.
[210] Ibid.
[211] Ibid.
[212] "Occupation Summary: Occupational Therapy Assistant," Maryland Workforce Exchange, accessed August 13, 2021, https://mwejobs.maryland.gov/vosnet/JobBanks/jobdetails.aspx.
[213] Ibid.
[214] "Summer 2020 Solicitation for Implementation Grant Proposals – Clean Energy Workforce Account," Maryland Department of Labor, July 13, 2020, accessed August 15, 2021, https://www.dllr.state.md.us/earn/earnprops.shtml.
[215] Ibid.
[216] "Maryland Offshore Wind Workforce Training Program – FY 2021," Maryland Energy Administration, accessed August 15, 2021, https://energy.maryland.gov/Pages/Info/renewable/offshorewindworkforce.aspx.
[217] Ibid.

in-demand jobs. To provide additional context on the various types of green training opportunities that are available in Maryland, several of these programs are summarized below.

Power52 Energy Institute

Power52 Energy Institute, located in Columbia, is the first clean energy private career school to be approved by the Maryland Higher Education Commission (MHEC).[218] This institution currently focuses on solar energy and provides a professional training program that is accredited by the National Center for Construction, Education and Research (NCCER). The curriculum consists of 320 hours of training that includes both classroom and laboratory instruction, in addition to job-readiness training. Topics covered include basic concepts of solar photovoltaic (PV) systems and their components as well as sizing, designing, and installing PV systems. A high school diploma and a passing score on the Test of Adult Basic Education (T.A.B.E) assessment are the only educational requirements for joining the program.[219]

Power52 is a North American Board of Certified Energy Practitioners (NABCEP) official provider. The institution does not charge fees for tuition, training materials, tutoring or certifications, however students must pay the NABCEP exam fee.[220] In addition to training, Power52 has also established an industry partner network that has committed to employ the graduates of the program in clean energy projects.[221] In the event a graduate is not placed immediately, case managers provide employment retention support to program individuals for up to one year. During its five years of operation, a total of 158 participants graduated the Power52 program with 134 establishing employment.[222]

The Prince George's Community College Sustainable Energy and Workforce Development Program

Prince George's Community College provides county residents with no-cost industry certified training, on the job basic skills training, and supportive services that help candidates get employed in the sustainable energy industry. [223] Candidates are required to live in Prince George's County and possess a high school diploma.[224] Enrollees in the program are prepared to earn credentials that include licenses in Hybrid/Electric Vehicle Specialist License and Maryland Home Improvement Contractor License.[225] Additional certifications for which students can train include weatherization technology, solar photovoltaics, business

[218] "Power52 Energy Institute," POWER52, accessed August 15, 2021, https://power52.org/training.
[219] Ibid.
[220] Ibid.
[221] Ibid.
[222] Ibid.
[223] "Sustainable Energy and Workforce Development Program," Prince George's Community College, accessed August 15, 2021, https://www.pgcc.edu/sewdp/.
[224] Ibid.
[225] Ibid.

performance improvement (BPI) building analysis, and BPI envelope professions that evaluate building air leakage. Each of the six training courses last for two to five weeks.[226]

Montgomery College's Green Training and Technology

Green training and technology courses are offered through Montgomery College's Workforce Development and Continuing Education (WDCE) programs and the Gudelsky Institute of Technology (GITE).[227] Students can enroll in WDCE courses that prepare candidates for the Leadership in Energy and Environmental Design (LEED) Associate Exam.[228] LEED is a program that sets international standards for different aspects of environmentally sustainable buildings and infrastructure, such as facility design and maintenance.[229] Individuals can take classes in environmental, social, and financial sustainability in addition to LEED Associate Exam preparation.[230] Additionally, courses available at the GITE train students to incorporate renewable and sustainable energy technologies into their building and construction projects, such as Solar PV design and installation.

While the training opportunities above are non-degree programs, degree seekers can explore Montgomery College's Landscape Technology degree, where candidates are provided with a combination of academic and practical training in the field of ornamental horticulture. Upon degree completion, graduates can utilize transfer agreements with four-year institutions to further their education.[231] While there are no prerequisites to enroll in the green training opportunities through WDCE and GITE, the Landscape Technology program requires successfully graduated secondary school for entry.[232]

Civic Works Center for Sustainable Careers Training Programs

The mission of the Civic Works Center for Sustainable Careers is to help Baltimore residents in building the skills needed to secure employment for unemployed and underemployed individuals, while focusing on both job quality and environmental justice. [233] The Civic Works Center for Sustainable Careers offers several training programs, collectively known as B'More Green Training, with five different tracks available in solar panel installation, utility infrastructure training, energy retrofit installation, Brownsfield site remediation, and

[226] "Sustainable Energy and Workforce Development Program," Prince George's Community College.
[227] "Green Training and Technology," Montgomery College, accessed August 15, 2021, https://www.montgomerycollege.edu/workforce-development-continuing-education/small-business/green/.
[228] Ibid.
[229] Ibid.
[230] Ibid.
[231] "Landscape Technology Degree, Associate of Applied Science," Montgomery College, accessed August 15, 2021, https://www.montgomerycollege.edu/academics/programs/landscape-technology/landscape-technology-aas-degree.html.
[232] Ibid.
[233] "B'more Green Training," Civic Works Center for Sustainable Careers, accessed August 15, 2021, http://sustainablecareers.civicworks.com/.

stormwater management.[234] Each track includes industry recognized certifications, marketable job skills, job placement support, case management support, jobs with livable wages, as well as career advancement opportunities.

B'More Green Training is structured to provide both classroom and OTJ training, as well as ongoing career support. After filling the application form, a phone interview determines eligibility for the training program. Graduates of B'More Green programs have a 90 percent employment placement rate, with average wages ranging from $13 to $17 per hour.[235]

7.0 Community Impacts

The transition away from fossil-fuel reliance not only impacts the workers employed in these industries, but the surrounding communities as well. In addition to direct employment effects, there are potential secondary employment impacts for companies that have relied on business or patronage from local workers and facilities, and potential for tax revenue losses that have supported local government and public services. It is also important to consider the negative effects experienced by surrounding "fenceline communities," that are often low-income and/or communities of color that have borne a significant amount of the pollution and other negative environmental effects resulting from fossil-fuel and industrial activities.[236] As plans are put forth to transition Maryland to a cleaner economy, these additional factors should be included to ensure that communities can move forward with new economic growth opportunities and restorative justice to improve residents' health and the environment.

In Maryland, the production, transportation, and processing of fossil fuels occurs throughout the state, with some activities more regionally concentrated. As Maryland moves away from fossil fuel reliance, the communities surrounding these facilities are likely to experience economic impacts from facility closings and decreased transportation needs. These include areas surrounding the six coal-fired power plants in the state—five of which have closed or announced their plans to retire coal-fired units—in Charles, Montgomery, Prince George's, and Anne Arundel Counties.[237] While Maryland has a small coal footprint in terms of coal reserves, comprising approximately 0.2 percent of U.S. production, all of the state's 12 coal mines are concentrated in Garrett and Alleghany County.[238] These two counties also contain the state's only natural gas wells.[239] Multiple petroleum product terminals are located near the state's

[234] "For Applicants," Civic Works Center for Sustainable Careers, accessed August 15, 2021, http://sustainablecareers.civicworks.com/for-applicants/.
[235] "B'more Green Training," Civic Works Center for Sustainable Careers.
[236] "Life at the Fenceline," Environmental Justice for All.
[237] Christine Condon, "50-year-old Maryland Power Plant to Stop Burning Coal in 2027," *The Baltimore Sun*, December 22, 2020, accessed June 15, 2021, https://www.baltimoresun.com/news/environment/bs-md-power-plant-closing-20201221-nu72tx5rufaptoiqlbqekitf74-story.html.
[238] "Maryland Profile Overview," U.S. Energy Information Administration, last modified October 15, 2020, accessed July 26, 2021, https://www.eia.gov/state/?sid=MD.
[239] "Energy," State of Maryland, accessed July 26, 2021, https://msa.maryland.gov/msa/mdmanual/01glance/html/energy.html.

waterways that allow tanker access, including in St. Mary's County and near the Port of Baltimore, where coal represents the top export commodity by tonnage.[240] Though this list is not exhaustive of all fossil-fuel activities in the state, it does provide some context on how both rural and urban communities could be impacted by reductions in fossil-fuel operations.

In communities where the fossil-fuel industry has been an anchor for the region, closings can have ripple effects for small businesses and alter community identity.[241] Examples of past industrial transitions, such as declines in U.S. textile and manufacturing operations, show how disruptive these changes can be for surrounding communities and how well-planned and proactive assistance is crucial. Often, these transitions occurred without adequate support for workers and communities who faced significant uncertainty during the process struggled to recover.[242]

There are also environmental impacts to consider, such as whether remediation of a former fossil-fuel site is needed to prevent contamination or negative health effects to the community. Remediation projects have been used as a bridge to both increasing employment and providing needed environmental improvements.[243] One example is the remediation of orphan oil and gas wells, which is particularly relevant in states with a large number of documented sites such as Kentucky, Pennsylvania, and Texas.[244] These types of projects are important for improving the wellbeing of surrounding fenceline communities that have borne a significant amount of the noise, pollution and other negative environmental effects resulting from fossil-fuel and industrial operations.[245] Providing restorative justice through environmental remediation can help these communities recover and research shows that these efforts increase local property values.[246] There is more limited evidence, however, that remediation projects support long-term employment in affected communities and whether local workers or outside contractors are more frequently utilized.[247]

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[240] "Maryland Profile Analysis," U.S. Energy Information Administration, last modified October 15, 2020, accessed July 26, 2021, https://www.eia.gov/state/analysis.php?sid=MD.
[241] J. Mijin Cha, et al., "Workers and Communities in Transition: Report of the Just Transition Listening Project," Labor for Sustainability Network (March 2021): 8, accessed July 27, 2021, https://www.labor4sustainability.org/files/JTLP_report2021.pdf.
[242] Ibid, 17-19.
[243] Daniel Raimi, "Environmental Remediation and Infrastructure Policies Supporting Workers and Communities in Transition," Resources for the Future and the Environmental Defense Fund (September 2020): 1, accessed April 7, 2021, https://www.edf.org/sites/default/files/content/Environmental-Remediation-and-Infrastructure-Report.pdf.
[244] Interstate Oil and Gas, "Idle and Orphan Oil and Gas Wells: State and Provincial Regulatory Strategies," 24, accessed July 27, 2021, https://iogcc.ok.gov/sites/g/files/gmc836/f/2020_03_04_updated_idle_and_orphan_oil_and_gas_wells_report_0.pdf.
[245] "Life at the Fenceline," Environmental Justice for All.
[246] Raimi, "Environmental Remediation and Infrastructure Policies Supporting Workers and Communities in Transition," 2.
[247] Ibid, 3.

National-, state-, and local-level policies are all potential tools to assist communities moving away from fossil-fuel activities. A 2020 report from Resources for the Future and the Environmental Defense Fund outlined three general mechanisms of federal support for communities:

- **Capacity building:** aid local economic development through programs that provide research and planning to leverage local assets for growth;
- **Financial support to public and community organizations:** may include grants or loans that bolster human capital (i.e., education, training, and skill development), physical capital, and funding infrastructure projects that increase opportunities and access; and
- **Financial support to private for-profit firms:** similar to public or nonprofit entities, but also includes provisions for tax credits and may be particularly useful to help local small businesses or industry startups that are expected to have strong economic potential.[248]

Together, the study found that these mechanisms can be effective tools for medium- to long-term economic development in communities affected by a transition from fossil fuels. [249] The authors also suggested that increasing interagency and local stakeholder communications, geographically targeting affected areas, and utilizing existing federal programs could increase the success of Just Transition programs.[250] While the focus of this study was the role of the federal government in providing support, these policies would also be applicable to state governments—and possibly local-level governments—that are aiming to minimize negative community impacts during a shift from fossil-fuel industries.

While support for economic development can be provided at the federal level, the specific needs within states and communities can vary greatly depending on local factors such as industry concentration and available assets. To gain a better sense of the size and scope of community impacts, President Biden issued an executive order in January 2021 that included the creation of an Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization (IWG).[251] As part of its mission, the IWG was tasked with identifying the most vulnerable coal, oil and gas, and power-plant communities throughout the country.[252] Additionally, planned coordination of federal investment efforts include remediation of environmentally hazardous sites, exploration of local economic growth opportunities, and provision of benefits and protection for coal and power plant workers.[253]

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[248] Daniel Raimi et al., "Economic Development Policies to Enable Fairness for Workers and Communities in Transition," Resources for the Future and the Environmental Defense Fund (August 2020): 1-11, accessed August 2, 2021, https://www.edf.org/sites/default/files/content/worker-fairness-economic-development-report.pdf.
[249] Ibid, 2.
[250] Ibid.
[251] "Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis at Home and Abroad, Create Jobs, and Restore Scientific Integrity Across Federal Government," The White House.
[252] "Executive Order on Tackling the Climate Crisis at Home and Abroad," The White House, January 27, 2021, accessed August 2, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.
[253] Ibid.

In the first report of the IWG from April 2021, six regions of the country were identified as "dependent on fossil fuels for their livelihood" based on their concentration of energy-related employment, including the Appalachian Region that encompasses portions of Maryland.[254] Due to the smaller number of concentrated coal communities compared to traditional energy communities, and because of declines that are expected sooner in the coal industry, the IWG determined these communities should be the target of initial federal investments.[255] In Maryland, the California-Lexington Park region in St. Mary's County was identified as 15th in the top 25 coal-dependent areas, based on the proportion of direct coal-related jobs.[256] Additionally, the Maryland nonmetropolitan region was identified as being in the top 70 coal-reliant communities evaluated by metropolitan statistical area (MSA), which includes Garrett, Dorchester, Talbot, Caroline, and Kent Counties.[257,258] Because these rankings were based on MSAs, it is possible that certain counties within the Maryland nonmetropolitan region MSA (such as Garrett County) may have had a greater impact on areas' overall ranking of coal dependency.

Immediate actions planned by the IWG are based on approximately $37.9 billion in existing federal funds that would support efforts including infrastructure projects, expanding broadband access in rural areas, technological innovation investment, small business funding, and funding for rural innovation hubs.[259] Environmentally focused recommendations included reclamation of abandoned mines and orphan wells, treatment of mine-impacted runoff and waters, and revitalization of brownfields.[260] The IWG outlined near-term goals to be completed in 2021 to further expand federal support to vulnerable energy communities. While these plans are a starting point for the robust agenda planned by the IWG, they do represent significant federal action towards achieving a Just Transition for impacted energy communities.
These goals include, but are not limited to:

- Initiating a "listening tour" with members of all 25 priority coal-dependent areas, to both hear concerns and identify resources that could be immediately accessed,
- Establishing a regular schedule of meetings for the IWG with planned periodic reports,
- Creating an subcommittee focused on investments in the established priority energy communities, and
- Developing long-term strategies through a policy subcommittee focused on economic and community issues.[261]

[254] Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization, "Initial Report to the President on Empowering Workers Through Revitalizing Communities," 6-7.
[255] Ibid, 8.
[256] Ibid, 10.
[257] Ibid, 9.
[258] The IWG report did not specify ranking for the Maryland nonmetropolitan area within the top 70 coal-reliant communities.
[259] Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization, "Initial Report to the President on Empowering Workers Through Revitalizing Communities," 12-16.
[260] Ibid, 14-16.
[261] Ibid, 17-18.

In addition to federal plans that are being formulated, state and local governments have also taken steps to aid communities with Just Transitions. As mentioned previously in Section 3, some local governments have taken action by providing encouraging new industries to utilize local labor and displaced workers for projects.[262] This type of strategy could be bolstered by also including incentives for hiring marginalized workers and ensuring that labor laws allow for union formation and collective bargaining.[263] This supports not only the workers, but can improve the storyline around fossil-fuel transitions, particularly in areas that have previously experienced negative industry transitions in the past.[264]

State governments can also provide financial assistance to communities that have been heavily reliant on fossil-fuel activities for tax revenues as they transition to a cleaner economy. One such example can be found in Tonawanda, New York, where the closing of a coal-fired power plant threatened public school operations, electricity costs, and property tax stability.[265] Prior to the plant's closure, an alliance of stakeholders including labor and environmental groups was successful in lobbying the New York legislature to approve $30 million (later increased to $45 million) in "gap funds" for communities with fossil-fuel plants.[266] The area has since seen success from transformative planning efforts and this State-provided funding, with environmental remediation projects spurring the expansion of existing industries and entry of new solar and warehousing companies.[267] Notably, all of the workers at the shuttered coal-fired plant were all able to transition without the need for unemployment assistance.[268]

Some states have taken action to address environmental justice in communities where pollution—including from fossil-fuel activities—has had disproportionate impacts. Maryland's Commission on Environmental Justice and Sustainable Communities (CEJSC), established in 2001 and staffed by MDE, is tasked with providing guidance to state agencies on environmental justice issues and evaluating how existing state and local policies impact environmental inequities.[269] The CEJSC was revised during the 2021 legislative session with changes that include increasing diversity of commission members, requiring at least six meetings and four community listening sessions annually, and orienting new commission members on environmental justice issues in the state.[270] Additionally, the 2021 bill expanded the duties of

[262] Ceres, "Practices for Just, Equitable and Sustainable Development of Clean Energy," 7.
[263] Cha, et al., "Workers and Communities in Transition: Report of the Just Transition Listening Project," 13.
[264] Ibid, 9.
[265] Elizabeth McGowan, "Rising from the Ashes, a Buffalo Suburb Ends Its Dependence on Coal," Grist, July 11, 2017, accessed August 9, 2021, https://grist.org/justice/a-working-class-buffalo-suburb-retired-a-coal-plant-the-right-way/.
[266] Ibid.
[267] Ibid.
[268] Cha, et al., "Workers and Communities in Transition: Report of the Just Transition Listening Project," 10.
[269] Elizabeth Shwe, "Lawmakers Considering How to Remake State's Environmental Justice Commission," Maryland Matters, February 18, 2021, accessed August 9, 2021, https://www.marylandmatters.org/2021/02/18/lawmakers-considering-how-to-remake-states-environmental-justice-commission/.
[270] Maryland General Assembly, "SB 674 Fiscal and Policy Note," 1, accessed August 9, 2021, http://mgaleg.maryland.gov/2021RS/fnotes/bil_0004/sb0674.pdf.

the CEJSC, such as utilizing data and mapping tools to evaluate policy impacts (including permits and actions) on environmental justice issues, and to assess cumulative effects and hazardous exposures from environmental factors on communities.[271]

In 2020, MDE also released an Environmental Justice Policy and Implementation Plan (EJPIP) in an effort to reduce existing inequities and prevent further injustices that could result from implementation of environmental laws and programs.[272] The plan focuses on Environmental Justice (EJ) Communities, defined as having "a low-income or minority population greater than twice the statewide average."[273] The major objectives of the EJPIP include:

- Increasing understanding of environmental decisions within EJ Communities using outreach and dedicated communications;
- Providing equitable environmental and benefits for communities, with a focus on those that have been underserved or disproportionately burdened;
- Identifying and addressing existing inequities related to facilities in EJ Communities; and
- Prioritizing financing for infrastructure in EJ Communities.[274]

The goals of the EJPIP intersect with those of a Just Transition, addressing some of the challenges that fenceline communities have experienced as a result of fossil-fuel reliance and industrialization, among other factors. Providing consideration for these communities, often comprised of low-income and minority residents, offers an example of the holistic approach and restorative justice needed during the transition to a cleaner economy.

8.0 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 2030 GGRA Plan. RESI completed this analysis by studying the likely trends of employment in industries of focus over the next three decades, estimating the size of the impact of GHG-reduction strategies on employment trends for the same industries of focus, identifying employment trends in key occupations likely to be impacted by the GHG-reduction policies and the size of the impact, determining related occupations that provide alternative employment opportunities as the State transitions from fossil-fuel-reliant industries, and providing information on clean energy job training opportunities that can help transitioning workers into alternative positions.

[271] Maryland General Assembly, "SB 674 Fiscal and Policy Note," 3.
[272] Maryland Department of the Environment, "Environmental Justice Policy and Implementation Plan," 1, accessed April 20, 2021, https://mde.maryland.gov/Documents/MDE_EJ_Env%20Justice%20Policy_Final_Dec2020.pdf.
[273] Ibid.
[274] Ibid.

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 though Just Transition models that have been successfully implemented in other regions, as well as strategies to provide restorative environmental and social justice for communities potentially affected by transitions away from fossil-fuel reliance.

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 2030 GGRA 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 evident that 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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Appendix A—Occupations Within Industries of Focus

Figure 21: Impacted Occupations within Industries of Focus

SOC Code	Occupation	Average Annual Change 2021-2030	Average Annual Change 2031-2040	Average Annual Change 2041-2050
11-1021	General and Operations Managers	31	-19	-6
11-3071	Transportation, Storage, and Distribution Managers	0	-1	-1
11-9021	Construction Managers	43	-21	-6
13-1051	Cost Estimators	22	-11	-3
13-1071	Human Resources Specialists	2	-2	-1
13-1081	Logisticians	0	-1	0
13-1198	Project Management Specialists and Business Operations Specialists, All Other	18	-9	-3
41-3091	Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	17	-10	-3
43-1011	First-Line Supervisors of Office and Administrative Support Workers	1	-2	-1
43-3021	Billing and Posting Clerks	1	-1	-1
43-3031	Bookkeeping, Accounting, and Auditing Clerks	19	-12	-4
43-4051	Customer Service Representatives	5	-5	-2
43-4171	Receptionists and Information Clerks	3	-2	-1
43-5011	Cargo and Freight Agents	0	-1	0
43-5032	Dispatchers, Except Police, Fire, and Ambulance	1	-5	-2
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	85	-43	-13
47-2021	Brickmasons and Blockmasons	11	-5	-2
47-2031	Carpenters	111	-56	-16
47-2044	Tile and Stone Setters	6	-3	-1
47-2051	Cement Masons and Concrete Finishers	34	-17	-5
47-2061	Construction Laborers	144	-72	-21
47-2073	Operating Engineers and Other Construction Equipment Operators	43	-22	-6
47-3013	Helpers--Electricians	13	-7	-2
47-3014	Helpers--Painters, Paperhangers, Plasterers, and Stucco Masons	2	-1	0

47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	10	-5	-1
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	9	-5	-2
49-2098	Security and Fire Alarm Systems Installers	4	-2	-1
49-3031	Bus and Truck Mechanics and Diesel Engine Specialists	-1	-6	-3
49-3042	Mobile Heavy Equipment Mechanics, Except Engines	6	-3	-1
49-9021	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	50	-25	-7
49-9051	Electrical Power-Line Installers and Repairers	6	-3	-1
51-1011	First-Line Supervisors of Production and Operating Workers	1	-1	-1
51-8093	Petroleum Pump System Operators, Refinery Operators, and Gaugers	-1	-1	-1
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	0	-5	-3
53-1047	First-Line Supervisors of Transportation and Material Moving Workers, Except Aircraft Cargo Handling Supervisors	0	-5	-3
53-3031	Driver/Sales Workers	0	-1	0
53-3032	Heavy and Tractor-Trailer Truck Drivers	-12	-98	-50
53-3033	Light Truck Drivers	1	-7	-3
53-7021	Crane and Tower Operators	4	-2	-1
53-7051	Industrial Truck and Tractor Operators	1	-3	-2
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	3	-17	-8
53-7065	Stockers and Order Fillers	2	-2	-1

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

END OF DOCUMENT