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CENTER FOR GLOBAL SUSTAINABILITY

The Renewable Energy Transition in Maryland

Implications for Energy Generating Facilities and Small Businesses

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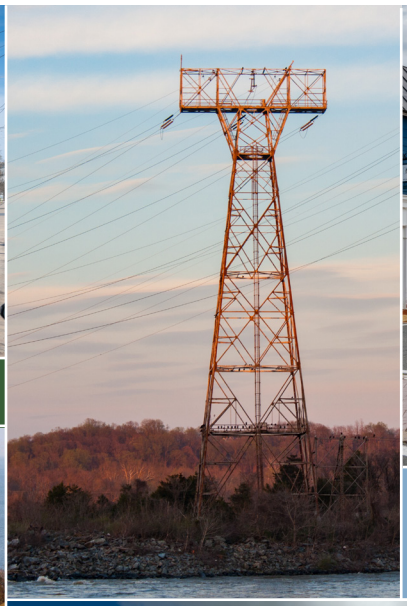

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Executive Summary

The continued output of environmentally damaging greenhouse gas (GHG) emissions drives global temperature rise and has created significant climate-related challenges across the United States. These challenges are evidenced by increasing weather-related disasters like Hurricane Helene. In response to the growing climate crisis, the State of Maryland enacted the Climate Solutions Now Act (CSNA) of 2022, which set the goal of reducing state-wide GHG emissions by 60% by 2031, relative to 2006 levels. The CSNA also set a further goal of achieving net-zero GHG emissions by 2045. The state's 2023 Climate Pollution Reduction Plan later detailed that Maryland must pursue a rapid clean energy transition to reduce GHG emissions across all sectors to meet these climate goals.

As part of this effort, the Energy Industry Working Group under the Maryland Commission on Climate Change was charged with producing a report on the impact of the energy transition on small businesses and existing power facilities throughout the state. Small businesses and energy facilities are key partners in implementing the clean energy transition, and in instituting an all-society approach to achieving the state's emission reduction goals where no one is left behind. This report is in fulfillment of the CSNA requirement to assess how the energy transition will affect small businesses and energy generating facilities in Maryland. It outlines the potential positive and negative effects of the clean energy transition, assessing the potential for different opportunities and challenges throughout the state. The report also outlines opportunities to create policies that are productive and beneficial throughout the energy transition process.

To that end, the report examines the current and potential energy transition policies and actions within the state. It analyzes which small businesses may experience the greatest impacts in the energy transition and describes the positive and negative ways those impacts may be felt. It provides recommendations on funding and financing for small businesses, as well as engagement and technical assistance to support these businesses through the transition. The report also highlights criteria that influence the pathways of energy facilities in the transition and develops options for facilities to take while considering the effects on employment, health, and equity. The report also provides recommendations to the State of Maryland on how to support these key actors while ensuring a just transition for energy facilities. Finally, the report discusses several case studies of small businesses and energy facilities in Maryland to contextualize the analysis.

Policy recommendations for small businesses include:

- **Supporting small businesses through funding and financing.** Maryland should support small businesses by providing access to funding and helping them navigate and utilize existing resources. Financial mechanisms such as green banks can play a critical role by leveraging public and private capital to offer low-interests loans for clean energy projects. Maryland has existing green banks, and these be further supported to enable more small businesses to access financial assistance for clean energy projects.

- **Creating processes for engagement and technical assistance.** Maryland should establish mechanisms for sustained engagement and technical assistance, supporting affected small businesses through the processes of needs assessments, funding applications, and project implementation for the energy transition. These policies should be flexible and inclusive enough to ensure a wide range of industries can participate. Engagement and technical assistance will also be important in spreading awareness of what the energy transition is, what that means for businesses, and what resources are available at the federal, state, and local levels to assist small businesses through the energy transition.

Policy recommendations for energy generating facilities include:

- **Achieving Maryland's climate goals.** Maryland should rapidly reduce emissions from both imported electricity and in-state generation, prioritizing phase-out of unabated fossil fuel generation to achieve air quality and health benefits. These considerations will be important as the state develops a clean energy standard.

- **Developing a framework for facility closures**. Maryland should develop a more comprehensive framework for facility closures that ensures grid reliability and addresses the broader challenges and opportunities of the energy transition. This framework should go beyond just financial and reliability concerns, considering social, economic, and environmental impacts. Such a framework will require working closely with PJM to ensure coordination with regional grid operations.

- **Leveraging funding at the federal and state level.** Maryland should support businesses, communities, and local governments by helping them leverage federal Inflation Reduction Act programs and tax credits while providing state-level financial and technical assistance to prioritize impacted communities.

- **Bolstering stakeholder engagement.** Maryland should design tailored engagement strategies, as each facility closure and community will require context-specific solutions. This engagement should include local stakeholders such as plant owners, utilities, communities, local governments, and regional stakeholders like PJM to foster collaboration and ensure community-centered approaches.

While the economic impacts of the energy transition are difficult to quantify because the transition could take multiple paths and because individuals and businesses may have different experiences of the same transition pathway depending on the nuances of their individual situations, the energy transition presents an opportunity for economic revitalization and positive change in local communities, especially through creating new industries, fostering innovation, and improving health, while also supporting long-term sustainability and resilience. The state has an opportunity to ensure that the key sectors and actors discussed in this report are well-positioned to navigate the energy transition and support Maryland's pathway to a cleaner and renewable energy future.

Introduction

In 2022, Maryland enacted the Climate Solutions Now Act (CSNA), which set ambitious goals for reducing greenhouse gas (GHG) emissions 60% by 2031 relative to 2006 levels, and achieving economy-wide net-zero GHG emissions by 2045.[1] Following the CSNA, the Maryland Department of the Environment (MDE) released the Climate Pollution Reduction Plan in 2023, outlining the rapid energy transition needed to reduce GHG emissions across all sectors. This Plan serves as a roadmap to ensure the successful implementation of the CSNA goals, while also emphasizing the associated benefits of achieving these goals through an all-of-society effort.[2,3] Governor Wes Moore has subsequently issued an executive order establishing a whole-of-government effort to implement the Climate Pollution Reduction Plan, with a focus on environmental justice and equitable implementation.[4]

In concert with these efforts, the Energy Industry Revitalization Working Group under the Maryland Commission on Climate Change was tasked in the CSNA with evaluating the potential impacts of climate change policies on small businesses and assessing the risk of facility closures due to the energy transition.[5] Both small businesses and energy facilities are critical partners in successfully navigating the energy transition. Small businesses play a crucial role in driving economic activity, accounting for 97% of total firms and 45% of total employment in Maryland in 2021. Energy generating facilities are substantial contributors to emissions in Maryland, with 45.8% of in-state electricity generation coming from fossil fuels. Ensuring their active participation will be essential for achieving the state's climate goals, and fulfilling the state's strong commitment to leaving "no one behind in this transition".[2]

This report is prepared in fulfillment of the CSNA requirement to address how the energy transition will affect small businesses and energy generating facilities. By adopting an all-of-society approach, the report aims to ensure that the energy transition is inclusive, benefiting all sectors of the economy, communities across various geographic locations, and stakeholders at both the local and regional level. Small businesses, which form the backbone of Maryland's economy, and energy-generating facilities, which are pivotal to the state's energy infrastructure, both play critical roles in this transition.

As the state embarks on this transformative process, it is important to recognize that the impacts of the energy transition will not be uniform. Impacts of the transition can be positive or negative, reflecting different opportunities and challenges. While some industries may experience new growth, such as through renewable energy deployment, others may face hurdles, including potential disruptions to their operation, particularly those phasing out fossil fuel energy facilities. This report explores these diverse impacts on small businesses and energy facilities to ensure that Maryland's energy transition is both equitable and sustainable for all the stakeholders involved.

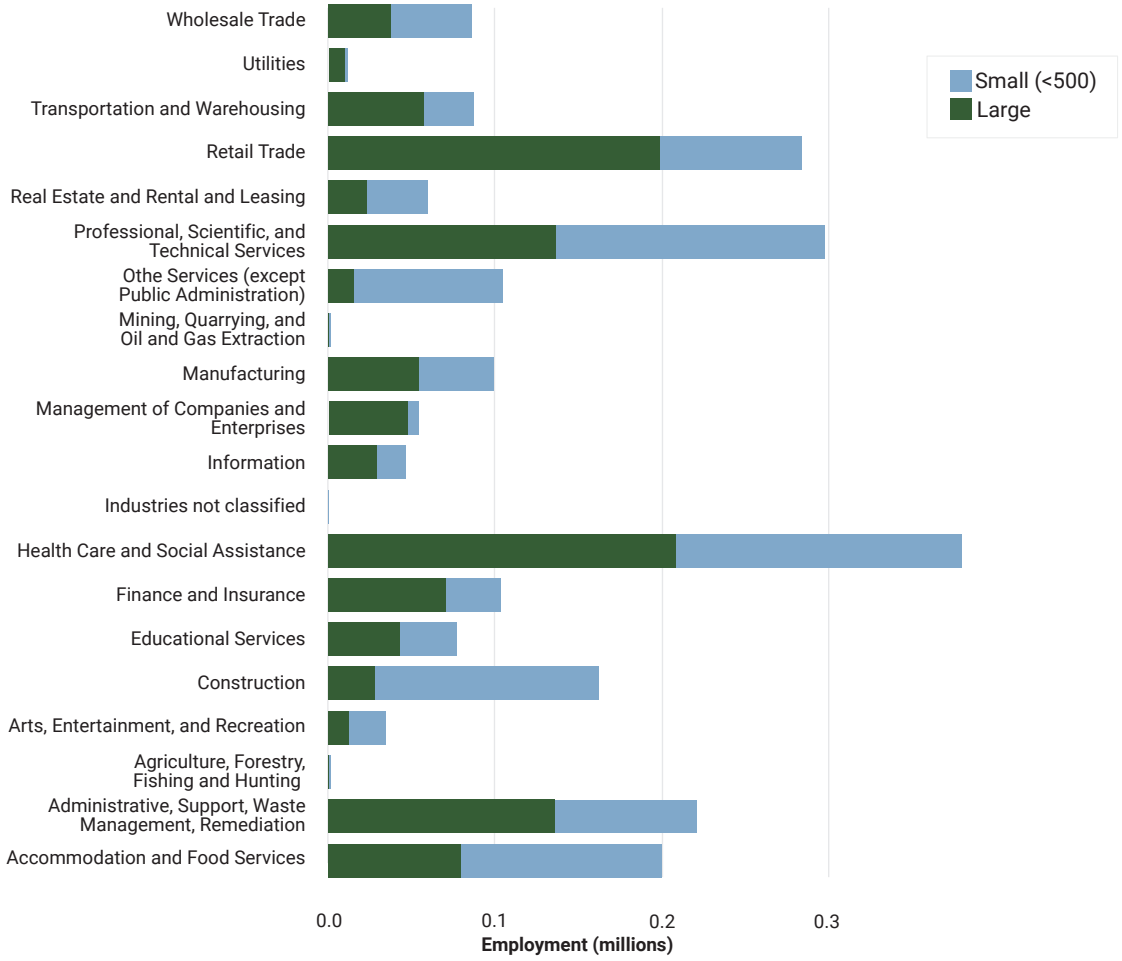
The structure of this report is outlined into two parts. The first part focuses on small businesses, beginning with an overview of current activities in the state, followed by defining small businesses most likely to be affected by the transition. We then explore how these impacts may be experienced, offering specific case studies of small businesses already participating in the energy transition and a list of policy recommendations. The second part shifts to energy generating facilities, starting with an analysis of the policy drivers influencing energy facilities in the state and suggesting potential paths for these facilities to navigate the transition while maximizing benefits to communities in terms of health, employment, and equity. Finally, we provide recommendations for how Maryland can support these key actors in successfully navigating the energy transition.

Small Businesses

Profile of Small Businesses in Maryland

Small businesses, defined in this context as firms with fewer than 500 employees,[6] accounted for 97% of total firms and 45% of total employment in Maryland in 2021, according to the US Census Bureau's Statistics of US Businesses (Figure 1).[7] Their impact is particularly pronounced in specific sectors, such as Construction (134,219 jobs; 83% of the sector's total employment), Professional, Scientific, Technical Services (160,606 jobs; 54%), and Health

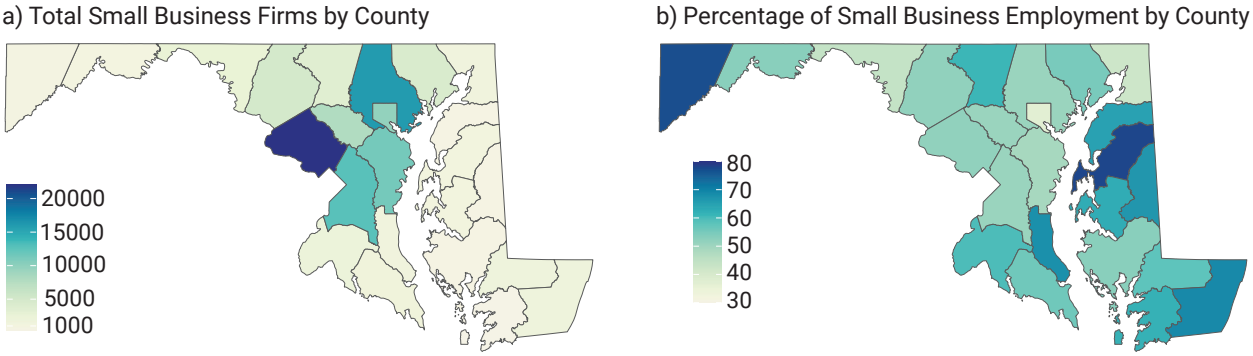
FIGURE 1. Maryland employment across industries in 2021, showing numbers for small and large businesses. *Source: U.S. Census Bureau Statistics of U.S. Businesses.*[7]



Care and Social Assistance (171,823 jobs; 45%). Notably, Health Care and Social Assistance, along with Professional, Scientific, and Technical Services, are the two largest sectors by total employment in Maryland, with 380,009 and 297,820 jobs, respectively.

Small business activity varies across geographical regions within the state. The greatest number of small businesses are found in the DC to Baltimore corridor (Figure 2a), which also has the highest population density. However, when you consider small businesses as a portion of total employment in each county, we find that small businesses are more concentrated in rural areas such as Garrett County and the Eastern Shore (Figure 2b). This is an important distinction, indicating that small businesses are a particularly important source of economic activities in these more rural areas.

FIGURE 2. (a) Number of small business firms by county in Maryland in 2021 and (b) small business employment as a percentage of total county employment. *Source: U.S. Census Bureau County Business Patterns.*[8]



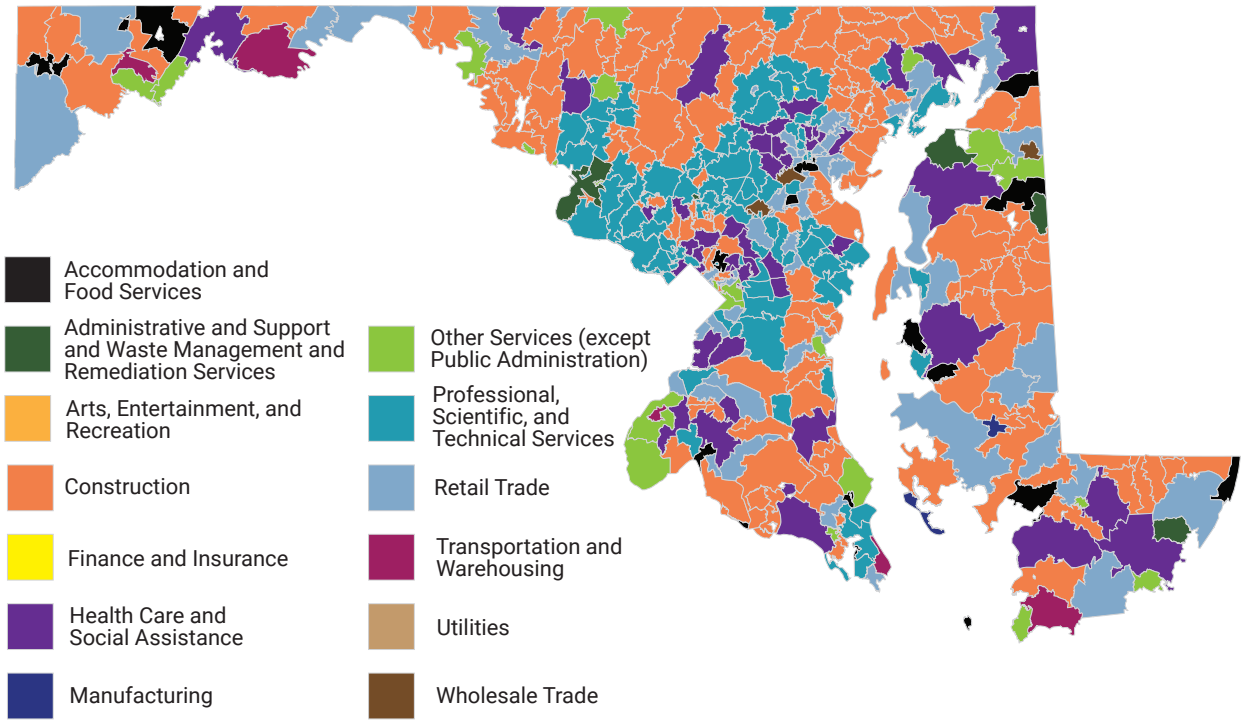
Additionally, there are differences in the types of activities which make up the majority of small business activity across different areas of the state, which can be traced down to the zip code level. Construction was the most common small business activity in 145 out of 434 reported zip codes in Maryland (Figure 3). The next most common activity was Professional, Scientific, and Technical Services, which predominated in the DC-Baltimore corridor of the state (100 zip codes). Retail trade was the third most common activity (61 zip codes), with a notable presence in more rural areas in Western Maryland and the Eastern Shore. These trends suggest that different areas of the state will have different priorities for small businesses during the energy transition, and it will be important to ensure that regionalized activities are supported equitably through any state programs.

Small Businesses Affected by the Energy Transition

For the purposes of this study, we define small businesses affected by the energy transition as falling into at least one of the following categories:

1. **Direct Supply**: Businesses that are involved in directly generating, selling, or otherwise supplying energy. This could include extraction, refining, and distribution of fossil fuels, generation of renewable energy, production and distribution of biofuels, or provision of energy from other sources.
2. **Energy Services**: Businesses that provide ancillary services to the energy industry described in the category above. These business activities could include manufacturing energy technologies, installing energy equipment, or other supporting services.
3. **Energy Intensive**: Businesses where value production is heavily dependent on energy inputs. Energy intensity is determined based on how much energy each industry purchases per dollar of that industry's output.

FIGURE 3. Most common small business activity by zip code in Maryland in 2021 based on number of firms, with sectors broken out by two-digit North American Industry Classification System (NAICS) codes. *Source: County Business Patterns data by the US Census Bureau.*[8]

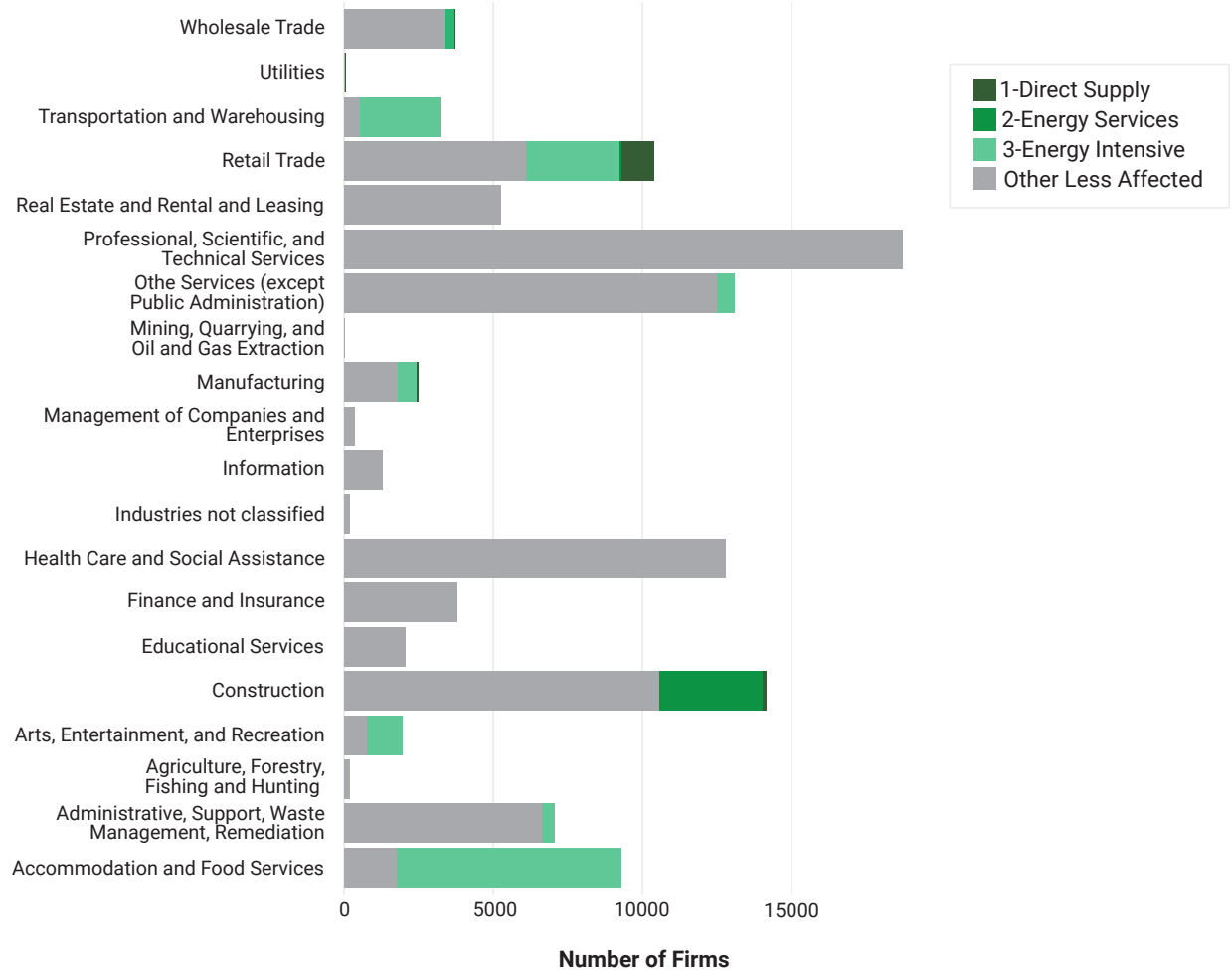


It is important to note that these categories do not necessarily indicate whether the impacts on small businesses would be positive, negative, or both. For instance, while businesses involved in direct supply of fossil fuels may experience negative impacts due to the energy transition, other small businesses that supply energy from renewable sources may see substantial opportunities for growth. Similarly, businesses in the "energy services" category may see significant growth due to electrification processes, with one previous estimate suggesting the state could add up to 64,000 such jobs over the next 10 years.[9] These categories do not include businesses that may experience more diffuse secondary impacts of the energy transition that may be felt throughout the economy, businesses that use fossil fuels as feedstocks rather than for energy (e.g., production of plastics), or businesses that may be impacted by the effects of climate change such as the insurance or finance industries. See Technical Appendix for more details on these categorizations.

Opportunities and Challenges for Small Businesses

Based on the three categories defined above, there were 21,551 small businesses (24% of total) in Maryland in 2021 employing 252,205 people that would be affected by the energy transition (Figures 4 and 5). 1,331 businesses employing 11,580 people were engaged in the direct supply of energy, primarily falling under the "retail trade" and "construction" NAICS categories. This category may include businesses where it is difficult to directly convert existing business models to fit in a renewable energy economy, such as a propane retailer. However, there are also opportunities with many benefits, such as the successful transition of the gas station owned by RS Automotive to an electric vehicle (EV) charging center (see Case Study). EV charging in particular can offer multiple benefits to small businesses, as charging infrastructure near retail establishments has been shown to boost sales at those businesses.[10]

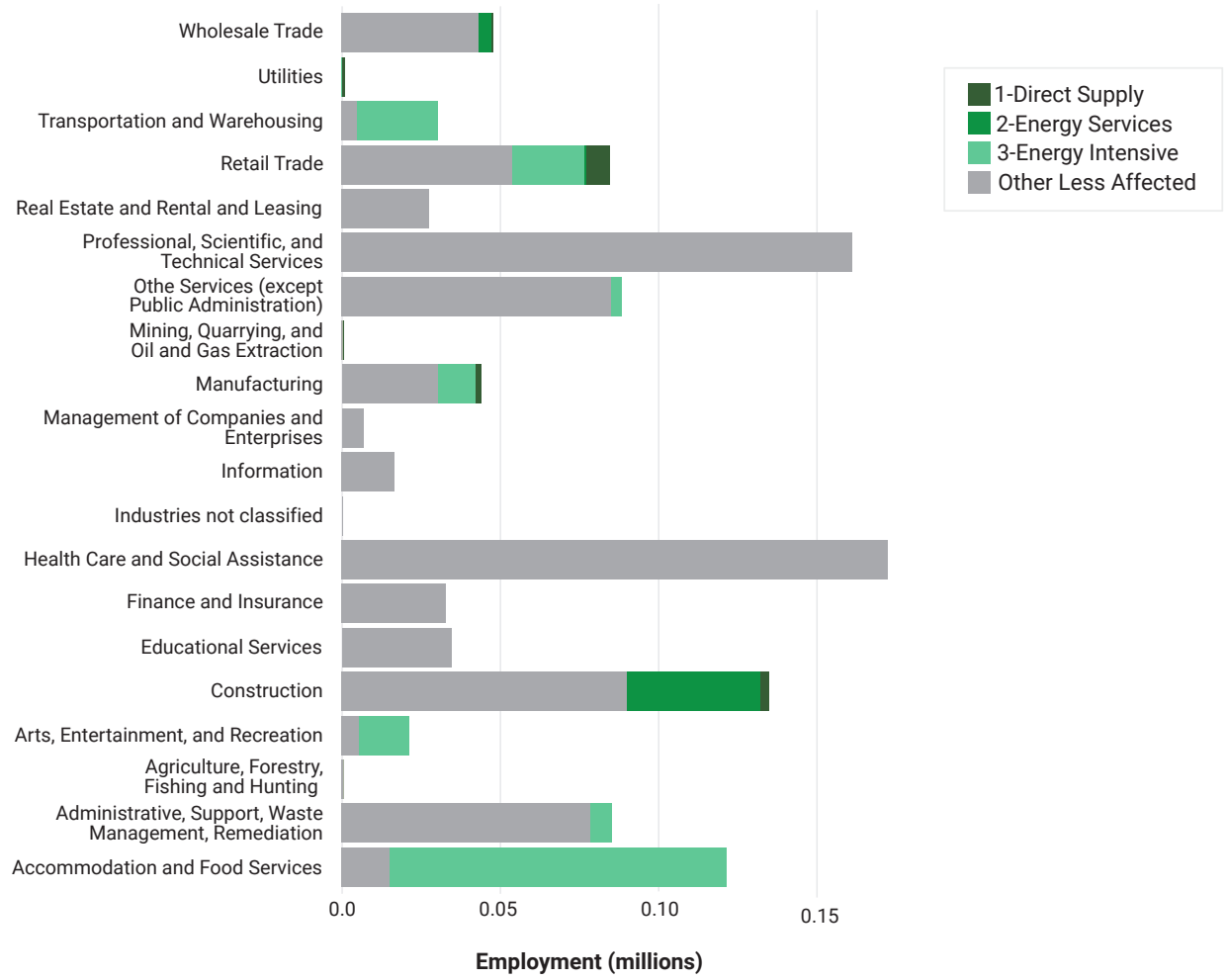
FIGURE 4. Number of small businesses affected by the energy transition, broken out by NAICS activity and category of impact. *Source: Authors' analysis of 2021 U.S. Census Bureau Statistics of U.S. Businesses.*[7]



In 2021, there were 3,940 small businesses employing 49,137 people engaged in providing energy services, primarily as part of the "construction" and "wholesale trade" NAICS categories. These businesses may have many opportunities as part of the energy transition, such as through building electrification. One example of this is Elysian Energy, a contractor that was selected by Montgomery County to support its electrification incentive program for county residents (see Case Study). This program offers a key example of how governments can partner with small businesses in the energy transition to achieve mutual benefits.

16,280 businesses employing 191,488 people were engaged in energy intensive industries, with the majority found in the "accommodation and food services", "transportation and warehousing", and "retail trade" NAICS categories. Some of these businesses may benefit from the energy transition if they are able to pursue energy efficiency and electrification measures that can reduce their long term energy costs.[11] However, this often requires initial capital investments that may be challenging for small businesses that operate on thin margins, such as restaurants (see Case Study). Additionally, for sectors such as manufacturing, electrification may be difficult or even impossible with currently available technologies.[12] Businesses that require a particularly high energy intensity that currently lack electrification options may run the risk of being among the last customers tied to fossil fuels infrastructures with diminishing customer bases, and therefore may

FIGURE 5. Number of employees at small businesses in Maryland affected by the energy transition, broken out by NAICS activity and category of impact. Source: Authors' analysis of 2021 U.S. Census Bureau Statistics of U.S. Businesses.[7]



experience increasing price volatility, presenting unique financial challenges.[13] It will be essential for these businesses to develop strategies to navigate these difficulties, with policy action likely needed to support development of new technological solutions or to provide other forms of support.

Case Studies

Direct Supply of Energy, RS Automotive and EV Institute[14]

RS Automotive is a full-service, small business auto repair and maintenance shop located in Takoma Park, Montgomery County, Maryland. In 2019, it partnered with the Electric Vehicle Institute (EVI), an EV supply equipment company, to fully convert all of its gas pumps to EV charging stations. EVI, which is also a small business, was crucial in supporting RS Automotive's transition. Additionally, the availability of EV charging stations has brought in activity for nearby retail businesses in Takoma, further underscoring that small businesses can mutually benefit from and support each other in the energy transition. State and local governments can help facilitate these partnerships to foster the energy transition and promote community economic health.

Gas stations can be very difficult to run as a small business. They have small profit margins and, as in the case of RS Automotive, the business is often locked into a monthly contract to buy a given

amount of gas despite the high volatility in gas prices and demand. However, with EV chargers, electricity prices are regulated and therefore much more stable, and monthly expenses are directly tied to monthly demand for charging. The combination of these factors meant that RS Automotive found financial relief and stability when it replaced its gas pumps with charging stations.

To help with installing the EV chargers, RS Automotive and partner EVI were awarded a competitive grant through the Maryland Energy Administration's Alternative Fuels Infrastructure Program to fully replace its gas pumps with four DC Fast Charging dispensers, remove underground tanks, and renovate its old retail room into an EV lounge. The conversion project has been a success. EVI, who helped co-develop the application to the grant, has continued to provide support through maintaining, operating, and upgrading the charging equipment at RS Automotive. Other small businesses within walking distance of RS Automotive have gotten to share in the benefits as customers wait for their car to charge and visit the nearby bakery, deli, grocery store, barber shop, and food truck.

While EVs have fewer maintenance requirements compared to vehicles with internal combustion engines, RS Automotive has still been able to use their expertise to address customer questions and technical issues around EVs. As EVs age, more vehicles have passed their warranties, leading to a higher need for more independent repair shops like RS Automotive. They have provided increased tire service for EVs, as well as supported appropriate disposal of EV battery packs through EVI. Even with the transition, RS Automotive's auto repair business has continued to thrive.

There are multiple initiatives that can help other small businesses in Maryland seeking to provide EV charging as part of their business. The Maryland Department of Transportation developed a state plan for National Electric Vehicle Infrastructure (NEVI) funding deployment and, in July 2024, announced recipients for the first round of awards to install public DC fast chargers along Maryland's designated EV Alternative Fuel Corridors.[15] The NEVI Program is limited in its geographic scope, as it focuses on delivering funding to projects located in the Alternative Fuel Corridors. The Maryland Energy Administration hosts a different program that may have a larger impact for small business gas stations: the Electric Vehicle Supply Equipment Rebate Program,[16] which aims to incentivize EV charging infrastructure installation at commercial and residential locations. Additionally, the IRA expanded the Alternative Fuel Infrastructure Tax Credit, which can be leveraged for businesses in low-income communities.[17]

As more small businesses think about installing EV infrastructure, the RS Automotive case points to important lessons that small businesses can use to share in the environmental, social and economic benefits of EV chargers. Developing good partnerships with charging operators can help small businesses access funds for installation, support for operations and maintenance of the chargers, and experience navigating the complexities of electricity rate designs.[18] Additionally, locating the chargers in an area where customers have easy access to multiple different small businesses can be helpful in promoting use of the chargers as well as bolstering the vitality of local businesses. State and local governments can create mechanisms to convene and promote this small business ecosystem to accelerate the transition through synergies, without the need to create entirely new funding streams. Five years later, the EVI Charging operations at RS Automotive continue to support EV drivers from throughout the region and the local small business community in Takoma Park.

Provision of Energy Services by Building Contractor, Elysian Energy[19]

Elysian Energy is a small business with 18 employees in Prince George's County providing a range of energy efficiency services, including home energy audits, insulation, HVAC,

electrical, plumbing, and building scientist training. Jim Conlon, the founder of Elysian, has worked to move his business from providing energy efficiency consulting to conducting holistic electrification projects. Over the years, this transformation of Elysian has brought some challenges because there is often substantial up-front work to educate consumers and provide detailed, data-driven proposals without any guarantee of income. A partnership program with Montgomery County focused on achieving the county's electrification goals has helped address these challenges - the program provides funding support for those initial activities, and provides connections to residents who want to transition away from fossil fuels in their homes. This program offers an example of the important role that local governments can play in promoting the energy transition.

Elysian Energy's journey has not been without challenges. In moving towards electrification, it was crucial that Elysian's services were well integrated. Historically, the four principal systems of the home–the envelope, mechanical systems, electrical systems, and plumbing–have been thought of as separate systems. Many home performance contractors understand one of the four, but may not understand how each interacts with the other systems. Elysian takes an interdisciplinary approach, due to Jim's background in biology and ecosystem dynamics, to think about residential systems' interactions. Jim retrained employees to understand each of these systems holistically, as well as hired new positions, including a master and journeyworker electrician, a master and journeyworker HVAC license holder, an HVAC mechanic, and an HVAC designer to ensure his in-house employees had well-rounded expertise to perform electrification projects.

It was also challenging to access financing from green banks for electrification projects due to specific eligibility requirements that exclude "fuel switching" from fossil to electric. While utility, county, and IRS incentives are available and IRA programs will become available soon, financing for electrification projects will remain a critical challenge for moving the energy transition forward. Green banks in Maryland have the opportunity to recognize the need for this type of fuel switch and help electrification projects access financing to support the residential and commercial building sectors in the energy transition.

Lastly, a significant challenge relates to raising homeowner awareness and expectations regarding how electrification projects require white collar re-engineering of the home's system to ensure safe, comfortable and efficient operation for the long term. Even in a county with customers that tend to be highly educated, it has been difficult to get homeowners to understand the full extent of what electrification means. Communication and education of consumers is critical for energy efficiency and electrification work, so that homeowners understand the benefits of investments that may cost more initially, but save money over time. This front end work to educate can take time and be costly, but after being selected through a competitive bidding process as Montgomery County's partner in its "Electrify MC" program, Elysian now has funding to support this initial effort to educate residents on electrification. This program has helped with marketing and has brought in more homeowners looking for electrification improvements. It offers an example of how local governments can partner with small businesses to facilitate the energy transition.

Energy Intensive Restaurant and Catering Businesses, Garden & Garnish[20]

Garden and Garnish is a small family catering business owned by Brian and Cathy Schmidt located in the Town of Trappe on the Eastern Shore of Maryland in Talbot County. Providing catering for a wide range of events, Brian and Cathy keep sustainability and the environment in mind when running their business, and were eager to explore the possibility of installing solar panels on their kitchen. To start the process, Cathy conducted research online for several weeks to learn about residential solar installations, their pricing, and where they are manufactured. They installed their

11 kW solar array system in 2016 and received a $1,000 grant from Maryland, as well as a 30% investment tax credit from the federal government.

Brian and Cathy were motivated to install solar panels for the environment, but they also saw it as a potential economic benefit to their business. On average, the solar panels save them about 30% on their energy bills, or about $100 - $150 per month, with higher savings during summer and lower savings during the winter. Since their array is connected to the grid, they are able to sell Solar Renewable Energy Credits (SRECs), which have brought in about $50-140 per month over the past few years. Between the electricity bill savings, SRECs, rebates, and tax credits, they were able to pay off their solar panels within 7 years. Overall, the panels have helped in reducing the environmental impact of their electric kitchen equipment and their business' monthly bottom line. The process to understand the financial benefits and available government assistance, however, could still pose high barriers to entry for those who may be less interested in sustainability. If solar installations were to scale widely, information and support must be simplified and made easier to access. The State could fill this need by providing clear information about incentives and technical assistance available to business-owners, or create a facilitator role that can help owners navigate these resources and make connections.

Installing solar panels was a large effort for Garden and Garnish, but it is just one piece of their work to be sustainable. Other sustainability measures that they have implemented include collecting rainwater for their gardens, donating leftovers to local shelters, composting kitchen scraps, and making their property Bay-Wise certified. They have considered electrifying their equipment, which would reduce burning propane and greenhouse gas emissions, but their kitchen equipment still functions and would be costly to replace and electrify. The long lifetime of kitchen appliances such as ovens could present a challenge for meeting the State's emission reduction and electrification goals. Strong financing support may be needed if small businesses are asked to replace expensive equipment before the end of its life.

Economic Impacts

The energy transition presents an opportunity for economic growth and positive change in local communities, especially through creating jobs, fostering innovation, and supporting long-term sustainability. However, the economic impacts of the energy transition can be difficult to quantify because the transition could take multiple paths, and because individuals and businesses may have different experiences of the same transition pathway depending on the nuances of their individual situations. Acknowledging these uncertainties, we use the state's Climate Pollution Reduction Plan as one example of the path the transition could take. Analysis of the Plan by the Regional Economic Studies Institute (RESI) at Towson University indicates that the transition may provide significant economic benefits to the state, including a net gain of 27,400 additional jobs, a $2.5 billion increase in total personal income, and a $5.3 billion increase in state Gross Domestic Product (GDP) between 2024 and 2031.[21]

These benefits were found to be broadly felt across different sectors of the economy, but were not uniformly distributed. The highest growth was found to be in construction (annual average gain of 2,033 jobs through 2035) and transportation (annual average gain of 2,016 jobs through 2035). In contrast, some sectors were expected to sustain fewer jobs such as food preparation and serving related (annual average of 248 fewer jobs through 2035). There were also geographical differences, with Central Maryland expected to gain the most jobs through the energy transition.[21]

There are also health benefits associated with air quality improvements due to the energy transition. The state's Climate Pollution Reduction Plan estimates that it could deliver health benefits monetized at $142 million to $321 million in 2031 compared to current policies alone.[22] While these health benefits are also expected to be concentrated in population centers with the most sources of pollutants, all counties were found to benefit from reductions in symptoms due to air quality including asthma, upper and lower respiratory symptoms, heart attacks, and even deaths.

While these results indicate broad trends associated with the energy transition needed to meet Maryland's climate goals, more analysis is needed to gain additional insight beyond these net effects. Future analysis could expand on these results by engaging directly with a wider range of businesses than the few case studies presented here, and by disaggregating economic modeling results to a more detailed sectoral level. Additionally, more work is needed to determine how changes in supply chains associated with the energy transition could impact the economic activities of the state and opportunities for small businesses.

Policy Frameworks

Maryland has a number of existing programs already in place that provide support to small businesses engaging in the energy transition, as well as some that support small businesses more broadly which could adopt an energy focus.

Resource/Platform-based Programs

The state can offer major benefits through its role as a convener by bringing together key groups of stakeholders around important topics. It can also participate in convenings by other entities, which can provide transparency and access to constituencies that may otherwise struggle to connect with government processes. There are several such convenings currently operating in Maryland that include small businesses.

The Maryland Entrepreneur Hub, run in partnership by Technology Development Corporation (TEDCO), Department of Commerce, and University System of Maryland, is a platform designed to support small businesses and startups. It provides resources, networking opportunities, and guidance, as well as mentorship and workshops to help entrepreneurs develop their skills and build a community.[22] The Maryland Energy Administration (MEA)'s Maryland Clean Buildings Hub is a clearinghouse of resources and information to help large commercial building owners navigate building decarbonization and could be used as a model for a hub specific to small business decarbonization.[23] The Small-Business Anti-Displacement Network is an initiative aimed at offering advice and information to small businesses to prevent displacement in gentrifying neighborhoods. The network consists of a diverse group of individuals with varied backgrounds and expertise, including real estate developers, policymakers, and small business owners.[24] The Maryland Green Registry is a program designed to promote sustainable practices among businesses and organizations. It consists of a green network where businesses can share their sustainable practices, connect with others, and gain recognition for their efforts.[25]

Loans/Grants (household focus)

The Multifamily Energy Efficiency and Housing Affordability (MEEHA) program is run by the Department of Housing and Community Development (DHCD) and offers funding through two main programs aimed primarily at households. However, this program is also relevant because many small businesses may be run out of the owners' home, particularly in early stages when the business is new. The Greenhouse Gas Reduction Program targets reduction of fossil fuels and includes a

budget of $8.75 million for 2024 and $5 million for 2025. Additionally, EmPOWER Maryland is a program run both by DHCD and state utility companies (Baltimore Gas and Electric (BGE), Delmarva, PEPCO, etc.). This initiative includes rebates and incentives for energy efficiency improvements and has a budget of around $134.9 million for the years 2024-2026.[26]

Loans/Grants (business focus)

There are also many programs that focus specifically on businesses, some of which explicitly relate to energy and some of which do not. For instance, the Energy and Environment for Maryland Manufacturers is a program aimed at providing manufacturers with resources and guidance on adopting energy efficiency measures and renewable energy technologies. It is funded by the Maryland Energy Administration (MEA) and run by both Maryland Manufacturing Extension Partnership (MEP) and Regional Manufacturing Institute (RMI). The Department of Commerce also oversees another program aimed at the manufacturing industry — the Maryland Manufacturing 4.0 program in partnership with MEP and RMI. This program includes grants ranging from $25,000 to $500,000 for small and medium sized businesses that invest in industry 4.0 related technology, machinery, and more to increase productivity and reduce costs.[27] The budget includes $1 million for 2024 and an additional $4 million for 2025.[28] The Maryland Innovation Investment Tax Credit incentivizes investment in Qualified Maryland Technology Companies (QMTC) through various tax credits.[29] QMTC companies have fewer than 50 employees and span various sectors, including energy and sustainability. The program has around $2 million in funding for 2024 fiscal year and is run by the Department of Commerce.

Maryland utility companies have programs aimed at small businesses more broadly. Most companies, including BGE,[30] SMECO,[31] Potomac Edison,[32] and Washington Gas,[33] offer free energy audits and incentives for HVAC, water and space heating, and lighting. While discounts differ based on the company, businesses can usually expect to have 75-85% of project costs covered.

The State Small Business Credit Initiative (SSBCI) program is aimed at socially and economically disadvantaged small businesses with limited growth opportunities. The overall budget is $198 million which is split among DHCD, Department of Commerce, and TEDCO. DHCD's budget includes $103 million for small businesses and nonprofits through the Neighborhood Businessworks Program. Additionally, the Department of Commerce has around $103 million in funding primarily for disadvantaged small businesses through the Maryland Small Business Development Financing Authority (MSBDFA) program. Lastly, TEDCO has around $50 million for tech and life science companies through various venture capital programs.[34] While these programs do not specifically focus on energy concerns, they are important mechanisms the state can use to support businesses through the energy transition.

Loans/Grants (broadly focused)

There are also programs which serve multiple different types of entities, including small businesses. The Maryland Clean Energy Center offers financial resources and technical assistance for clean energy projects state-wide. They have multiple programs based on the type of project and who is running them.[35] For example, they have the Maryland Energy Innovation Accelerator to provide investments for clean energy and green technology inventors,[36] the MD Property Assessed Clean Energy Program (MDPACE) for property owners, contractors, and local governments,[37] as well as the Maryland Clean Energy Capital Program (MCAP) for institutions and nonprofits.[38] They also have a Clean Energy Advantage Loan Pilot Program that is run in partnership with Montgomery County Green Bank and funded by the Public Service Commission. The Jane E. Conversation Loan Program offers low-interest loans to Maryland nonprofits, local governments, businesses,

and state agencies for energy efficiency and conservation projects. The MEA has allocated an annual budget of around $4.2 million for this program, prioritizing a reduction of energy consumption across the state.

The MEA also runs the Maryland Smart Energy Communities (MSEC) programs and has various loans and resources for facilitating communities to adopt clean energy projects. They offer grants for four main programs: Clean Energy for Local Governments Program ($1.5 million), Public Facilities Solar Program ($1 million), Streetlight and Outdoor Lighting Efficiency Program ($1 million), and Clean Energy and Community Development Pilot Program ($6 million for energy efficiency, $4 million for clean energy). The Resilient Maryland Program run by MEA provides funding and technical assistance to implement microgrid and distributed energy resource projects. They have allocated $8.8 million of funding split between three main areas: preconstruction planning, capital support, and resiliency hubs.

MEA runs the Commercial Industrial and Agricultural Grant Program for deep energy retrofit projects with the goal of reducing energy usage. The budget includes $4.4 million split between projects related to energy efficiency and electrification, manufacturing and combined heat and power, as well as agricultural energy efficiency.

Other Resources

It should be noted that these Maryland programs act in addition to the various programs available at the federal level, particularly the tax credits, rebates, and other resources available to small businesses under the Inflation Reduction Act and CHIPS Act.[39] Some important federal resources include the Department of Energy loans (Advanced Technology Vehicle Manufacturing Loan, Tribal Energy Loan Guarantee Program, Title 17 Clean Energy Financing, Carbon Dioxide Transportation Infrastructure Finance and Innovation Program), Small Business Administration loans, the Small Business Voucher Pilot Program, and more. Additionally, counties may provide specific programs and support at the local level.

Policy recommendations

This analysis suggests several potential ways that Maryland could act to support small businesses engaging in the energy transition, and to partner with them to ensure the transition is successful.

Funding & Financing

One key way that Maryland can support small businesses is to provide funding to navigate the energy transition and to support businesses in accessing existing funding from other sources. Green banks are a key mechanism for this, as entities that leverage public and private capital to support clean energy projects through various financial services, like low-interest loans.[40] There are currently three green banks in the state of Maryland:

- The Maryland Clean Energy Center (MCEC) is the State's official green bank and works to transform the energy economy in Maryland by increasing clean energy jobs, driving commercialization of technological innovations, and enabling consumer adoption of clean energy products and services. MCEC is currently funded through state budget funding, private donations, federal grants, repayments, and proceeds from sales of collateral and assets.

- The Montgomery County Green Bank (MCGB) is a county green bank that focuses on local energy efficiency and renewable energy projects in Montgomery County and across the State. Currently, it is funded annually through a 10% allocation from the Montgomery County Energy Tax revenues, estimated to be around $20 million.

- The Climate Access Fund is a nonprofit in Baltimore that provides low-cost financing to developers who offer discounted community solar rates to low-income households and who create community solar projects that are located in and benefit historically disinvested communities across Maryland. Climate Access Fund is funded through investments from local philanthropy, state government agencies, and crowdfunding.

Green banks are crucial to lowering financial barriers to climate investing and increasing deployment of clean energy projects. An expansion of funding to these entities will ensure access to funding and financing, as well as other services, for clean energy projects that benefit disadvantaged communities or that might be too small for standard investors.

Engagement and Technical Assistance

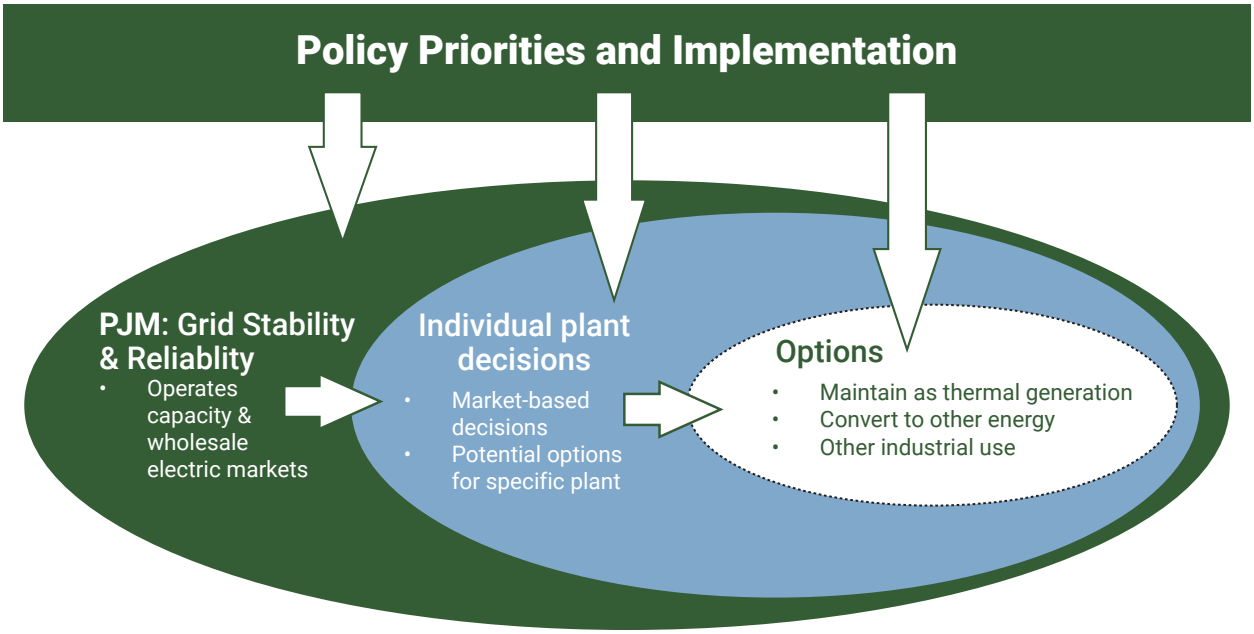
Another critical way that Maryland can support small businesses is to create mechanisms for sustained engagement with businesses in its role as a convener, and for provision of technical assistance for businesses undertaking energy-related projects. These mechanisms could serve as a way to build support and buy-in among small businesses for the energy transition, and can also connect businesses to trusted partners who can assist with navigating the process of energy efficiency and electrification, from needs assessments to funding applications to project implementation. One example of this is the SmartRegs and EnergySmart programs in Boulder, Colorado, which provided education, incentives, and technical support to improve energy efficiency in rental housing.[41,42] Their successful navigation of split incentives between renters and landlords could serve as an example of how to navigate these issues in the commercial space for small businesses as well.

Another critical aspect of engagement with businesses will be ensuring broad access to policy support. For instance, any policies designed to support small businesses should be as flexible as possible, enabling businesses from a wide variety of industries to participate. Additionally, policymakers should consider how to structure programs so that businesses which rent space can still take advantage of incentives or other funding opportunities. This will involve both engaging directly with businesses to understand their needs and engaging with commercial landlords.[43] Finally, the state can act to raise awareness and provide information about resources available at the federal level. An outreach campaign could be particularly effective by prioritizing high energy consuming industries to help businesses access IRA incentives for renewables adoption and electrification.

Energy Generating Facilities

In this section we discuss the factors that could contribute to the retirement of energy generating facilities (primarily fossil fuels based power generating facilities) during the energy transition, and the implications of these retirements. The potential pace of facility retirements will be dependent on a complex set of decision-making processes among different stakeholders within the context of Maryland state policy goals, the broader PJM grid region, and the United States overall. PJM is the regional transmission organization responsible for maintaining grid reliability and managing the wholesale electricity market within its territory, which covers 13 states and Washington D.C. It works in concert with the state utility regulators within its region, such as the Maryland Public Services Commission (PSC), to set the conditions for utilities to operate at a more local level. There are also multiple other entities with regulatory roles that oversee aspects of facility operations both at the federal level (e.g., Federal Energy Regulatory Commission — FERC, Environmental Protection Agency — EPA) and state level (e.g., MDE). Within this broader setting, individual plant owners must make decisions about facility retirements based on market conditions and any policy requirements set by the state and federal governments. These decisions may also involve community stakeholders, and will be constrained by the specific options suitable for that specific facility. These dynamics are summarized in Figure 6.

FIGURE 6. Schematic showing factors involved in facility retirement decisions.



In this report, we focus on decision-making at the level of state policy and individual plants, while lightly discussing how these processes intersect with grid-level decisions. More detailed questions about grid-level stability and reliability concerns will be addressed separately in the forthcoming Energy Resilience and Efficiency Working Group study, and the forthcoming 100% RPS study by the Department of Natural Resources.[44,45]

Policy Context

There are four major policies that may impact retirement timelines for Maryland power generation facilities. The first is Maryland's Renewable Portfolio Standard (RPS) which requires reaching 50% consumption of renewable energy by 2030. The RPS defines renewables as solar, wind, qualifying biomass, methane from a landfill or wastewater treatment plant, geothermal, ocean, hydroelectric power plants of less than 30 MW capacity, poultry litter-to-energy, waste-to-energy, refuse–derived fuel, and fuel cells that produce electricity from one of the prior technologies. The RPS also includes hydroelectric power other than pump storage generation as a second tier resource.[46] The RPS requirements are met through purchase of Renewable Electricity Credits (RECs) in PJM's Generation Attribute Tracking System (GATS), which as of 2023 provides hourly matching of generation and load.[47] While the RPS provides some impetus to shift toward renewable energy production within Maryland, because RECs may be purchased anywhere within the PJM region, ultimately power generated in Maryland under the RPS is determined by broader market conditions and resource availability within PJM, and the need to meet reliability requirements.[48]

The second policy is the Regional Greenhouse Gas Initiative (RGGI), which is a multistate, market-based program designed to reduce carbon dioxide emissions from the power sector 30% below 2020 levels by 2030. RGGI requires fossil fuel-based electric power generators with capacities of 25 MW or greater to hold RGGI allowances that are equal to their carbon dioxide emissions over a three-year period. The allowances are auctioned quarterly, and once distributed can be held and traded in a secondary market. Regulated plants can also purchase allowances from offset projects up to 3.3% of their compliance obligation.[49] While power plant closures can be the result of a variety of factors, RGGI has helped incentivize the reduction of coal and natural gas consumption for electricity generation by increasing the cost of their GHG emissions.[50]

The third policy is the EPA's 2024 rule regulating emissions from new and existing fossil-fueled power plants.[51] This rule requires that coal plants adopt carbon capture and storage (CCS) to capture 90% of their emissions by January 1, 2032. For natural gas and oil steam generating units, the EPA set an emissions intensity standard (pounds of CO2 released per MWh of electricity produced) based on capacity factor, because units with a similar capacity factor tend to perform similarly to one another. These standards will require compliance by January 1, 2030, which may accelerate the timing of some plant closures as it requires often-expensive pollution control upgrades.[51]

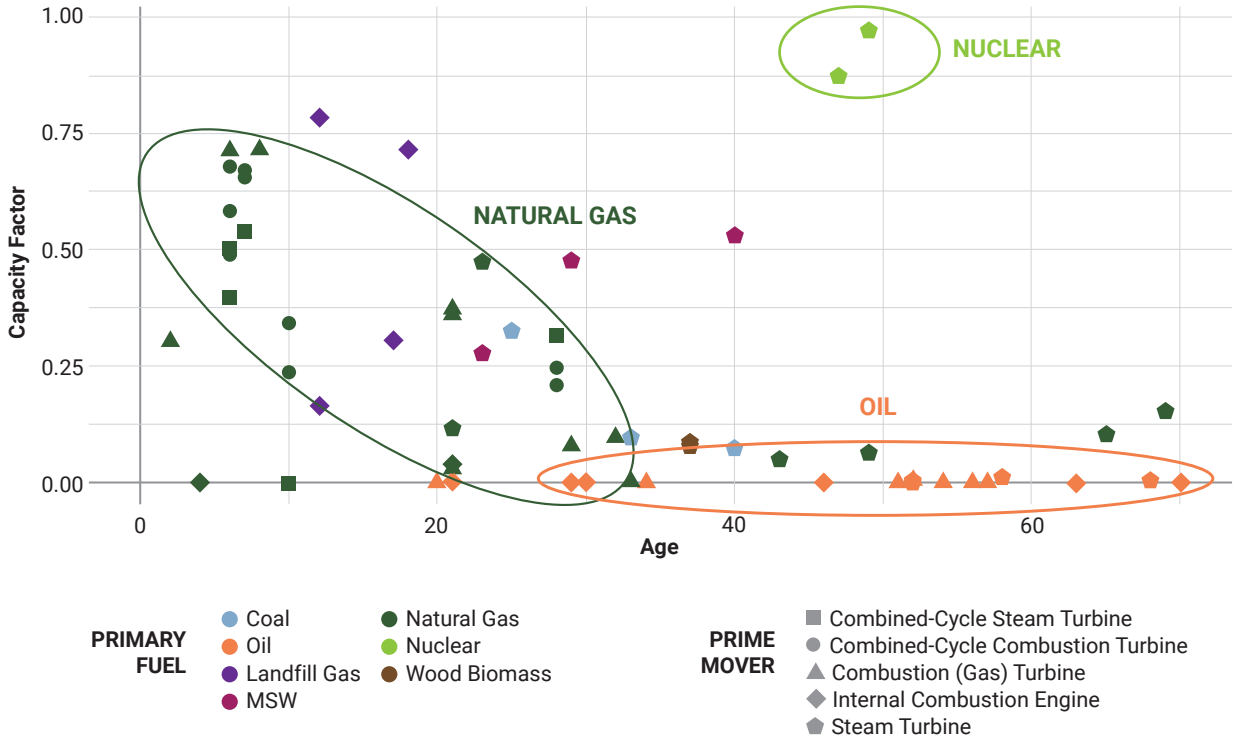
The final policy is the Governor's Executive Order directing the MEA to establish a framework to achieve 100% clean electricity in Maryland by 2035. This Clean Energy Standard (CES) is still under development, so the specifics of how it will be defined are not yet known. If a standard is established that requires 100% clean generation within Maryland's borders, this policy would likely be the primary driving force behind retirement timelines for Maryland power plants. If the policy is established on a consumption basis similar to the RPS, some Maryland fossil fuel plants may continue to operate beyond 2035 due to a need for some location-specific power that can be turned on or off easily to meet demand. It is also not yet known which energy generation technologies will be considered "clean" under the proposed CES.

Electricity Generation in Maryland

As of 2023, Maryland produced 45.8% of its in-state electricity generation from fossil fuels.[52] The majority of this came from natural gas facilities (41.0% of in-state generation), with 4.6% produced by coal facilities, and only 0.2% produced by petroleum facilities. The other major categories of electricity production were nuclear (40.1% of generation by the two Calvert Cliffs reactors) and renewables (9.1% of generation). This lags notably behind the state's Renewable Portfolio Standard goals, which target 31.9% generation by renewables by 2023, rising to 50% by 2030.[53] This discrepancy is due to the use of imported electricity to meet Maryland's energy needs, and the use of out-of-state RECs for compliance with the RPS. A more complete summary of in-state energy generation in Maryland is provided below in Table 1.

Figure 7 provides a more detailed view of the roles of different generation types in Maryland. The Calvert Cliffs nuclear generators have the highest capacity factors. The next highest capacity factors include younger generators that are internal combustion engines and combined cycle turbines using landfill gas and natural gas, respectively. Natural gas generators span across almost all mover types, with a general downward trend in capacity factor with age. Many generators using distillate fuel oil have low capacity factors, are generally older than 40 years, and use combustion and steam turbines. Natural gas steam turbines are among the oldest generators but still have relatively higher capacity factors compared to generators that are the same age.

FIGURE 7. All current thermal power generators in Maryland, shown by fuel, generator type, generator capacity factor, and generator age. Note that some facilities only report generation at the level of fuel type and prime mover, so multiple small generators may be aggregated together to calculate a capacity factor. Data is from 2023, publicly available from the EIA.[52,54] The primary ranges of activity for nuclear, oil, and natural gas generators are circled.



Tables 2 and 3 below list the individual fossil fuel facilities that were active in Maryland in 2023, summarized by load segment, fuel, and age. After the retirement of the Warrior Run facility in 2024, all remaining baseload and intermediate fossil fuel plants in Maryland currently run on natural gas. These baseload and intermediate facilities tend to be younger and primarily use combined cycle technologies, which are more expensive but also more efficient.

TABLE 1. Profile of electricity generation in Maryland by generation technology, for facilities with greater than 1 MW capacity. Facility generation data is from 2023.[52,54] Energy storage (-540MWh) is not included here. For the 5 facilities with multiple generators on site that use different fuels, the facility is counted under both fuel categories. *For solar generation, the number of facilities indicates the number of utility-scale generation facilities reported by the EIA, but the MWh of generation includes both utility-scale generation and small-scale distributed generation reported in the EIA State Energy Data System (SEDS).[55]

	Number of facilities (2023)	MWh generation (2023)	% of state generation (2023)
Coal	2	1,708,970	4.6%
Natural Gas	17	15,336,203	41.0%
Petroleum	14	64,240	0.2%
Fossil Total	**33**	**17,109,413**	**45.8%**
Nuclear Total	**1**	**14,983,751**	**40.1%**
Biomass/Waste/ Landfill	10	634,689	1.7%
Hydro	2	1,849,088	4.9%
Solar*	144	2,324,764	6.2%
Wind	5	481,526	1.3%
Renewable Total	**161**	**5,290,067**	**9.1%**

TABLE 2. Fossil fuel facilities in Maryland that provide intermediate or baseload power, defined here as between 20-60% capacity factor and >60% capacity factor, respectively.[56] Data publicly available from the EIA.[57] Highlighted rows indicate facilities that have fully or partially retired since this data was published.

Plant Name	Load Segment	Age	Fuel
Keys Energy Center	Baseload	6	Natural Gas
NIH Cogeneration Facility	Baseload	6	Natural Gas
APG Combined Heat and Power Plant	Baseload	8	Natural Gas
Maryland Bioenergy Center (Jessup)	Intermediate	2	Natural Gas
Wildcat Point Generation Facility	Intermediate	6	Natural Gas
CPV St Charles Energy Center	Intermediate	7	Natural Gas
Central Utility Plant at White Oak	Intermediate	10	Natural Gas
AES Warrior Run Cogeneration Facility	Intermediate	25	Coal
Brandywine Power Facility	Intermediate	28	Natural Gas

Peaker facilities in Maryland (Table 3) primarily run very infrequently, with the majority (10 out of 18 facilities) running at a less than 1% capacity factor. There were an additional six facilities in Maryland that had no net generation in 2023, but actually used more power than they produced.

TABLE 3. Fossil fuel facilities in Maryland that provide peak generation, defined here as 0-20% capacity factor,[56] and facilities that had no net generation in 2023. Where multiple generators exist within the same facility, the oldest generator is used to determine the facility age. Data publicly available from the EIA.[52] Highlighted rows indicate facilities that have fully or partially retired since this data was published.

Plant Name	Load Segment	Age	Fuel
Brookville Smart Bus Depot Microgrid	Peak	1	Natural Gas
Essential Power Rock Springs LLC	Peak	21	Natural Gas
Central Utility Plant at White Oak	Peak	21	Oil
UMCP CHP Plant	Peak	22	Natural Gas
Domino Sugar Baltimore	Peak	23	Natural Gas
Perryman	Peak	29	Natural Gas
Smith Island	Peak	30	Oil
Dickerson Power	Peak	32	Natural Gas
NRG Chalk Point CT	Peak	34	Oil
Eastern Correctional Institute	Peak	36	Oil
Brandon Shores	Peak	40	Coal
Chalk Point Power	Peak	49	Natural Gas
Perryman	Peak	52	Oil
Philadelphia	Peak	54	Oil
Vienna Operations	Peak	56	Oil
Crisfield	Peak	56	Oil
Chalk Point Power	Peak	57	Oil
Herbert A Wagner	Peak	68	Oil
Berlin	No net generation	4	Natural Gas
Inner Harbor East Heating	No net generation	20	Natural Gas
Easton 2	No net generation	46	Oil
Morgantown Generating Plant	No net generation	51	Oil
Berlin	No net generation	63	Oil
Easton	No net generation	70	Oil

Wages associated with each type of generation in Table 4 are based on an "industry crosscut," which include jobs across NAICS industries (e.g., utilities, manufacturing, construction, etc.) for a specific fuel type. The U.S. Energy & Employment Jobs Report (USEER) Wage Supplemental Report found that a higher share of jobs from the utilities industry correlated with higher wages within an industry crosscut.[58] For example, within the nuclear industry crosscut, jobs associated with utilities make up a large majority of the crosscut, whereas within the solar industry crosscut, utilities make up only a few percent.[58] In 2023, construction jobs made up the majority of solar jobs at about 64%, while operations and maintenance jobs made up only 8%.[59] While both construction and operation jobs will likely grow over the next decades to meet solar deployment goals, a high growth rate means that construction jobs will make up a larger portion of solar's industry crosscut in the coming years, making its wage profile different than more established fossil fuels.[59] Solar and wind wages have also historically been lower than fossil fuel wages, in part, because, as newer industries, they often do not have the same labor protections through unionization as more established fossil fuel jobs.[60] While unionization rates for renewable energy are growing, nuclear, natural gas, and coal had the highest average unionization rates in 2023.[61]

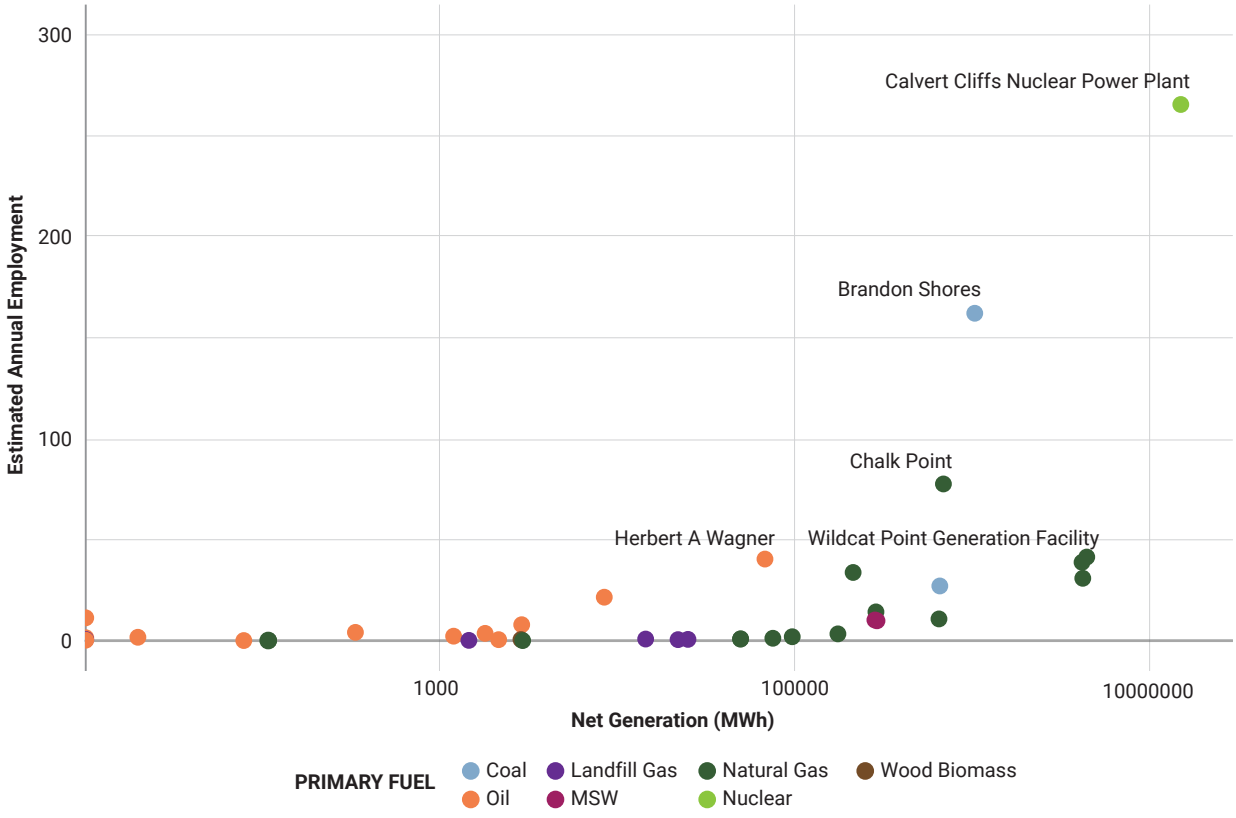
Figure 8 provides a more detailed view of direct employment at individual facilities — not accounting for the upstream jobs in the industry crosscut which may or may not actually be located within Maryland. Estimated employment numbers are based on the facility's nameplate capacity, capacity factor, fuel type, and prime mover type. Nameplate capacity refers to the maximum power generation the facility is capable of producing, while the capacity factor is the ratio of actual power produced over a given period of time compared to if the facility had been operating at its nameplate capacity continually over that period. The prime mover refers to the type of device that converts energy to electricity — specifically the type of engine or turbine used for thermal generators. It is important to note that these estimates are based on national statistics and not plant-specific information, which was not publicly available for most facilities.

TABLE 4. Profile of employment in Maryland's electricity generation sector by industry (not specific to facilities). All data is for the most recent available year: estimated employment numbers are from 2023,[61] and national hourly wage data are from 2019.[58] Not included in the data above are geothermal jobs (183) and other electricity jobs (1,194).

Industry	# of jobs (2023)	% of jobs (2023)	Median hourly wage (2019)
Coal	1,599	11.1%	$28.69
Natural Gas	2,086	14.5%	$30.33
Petroleum	107	0.7%	$26.59
Fossil Total	**3,792**	**26.3%**	**-**
Nuclear Total	**1,143**	**7.9%**	**$39.19**
Biomass/Waste/ Landfill	516	3.6%	-
Hydro	502	3.5%	$26.97
Solar	7,195	49.9%	$24.48
Wind	1,280	8.9%	$25.95
Renewable Total	**9,493**	**65.8%**	**-**

The facilities with the highest numbers of employees are primarily those that generate the most electricity. Overall, there are three primary groups of facilities. First, those that employ greater than 50 people, which include plants with higher nameplate capacities, even if they have lower capacity factors, such as Brandon Shores and Chalk Point Power. Calvert Cliffs is by far the plant with the highest employment due to its large nameplate capacity, high capacity factor, and the types of employment needed at nuclear plants. Second, medium employment levels (10 to 50 employees) include many natural gas plants and municipal solid waste plants. One thing to note is that newer combined cycle natural gas plants had mid-level employment with high net generation, i.e. greater than 1,000,000 MW. This grouping includes CPV St. Charles Energy Center, Wildcat Point Generation Facility, and the Keys Energy Center, which are in the lower right corner of Figure 8. Lastly, those plants with minimal employment, or fractions of jobs that may only be needed a few days out of the year, include many plants with small capacity factors for peak or intermediate loads and with small nameplate capacities. Many of these jobs are at oil plants and landfill gas plants.

FIGURE 8. Estimated employment at current thermal power plants in Maryland, shown facility net generation and fuel type. The x-axis is on a logarithmic scale and increases by one order of magnitude for each tick mark. Annual employment numbers are calculated based on employment factors provided by PNNL,[62] as derived from NREL's JEDI model,[63] and they should not be taken as exact. See Technical Appendix for further details.



Options for Facilities in the Energy Transition

For facility operators, the determinant of facility retirements will be economic, where markets are constrained by the policy context. However, there may be many other options besides retirement that a facility can consider depending on the specifics of the facility and how policymakers structure policies and regulations. Some of the key aspects that may influence how facilities make decisions are summarized in Table 5.

Here, we consider five options for facilities:

1. Reduction in frequency of usage
2. Use of alternate fuels
3. Retrofitting facility with carbon capture and storage
4. Retirement and re-use of facility
5. Retirement without re-use

Reducing Frequency of Usage

The first option a fossil fuel facility might pursue is reducing its frequency of usage, which would allow it to reduce overall emissions while still continuing to operate. This kind of infrequent generation pattern is associated with "peaker" plants that operate during peak load periods and can also provide grid services that are essential for maintaining reliability. Some of these services will grow more important as the fraction of renewables in the grid increases. However, to be economically viable these services must be provided with low capital costs, although they may have high operational costs since spot prices will be high when they are needed. This approach also does not fully eliminate emissions from the facility, and would be insufficient if Maryland's 100% clean electricity policy were structured to apply to all in-state generation.

TABLE 5. Facility characteristics that will influence potential future pathways.

Criteria	Description
Facility age	Years since the facility began operation and age of the operating equipment. Energy generating facilities pay off the cost of their construction over time by operating at a profit. Therefore, newer facilities will have an incentive to continue operating in order to pay off that initial investment, while older facilities may have already recovered those costs. Older facilities will also tend to incur higher operations and maintenance (O&M) costs.
Load segment	Some facilities operate nearly constantly throughout the year providing "baseload" power (e.g., nuclear). Others operate only a few days out of the year at times of peak load such as on a particularly hot day in the summer (often oil generating units). There is also a continuum of facilities in between these extremes. The differences in these types of operation are characterized by capacity factors, which quantify the amount of actual power produced compared to the theoretical maximum for the facility.
Prime mover	Type of engine or turbine used for thermal generation. Different types of prime movers may be more common in older units, and will range from cheaper units that are less efficient to more costly units with higher efficiencies. The type of prime mover will also influence other important characteristics of the facility, such as start-up time and suitability for retrofits.

Use of Alternate Fuels

Another option for facilities is to switch from fossil fuels to another fuel source such as biofuels or hydrogen. This could allow facilities to continue using their generator equipment in a new way, avoiding or mitigating the problem of stranded assets. However, converting to a new fuel may still require retrofitting equipment which would incur costs. Additionally, both biofuels and hydrogen have many complicating factors associated with their use. While biofuels are a proven fuel for commercial electricity generation, large-scale use of biofuels would require a steady supply from either large areas of land producing biofuel crops and/or production of residues. While biofuels are usually assumed to be carbon-neutral, they still produce combustion byproducts such as particulates that can be harmful for human health.[64] Hydrogen energy generation technologies are still under development, and are not yet available on the market at competitive prices.[65] In thermal generation, hydrogen would most likely be used first as an additive to natural gas to reduce (but not eliminate) CO_2 emissions. Alternatively, hydrogen can be used to produce electricity in a fuel cell, which can achieve higher efficiencies than a thermal generator. However, to be considered a "clean" fuel hydrogen must be produced using renewable energy. This means hydrogen would not be a good candidate for baseload power production, because using electricity to produce hydrogen and then using hydrogen in turn to produce electricity is a highly inefficient process. Instead, hydrogen might function more like an energy storage technology.[66] Finally, hydrogen is not currently listed as a Tier 1 or Tier 2 resource in Maryland's RPS, so unless future policies list hydrogen as a "clean" fuel, converting a fossil generator to hydrogen would not be a compliance option for generating facilities.

Adoption of CCS

A third option for fossil fuel facilities to continue operating through the energy transition is adoption of carbon capture and storage (CCS). Installing CCS equipment requires a large capital investment and relatively continuous operation, and therefore this would likely not be an option for low capacity factor facilities, which must maintain low capital costs to be competitive. Because Maryland has relatively few baseload generators that operate at high capacity factors, CCS would likely only be an option for a select few facilities in the state. Additionally, CCS is still an emerging technology, and the few existing demonstration projects have often struggled to reach sufficiently high capture rates (>90%).[67,68] This means that even under the best case scenario for CCS, a portion of the facility's original emissions will still be released into the atmosphere. For CCS to reduce emissions, the CO_2 that is captured must also be stored permanently such that it is not released back into the atmosphere. There is currently no infrastructure to transport captured CO_2 from energy generating facilities to suitable storage sites, and there is also no regulatory framework to monitor and verify that the CO_2 remains in storage. Addressing these challenges would require significant new policy and physical infrastructure, and potentially the development of cross-state regulatory structures to appropriately track sequestered carbon.[69] Finally, adoption of CCS may not reduce co-pollutants to the same degree it reduces GHG emissions, leading to continued concerns around air quality and human health impacts.[70]

Re-use of the Facility Site

A fourth option for facilities is to retire the existing plant and re-use the site for energy storage, a new type of electricity generation, or another type of industrial use. Battery storage facilities offer one promising re-use case, with three facilities currently operational in Maryland,[54] and larger-scale usage already demonstrated in other markets such as California.[71,72] Batteries can make use of the existing interconnection infrastructure at a retired facility, while also providing grid services to maintain reliability and support the introduction

of renewable electricity generation. Batteries (and other types of energy storage) are most economically viable when they operate frequently and can take advantage of a large price spread, meaning they charge when prices are low and discharge when prices are high. A retired facility could also be reused for generation by renewables (solar or wind) or emerging technologies such as small modular reactors (SMRs).[73] Retired facility sites may offer value for other industrial uses as well because they are already zoned for industry and may have better community acceptance on a site that is already in use. The primary value of a retired facility site from an industrial viewpoint is the grid interconnection, which is most valuable for uses such as data centers that require extremely large quantities of energy. Changing a facility from providing power to the grid to adding a significant load to the grid could pose challenges for grid reliability in that location. A data center or other industrial use of a site would provide employment, and potentially re-employment opportunities for former utility workers.

As energy companies shift their operations towards cleaner energy generation and consider site re-use, they will need to develop labor training programs as part of plant retirement plans, either through internal programs or through partnerships with other educational entities. The AES Corporation (AES) offers one example of an internal re-training program. AES recently retired the last coal plant in Hawaii and provided a renewable energy re-skilling training for all its employees. Through the re-training program, it was able to place the majority of employees from the retired coal plant in clean energy positions within AES, including in Hawaii.[74] AES launched a 12.5 MW solar-plus-storage project on the same island as the retired coal plant,[75] and is also considering the possibility of siting a renewable energy resource at the coal plant property in the near future.[76]

Retirement without Re-use

Finally, facilities could retire without re-using the facility site in any way. This option creates the most concerns for local employment, but may be preferable for some communities whose greatest concerns are the environmental and health impacts of facility operation.

Potential for Facility Retirements

This study focuses on the potential for facility retirements due to the energy transition in Maryland, so we primarily address pathways for fossil fuel-based facilities. We discuss the likely options for facilities if the state's proposed 100% clean standard were to force in-state fossil generation to end emissions by 2035. Importantly, in the absence of mandates for in-state fossil generation, there is little reason to expect facilities to close except for economic reasons. However, current economic forces and existing policies are already leading to the phase-out of coal within the state.

Of the 33 fossil fuel generators identified in Maryland as operating in 2023, five already have planned retirement timelines according to PJM records.[77] This includes the Warrior Run coal facility, which has retired (see Case Study), and the Morgantown oil facility (formerly coal), which was scheduled to retire in June of 2024 but has two remaining generators active. The Vienna facility and two units of the Wagner facility plan to close in 2025. Brandon Shores (Maryland's last active coal plant) and two oil-fired units (one formerly coal) of the Wagner facility are currently going through a reliability-must-run (RMR) process to confirm a retirement timeline with PJM and FERC. This leaves a remaining 17 natural gas plants and 11 oil plants in the state, with only one active interconnection request for a new natural gas facility in PJM's queue.[78] There are also six landfill gas facilities, two biomass waste facilities, and two municipal solid waste (MSW) incineration facilities active in Maryland which provide similar functions as fossil generation plants, but are currently

considered to be renewable resources under the state's RPS. Finally, there is one nuclear facility in Maryland, which is not considered renewable, but would likely be considered a "clean" generation source under the proposed 100% CES.

TABLE 6. Summary of facility options and the types of facilities that might be suitable for each option.

Facility Options	Types of facilities
Reduce frequency of usage	Baseload and intermediate plants may be able to reduce their generation over time in response to increasing mandates for clean power. Peaker plants already operate at low capacity factors, and would only further reduce generation if mandated by policy and their grid services were replaced.
Use alternate fuels	Some facilities may be able to either introduce cofiring of non-emitting fuels or entirely switch their operations to a new fuel source. Possible alternate fuels include bio-based fuels or green hydrogen. This approach may be suitable for facilities that want to continue operations using existing thermal generating equipment, avoiding costly investments in CCS or re-use of the facility site. However, alternative fuels may not be feasible for every type of generator, and may still require some investments to retrofit existing equipment.
Adopt CCS	CCS requires a substantial capital investment, which must be paid off by operation of the facility at a profit over time. Therefore, baseload and high capacity factor intermediate facilities are the most likely candidates for CCS adoption. Peaker facilities that operate infrequently are not likely candidates for CCS.
Retire and re-use facility	For facilities with no net generation or low capacity factor peaker plants, replacement with energy storage such as batteries can help maintain grid reliability, reduce need for new transmission infrastructure, and provide for continued employment opportunities at the site. For intermediate and baseload facilities, new generation technologies such as solar can provide continued output and employment. It may be optimal to pair renewables with energy storage to maintain reliability in these cases, or use new firm generation such as SMRs as such technologies become available.
Retire facility	For facilities already at or near the end of their economic life, simply retiring the facility without seeking any alternate use of the site may be a suitable option. This still poses questions about how to support employees in finding new jobs and how to maintain reliability in the electricity grid, but economic retirements are a normal part of electricity sector operation.

Baseload and Intermediate Facilities

Under the current RPS, while requirements for greater percentages of electricity consumption to be met with RECs may increase the price of fossil fuel generation, baseload and intermediate plants may continue to operate since they are substantial contributors to reliability. If they did choose to retire, it is likely that they would be offered an RMR agreement, similar to what has happened with Brandon Shores (see Case Study), which would extend the plant's lifetime. Baseload and intermediate plants on average are younger, making them more at risk of becoming a stranded asset (see Wildcat Point Case Study). However, baseload and intermediate plants by definition run at higher capacity factors, making them more likely to find the additional investment in CCS worthwhile if there was a policy driver, such as a CES or carbon tax. Another way to reduce reliability problems associated

with closing these high capacity factor facilities is to replace them with other electricity generation on the same site. However, renewables would likely produce less power on the same land area compared to a fossil generator,[79] and may need to be paired with energy storage. SMRs are another option that has been explored for replacing retired coal plants,[80] but they are currently still in the technology demonstration stage,[65] which means they are unlikely to be deployed widely in the near term. This outlook could improve due to recent announcements about SMR contracts for data centers and the $900 million offered by DOE to support SMR deployment, which could lead to rapid improvements in technology viability.[81]

Low Load (Peaker) Facilities

Several facilities in Maryland are listed as operational but had no net generation in 2023. For these facilities and peaking facilities that run at very low capacity factors, there may be minimal impacts from retirement in terms of employment (Figure 8). These facilities tend to be smaller, and may be good candidates for replacement with batteries, which can provide similar grid services to peaking plants to support reliability. However, since batteries currently have high capital costs, they are most economical when they are used frequently. Therefore, batteries will become more suitable as intermittent renewables become more prevalent in the grid, necessitating more frequent usage of dispatchable generation or energy storage. As battery technologies continue to improve and prices drop, this transition will also become more economic for facility operators. While these facilities would not be good candidates for installation of CCS due to the high capital costs, depending on the specific technologies at the facility they may be able to transition to bio-based fuels, which can allow for re-use of existing thermal generation equipment. Finally, peaking facilities tend to be much older, so they are less likely to become stranded assets in the transition. Retirement without re-use may therefore be a reasonable option for some facilities, as long as provision is made to ensure reliability at that location through other means.

Non-fossil Generation

There is no reason to expect that biomass waste facilities would close under current or proposed policies. The waste-to-energy (WTE) facilities would not be expected to close unless WTE were removed from the RPS, and they could no longer compete economically without the revenue from selling RECs (see Wheelabrator Case Study). The profitability of these facilities cannot be fully known without access to confidential information, so it is unclear if the facilities would be likely to close due to exclusion from the RPS or not.

The Calvert Cliffs nuclear facility consists of two reactors which will reach the end of their licensed period of operation in 2034 and 2036 respectively. While official plans have not been announced, it is expected that the facility will seek relicensure to continue operation. Because we are concerned here with facilities that might close due to the energy transition, renewable facilities such as solar and wind are outside the scope of our analysis.

Case Study: Reuse of Coal Plants, Warrior Run[74]

Warrior Run, a coal-fired generation facility in Cumberland, Maryland, retired in June 2024. The plant's owner, AES, is considering multiple options to convert or repurpose the facility. Fuel conversion opportunities include using less carbon dioxide intensive fuels, like biomass or gas, which tends to be the easiest transition option for a facility. If fuel conversion is not chosen, much of the existing facility equipment will not be useful in other repurposing options, like siting a battery

energy storage system or building a manufacturing facility or data center. However, repurposing the site may still be a lucrative option because the most significant asset at Warrior Run, as well as other retired energy generation facilities, is its interconnection point to the electric grid. This existing interconnect will make it easier for any new generation or load to more quickly connect to the grid. However, it is important to note that switching a site from being a generation facility to a facility such as a data center that would be a substantial new load could pose significant challenges for grid reliability.

Case Study: Impact of Grid Reliability Constraints, Brandon Shores & H. A. Wagner

In April 2023, Talen Energy announced that it would retire Brandon Shores, a coal-fired generation facility, by June 2025 due to an expiring National Pollution Discharge Elimination System permit and economic issues, particularly in converting Brandon Shores from coal-fired operations to fuel oil.[82] Later that year in October 2023, Talen Energy also announced it would retire H. A. Wagner on the same timeline due to the economics of the energy market and limits to running under its air quality permit.[82] In response to the retirement announcements, PJM, the region's grid operator, conducted a reliability analysis and determined that retiring Brandon Shores and two units of the Wagner facility would create reliability issues.[83] PJM requested that both facilities continue to operate under a Reliability Must Run (RMR) agreement until new transmission lines could be built, which would likely take until at least 2028. RMR agreements allow generators to continue to operate past their proposed retirement dates and recover costs incurred due to that.

The Federal Energy Regulatory Commission (FERC) has approved PJM's plan for transmission upgrades to handle the Brandon Shores and Wagner retirement and has accepted Talen Energy's proposed rate schedule to recover costs. However, FERC also immediately suspended the rate schedules to initiate settlement and hearing procedures because of protests filed by the Maryland Office of the People's Council, the Maryland Public Service Commission, the Independent Market Monitor for PJM, and the Sierra Club that claimed the submitted rate schedule was not just and reasonable.[84] The purpose of the ongoing settlement hearings is to establish an agreed upon rate schedule. Additionally, to implement any RMR filing, Brandon Shore must amend a settlement agreement with the Sierra Club that states Brandon Shores must stop burning coal by December 31, 2025. Wagner was also subject to this settlement, but has since converted its remaining coal-fired unit to oil. The Brandon Shores and H. A. Wagner cases demonstrates the intricacies of facility retirements, which must reconcile technical considerations, like maintaining grid reliability, as well as environmental and health impacts from emissions.

Case study: Balancing Different Sustainability Goals, Wheelabrator[85]

The Wheelabrator facility is a 64.5 MW waste-to-energy (WTE) power plant in Baltimore that burns around 700,000 tons of municipal solid waste (MSW) every year to generate electricity. Wheelabrator is one of two WTE plants in Maryland which contributed 12.5% of Tier 1 RECs produced inside the state of Maryland in 2022 under the RPS program.[86] The purpose of the RPS is to incentivize renewable energy growth and reduce greenhouse gas emissions in the energy sector. Many states include WTE in their RPS programs,[87] but air emissions from WTE plants have made it a controversial technology to be subsidized by RPS programs. Any Maryland policy decisions on the inclusion of WTE in the RPS will have implications for the future of the Wheelabrator facility and its emissions. RECs are an important part of the economic viability of Wheelbrator, as it is for many other WTE plants in the US,[87] so removing WTE from the state RPS could result in the eventual closure of the facility.

Although WTE is a part of the RPS, WTE facilities still release both greenhouse gas emissions and co-pollutants, such as NO_x, SO_x, and fine particulates. As part of its contract renewal and settlement with the City of Baltimore, Wheelabrator upgraded its air pollution controls over the past two years with new technologies, including a fabric filter system and nitrogen oxide emissions reduction systems.[88] These retrofits did not become effective until the end of 2023, so data is not yet available on how deeply they will reduce emissions rates. The facility does not have plans to install CCS, noting that it would be a large capital investment for a technology that is not yet fully viable (see Adoption of CCS section).

In addition to its emissions and role in Maryland's energy system, Wheelabrator has other considerations to take into account when considering future pathways for the facility. Some environmental groups and community members have advocated for removing WTE from the RPS, citing the detrimental effects of air pollutant emissions from the facility on human health.[89] Evidence directly linking WTE emissions to local negative health outcomes is mixed,[90–92] as it can be difficult to isolate the primary determinant of health outcomes among confounding variables. According to MDE, the communities surrounding the Wheelabrator facility have a high Climate Vulnerability Score,[93] which takes into account a community's exposure to climate hazards, as well as its adaptive capacity and sensitivity to those hazards. While Wheelabrator is not the sole source of pollutant emissions, its emissions contribute to the cumulative impacts that these underserved and overburdened communities experience over time. Legislators are considering removing WTE from the RPS due to these environmental justice concerns,[89] and it will be important for the facility to have a transition plan in place to support employees and community members in case removal of RPS subsidies makes it uneconomical to continue to run the plant in the coming years.

It is also important to note that removing WTE from the RPS does not solve the issue of waste management in Maryland — yet another consideration that must be taken into account in decisions about Wheelabrator's future. Wheelabrator currently significantly reduces the volume of material sent to landfills in Maryland and allows for metal recovery and recycling.[94,95] WIN Waste states that the alternative to diverting waste to the Wheelabrator facility would most likely be shipping the waste to be landfilled near another environmental justice community in Virginia.[85] Baltimore County has stated in its most recent 10-year solid waste management plan that it would be able to manage the 215,000 tons of waste that it currently delivers to Wheelabrator with an existing in-state landfill, but this represents only a portion of the total waste received by the facility.[95] Landfilling in any location is not a preferred solution for waste management as it can lead to methane emissions and its own set of environmental concerns, so any potential closure of the facility should be coupled with strong measures to reduce waste overall and divert bio-based waste for composting. One example of such measures can be found in Massachusetts, which has been successful in diverting food waste through a food waste ban, in part due to compliance affordability, regulatory simplicity, and strong enforcement and monitoring.[96]

Wheelabrator does not have closure plans in the near future, and its contract with Baltimore continues through the end of 2031. WIN Waste notes that it provides other services to the community in addition to its 80 full-time employees. It recognizes that disposal and incineration are at the bottom of the waste management hierarchy and that recycling, reuse, and composting options should all be prioritized before incineration. The company hosts educational recycling and composting initiatives to help inform community members. The facility has also contributed to the regional economy and local communities through tax revenues and employment, as well as by contracting minority-owned businesses in Baltimore as vendors for facility repair and maintenance. WIN Waste has closed facilities in other states and has plans in place to ensure that employees

remain employed and receive the benefits they deserve. They also provide low-barrier entry-level jobs and on-the-job training, as well as prioritize hiring and promoting within the company.

Any decisions around the future of WTE in the RPS and the overall future of the Wheelabrator facility requires the consideration of several different policy goals. Policymakers will need to simultaneously consider how to reduce emissions in the energy sector in accordance with Maryland's RPS program; reconcile environmental justice concerns and Wheelabrator's contribution to cumulative impacts on the surrounding communities; ensure Maryland's waste can be reduced and managed properly; address employment and tax revenue impacts from a potential facility closure; and ensure that Maryland's electricity grid remains reliable. Navigating these priorities will require stakeholder engagement with communities, local government, and WIN Waste to ensure that all of these aspects are addressed in any decision making process.

Case study: Potential for Stranded Assets, Wildcat Point[97]

Wildcat Point Generation Facility, located in Cecil County, began operating in 2018 and is one of Maryland's newer combined-cycle natural gas power plants. If Maryland establishes policies to phase out in-state fossil generation as part of its climate goals, newer gas plants, like Wildcat Point, stand at risk of retiring before their expected life or needing to adopt a different fuel or new technology. Closure of the plant, fuel switching, or adoption of new technology are generally financial decisions for power plants, and for ODEC, the cooperative that owns Wildcat Point, that involves considering its eleven members and ratepayers.

The energy transition may require a retirement decision sooner than originally planned. These premature closures would create stranded assets for power plant owners. Stranded assets are investments that have already been made but have stopped earning a financial return earlier than the end of their planned economic life as a result of changes in the market or regulatory environment and can lead to these costs being passed on to consumers.[98,99] Climate policies can strand power generation assets through policies like emissions regulations, incentives to reduce fossil fuel use, or carbon pricing.[100] While switching to a different fuel or adopting CCS can potentially safeguard power generation assets, these options must be financially viable.

For example, if Wildcat Point were to close in 2035 due to the implementation of a 100% clean energy standard in Maryland, that would be 13 years before its expected economic lifetime of 30 years. The proposed clean energy standard may allow a fossil fuel generator to continue to operate with the installation of CCS, but given the early stage of the technology, ODEC does not consider CCS to be a viable option for Wildcat Point. Even with federal incentives for CCS installation, ODEC is not eligible for federal tax incentives that lack a direct pay option because it is a not-for-profit organization. While there are some ways to circumvent the potential risk of stranded fossil fuel investments, energy producers, at a minimum, should stop investing in the expansion of fossil fuel infrastructure to limit the risk of stranded assets in the future. Meanwhile, the state will need to facilitate the build out of renewable and clean energy, storage, and CCS technology to meet load demands and prevent the need for new fossil fuel-burning generators.

Retirement of Wildcat Point would mean ODEC would need to consider potential ways to support its 30 full-time employees at the facility. ODEC owns and operates three power generating facilities, with Wildcat Point being the only facility in Maryland. Small companies that do not own many facilities in the same region may lack opportunities for relocating employees internally, which emphasizes the need for retraining opportunities that are not reliant on current employers. The state

could incentivize employers to provide transitional workforce and financial support, as discussed in the recommendations section. The state may also have opportunities to incentivize companies to build out renewable generation that could provide internal transition options. Retirement of Wildcat Point would also mean a significant loss in property tax revenue for Cecil County, as well as a loss of local events that ODEC hosts in the community.

The Illinois Climate and Equitable Jobs Act (CEJA) is an example of comprehensive state legislation that prioritizes plant closures and community revitalization. It mandates the closure of fossil fuel plants by 2045 while also standing up funds and safeguards for impacted workers and communities, such as career and financial services and employment assistance. In this case, the state plays a crucial role to ensure that the power plants and communities are supported as Illinois transitions to clean and renewable energy. Similarly, as Maryland moves towards meeting its climate goals, the State must consider how to support and transition not only fossil fuel plants and their employees, but also the wider community that those plants contribute to.

Impacts of Potential Facility Closures

While the potential of stranded assets discussed in the Wildcat Point case study is one possible negative impact caused by facility closures, closures can also have both positive and negative impacts on the surrounding communities and environment. With the decline of the U.S. and global coal industry and retirements of coal facilities, power plant closures have been studied closely over the past decade. Facility closures directly affect jobs and tax revenue within a community, but it can also bring about air quality improvements that affect the health of residents and the environment.

The loss of jobs is one direct negative impact of a facility closure. As noted in a few of the facility case studies, some companies who own energy generating facilities are prepared to retrain or relocate employees. However, workers likely have strong ties to their communities and may be unwilling to move.[101,102] Former power plant employees can transition to jobs with similar skill sets, which include many green jobs,[101] but they may not earn a comparable salary or work less hours due to re-employment to a less unionized industry or due to other job-specific characteristics.[103] Repurposing facilities and retraining employees to work in the same locality for a different purpose can help overcome the challenges of finding a new job and the reluctance of relocating for a job. Programs established through the IRA emphasize making investments in energy communities, or communities that have been dependent on fossil fuel production and generation, underscoring the importance of considering locally targeted interventions. These IRA programs are discussed further in the recommendations section.

Facility closures would also affect state and local tax revenues from the loss of facility income tax and real and personal property tax.The loss in tax revenue can be difficult to estimate beforehand because it is dependent on several factors, such as the local valuation methods for the taxable value of the plant and fiscal agreements between plants and counties.The Maryland Department of Legislative Services attempted to estimate the magnitude and timing of revenue loss from fossil fuel plant closures in Prince George's County[104] but were unable to develop exact estimates due to lack of data availability. Additionally, there would be negative indirect effects on other businesses within a facility's economic ecosystem, such as businesses that provide the power plant with maintenance, food services, and fuel sources. To address potential loss in tax revenues, communities can stabilize local economies by developing revenue strategies focused on building local capacity and investing in diverse industries.[105]

One of the benefits of a fossil fuel plant closure is the positive impact on air and water quality and the co-benefits that result, which are externalities that are usually not considered in economic valuation. Fossil fuel power plants emit a range of emissions from carbon dioxide to nitrogen oxides, sulfur dioxide, and particulate matter, among other co-pollutants. These emissions are known to drive climate change and contribute to adverse health effects, such as pulmonary and cardiovascular diseases, in populations near the emitting point source.[106] Power plants also have water-related impacts. Thermal generators account for about 40% of freshwater withdrawals in the U.S.[107] While excessive withdrawals of source water and discharges of hot cooling water are environmental concerns for any thermal power plant, coal plants also have the added impact of coal ash, which, when inadequately managed, can leach into and contaminate waterways with toxic components such as arsenic and mercury.[108] Plant closures generally do not take health and environmental effects into account in financial decision making, but studies have shown that, based on monetized values, health co-benefits and environmental impacts from plant closures often exceed the value of continuing to generate electricity using fossil fuel plants.[109,110] These findings underscore the importance of considering health and environmental impacts while moving towards policy and decision making that prioritize emissions reductions once grid reliability and affordability are secure.

Decision-Making Framework for Policymakers

Policymakers set the context for facility retirements both through requirements for clean generation such as the RPS and proposed CES, and through regulatory oversight of electricity markets and facility operations. This means that policymakers have many different levers they can use to prioritize different types of electricity generation within their jurisdiction. Here, we describe a set of criteria for existing energy generation facilities that can be used by state policymakers to consider the relative contributions and harms of a given facility, with a focus on equity. This criteria can be used as a framework for prioritizing specific facility operational changes or retirements. It is critical to note that these criteria are not directly comparable to one another, and a crucial part of this prioritization process will be determining which criteria state policymakers wish to emphasize under what circumstances. This should be done in consultation with stakeholders who can provide policymakers with input about which criteria are most important for specific communities.[111] We summarize these criteria in Table 7.

A best-practices approach to facility decision-making will include engaging with both facilities and communities around all of these criteria. Embedding a stakeholder engagement process in electricity sector policies can help ensure community support for adoption of new technologies or re-use of a facility site. A framework for this type of stakeholder engagement process has been developed by researchers at the Pacific Northwest National Laboratory, with detailed procedures suggested for community engagement at all steps in the decision-making process.[111]

TABLE 7. Criteria for policymakers when considering power plant closure impacts, with a focus on equity-based concerns.

Criteria	Description
Efficiency	The amount of energy input needed to produce a given amount of power. This can either be characterized through an efficiency value or a heat rate.
CO_2 total tons of emissions	The total amount of carbon dioxide emitted by a facility per year. This has significant implications for Maryland's ability to meet its climate goals.
CO_2 output rate	The amount of carbon dioxide emitted by a facility per unit of generation.
Co-pollutant emissions	NO_x, SO_2, N_2O, CH_4, PM output rates and total tons of emissions. All of these emissions have important implications for human health.
Dispatchability	How quickly a facility can ramp from being shutdown to operating at full load. This is a critically important service for maintaining reliability, and will become more important with higher penetration of variable renewable resources.
Co-generation	Co-generation is the production of both electricity and heat from a thermal generator. This increases the efficiency of fuel use because the heat would otherwise be wasted.
Alternate job availability	If the facility is in an area heavily dominated by a single industry, it may be more difficult for unemployed workers to find new jobs without relocating.
Unemployment in the immediate area around the facility	It may be harder in areas with high unemployment for workers to find new jobs, particularly jobs with comparable wages and benefits.
Number of direct jobs	The number of people employed at the facility.
Disadvantaged Community	This designation can have many contributing factors — here, we use the definition of disadvantaged communities established by the Council on Environmental Quality (CEQ) in its Climate and Economic Justice Screening Tool.[112]
Water quality	Energy facilities can also use large quantities of water in cooling systems, and can contribute to water pollution.
Tax revenue	The amount of revenue a facility provides to a local community through property taxes. Depending on the facility, this may be a significant source of revenue for the locality.
Ratepayer impacts	Facility decisions may have impacts on ratepayers if they involve significant investments in facility retrofits that need to be recovered over time, or if the facility site is re-used for another type of energy generation/storage with a different financial profile.

Policy Recommendations

Meeting Maryland's Climate Goals

In order to meet Maryland's GHG emission reduction targets of 60% reduction by 2031 and net-zero emissions by 2045, it is clear that the electricity sector will need to rapidly reduce emissions within the next decade.[2,3,113] This applies to both imported electricity, which may be covered by RECs, and in-state generation, which will count towards the state's emissions budget whether that power is consumed within Maryland or exported to surrounding states. Therefore as the state considers its approach to crafting a 100% CES, both of these sources of emissions must be addressed, and careful consideration should be given to how the state prioritizes reducing emissions at in-state facilities through the various pathways outlined in this report. Phasing out unabated fossil generation within the state will also be an essential part of achieving the air quality and health benefits associated with emissions reduction.[3]

Framework/Approach

Facility closures are embedded within a layered governance structure made up of federal, state, and local actors. Historically, this structure has been geared primarily towards maintaining grid reliability. As decarbonization efforts and the deployment of renewable energy continue to grow, this framework may need to be expanded to address the challenges and opportunities of the energy transition. In order to ensure a just transition, decision making processes must include inputs from communities, with consideration given to community-level impacts such as air pollution and employment. This requires thinking about decisions such as facility retirement or installation of emission reduction technologies in a broader context than just the financial and reliability considerations at the plant level. Policymakers will need to negotiate trade-offs, including between a range of technical, environmental, and social criteria, while weaving in stakeholder engagement throughout to help drive decisions towards a cleaner and more reliable grid over the long term.

Moreover, on a regional level, PJM could institute changes to help make facility and state-level decisions easier. PJM has engaged with states and stakeholders in the past for long-term transmission planning, and that engagement should be sustained as well as increased to coordinate grid reliability and the State's climate goals. For example, energy storage is a crucial part of the energy transition and must be considered in long-term grid planning. Currently, PJM has not conducted any studies on how storage can play a role in supporting reliability and climate goals. PJM has discussed storage as a transmission asset during planning committee meetings, but it has not come to a final conclusion about how storage can be evaluated and incorporated into PJM transmission planning.[114] FERC Order 1920 does have provisions for the consideration of electric storage resources in long-term planning, and while PJM has filed a request for rehearing and clarification of this order, it does plan to comply with it in the interim.[115] One option for Maryland would be to pursue a State Agreement Approach (SAA) with PJM to take Maryland's state policy goals, such as installing 3 GW of energy storage by 2033[116] or producing 8.5 GW of power from offshore wind by 2031,[117] and align them with PJM's transmission planning process. An SAA may be an avenue to initiate the consideration of battery storage as transmission within the PJM grid, or it could be a way for Maryland to ensure there are adequate in-state transmission lines for its offshore wind projects. While the cost of implementing these projects would be borne on Maryland residents rather than spread across the PJM footprint, New Jersey has been the first state to enter an SAA with PJM to meet its 7.5 GW offshore wind target and found that it would create significant cost savings over the long-term.[118] Any implementation of an SAA would require sustained and close collaboration and coordination between Maryland state agencies and PJM.

Accessing Federal Funding

The State can support businesses, communities, and local governments through the energy transition by encouraging them to utilize programs and tax credits created and expanded by the IRA. The Energy Infrastructure Reinvestment program provides financing for projects that retool, repower, repurpose, or replace energy infrastructure that has retired or for projects that reduce greenhouse gas emissions.[119] Examples of eligible projects for the reinvestment program include siting a solar photovoltaic system and storage at a retired power plant or installing CCS. EPA's RE-Powering America's Land Initiative also promotes renewable energy development on brownfields by providing technical and programmatic assistance, disseminating information, and strengthening stakeholder and funding networks.[120] Siting renewable energy and storage at retired facilities could be critical components of rapid large-scale deployment of clean energy technology, since siting and interconnection points are usually bottlenecks. Additionally, such projects would be eligible for the Clean Electricity Production Credit.[121] Installing CCS at an existing facility would also be eligible for the Credit for Carbon Oxide Sequestration.[122]

For supporting communities and workforce at energy facilities, the Department of Energy's Capacity Building for Repurposing Energy Assets program assists communities, which have been historically dependent on fossil fuel energy assets, to build technical capacity and workforce to help revitalize their energy systems. While no Maryland-based organizations were selected for this program,[123] several of the selected projects can serve as best practice examples for how Maryland can transition to clean and renewable energy while centering the economic health of communities. Additionally, the Appalachian Regional Commission's (ARC) Partnerships for Opportunity and Workforce and Economic Revitalization (POWER) Initiative leverages collaborative partnerships to invest economic and workforce development resources in communities and regions negatively impacted by changes in the coal economy. POWER has supported projects in Allegany County and Garrett County, and the ARC overall is supporting 22 projects benefiting Maryland's three Appalachian counties. Lastly, the Energy Community Tax Credit Bonus is also available to energy communities, which include census tracts where a coal-fired electric generating unit has retired after 2009.[124] Several census tracts in Maryland are eligible for the bonus, which can help bring clean energy projects into areas formerly dependent on fossil fuels and diversify local economies.

State Funding and Incentives

Beyond the federal funding opportunities outlined above, Maryland may be able to pursue more state-specific goals by establishing funding at the state level as well. As noted in the previous section, the impacts of energy facility closures will be highly localized. The federal programs mentioned above further emphasize this, and any financial and technical assistance at the state level should also target the most impacted localities. The state can utilize existing state sources, such as the RGGI Strategic Energy Investment Fund (SEIF), to increase support for existing programs that can provide stability to communities transitioning away from fossil fuels, such as solar or onshore wind programs. There will likely be new proposals for climate plan implementation funds in the upcoming 2025 legislative session and beyond, and Maryland does have an opportunity to generate or pool funding to directly help energy facilities and communities through the energy transition. Currently, Maryland does not have any direct policies that ensure the social and economic impacts from closures are minimal. One way Illinois is generating funding through CEJA is implementing an "energy transition assistance charge" for customers of utilities serving more than 500,000 customers. While it is estimated that this charge would add $3 - $4 to monthly utility

bills, CEJA has provisions to also increase consumer savings through capacity market reform, energy efficiency, and a consumer protection adjustment.[125,126]

Any funding mechanisms that Maryland develops should be associated with a broader energy transition plan that provides a roadmap for navigating the short- and long-term impacts of repurposing and retirement of fossil fuel plants. Potential impacts discussed in the previous section point to aspects that should be addressed in any transition plan, including replacing and stabilizing lost revenue streams, displaced worker retraining and support, economic development strategies that are appropriate for the local context, and the inclusion of community and stakeholder participation throughout the planning and implementation process.[105] The State has an opportunity to prepare to support facilities and communities through the transition and realize the clean, just energy future it envisions. More details on how Maryland can foster a just transition across different sectors will be provided in the report associated with the Just Transition Employment and Retraining Working Group.[127]

Stakeholder Engagement

As with any decision making process, stakeholder engagement and participation are important for the energy transition. Perceptions of residents about the energy transition and their communities' resilience can affect the success of policy interventions and support. Often communities around and dependent on power plants have been left out of conversations. Thus, community engagement and participation will be important for the energy transition because each closure and community will have a solution specific to their context. Throughout Figure 7, there are opportunities for plant owners, utilities, communities, and local governments to iteratively engage with each other to determine the best possible pathway for a plant and meet the needs of each stakeholder, which will be key to the energy transition process.[111]

One example where stakeholder and community engagement will be critical is the Maryland WTE plants. Legislation removing waste incineration from Maryland's RPS could be introduced in the upcoming legislative session,[89] and stakeholder engagement and alignment will be important as different perspectives reach a critical point. As we have noted throughout this report, facility closures are a balance of several different criteria, and WTE plants bring in the additional consideration of waste management. The RPS and future CES must be clear on where WTE plants stand, and the decision making to come to that clarification must be done with community and stakeholder engagement. Maryland is currently facing grid reliability issues and rising electricity rates, while trying to implement its climate plan and renewable energy goals equitably. The decision-making process around whether to include WTE plants in the state's RPS or CES should therefore engage communities, local governments, and facilities to balance the trade-offs and the state's approach.

At the regional level, Maryland can and should increase its engagement with PJM, particularly around long-term planning through FERC Order 1920 and in the analysis of the role of energy storage for the future of Maryland's grid. The governance framework for reconciling grid reliability and individual state policy goals has historically been disjointed, but detailed and deliberate planning and coordination can overcome that. Maryland policymakers who set clean energy goals and the agencies that implement them will need to collaborate closely with PJM in order to support a reliable and just transition of the electric grid.

Summary and Conclusions

Small businesses are a vital part of Maryland's economy, particularly in rural areas where they play a significant role in driving economic activity. Energy generating facilities have a critical role in reducing emissions by transitioning to cleaner energy sources, adopting advanced technologies, and supporting the retirement of high-emission plants. Together, these actors hold substantial potential to contribute to the state's ambitious climate goals, provided the energy transition is effectively managed with a supportive policy framework. This report focuses on ensuring that these key sectors are well-positioned to navigate the energy transition.

This report identified those small businesses most affected by the energy transition through three categories: direct supply, energy services, and energy intensive. We estimate that 24% of Maryland's small businesses—representing 21,551 firms and employing 252,205 people in 2021—would be affected by the energy transition. For energy generating facilities, our report focuses on the factors contributing to the potential retirement of those facilities during the energy transition, estimating the possible retirement of 17 natural gas plants and 11 oil plants, and assesses the broader implications of these closures.

To realize the potential benefits of the state's energy transition, it is essential to address the challenges and opportunities that the transition presents. The report explored three categories of small businesses that will need to navigate the impacts of the transition: 1) **Direct supply** businesses face significant challenges where business models are based around fossil fuels, but can also see substantial benefits where they are able to transition to a renewables focus. State and local governments can foster partnerships to support their energy transition, leveraging federal funding to facilitate these changes; 2) **Energy services** businesses have the potential to thrive, particularly in areas like building electrification. Local governments can play a key role by partnering with these businesses to promote the shift to clean energy; 3) **Energy-intensive** businesses will require long-term planning, significant initial investments, and access to advanced technologies. The state can help by providing clear information on available incentives and technical assistance, and by creating facilitator roles to guide business owners through the process and connect them with necessary resources.

The report identifies five options for energy generating facilities undergoing the energy transition: 1) **Reducing usage of the facility** allows facilities to reduce overall emissions while continuing to operate. However, it does not fully eliminate emissions, which may be insufficient if Maryland's 100% clean electricity policy applies to in-state generation; 2) **Use of alternative fuels** would likely require costly retrofitting due to the replacement of biofuels or hydrogen with traditional fuels. There are also challenges related to emissions from land use for biofuels, and hydrogen technology is not yet fully mature; 3) **Retrofitting with CCS** requires significant capital investment and may not be feasible for facilities with low capacity factors; 4) **Retirement and re-use** takes advantage of existing grid interconnections, though concerns about grid reliability due to increased loads must be addressed if the facility is transitioned to a use such as a data center; 5) **Retirement without re-use** presents the greatest concern for local employment, as it could result in job losses without the opportunity for facility re-purposing.

Policy recommendations for small businesses:

- Funding and financing: Maryland should support small businesses by providing access to funding and helping them navigate existing resources. Financial mechanisms such as green banks can play a critical role by leveraging public and private capital to offer low-interests loans for clean energy projects.

- Engagement and technical assistance: Maryland should establish mechanisms for sustained engagement and technical assistance, supporting affected small businesses through needs assessments, funding applications, and project implementation. These policies should be flexible and inclusive enough to ensure a wide range of industries to participate.

Policy recommendations for energy generating facilities:

- Maryland's climate goals: Maryland should rapidly reduce emissions from both imported electricity and in-state generation, prioritizing phase-out of unabated fossil fuel generation to achieve air quality and health benefits.

- Framework for facility closures: Maryland should develop a more comprehensive framework for facility closures that ensures grid reliability and addresses the broader challenges and opportunities of the energy transition. This framework should go beyond just financial and reliability concerns, considering social, economic, and environmental impacts.

- Funding at the federal and state level: Maryland should support businesses, communities, and local governments by helping them leverage IRA programs and tax credits while providing state-level financial and technical assistance to prioritize impacted communities.

- Stakeholder engagement: Maryland should design tailored engagement strategies, as each facility closure and community will require context-specific solutions. This engagement should include local stakeholders such as plant owners, utilities, communities, local governments, and regional stakeholders like PJM to foster collaboration and ensure community-centered approaches.

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