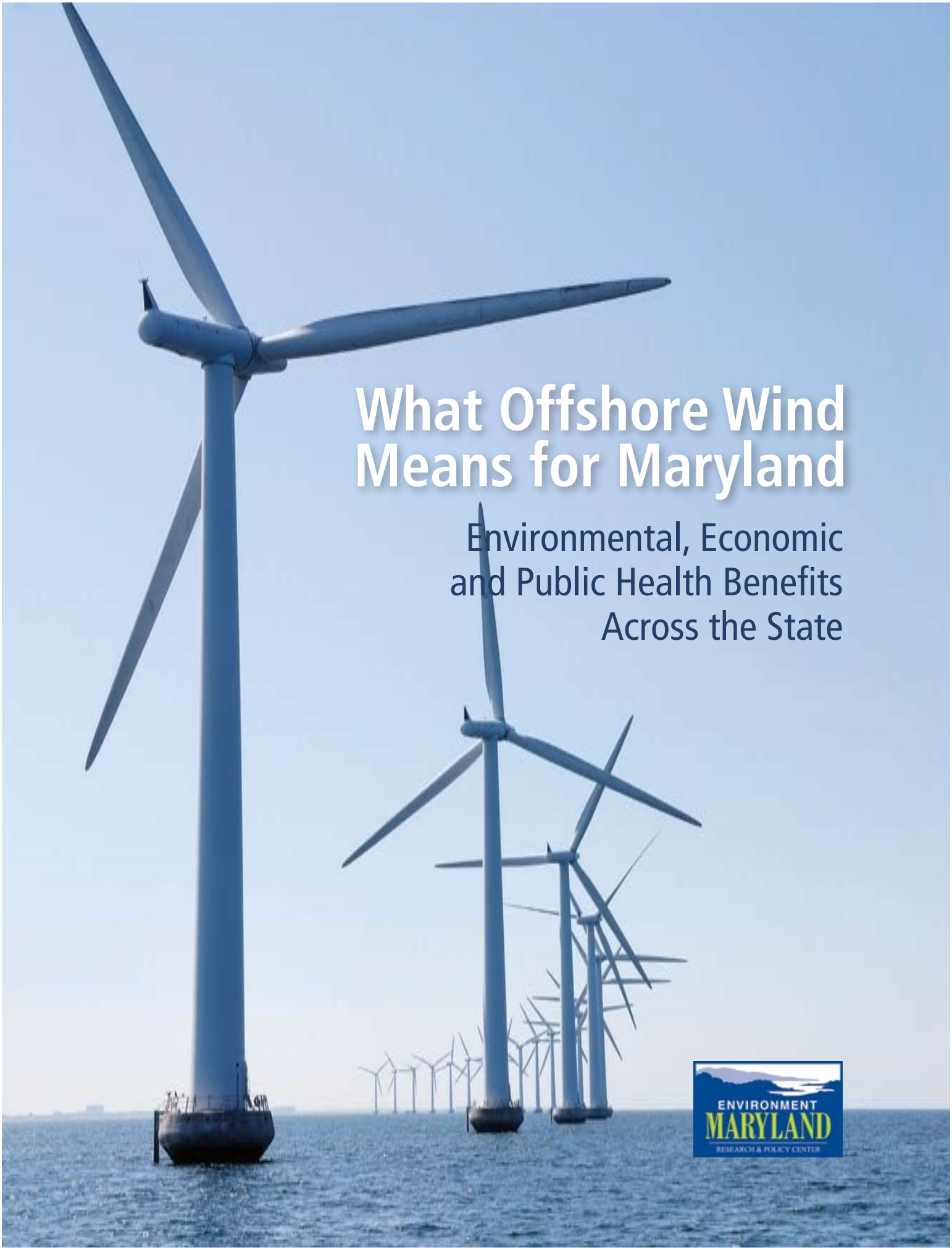

What Offshore Wind Means for Maryland

Environmental, Economic and Public Health Benefits Across the State

ENVIRONMENT MARYLAND
RESEARCH & POLICY CENTER

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Environment Maryland
Research & Policy Center

Elizabeth Ridlington and Rob Kerth,
Frontier Group

Tommy Landers,
Environment Maryland
Research & Policy Center

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Cover Photo Credit: Wind turbines off the coast of Denmark. Credit: Mara Ploughmann/istockphoto.com.
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Executive Summary

Maryland has abundant potential for generating electricity from wind by deploying offshore wind farms. Investing in offshore wind would provide cleaner air and foster a more vibrant economy, while helping to protect healthy ecosystems for future generations of Marylanders.

Everyone in Maryland—from workers in resource-based industries on the Eastern Shore to anglers in Western Maryland—has something to gain from offshore wind development. Capturing the vast potential of offshore wind energy, however, will require the state to take action and provide certainty for developers of offshore wind farms by ensuring that the power they produce will find buyers in the state.

Offshore wind power is Maryland's single largest renewable energy resource. Developing offshore wind generating capacity is one of the biggest steps Maryland can take to reduce global warming pollution. Maryland cannot tackle global warming and transition to a clean energy grid without tapping into offshore wind power.

- Maryland's offshore wind power resources could generate the equivalent of roughly two-thirds of the power consumed in the state annually, using technology available today.

- Electricity generated by wind turbines has effectively zero emissions, making it an essential resource for meeting the state's clean energy goals and global warming pollution reduction targets and for cleaning up our air. Wind power produces no smog or soot, and a single, 500-megawatt (MW) wind farm could reduce global warming pollution by more than 1 million metric tons annually, equal to the pollution emitted by 196,000 passenger vehicles each year.

Developing Maryland's offshore wind resource would bring benefits to all regions of the state, as soon as a wind farm is built and for years down the road. Below are some of the benefits that various regions of Maryland may achieve from the development of offshore wind power.

- Employment could increase on the **Eastern Shore**. Already, AC Wind is preparing to open a

blade-manufacturing plant in Salisbury that will employ 200 people. In the longer term, the low-lying Eastern Shore could benefit from offshore wind's contribution to curbing global warming and slowing sea level rise. Sea level is expected to rise by more than a foot in Maryland by 2050 and potentially by 3.4 feet by the end of the century, which could submerge hundreds of square miles of land.

- Offshore wind, together with other measures to cut global warming pollution, can help to maintain the agricultural productivity of **Southern Maryland** by limiting temperature increases and changes in precipitation patterns due to global warming. By 2050, a projected 2 to 3° F increase in temperature could cause corn and wheat yields to decline by 8 to 14 percent. A drop in agricultural productivity could undermine the economic viability of farms in the region.

- Investment in offshore wind facilities, which require large amounts of steel, could bring an economic boost to **Central Maryland**, adding thousands of jobs if workers at Baltimore's Sparrows Point steel mill and other area industries are employed to produce steel and fabricate components. Producing electricity from wind turbines in Maryland and elsewhere could help avoid the hotter and more prolonged heat waves that will hit residents of urban areas in Central Maryland especially hard. Reducing global warming pollution with offshore wind could help avoid some of the 90 additional heat-related deaths projected in Maryland annually by mid-century.

- The entire ecosystem of the **Chesapeake Bay** will benefit as offshore wind's clean power helps to reduce global warming pollution, stabilizing water temperatures that determine whether rockfish, oysters and crabs can survive in the bay. If emissions rise unabated, by 2100 the bay will be as warm as the ocean off South Florida. With a slower emissions increase, the temperature rise will be more moderate, making the temperature of the bay more like the temperature of the ocean off the Carolinas.

- Electricity from offshore wind produces no solid waste that must be disposed of, unlike electricity from coal burning. For the **Capital Region**, this means that the Westland and Brandywine coal ash dumps could receive less toxic waste from coal plants, lowering the risk of groundwater contamination. Obtaining emissions-free electricity from offshore wind is also one of the key steps Maryland must take to reduce the future severity of heavy precipitation events that can cause flooding across the region.

- Emissions-free offshore wind will help to preserve the current mix of trees that make up the forests in the mountains of **Western Maryland**. Limiting temperature increases due to global warming will help to maintain the maples, beeches and birches that cover three-quarters of the region. In addition, clean electricity from wind power can replace electricity from dirty, coal-fired power plants and will hasten the day when fish caught in the region's lakes are free of mercury and are safe for human consumption.

Building an offshore wind farm will help Maryland begin to capture the environmental, public health and economic benefits of reducing consumption of electricity from coal-fired power plants. While a single wind farm will not solve all problems of the state's current dependence on dirty sources of electricity, construction of an initial wind farm will put Maryland on the right path. Ultimately, tapping into the full potential of the wind off Maryland's coasts will deliver even greater benefits. To encourage the development of offshore wind power:

- The Maryland Public Service Commission should solicit proposals for construction of wind-powered electricity generation off Maryland's coast and establish effective incentives to encourage offshore wind development.

- State and federal governments should set bold goals for offshore wind development in the Atlantic, in order to provide clear leadership and vision regarding the important role of offshore wind in America's energy future and to demonstrate that it is a high priority.

- The U.S. Department of the Interior should expedite siting regulations for offshore wind projects in federal waters, while maintaining a high level of environmental protection. In so doing, they should maintain strong standards to make sure that offshore wind facilities do not have major impacts on wildlife, shipping channels, commercial fishing grounds or military operations.

- The federal government should use its buying power to facilitate the financing of offshore wind. The government should negotiate long-term power purchase agreements with an offshore wind developer covering electricity purchases for military installations and other federal facilities.

Introduction

Decades ago, *National Geographic* described Maryland as "America in miniature" for its diverse landscape.[1] With ocean beaches, rolling farmland, a large estuary, cities and towns of all sizes, and forested mountains—everything but desert—the various regions of Maryland have evolved with distinct economic, cultural and political landscapes.

Despite the state's diversity, Marylanders remain closely connected, facing many of the same challenges. Air pollution plagues Marylanders regardless of where they live. Increasingly erratic precipitation and storm patterns disrupt lives and destroy property. The future viability of livelihoods based on agriculture and forestry is clouded by uncertainty about the impacts of global warming. The economic health and vitality of one region affect the health of neighboring areas.

So it is with offshore wind energy. Maryland's immense offshore wind energy potential exists miles off the Atlantic Coast in an area that few Marylanders may ever see. Developing that potential will yield benefits *statewide*—whether those benefits are in the form of cleaner air, new jobs and economic activity, or greater protection against the threat posed by global warming to our precious environment and to our health.

To reap the greatest benefit from the state's offshore wind power capacity, Maryland needs other states to join in developing their sources of wind energy. A series of wind farms up and down the Atlantic coast will yield a far greater reduction in pollution from fossil fuel-based power plants than would a single wind farm. Maryland should take the first step toward creating this network of wind farms by committing to construction of a wind farm off its coastline.

As Maryland considers whether to take leadership in the development of offshore wind in the Atlantic, residents across the state have a stake in the decision. It is time for Maryland to move forward in the development of this clean, abundant energy source—and for all Marylanders to start reaping the benefits.

Offshore Wind Is a Powerful Solution to Maryland's Electricity Challenges

Offshore wind is a powerful and essential solution to Maryland's energy problems. The winds blowing off our coast are a bountiful resource that can generate clean, renewable electricity. Taking advantage of this local energy source is one of the most important ways the state can clean up our air and meet our requirements for renewable energy development and reducing global warming pollution.

A Clean Source of Electricity

Compared to coal- and natural gas-fired power plants, offshore wind power has effectively zero emissions. According to a recent analysis, the energy spent in building an offshore wind farm with 2-megawatt-sized turbines is "paid back" in energy from the wind farm in less than six months, and the global warming emissions produced from building wind turbines are repaid in less than three months.[2]

Wind power will be critical in helping Maryland break its dependence on polluting fossil fuels. More than half of the electricity generated in Maryland comes from coal—a key source of pollution linked to health problems and global warming.[3]

Under Maryland's renewable electricity standard, 20 percent of the state's electricity supply must come from renewable sources of energy—including wind, solar, biomass, geothermal, ocean, and low-impact hydroelectric power—by 2022.[4] With current technology, offshore wind is the largest renewable energy resource available to Maryland as it strives to meet that standard.[5] A single, moderately sized offshore wind farm (500 megawatts) would generate 2.8 percent of Maryland's electricity, putting Maryland a seventh of the way towards its 2022 renewable electricity goal.[6]

Wind power can also go a long way in curbing Maryland's emissions of pollutants that contribute to degradation of the Chesapeake Bay and increase global warming. In an effort to do our share to limit the severity of global warming, Maryland state leaders have committed to reduce global warming pollution by 25 percent below 2006 levels by 2020.[7] The electricity sector is the largest source of Maryland's global warming pollution,

Offshore wind is the largest renewable energy resource available to Maryland.

and so it is where we must achieve many of the reductions as well. Maryland must reduce emissions of global warming pollution from existing power plants and shift its electricity system toward sources of energy that do not produce carbon dioxide, such as offshore wind.

A state commission that created a plan for how Maryland can achieve its goals for reducing global warming pollution found that greater use of clean, renewable electricity is one of the easiest and first steps that Maryland should take.[8] Offshore wind is a crucial component of this because wind electricity generating potential is much greater offshore than onshore.[9]

Building one 500 MW wind farm would reduce emissions from electricity generation in Maryland by more than 1 million metric tons.[10] That's equal to annual emissions from 196,000 passenger vehicles, or one-quarter the annual emissions from a coal-fired power plant.[11]

Wind turbines installed off the coast of Maryland—like these turbines near Belgium—would be capable of supplying 43,600 gigawatt-hours of electricity each year—equivalent to roughly two-thirds of the electricity that Maryland consumes annually. Credit: Hans Hillewaert / CC-BY-SA-3.0

An Abundant Local Resource

Maryland has tremendous potential to generate clean, renewable electricity from the winds blowing off its coast. Tapping even a portion of Maryland's immense wind energy potential could result in the generation of large amounts of clean, renewable energy.

A 2010 study by researchers at the University of Delaware estimated that the shallow waters (less than 35 meters in depth) off Maryland's coast are capable of hosting 14,600 megawatts of wind power capacity, which in turn would be capable of supplying 43,600 gigawatt-hours of electricity each year—equivalent to roughly two-thirds of the electricity that Maryland consumes annually. Wind turbines based on existing technology can be installed in depths up to 35 meters; deeper waters may require more advanced technologies. Counting the potential offshore wind resource in deeper waters, Maryland could host nearly 60,000 megawatts of wind power capacity, which is enough to generate 179,000 gigawatt-hours of electricity each year.[12] At Maryland's current

electricity consumption rates, that would be nearly enough to power the entire state three times over, since Maryland currently consumes roughly 63,000 gigawatt-hours of electricity each year.[13]

Most of the fuel that generates electricity for Marylanders comes from other states. Because Maryland produces little coal or natural gas, the state's power plants buy fuel from out-of-state suppliers, sending billions of dollars out of the state's economy each year.

Tapping into just a fraction of Maryland's offshore wind power potential would help to alleviate some of the impacts of the state's current reliance on imported fossil fuels for electricity. An investment in a wind farm off Maryland's Atlantic coast would yield benefits for the environment and public health across the state.

Offshore Wind Can Benefit All Regions of Maryland

The five regions of Maryland all suffer from environmental, public health and economic consequences of our reliance on dirty sources of electricity. Tapping Maryland's potential for offshore wind energy, in conjunction with increased renewable energy development elsewhere, could deliver a variety of benefits across the state for our environment, for public health, and for our economy. Some of those benefits will be felt immediately, while other benefits will help ensure a strong, healthy Maryland for future generations.

In this report, we describe the benefits that offshore wind energy can produce for each of the five regions in Maryland. Some benefits will be experienced only by residents of a particular region, while others will be experienced by all Marylanders.

Generating emission-free electricity from offshore wind power will help protect Maryland's environment by:

- **Minimizing land loss due to sea level rise.** With emission-free electricity, offshore wind can help limit future sea level rise due to global warming. (See the "In Focus" discussion on p. 10 for a more detailed discussion of this issue.)

- **Protecting critical ecosystems in the Chesapeake Bay.** (See p. 31.)

- **Protecting forests.** Offshore wind is an essential element of reducing Maryland's contribution to global warming, helping to slow changes that are expected to occur to forests across the state. (See p. 41.)

Offshore wind can help alleviate threats to public health by:

- **Curbing extreme heat.** Offshore wind is crucial to achieving Maryland's goal of reduced global warming pollution. Slower climate change can help moderate future increases in temperature and limit the length and intensity of potentially fatal heat waves that are of greatest concern in urban areas. (See p. 24.)

- **Improving air quality.** Reducing smog and soot pollution from coal-fired power plants will reduce illness for Marylanders. (See p. 36.)

- **Limiting toxic waste.** By displacing electricity generation at coal-fired power plants, offshore wind can reduce the volume of toxic coal wastes that must be disposed of in landfills, with their risk of groundwater contamination. (See p. 37.)

- **Making fish safer to eat**. By reducing the need to use coal-fired power plants, offshore wind can help limit mercury emissions and help make fish safer for human consumption. (See p. 42.)

Offshore wind can provide economic benefits by:

- **Maintaining agricultural productivity.** Offshore wind can reduce the need for electricity from coal-fired power plants. When paired with other measures to reduce global warming pollution, it can help curtail the extent of temperature increases and precipitation changes from global warming that affect agricultural productivity. (See the "In Focus" discussion on p. 18.)

- **Limiting the power of tropical storms**. As part of the solution to lowering global warming emissions, offshore wind has a role in limiting the severity of tropical storms that can cause extensive property damage. (See p. 23.)

- **Boosting manufacturing and economic activity.** Building an offshore wind farm requires materials and labor that could be provided by Maryland businesses and workers. (See pages 13 and 26.)

- **Limiting flooding.** Densely developed areas will benefit from avoiding strong rainstorms. (See p. 34.)

Guide to icons used throughout text


Minimizing land loss due to sea level rise.


Protecting critical ecosystems in the Chesapeake Bay.


Protecting forests.


Curbing extreme heat.


Improving air quality.


Limiting toxic waste.


Making fish safer to eat.


Maintaining agricultural productivity.


Limiting the power of tropical storms.


Boosting manufacturing and economic activity.


Limiting flooding.

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Eastern Shore

Farms separated by forested buffers cover the flat Eastern Shore, from Cecil County bordering Pennsylvania and Delaware, to Somerset and Worcester counties on Maryland's border with Virginia. Offshore wind can play a key role in providing a stable future with a strong agricultural sector by limiting the impacts from sea level rise.

In Focus: Minimizing Land Loss

The Eastern Shore is intimately connected with the waters surrounding it. Extensive marshes and wetlands blur the boundary between land and water on the bay side, while coastal inlets and estuaries create a lengthy Atlantic coastline. The rivers and streams that flow from the Eastern Shore at low tide also allow the bay and the ocean back in at high tide. However, the close relationship between land and water that creates the Eastern Shore's beauty is also the area's weakness in the face of rising sea level caused by global warming.

A one-foot increase in sea level in the bay in the past 100 years has already begun to reveal this vulnerability.[14] Approximately half of this increase is due to global warming. Warmer temperatures have melted glaciers, adding to the volume of water in the oceans, and have caused thermal expansion. The other half of the increase comes from the sinking of the Earth's crust that underlies Maryland. During the last Ice Age, huge glaciers to the north of Maryland distorted the Earth's crust, causing the Mid-Atlantic region to rise. Though the glaciers melted thousands of years ago, the warping they caused is still flattening back out, causing the land under Maryland to sink. (Think of what happens when you sit on an air mattress: the area under you sinks, just as heavy glaciers depressed the Earth's crust, and the surrounding areas rise. When you stand up—i.e., as the glaciers melt—the elevated areas sink.)

In coming years, the land beneath Maryland will continue to subside and sea level will continue to rise. While we can't do anything about the land sinking, we can influence how much sea level rises in the next 100 years. We're already on course

This view of Harris Creek, a tributary of the Choptank River, shows why the Eastern Shore is so vulnerable to rising sea level. Credit: Jane Thomas, IAN UMCES (ian.umces.edu/imagelibrary)

for relative sea level rise of more than a foot in Maryland by 2050. What happens after that depends on future emissions of global warming pollution. High emissions could result in sea level rise of as much as 3.4 feet by the end of the century.[15] In a scenario where the emissions increase is more modest, sea level rise would be lower but still as much as 2.7 feet.

Sea level rise of this magnitude will have a dramatic impact on the shoreline of the Eastern Shore. Most of the 430 square miles of marshes and wetlands—crucial fish and bird habitat—are at risk. On the bay side, sea level rise of one foot by 2050 will be fast enough to submerge marshes in the lower shore, while marshes farther north will likely manage to maintain themselves by adding sediment and organic matter. After 2050, the pace of sea level rise will increase. In the worst case scenario, marshes will not be able to rebuild themselves quickly enough to remain above water. Even under a lower emissions scenario, the survival of marshes is questionable.[16] A 3.4-foot increase in sea level could cover essentially the entire Blackwater National Wildlife Refuge in Dorchester County by 2100.[17] In total, approximately 10 percent of the state's tidal marshes could migrate inland, establishing themselves on land that is currently dry, but roads, buildings, and structures to stabilize shoreline will limit this. As a result, the Eastern Shore is likely to lose much of this important wildlife habitat.

Land at higher elevation is also vulnerable to rising sea level. Dorchester County is laced with 1,700 miles of shoreline that creates easy access for water to reach higher land.[18] In some parts of the county, freshwater drainage ditches have already turned into tidally influenced creeks that have begun to whittle away at solid land. To the south, in Tangier Sound, Deal Island, Smith Island and Crisfield are all at risk. As much as 23 percent of dry land in this region of Somerset County could be

lost if sea level increases more than three feet.[19] On the coastal side of the Eastern Shore, Assateague Island, the barrier island on the eastern side of Chincoteague Bay and a national seashore, would lose much of its land mass.[20]

The financial impact of sea level rise and the gradual inundation of developed areas will be immense. With an elevation of just 4.5 feet, Upper and Middle Hoopers Islands in Dorchester County could be largely flooded in a matter of decades. The $19 million worth of structures on the islands would be worthless, as would the $16 million worth of land.[21] Improving infrastructure and protecting existing buildings to maintain human habitation on the islands would cost more than the buildings and land are worth. Elevating just the 10 miles of two-lane highway that runs the length of the islands could cost more than $30 million.[22] This financial challenge could be repeated all over the Eastern Shore.

An additional benefit of slowing sea level rise is minimizing the potential damage that could occur from a storm surge striking the Eastern Shore. The U.S. Geological Survey modeled the potential consequences of a storm surge from a Category 2 storm such as Hurricane Isabel striking Worcester County. Whereas at current sea level, such a storm would cover a small part of Route 50 just at Herring Creek, by 2100, a comparable storm would overlap a longer section of highway and flood surrounding land.[23]

Storm surges and other damage from hurricanes put billions of dollars of property at risk. The Insurance Information Institute calculates that as of 2007 Maryland had $14.9 billion worth of insured coastal property that could be affected by a hurricane.[24]

Water has already significantly eroded this bank along the Chester River on the Eastern Shore. Credit: Chesapeake Bay Program

In Focus: Manufacturing Wind Turbines

Though the Eastern Shore is better known for agriculture and tourism, it could become an important industrial center for the manufacturing and assembly of offshore wind turbines. Manufacturing sites that offer easy transportation to offshore wind farms are among the most promising sites for wind power-related industrial development.

Already, the Eastern Shore is home to more than a dozen businesses that have the potential to manufacture components for wind turbines. (See Table 1.) More than 90 companies engage in work that might enable them to provide raw materials for an offshore wind farm or to help with its installation. (See Table 2.)

The Eastern Shore's proximity to potential offshore wind sites and its history of shipbuilding have already attracted one wind energy company. AC Wind, a

Table 1. Eastern Shore Industries with the Potential to Take Part in Wind Turbine Manufacturing[25]

Industry	Number of Businesses
Adhesive manufacturing	2
All other plastics product manufacturing	5
Fabricated structural metal manufacturing	1
Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables	2
Other communication and energy wire manufacturing	1
Relay and industrial control manufacturing	2
Switchgear and switchboard apparatus manufacturing	1
Total	**14**

Table 2. Eastern Shore Industries with Potential to Supply Raw Materials or Aid in Installation of Offshore Wind Farms[26]

Industry	Number of Businesses
Deep sea, coastal, and great lakes water transportation	4
Electric power transmission, control, and distribution	10
General freight trucking, long-distance, full truckload	41
Highway, street, and bridge construction	19
Iron and steel mills	1
Power and communication line and related structures construction	6
Ship building and repairing	4
Support activities for water transportation	8
Total	**93**

Maryland-based wind energy company, plans to open its first manufacturing facility in a former boat factory in Salisbury.

The former U.S. Marine boat factory is located a quarter mile from a rail spur in a nearby industrial park, and two and a half miles from a river where turbine components could be loaded onto barges for waterborne transport.[27] Boat hull factories are good candidates to be repurposed to produce components for the wind power industry because both industries involve sophisticated use of fiberglass.

AC Wind intends to spend up to $10 million to convert the former boat plant in Salisbury into a turbine blade manufacturing facility.[28] Through a partnership with the University of Delaware's Center for Composite Materials, the company plans to have the capacity to manufacture blades up to 328 feet long.[29] Once operating at full capacity, the facility could employ more than 200 workers.[30]

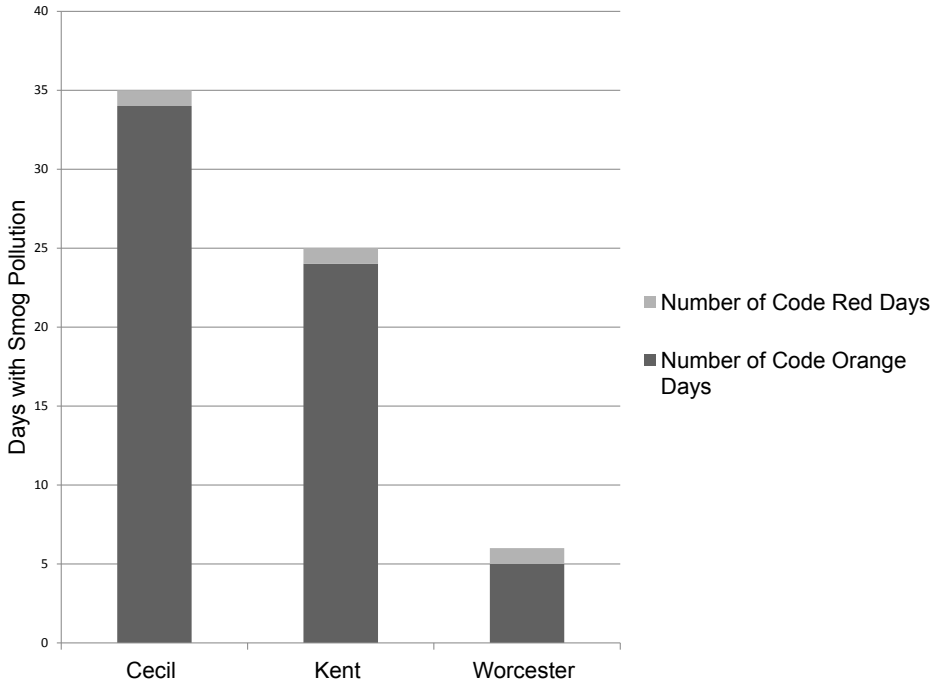
Maryland's interest in developing wind power was an important factor in AC Wind's selection of a location for their Salisbury facility and raises the possibility that the company will look to Maryland again when it next expands its operations.[31]

Improving Air Quality

Residents in the northern portions of the Eastern Shore are downwind from power plants in Pennsylvania and neighboring states that produce some of the electricity consumed by Marylanders. Wind-blown pollution leads to high concentrations of ground-level ozone in Cecil and Kent

AC Wind will manufacture blades for wind turbines at a facility in Salisbury. Credit: flickr user Tuey

Figure 1. Air Quality Indicators for 2007 through 2009[33]



counties. Replacing electricity from coal-fired power plants with emission-free electricity from an offshore wind farm would help reduce this pollution.

Figure 1 shows the number of days with poor air quality in selected Eastern Shore counties. On days identified as "Code Orange" because of elevated ozone levels, sensitive groups, such as children, the elderly, and people with lung disease (like asthma) may experience difficulties while engaged in activity outdoors.[32] People who are otherwise healthy but exercise outdoors may also be at risk. EPA estimates that, on Code Orange days, nearly 20 percent of people who engage in modest exertion will experience at least moderate impairment of lung function. To avoid this, the EPA recommends that members of sensitive groups reduce "prolonged or heavy exertion outdoors" on Code Orange days. On Code Red days, EPA estimates that any healthy individual who exercises outside may feel the impacts of high ozone levels and recommends that active individuals, children, the elderly and those with underlying disease should avoid "prolonged or heavy exertion outdoors." Table 3 tallies the number of residents put at risk. (See p. 36 for a more detailed discussion of the health impacts of air pollution.)

Table 3. Number of People at Risk from Poor Air Quality[34]

County	Total Population	Under 18	65 & Over
Cecil	100,796	24,927	11,978
Kent	20,247	3,646	4,089
Worcester	49,122	9,236	11,303

Making Fish Safer to Eat

With its emission-free electricity, offshore wind can help reduce the mercury pollution from coal-fired power plants that contaminates many fish found in Eastern Shore lakes and rivers. Table 4 shows the existing fish consumption advisories issued by the Maryland Department of the Environment for Eastern Shore water bodies. (See p. 42 for an explanation of the health risks of mercury exposure.)

Table 4. Waterbodies on the Eastern Shore with Fish Consumption Advisories Because of Mercury in Fish[35]

Water Body	County	Fish Affected
Smithville Lake	Caroline	Smallmouth and Largemouth Bass
Tuckahoe Lake	Caroline	Black Crappie, Smallmouth and Large-mouth Bass
Stemmers Run Reservoir	Cecil	Smallmouth and Largemouth Bass
Millington Wildlife Management Area	Kent	Black Crappie, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Unicorn Lake	Queen Anne's	Smallmouth and Largemouth Bass
Wye Mills Community Lake	Queen Anne's	Smallmouth and Largemouth Bass
Johnson's Pond	Wicomico	Smallmouth and Largemouth Bass
Pocomoke River	Worcester	Channel Catfish, White Perch

Maintaining Agricultural Productivity

Agriculture, a key component of the Eastern Shore's economy, is threatened by global warming. Offshore wind can help maintain the productivity of crops and poultry production by moderating warming and precipitation changes.

Sales of agricultural goods provided $1.3 billion in income to Eastern Shore counties in 2007. Sixty-five percent of that income came from the poultry industry, where costs could rise as temperatures rise.[36] Summer heat waves could raise the temperature in growing houses to potentially fatal levels for chickens.[37] Improving insulation and ventilation to avoid mortality impacts would be extremely costly for chicken growers. Corn, wheat, fruit, vegetable and dairy production are also susceptible to the impacts of global warming. (See Table 5.) (A full explanation of the impacts of global warming on agriculture can be found on p. 18.)

Table 5. 2007 Market Value of Eastern Shore Agricultural Goods at Risk from Global Warming (in millions)[38]

Agricultural Product	Caroline	Cecil	Dorchester	Kent	Queen Anne's	Somerset	Talbot	Wicomico	Worcester
Corn	$14.9	$9.5	$14.7	$17.3	$19.8	$6.9	$11.5	$6.1	$14.1
Wheat	$6.1	$1.8	$4.0	$4.0	$6.9	$1.3	$3.9	$0.5	$2.1
Fruits & vegetables	$304.0	$2.3	$13.4	(D)	$1.8	$1.5	$1.1	$6.0	$1.3
Poultry & eggs	$126.8	(D)	$122.1	$20.1	$56.0	$176.5	$22.5	$155.9	$159.1
Milk & dairy	$5.2	$11.2	$0.0	$15.1	$6.9	$0.0	$1.8	(D)	(D)

(D) = data not disclosed

Southern Maryland

In contrast to the counties in the Central and Capital regions of Maryland, Charles, Calvert and Saint Mary's counties stand out for having retained much of their rural nature. Farmland and forests cover the landscape, with small towns serving as community gathering places. The moderating influence of offshore wind energy on global warming emissions can help to protect what makes Southern Maryland unique, by preserving the viability of its farms and forestland.

The continued economic viability of Southern Maryland's farms is essential to retaining the rural nature of the region. Credit: Sammy Starr

In Focus: Maintaining Agricultural Productivity

Maintaining agricultural productivity is key to protecting farmland. Farmers who can't earn a decent living on the land will be more likely to sell their land for development. Recognition of this problem led to creation of Maryland's Tobacco Transition Project in 2000 to help farmers who wanted to stop growing tobacco—a lucrative but deadly crop—continue to earn a living without having to sell their farms for development.[39] Helped by the program, farmers throughout Southern

Maryland have successfully transitioned to other crops, keeping their land in production. Global warming presents another big challenge to agricultural viability.

Projected increases in temperature will have mixed impacts on farmers, at least in the short term, creating a longer growing season but raising the risk that summer highs will hurt yields. For example, grain may grow more quickly with warmer temperatures, but over a certain temperature threshold, the ear may not fill out as much.[40] As a result, corn and wheat yields are expected to decline by 8 to 14 percent if temperatures rise—as projected—by 2 to 3° F within the coming decades.[41] Productivity will take a greater hit if temperatures continue to increase after 2050.

Changes in rainfall also will undermine crop yields. Currently, most Maryland farmers are able to rely on precipitation—rather than irrigation—to water crops and pastures because small amounts of precipitation fall at regular intervals, with little seasonal variation.[42] Global warming is expected to change the timing of rain and snowfall, with heavy precipitation events separated by lengthy dry periods. Thus, the ground may be drier due to periodic drought-like conditions and increased evaporation due to warmer temperatures.[43] Farmers in Southern Maryland will not be able to fully compensate for these changes with increased irrigation because the region's limited aquifers cannot support extensive water withdrawals.[44]

Increased atmospheric carbon dioxide—which can spur plant growth—is unlikely to overcome the damage done by higher temperatures and sporadic water availability.[45] For plants to benefit from the fertilizing effect of carbon dioxide, they need sufficient water, weed control and nitrogen fertilizer (which would compound pollution problems in the bay). Higher concentrations of ground-level ozone, a possible consequence of global warming especially after 2050, also could lower plant productivity.[46]

Erratic rainfall and periodic droughts may undermine crop productivity. A 2007 drought caused this Maryland corn field to wither. Credit: Ben Fertig, IAN UMCES

In addition to its impact on cash crops, global warming will affect another major source of income for Southern Maryland's farmers: beef and dairy products.[47] Extrapolating from projections made for New Jersey and Pennsylvania, heat stress could cause dairy production to decline by 12 percent by 2050.[48] Further temperature increases after that could trigger another 10 to 20 percent drop, though this could be avoided by reducing global warming pollution to achieve more stable temperatures.

Creating Economic Opportunity

Building an offshore wind farm could provide an economic boost to Southern Maryland businesses engaged in manufacturing, transportation, electric power transmission and other activities.

The construction of an offshore wind farm is a vast, complex endeavor, involving

workers from dozens of industries—everything from basic manufacturing to finance. The most relevant elements of wind farm construction for Southern Maryland include:

- **Turbine Components** – Wind turbines are the most visible and technologically complex parts of any offshore wind installation. Each wind turbine contains thousands of mechanical components, which can be sourced from a variety of vendors both large and small.[49]

- **Electrical Infrastructure** – Submarine electrical cables link wind turbines with each other and with the on-shore electric grid. This segment of the supply chain includes cable manufacturing and installation, and the construction of on-shore and off-shore electrical substations and conversion stations.

- **Shipping and Logistics** – Offshore wind turbines are installed in difficult and often harsh marine environments, requiring special facilities and skills. Port operation, shipbuilding, piloting of a variety of vessels, diving, and other forms of maritime work are important contributors to wind farm construction.

Table 6. Southern Maryland Industries with the Potential to Take Part in Wind Turbine Manufacturing[51]

Industry	Number of Businesses
All other plastics product manufacturing	4
Fabricated structural metal manufacturing	1
Printed circuit assembly (electronic assembly) manufacturing	1
Relay and industrial control manufacturing	1
Total	**7**

Table 7. Southern Maryland Industries with Potential to Supply Raw Materials or Aid in Installation of Offshore Wind Farms[52]

Industry	Number of Businesses
Electric power transmission, control, and distribution	8
General freight trucking, long-distance, full truckload	4
Highway, street, and bridge construction	11
Power and communication line and related structures construction	3
Ship building and repairing	2
Support activities for water transportation	2
Total	**30**

Each of these segments of the supply chain is an important source of economic activity. Based on experience with offshore wind development in Europe, a recent University of Maryland study estimated the relative capital cost (not including ongoing maintenance) of building a new wind farm. Turbine construction, transport and installation accounts for 49 percent of the capital cost, while construction of transformer stations and the main cable to the coast accounts for 16 percent.[50] With the cost of constructing an offshore wind farm totaling hundreds of millions of dollars, even a small share of such a large project could have a meaningful impact on Southern Maryland.

As Tables 6 and 7 show, dozens of Southern Maryland companies have experience that could enable them to bid for work helping to build and transport turbines, link a wind farm to the grid, and otherwise support construction. With the total cost of constructing a wind farm in the hundreds of millions of dollars, this represents a significant economic opportunity.

Table 8. Number of People at Risk from Poor Air Quality[54]

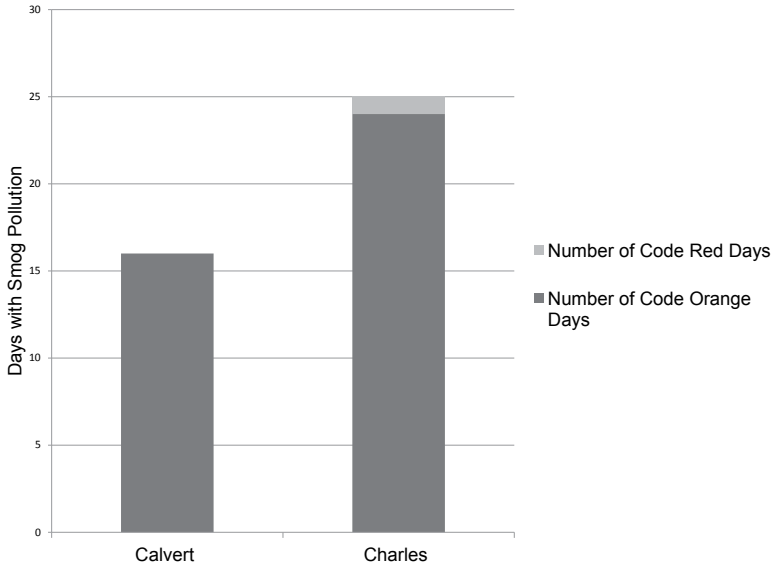
County	Total Population	Under 18	65 & Over
Calvert	89,212	22,948	9,284
Charles	142,226	38,002	13,247

Improving Air Quality

Residents of Southern Maryland would benefit from offshore wind's ability to produce electricity without air pollution. Currently, air pollution from coal-fired power plants contributes to poor air quality in Calvert and Charles counties. (St. Mary's County does not have an air quality monitoring station.)

Air quality monitors in Calvert and Charles counties record multiple days each year when ozone levels are too high (see Figure 2), putting at risk the health of tens of thousands of county residents (see Table 8). (See p. 36 for a more detailed discussion of the health impacts of air pollution.)

Figure 2. Air Quality Indicators for 2007 through 2009[53]



Making Fish Safer to Eat

By producing electricity without pollution, offshore wind can help address the problem of mercury contamination in fish. The Maryland Department of the Environment has issued fish consumption advisories for a number of fish species popular with recreational anglers in Southern Maryland. (See Table 9 for the Southern Maryland advisories.) (See p. 42 for an explanation of the health risks of mercury exposure.)

Table 9. Waterbodies in Southern Maryland with Fish Consumption Advisories Because of Mercury in Fish[55]

Water Body	County	Fish Affected
Lake Lariat	Calvert	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Myrtle Grove Lake	Charles	Smallmouth and Largemouth Bass
Potomac River, 301 Bridge to DC Line	Charles	Smallmouth and Largemouth Bass
St. Mary's Lake	St. Mary's	Smallmouth and Largemouth Bass

Central Maryland

Central Maryland stands apart from the rest of Maryland for its combination of intensely developed urban areas, extensive agricultural lands, and strong manufacturing base. Anne Arundel, Baltimore, Carroll, Harford and Howard, along with Baltimore City, could experience broad benefits if a wind farm were constructed off Maryland's coast.

In Focus: Limiting the Impact of Tropical Storms

The historically and economically important centers of Annapolis, Baltimore City and Havre de Grace are already vulnerable to flooding from storm surges; higher water levels in the Chesapeake from sea level rise will increase the frequency and severity of water damage. More powerful storms with increased precipitation will increase river-related flooding. By providing emission-free electricity, offshore wind power in Maryland is a key element of efforts to lessen the impact of global warming and rising oceans.

One of the projected impacts of global warming is an increase in the intensity of hurricanes and tropical storms.[56] Warmer ocean waters feed storms, giving them greater destructive potential. While storms will not necessarily be more frequent, they are expected to be more powerful, with increased wind strength and rainfall. Stronger winds cause more powerful storm surges, which can cause extensive flooding.

The biggest impact will be felt when a tropical storm or hurricane sweeps up the Chesapeake Bay, pushing a bulge of water. A storm on precisely the wrong trajectory is capable of causing a large storm surge in the northern reaches of the bay. That's exactly what Hurricane Isabel did in 2003 as the storm struck on the western side of the bay, allowing the northerly winds on the east side of the storm to drive water up the bay and producing a storm surge 5 to 9 feet higher than normal tides.[57] As a result, Hurricane Isabel flooded downtown Annapolis, and in Baltimore City, the Inner Harbor and Fells Point flooded. Millers Island, Edgemere, North Point, Bowleys Quarters and Turners Station in Baltimore County had to be evacuated,

Hurricane Isabel caused a storm surge 5 to 9 feet higher than normal tides, leading to extensive flooding in Central Maryland. Credit: NASA

and 300 buildings were destroyed.[58] Some areas in Havre de Grace and communities along the Bush River in Harford County also were evacuated and suffered extensive damage. Overall, the storm killed seven people in Maryland.[59] It also caused $531 million worth of property damage.[60] A hurricane on a similar track in the 1930s triggered less destruction because average water levels in the bay were lower.[61]

Though strikes by tropical storms are not an annual occurrence in Maryland, they happen often enough that the state has an interest in avoiding future increases in storm intensity and mitigating the impacts of those storms that do reach Maryland. Maryland has been struck by 10 hurricanes or major tropical storms since 1954.[62] Even when these storms do not follow the same track as Hurricane Isabel, they can cause major flooding.

Tropical storms and extreme precipitation events present an additional flooding risk to Harford County towns along the Susquehanna River, Baltimore City neighborhoods along the Jones Falls, the Baltimore County towns of Ellicott City and Cockeysville, and many other older communities built near water. Heavy rainfall events in recent years have caused heavy flooding. For example, Tropical Storm Lee, coming close on the heels of Tropical Storm Irene, raised the Susquehanna to near-record levels in September 2011. In Port Deposit, flooding was so severe that officials ordered a mandatory evacuation of the entire town.[63]

The severity of future tropical storms and heavy rainfall events will determine the frequency with which residents and businesses of those flood-prone areas must evacuate and invest in expensive repairs after floods.

In Focus: Curbing Extreme Heat

As anybody who has lived in Baltimore or a surrounding county in June, July or August can attest, summer in Maryland is a sweaty, sticky affair. In the 1990s, Maryland averaged 30 days per year when daytime temperatures exceeded 90° F and just two days per year with temperatures above 100° F.[64] Urbanized areas had 30 percent more of these extremely hot days.[65] That's due to the "urban heat island effect," in which rooftops, buildings, asphalt and concrete absorb more heat during the day than do natural surfaces. This difference can be felt when walking across a scorching hot parking lot at a park and then onto the relatively cooler grass next to it. At night, these artificial surfaces radiate back the heat they absorbed during the day, limiting night-time cooling. The effect is most pronounced in cities but can be felt in suburban areas as well.

By 2100, Maryland will have many more summer days on which temperatures exceed 90° F.[66] In the most extreme emissions scenario, temperatures could be above 90° F for 110 days—virtually every day in the summer—and temperatures could hit 100° F as often as 35 days a summer in urban areas. In a more moderate

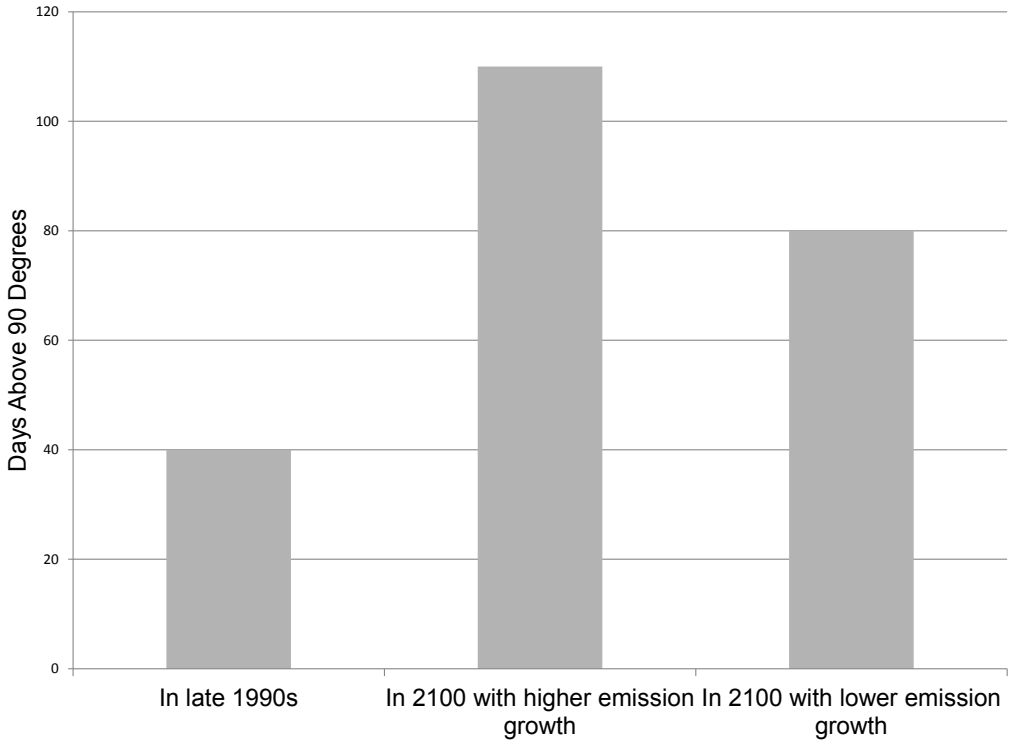
emissions scenario, one supported by the use of offshore wind, urban areas could average roughly 80 summer days above 90° F. (See Figure 3.) Outside of urban areas, Marylanders would face 10 days per summer above 100° F, while residents in urban areas could face 15 sweltering days. (That would feel like being in Phoenix, but with humidity.[67])

A single hot summer day poses a health risk, triggering illness or even death. The health impacts from heat waves—multiple days in a row above 90° F—are greater. The elderly and very young are most vulnerable because their bodies are not able to cool off as effectively, and are more likely to become dehydrated.[69] The risk is also higher for people who cannot afford air conditioning, and who live in urban areas where the heat is more intense.

Heat waves are projected to become more common in the years to come, as are heat-related deaths. In the 20th century, there was a 13 percent chance that a heat wave of 20 days or more would occur in any given summer.[70] If global warming pollution is kept in check, a typical summer will have a 30 percent chance of a heat wave of 20-40 days duration. However, under higher emission scenarios the odds are nearly 90 percent that Maryland will experience a heat wave of more than 20 days. The most likely duration of that heat wave is more than 140 days.

Increased summer temperatures could cause an additional 90 heat-related deaths in Baltimore each summer by mid-century.[71] Reducing global warming with offshore wind electricity and other steps to cut global warming pollution could help avoid the worst impacts of stronger summer heat waves.

Figure 3. Number of Days in Urban Areas with Temperatures above 90° F[68]



In this satellite image of surface temperatures in the Baltimore region, light-colored areas are the warmest, while darker areas are cooler. Because urban areas are much warmer than rural areas, cities are especially hard hit by heat waves. Credit: Robert Simmon, NASA

In Focus: Making Steel for Wind Turbines

Investment in offshore wind facilities could bring an economic boost to Central Maryland. Hundreds of companies in the region have the expertise that could allow them to compete for contracts to help build and install an offshore wind farm. In particular, offshore wind turbines require large amounts of steel in the monopiles and structures that anchor the turbines to the seafloor as well as in the towers, in the covering for the turbine gears atop the tower, and for the attachment of the gears to the tower. This steel could be produced at the steel mill at Sparrow's Point and fabricated into components in an industrial cluster at the Port of Baltimore. Port infrastructure at Dundalk Marine Terminal and Sparrows Point could serve as key assembly and transport areas for offshore wind farms in Maryland and neighboring states.

Traditionally, offshore wind turbines are anchored to the seabed with steel "monopile" foundations that are large, heavy, and extremely costly and cumbersome to transport. The monopile foundations for one offshore wind farm off the coast of Denmark, for example, weigh between 165 and 231 tons each.[72] The offshore wind sector is moving toward even larger, heavier jacket-type or gravity foundation technologies. Because of their weight and size, the fabrication of offshore wind foundations is very likely to occur near the site of an offshore wind farm.

One of the likeliest candidates for manufacturing the steel for those monopiles is the RG Steel facility at Sparrows Point, the Northeast's largest steel manufacturing plant. Sparrows Point's proximity to Maryland's coast and the Port of Baltimore's capacity to efficiently transport large shipments make Baltimore an appealing location for companies hoping to serve the offshore wind industry. Large numbers of ships, workers, and material need to be brought to an offshore wind construction site, preferably as quickly as possible. In addition, as one of the area's largest ports already being improved to handle the extra-large container ships that will reach the Atlantic after construction on the Panama Canal ends in 2014, the Port of Baltimore is well equipped to serve as a staging ground for offshore wind.[73]

With a modest investment to increase the Sparrows Point plant's capacity and to upgrade technology, and with a strategy to attract a variety of offshore wind service companies, Sparrows Point and the Port of Baltimore could become a competitive manufacturing hub for offshore wind

components. A recent study estimates that 3,500 to 5,000 jobs could be created through modest investment, and could add $650 million annually to the local economy.[74]

As investment in the offshore wind sector increases, Baltimore is well-positioned to compete for the shipping and manufacturing activity that will result. With good port facilities, an industrial facility that could be repurposed to serve the primary needs of the growing offshore industry, and a location right in the heart of the eastern seaboard, the city has every chance to become a major hub for offshore wind construction up and down the Atlantic coast.

Beyond the Port of Baltimore and the Sparrows Point steel mill, there are dozens of companies in Central Maryland that could be hired to help manufacture, install and maintain an offshore wind farm. Tables 10 and 11 show that hundreds of firms in Central Maryland specialize in manufacturing and services that could be applied to building an offshore wind farm.

With its extensive facilities, the Port of Baltimore could become part of a competitive manufacturing hub for offshore wind components. Credit: Richard S. Quarles Sr., Voxefx Photography, www.voxefx.com

Table 10. Central Maryland Industries with the Potential to Take Part in Wind Turbine Manufacturing[75]

Industry	Number of Businesses
Adhesive manufacturing	4
All other miscellaneous electrical equipment and component manufacturing	3
All other plastics product manufacturing	27
Fabricated structural metal manufacturing	14
Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables	2
Mechanical power transmission equipment manufacturing	2
Metal tank (heavy gauge) manufacturing	4
Other measuring and controlling device manufacturing	7
Printed circuit assembly (electronic assembly) manufacturing	4
Relay and industrial control manufacturing	4
Switchgear and switchboard apparatus manufacturing	3
Urethane and other foam product (except polystyrene) manufacturing	2
Total	**76**

Table 11. Central Maryland Industries with Potential to Supply Raw Materials or Aid in Installation of Offshore Wind Farms[76]

Industry	Number of Businesses
Deep sea, coastal, and great lakes water transportation	18
Electric power transmission, control, and distribution	35
General freight trucking, long-distance, full truckload	136
Highway, street, and bridge construction	81
Iron and steel mills	4
Power and communication line and related structures construction	75
Ship building and repairing	11
Support activities for oil and gas operations	3
Support activities for water transportation	42
Total	**405**

Maintaining Agricultural Productivity

The productivity of both crops and livestock is influenced by temperature and precipitation. Changes that significantly alter Maryland's climate could result in declining agricultural yields.

Agriculture provides $240 million worth of income to Central Maryland farmers each year, but a changing climate could cause productivity to drop.[77] Warmer temperatures could cause wheat and corn yields to decline by 8 to 14 percent by 2050, while dairy yields might drop by as much as 12 percent.[78] Future impacts, especially after 2050, would be greater, with the extent depending on how much more emissions increase.

Fruit and vegetable crops grown for wholesale or retail sales are also at risk. As frustrated backyard gardeners in Maryland already know, excessive temperatures can stunt growth, keep fruit from setting, and damage produce. Green beans and tomatoes are particularly susceptible.[79] Lack

Table 12. 2007 Market Value of Central Maryland Agricultural Goods at Risk from Global Warming (in millions)[80]

Agricultural Product	Anne Arundel	Baltimore	Carroll	Harford	Howard
Corn	$1.6	$9.4	$10.4	$10.6	$1.8
Wheat	$0.3	$1.1	$2.3	$1.6	$0.5
Fruits & vegetables	$1.4	$6.3	$4.7	$2.1	$0.9
Retail (farmers market)	$0.7	$1.4	$1.6	$1.2	$0.3
Milk and dairy	$0.0	$3.6	$22.9	$8.2	$2.0

of prolonged cold in the winter is also a concern, depriving plants such as apple trees and grapes of the dormant period that is crucial for optimum production. Table 12 shows the market value of Central Maryland agricultural products that are most likely to suffer declining yields in a warmer climate.

Improving Air Quality

The ability of offshore wind to produce essentially emission-free electricity can play a role in addressing the air quality problems that plague Central Maryland and compromise the health of its more than 2 million residents. We see air pollution as a haze in the sky: consider how rare a sparkling blue sky is in the summertime. Reducing use of coal-fired power plants would reduce this pollution almost immediately.

Harford County has the worst smog (ground-level ozone) pollution in the state, with more Code Orange and Red days than any other county, while Anne Arundel County had the only Code Purple day. On a Code Purple day, ozone levels are so high that many members of the general population will feel the impacts of air pollution. At-risk groups and active adults should avoid all outdoor exercise on a Code Purple day.[81]

Figure 4. Air Quality Indicators for 2007 through 2009[84]

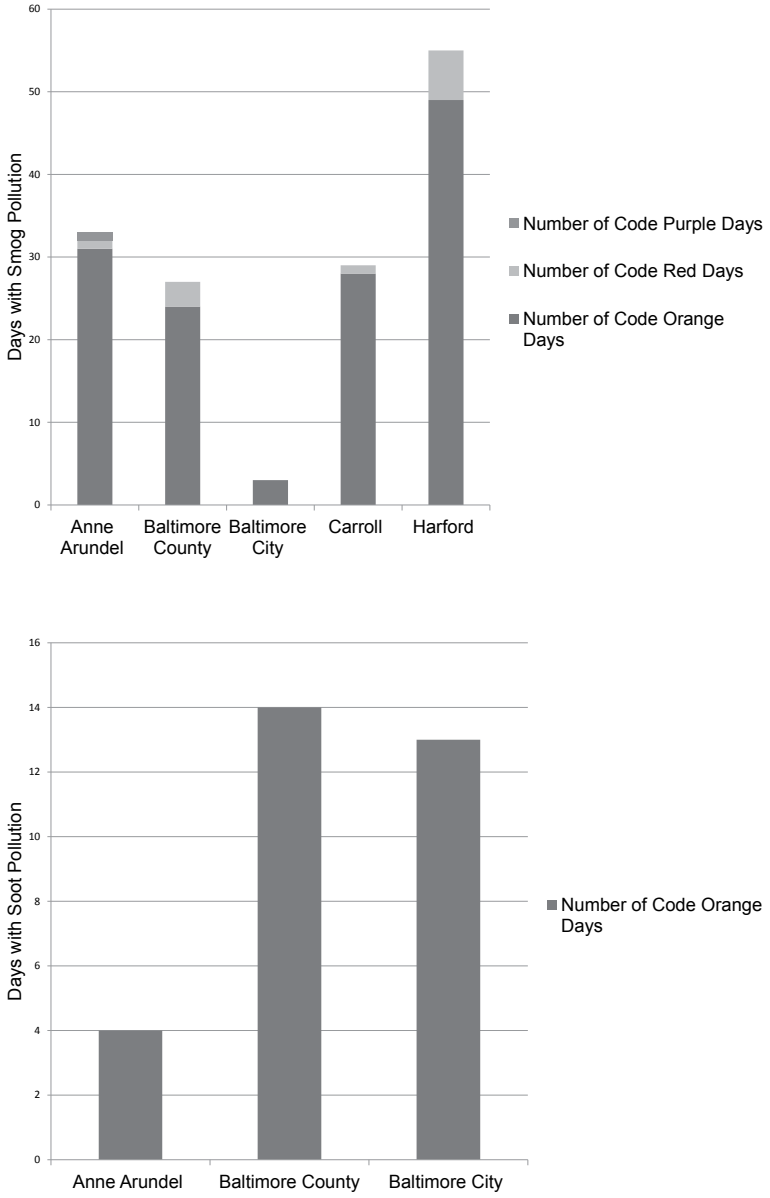


Table 13. Number of People at Risk from Poor Air Quality[85]

County	Total Population	Under 18	65 & Over
Anne Arundel	521,209	121,140	60,879
Baltimore	789,814	173,026	113,391
Baltimore City	637,418	142,991	75,292
Carroll	170,089	41,821	21,874
Harford	242,514	59,776	29,902

Baltimore City and Baltimore County have the worst soot (particulate matter) pollution. Smog can trigger asthma attacks, increase respiratory difficulty, reduce lung function, increase emergency room visits, and cause premature death. Soot, when inhaled, can become lodged deep in the lungs where the fine particles cause a variety of health problems, including asthma, bronchitis, lung cancer and heart attacks.[82] (See p. 36 for a more detailed discussion of the health impacts of air pollution.)

The region is home to 2.4 million people who are regularly exposed to this poor air quality.[83] Hundreds of thousands are particularly vulnerable: more than half a million are children under 18 and another 300,000 are over the age of 65. Figure 4 shows the number of poor air quality days in the region, and Table 13 shows how many residents are affected.

Making Fish Safer to Eat

Located in the middle of forested hills protected from development and offering only limited public access so as to protect water quality, Baltimore's drinking water reservoirs would seem to be pristine. However, mercury pollution from distant coal-fired power plants contaminates Liberty, Loch Raven and Prettyboy reservoirs.

Anglers are warned to limit their consumption of bass, yellow bullhead catfish, white perch and black crappie caught in Baltimore's drinking water reservoirs because those species regularly contain high levels of mercury. As Table 14 shows, fish in other water bodies in Central Maryland are also affected by mercury pollution. Offshore wind can help reduce this mercury pollution. (See p. 42 for an explanation of the health risks of mercury exposure.)

Table 14. Waterbodies in Central Maryland with Fish Consumption Advisories Because of Mercury in Fish[86]

Water Body	County	Fish Affected
Lake Roland	Baltimore	Smallmouth and Largemouth Bass
Liberty Reservoir	Baltimore	Black Crappie, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass, Yellow Bullhead Catfish, White Perch
Loch Raven Reservoir	Baltimore	Black Crappie, Smallmouth and Largemouth Bass
Prettyboy Reservoir	Baltimore	Smallmouth and Largemouth Bass
Piney Run Lake	Carroll	Smallmouth and Largemouth Bass, Yellow Perch
Bush River	Harford	Sunfish (incl. Bluegill)
Susquehanna River above Conowingo Dam	Harford	Smallmouth and Largemouth Bass
Centennial Lake	Howard	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Rocky Gorge Reservoir	Howard	Channel Catfish, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Triadelphia Reservoir	Howard	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass, White Perch
Wilde Lake	Howard	Sunfish (incl. Bluegill), Smallmouth and

Chesapeake Bay

The Chesapeake Bay is central to Maryland's identity. Eleven of the state's 23 counties, plus Baltimore City, have shoreline along the bay. The location of major cities has been determined by access to the bay, and fishing, crabbing, shipping and recreation centered around the bay have played a large role in their economies. Offshore wind can help protect this heritage and ensure its viability for future generations.

In Focus: Protecting Ecosystems

The plants and animals that live in the bay require water that isn't too warm. While the temperature in the bay is likely to rise in coming years due to global warming, a slower and more modest increase in temperature has multiple benefits, including smaller dead zones and better habitat protection.

Water temperature in the bay is influenced by air temperature. Average temperature in Maryland increased by 2° F from 1977 to 1999, and temperatures are projected to increase by another 2° F by 2025.[87] Depending on how much emissions of global warming pollutants increase in future years, temperatures could rise by 3-4° F by 2050, compared to 1999, with much sharper increases by 2100. By the end of the century, if emissions have increased unabated, summer temperatures in Maryland could increase by 9° F and winter temperatures could rise by 7° F compared to 1999. This means that by 2100, the average summer day- and nighttime temperature over the Chesapeake Bay and surrounding counties could be 86° F, versus 77° F in 1999.

As air temperature increases, so does water temperature in the bay, which is relatively shallow and therefore responsive to changes in air temperature. Since 1940, water temperature in the bay has risen 2.8° F.[88] In the future, the bay's water could be 4° F warmer by 2050 and 9° F warmer by 2100 if global warming emissions rise dramatically. That would make water in the bay as warm in the summer as the ocean is today off the coast of South Florida.

Offshore wind power could help reduce global warming pollution and limit

the extent of warming in the bay. Under a lower emission scenario, water temperature could increase 2.5° F by 2050 and 5° F by 2100, comparable to ocean temperature near the Carolinas.[89]

A slower increase in water temperature will help minimize the size of the dead zones. Dead zones are areas throughout the bay where oxygen levels in water are too low to support much life.[90] They appear on a seasonal basis, disappearing in the winter and re-occuring when the weather—and water temperatures—warm. Aquatic animals that can flee from these areas do, congregating in the limited areas with sufficient oxygen.

Cooler water holds more oxygen than warmer water does, enabling the bay to build greater oxygen reserves in the water each winter and hold the oxygen longer into the spring and summer. Lower air temperatures will help to maintain winter snowpack and limit heavy precipitation events; sudden melting of snow and extreme precipitation events can bring an influx of nutrients into the bay, triggering algae blooms and subsequent oxygen depletion.[91] More modest temperatures mean a slower increase in sea level rise, limiting the northward intrusion of saline ocean water into the bay. Areas of the bay with both saline and fresh water are more prone to forming dead zones because the two types of water, which have different densities, do not mix in the absence of wind and currents (i.e. during warm summer months). That leaves oxygen-depleted water undisturbed in deep waters, causing dead zones to persist longer.

Another way that emission-free electricity from offshore wind can help reduce dead zones is by lowering emissions of nitrogen from coal-fired power plants. Nitrogen feeds excessive growth of algae that lead to formation of huge dead zones in the bay. Air deposition of nitrogen accounts for as much as one-third of the nitrogen the ends up in the bay.[92] That pollution comes from power plants as well as vehicles, vaporized ammonia from manure, industrial activity, and other sources. Even with modern emission-control equipment, power plants add 2.5 million tons of nitrogen to the bay each year.[93] Less demand for electricity from coal-fired power plants means less nitrogen in the bay.

Slower temperature rise will help aquatic species, which are sensitive to water temperature. Fish forced to live in overheated water may survive, but are less likely to thrive. Fish may swim elsewhere to find a suitable temperature. If these areas of preferred water temperature are limited in the bay, they may become overcrowded, facilitating the spread of disease and parasites and further stressing fish.[94] Moderating the increase in water temperature will help to limit pressure on aquatic species. Rockfish, for example, already under stress in the bay, may find water temperatures are

Table 15. Bay Species at Risk from Warming Waters[96]

Species	Potential Impact	Why
Winter flounder	Potential loss	Water too warm
Soft-shelled clam	Potential loss	Water too warm
Rockfish	Likely decline	Water too warm; increased disease due to warmer water
Atlantic sturgeon	Likely decline	Water too warm
Atlantic menhaden	Likely decline	Increased disease due to warmer water
Eastern oyster	Likely decline	Increased disease due to warmer water

Warmer water temperatures threaten the survival of eelgrass, a key habitat for blue crabs. Credit: Courtnay Janiak

too warm.[95] Table 15 shows data compiled by the National Wildlife Federation on other common bay species at risk from the warming of bay waters.

Slowing down global warming could also aid two iconic bay species—the oyster and the blue crab—that are vulnerable to multiple changes caused by carbon dioxide pollution. Oysters are threatened by diseases that flourish in warmer water and by ocean acidification. Warm winters and saline water facilitate the spread of the two most common oyster diseases, Dermo and MSX, which have decimated the bay's oysters in recent decades. Cooler temperatures in the bay and more fresh water can slow down the rate at which Dermo and MSX spread.[97] The bay's salinity is determined by multiple factors linked to global warming, including the amount of evaporation, which removes water and leaves behind salt; sea level rise that brings saline water farther north in the bay; and precipitation that determines how much freshwater is carried into the bay by tributaries.

Oyster reproduction and survival will also be influenced by the acidity of the bay. Water absorbs carbon dioxide from the atmosphere, raising the bay's acidity and making it more difficult for oysters to develop their shells. Oyster calcification rates may drop by 10 percent by 2100 under some emission scenarios.[98] In addition, increased acidity may impair oyster reproduction by inhibiting shell mineralization for oyster larvae.[99]

Eelgrass, a key habitat for blue crabs, will be helped by limiting temperature increases. Eelgrass is already under threat from sediment pollution and nutrient pollution-fueled algae blooms, both of which block sunlight to eelgrass on the floor of the bay. In especially hot summers, eelgrass foliage and roots die.[100] Eelgrass can regrow the following year if its seeds, buried in the sediment, remain viable. Because eelgrass seeds are short-lived, however, successive hot summers can eliminate eelgrass.

Investing in offshore wind generating capacity and slowing emissions of global warming pollution will help stave off the worst impacts of global warming, limiting temperature increases, protecting rockfish, oysters and blue crabs, and mitigating habitat and species shifts.

Capital Region

Frederick, Montgomery and Prince George's counties are part of one of the largest metropolitan regions in the nation.[101] Environmental problems often strike close to home for residents of the Capital Region—whether it is the effect of air pollution on residents' health, the dangers posed by toxic waste dumps, or the potential for property damage caused by the more intense downpours and floods that are likely to result from global warming. Offshore wind can help address these challenges for the Capital Region and ensure a better future for the region's people.

In Focus: Limiting Flooding

The Capital Region's many waterways support a network of small forests that add a pastoral element to even the most urban neighborhoods. Unfortunately, these streams can also present a risk to developed areas: the waterways' proximity to homes and businesses increases the risk of flooding and damage during heavy precipitation events. Offshore wind offers the potential for reducing the severity of future extreme rainfall or snowfall events that can trigger flooding.

The Capital Region is made vulnerable to flooding from heavy rain and sudden snow melt due to development patterns and geography. Extensive development has covered large portions of the region with impervious surfaces that cannot absorb water. Instead, stormwater systems were designed to channel water away from buildings and roads and into storm drains and streams. During heavy rainstorms, huge volumes of water are funneled into streams, potentially causing them to overflow their banks. Because centuries of development have placed residential and commercial buildings close to streams for practical and aesthetic reasons, many buildings are at risk.

Adding to the problem is the fact that so much of the region lies within the 100-year flood plain, especially near the Potomac, Anacostia and Patuxent rivers. This is particularly true in Prince George's County, where more than 10 percent of the county lies within the 100-year floodplain, a higher percentage than any other county not on

the Eastern Shore.[102] Based on historical flooding patterns, land at the outer edges of the 100-year flood plain has a 1 percent chance in any given year of being flooded. Land closer to the center of the floodplain and thus closer to streams and rivers has a higher annual risk of flooding. Slightly over 8 percent of Montgomery County and nearly 7 percent of Frederick County are within the 100-year flood plain.

As residents and commuters know, flooding has become commonplace after heavy rain in the Capital Region. Smaller floods regularly close roads and force detours for a day or two. Numerous larger floods have inundated buildings and caused deaths. Some recent flooding events include:

- In September 2011, rain from Tropical Storm Lee flooded parts of Upper Marlboro in Prince George's County and caused nearly $15 million worth of flood damage to county-owned buildings.[103]

- In March, April and May of 2011, areas near the Potomac River at Point of Rocks in Frederick County experienced minor to moderate flooding.[104]

- The Monocacy River in Frederick flooded in March 2011 due to heavy rain.[105] A slow-moving storm forecast to deposit three inches of rain triggered a county-wide flood watch.[106] Flooding caused extensive road closures.[107]

- Heavy rain in late September of 2010 caused extensive road closures in Montgomery County.[108]

- In late June 2006, creeks and rivers throughout the Capital Region flooded. More than 2,000 residents in Montgomery County were evacuated, dozens of roads were closed, and six people in Frederick and Prince George's counties were killed.[109]

Flooding imposes major financial costs on the region. Rebuilding damaged homes and businesses and replacing their contents are the most obvious, but major flooding also disrupts lives, reducing income from jobs and rent. In Prince George's County, for example, a 100-year flood could damage workplaces and disrupt commuters' ability to get to work, causing $560 million in lost wages.[110] (See Table 16.)

Flooding could become more frequent and more severe in the coming decades as global warming causes precipitation patterns to change. Already, researchers have observed increases in streamflow around the world, with both average and maximum levels rising.[112] The risk of a 100-year flood has already increased in large river basins around the world.[113]

In Maryland, floods of the 100-year magnitude could become 20 percent more

Table 16. Potential Financial Losses from a 100-Year Flood[111] (millions of dollars)

County	Capital Stock Losses					Income Loss		
	Structural Damage	Contents Damage	Inventory Loss	Relocation Loss	Capital-related Loss	Lost Wages	Lost Rental Income	Total
Frederick	$177	$150	$5	$5	$31	$75	$3	$447
Montgomery	$196	$212	$2	$4	$40	$145	$3	$702
Prince George's	$334	$295	$5	$7	$76	$561	$4	$1,283

common if global warming pollution is not controlled within and beyond Maryland.[114] Taking steps to reduce future emissions—such as investing in offshore wind—could help curtail increases in flood frequency, limiting the increase in frequency of 100-year floods.

In Focus: Improving Air Quality

The summertime haze that obscures views of the region's historic monuments and that dulls the bright green of the poplars, oaks and hickories that line streets and highways is a hallmark of summer in the Capital Region. However, that haze isn't an inevitable part of a Maryland summer—it's ozone smog created in part by emissions from the coal-fired power plants that generate so much of the region's electricity. Clean electricity from offshore wind can help reduce some of this pollution that contributes to health-damaging smog.

When inhaled, ozone quickly reacts with airway tissues and produces inflammation similar to sunburn on the inside of the lungs. This inflammation makes lung tissues less elastic, more sensitive to allergens, and less able to ward off infections.[115] Minor exposure to ozone can cause coughing, wheezing and throat irritation. Constant exposure to ozone over time can permanently damage lung tissues, decrease the ability to breathe normally, and exacerbate or potentially even cause chronic diseases like asthma.[116] Children, adults who are active outdoors, and people with existing respiratory system ailments suffer most from ozone's effects.

Studies from across the country show that on days with elevated levels of ozone pollution:

- Hospitals admit increased numbers of patients for respiratory and cardiovascular disease.[117] Scientists have estimated that typical summertime smog pollution is responsible for up to half of all respiratory hospital admissions on bad air days.[118]
- More people visit hospital emergency rooms for asthma, pneumonia and upper respiratory infections.[119]
- Children and adults suffer more asthma attacks, increased respiratory difficulty and reduced lung function.[120]
- More adults miss work and more children miss school due to illness.[121]

The Capital Region is plagued by poor air quality in the summer, averaging more than 8 days per year when smog concentrations rise so high that vulnerable people are advised to curb their outdoor activities.[122] Figure 5 shows the number

Table 17. Number of People at Risk from Poor Air Quality[124]

County	Total Population	Under 18	65 & Over
Frederick	227,980	58,175	24,364
Montgomery	971,600	237,621	119,511
Prince George's	834,560	206,580	79,223

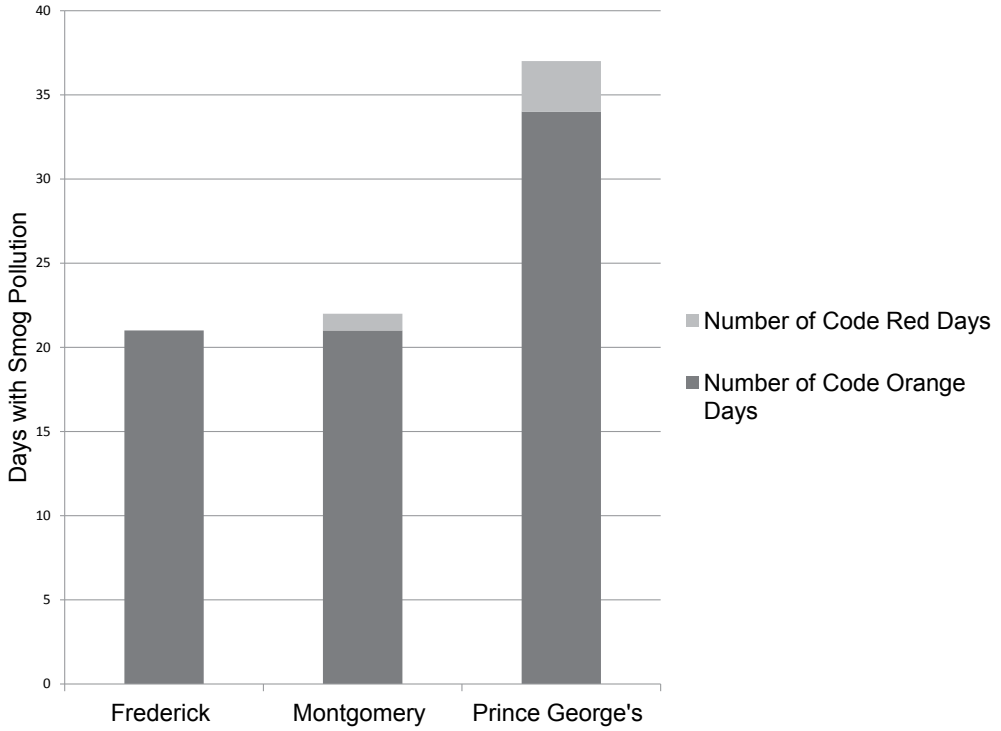
of "code orange" and "code red" bad air days. On "code orange" days, children, the elderly and those with heart or lung disease are at risk, while on "code red" days all residents may experience some health impacts. Table 17 shows that there are more than 2 million residents exposed to these unhealthy levels of smog, hundreds of thousands of whom are especially vulnerable.

Offshore wind energy can help reduce air pollution by replacing power from polluting coal-fired power plants. It can also reduce future problems. Future climate conditions could exacerbate the creation of smog. Sunlight speeds the reaction of emissions from coal-fired power plants to create smog, while stagnant air allows pollution to build for days at a time. With global warming, air stagnation could become more frequent and prolonged, and summer cloudiness might decline.[125] If the Capital Region experiences changes such as those predicted for the Philadelphia region, smog concentrations could rise as much as 26 percent by 2100.[126] Controlling emissions of global warming pollution in Maryland and around the world through steps such as the development of offshore wind energy could help limit the increase to 4 to 11 percent.

In Focus: Limiting Toxic Waste

One of the less recognized benefits of generating electricity from wind turbines in the Atlantic Ocean is protection of groundwater supplies used for drinking water. That's because, unlike coal, offshore wind has no combustion byproducts that have to be disposed of, a process that can contaminate ground water. The Capital Region is

Figure 5. Air Quality Indicators for 2007 through 2009[123]



Coal burned in power plants—such as these piles of coal outside a Baltimore power plant—creates solid residues that often are disposed of in landfills. Credit: Joanna Woerner, IAN UMCES (ian.umces.edu/imagelibrary)

home to two coal ash dumps for waste from coal-fired power plants. The Westland Fly Ash Site in western Montgomery County accepts wastes from the Dickerson Power Plant while wastes from the Chalk Point Power Plant are deposited at a site in Brandywine in Prince George's County.[127]

Burning coal leaves residue in the bottom of the boiler, which is collected as bottom ash, and creates other solids that become airborne and are captured by pollution control equipment before exhaust is released. These solids can contain hazardous products such as selenium, lead, sulfate, arsenic, mercury, chromium, cadmium, molybdenum, boron, iron and manganese.[128]

Often this waste is disposed of in a coal ash dump. When placed in a poorly designed or constructed landfill, coal combustion byproducts can leak into groundwater. That's what happened in 2007 in Anne Arundel County, where pollution from a coal ash dump leaked into groundwater and tainted drinking water wells near Crofton.[129]

The Maryland Department of the Environment (MDE) is concerned that similar pollution might be underway at the Brandywine and Westland sites. In 2010, the MDE sued the operator of the Brandywine site for causing groundwater pollution. The MDE is also concerned about water pollution from the Westland site, the largest in the state.[130] In early 2011, the Maryland Department of the Environment indicated it planned to sue the owner of the Westland disposal site for water quality violations.[131] Though the MDE never filed suit against Westland,

the operator has entered settlement talks that could include paying a $1.9 million fine for violations at Brandywine, Westland, and a third facility.[132]

By producing electricity without combustion byproducts, offshore wind turbines can help reduce the potential risk of groundwater pollution from disposal of toxic byproducts.

Making Fish Safer to Eat

Offshore wind energy could further help protect public health in the Capital Region by reducing the amount of mercury pollution that has made many locally caught species of fish unsafe to eat. To protect public health, the Maryland Department of the Environment warns Marylanders to limit their consumption of certain species of fish from a dozen fishing areas in the Capital Region. (See Table 18.) (See p. 42 for an explanation of the health risks of mercury exposure.)

Boosting the Economy

Building wind turbines off Maryland's Atlantic coast could spur economic activity throughout the state. From planning to permitting to construction, erecting a major wind facility could engage many Capital Region companies and their employees.

Montgomery, Frederick and Prince George's counties are home to nearly 200 companies that could help manufacture components for wind turbines or help

Table 18. Waterbodies in the Capital Region with Fish Consumption Advisories Because of Mercury in Fish[133]

Water Body	County	Fish Affected
Lake Roland	Baltimore	Smallmouth and Largemouth Bass
Cunningham Falls Lake	Frederick	Smallmouth and Largemouth Bass
Lake Linganore	Frederick	Smallmouth and Largemouth Bass
Monocacy River	Frederick	Channel Catfish, Smallmouth and Largemouth Bass
Clopper Lake	Montgomery	Smallmouth and Largemouth Bass
Lake Bernard Frank	Montgomery	Smallmouth and Largemouth Bass, Yellow Bullhead Catfish
Lake Needwood	Montgomery	Black Crappie, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Little Seneca Lake	Montgomery	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Potomac River, DC Line to Dam #3	Montgomery	Channel Catfish, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Anacostia River	Prince George's	Black Crappie, Sunfish (incl. Bluegill)
Cash Lake	Prince George's	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Greenbelt Lake	Prince George's	Smallmouth and Largemouth Bass
Lake Artemesia	Prince George's	Black Crappie, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass

transport or install this addition to the power grid. Turbines contain hundreds of components which can be manufactured at various facilities before being brought to one place for assembly. Table 19 provides a list of manufacturers in the region who might be able to secure a contract to provide elements of wind turbines. Table 20 lists companies that could provide raw materials for a wind farm, or help with installation.

In addition, the Capital Region is home to many white-collar professionals, from financial experts to engineers, who could help with the planning, permitting and project management aspects of building a wind farm. These white collar tasks can make up a significant share of the cost of an offshore wind farm—roughly 12 percent, according to the accounting firm Ernst & Young, based on experience in Europe.[134]

Table 19. Capital Region Industries with the Potential to Take Part in Wind Turbine Manufacturing[135]

Industry	Number of Businesses
All other miscellaneous electrical equipment and component manufacturing	1
All other plastics product manufacturing	9
Fabricated structural metal manufacturing	6
Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables	6
Metal tank (heavy gauge) manufacturing	1
Other communication and energy wire manufacturing	1
Other measuring and controlling device manufacturing	5
Printed circuit assembly (electronic assembly) manufacturing	2
Switchgear and switchboard apparatus manufacturing	2
Total	**33**

Table 20. Capital Region Industries with Potential to Supply Raw Materials or Aid in Installation of Offshore Wind Farms[136]

Industry	Number of Businesses
Deep sea, coastal, and great lakes water transportation	5
Electric power transmission, control, and distribution	15
General freight trucking, long-distance, full truckload	4
Highway, street, and bridge construction	52
Power and communication line and related structures construction	45
Support activities for oil and gas operations	1
Support activities for water transportation	1
Total	**160**

Western Maryland

The forested mountains of Allegany, Garrett and Washington counties set Western Maryland apart from the rest of the state. The mountains of Western Maryland sustain a vibrant forestry industry, while also attracting visitors to hike, fish, hunt and otherwise enjoy the region's natural beauty. Offshore wind power could help Western Maryland preserve the ecological integrity of its forests and help make the fish in the region's streams and lakes safe to eat once more, while delivering a host of other benefits to the region and its people.

In Focus: Protecting Forests

Global warming presents a variety of threats to Western Maryland's forests, beginning with changes in temperature and precipitation. Forest productivity could increase in the next few decades with warmer temperatures, increased atmospheric carbon dioxide and a longer growing season, but greater temperature increases after 2050 will not be beneficial as heat places stress on trees.[137] Summer temperatures are expected to increase more in Western Maryland than in other parts of the state because it is too far from the Atlantic to

The maples, beeches and birches on this hillside in Rocky Gap State Park could give way to oaks, hickories and pines in coming decades. Credit: Nathan Alderman

benefit from the moderating influence of the ocean.[138] A change in precipitation patterns away from today's evenly spaced rain and snowfall events to more drought-like conditions punctuated by heavy rain or snowfall could stress trees further.

Insect damage will likely increase as temperatures rise, with stress from heat and drought eroding trees' ability to resist insect damage. In addition, insect populations are likely to increase as more pests survive from year to year due to milder winters. Gypsy moths and hemlock woolly adelgid are of particular concern for forests in Western Maryland, where these insects have already caused tremendous damage despite cold winters that keep the populations in check.[139]

Stress and damage to trees from heat, drought and insects may increase tree deaths. As the maples, beeches and birches that currently cover the hills of Western Maryland die, they are likely to be replaced by oaks and hickories that are more heat and drought tolerant. By the end of the century, pines could also become common, making the forests of Western Maryland look more like those eastern Virginia or North Carolina.[140]

As the forest changes, so too will its ability to shelter wildlife and provide recreational opportunities. The problem isn't that the forest won't be able to do these things at all; rather, the forest will look and function differently. As hemlocks disappear, for example, the Blackburnian warblers and blue-headed vireos that prefer hemlock forest will likely also disappear from Maryland.[141] Other birds are likely to settle into the new forest, but it will not look and sound the way Western Maryland forests have for generations.

Fish may be affected, too. As mature trees die off and new species become established, erosion and lack of shade may pollute and warm mountain streams, altering habitat conditions so that common species of fish cannot survive. Brook trout, an economically important species for Western Maryland's recreational fisheries, are sensitive to water temperature, and water temperature is the key determining factor for whether brook trout will live in a particular stream. Water temperatures above 66° F curtail brook trout survival.[142] Brook trout have already disappeared from nearly 60 percent of their historic habitat, and high temperatures are the leading threat to remaining populations.[143]

Warmer temperatures may encourage migration of heat-tolerant species into Maryland, replacing trees and wildlife common today, but that change won't be possible for every species. The complete ecosystem of a forest in eastern Virginia won't be transplanted to Maryland; instead, a few of the species that can travel most easily and that are most tolerant of new climate conditions will thrive. The resulting mix could be a far less vibrant and diverse forest.[144]

A changing forest will have far-reaching implications for Western Maryland. Nearly three-quarters of Allegany and Garrett counties are covered in forest and thus change will be widely apparent.[145] The timber industry employs several hundred people in Western Maryland in timber harvesting and management, and approximately 3,000 people in wood product manufacturing at sites such as the New Page paper mill in Luke.[146]

In Focus: Making Fish Safer to Eat

A few days fishing in Western Maryland offers a break from the hustle of daily life, an opportunity to quietly enjoy nature. Hundreds of thousands of Marylanders go fishing every year, many of them in Western Maryland, for these very reasons.[147] Too often, eating the fish they catch is

Table 21. Waterbodies in Western Maryland with Fish Consumption Advisories Because of Mercury in Fish[153]

Water Body	County	Fish Affected
Lake Habeeb	Allegany	Smallmouth and Largemouth Bass
Potomac River at Spring Gap	Allegany	Smallmouth and Largemouth Bass
Broadford Lake	Garrett	Smallmouth and Largemouth Bass
Deep Creek Lake	Garrett	Chain Pickerel, Smallmouth and Largemouth Bass, Yellow Perch
Jennings Randolph Reservoir	Garrett	Smallmouth and Largemouth Bass, Walleye
Piney Reservoir	Garrett	Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass
Savage River	Garrett	Walleye
Savage River Reservoir	Garrett	Rock Bass, Smallmouth and Largemouth Bass, Walleye, Yellow Bullhead Catfish
Youghiogheny River Lake	Garrett	Smallmouth and Largemouth Bass, Walleye, Yellow Perch, Yellow Bullhead Catfish
Antietam River	Washington	Sunfish (incl. Bluegill)
Big Pool	Washington	Smallmouth and Largemouth Bass
Blair Valley Lake	Washington	Smallmouth and Largemouth Bass
Conococheague Creek	Washington	Channel Catfish, Rock Bass, Smallmouth and Largemouth Bass
Potomac River, Dam #4 to Dam #5	Washington	Black Crappie, Channel Catfish, Sunfish (incl. Bluegill), Smallmouth and Largemouth Bass, Walleye

not a safe option for anglers or their families because fish contain elevated levels of mercury. Offshore wind energy offers a way to reduce the airborne mercury pollution that contaminates fish.

Mercury is a potent neurotoxicant.[148] Children are particularly vulnerable to the harmful impacts of mercury during critical windows of development that occur before birth and through the first few years of life.[149] Mercury exposure can lead to irreversible deficits in verbal skills, damage to attention and motor control, and reduced IQ. Even adults are vulnerable to mercury pollution. Eating contaminated fish at any age can cause deficits in brain function, as well as fertility and cardiovascular problems.[150]

Smallmouth and largemouth bass caught in Lake Habeeb in Allegany County contain dangerous levels of mercury. Credit: @mister_ethan

When power plants burn coal, they emit mercury into the air. After leaving the power plant smokestack, mercury pollution falls to the ground in rain or snow and then washes into lakes and streams.

Mercury does not readily decompose in the environment. Instead, small organisms can transform it into mercury compounds that accumulate in the bodies of living things. These compounds build up in aquatic organisms and tend to increase in concentration in species at the top of the food chain. People who eat contaminated fish end up with mercury that builds up in their bodies.[151]

The Maryland Department of the Environment has issued fish consumption advisories for a number of fish species that are commonly sought by anglers.[152] Thirteen Western Maryland lakes, reservoirs or rivers are affected, including popular fishing destinations such as Deep Creek Lake. The strongest restrictions apply to fish caught in the Savage River Reservoir, where walleye contain so much mercury that children should not consume them at all and adults should eat no more than a single serving every other month. Table 21 shows all the waterbodies and species of fish where mercury pollution forces limits on fish consumption in Western Maryland.

Improving Air Quality

Though Allegany, Garrett, and Washington counties don't suffer from the heavy traffic that plagues other regions of the state, Western Maryland still suffers from poor air quality. The haze that dulls scenic

Figure 6. Air Quality Indicators for 2007 through 2009[154]

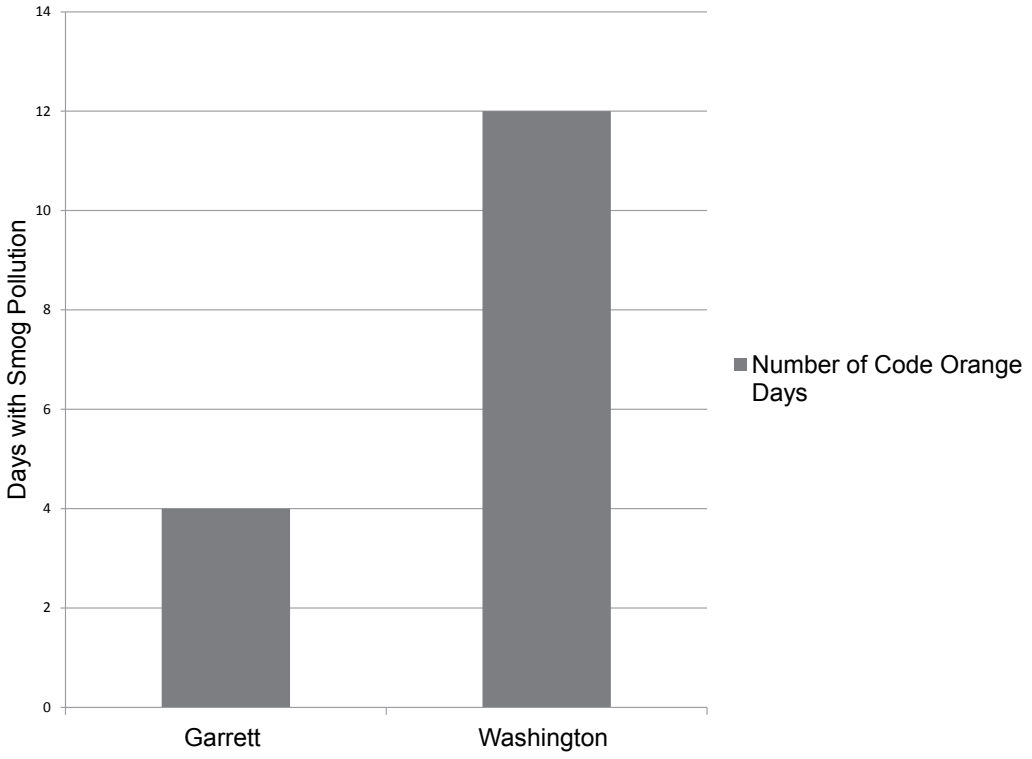


Table 22. Number of People at Risk from Poor Air Quality[155]

County	Total Population	Under 18	65 & Over
Garrett	29,555	6,361	5,141
Washington	145,910	33,346	20,874

vistas from the Appalachian Mountains also harms the health of the region's residents. Offshore wind could help reduce this pollution.

Figure 6 shows the number of days in recent years when smog levels reached unsafe levels for vulnerable populations, while Table 22 shows the number of residents affected by poor air quality. (See p. 36 for a more detailed discussion of the health impacts of air pollution.)

Boosting the Economy

In addition, investing in offshore wind could boost economic activity in Western Maryland. The region is home to dozens of companies that could provide components for turbines or raw materials for a wind farm (see Table 24). The region could gain wind-related manufacturing capacity, as well: AC Wind, which is preparing to open a manufacturing facility on the Eastern Shore, has considered options

Table 23. Western Maryland Industries with the Potential to Take Part in Wind Turbine Manufacturing[158]

Industry	Number of Businesses
All other plastics product manufacturing	6
Fabricated structural metal manufacturing	3
Printed circuit assembly (electronic assembly) manufacturing	1
Relay and industrial control manufacturing	1
Total	**11**

Table 24. Western Maryland Industries with Potential to Supply Raw Materials or Aid in Installation of Offshore Wind Farms[159]

Industry	Number of Businesses
Electric power transmission, control, and distribution	3
General freight trucking, long-distance, full truckload	23
Highway, street, and bridge construction	6
Power and communication line and related structures construction	9
Total	**41**

for opening a plant near Cumberland.[156] Other companies have the capacity to participate in manufacturing components for a wind farm. (See Table 23.)

Residents of Western Maryland have more experience with the economic benefits of wind power than other Marylanders. Construction of Constellation Energy's wind farm on Backbone Mountain in Garrett County added $10 million to local economic activity while employing 150 construction workers and creating nine permanent jobs.[157] An offshore wind farm would be far larger, potentially adding to Western Maryland's manufacturing activity.

Policy Recommendations

Building its first offshore wind farm will mean that Maryland has taken an important step toward a better future with resilient ecosystems, less air pollution, and a more robust economy.

To capture the many benefits of offshore wind, Maryland and the United States should make a strong commitment to the development of wind energy off the mid-Atlantic coast. Specifically:

- The Maryland Public Service Commission should solicit proposals for construction of wind-powered electricity generation off of Maryland's coast, and should establish effective incentives to encourage offshore wind developers.

- State and federal governments should set bold goals for offshore wind development in the Atlantic, in order to provide clear leadership and vision regarding the important role of offshore wind in America's energy future and to demonstrate that it is a high priority.

- The U.S. Department of the Interior should expedite siting regulations for offshore wind projects in federal waters, while maintaining a high level of environmental protection. In so doing, they should maintain strong standards to make sure that offshore wind facilities do not have major impacts on wildlife, shipping channels or military operations.

- The federal government should use its buying power to facilitate the financing of offshore wind. The government should negotiate long term power purchase agreements with an offshore wind developer covering electricity purchases for military installations and other federal facilities.

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