Maryland's **Greenhouse Gas Reduction Act Plan**

October 2013

The Maryland Department of the Environment is the agency responsible for preparing and submitting this 2013 Greenhouse Gas Reduction Act Plan.

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Abbreviations & Acronyms

BMPs	Best Management Practices
BWI	Baltimore Washington International Thurgood Marshall Airport
CAMD	Clean Air Markets Division
CIER	Center for Integrative Environmental Research
CO_2e	Carbon dioxide equivalent
CO_2-equivalent	Carbon dioxide equivalent
DBED	Maryland Department of Business and Economic Development
DGS	Maryland Department of General Services
DHCD	Maryland Department of Housing and Community Development
DNR	Maryland Department of Natural Resources
EPA	U.S. Environmental Protection Agency
GGRA	Greenhouse Gas Emissions Reduction Act
GHG	Greenhouse Gas
HVAC	Heating, Ventilation and Air Conditioning
LEED	Leadership in Energy and Environmental Design
MACT	Maximum Achievable Control Technology
MARC	Maryland Area Regional Commuter
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MDOT	Maryland Department of Transportation
MEA	Maryland Energy Administration
MIA	Maryland Insurance Administration
$MMtCO_2e$	Million Metric Tons of CO_2-equivalent
MW	Megawatt
NE-MARKAL	Northeast version of the Market Allocation model
ODS	Ozone-depleting substances
PJM	Pennsylvania Jersey Maryland Interconnection, LLC
PSC	Maryland Public Service Commission
RCI	Residential, Commercial and Industrial Building Fossil Fuel Combustion
REC	Renewable Energy Credit
REMI	Regional Economic Models, Inc.
RESI	Regional Economic Studies Institute of Towson University
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Energy Portfolio Standard
"The Strategy"	Maryland's Climate Change Adaptation Strategy
UMCES	University of Maryland Center for Environmental Science
VMT	Vehicle Miles Traveled
WTE	Waste-to-energy

Climate change is real.

Scientists agree.

It's happening now.

It's harmful and human-caused.

We can make a difference through our actions.

Chapter 1

Background

Unlike other air pollution...

Greenhouse gases (GHGs) are not like other air pollutants. GHGs are so named because they are heat-retaining gases and they are fairly abundant in the atmosphere. Ozone, fine particles and other air pollutants are found in very small amounts and undergo chemical changes in the atmosphere so that harmful levels typically dissipate after a few hours, days or weeks. GHGs, on the other hand, accumulate in the atmosphere and stay there for a very long time. A pound of carbon dioxide emitted today by driving a car or using electricity generated by burning fossil fuels, such as coal, will still be in the atmosphere decades to hundreds of years from now. It is this persistence in the atmosphere coupled with their heat-retaining properties that create the problem. It does not matter if the GHG is emitted in Maryland, China, or elsewhere—the climate impact is the same.

Greenhouse gases are emitted every time you drive your car.

Photo © Taber Andrew Bain.

Why should Maryland care?

Climate change resulting from the accumulation of GHGs will affect Maryland in a variety of ways. More obvious impacts could include continued sea-level rise; an increased risk for extreme events such as drought, storms, flooding, and forest fires; more heat-related stress; the spread of existing or new vector-born disease; and increased erosion and inundation of low-lying areas along the State's shoreline and coast. In many cases, Maryland is already experiencing these problems to some degree, today. Climate change raises the stakes in managing these problems by changing the frequency, intensity, extent, and magnitude of these problems.

ASSATEAGUE ISLAND NATIONAL SEASHORE

JOCELYN AUGUSTINO, FEMA

JANE HAWKEY, IAN IMAGE LIBRARY

Coastal roads were washed away on Assateague Island, following Hurricane Sandy in October 2012.

Extreme storm events & tornadoes will become more frequent.

Maryland agriculture will be affected by droughts, floods, pests, disease, and ozone levels.

The Chesapeake Bay region's geography and geology make the State one of the three most vulnerable areas of the country to changes resulting from sea-level rise. Health risks to Maryland's citizens, including heat-related stress and cardiovascular mortality and morbidity, respiratory illness, altered infectious disease patterns (both vector-borne and water-borne diseases), impacts to water supply and quality, and direct or mental harm from extreme storm events and flooding, are all possible. Maryland's large agriculture economy will also be affected, as many of the stressors farms already face are likely to intensify or become less predictable, such as drought frequency, winter flooding, pests and disease, and ozone levels.

What happens when GHGs accumulate?

Simply stated, the accumulation of GHGs in the atmosphere traps heat from the sun and warms the planet. As synthesized by the Intergovernmental Panel on Climate Change (IPCC), when GHG concentrations in the atmosphere—expressed as carbon dioxide equivalent (CO_2e)—reach 445 to 490 parts per million, it will increase the annual mean temperature of the earth's surface 2–2.4°C (3.6–4.3°F) above pre-industrial levels.

The scientific evidence assembled by the international community and Maryland's best scientists indicates that temperature increases above this level are very likely to result in dangerous consequences in terms of food production, biodiversity, and initiation of uncontrollable and unpredictable changes in the earth's climate system, such as rapid melting of polar ice caps and changes in the ocean circulation that regulate the planet's climate. GHG concentrations have to be held in the range of 445 to 490 parts per million CO_2e to avoid this level of global warming.

In May of 2011, the National Academy of Sciences' National Research Council released a new report confirming the mounting scientific evidence pointing to human-caused emissions of GHGs as the most likely cause of the noticeable increase in strange climate and weather across the world over the past few years. The report concludes that the most efficient way to accelerate emissions reductions is through a coordinated national response.

So what's the rush?

To stabilize GHGs at or below this level requires substantial early action because atmospheric concentrations are approaching the 445 to 490 parts per million range quickly. The international scientific community predicts these ranges may have been breached already. Global annual man-made GHG emissions have grown by 70 percent between 1970 and 2004.

Man-made

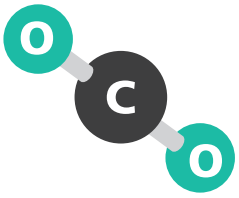
greenhouse gas emissions

have grown by 70%

between 1970 and 2004

What are GHGs?

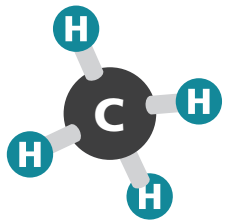
Gases that trap heat in the atmosphere are often called greenhouse gases (GHGs). Some GHGs, such as carbon dioxide, occur naturally and are emitted to the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The principal GHGs that enter the atmosphere because of human activities are:



Carbon Dioxide

Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., the manufacturing of cement). Carbon dioxide is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

MARK TWERY, US FOREST SERVICE



Methane

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

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Nitrous Oxide

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

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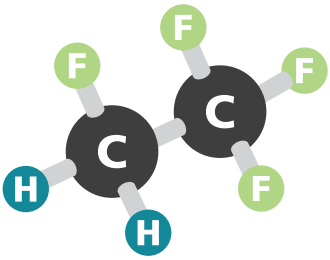
Fluorinated Gases:

Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. These gases are typically emitted in smaller quantities, but because they are potent GHGs, they are sometimes referred to as High Global Warming Potential gases.



What is CO_2-equivalent?

A scale has been developed to allow the comparison of all the GHGs on an equivalent level. Carbon dioxide was selected as the compound to which all others would be equated since carbon dioxide is by far the most prevalent GHG and has been identified as having the Global Warming Potential of 1. The goals, inventory and reductions in this plan are expressed as carbon dioxide equivalents or CO_2e based on the conversions to CO_2e in Figure 1.1.

Maryland has used the established Intergovernmental Panel on Climate Change (IPCC) global warming potentials for the GHG pollutants.

The rate of increase of carbon dioxide levels has grown as more developing countries become industrialized and the use of fossil fuel for transportation and electricity production has grown. Levels of methane and carbon dioxide now exceed the natural ranges from the last 650,000 years, which, for carbon dioxide, varied between 180 and 300 parts per million. Over the past century, GHG levels rapidly increased well out of this range, and are now around 400 parts per million. Atmospheric nitrous oxide far exceeds pre-industrial levels.

Considering that GHGs remain in the atmosphere for a long time, global reductions in emissions by 50 to 85 percent below 2000 levels would be required by 2050 in order to reach the 445 to 490 parts per million level of stabilization. Developed countries such as the U.S. are responsible for the majority of the GHG emissions and have much higher emissions on a per capita basis than developing nations, so they would have to achieve reductions on the high side of this range in order to achieve this result.

Consequently, wide-spread concern over climate change has lead to action from many different organizations including governments. Governments, at both the national and state level, and political partnerships such as the European Union, have adopted policies and goals intended to reduce GHG emissions on both a voluntary and mandatory level. These actions range from adopting GHG reduction legislation to implementing clean energy policies and promoting energy efficiency, renewable energy alternatives, and conservation.

Figure 1.1 The global warming potentials of greenhouse gases (GHGs) compared to carbon dioxide with a Global Warming Potential of 1.

GHG Pollutant	Global Warming Potential
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
Sulfur Hexafluoride	23,900
Perfluorocarbons	9,200
Hydro Chlorofluorocarbons	11,700

The 2012 Greenhouse Gas Emissions Reduction Act (GGRA) Plan* fulfills the mandate to, by the end of 2012, propose a plan that achieves a 25 percent statewide reduction in GHG emissions by 2020, while also spurring job creation and helping improve the economy. The GGRA also requires a report in 2015 that, amongst other things, requires Maryland Department of the Environment (MDE) to provide a recommendation on what the State's longer term reduction target should be. In 2008, the Maryland Commission on Climate Change, appointed by Governor O'Malley, recommended that Maryland consider a 2050 goal as high as a 90 percent reduction from 2006 levels.

This plan spurs reductions in GHGs through incentives that increase energy efficiency using existing technologies, and identifies ways to transition to new energy sources and stimulate further technology development. This requirement, like those of the European Union and leadership states in the U.S., is based on the scientific conclusions of the IPCC regarding the level and pace of reductions that industrialized societies will need to achieve in order to keep global concentrations of GHGs below the 445 parts per million lower limit.

The plan also shows that the measures to reduce GHG emissions can spur the creation of new jobs and help improve the economy.

* This Plan also fulfills the reporting requirements of Executive Order 01.01.2007.07.

Steps in the right direction

The Healthy Air Act

Adopted as Maryland law in 2006, the Healthy Air Act included a provision for the State to join the Regional Greenhouse Gas Initiative (RGGI)—a groundbreaking cap and trade program designed to reduce carbon dioxide emissions from power plants in participating states in the Northeast and Mid-Atlantic. Under Governor O'Malley's leadership, the Healthy Air Act was implemented in July 2007, reducing pollutants that degrade the Chesapeake Bay and Maryland's air quality. Sources that emit pollution, like Constellation Energy, created new Maryland jobs to implement the Healthy Air Act.

The Maryland Clean Cars Act

Sponsored by Governor O'Malley and adopted in 2007, this law required Maryland to implement the California Clean Cars Program which requires the most stringent emissions standards for light duty cars and trucks allowed by law. The Maryland Clean Cars Program began with vehicle model year 2011.

EmPOWER Maryland

Launched by Governor Martin O'Malley in July 2007 and codified by the General Assembly in its 2008 session. This program includes lighting and appliance rebates for homeowners, home energy audits, commercial lighting rebates, and energy efficiency services for industrial facilities. As part of EmPOWER Maryland, the Maryland Energy Administration also offers a variety of programs that encourage energy efficiency improvements.

Greenhouse Gas Emissions Reduction Act

Governor O'Malley sponsored this legislative initiative, adopted as a Maryland law in 2009, with broad support from the General Assembly and stakeholders. GGRA requires MDE to work in cooperation with State agencies to develop a 2012 GGRA Plan to achieve a 25 percent reduction in GHGs from a 2006 baseline by 2020 that creates jobs and improves the economy.

EmPOWER Maryland includes home energy audits (left), encourages energy efficiency improvements (middle) and offers rebates for homeowners that install energy efficient lighting and appliances.

JAY BAKER, OFFICE OF THE GOVERNOR, MARYLAND

Now is the best time to start!

Policy decisions regarding climate change made today have a larger influence on the future than most people realize. To stay below the 445 parts per million CO_2e lower limit, we must eliminate growth in the amount of GHGs emitted as well as make a significant reduction in the amount of GHGs we emit. GHGs persist in the atmosphere for a long time accumulating quite rapidly. Think of it this way: a program that keeps a ton of GHGs out of the atmosphere today is worth more than the same program started five years from now, because five years of GHG accumulation will be avoided if started today. Here are two example scenarios:

1. 'Business-as-Usual' Scenario

Under this scenario, 'business-as-usual' activities allow GHGs to accumulate. Like compounding interest on an unpaid credit card debt, GHG will accumulate (the needed emission reductions grow larger every year) until a point is reached where we can no longer make payments because the reduction measures are vastly harder, or impossible, and too expensive, to achieve the goal by 2020, or any other year. The ability to level off the growth in GHGs and reduce emissions to stay within the 445 to 490 parts per million CO_2e range may be possible now but if we delay and try to compress the time frame for these reductions, we may not be able to succeed.

2. 'Early Action' Scenario.

Under this scenario, the timing and pace of GHG accumulation is metered by implementing early and significant GHG reduction programs now, and phasing in medium and long-term programs on an aggressive "ramp up" schedule. In so doing, continued rapid GHG accumulations—the compounding interest—is avoided and Maryland begins stabilizing and reducing emissions. This puts the State on a sustainable path to its 2020 goal through controlling growth in GHG emissions and transitioning into a clean energy economy. Even programs that won't yield reductions in the early years must be launched now in order to ramp up to their full effectiveness within the needed time frame.

Solar tracking recharging station. for electric vehicles

Shrinking our footprint will grow Maryland's economy

Maryland's GGRA recognizes that human activities such as sprawl and coastal development and the burning of fossil fuels contribute to the causes and consequences of climate change. GGRA mandates Maryland to reduce its statewide GHG emissions 25 percent from a 2006 baseline by 2020. Reducing emissions is not enough; GGRA requires that reductions be done in a way that has a positive effect on the State's economy and job creation and does not have a direct negative impact on manufacturing jobs.

The 2012 GGRA Plan identifies a suite of cost-effective GHG reduction programs which, if fully implemented, will benefit Maryland consumers, businesses and the State's economy as a whole. The Regional Economic Studies Institute (RESI) recently estimated that by implementing these policies, Maryland could see as much as a $1.6 billion increase in the state economy by 2020. The impact and benefit of our climate policies will depend on how and when they are implemented (the sooner the better).

Reducing Maryland's GHG emissions will also create new jobs, such as installing solar panels on residential buildings.

Energy efficiency: the low hanging fruit

Energy efficiency is the fastest and least expensive approach available to reduce GHG emissions. According to the EPA-DOE National Action Plan for Energy Efficiency, energy efficiency will not only help to address GHG emissions, but actions in this area also can lower energy bills, help stabilize energy prices, enhance electric and natural gas system reliability thereby reducing the need for new generation sources, and reduce harmful air pollutants. In fact, some states with well-designed energy efficiency programs are saving enough energy at about half the cost of building a new electric power plant to avoid the need for a new power plant.

Maryland research suggests even greater savings for the State. A 2006 study funded by the Maryland Department of Business and Economic Development and the Maryland Energy Administration, and carried out by the Baltimore-based International Center for Sustainable Development, found that energy efficiency can reduce energy costs to homeowners, businesses, institutions and government by 60 to 70 percent which is a great savings over adding the cost of building new generating capacity in Maryland.

As noted earlier, Maryland has launched important energy efficiency programs such as EmPOWER Maryland and RGGI, which have started yielding GHG emission reductions. The 2012 GGRA Plan includes many energy efficiency programs that will yield additional early, significant and cost-effective GHG reductions.

A worker installing insulation to improve energy efficiency.

Growing clean energy industries and green collar jobs

Maryland could create more than 37,000 jobs by addressing climate change, such as designing, constructing, and operating windmills.

RESI estimated that, by addressing climate change, Maryland could create more than 37,000 new jobs in the State by 2020. Since 2009, with investments in energy efficiency through the EmPOWER Maryland program, Maryland has moved ahead with other states to create green jobs and businesses. Examples of Maryland's robust business and job opportunities abound. They include: designing and constructing green buildings; retrofitting older buildings with energy efficient appliances and technologies; expanding and maintaining public transit systems; designing, constructing, and operating windmills, biomass generators, and solar collectors; and research and development in a wide array of new practices and technologies.

Shrinking energy costs

The Maryland Clean Cars program encourages fuel-efficient and low emissions vehicles, which means paying less at the gas pump.

In addition to paying lower monthly utility bills through energy savings from RGGI, EmPOWER Maryland and other programs implemented prior to the draft 2012 GGRA Plan, Maryland consumers will be able to offset higher prices at the gas pump through the Maryland Clean Cars program, which encourages fuel-efficient and low emissions vehicles. Other programs also lower energy use in the transportation sector such as transit-oriented development designed to reduce vehicle miles traveled.

States provide leadership for a difficult challenge

Maryland began developing and implementing climate programs as early as 2006, and the programs usually had a dual purpose. The Healthy Air Act and the Maryland Clean Cars programs reduce air pollution as well as GHG emissions. EmPOWER Maryland and the RPS were focused on reducing electricity demand to provide an adequate electricity supply during peak demand and avoid the need for new power plants and thus reduce electricity costs. These programs also provide substantial GHG emissions reductions. In the face of growing concerns over the pace of climate change and the lack of federal leadership, Maryland and other states assumed a leadership role in developing programs to reduce GHG emissions. Leadership by Maryland and other select states on climate issues encourages states that are "on the fence" about climate change to seriously consider making the hard policy decisions to reduce GHG emissions.

Most states are not equipped to provide all of their energy needs. Attempts to move toward cleaner fuels and renewable energy are often inconsistent and would benefit from a uniform national policy.

Since 2006, Maryland's work on the front lines to develop climate programs has also pushed the federal government to acknowledge the need for uniform national climate policy. Federal movement on national climate policy, which seemed imminent in 2009, has been relegated to a much lower priority. In the meantime, the nation is relying upon states, like Maryland, California and New York to apply pressure for more work on national climate policy. (Figure 1.2) The transition to a clean energy economy is a very difficult task and will require time to develop these alternative options. From commuters driving the beltways, to heating homes and businesses, and to buying locally made products, Marylanders rely heavily on fossil fuels which have been shown to contribute to the devastating effects of climate change. The option simply to stop fossil fuel use without alternative options is unrealistic.

Figure 1.2 States with laws requiring GHG reductions.

State	Year of Legislation	GHG Reduction Goal(s)
Arkansas	2007	By 2020: 20% below 2000 levels By 2025: 35% below 2000 levels By 2035: 50% below 2000 levels
California	2006	By 2020: 1990 levels
Connecticut	2008	By 2020: 10% below 1990 levels By 2050: 80% below 2001 levels
Hawaii	2007	By 2020: 1990 levels
Maine	2003	By 2020: 10% below 1990
Maryland	2009	By 2020: 25% below 2006 levels
Massachusetts	2008	By 2020: 10% below 1990 levels
Minnesota	2007	By 2015: 15% below 2005 levels By 2025: 30% below 2005 levels By 2050: 80% below 2005 levels
New Jersey	2007	By 2020: 1990 levels By 2050: 80% below 2006 levels
Oregon	2009	By 2020: 10% below 1990 By 2050: 75% below 1990
Vermont	2007	By 2012: 25% below 1990 levels By 2028: 50% below 1990 levels
Washington	2008	By 2020: 1990 levels By 2035: 25% below 1990 levels By 2050: 50% below 1990 levels

What we do in Maryland matters in Maryland

Maryland is small— why should we care?

Small Geography, Big Footprint

Although Maryland is a small state, it is responsible for nearly as many GHG emissions as Sweden and Norway combined. Maryland's gross emissions have increased by about 18 percent between 1990 and 2005, a faster rate of growth than the U.S. as a whole (16 percent between 1990 and 2005). Per capita GHG emissions by Maryland citizens also grew between 1990 and 2005, during a period when per capita emissions for the U.S. as a whole decreased. Relative to its size, Maryland has a big and growing carbon footprint. It is therefore incumbent on the State to take leadership responsibility to shrink both its statewide and per capita GHG emissions.

Local Actions Yield Local Benefits

In addition to stimulating economic development and creating jobs, GHG reduction programs will result in other local benefits for Maryland citizens. For example, policies in place to reduce GHG emissions also will reduce air and water pollution in Maryland.

The Maryland Department of Natural Resources' Urban Tree Canopy project represents an effective strategy for local communities to reduce GHGs because trees sequester carbon dioxide from the atmosphere as well as cool nearby buildings, reducing the need for air conditioning and lowering the demand for midday electricity. By contributing to lower summertime temperatures at street level, trees also improve ambient air quality. The lower temperatures slow the formation of ground-level ozone.

Other synergies abound. Managing forests for enhanced carbon sequestration from the atmosphere also promotes forest health, biodiversity and water quality and reduces soil erosion. Transit-oriented development programs not only reduce GHGs by reducing vehicle miles traveled by cars, but these projects also reduce air pollution, highway congestion and lost productivity. They also reduce public expenditures for roads, sewers and water infrastructures and school bus transportation—costs that increase with sprawling development. Agricultural nutrient trading programs promote soil carbon sequestration and protect the Chesapeake Bay watershed by reducing nitrogen and phosphorus loads from fertilizer run-off through a market-driven, public marketplace. Maryland's water-based livelihoods, cultural heritage and unique quality of life derive from the Chesapeake Bay and its many tributaries.

Maryland's exceptional vulnerability to sea-level rise poses a unique leadership responsibility on Marylanders to reduce State and personal GHG footprints. We have a tremendous amount to lose. We also have a tremendous amount to gain.

State Leadership Is Pushing Federal Action

It is true that acting alone, Maryland cannot reduce the world's GHGs by much. But together with more than the dozen other states that have adopted GHG reduction laws and have implemented climate plans, the cumulative impact will be significant. These efforts are forcing the federal government to continue considering comprehensive climate change and clean energy policy, a vitally needed step toward achieving reductions globally.

Chapter 2

Update on climate change science

This chapter is based upon material provided by the University of Maryland Center for Environmental Science.

A CBOS buoy collects data in the Chesapeake Bay.

Photo © Anne Gauzens, UMCES

Since the enactment of the Greenhouse Gas Emissions Reduction Act of 2009 (GGRA), the science of climate change has made steady advances that, in aggregate, increase certainty regarding human-caused global climate change and demonstrate significant changes that are already taking place. This chapter provides a very general overview of key advances in understanding and the implications for Maryland. A more detailed report called Global Warming in the Free State: Comprehensive Assessment of Climate Change Impacts in Maryland, prepared by the Maryland Commission on Climate Change, is available at *http://www.umces.edu/sites/default/files/pdfs/global_warming_free_state_report.pdf* and *http://www.mde.state.md.us/programs/Air/ClimateChange* (Chapter 2 of the 2008 Climate Action Plan).

In late 2009, the media were atwitter with news of "Climategate," with the unauthorized release of emails suggesting that climate scientists had conspired to mislead the public about the recent warming of earth's climate. This led to several formal investigations by the British government, the National Oceanic and Atmospheric Administration, and universities employing the implicated scientists. Every one of these investigations concluded that there was no evidence that scientists had manipulated their research and the Inspector General for the U.S. Department of Commerce noted that nothing in the emails conflicted with the scientific consensus that "global warming is happening and that it is induced by human activity."

As if to accentuate the confusion caused by this controversy and the time lost as a result of the failure to come to binding agreements on greenhouse gas (GHG) emission reductions in meetings of the United Nations Framework Convention on Climate Change

in Copenhagen in 2009, Cancun 2010, and Durbin in 2012, the global average temperature continued to increase. The year 2010 proved to be the warmest year on record and thus far, 2012 has been the warmest year recorded for the United States.

If air temperatures continue to rise through this century (Figure 2.1), global warming could lead to deadly temperatures for humans based on reasonable worst-case scenarios for global warming accompanied with high humidity.[1] This suggests that the pressing need to reduce GHG emissions will finally be understood and accepted by society as temperatures become more unbearable. But, there is a lag time in the climate system, so will this realization come in time?

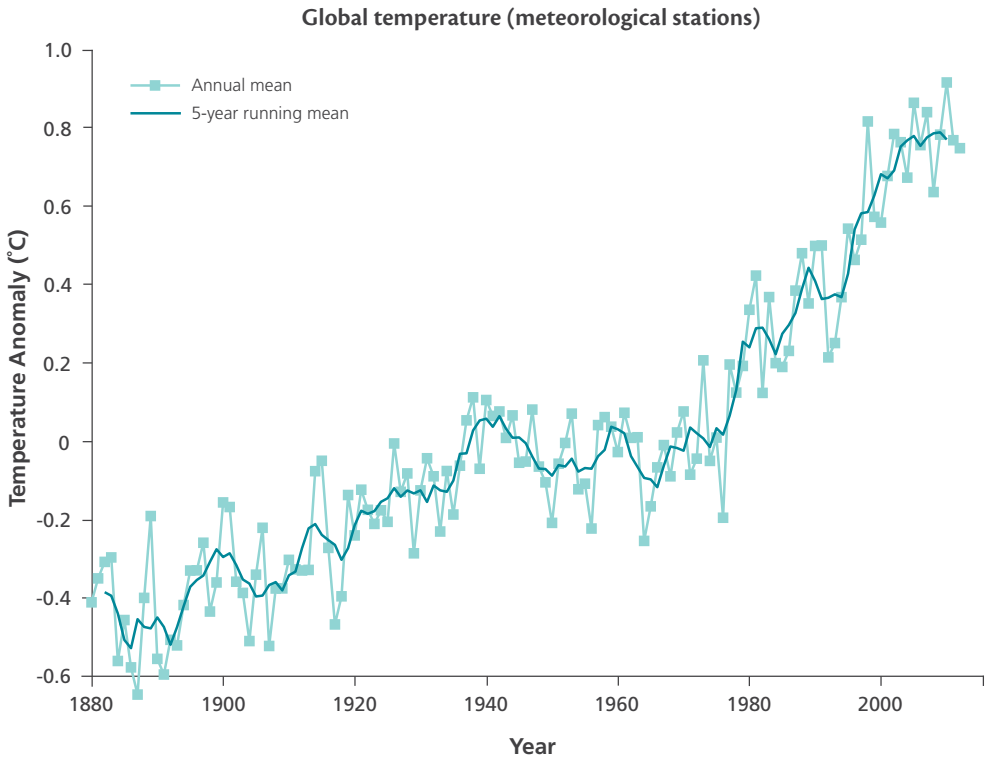


Figure 2.1 Global average air temperature by year expressed as the anomaly (difference) from the average temperature during the 1951 through 1980 period. Source: *http://data.giss.nasa.gov/gistemp/graphs_v3/*

Meanwhile, scientists are beginning to document changes in the earth's critical biological systems as the planet warms. Long-term records suggest a decline in the concentration of phytoplankton in the most of the world's oceans commensurate with their warming.[2] Phytoplankton provide the base of the food chains that support the ocean's fisheries. A reduction in phytoplankton production also would mean a reduced capacity of the oceans to remove carbon dioxide from the atmosphere.

On land, there is evidence that soils are emitting more carbon dioxide as a result of more rapid decomposition of soil organic matter as temperatures have increased over the past 20 years.[3] This is an example of a positive feedback loop that exacerbates the buildup of GHGs and accelerates climate change. Also on land, available evidence indicates that recent warming has increased atmospheric moisture demand and likely altered circulation pattern, both contributing to droughts in Africa, Southern Europe and Asia. Climate models project increasing aridity in many parts of the world, including the western and southern U.S.[4] This would provide serious challenges to agriculture to meet the food requirements for the growing world population.

The largest changes in the earth's climate are being witnessed in the polar and high latitude regions, where atmospheric and oceanic temperatures have warmed most and the spatial extent of sea ice cover—or, even more so, sea ice thickness—has rapidly declined to levels not anticipated for decades. The extent of Arctic sea ice in September 2012 was the smallest ever recorded when there was less ice cover than experienced for thousands of years. Although seemingly far removed, polar warming has great significance for Maryland as well as for polar bears and penguins. The future course of sea level along our State's shores will largely be

determined by how rapidly ice sheets sitting on the land masses of Greenland and Antarctica melt.[5] Based on our recent capabilities to observe changes in the thickness of these ice sheets by satellite measurements of gravity, it is now clear that both Greenland and West Antarctica are losing ice mass at an accelerating rate.[6,7] This has led several scientists[8] to increase their estimates of how much sea-level rise we will see during the 21st century to levels three times those forecast in 2007 by the IPCC.[9] A recent, detailed assessment by the National Research Council[10] suggests somewhat lower rates that would, when adjusted for land subsidence, largely fall in the 2 to 4 feet range used in Maryland's 2008 Climate Action Plan's climate change impacts assessment,[11] but could be as high as 5 feet by the end of the century. Moreover, another recent analysis showed that since the 1950s sea level rose three to four times more rapidly along the northeast coast of the United States, including Maryland, than the global average, probably because of dynamic ocean processes.[12] This raises another warning flag for future rapid sea-level rise along our coast.

The warming of the polar regions is very likely to produce several other positive feedbacks that accelerate global warming. The loss of ice cover (Figure 2.2), presently more evident in and around the Arctic Ocean than in the Southern Ocean around Antarctica, means that more of the sun's heat is captured by dark ocean waters rather than reflected back to space by ice. Large supplies of methane, which has a 21 times greater greenhouse effect than carbon dioxide on a molecule-by-molecule basis, are likely to be released into the atmosphere from Arctic soils and continental shelf sediments.[13]

The year 2010 was legendary for its very extreme weather events. These started with Snowpocalypse and Snowmageddon blizzards in December 2009 and February 2010, and continued with the 1000-year floods in Tennessee in May, heat waves throughout the summer in the Northern Hemisphere, the Russian drought and wildfires in July 2010, the Pakistani floods from late July through August, record-breaking rainfall in Maryland in September that same year, and an unusually cold and snowy end of the year in Great Britain and parts of Europe. The years 2011 and 2012 produced even more extreme weather events, including the Texas drought and a drought in the Midwest in 2012. Although skeptics pointed to the blizzards as evidence that the world is not warming, each of these extreme events, although not linked definitively, is consistent with the scientific expectations of global warming.[14] More droughts result from warmer and more persistent high pressure systems that dry out the land. More deluges, whether they are in a liquid or crystallized form of precipitation, are to be expected as hotter air and warmer oceans result in more evaporation from land and water surfaces. Scientists have demonstrated more and more cases in which climate disruptions related to the build-up of GHGs have contributed to the observed record breaking extremes, be they heat waves, droughts or floods.[15,16] These findings underscore the need to take into account the frequency and magnitude of such extreme events as Maryland plans its strategies to adapt to its changing climate.

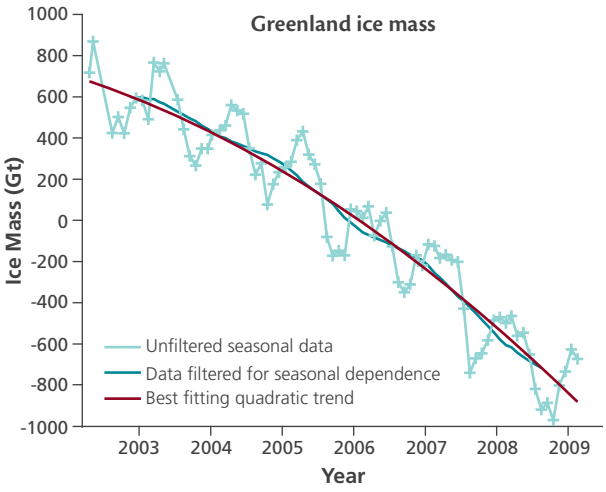


Figure 2.2 The rate of decline in the mass of ice on Greenland, as determined from satellite gravity measurements, is accelerating.[6]

Polar warming has great significance for Maryland as the future course of sea level along our State's shores will largely be determined by how rapidly ice sheets sitting on the land masses of Greenland and Antarctica melt.

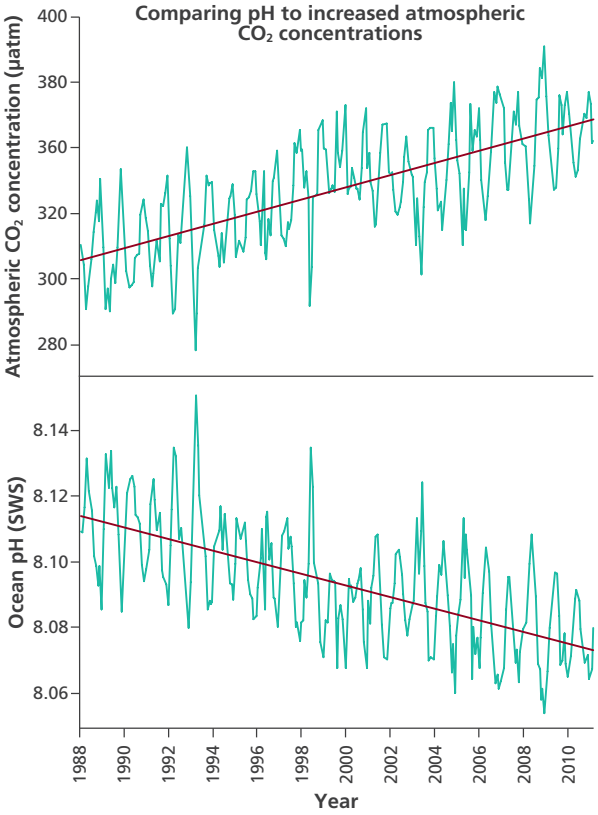


Figure 2.3 The decline in pH of surface waters in the Pacific Ocean off Hawaii is directly related to the increase in the atmospheric concentration of carbon dioxide. Adapted from Dore et al., 2009.[21]

Another manifestation of the increased carbon dioxide concentrations in the atmosphere that has received substantial recent attention is ocean acidification. Although not strictly, a "climate" change, it has the same root cause. As carbon dioxide concentrations in the atmosphere increase, more carbon dioxide is absorbed in ocean surface waters (Figure 2.3), which results in lowering their pH, a measure of whether a solution is a base (greater than 7) or an acid (less than 7). The average pH of ocean surface waters has decreased from 8.2 to less than 8.1 since the beginning of the industrial revolution and an additional 0.2–0.3 drop is likely by the end of the century even if we stabilize atmospheric carbon dioxide concentrations.[17] While this might not seem like much, the pH scale is logarithmic and reductions of pH of this amount have been shown to limit the ability of organisms, such as oysters and corals, to build shells and skeletons of calcium carbonate.

Ocean acidification presents not just a challenge for the life of the open ocean and for coral reefs, but also for coastal regions such as the Chesapeake Bay. Scientists working at the University of Maryland Center for Environmental Science examined Bay water quality data collected over 23 years and found that average pH significantly declined in the waters of the lower Bay to below 8.0, a trend consistent with that observed in the open ocean.[18] While pH in lower salinity waters, including tributaries that once supported large oyster populations, has not declined, current average conditions in some of these tributaries correspond to values found in the laboratory to reduce or eliminate the ability of juvenile oysters to form new shell.

This brief review of recent findings concerning global climate change does not do justice to the massive amount of new research findings that are being published by scientists every week. The good news is that we are improving our understanding of the phenomenon of climate change, its repercussions and its likely course. The bad news is that the substantial preponderance of the new scientific evidence indicates that significant climate change is more certain, will occur sooner than previously thought, and will result in largely negative consequences for the wellbeing of humans and our planet's critical living systems.

Several Marylanders participated in the National Academies study, America's Climate Choices,[19] which produced thoughtful and informative reports on advancing the science, limiting the magnitude and adapting to the impacts of climate change, as well as informing an effective response to climate change. The findings and recommendations of these reports resonate well with the efforts of the State of Maryland as it moves ahead with the GGRA Plan to do its part to limit the magnitude of global climate change and adapt to its impacts based on sound scientific understanding. Meanwhile, the global scientific community is already busy in developing the Fifth Assessment of the IPCC to be finalized in 2014. The new assessment will evaluate the consequences of GHG emission scenarios more in line with the aggressive reductions called for in Maryland's Climate Action Plan,[20] thus allowing a better appraisal of the benefits of early action to Maryland.*

* On September 27, 2013, the IPCC released a report concluding that human influence on climate systems is clear.

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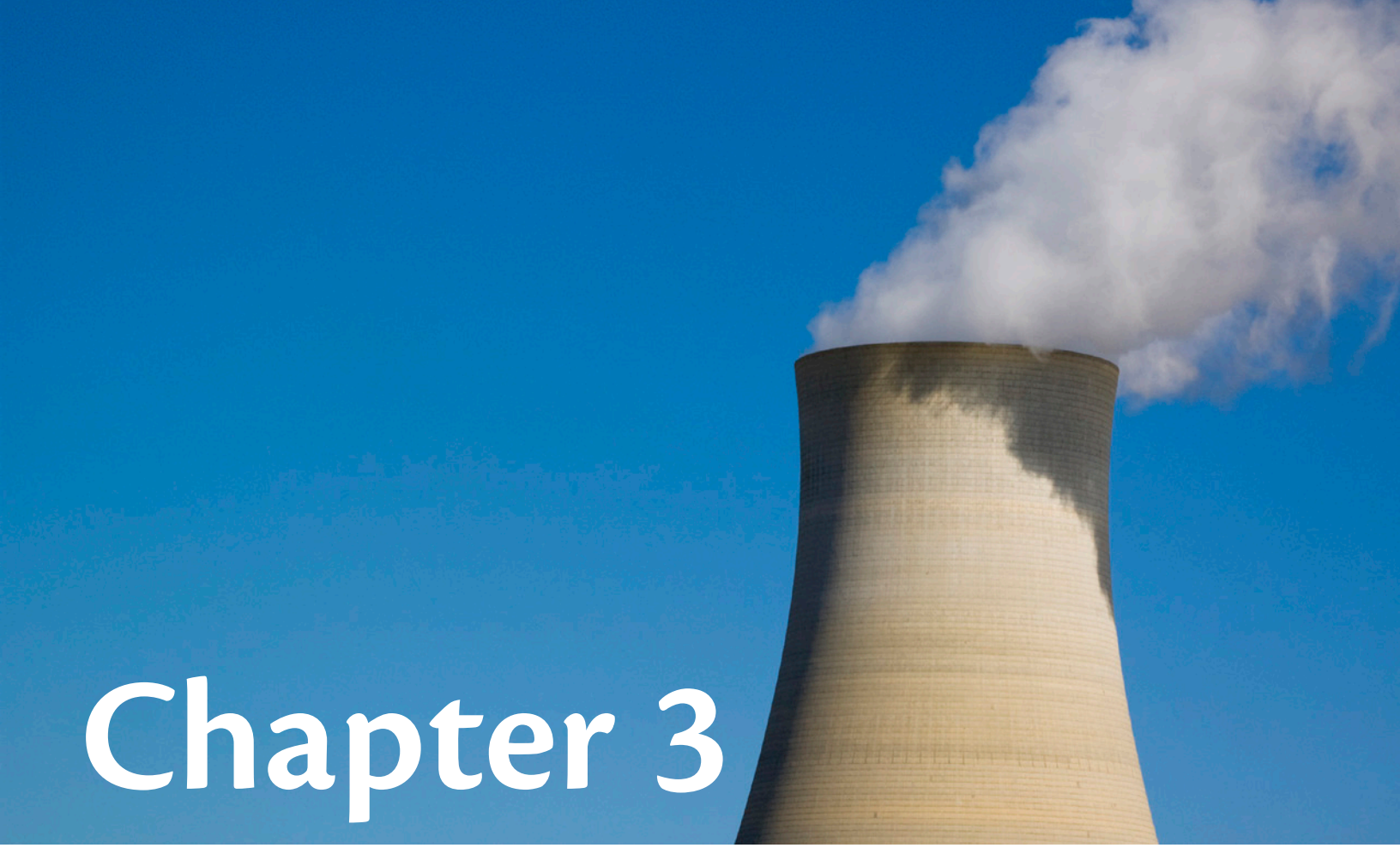


Chapter 3

Inventory and forecast

We calculated our current emissions and established a baseline, so that we can achieve a 25% reduction in emissions by 2020.

The inventory and forecast process overview

The Greenhouse Gas Emissions Reduction Act of 2009 (GGRA) requires the State to develop and implement a 2012 GGRA Plan (this Plan) to achieve a 25 percent reduction in greenhouse gas (GHG) emissions by the year 2020. GGRA specifically requires the development of a baseline inventory for 2006. This inventory was developed based on six categories of greenhouse gases: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons and perfluorocarbon. Collectively, these gases are referred to as carbon dioxide equivalent, or CO_2e. The 25 percent reduction is subtracted from the baseline to create a target level of emissions for 2020.

To calculate the reductions needed to achieve the target, a projected inventory for the year 2020 was developed to estimate emissions due to growth from 'business-as-usual' activities (i.e. estimated emissions in the absence of any climate control programs). The growth emissions added to the emissions needed to achieve the 25 percent reduction are the total emission reductions needed for success of the Plan. The emissions estimates, assumptions, and methodologies are explained further in this chapter. The full report and emissions inventory is located on the MDE web page at:

http://www.mde.state.md.us/programs/Air/ClimateChange/Pages/GreenhouseGasInventory.aspx

Emissions inventories are the foundation of air quality decisions; it is essential the data be as accurate as possible. Inventory quality is critical since the inventory assists decision makers in defining realistic regulations and reduction strategies.

GHG emissions reporting requirements in Maryland

Federal regulations established under the U.S. Environmental Protection Agency's (EPA) Acid Rain program require large sources of air pollutants to report carbon dioxide emissions data quarterly to EPA's Clean Air Markets Division (CAMD) public access database. These sources are mainly electric generating units. The data reported is obtained through direct measurement of carbon dioxide emissions by monitors located in the exhaust stacks of the sources. These instruments collect data continuously. In the absence of a monitoring system, sources calculate the amount of carbon dioxide using an accepted methodology and then report this into CAMD. These regulations include standards for monitoring, recordkeeping, and reporting.

More recently, EPA promulgated the Mandatory GHG Reporting Rule.* This regulation requires affected sources to report GHG emissions data directly to EPA. An affected source is any source expected to emit more than 25,000 tons of GHG emissions annually. EPA will then disseminate the information to the states. 2010 was the first year affected by these requirements and, as yet, no data is available from EPA. Accurate GHG data will assist on a national level in determining the relative emissions of specific industries, the variability in GHG emissions from industrial processes and unit emissions across each source category, and factors that influence GHG emission rates.

In the fall of 2007, MDE requested that industrial sources in Maryland include GHG emissions reporting along with annual reporting of other criteria air pollutants. For calendar year 2007, about one half (267) of Maryland's registered sites reported a total of 46.5 million tons of CO_2e. For calendar year 2008, 324 Maryland sites reported a total of 44.3 million tons of CO_2e. For calendar year 2009, 351 Maryland sites reported a total of 37.0 million tons of CO_2e. For calendar year 2010, 367 Maryland sites reported a total of 41.6 million tons of CO_2e. For calendar year 2011, 339 Maryland sites reported a total of 36.5 million tons of CO_2e. The CO_2e emissions data for calendar year 2012 has not been finalized.

As part of the Maryland CO_2 Budget Trading Program, which began in 2009, electric generating units greater than 25 megawatts in Maryland are required to report carbon dioxide emissions into EPA's CAMD database. For the most part, the same sources are reporting emissions under the Maryland CO_2 Budget Trading Program as report under the federal Acid Rain Program.

This data from these programs provide a basis for emissions estimates for several categories of sources in the inventory.

* The Mandatory GHG Reporting Rule, 40 CFR Part 98, was signed by EPA Administrator Lisa Jackson on September 22, 2009 and published in the Federal Register on October 30, 2009 (74 FR 56260). The Rule took effect on December 29, 2009.

The GGRA inventory and forecast

Emissions inventories are essential to developing environmental policies. The quality of a state-specific inventory is vital to the process if Maryland expects to set and achieve realistic pollution reduction goals. A baseline GHG inventory will pinpoint the business sectors that contribute to Maryland's GHG emissions, identifying where priorities should be placed in the development of climate policies. It also is necessary to determine what Maryland's future GHG emissions will be through the use of a forecast and modeling. Since GHG emissions may increase in the future, Maryland can take advantage of any cost-effective opportunities for early GHG reductions that may exist.

An initial inventory was developed for the 2008 Climate Action Plan by the Center for Climate Strategies, which provided necessary technical support for policy discussion at the time. This inventory was a "top-down" inventory that provided a broad-brush 2006 GHG inventory and a 2020 emissions forecast for Maryland. To further refine any GHG emissions reduction strategies, however, a more state-specific "bottom-up" GHG inventory is necessary. Such an inventory and forecast is what MDE has developed for GGRA.

The Maryland General Assembly passed GGRA in 2009.* GGRA requires MDE to prepare and publish an updated inventory of statewide GHG emissions for calendar year 2006 and develop a projected 'business-as-usual' inventory for calendar year 2020 on or before June 1, 2011.† This GGRA requirement was met and can be found on the MDE web page. GGRA also requires an updated inventory every three years, starting in 2011. These periodic inventories are the primary tool that MDE will use to track emission reduction progress.

GGRA identified 2006 as the base year for Maryland's process and as the year for the first compliance-quality inventory. Since Maryland GHG data existed for 2006, using 2006 as the base year for Maryland's GHG inventory made sense from a resource perspective. Many states and other jurisdictions have used 1990 as their starting point, while others chose later years like 2000 or 2005. Using an earlier year, such as 1990, does not always sufficiently communicate the magnitude of the challenges of achieving reductions. In Maryland, a 25 percent reduction from 2006 levels by 2020 goal is nearly the same as meeting 1990 levels by 2020. That means the target level of emissions for 2020 under the GGRA is very similar to 1990 GHG emissions levels in Maryland. The difference between the two numbers is small. On the other hand, population and economic growth between 1990 and 2006 was robust and is expected to continue through 2020. This growth represents a large number and must be offset to reach the 1990 goal, yet the need to offset growth in order to be successful in reaching an emissions target is often overlooked. For these reasons a more current year, 2006, with more recent data and better inventory methodologies was selected as the base year.

* Environment Article, Title 2, Subtitle 12, "Greenhouse Gas Emissions Reductions," §§2-1201—2-1211, Annotated Code of Maryland
† Id., §2-1203.

Figure 3.1 The global warming potentials of greenhouse gases (GHGs) compared to carbon dioxide with a Global Warming Potential of 1.

GHG Pollutant	Global Warming Potential
Carbon Dioxide	1
Methane	21
Nitrous Oxide	310
Sulfur Hexafluoride	23,900
Perfluorocarbons	9,200
Hydro Chlorofluorocarbons	11,700

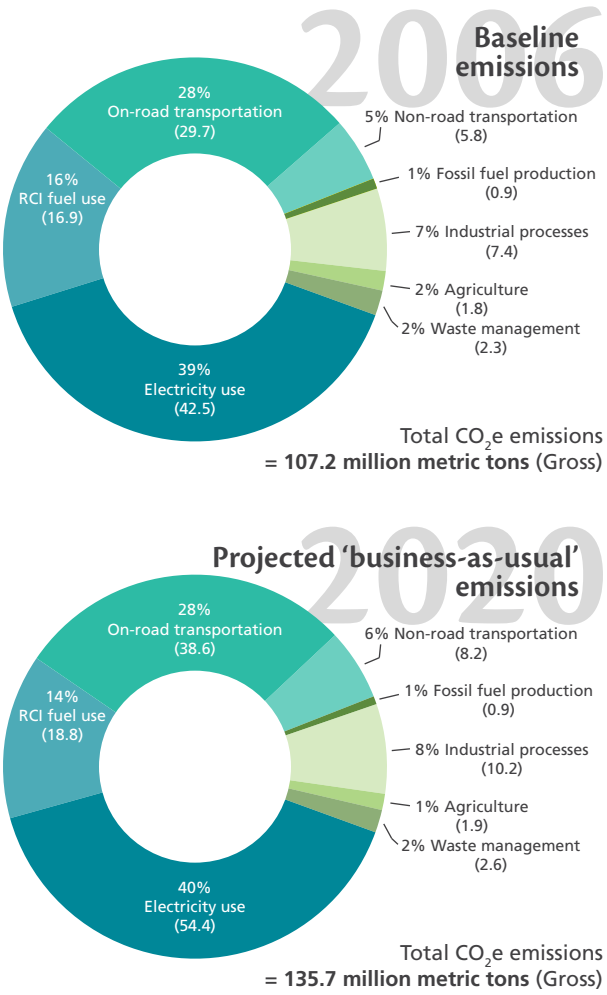


Figure 3.2 Baseline CO_2e emissions in 2006 compared with projected 'business-as-usual' emissions in 2020, show emissions are projected to increase by 28.5 million metric tons. CO_2e emissions are shown as % per activity, with total emissions (in million metric tons) in brackets.

Steps to conducting a GHG inventory

To comply with this mandate, MDE prepared a report that estimates the statewide emissions of GHGs for calendar year 2006 and a 'business-as-usual' projected inventory for calendar year 2020. The report and the emissions inventory is divided into seven major source categories that contribute to GHGs emissions in Maryland and can be found in its entirety on the MDE web page. The seven major source categories are:

- Electricity use
- Residential, commercial, and industrial (RCI) fuel use
- Transportation (on-road and non-road)
- Fossil fuel production (including fugitive emissions from GHGs released from leakage)
- Industrial processes
- Agriculture
- Waste management

The inventory also includes forestry and land use as a "sink" category based on its carbon sequestration.*

Maryland's manmade GHG emissions and terrestrial sinks for carbon storage were estimated for the base year 2006 using a set of generally accepted principles and guidelines for State GHG emissions, relying to the extent possible on Maryland-specific input data (Figure 3.2). The projections are based on the application of appropriate growth factors to the base year GHG emission inventory. Growth factors associated with the emissions projections are described in detail in the report. The projected inventories were based on a 'business-as-usual' forecast as required in GGRA; therefore, to the extent possible, no control or reduction programs were taken into consideration in the estimation. Programs like RGGI and EmPOWER Maryland that were implemented after the 2006 base year are credited toward the 25 percent reduction requirement (Figure 3.2).

The inventory and forecast cover the six types of gases included in the U.S. Greenhouse Gas Inventory for 2006: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. A scale has been developed to allow the comparison of all the GHGs on an equivalent basis. Carbon dioxide was selected as the compound to which all others would be equated since carbon dioxide is by far the most prevalent GHG and has been identified as having the Global Warming Potential of 1. The goals, inventory and reductions in this plan are expressed as CO_2e based on the conversions in Figure 3.1.

* As defined by EPA, terrestrial carbon sequestration is "… the process through which CO_2 from the atmosphere is absorbed by trees, plants and crops through photosynthesis, and stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. The term "sinks" is also used to refer to forests, croplands, and grazing lands, and their ability to sequester carbon. Agriculture and forestry activities can also release CO_2 to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over some time period." www.epa.gov/sequestration/faq.html

Maryland has used the global warming potentials for the GHG pollutants established by the IPCC.

Figure 3.3 provides a graphic representation of the relative proportions of the major sectors of the GHG inventory for the 2006 base year and the 2020 projection year respectively. Figure 3.4 provides a summary of the base year and projection year GHG emissions for Maryland for the years 2006, 2010, 2015, and 2020. Activities in Maryland accounted for approximately 107.2 million metric tons of *gross*[*] CO_2e emissions (consumption basis) in 2006, an amount equal to about 1.5 percent of total U.S. gross GHG emissions (7,054.2 million metric tons of CO_2e).[†]

Estimates of carbon sinks within Maryland's forests, including urban forests and land use changes, are also included in the inventory and projection. Current estimates indicate that about 11.8 million metric tons of CO_2e were stored in Maryland forest biomass and agricultural soils in 2006. This leads to net emissions of 95.4 million metric tons of CO_2e in Maryland in 2006.

There were three principal sources of GHG emissions in Maryland in 2006: electricity consumption, transportation, and RCI fossil fuel use. Electricity consumption accounted for 43 percent of gross GHG emissions, transportation for 30 percent and RCI fuel use accounted for 17 percent.

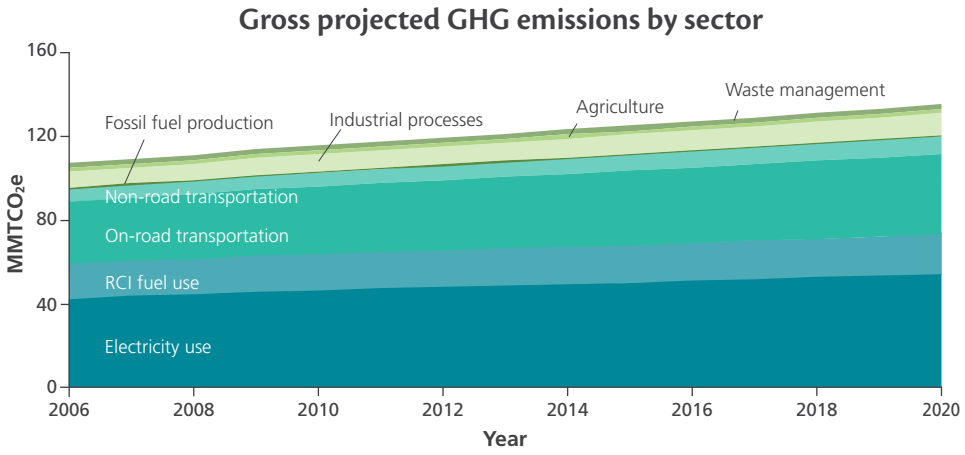


Figure 3.3 Maryland's gross GHG emissions are projected to increase 28.5 million metric tons from baseline levels in 2006 to 2020. Emissions are shown by sector.

As shown numerically in Figure 3.3, under the reference case projections, Maryland's gross GHG emissions continue to grow and are projected to climb to about 135 million metric tons of CO_2e by 2020. This is approximately 27 percent above 2006 levels.[‡] Maryland's electricity consumption sector is projected to be the largest contributor to future GHG emissions growth in Maryland, followed by the transportation sector and RCI fossil fuel use.

Some data gaps exist in this analysis, particularly for the reference case projections. Key refinements include review and revision of key emissions drivers that will be major determinants of Maryland's future GHG emissions (such as the growth rate assumptions for electricity generation and consumption, transportation fuel use, and RCI fuel use). The full report provides the detailed methods, data sources, and assumptions for each GHG sector. Also included are descriptions of significant uncertainties in emission estimates or methods, and suggested next steps for refinement of the inventory.

* Excluding GHG emissions removed due to forestry and other land uses.

† The national emissions used for these comparisons are based on 2006 emissions from Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2006, April 15, 2008, US EPA # 430-R-08-005, *http://www.epa.gov/climatechange/emissions/usinventoryreport.html.*

‡ Note that electricity sector emission reductions attributable to the Maryland CO_2 Budget Trading Program are not included in the reference case emissions inventory.

Figure 3.4 Maryland 2006 base year and projected 2020 GHG emissions by sector. Totals may not equal sum of subtotals shown in this table due to independent rounding.

	MMtCO$_2$e	2006	2010	2015	2020	Explanatory notes for projections
ELECTRICITY USE (CONSUMPTION)	Electricity production (in-state)	32.16	34.04	35.91	37.78	MEA statistical analysis
	Coal	28.28	28.85	29.57	30.29	MEA statistical analysis
	Natural gas	3.65	4.55	5.70	6.85	Output optimization
	Oil	0.24	0.64	0.64	0.64	Output optimization
	Wood	0.00	0.00	0.00	0.00	Population growth
	MSW/LFG	0.00	0.00	0.00	0.00	Population grown
	Net imported electricity	10.31	12.59	14.25	16.65	Power balance
	Electricity use (consumption)	**42.48**	**46.63**	**50.16**	**54.42**	**PSC projections**
RCI FUEL USE	Coal	3.00	3.17	3.68	4.20	Household growth
	Natural gas & LPG	9.21	9.42	9.72	10.00	Household growth
	Petroleum	4.58	4.57	4.57	4.56	Household growth
	Wood	0.09	0.09	0.09	0.09	Household growth
	Residential/Commercial/Industrial (RCI) fuel use	**16.87**	**17.24**	**18.07**	**18.84**	
TRANSPORTATION	On-road gasoline	23.76	25.75	28.23	30.71	MOVES modeling
	Non-road gasoline	1.04	1.05	1.06	1.06	Various
	On-road diesel	5.91	6.47	7.18	7.88	MOVES modeling
	Non-road diesel	1.50	1.60	1.73	1.85	Various
	Rail	0.24	0.25	0.27	0.30	EPA RIA
	Marine vessels (gas & oil)	1.00	1.21	1.48	1.75	EPA RIA
	Lubricants, natural gas, and LPG	0.30	0.34	0.40	0.47	Industrial employment
	Jet fuel and aviation gasoline	1.72	1.98	2.34	2.76	Aircraft operations
	Transportation	**35.47**	**38.66**	**42.68**	**46.78**	
FOSSIL FUEL PRODUCTION	Natural gas industry	0.81	0.69	0.74	0.79	Industrial employment
	Oil industry	0.00	0.00	0.00	0.00	Industrial employment
	Coal mining	0.13	0.13	0.13	0.13	Production growth
	Fossil fuel production	**0.94**	**0.82**	**0.87**	**0.92**	
INDUSTRIAL PROCESSES	Cement manufacture	1.48	1.57	1.83	2.09	Production growth
	Limestone and dolomite	0.11	0.15	0.18	0.21	Production growth
	Soda ash	0.05	0.05	0.05	0.05	Production growth
	Iron and steel	3.60	3.65	3.75	3.85	Production growth
	ODS substitutes	1.97	2.65	3.35	4.04	Population growth
	Electricity transmission and dist.	0.23	0.14	0.05	0.00	Population growth
	Semiconductor manufacturing	0.00	0.00	0.00	0.00	Industrial employment
	Ammonia and urea production	0.00	0.00	0.00	0.00	Industrial employment
	Aluminum production	0.00	0.00	0.00	0.00	Industrial employment
	Industrial processes	**7.44**	**8.21**	**9.21**	**10.24**	

Figure 3.4 Maryland 2006 base year and projected 2020 GHG emissions by sector. Totals may not equal sum of subtotals shown in this table due to independent rounding.

	MMtCO_2e	2006	2010	2015	2020	Explanatory notes for projections
AGRICULTURE	Enteric fermentation	0.42	0.44	0.42	0.51	Population growth
	Manure management	0.32	0.32	0.30	0.29	Population growth
	Agricultural soils	1.02	1.08	1.06	1.05	Population growth
	Agricultural burning	0.01	0.01	0.01	0.01	Population growth
	Urea fertilizer usage	0.01	0.01	0.01	0.01	No growth
	Agriculture	**1.77**	**1.85**	**1.79**	**1.86**	
WASTE MANAGEMENT	Waste combustion	1.29	1.34	1.42	1.49	Population growth
	Landfills	0.39	0.40	0.43	0.45	Population growth
	Wastewater management	0.54	0.56	0.59	0.62	Population growth
	Residential open burning	0.03	0.03	0.04	0.04	Household growth
	Waste management	**2.26**	**2.34**	**2.48**	**2.60**	
	Gross emissions (CO_2, CH_4, N_2O)	**107.23**	**115.75**	**125.26**	**135.68**	
	Increase in gross emissions relative to 2006		7.95%	16.82%	26.53%	
EMISSIONS SINKS	Forested landscape	-10.45	-10.45	-10.45	-10.45	
	Urban forestry and land use	-1.33	-1.33	-1.33	-1.33	
	Agricultural soils (cultivation practices)	-0.05	-0.05	-0.05	-0.05	
	Forest fires	0.04	0.04	0.04	0.04	
	Emissions sinks	**-11.79**	**-11.8**	**-11.8**	**-11.8**	
	Net emissions (CO_2, CH_4, N_2O)	**95.44**	**104.00**	**113.51**	**123.93**	
	Increase in net emissions relative to 2006		8.97%	18.94%	29.85%	

Source and sink categories

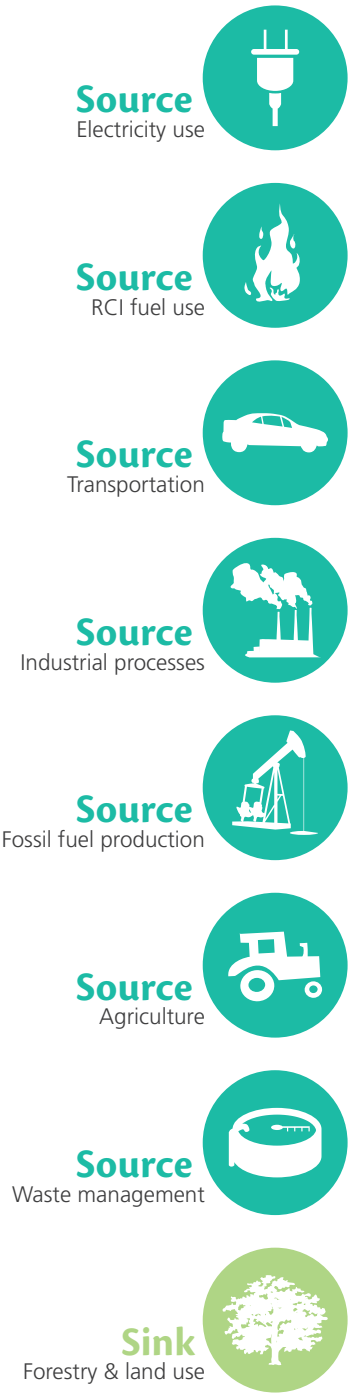


Figure 3.5 The 7 source categories of GHG pollutants, and the sink category of forestry and land use based on carbon sequestration.

The full inventory and forecast report describes the inventory procedures MDE used to compile the 2006 base year emissions inventory of the six GHG pollutants. The emission sources are divided into the following seven source categories:

- Electricity use
- Residential, commercial, and industrial buildings (RCI) fuel combustion
- Transportation
- Industrial processes
- Fossil fuel production
- Agriculture
- Waste management

As noted earlier, the inventory also includes forestry and land use as a sink category based on its carbon sequestration (Figure 3.5).

The inventory has been calculated on a statewide basis and has not been allocated to the county level unless otherwise stated. Brief descriptions of each emission source and sink category are presented in the following paragraphs:

Source: Electricity use

The electricity use sector accounts for GHG emissions occurring as a result of the combustion of fossil fuel at electricity-generating facilities located both in and outside of the State. Carbon dioxide represented more than 99.5 percent of total sector emissions, with methane and nitrous oxide CO_2e emissions comprising the balance.

Maryland is a net importer of electricity, meaning that the State consumes more electricity than is produced here.* For this analysis, it was assumed that all power generated in Maryland was consumed in Maryland, and that remaining electricity demand was met by imported power. Sales associated with imported power accounted for 28 percent of the electricity consumed in Maryland in 2006.† GHG emissions from electricity produced in-state are dominated by the combustion of coal, followed by emissions from the use of oil and natural gas. As shown previously in Figure 3.2, electricity consumption accounted for about 39 percent of Maryland's gross GHG emissions in 2006 (about 43 million metric tons of CO_2e), which was higher than the national average share of emissions from electricity consumption (34 percent).‡

In 2006, emissions associated with Maryland's electricity consumption (43 million metric tons of CO_2e) were about 10 million metric tons of CO_2e higher than those associated with electricity production (32 million metric tons of CO_2e). The higher level for consumption-based emissions reflects GHG emissions associated with net imports of electricity to meet Maryland's electricity demand.§ Projections of electricity sales for 2006

* The geographic boundary of the inventory is identical with the borders of Maryland except for a single category: electricity consumption. As part of the 2006 baseline, the GGRA requires Maryland to include GHG emissions from electricity consumed by its citizens whether that electricity is generated within Maryland or imported into Maryland from outside the state. Several factors contributed to the decision to use a consumption-based approach to electricity emissions rather than just include emissions from electricity generated in Maryland. Data is available to estimate both categories of emissions with reasonable accuracy. Historically 30 percent of the electricity consumed by Marylanders is generated outside Maryland. Since electricity consumption is a very large portion of the GHG emissions generated by Marylanders, excluding 30 percent of those emissions would reduce the effectiveness of the Plan. Some of the early reduction strategies, like the EmPOWER Maryland goals, are based on consumption of electricity not generation of electricity. While other sectors such as transportation also produce emissions from GHG sources originating outside Maryland (e.g. out-of-state vehicles traveling through Maryland), these emissions are not included in the inventory. This is in part because these emissions are quite variable and also because a good source of accurate data for these emissions is not available.

† In 2006, total Maryland retail sales were 63,173 gigawatt-hours, of which 17,643 (i.e., 28 percent) were estimated to be from imports.

‡ For the U.S. as a whole, there is relatively little difference between the emissions from electricity use and emissions from electricity production, as the U.S. imports only about 1 percent of its electricity, and exports even less. Maryland's situation is different, since it is a net electricity importer.

§ Estimating the emissions associated with electricity use requires an understanding of the electricity sources (both in-state and out-of-state) used by utilities to meet consumer demand.

through 2020 indicate that Maryland will remain a net importer of electricity (Figure 3.6). The 2020 'business-as-usual' forecast assumes that in-state production-based emissions will increase by about 10 million metric tons of CO_2e. In addition, consumption-based emissions associated with imported electricity will increase by about 6 million metric tons of CO_2e.

The consumption-based approach better reflects GHG emissions and emissions reductions occurring in Maryland, particularly with respect to electricity use and energy efficiency improvements. This is particularly useful for policy-making.

Source: RCI fuel use

The full report and inventory discusses emissions associated with direct fossil fuel used in the residential, commercial and the industrial buildings sector to provide space and process heating.

Source: Transportation

Emissions estimated for this business sector are the result of the combustion of fossil-fuel primarily for transportation purposes. Sources include:

- Cars
- Light-duty trucks
- Vans
- Buses
- Other diesel vehicles

The majority of CO_2e emissions in the transportation sector relate to on-road gasoline, with on-road diesel accounting for a significant percentage. This is illustrated in Figure 3.7 for 2006 baseline and projected 2020 'business-as-usual.'

Other modes of transportation, such as airplanes, trains and commercial marine vessels are included under the general category of non-road mobile sources. It is often difficult identifying the actual end-use for non-road gasoline and diesel fuels (other than marine use). Natural gas and liquefied petroleum gas used as transportation fuel are easily broken out. Also, jet fuel and aviation gasoline are discrete products that are treated as a separate sector. For illustrative purposes, Figure 3.7 provides a visual breakout of non-road fuel uses.

Non-road mobile sources are motorized vehicles and equipment not normally operated on public roadways. These include:

- Lawn and garden equipments
- Agricultural or farm equipment
- Logging equipment
- Industrial equipment
- Construction equipment
- Airport service equipment

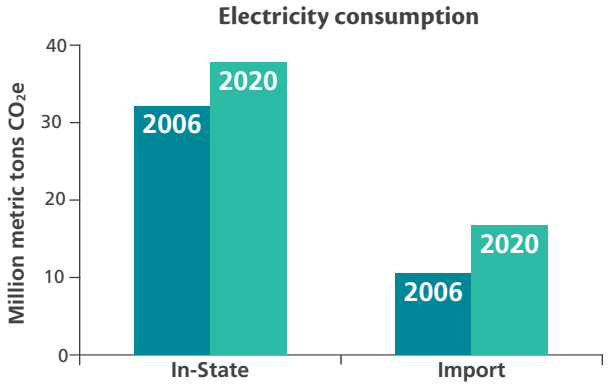
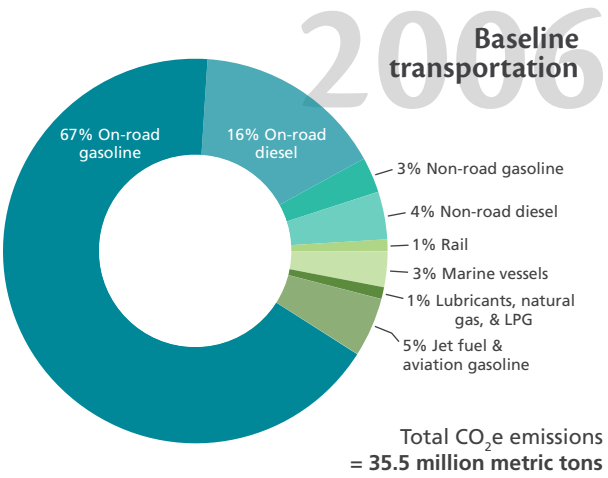


Figure 3.6 Baseline (2006) vs. Projected (2020) 'business-as-usual' emissions for electricity consumption from both in-state generation and imported electricity.



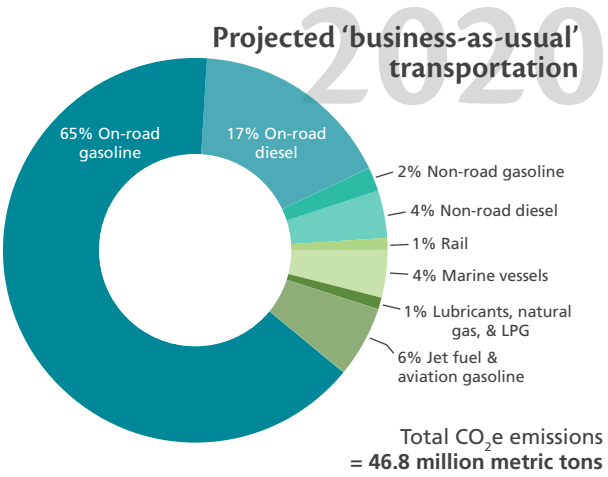


Figure 3.7 Baseline transportation emissions in 2006 compared with projected 'business-as-usual' transportation emissions in 2020 by sector. Overall CO_2e transportation emissions are projected to increase by 11.3 million metric tons.

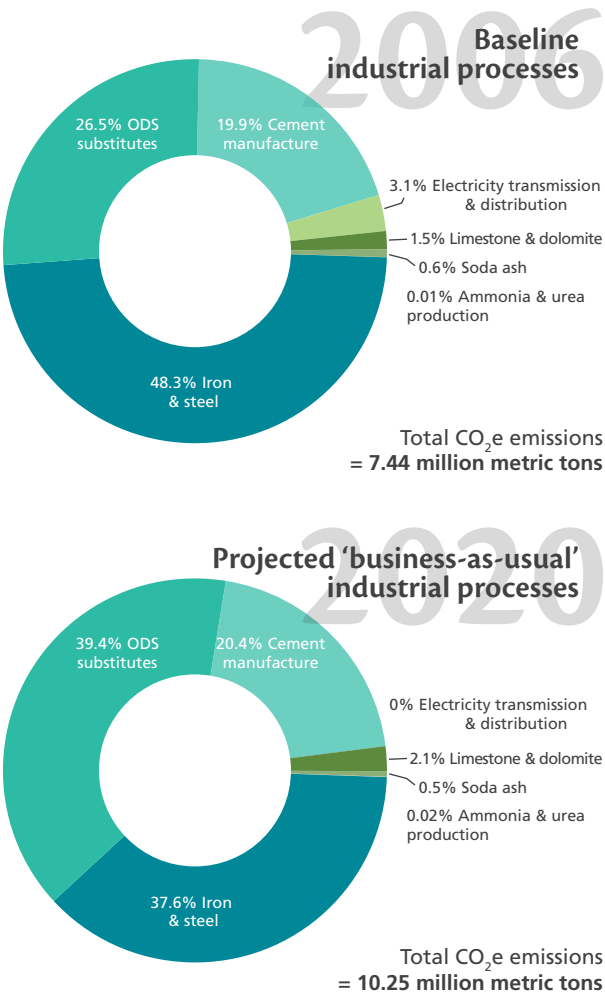


Figure 3.8 Baseline emissions for industrial processes in 2006 compared with projected 'business-as-usual' emissions for industrial processes in 2020 by sector. Overall CO_2e transportation emissions are projected to increase by 2.8 million metric tons.

- Recreational land vehicles or equipment
- Recreational marine equipment
- Locomotives
- Commercial aviation
- Air taxis
- General aviation
- Military aviation
- Commercial Marine Vessels

As shown previously in Figure 3.2, the transportation sector accounted for about 33 percent of Maryland's gross GHG emissions in 2006 (about 35.5 million metric tons of CO_2e), which was higher than the national average share of emissions from transportation fuel consumption (27 percent).

For 2006, on-road gasoline vehicles accounted for about 65 percent of transportation GHG emissions. On-road diesel vehicles accounted for another 17 percent of emissions, and air travel for roughly 6 percent. Marine vessels, rail, and other sources, such as natural gas- and liquefied petroleum gas-fueled vehicles used in transport applications accounted for the remaining 12 percent of transportation emissions.

Source: Industrial processes

Emissions estimated in the industrial sector account for process-related GHG emissions resulting from the four main industrial processes that occurs in the State:

1. Carbon dioxide emissions from cement production, soda ash, dolomite and lime/limestone consumption;
2. Carbon dioxide emissions from iron and steel production;
3. Sulfur hexafluoride emissions from electric power transmission and distribution system transformer use; and
4. Hydrofluorocarbon and perfluorocarbon emissions resulting from the consumption of substitutes for ozone-depleting substances (ODS) used in cooling and refrigeration equipment.

As illustrated in Figure 3.8, industrial process CO_2e emissions are estimated to increase in the projected 2020 'business-as-usual' forecast, although not uniformly across sectors.

Source: Fossil fuel production

This section reports GHG emissions that are released during the production, processing, transmission, and distribution of fossil fuels (primarily natural gas and coal) in the State. Methane emissions released via leakage and venting from oil and gas fields, processing facilities and natural gas pipelines, and fugitive methane emissions during coal mining, are estimated in this section, as well as carbon dioxide emissions associated with the combustion of natural gas in compressor engines.

Fossil fuel production emissions are projected to drop in the 2020 'business-as-usual' forecast. This is attributable to a decrease in emissions in the fossil fuel and natural gas industries (Figure 3.9). Coal mining emissions are expected to remain constant between the 2006 baseline and the 2020 'business-as-usual' forecast.

Source: Agriculture

The emissions estimated in this section refer to non-energy generating methane and nitrous oxide emissions from enteric fermentation,* manure management, and agricultural soils. Emissions and sinks of carbon in agricultural soils also are estimated in this section. Energy emissions, such as combustion of fossil fuels in agricultural equipment, are not included in this section, but are already accounted for under the RCI and non-road transportation sectors.

Agriculture CO_2e emissions are projected to increase from the 2006 baseline (Figure 3.10). The growth is different by type of emission source, some going down and some going up at different rates. Enteric fermentation shows the largest percentage of growth.

Source: Waste management

This section estimates all GHG emissions from Maryland's waste management practices based on the three main classes of waste management in the state:

1. Solid waste management
2. Wastewater management
3. Solid municipal waste incinerations

Waste CO_2e emissions are projected to increase from the 2006 baseline.

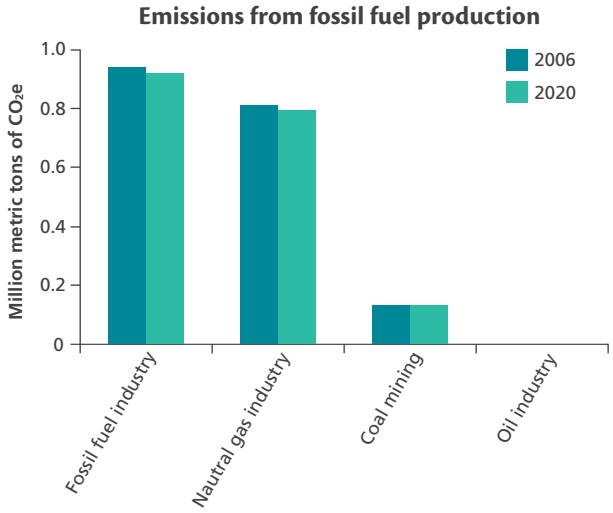


Figure 3.9 Baseline (2006) vs. Projected (2020) 'business-as-usual' emissions for fossil fuel production.

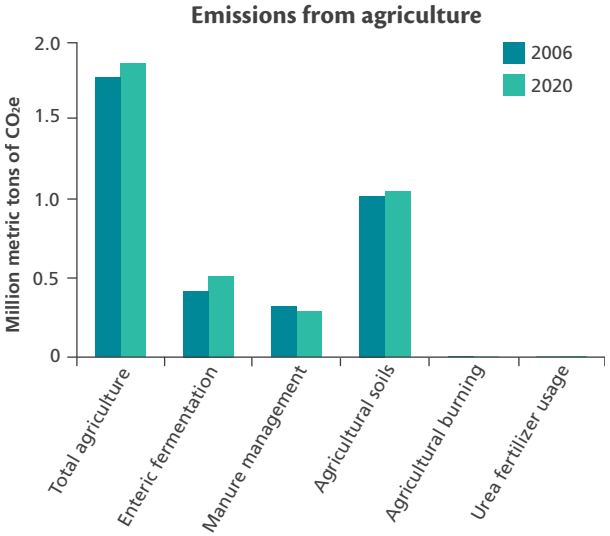


Figure 3.10 Baseline (2006) vs. Projected (2020) 'business-as-usual' emissions for agriculture.

* Enteric fermentation is a natural part of the digestive process of cattle, sheep, and other ruminants which produces methane emissions as a byproduct. Most of the methane is belched by the animal. A small percentage of methane is also produced in the large intestine and passed out as flatulence.
www.epa.gov/ttnchie1/ap42/ch14/final/c14s04.pdf;
www.c2es.org/technology/fact sheet/EntericFermentation

Waste-to-energy (WTE) emissions and biomass

For emission inventory purposes, MDE includes waste-to-energy (WTE) in the same category as incinerators. Incinerators and WTE facilities report and certify emissions of greenhouse gases and other pollutants to MDE in annual Emission Certification Reports, which undergo a quality assurance/quality control review by the air quality compliance program at MDE. MDE includes WTE emissions from all combusted materials in the GHG emissions inventory, including emissions from items that some would call "life cycle" or "biomass" emissions like paper, wood products and other "biomass" materials, commonly referred to as "biogenic" carbon emissions.

The International Panel on Climate Change (IPCC) estimates that biogenic carbon materials (e.g., paper and wood) comprise about 60% of the carbon in MSW. Therefore, the inclusion or exclusion of emissions from biogenic materials in the GHG accounting system of a waste disposal facility will have a significant impact on its total GHG emissions profile.

EPA currently treats biogenic emissions from WTE as carbon-neutral when calculating greenhouse gas emissions. This is based on the fact that in a natural ecosystem, biogenic materials will decompose over time as part of the natural carbon cycle, emitting the same quantity of greenhouse gases, just more slowly over a 20–30 year decomposition period. In a forest, for example, a tree consumes CO_2 during its life and releases the same quantity of CO_2 as it decomposes. When another tree grows to fill its place, it consumes CO_2. In theory, the quantity of CO_2 in the atmosphere remains unchanged. In reality, however, deforestation and reforestation are not occurring at equivalent rates. As the global forests continue to shrink in size, the natural carbon cycle is broken and consumption of biomass goods, such as wood and paper, results in a net source of CO_2 emissions.

MDE chose to include WTE biogenic emissions in the GHG emissions inventory because the inventory is combustion-based, the carbon released from combusted biogenic materials is occurring now over a much shorter period of time and some portion of the emissions are not carbon neutral. Moreover, EPA is commencing a comprehensive review of how biomass emissions should be treated in conjunction with development of GHG emissions inventories.

Sink: Forestry and land use

This section provides an assessment of the net GHG flux resulting from land uses, land-use changes, and forest management activities in Maryland. The balance between the emission and uptake of GHGs is known as GHG flux.* The GHG emissions estimated in this section include carbon dioxide emissions from urea fertilizer use, methane and nitrous oxide emissions from wildfires and prescribed forest burns, and nitrous oxide emissions from synthetic fertilizers application to settlement soils. Carbon sequestration pathways estimated in this section include:

- above and below ground biomass
- dead wood and forest litters
- landfilled yard trimmings and food scraps
- harvested wood product
- wood products in landfills
- urban trees

Net forestry emissions remain basically constant from the 2006 baseline to the forecasted 2020 'business-as-usual'.

* The term "flux" is used here to encompass both emissions of GHGs to the atmosphere and removal, or "uptake," of carbon from the atmosphere (carbon sequestration).

2020 Goal: How much do we need to reduce?

To calculate a specific 2020 emissions reduction goal for Maryland, two key pieces of information are needed: the 2006 statewide GHG emissions baseline and the 2020 statewide 'business-as-usual' forecast (anticipated emissions in the absence of any climate control programs). The growth in emissions is the difference between these two numbers. The total GHG emissions reduction needed under GGRA must not only offset this growth; it must also reduce emissions 25 percent below the 2006 baseline. This is the same methodology that MDE uses for reduction efforts for criteria pollutants, such as precursors of ozone.

Maryland's 2006 baseline GHG emissions are confirmed at 107.23 million metric tons of CO_2e. A 25 percent reduction from this equals 80.42 million metric tons of CO_2e (a reduction of 26.81 million metric tons). Another way to think about this is that the GGRA climate strategies should lead Maryland down to a 2020 actual statewide emissions profile of 80.42 million metric tons of CO_2e (107.23 minus 26.81).

Maryland's 2020 'business-as-usual' GHG emissions forecast is 135.68 million metric tons of CO_2e. This represents a 27 percent increase over the 2006 actual baseline. This forecast does not include any measures to reduce GHG emissions that were implemented after 2006.

The 2020 GHG reduction target is calculated by subtracting where we need to be in 2020 (25 percent below the 2006 baseline, or 80.42 million metric tons of CO_2e) from the 2020 'business-as-usual' forecast (135.68 million metric tons of CO_2e). Therefore, the 2020 reduction target required under GGRA is 55.26 million metric tons of CO_2e (Figure 3.11).

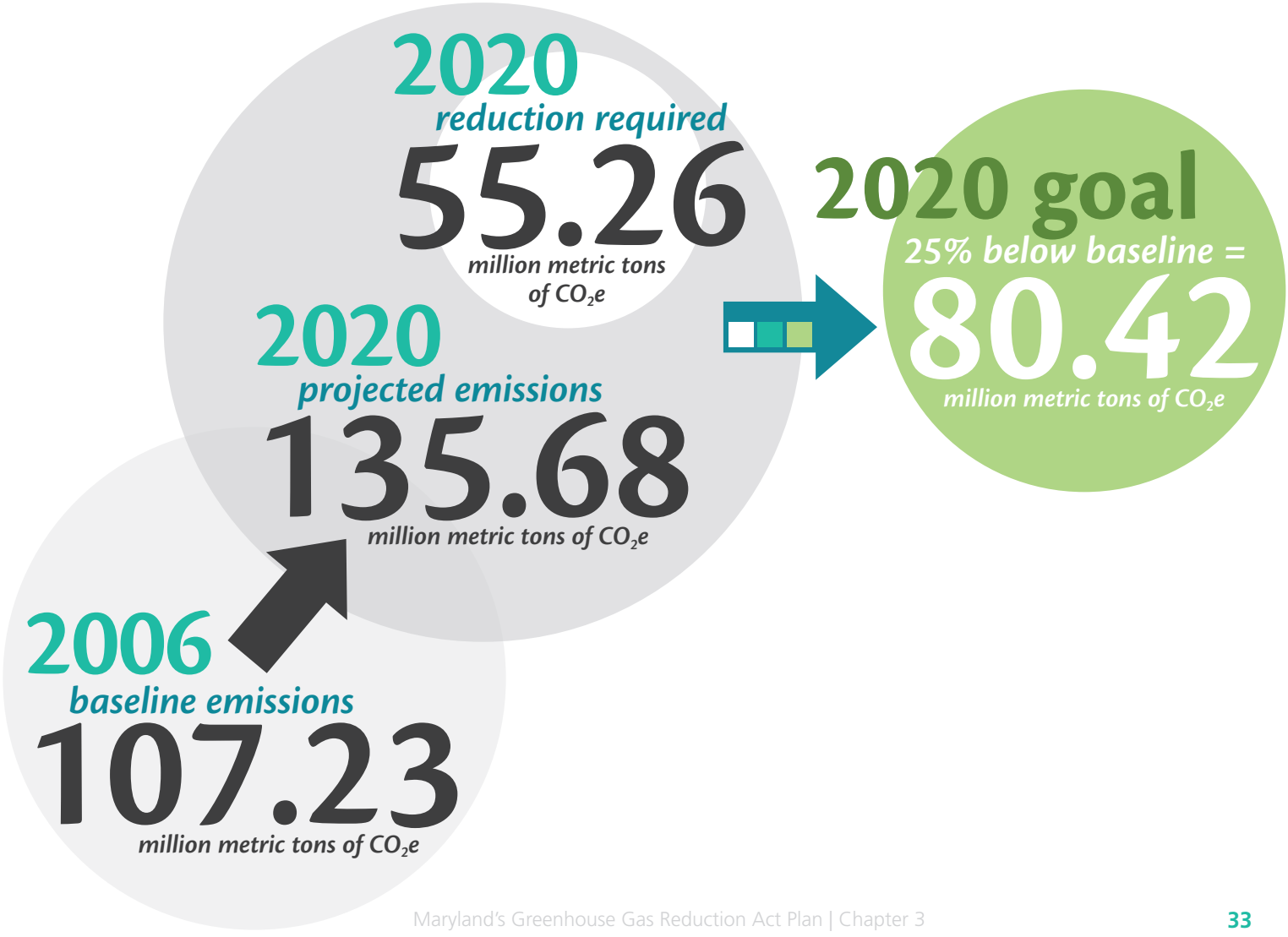


Figure 3.11 Scale representation of baseline (2006) vs. projected (2020) 'business-as-usual' GHG emissions, showing the 2020 reduction goal of 25% below baseline, which will require an overall reduction of 55.26 million metric tons of CO_2e.

DON BOESCH, UMCES

Chapter 4

Climate change and the cost of inaction in Maryland: a 2011 review

This chapter is based upon material provided by the University of Maryland's Center for Integrative Environmental Research

This Chapter summarizes a report by the Center for Integrative Environmental Research (CIER) on the costs associated with failure to implement policies in Maryland to combat the impacts of climate change.* An understanding of the costs associated with inaction is important to inform investment decisions and development of policy. All too often, the focus is on the cost of action and its importance relative to other societal need. Yet, not acting to prevent the impacts of climate change has its own set of costs. Understanding the costs of inaction is vitally important to informed and sound decision making.

Acknowledgment and avoidance of the costs associated with inaction will result in clear local and regional benefits. Without understanding the true benefits of climate action, decision-makers may be misled into thinking that stabilizing or reversing global climate change is a futile expenditure of funds by local governments. In fact, understanding the impacts of climate variability and change on a region's economy, society, and environment is an important precondition for determining the viability and profitability of investments in the economy, society and environment, be it through investments in institutions, infrastructure or the preservation of natural systems.

* The full report, which appears in Appendix F of this Plan, updates CIER's earlier report on the subject (Williamson et al., 2008),[1] which was Chapter 3 of the 2008 Maryland Climate Action Plan.

The high cost of inaction

Temperature is projected to increase substantially, especially due to higher emissions.

Sea-level rise is likely to accelerate, inundating hundreds of square miles of wetlands and land.

Rain and wind from hurricanes are likely to increase.

Precipitation is projected to increase during the winter and become more episodic.

Urban flooding will likely worsen because rainfall events will be more intense.

Health risks due to heat stress will increase.

The number of respiratory illnesses is likely to increase.

Crop production may increase initially, but then decline.

Biodiversity of plants and animals associated with forests is likely to decline.

Chesapeake and Coastal Bays restoration goals will be more difficult to achieve.

As ocean water becomes more acidic, shellfish production and food webs may be harmed.

An increased risk of diseases caused by bacteria and viruses.

Key findings

The updated CIER 2011 report presents the most recent cost/benefit information, and further substantiates CIER's initial findings on the costs of inaction as described in Maryland's 2008 Climate Action Plan.[2] None of the issues presented in the 2008 Plan as important to Maryland have declined in importance, and many have taken on increased importance. The following six factors may have contributed to the rise in the potential cost of inaction and serve to reinforce the urgency of early action to address climate change:

1. Research on climate impacts and response options has progressed significantly in the last few years.

New data and better models confirm that past predictions of global climate change impacts were on the conservative side for both severity and cost. Data confirms that the average temperature of the Chesapeake Bay has warmed by 2°F over the past half-century, which is consistent with observed increases in air temperatures. By mid-century, under a 'business-as-usual' scenario, additional atmospheric warming will surpass 3°F, and the number of days with temperatures exceeding 90°F is expected to triple to 90 days per year. By 2050, there are expected to be 25 to 35 summer days with temperatures exceeding 100°F.[3,4]

2. GHG emissions have grown more rapidly than previously assumed, Arctic sea ice has retreated faster than models predicted, and satellite measurements have shown a recent increase in the rate of sea-level rise.

Average global land and ocean surface temperatures in 2010 tied 2005 as the warmest on record.[5] The acceleration of atmospheric warming, changes in the frequency and severity of extreme weather events, and the rate of sea-level rise have all been faster than previously anticipated. Extreme weather events, including the Texas drought, the lower Mississippi River flood, devastating tornadoes, and forest fires, have broken records, reminding us of the increased risks from both extreme precipitation and extended periods of drought forecast for Maryland.

3. Frequently, the relationship between climate change and associated impacts is non-linear.

Small increases in the rate at which the climate changes can have disproportionately large and far-reaching implications for the economy, society and environment. For example, as the rate of freshwater flow into the Chesapeake Bay increases, driven by precipitation events and snowmelt, the amount of erosion and thus sediment deposition in the Chesapeake Bay will increase

at a faster rate.[6] As an illustration, the first 1,000 cubic feet of water flow may result in 2 pounds of sediment added to the Chesapeake Bay; as water flow increases to 2,000 cubic feet, the sediment addition might be 6 pounds, more than a simple doubling.

4. A steadily growing economy and population mean that even more assets are at risk.

Because most of the growth in Maryland's economic activity and population has occurred along the coast and in urban areas, the costs of inaction have risen. Maryland's coastal zone encompasses two-thirds of the state's land area and is home to almost 70 percent of its residents.[7] By the end of the century, an estimated 6.1 percent of Maryland's 3,190 miles of coastline will be vulnerable to inundation from a 3.3–foot increase in sea level.[8,2] With two feet of additional sea-level rise, 550 square miles of land could also be inundated at high tide, including the homes of over 60,000 people and 66 miles of roads.[9]

5. Interdependencies among social, economic and environmental impacts can ripple through the economy to magnify climate impacts.

Since 1973, the amount of developed land area in Maryland has grown by 135 percent at the expense of other types of land, use such as agriculture and forests.[10] The loss of agricultural and forested land can exacerbate the effect of climate change on water availability from aquifers because as the share of developed land area increases, storm water runoff increases and water is unable to enter and recharge aquifers. In contrast, permeable surfaces such as forest and farmland allow water to infiltrate the soil and recharge aquifers. As another example of ripple effects, increased urbanization can worsen extreme heat in cities, thus requiring more air conditioning during peak heat events, which further drives energy consumption and GHG emissions.

6. The absence of a globally binding climate accord and a robust national energy and climate policy means continuing increases in emissions of GHGs, temperatures, sea-level rise and the frequency and severity of extreme weather events.

CRYSTAL PAYTON, FEMA

Bayside homes in Bowleys Quarters are swamped the day after Hurricane Isabel hit Maryland. The six-foot storm surge generated by the hurricane caused extensive damage in this east Baltimore County community.

JANE HAWKEY, JAN IMAGE LIBRARY

OFFICE OF THE GOVERNOR, MARYLAND

Even without a storm, a full-moon high tide can flood roads, utilities, and waterfront properties on the Eastern Shore of Maryland, 6th June 2012.

The Governor of Maryland surveys infrastructure damage following Hurricane Irene in Anne Arundel County.

Findings by sector

The CIER update report highlights important new developments in climate science and the anticipated impact of climate change on the following five Maryland sectors: (1) coastal land and ecosystems; (2) tourism; (3) agriculture; (4) public health; and (5) energy.

1. Coastal lands, infrastructures, and ecosystems

Maryland's coastal counties, including all of those adjacent to the Chesapeake Bay and the Atlantic Ocean, are home to a significant share of the State's population and infrastructure. Sea-level rise and more frequent and intense weather events will jeopardize the state's infrastructure and related services. For example, in 2010, the trade, transportation, and utility sector alone accounted for $42 billion, or 14 percent, of the gross domestic product in Maryland.[11] Increasingly frequent and severe weather events will not only disrupt supply chains and threaten businesses, but also require expansion of emergency services and thus divert economic resources.

The Federal Emergency Management Agency (FEMA) estimates that existing development in the U.S. coastal zone would experience a 36–58 percent increase in average annual damages for a 1-foot rise in sea level, and a 102–200 percent increase for a 3-foot rise.[12] For every meter of sea-level rise, it is estimated that economic damages from hurricanes double.[13] A storm similar to Hurricane Isabel, which resulted in $485 million (2010$) in damages,[14] is estimated to result in at least twice the damage cost (i.e., close to $1 billion) in the context of a three-foot rise in sea level. By accounting for population growth and development, this figure would be higher.

Increasing atmospheric carbon dioxide levels and sea-surface temperatures is expected to increase storm intensity and economic damages. It is estimated that every doubling of atmospheric carbon dioxide results in a doubling of hurricane damages — independent of the effects of sea-level rise.[13] If this climate influence is again applied to the impacts of Hurricane Isabel, the damage done by a hurricane striking at the end of the century would be amplified four times and reach damages of approximately $1.9 billion (2010$).

The Maryland Commission on Climate Change's Scientific and Technical Working Group projected 2.7–3.4 feet (0.82 meters to 1.04 meters) of relative sea-level rise by the end of the century.[3] Figure 8 in Appendix F of this Plan depicts the low lying areas at risk from sea-level rise in the southern half of the Eastern Shore (Dorchester and Somerset Counties). These areas have many acres of ecologically diverse tidal wetlands, marshes, and farmland that could be swallowed by waves. Already, 13 islands in the Chesapeake Bay are submerged and a similar fate awaits 400,000 acres on the Eastern Shore.[15]

The vulnerability of Maryland residential areas (U.S. Census Populated Places) to a sea-level rise of 3.3 feet (1 meter) was evaluated using geographic information system tools. Storm surge and high tide were not considered in the analysis. The analysis shows that 67.3 square miles of Maryland residential area would be inundated. Figure 4.1 below identifies the top twenty locations that would be affected by a

3.3 foot sea-level rise according to the percentage of each land area that is at risk.

Experience from Florida shows that by failing to adequately take into account higher risks of property damage due to floods and winds, insurers may pull out of high-risk areas or default on claim coverage upon high-impact events. In turn, this shifts the burden of risk and damage to the taxpayer. For instance, after massive storms hit Florida in 2004 and 2005, many companies retreated from vulnerable parts of the state to limit their exposure. Average rates in Florida doubled and the state government is playing a growing role as an insurer of last resort for homeowners who cannot find private insurance.[16]

The trade, transportation, and utilities sectors accounted for $42 billion or 14 percent of Maryland's gross domestic product in 2010.[11] These sectors provide an indispensable pillar to the state's economy. Much of the income generated in Maryland's Baltimore-Washington corridor—the State's most economically valuable region, with 89 percent of the wages[17,18]—depends on reliable transportation. Existing storm water and transportation infrastructures are generally designed based on historic precipitation patterns and do not account for future climatic trends. As a result, key dimensions of major infrastructure investments, such as bridge height, pipe diameters, and storm water retention facilities, may be significantly under-designed to accommodate more precipitation, particularly for intermediate term peak events. One consequence of under-designed storm water infrastructure is that peak floods may be more frequent and severe than in the past.

Although snow is projected to diminish on average, episodes of intense snowfall are expected to increase, making driving conditions difficult or roads impassable. Other consequences of extreme snow include disrupted supply chains, hindered emergency services and increased costs for snow removal. For example, in 2010, the blizzard "Snowmageddon" blanketed Maryland under a thigh-high layer of snow and brought practically all transportation to a standstill, causing billions of missed income for the retail sector throughout the Northeast.[19] Moreover, Maryland's $26 million snow budget had already been depleted from cleaning up a December 2009 blizzard.

Maryland's transportation sector and economy are also vulnerable to climate-induced disruptions of the fuel supply chain, whether originating within or outside the state. For example, after Hurricane Katrina hit the Gulf Coast, disruptions in oil and gas extracting, refining and transmission increased gasoline prices in the Mid-Atlantic by 17 percent, from $2.50 to $2.93 per gallon.[20] Similarly, in 2008, the arrival of Hurricanes Ike and Gustav on the Gulf Coast disrupted refinery operations and caused power outages, which ultimately shut down transportation pipelines and significantly reduced the supply of gasoline, jet-fuel, heating oil, and propane in Maryland.

JONATHAN BRUCK

A line-up of snowplows remove snow from the road in Silver Spring following record snowfall known as Snowmageddon, on February 6, 2010.

Figure 4.1 Top twenty Maryland places (U.S. Census populated places) by percentage area at risk from 3.3 ft (1 m) relative sea-level rise.

Locations	Area (mi^2)	Sea-level rise risk area (mi^2)	Percentage at risk
Frenchtown-Rumbly	4.18	3.88	92.73
Dames Quarter	12.70	11.24	88.47
Deal Island	3.29	2.32	70.53
Smith Island	6.92	4.02	58.08
Fairmount	15.33	8.53	55.66
Church Creek	0.31	0.17	53.89
Chance	1.77	0.83	47.16
Crisfield	1.69	0.69	40.93
Potomac Heights	1.37	0.48	35.38
Kent Narrows	2.25	0.72	32.05
Chesapeake City	0.61	0.19	30.74
Highland Beach	0.08	0.02	30.47
Golden Beach	3.44	1.03	29.99
Oxford	0.72	0.21	29.65
Ocean City	4.62	1.34	28.94
Tilghman Island	2.85	0.82	28.65
West Ocean City	4.32	1.11	25.76
Mount Vernon	15.01	3.82	25.47
Stevensville	6.17	1.44	23.28
Deale	4.31	0.98	22.82

CRYSTAL PAYTON, FEMA

The remains of the half-mile Boardwalk Promenade in Havre de Grace litter the shoreline of Chesapeake Bay at Havre de Grace. The well known tourist attraction was completely destroyed by the storm surge generated by Hurricane Isabel.

2. Tourism

In 2009, tourism in Maryland generated roughly $13.7 billion in spending, which resulted in $1.6 billion in tax revenue, directly supported 134,677 full-time equivalency jobs and provided $3.8 billion in salaries and wages. Every year, between 27 and 30 million visitors come to Maryland. Each visitor stays an average of 1.6 days and spends $250 per trip.[21]

Since much of Maryland's tourism is heavily dependent on short-term summer trips made by people from nearby destinations, and since such trips are not usually booked months in advance, the State's tourism industry is sensitive to extreme summer weather conditions. By mid-century, the number of days with temperatures exceeding 90°F is expected to increase threefold. Heat waves will be more frequent and longer lasting,[3] making Baltimore and other Maryland cities less pleasant to visit. While the loss of summer revenues could be offset by increased travel during the "off season," businesses will be adversely impacted by increasing volatility in tourism and an atmosphere of economic uncertainty driven by weather events. Assuming a linear relationship, a five percent reduction in the tourist sector would translate to a loss of $685 million annually and approximately 6,700 jobs.

In addition, tourism can be affected by threats to the physical environment such as sea-level rise (Figure 4.1). Increasing beach erosion as well as the frequency of major storms will most likely raise the cost of maintaining Maryland's beaches and shoreline, or make it a less attractive tourist destination. It is estimated that beaches will move inland at a rate 50 to 100 times faster than the rate of sea-level elevation and that the cost of replenishing the coastline after a 20-inch rise in sea level would be between $35 and $200 million.[8,22] In addition, beach replenishment creates its own adverse externalities, including high ecological costs. Dredged material buries beach plants and animals and is detrimental to the existing ecosystem because the material used to replenish beaches is often unsuitable for the reintroduction of the same species, or of any species.[16]

3. Agriculture

Roughly one-third of Maryland's six million acres is farmland and agriculture plays a central role in the State's economy. In 2007, the market value of agricultural products sold by Maryland farms was $1.8 billion. Of this value, $629 million (34 percent) was in the form of crop sales and $1.2 billion (66 percent) in livestock. Of the latter, poultry and egg production comprised 75 percent ($903 million, 49 percent of the total).[23]

It is because of the significance of Maryland's agricultural sector to the economy as a whole that consideration of climate impacts is particularly important. Most segments of the Maryland agriculture industry face increasing costs resulting from climate variability. As mentioned above, poultry production is responsible for a large portion of the industry's revenue. The majority of production is located on the Eastern Shore, the area of the State most at risk of inundation from a rise in sea level. In addition, rising summer temperatures and more frequent and longer-lasting heat waves could cause animals to grow more slowly or even die from heat stress. Chickens and turkeys are primarily raised in enclosures, so warmer temperatures will require more energy for building cooling and ventilation.[24] Finally, changing climatic conditions may increase the prevalence of pathogens that, in turn, increase the cost of disease prevention or decrease production. In the absence of climate change, poultry meat, which cost $1,203 per metric ton in 2000, would be expected to increase 34.7 percent to $1,621 per metric ton in 2050. With climate change, the price increase is 63.6 percent, resulting in $1,968 per metric ton in 2050, a difference of $347 per metric ton compared to the no-climate change scenario.[25]

The production of crops such as corn, soy and wheat will face new challenges, for example: increased irrigation needs, a higher risk of flooding, lower crop yields due to rising temperatures, new pests and increased variability in precipitation. Photo © istockphoto

The production of crops such as corn, soy and wheat will also face new challenges. Those that seem most likely include increased irrigation needs, a higher risk of flooding, lower crop yields due to rising temperatures, new pests and increased variability in precipitation. Although a moderate rise in average temperatures and higher carbon dioxide levels can lengthen the growing season and stimulate crop growth, the adverse impacts of climate change are expected to outweigh these benefits. Even where positive impacts are expected in the short term, optimal growing conditions will be surpassed towards the end of this century.[24]

Additionally, more frequent and intense rainfall can overwhelm nutrient runoff management systems and require investments by farmers and local communities to reduce the adverse impacts to water systems caused by nutrient runoff. For example, farmers may need to more actively monitor soil nutrients and moisture to ensure optimal growing conditions. Furthermore, downstream impacts on streams, rivers and the Chesapeake Bay will be exacerbated by increased nutrient runoff. It may become increasingly difficult for Maryland localities and the State to comply with federal water quality standards (e.g., Total Maximum Daily Loads), something that will require Maryland to adopt more aggressive and costly water protection measures to achieve and remain in compliance.

Increased climate variability means that farmers will have to be prepared for a wider range of climatic conditions. This could mean compromising crop yield with disease and weather resilience, or risk crop failure.[24] It also means more intense crop management with increasing equipment costs, which could be problematic for the many small-scale farmers in Maryland.

4. Public health

Rising temperatures and an increase in precipitation variability is likely to influence air quality, heat stress, and vector-borne diseases across Maryland. Additionally, the risk of water contamination, such as harmful algal blooms, will increase due to changes in temperature and precipitation patterns.[24] As summer days grow warmer due to the effects of climate change, Baltimore and other urban areas should be prepared to manage higher rates of heat-related adverse health effects. Furthermore, large changes in day-to-day temperatures can be expected to happen more frequently, which will have an adverse impact on mortality rates.[26]

The impacts of climate change on human health will depend on a number of factors, including an individual's particular sensitivity or vulnerability. The capacity to adapt to change is partially a function of socioeconomic factors. Socially and economically disenfranchised individuals—the elderly, the disabled and the poor—are the most vulnerable, raising environmental justice concerns.[27]

5. Energy

Climate changes will influence energy demand. Higher winter temperatures will reduce heating needs and lower demand for heating fuels. However, summer cooling requirements, typically met by electricity, will increase with more frequent and extreme heat events. Even if total annual electricity consumption in the State remains relatively constant, more extreme heat events are likely to lead to higher peak electricity demand during the summer months, thereby necessitating an increased investment in electricity generation capacity and transmission with those costs being passed along to rate payers.

Energy resource production and transmission/delivery systems along the Gulf Coast and the East Coast are vulnerable to sea-level rise and extreme weather events. A hurricane landfall in the Gulf Coast region, where such storms occur more frequently than in the Mid-Atlantic, poses a substantial risk to Maryland due to the oil and gas interconnections between the two regions. Hurricanes Katrina and Rita shut down large natural gas production facilities in the Gulf region, which led to an increase in prices from under $10 to over $14 per million British Thermal Unit. Locally, snowstorms and hurricanes damage power lines and disrupt the delivery of fuel oil. Heating fuels are expected to be in less demand as winter temperatures increase. The net impact on natural gas, which serves as both a peak electricity fuel and a primary heating fuel, is uncertain. While less natural gas will be consumed to meet heating requirements, more natural gas is likely to be consumed to meet electricity demand during extreme heat events in the summer. Climate change will also impact renewable electricity sources such as bio-fuels, solar and wind. The warming of the planet is expected to mean greater variability in wind resources and direct solar radiation, which has substantial implications for the planning, siting, and financing of wind farms and solar power generators.[28]

Approach

Appendix F contains a detailed discussion of CIER's study methodology. Section 3 of the appendix provides an overview of new developments in global climate change science since the 2008 Plan, followed by a review of expected climate changes in Maryland in Section 4. Section 5 assesses how the regional climate projections play out in Maryland's urban and rural coastal zones, where vulnerability is expected to be especially high. Sections 6, 7, 8 and 9 focus on tourism, agriculture, public health and energy sectors, respectively. Appendix F closes with a summary of the most important findings and lessons learned.

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Chapter 5

UNIVERSITY OF MARYLAND, BALTIMORE COUNTY

A multi-pollutant planning approach for Maryland

The Northeast States for Coordinated Air Use Management (NESCAUM) contributed to this Chapter.

The GGRA and environmental planning in Maryland

The 2012 Greenhouse Gas Emissions Reduction Act (GGRA) Plan is part of a larger environmental planning effort in Maryland. It is the first of three key pollution reduction plans the Maryland Department of the Environment (MDE) will be releasing over the next few years that use a "multi-pollutant" planning approach for selecting and analyzing control programs. The 2012 GGRA Plan will not only help reduce emissions of greenhouse gases (GHG), but will also help Maryland meet its mandates to: (1) further clean up the Chesapeake Bay; (2) meet new National Ambient Air Quality Standards* for ground-level ozone, fine particles, sulfur dioxide, and nitrogen dioxide; and (3) meet federal and State requirements to further reduce regional haze as well as mercury and other air toxics.

The three key pollution reduction plans will be developed as follows:

- Phase 1: Developing the GGRA Plan that must be adopted in December 2012
- Phase 2: Developing the State Implementation Plan required by the federal Clean Air Act to implement the revised 0.075 parts per million ozone standard. This plan will be due in 2013 or 2014.
- Phase 3: Developing the State Implementation Plan required by the federal Clean Air Act to meet the revised fine particle standard (expected in late 2012), and will be due in 2013 or 2014.

In addition to these key plans, there are several other environmental planning efforts that will benefit from the multi-pollutant planning process established for the 2012 GGRA Plan, such as regional haze, and mercury and other air toxics. The 2012 GGRA Plan is also expected to help the State with economic recovery and to help create new green jobs.

* The U.S. EPA sets National Ambient Air Quality Standards for 6 pollutants considered harmful to public health and the environment, which are called criteria pollutants. Some of these pollutants are emitted directly into the air; others form as the result of a combination of emissions. The six criteria pollutants are: ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead.

Linkages between GHGs & air pollution

There are some critical linkages between GHGs and other air pollutants. First, studies have indicated that climate change, if unaddressed, could result in increased ozone and fine particle levels.[1] Second, many programs that are designed to lower GHG emissions, such as energy efficiency programs, may also reduce emissions of nitrogen oxides, sulfur dioxide, mercury, other toxic metals, diesel exhaust, and black carbon. Third, some programs that are designed to lower GHG emissions may result in increases in ozone-forming emissions, such as volatile organic compounds. Working on climate, energy, criteria pollutant, and toxics issues together helps maximize benefits while also ensuring that any adverse effects are minimized.

The next section describes how Maryland defines multi-pollutant planning.

The multi-pollutant approach

Historically, Maryland's air pollution problems have been addressed on a pollutant-by-pollutant basis. Each pollutant, or pollutant category, of concern has required its own discrete planning effort. As today's environmental and public health challenges become more complex, states are recognizing the importance of moving to a more integrated, multi-pollutant, economy-wide approach. Maryland began its movement into an integrated approach with the 2006 Healthy Air Act, a four pollutant law. It set standards for three pollutants; 1) nitrogen oxides, 2) sulfur dioxide, and 3) mercury. Additionally, it required Maryland to participate in a GHG reduction program.

This approach was extremely successful and very cost effective. The controls for nitrogen oxides and sulfur dioxide also lead to reductions in mercury so that, in some cases, mercury-specific technologies were not necessary. This success has led to a more in-depth approach to multi-pollutant planning that not only considers cost effectiveness to the source but a broad spectrum of benefits from an overall economic and public health perspective as well as energy implications.

A comprehensive multi-pollutant planning approach looks at multiple air quality goals concurrently and assesses potential control approaches and their collective environmental, public health, energy, and economic impacts. It will help Maryland address multiple pollution problems in a more strategic, cost-effective and resource-efficient manner.

For years, major businesses have pushed for a more integrated, multi-pollutant approach for pollution controls. Through this multi-pollutant planning process, MDE's Air and Radiation Management Administration hopes to better integrate across environmental problems and design commonsense, integrated, cost-effective solutions that will not only maximize environmental protection, but also significantly reduce the cost to regulated sources.

While the concept of multi-pollutant planning sounds simple, implementing the approach is complex and pioneering work. Only a handful of states have been proactively engaging in multi-pollutant activities, and the U.S. Environmental Protection Agency (EPA) has only recently begun exploring how to assist states in such efforts. Maryland has been a leader, working with other Northeast states such as New York, the Northeast States for Coordinated Air Use Management* (NESCAUM), and EPA on multi-pollutant planning.

A multi-pollutant approach can help educate the State's decision makers about how various policies and programs may interact, be effective, and yield benefits. A multi-

* Northeast States for Coordinated Air Use Management is a non-profit association of air quality agencies in the Northeast. For more information, see: *http://www.nescaum.org*

pollutant approach that makes sense for Maryland is one that integrates climate, the Chesapeake Bay, air quality, and energy goals. It can also conduct health and economic assessments in addition to traditional air quality assessments. Maryland's view of multi-pollutant planning is that it:

- Address multiple pollutants, including carbon dioxide, sulfur dioxide, nitrogen oxides, and mercury
- Highlight tradeoffs and co-benefits of various policy options
- Analyze the environmental, public health, economic, and energy implications of various potential control programs
- Allow for multi-sector analyses

The multi-pollutant approach will enable simultaneous policy and economic analyses consistent with requirements of the GGRA. It will also help Maryland integrate GHG mitigation and future air quality planning for ozone, fine particles, and regional haze into a consolidated analytical and policy framework.

JACK LYONS

Programs that are designed to lower GHG emissions may also reduce emissions that cause regional haze.

Fossil fuel combustion at power plants is the key source of nitrogen oxides, sulfur dioxide, fine particles, and mercury. Reducing nitrogen oxide emissions also leads to lowered ozone levels.

Sulfur dioxide emissions also come from burning high-sulfur fuel in locomotives and marine vessels.

List of co-pollutants

Almost all of the control programs selected to reduce GHG emissions in the proposed GGRA Plan also reduce emissions of other pollutants of concern. These pollutants include nitrogen oxides, sulfur dioxide, ozone, fine particles, and mercury and other air toxics. In addition, air pollution affects not only the quality of the air, but also the land and the water, as many pollutants released into the air will eventually make their way down to the earth's surface. Rain and snow wash air pollution deposited on vegetation and architectural surfaces into the streams and rivers of the region and finally into the Chesapeake Bay.

This section describes the non-GHG co-pollutants and benefits associated with reducing them.

Nitrogen oxides

Nitrogen oxides contribute significantly to Maryland's primary air quality problems: ground level ozone (a lung irritant), fine particles (associated with lung and pulmonary public health problems), and nitrogen dioxide (adversely affects the respiratory system). They also contribute to Maryland's water quality problems in the Chesapeake Bay and elsewhere. While the Chesapeake Bay suffers from water pollution run-off from the surrounding land, it is important to note that approximately one-third of the Chesapeake Bay's nitrogen pollution problem is due to airborne nitrogen.

Nitrogen oxides are primarily a product of combustion emitted from power plants, and many types of motor vehicle engines used on and off highways, that burn fossil fuels. Nitrogen oxides are a major contributor in the creation of ground level ozone. In Maryland, ozone typically is formed on hot summer days, when nitrogen oxides combine with volatile organic compounds in the presence of sunlight to photochemically produce ozone. Nitrogen oxides also play a key role in contributing to Maryland's fine particle pollution.

Sulfur dioxide

Sulfur dioxide is the primary pollutant contributing to unhealthy fine particle levels in Maryland. It is also the primary pollutant linked to acid rain, as well as the main contributor to reduced visibility across the country. The regional haze requirements of the federal Clean Air Act are designed to address the visibility issues. Sulfur dioxide by itself has adverse respiratory effects, and as a result EPA has established National Ambient Air Quality Standards for the pollutant.

Sulfur dioxide emissions mostly come from fossil fuel combustion at power plants and other industrial facilities, as well as from the burning of high-sulfur fuel in off-road vehicles, such as locomotives and marine vessels.

Fine particles

Reducing emissions of sulfur dioxide and nitrogen oxides generates significant public health benefits by lowering levels of fine particles in the air Marylanders breathe. The size of particles is directly linked to their potential for causing health problems. Fine particles less than 2.5 microns in diameter pose the greatest risk because they can lodge deep into the lungs and some particles may pass into the bloodstream. Therefore, exposure to such particles can affect both lungs and heart. Particulate pollution exposure is linked to increased risk of respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; decreased lung function; aggravated asthma; onset of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. Another concern with fine particles is that their adverse impacts occur year-round versus the seasonal nature of ozone impacts.

Environmental effects of particle pollution include reduced visibility, environmental damage, and structural degradation. Fine particles are the major cause of haze in many national parks and wilderness areas. Particles can be carried over long distances by wind and then settle on ground or water, causing more acidic lakes and streams, changed nutrient balance in coastal waters and large river basins, depletion of nutrients in soil, damage to sensitive forests and farm crops, and affects on the diversity of ecosystems. Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments.

Ozone

Reducing nitrogen oxide emissions leads to lowered ozone levels, resulting in significant public health benefits. Ozone is a highly reactive gas that reacts strongly with living tissues as well as many man-made substances. Volatile organic compounds assist in forming ozone; volatile organic compounds are emitted from a variety of products, such as gasoline, paints and building materials.

Ninety percent of the ozone breathed into the lungs is never exhaled, as the ozone molecules react strongly with lung tissue. The most common symptom is pain when taking a deep breath. Exposure to ozone can result in long- and short-term effects in healthy individuals as well as those who are already sensitive to air pollution, such as children, asthmatics and the elderly.

SHENANDOAH NATIONAL PARK

Fine particles are the major cause of haze in many national parks and wilderness areas. Here you can see the impacts of haze from the Dickey Ridge viewpoint in Shenandoah National Park.

Children are at greater risk for ozone-related respiratory problems because their lungs are still developing, they breathe more rapidly, and they play outside during the afternoons, when ozone is at its highest levels.

Healthy young people can develop significant reduction of lung function, additional coughing and breathing pains, and enhanced airway reactivity to irritants when exposed to ozone while exercising moderately.

Long-term ozone effects may include reduced lung function, scarring of lung tissue, and even premature death.[2] Research suggests that repeated exposure to ozone may cause damage to lung tissue, thereby reducing lung function. According to EPA, "Long-term exposures to ozone can cause repeated inflammation of the lung, impairment of lung defense mechanisms, and irreversible changes in lung structure, which could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis."[3]

Children are at greater risk for ozone-related respiratory problems because their lungs are still developing, they breathe more rapidly, and they play outside during the afternoons, when ozone is at its highest levels. Children also inhale more air, hence more pollution, per pound of body weight than do adults.[4] Additionally, people suffering from lung disease have even more trouble breathing when air is polluted with high levels of ozone. Prolonged exposure, even to relatively low levels of ozone, can even significantly reduce a healthy adult's lung function.[5]

Short-term ozone effects among healthy populations include impaired lung function and reduced ability to perform physical exercise. For example, healthy young people developed significant reduction of lung function, additional coughing and breathing pains, and enhanced airway reactivity to irritants when exposed to ozone at concentrations between 80–120 parts per billion for 6.6 to 7.0 hours while moderately exercising.

Ozone poses a threat to the health of natural ecosystems. Scientific evidence suggests that air pollution weakens the immune systems of many types of vegetation and can cause significant crop damage.

Mercury and other air toxics

Mercury is a potent air toxic that can cause serious adverse neurological effects, as well as harm the brain, heart, kidneys, lungs, and immune system. Airborne chemical contaminants such as mercury also affect the Chesapeake Bay. Mercury is a naturally occurring element found in rocks, including coal. When coal is burned at power plants, mercury is released into the environment. It can then be deposited into Maryland's waters by falling to the ground in rain, snow, or fog and by attaching to dust or smoke. Airborne mercury emissions are the primary contributor to the State's ongoing problems with mercury in water bodies. Accumulation of mercury in fish tissue has resulted in widespread fish consumption advisories.

Further reducing the risk of exposure to other air toxics, such as benzene and acetaldehyde, is also critical for protecting public health. Levels of these toxic emissions, which typically come from cars and other mobile sources, have significantly declined in Maryland with the implementation of cleaner fuels, advanced technology vehicles, and inspection & maintenance programs.

Benefits from reducing co-pollutants

Chesapeake Bay benefits

One of the primary goals of Maryland's effort to reduce GHG emissions is to begin addressing sea-level rise, which can have a dramatic impact on the living resources of the Chesapeake Bay and other coastal areas. Chapters 2 and 4 of the 2012 GGRA Plan provide additional information on the impacts of sea-level rise in Maryland.

In addition to addressing sea-level rise, the 2012 GGRA Plan could yield co-benefits that assist in Maryland's efforts to further reduce pollution entering the Chesapeake Bay. One co-benefit is achieved by adopting programs that reduce nitrogen oxide emissions contributing to excess nitrogen pollution in the Chesapeake Bay. While nitrogen is a needed nutrient for plant growth, too much nitrogen from human activities degrades water quality in the Chesapeake Bay watershed.

According to the Chesapeake Bay Program,* most nitrogen comes from:

- Airborne emissions from vehicles, power plants, industries, and other sources (33%);
- Chemical fertilizers applied to agricultural and urban and suburban lands, such as lawns and golf courses (26%);
- Treated wastewater discharged from industrial facilities and municipal wastewater treatment plants (19%);
- Manure from agricultural lands (18%);
- Septic systems that treat household wastewater and discharge nutrients into groundwater (4%);
- Nitrogen also occurs naturally in soil, animal waste, plant material and the atmosphere.

* Chesapeake Bay Program. "Nutrients." *http://www.chesapeakebay.net/nitrogen.aspx?menuitem=19412*

P. ALEJANDRO DIAZ

Too much nitrogen pollution in the Chesapeake Bay can cause algal blooms. Reducing GHG emissions will also help to improve water quality in the bay.

Excess nitrogen fuels the growth of algae, creating dense algae blooms on the surface of the water that rob the Chesapeake Bay's aquatic life of sunlight and dissolved oxygen. "Leftover" algae that are not consumed by algae-eating organisms eventually die and sink to the bottom. There, they are decomposed by bacteria in a process that leaves bottom waters with little or no dissolved oxygen that crabs and other bottom-dwelling species need to survive.

Algae can also grow directly on vegetation, further reducing the amount of sunlight they receive. Without sunlight, bay grasses cannot grow and provide critical food and habitat for blue crabs, waterfowl, and juvenile fish.

Nearly 600,000 Marylanders living in areas with high ozone pollution suffer from asthma, chronic bronchitis, or emphysema.

Impacts on public health

In the 2011 "State of the Air" report for Maryland,[6] the American Lung Association reported that there are almost five million people living in Maryland's ozone non-attainment areas, of whom over one million were under 18 years old and over 600,000 were 65 years or older. Of these, there were:

- Nearly 350,000 adult asthmatics and over 140,000 child asthmatics;
- Almost 165,000 residents with chronic bronchitis;
- Over 80,000 residents with emphysema.

Given that multiple pollutants and a variety of sources cause Maryland's pollution problems, it is critical to implement a multi-pollutant approach. The 2012 GGRA Plan provides an opportunity to start this process.

Key multi-pollutant programs in Maryland

Maryland has made considerable progress in improving the region's air quality. Throughout the 1990's, Maryland, on average, experienced half the number of bad air quality days when the ozone levels exceeded the federal Clean Air Act national standard than were seen in the 1980's. The summers of 2003 and 2004 were the cleanest on record since Maryland began measuring ozone air pollution. Numerous pollution controls within Maryland as well as some significant pollution controls occurring on a national level have had a major effect upon Maryland's air quality with respect to ozone.

The Maryland Healthy Air Act

The Maryland Healthy Air Act (Annotated Code of Maryland Environment Title 2 Ambient Air Quality Control Subtitle 10 Health Air Act Sections 2-1001–2-1005) was developed with the purpose of reducing emissions of nitrogen oxides, sulfur dioxide, and mercury from the coal-burning electricity generating sector (power plants). The State's Healthy Air Act is one of the most stringent power plant emission laws on the East Coast.

The law was designed to bring Maryland into attainment with the National Ambient Air Quality Standards for ozone and fine particulate matter while also reducing mercury emissions and deposition of nitrogen to the Chesapeake Bay and other waters. The Healthy Air Act also required that Maryland become involved in the Regional Greenhouse Gas Initiative which is aimed at reducing GHG emissions from electricity generation. The Regional Greenhouse Gas Initiative is discussed in more detail in Chapter 6.

MDE was charged with implementing the Healthy Air Act through regulations. These regulations, which became effective on July 16, 2007, constitute the most sweeping air pollution emission reduction measures in Maryland's history.

Over 95 percent of the air pollution emitted from Maryland's power plants came from the largest and oldest coal burning plants. The emission reductions from the Healthy Air Act occur in two phases. The first phase required reductions in the 2009/2010 timeframe. The law was designed to reduce nitrogen oxide emissions by almost 70 percent, sulfur dioxide emissions by 80 percent, and mercury emissions by 80 percent, from a 2002 emissions baseline. The second phase of emission controls will occur in the 2012/2013 timeframe. When fully implemented, the Healthy Air Act will reduce nitrogen oxide emissions by approximately 75 percent, sulfur dioxide emissions by approximately 85 percent, and mercury emissions by 90 percent from 2002 levels. Figures 5.1 and 5.2 illustrate the dramatic emission reductions from the 2009/2010 phase of the Healthy Air Act.

In addition to tackling the State's ozone problem, the Healthy Air Act protects the Chesapeake Bay by reducing nitrogen and mercury pollution from the air. In 2010, emission monitoring showed the mercury emissions from HAA sources had been reduced by 93 percent. It also helps to improve visibility throughout scenic areas in Maryland and other states.

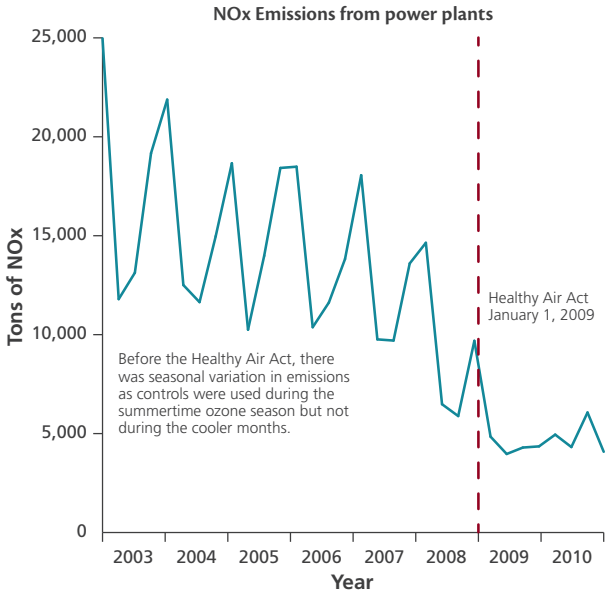

Figure 5.1 Quarterly emissions trend of nitrogen oxides (NOx) between 2003 and 2011.

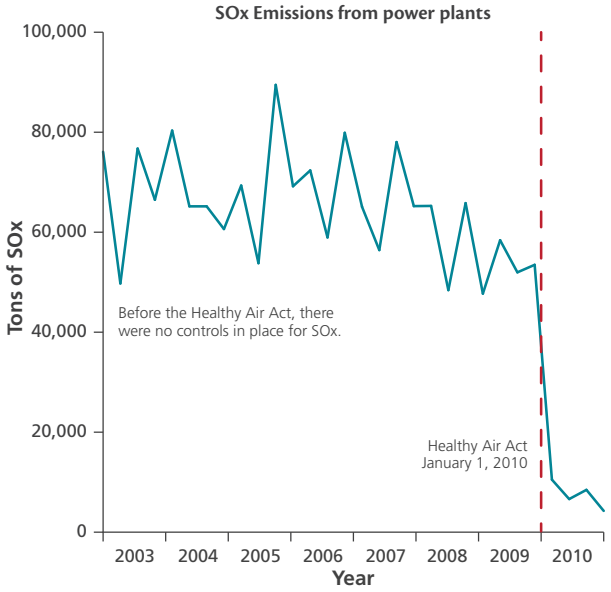

Figure 5.2 Quarterly emissions trend of sulfur oxides (SOx) between 2003 and 2011.

The Maryland Clean Cars Program requires all vehicles sold in Maryland to comply with stringent emission standards, reducing four key pollutants: GHGs, nitrogen oxides, volatile organic compounds, and air toxics.

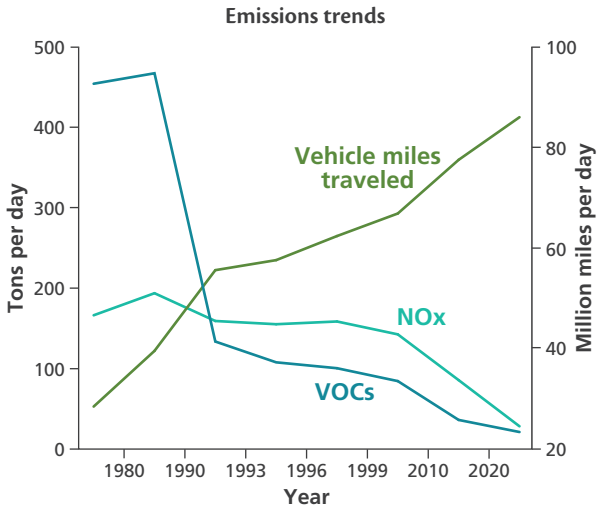

Figure 5.3 Emissions trends for vehicle related nitrogen oxides (NOX) and volatile organic compounds demonstrating sharp reductions in overall emissions while total vehicle miles traveled significantly increases.

The Maryland Clean Cars program

In 2006, Maryland adopted the Clean Cars Act. This law requires that the cleanest cars allowed by law must be sold in Maryland, starting with model year 2011 vehicles. The law requires all vehicles sold in Maryland to comply with stringent emission standards, which reduces emissions of four key pollutants: GHGs, nitrogen oxides, volatile organic compounds, and air toxics.

The Maryland Clean Cars Program helps Maryland in four important ways. First, it is a key part of the State's plan to combat climate change. Second, it helps move the State closer to meeting federal health-based standards for ozone and fine particles. Third, it reduces emissions of air toxics like benzene. Fourth, by reducing nitrogen emissions and toxics, it supports efforts to protect the Chesapeake Bay.

When fully implemented, the Maryland Clean Car Program is estimated to reduce GHG emissions by 7.8 million tons per year and air toxics by 80.2 tons per year. The carbon dioxide reductions provided by this program are the equivalent to removing one 1,200 megawatt coal burning power plant from the State. In addition, the Maryland Clean Car Program will reduce the emissions of nitrogen oxides and volatile organic compounds by 5.18 tons per day and 3.55 tons per day, respectively. The Maryland Clean Cars Program is further discussed in Chapter 6.

Figure 5.3 shows the dramatic emission reductions of nitrogen oxides and volatile organic compounds from mobile sources already achieved, and anticipated to be achieved, in Maryland.

EmPOWER Maryland

In 2007, Maryland launched EmPOWER Maryland as an executive initiative, setting a goal for the State government to reduce its electricity consumption by 15 percent by 2015. The initiative called on State government to increase energy efficiency in its operations through improved facility operations and purchasing practices and established accountability through energy data reporting into StateStat, the Maryland statistics-based government management process.

The EmPOWER Maryland goal was broadened and codified in the EmPOWER Maryland Energy Efficiency Act of 2008.* The law established a statewide goal of reducing per capita electricity consumption and per capita peak demand by 15 percent from a 2007 baseline by the end of 2015. These reductions are being achieved through a number of programs, such as utility energy efficiency programs targeted to consumers and demand-side management. The utilities' initial program plans and periodic updates must be submitted to the Maryland Public Service Commission for review and approval, following advisory review by the Maryland Energy Administration.†

Although the primary purpose of the EmPOWER Maryland Program is to reduce energy consumption, the initiative will also significantly reduce emissions of GHGs, nitrogen oxides, and sulfur dioxide from the energy generation sector, primarily from power plants. EmPOWER Maryland is discussed in more detail in Chapter 6.

* Md. Public Utility Companies Code § 7-211 (House Bill 374, General Assembly 2008).

† Links to the utilities' EmPOWER Maryland programs are on the Maryland Energy Administration's website at: *http://energy.maryland.gov/facts/empower.html*

Multi-pollutant policy analysis framework

The non-GHG co-pollutants described previously are strongly linked to energy infrastructure in many sectors of the economy. In order to maximize human resource savings, multi-pollutant planning tools are needed that can simultaneously examine policies and programs across pollutants, sectors, and programs. To assist states in implementing a multi-pollutant planning approach, NESCAUM developed a Multi-pollutant Policy Analysis Framework, as shown in Figure 5.4. The Multi-pollutant Policy Analysis Framework brings together and uses a series of assessment models, tools, and databases that are linked in order to conduct multi-pollutant analyses. These models include:

- NE-MARKAL, a Northeast version of the Market Allocation model, an energy model that is widely used in Europe;
- Regional Economic Models, Inc. (REMI), which evaluates the effects of policies on the economies of local regions;
- The EPA's Community Multi-scale Air Quality (CMAQ) model, which assesses future air quality changes for a set of policies;
- The EPA's Environmental Benefits Mapping and Analysis Program (BenMAP), which estimates health impacts and associated economic values resulting from changes in ambient air pollution.

These models, through the Multi-pollutant Policy Analysis Framework, can evaluate potential programs to simultaneously address air quality, Chesapeake Bay and climate goals in Maryland.

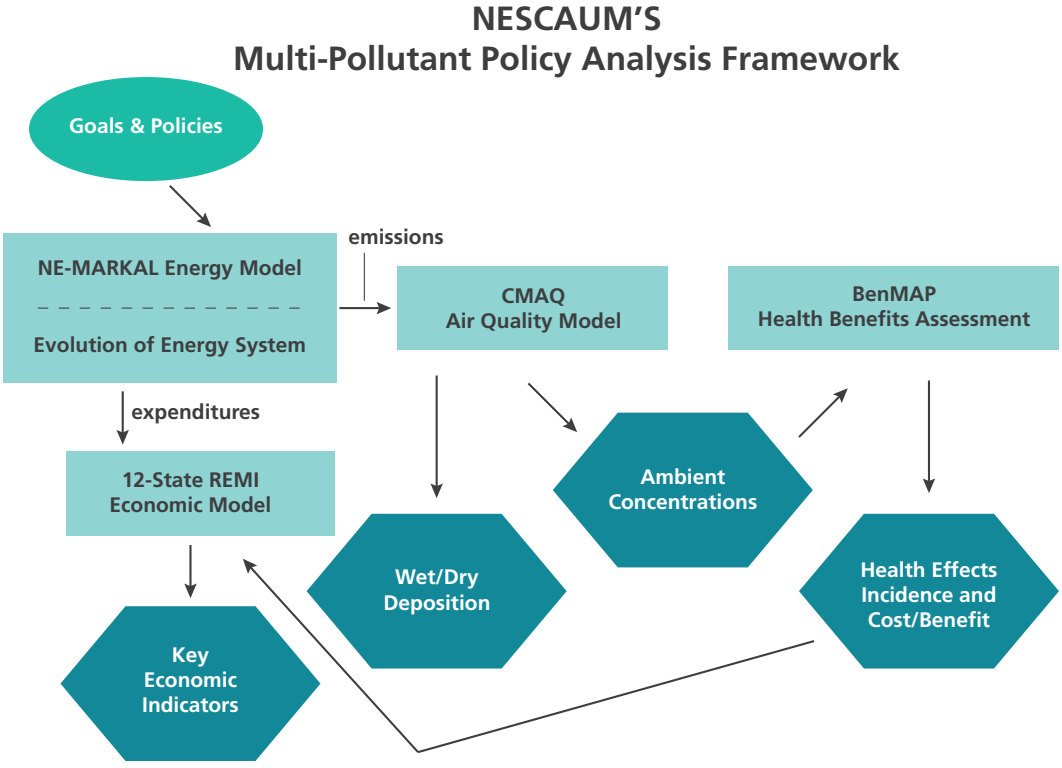

Figure 5.4 NESCAUM's Multi-Pollutant Policy Analysis Framework.

The centerpiece of the framework is the NE-MARKAL model, an energy model that can calculate least-cost combinations of energy technologies to achieve a prescribed pollution reduction goal. The model covers 11 states plus the District of Columbia,* and

* The jurisdictions covered in the NE-MARKAL model include: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

characterizes electricity generation, transportation, and the industrial, residential and commercial building sectors over a 30- to 50-year time horizon.

The Multi-pollutant Policy Analysis Framework models provide a range of outputs. In addition to assessing the potential emissions reductions of several different pollutants of concern for a given policy, it allows the user to input the emissions reductions data from NE-MARKAL into other models that, in turn, can provide output data on potential air quality and health benefits. NE-MARKAL can also link to REMI, the regional economic model, which can estimate useful economic metrics such as gross state product, jobs, and household disposable income. This level of linked analyses and data has not been traditionally available to air quality planners.

The Multi-pollutant Policy Analysis Framework can help policymakers evaluate the relative importance of various policies and programs over others by assessing cross-sector impacts, such as how transportation programs could affect power plant emissions. It also provides data on technology for modeled programs, such as how many and what type of electric vehicles would be needed to achieve a certain emissions reduction goal. This type of specific information on program characteristics can be very helpful to Maryland in designing future regulatory programs.

MDE has worked with NESCAUM over the past few years on multi-pollutant assessment exercises to become familiar with the Multi-pollutant Policy Analysis Framework tools. An earlier phase included conducting a calibration of the NE-MARKAL model so that the model behaves in a manner that replicates standard assumptions about energy and air emissions trends in Maryland. That work was conducted in collaboration with the Maryland Public Service Commission, the Maryland Energy Administration, and the Maryland Department of Natural Resources' Power Plant Research Project.*

MDE has initiated this pioneering work with the GGRA goals as its primary focus, and is also keeping the other pollutants in mind. Specifically, MDE has employed the Multi-pollutant Policy Analysis Framework to conduct "weight-of-evidence" analyses to help inform the 2012 GGRA plan. For this effort, NESCAUM collaborated with the Regional Economic Studies Institute at Towson University and the University of Maryland College Park. In later phases, the Multi-pollutant Policy Analysis Framework could also be used when MDE commences work on the ozone and fine particle State Implementation Plans. The full report on the Multi-pollutant Policy Analysis Framework exercise and its role in Maryland's multi-pollutant planning approach can be found in Appendix G.

* Northeast States for Coordinated Air Use Management, Maryland Multi-Pollutant Project; Final NE-MARKAL Calibration for Maryland, March 2011.

Multi-pollutant analyses to support the final GGRA Plan

The exercise

As a weight-of-evidence exercise, the use of the Multi-pollutant Policy Analysis Framework is solely intended to complement and inform the planning efforts and analyses described in other chapters of the GGRA Plan. It represents the first phase of a multi-phased process that would include more refined analyses.

The ability to assess combinations of programs simultaneously is the Multi-pollutant Policy Analysis Framework's strength. Our focus is on the NE-MARKAL energy model, as it is a new tool for air quality planners and serves as the centerpiece of the Framework.

The NE-MARKAL model is best used to assess programs that affect the power generation and motor vehicle sectors, and residential and commercial buildings (energy efficiency). The vast majority of Maryland's GHG reductions are expected to come from these sectors, which include more than 90 percent of the approximately 61 million metric tons (MMT) of proposed reduction potential. Drawing from the full complement of proposed programs presented in the Draft GGRA Plan, a subset of targeted technology changes envisioned for Maryland's power generation, vehicles, and residential and commercial buildings were simulated in NE-MARKAL (individually and collectively).

The modeled policies and programs were:

- Updated assumptions (as of 2011) regarding the 'business-as-usual' reference case energy consumption in Maryland
- Implementation of the Regional Greenhouse Gas Initiative (RGGI)
- Implementation of the Maryland Renewable Portfolio Standard (RPS)
- Increased low-carbon electricity imports that reduce the carbon-intensity of the Maryland electric grid
- Adoption of new standards for light-duty vehicles (CAFE)
- Technology deployment consistent with a regional clean fuels standard
- Reduced vehicle miles traveled (VMT) through "smart-growth" development and transit programs
- Buildings efficiency improvements consistent with the EmPOWER Maryland program goals.

Constraints representing each of these programs were introduced to the NE-MARKAL framework to identify the cost-optimized pattern of technology deployment that satisfies Maryland's growing demand for energy services (e.g., heating, cooling, transportation) while satisfying the program goals. Each policy run is called a simulation. We present results of the NE-MARKAL model simulations for each program individually as well as collectively. The collective (or combination) run is called the "GGRA Case." The reader will notice differences between the results of those two types of simulations (individual and combination), and those differences reflect strategy interactions.

The programs were then analyzed through the other models of the Framework, specifically: (1) the CMAQ model to assess air quality impacts; (2) the BenMAP model to assess health impacts; and (3) the REMI model to examine economic effects. For detailed information about this exercise, the models used, results, and caveats that place the results into appropriate context, please refer to Appendix G.

The results of this exercise, as shown below, demonstrate the power of such an integrated framework in showing cross-sector interactions. They also indicate that the synergistic effects of the multiple programs can enable them to be achieved with significant environmental and public health benefits, and no increased net cost over the long term.

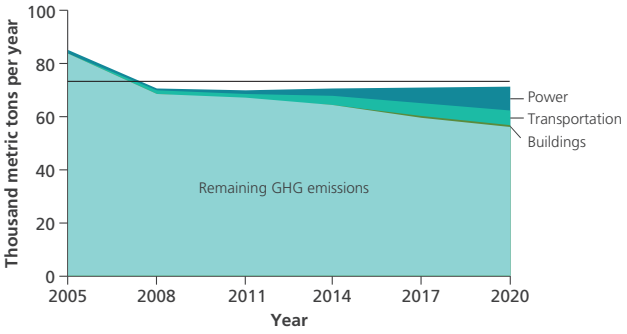

Figure 5.5 Modeled reductions in multi-sector GHG emissions under the "GGRA Case" through 2020 (black line indicates a 25% reduction).

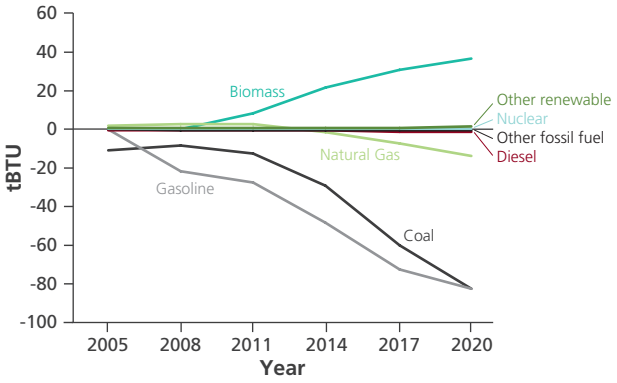

Figure 5.6 Modeled changes in fuel use under the "GGRA Case" relative to the reference case through 2020.

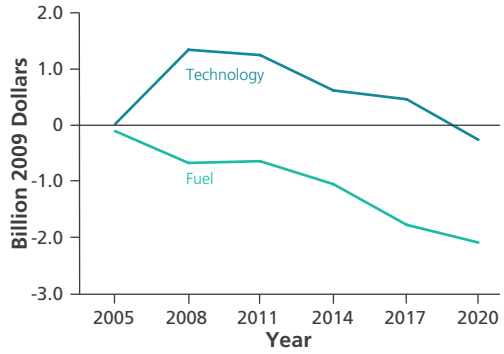

Figure 5.7 Modeled multi-sector technology investments and fuel savings under the "GGRA Case" relative to the Reference Case through 2020.

Key findings

As outlined in the introductory paragraph of this chapter, the GGRA has many objectives, including further clean-up of Chesapeake Bay, helping to meet new National Ambient Air Quality Standards (NAAQS), and meeting federal and State requirements for regional haze, mercury and other air toxics. The GGRA's primary objective is to reduce GHG emissions while helping the State with economic recovery and creating new green jobs. As shown in Figure 5.5, the multi-pollutant exercise results indicate that the State could achieve a greater than 25 percent reduction in GHG emissions by 2020 within the power, transportation, and building sectors if patterns of technology deployment are shifted as suggested by the NE-MARKAL model.

These large GHG reductions would be achieved through a broad shift in fuel consumption patterns relative to the reference—or "no policy"—case. As shown in Figure 5.6, the modeling indicates that coal-fired generation in the power sector and gasoline use in the transportation sector would be replaced by renewable electricity from wind, solar, and biomass.* While this would require significant investment, as shown in Figure 5.7, the large savings that would accrue as coal and gasoline use are reduced could offset those investments by 2020. While there are other costs associated with these programs that would need to be factored into the larger economic analysis, from a technology and fuel cost standpoint, these programs balance out over time.

As illustrated in Figure 5.8, the model also indicates that such an outcome would not be assured for the individual programs if they were to be implemented individually, as stand-alone programs. The economic benefit seems to accrue when all programs are implemented as a package. For example, the model indicates that the full cost of the light-duty fuel efficiency standard would not be recouped by 2020 if the fuel savings accrued in the transportation sector were lost to additional coal purchases in the power sector. Renewable investments also take some time to pay back. If implemented together, however, fuel savings would accrue across the sectors more quickly, thus better ensuring that all of the programs could achieve the anticipated reductions without additional net cost.

In addition to the GHG emissions benefits shown in Figure 5.5, the modeling further indicates that the broad shifts in the power and light-duty transportation sectors would lead to dramatically reduced coal and gasoline combustion, resulting in reductions in the pollution associated with power plants and cars. These emission changes were used as inputs (specifically, as inventory growth and control factors) for air quality modeling simulations carried out with the CMAQ model. CMAQ is a model routinely used by MDE for air quality planning purposes.

* For purposes of this analysis, "biomass" refers to dedicated biomass-electric generating plants. It does not include disaggregated wood burning for residential heating or in outdoor wood-fired boilers.

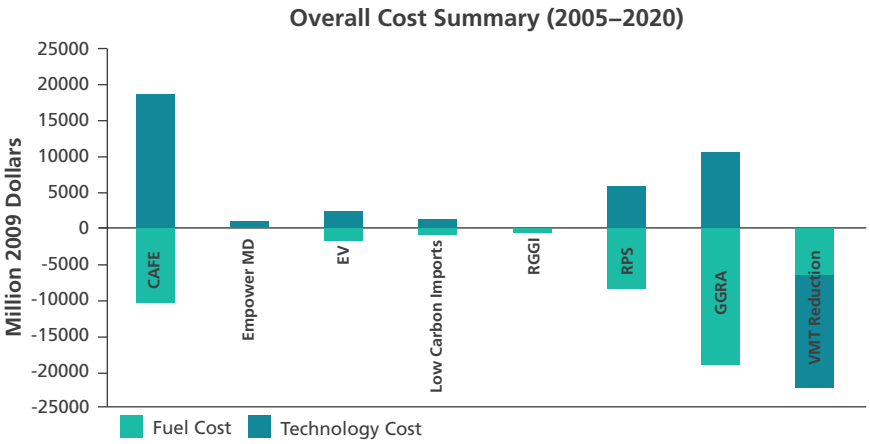

Figure 5.8 Modeled investment costs and fuel savings for individual programs and the combined "GGRA Case" (second from right) relative to the "Reference Case" through 2020. This highlights the benefits of implementing the programs as a package, rather than individually.

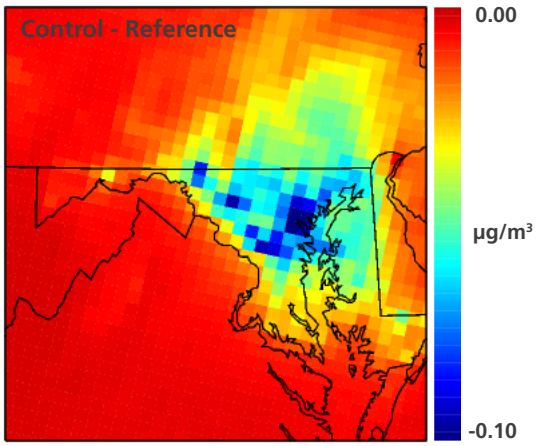

Figure 5.9 Difference between average 24-hour mean fine particle concentrations calculated for the "GGRA" and Reference Cases (control minus reference) for Maryland.

The air quality modeling exercise using NE-MARKAL data showed air quality improvements along major transit corridors as well as near population centers with higher concentrations of coal power plants. Figure 5.9 illustrates these air quality benefits by showing modeled decreases in fine particles, which occur primarily around Baltimore, the District of Columbia, and along the western edge of the state. This may be indicative of the decrease in on-road emissions and coal power generation along the I-95 and I-270 corridors. Note that the modeled air quality benefits of these programs were not confined to Maryland, as broad areas of southeastern Pennsylvania, Delaware, and central New Jersey would also experience air quality improvements.

These illustrative benefits for fine particle pollution are mirrored in additional environmental benefits that accrue through a reduction in acid deposition throughout the Chesapeake Bay and its watershed, as well as reductions in 8-hour average tropospheric ozone (smog) concentrations.

The changes in ambient air quality values projected for the "GGRA Case" by the CMAQ model for 2020 were used as inputs in the BenMAP model to estimate specific increases and decreases in incidence of ozone and fine particle health effects. BenMAP indicated that major population centers experiencing air quality benefits would also experience reduced adverse health impacts associated with poor air quality. Detailed results of this assessment are presented and explained in Appendix G. The modeled health benefits include many reduced incidences of: respiratory ailment, asthma attack, heart attack, hospital room visits, and lost work and school days. The monetary benefits of these public health improvements are driven by reduced mortality, which includes between 21–71 lives prolonged per year due to reduced fine particles, and 3–5 lives prolonged per year due to reduced ozone. The value of avoided mortality ranges between $168–$568 million per year within Maryland for fine particles and another $25–$35 million per year due to ozone. These types of benefits are also seen outside the state.

Finally, outputs from NE-MARKAL (specifically, technology alternatives including costs and fuel savings) were used as inputs into the REMI

macroeconomic model in order to understand the implications of these investments and fuel savings on the broader Maryland economy. Results of that exercise indicated that investments associated with the modeled "GGRA Case" clean energy technology deployment would lead to a direct job increase of more than 4,300 jobs per year between now and 2020. We note, however, a trend of decreasing job creation relative to the reference case after the initial technology transition is complete. This trend may continue downward unless steps are taken to realign the economy with the new spending patterns (e.g., creating green technology jobs in Maryland to replace fossil fuel industry jobs that may be lost over time).

These modeled investments would have a corresponding positive impact on wages, with an average increase of approximately $159 million per year in new wages over the ten-year period.

The analysis further indicates that the policies included in the "GGRA Case" could benefit the average Maryland household. The associated fossil fuel savings would yield an increase in household real disposable income of more than $170 million per year. This equates to an increase of $80 per year per household in Maryland in real disposable income.*

The NE-MARKAL model shows that the significant environmental and public health benefits associated with the "GGRA Case" policies and programs could be achieved with no net cost with respect to technology investment and fuel costs. The REMI model indicates that those benefits are complemented by an increase in jobs, wages, and disposable income. The analysis also suggests that policymakers consider the potential future negative impacts on output. While the analysis shows that the ten-year average of output will increase by roughly $86 million per year, the gain is heavily weighted to early investments in new technologies. The analysis indicates that output trends downward and is negative by 2020. This is the result of projected fuel savings not being adequate to outweigh the lost revenue in the fossil fuel sectors.

Incentive programs designed to encourage and grow clean technology industry segments in Maryland could affect the predicted impacts on future state output by creating new revenue sources to replace the existing fossil fuel revenue. To that end, implementation of the GGRA Plan might include complementary incentives and fiscal policies that support the industrial sectors associated with technology deployment for these policies. Some examples include subsidies to renewable generation, investments in vehicle-2-grid technologies, and investments in energy efficiency. These policies could help stimulate growth sectors and offset increased business costs that could otherwise lead to reduced state output in the future.

By way of example and as part of the REMI analysis, two scenarios were examined that extended the timeline and doubled the amount of the Maryland Clean Energy Incentive Tax Credit. This program was enacted in 2006 and expires at the end of 2015. It allows a maximum tax credit to electrical generators seeking to invest in renewable energy within Maryland of $2.5 million over five years. The total program credit is not to exceed $25 million over ten years. The scenario, which doubled the potential credit and extended it through 2020, resulted in nearly $10 million in additional output and an additional 100 new jobs in 2020. Future research and analyses could focus on a suite of complementary policies that could take advantage of the low carbon economy created through the GGRA Plan.

* United States Census Bureau. "2011 American Community Survey 1-Year Estimates: Selected Social Characteristics in the United States." American FactFinder2, 2012. *http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml*

Summary

The multi-pollutant approach, including the Multi-pollutant Policy Analysis Framework analyses, examines multi-pollutant benefits and tradeoffs through data and data analysis. It provides illustrative results of the relative importance of various modeled pollution control programs. The Multi-pollutant Policy Analysis Framework is a pioneering tool, providing linked analyses and data that are not generally available to air quality planners through their typical state planning efforts. Moreover, a multi-pollutant approach provides: (1) specific information on program characteristics from the NE-MARKAL technology evolution analyses that can be used directly in future air program planning analyses, as well as in regulation development and implementation; and (2) the capability to more easily identify influences and interactions of an individual strategy with the other programs in the suite of programs that are modeled.

This weight-of-evidence exercise that examined a subset of the GGRA programs using the Multi-pollutant Policy Analysis Framework indicated that:

1. The combination of key power and transportation sector and building efficiency programs could yield significant emission reductions at no net cost to the State with respect to technology investment and fuel expenditures;
2. Implementing those programs could result in major technology changes, including: reduced coal and increased renewable and clean imported generation; reduced gasoline consumption and transportation demand; and increased building efficiency and additional emission reduction opportunities through conservation;
3. These technology changes could result in reductions in fine particle and ozone in central Maryland, as well as fine particle benefits that extend to neighboring states;
4. Such air pollution reductions could result in monetized health benefits of approximately $300 million annually within Maryland, and in even greater amounts in the surrounding region, by 2020 through reduced mortality and morbidity;
5. The air pollution reductions from these programs would have positive effects on the Chesapeake Bay and its watershed; and
6. The GGRA Plan could be implemented with a net increase in jobs, wages, and household disposable income in the short term. Total economic output would likely increase during program implementation. After the technology transition and investment in new technology abates, output would decrease and trend into the negative by 2020. Complementary fiscal incentive programs could alter this trajectory.

These results, though preliminary, underscore the importance of working from a combined energy, environmental, and economic platform to examine programs. As indicated in this exercise, the analyzed GHG programs can assist Maryland in meeting not only its GGRA goals, but also Maryland's Chesapeake Bay protection and air quality goals while yielding positive economic effects during their implementation.

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Chapter 6

Summary of reduction programs

Baltimore at dusk shows energy being used by vehicles, street lighting, and commercial and residential buildings.

In 2009, Maryland Governor Martin O'Malley signed the Greenhouse Gas Emission Reduction Act of 2009 (GGRA). The Act requires the State to develop and implement a GGRA Plan to reduce greenhouse gas (GHG) emissions 25 percent from a 2006 baseline by 2020. This Plan lays out a blueprint which, if fully implemented, can achieve the 25 percent GHG reduction required by the law, with positive job and other economic benefits. The Plan also advances efforts to restore the Chesapeake Bay, improve the State's air quality, and preserve Maryland's valuable agricultural and forest lands.

Understanding the reduction requirement

To achieve a 25 percent reduction in Maryland's GHG emissions by 2020, the State, through its implementation of the 150 plus initiatives described in this Chapter, has to reduce Maryland's annual GHG emissions by 55.26 $MMtCO_2e$. This reduction includes offsetting unmitigated growth (called the 'business-as-usual' forecast) between 2006 and 2020. Maintaining this reduction after 2020 will require continued offsets of unmitigated growth over time.

Business as usual forecasting is important because in the absence of regulatory programs requiring GHG emission reductions, emissions will continue to grow through 2020, thereby increasing the size of the reduction needed to reduce emissions by 25 percent from 2006 levels. The 'business-as-usual' forecast accounts for this growth in emissions. In Figure 6.1, the dark blue line depicts the 'business-as-usual' forecast.

Another key component of the reduction requirement revolves around the issue of overlap. Many of the policies in this Plan have emission reductions that overlap with the

Approximately 30% of Maryland's electricity is generated out of state in the surrounding Pennsylvania Jersey Maryland Interconnection LLC (PJM) electricity grid region.

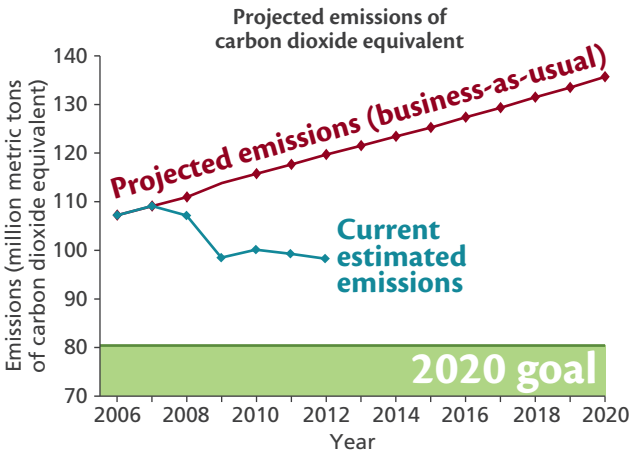

Figure 6.1 The 2020 emissions goal (green line) is 80.4 million metric tons of carbon dioxide equivalent annual emissions, which is 55 million metric tons less annually than the projected emissions in 2020 with unmitigated growth or 'business-as-usual' (red line). The light blue line is current actual emissions, which is 8.9 million metric tons of CO_2e less than 2006 levels (8% reduction) and 21.4 million metric tons of CO_2e less than the projected 'business-as-usual' emissions for 2013 (18% reduction).

reductions from another program. For example, the benefits of a recycling program overlap with benefits of a heavy duty truck program as both policies have an impact on truck traffic. For this reason, Maryland, has removed 33 percent of the emission credits from most of the initiatives in the plan to ensure double counting did not occur. For more information on overlap see Appendix B.

Annual vs. cumulative reductions

The GGRA requirement is that Maryland reduce its GHG emissions 25 percent by 2020 which is an annual goal. Cumulative reductions occur when a program builds on itself and that process is vital to Maryland meeting the GGRA requirements. However, those cumulative reductions should not be misinterpreted as calendar year reductions. The goal of the GGRA is to show that during the 2020 calendar year Maryland's emissions were 25 percent less than during the calendar year of 2006.

Potential market, non-government strategy and program reductions

It should be noted that the current trends relating to motor vehicle miles traveled (VMT) in Maryland and to power plant fuel switching (from coal to natural gas) could aid the State in reaching its 2020 goal. The State recognizes these trends and allows that, if maintained, they could contribute to future GGRA Plan adjustments. However, given that they are not directly related to State action, they have not been incorporated into the Plan. For more information on VMT trends see Appendix C.

Imported fuel and fuel switching

GHG emissions from the energy supply sector in Maryland include emissions from fossil fuel-fired electricity generation from out-of-state generators and represent a substantial portion of the State's overall GHG emissions. Approximately 30 percent of the electricity consumed in Maryland is generated out-of-state in the surrounding Pennsylvania Jersey Maryland Interconnection LLC (PJM) electricity grid region. Given this, it's important to consider the carbon intensity of the full fuel mix of the PJM region when devising ways to reduce Maryland's GHG emissions. The PJM region is comprised of 13 other states and Washington, D.C.

In the GGRA 2006 Baseline, the average carbon intensity for PJM was about 1,250 lbs/MWh. The BAU forecast was designed to be policy neutral, and as such this value was kept constant through 2020. The recent influx of inexpensive natural gas, however, has changed future expectations regarding the regional grid's fuel mix, which has and will continue to alter the carbon intensity of imported power in Maryland.

In 2006, roughly 5.5% of PJM's electricity was generated from natural gas sources. Through the third quarter of 2012, this figure has increased to 20.5 percent. At the same time, the carbon intensity of PJM electricity has decreased by nearly 13 percent, to less than 1,100 lbs/MWh. Between the retirement of thousands of MW of

coal-fired power plants and continued availability of inexpensive natural gas, it is highly likely that natural gas will continue to produce an increasing share of electricity in PJM and continue to contribute to a reduction in GHG emissions in Maryland for years to come.

MEA analyzed a future scenario in which this trend continued and natural gas generation in PJM increases from 20.5 percent to 30.8 percent while coal decreases from 39.8 percent to 32 percent between 2012 and 2020, respectively. In this case, the carbon intensity of PJM electricity will decrease to 930 lbs/MWh. Additionally, as in-state generation is more coal-heavy than the PJM average, Maryland generation will be impacted more by this shift than imported electricity. In-state generation will be reduced from 1,494 lbs/MWh to 1,068 lbs/MWh, primarily due to a larger decrease in coal-fired generation in Maryland.

The result of these market-driven scenarios is that carbon emissions from the electricity sector will decrease by an additional 4.44 $MMtCO_2e$ annually relative to the original BAU Forecast for 2020, with 2.72 $MMtCO_2e$ of reductions coming from imported electricity and 1.71 $MMtCO_2e$ of reductions coming from in-state generation (Figure 6.2).

Figure 6.2 Business as usual and fuel switching impact for 2020.

	CO_2 Intensity (Lbs/MWh)		Emissions (MMt)	
	Imports (PJM)	Maryland	Imports (PJM)	Maryland
BAU forecast for 2020	1251	1494	16.65	37.78
Fuel switching impact for 2020	930	1068	13.93	36.08
Difference			**2.72**	**1.71**

Potential impacts of market trends on Maryland's GHG goal

Figure 6.3 below summarizes anticipated Plan related emissions reductions: as initially drafted (in February 2012), and as currently drafted with additional policy enhancements that are likely to be added later. The table also illustrates how current VMT and fuel switching related trends could impact Maryland's ability to meet its 2020 emissions reduction goal.

Transportation plans and programs VMT update

MDOT forecasted VMT growth associated with implementation of funded transportation plans and programs from 2006 to 2020 consistent with population and employment growth forecasts, and the impact of funded transportation Plans and Programs including the 2011–2016 Consolidated Transportation Program (CTP) and Metropolitan Planning Organization (MPO) Long-Range Transportation Plan's (LRTPs). According to estimates developed by MDOT in 2010, these plans in aggregate forecasted a 1.4 percent annual VMT growth rate from 2006 to 2020.

Figure 6.3 Policy Scenarios and Associated Current and Enhanced GHG Emission Reductions (in $MMtCO_2e$).

Policy Scenario (all in $MMtCO_2e$)	Initial GGRA Plan Reductions	With Plan Enhancements
Revised Minimum GGRA Goal	55.26	55.26
Goal Shortfall (in red)	16.39	0.21
Forecasted Fuel Switching Reductions	4.44	4.25
Transportation Plans and Programs VMT Update	2.78	2.78
Revised NET Goal Shortfall (in red)/Surplus	9.17	7.24

VMT growth in Maryland has been stagnant since 2008. In 2011, total VMT, as reported in MDOT's 2012 Annual Attainment Report, was 56.1 billion, a 0.9 percent reduction from 2006. Based on preliminary data, 2012 VMT is anticipated to remain the same as 2011.

For VMT to increase from 2012 to the 2020 VMT forecast for the Plans and programs conducted by MDOT in 2010, a 2.3 percent annual VMT growth rate would need to occur. This level of VMT growth has not been seen on an annual basis since the late 1990s and is not anticipated at any time over the next 8 years. As a result, MDOT reassessed the VMT growth rate associated with implementation of current Plans and Programs through 2020.

The result of this new growth rate is a reduction of 5.553 billion VMT in 2020 (8 percent reduction) compared to the original 2020 Plan and Program VMT forecast. This reduction potentially lowers Maryland's greenhouse gas emissions reduction target by 2.78 $MMtCO_2e$ in 2020.

Fuel switching and lifecycle emissions:

As noted above, the potential annual GHG emissions reductions from fuel switching by 2020 are estimated to be slightly over 4 $MMtCO_2e$. These reductions are derived using combustion-based accounting. It is important to add, that when the full fuel cycle emissions of fuel switching from coal-fired electricity to natural gas are considered, the emissions reductions are smaller, and potentially can be much smaller.

For natural gas, the full fuel cycle emissions will vary depending on two key factors: (1) the share of natural gas produced from conventional drilling relative to hydraulic fracturing; and (2) the methane leakage rate of hydraulically fractured gas. There is currently a great deal of uncertainty regarding how much future gas will come from hydraulic fracturing, and the extent to which technology will be employed to capture the leaked methane. If the methane leakage rate is high, then the climate benefits from the phasing out coal in favor of natural gas could be negligible. The International Energy Agency, for example, determined that when averaged over 20 years, any leakage rate over three percent results in well-to-burner GHG emissions from natural gas that are equal to or greater than coal.*

It is, therefore, critically important for Maryland and the federal government to develop and implement standards to keep the methane leakage rate as low as possible. More information on the importance of considering the full fuel cycle emissions of imported power can be found in the appendix of this report.

In sum, Maryland's GHG reduction efforts are, in the near term, likely to continue to benefit to some extent from the ongoing power plant fuel switch from coal to natural gas. However, given the uncertainty of the economy, energy markets, and methane leakage rates, the climate benefits associated with fuel switching are difficult to quantify or assure. Fuel switching to natural gas has not, therefore, been included as a strategy within the State's GGRA Plan. Moreover, because natural gas is a fossil fuel with carbon emissions, it should be considered as a transitional fuel as the State works to achieve a 90 percent State-wide reduction in GHG emissions by 2050.

* International Energy Agency. Golden Rules for a Golden Age of Gas, World Energy Outlook Special Report on Unconventional Gas. Rep. N.p.: n.p., 2012

GGRA Plan strategies, programs, and initiatives

This Chapter summarizes the various strategies and initiatives that the State is developing and employing to meet the GGRA's GHG emissions reductions and economic benefits goals. Some of the Plan's strategies are already being implemented in full, others are in process, and some will require additional legislative, budgetary or regulatory action.

The GGRA Plan's initial suite of strategies (February 2012) were determined to be insufficient and a number of strategy and program enhancements have been added. The major sectors where greenhouse gas emissions can be reduced are energy and transportation; however every sector will need to do its part to reduce emissions (Figure 6.4).

Figure 6.5 on the following pages summarizes the Plan's key strategies and anticipated CO_2e reductions, as initially drafted, and with the addition of planned and possible enhancements. Initial reductions refers to what is expected from each program absent any policy enhancements. These are the programs as currently being implemented between now and 2020. Enhanced reductions represents potential reductions from enhancements to the current programs. These enhancements were offered by stakeholders and state agencies as they reviewed the programs in search of any possible additions that could be made to each program to strengthen them.

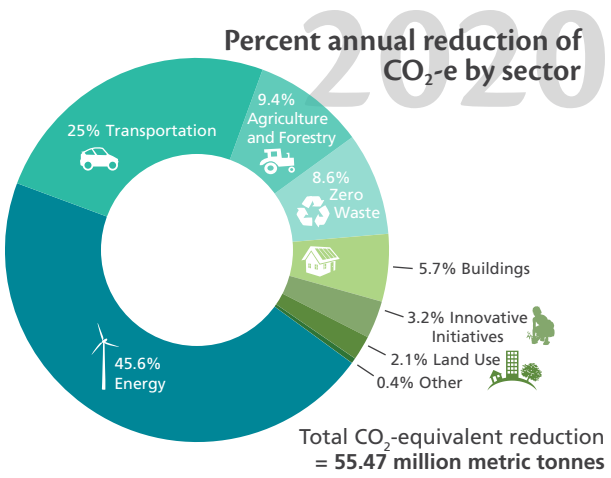

Figure 6.4 Percent annual reduction of CO_2e by sector.

The GGRA Plan has a suite of strategies and programs to reduce our CO_2e to meet the 25 percent reduction goal.

Figure 6.5 Strategy assigned GHG emission reductions by policy, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
ENERGY	**A**	**EmPOWER Maryland**		**8.42**	**10.52**
	A.1	EmPOWER Maryland: Energy Efficiency in the Residential Sector	MEA	Included in A	Included in A
	A.2	EmPOWER Maryland: Energy Efficiency in the Commercial and Industrial Sectors	MEA	Included in A	Included in A
	A.3	EmPOWER Maryland: Energy Efficiency in Appliances and Other Products	MEA	Included in A	Included in A
	A.4	EmPOWER Maryland: Utility Responsibility	MEA	Included in A	Included in A
	A.5	Combined Heat and Power	MEA	Included in A	Included in A
	B	**Maryland Renewable Energy Portfolio Standard (RPS)**	-	**6.86**	**10.96**
	B.1	Maryland Renewable Energy Portfolio Standard (RPS) Program	MEA	5.86	9.96
	B.2	Fuel Switching	MEA	1.00	1.00
	B.3	Incentives and Grant Programs to Support Renewable Energy	MEA	Included in B	Included in B
	B.4	Offshore Wind Initiatives to Support Renewable Energy	MEA	Included in B	Included in B
	C	**Regional Greenhouse Gas Initiative (RGGI)**	**MDE**	**0.00**	**3.60**
	D	**Other Energy Programs**	-	**0.13**	**0.23**
	D.1	GHG Power Plant Emission Reductions from Federal Programs	-	-	-
	D.1.A	Boiler Maximum Achievable Control Technology (MACT)	MDE	0.07	0.07
	D.1.B	GHG New Source Performance Standard	MDE	Included in D.1	Included in D.1
	D.1.C	GHG Prevention of Significant Deterioration Permitting Program	MDE	Included in D.1	Included in D.1
	D.2	Main Street Initiatives	DHCD	0.05	0.14
	D.3	Energy Efficiency for Affordable Housing	DHCD	0.01	0.02
			TOTAL ENERGY REDUCTIONS	**15.41**	**25.31**
TRANSPORTATION	**E**	**Transportation Technologies**	-	**8.10**	**8.61**
	E.1	Motor Vehicle Emission and Fuel Standards	-	-	-
	E.1.A	Maryland Clean Cars Program	MDE	4.33	4.33
	E.1.B	Corporate Average Fuel Economy Standards (CAFÉ): Model Years 2008–2011	MDOT	2.27	2.27
	E.1.C	National Fuel Efficiency and Emission Standards for Medium and Heavy-Duty Trucks	MDE	0.88	0.88
	E.1.D	Federal Renewable Fuels Standards	MDOT	0.24	0.24
	E.2	On Road, Airport, Port and Freight/Freight Rail Technology Initiatives	-	0.38	0.62
	E.2.A	On Road Technology	MDOT	Included in E.2	Included in E.2
	E.2.B	Airport Initiatives	MDOT	Included in E.2	Included in E.2
	E.2.C	Port Initiatives	MDOT	Included in E.2	Included in E.2
	E.2.D	Freight and Freight Rail Programs	MDOT	Included in E.2	Included in E.2
	E.3	Electric and Low Emitting Vehicle Initiatives	MDOT/MEA	0.00	0.27

Figure 6.5 Strategy assigned GHG emission reductions by policy, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
TRANSPORTATION	**F**	**Public Transportation**	**-**	**2.00**	**2.89**
	F.1	Public Transportation Initiatives	MDOT	Included in F	Included in F
	F.2	Intercity Transportation Initiatives	MDOT	Included in F	Included in F
	G	**Pricing Initiatives**	**MDOT**	**0.41**	**2.30**
	H	**Other Innovative Transportation Strategies/Programs**	**-**	**-**	**-**
	H.1	Evaluating the GHG Emissions Impact of Major New Transportation Projects	MDE	Included in F	Included in F
	H.2	Bike and Pedestrian Initiatives	MDOT	Included in F	Included in F
		TOTAL TRANSPORTATION REDUCTIONS		**10.51**	**13.80**
AGRICULTURE & FORESTRY	**I**	**Forestry and Sequestration**	**-**	**4.56**	**4.56**
	I.1	Managing Forests to Capture Carbon	DNR	1.80	1.80
	I.2	Planting Forests in Maryland	DNR	1.79	1.79
	I.3	Creating and Protecting Wetlands and Waterway Borders to Capture Carbon	DNR	0.43	0.43
	I.4	Biomass for Energy Production	DNR	0.33	0.33
	I.5	Conservation of Agricultural Land for GHG Benefits	MDA	0.18	0.18
	I.6	Increasing Urban Trees to Capture Carbon	DNR	0.02	0.02
	I.7	Geological Opportunities to Store Carbon	DNR	Included in I	Included in I
	J	**Ecosystems Markets**	**-**	**0.20**	**0.68**
	J.1	Creating Ecosystems Markets to Encourage GHG Emission Reductions	DNR	0.11	0.11
	J.2	Nutrient Trading for GHG Benefits	MDA	0.09	0.57
		TOTAL AGRICULTURE AND FORESTRY		**4.76**	**5.24**
BUILDING	**K**	**Building and Trade Codes in Maryland**	**DHCD**	**3.15**	**3.15**
		TOTAL BUILDING REDUCTIONS		**3.15**	**3.15**
ZERO WASTE	**L**	**Zero Waste**	**MDE**	**2.80**	**4.80**
		TOTAL ZERO WASTE REDUCTIONS		**2.80**	**4.80**

Figure 6.5 Strategy assigned GHG emission reductions by policy, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
INNOVATIVE INITIATIVES	**M**	**Leadership-by-Example**	-	**1.45**	**1.77**
	M.1	Leadership-by-Example: State of Maryland Initiatives	DGS	0.56	0.88
	M.2	Leadership-by-Example: Maryland Colleges and Universities	MDE	0.37	0.37
	M.3	Leadership-by-Example: Federal Government	MDE	0.27	0.27
	M.4	Leadership-by-Example: Local Government	MDE	0.25	0.25
	N	**Maryland's Innovative Initiatives**	-	**0.21**	**0.21**
	N.1	Voluntary Stationary Source Reductions	MDE	0.17	0.17
	N.2	Buy Local for GHG Benefits	MDA	0.02	0.02
	N.3	Pay-As-You-Drive® Insurance in Maryland	MIA	0.02	0.02
	N.4	Job Creation and Economic Development Initiatives Related to Climate Change	DBED	Included in N	Included in N
	O	**Future or Developing Programs**	-	**0.02**	**0.02**
	O.1	The Transportation and Climate Initiative	MDE/ MDOT	0.02	0.02
	O.2	Clean Fuels Standard	MDE	0.00	0.00
		TOTAL INNOVATIVE INITIATIVES REDUCTIONS		**1.68**	**2.00**
LAND USE	**P**	**Land Use Programs**	-	**0.54**	**1.14**
	P.1	Reducing Emissions through Smart Growth and Land Use/Location Efficiency	MDP	Included in P	Included in P
	P.2	Priority Funding Area (Growth Boundary) Related Benefits	MDP	Included in P	Included in P
		TOTAL LAND USE REDUCTIONS		**0.54**	**1.14**
OUTREACH	**Q**	**Outreach and Public Education**	**MDE**	**0.03**	**0.03**
		TOTAL PUBLIC REDUCTIONS		**0.03**	**0.03**
		TOTAL GHG EMISSION REDUCTIONS		**38.87**	**55.47**
		REVISED MINIMUM GGRA GOAL		**55.26**	**55.26**
		SHORTFALL (Red)		**16.39**	**0.21**
		Forecasted Imported Power/Natural Gas Shifting Reduction		**4.44**	**4.25**
		Forecasted VMT Related Reduction		**2.78**	**2.78**
		NET SHORTFALL Including Above Referenced Market Induced Reductions (Red)		**9.17**	**7.24**

Key strategies and programs

A handful of key GGRA Plan strategies and programs will drive more than 80 percent of Maryland's GHG emissions reductions under the "Enhanced" scenario. They are:

1. Maryland Renewable Energy Portfolio Standard (RPS) program

Maryland became one of the first states to adopt a Renewable Energy Portfolio Standard (RPS) in 2004. Requiring that power providers buy a growing portion of electricity supplied from renewable sources, the intent of this law is to establish a market for new sources of mostly in-state renewable electricity generation and to recognize the economic, environmental, fuel diversity, and security benefits of renewable energy resources. In 2020 the law requires that Maryland attain 18 percent of its electricity from renewable sources, increasing to 20 percent renewables by 2022. Maryland's RPS should contribute to a **10.96 MMtCO$_2$e** reduction in the State's GHG emissions by 2020.

2. EmPOWER Maryland

Enacted in 2008, the EmPOWER Maryland Energy Efficiency Act (EmPOWER) set a target to reduce both Maryland's per capita total electricity consumption and peak load demand by 15 percent below 2007 levels by 2015. EmPOWER includes numerous State and utility managed energy efficiency and conservations programs. EmPOWER programs, with some General Assembly and PSC approved enhancements, should reduce Maryland's GHG emissions by **10.52 MMtCO$_2$e** by 2020.

3. Zero Waste: Maryland's long-term strategy to an 85% reduction in the generation of solid waste by 2030

Zero Waste is a concept that calls for the near complete elimination of solid waste sent to landfills or incinerators for disposal, and where, instead, the vast majority of Maryland's solid waste is reused, recycled, composted, or prevented through source reduction. Maryland's zero waste efforts should contribute to a **4.80 MMtCO$_2$e** reduction in the State's GHG emissions by 2020.

4. Maryland Clean Cars program

Enacted into law on November 19, 2007, the Maryland Clean Cars Program adopted California's stricter vehicle emission standards, the first program in the nation to directly regulate CO2 emissions from motor vehicles. These standards became effective in Maryland for model year 2011 vehicles, significantly reducing a number of emissions including volatile organic compounds (VOCs) and nitrogen oxides (NOx). By adopting the more stringent California standards, significant reductions in both localized pollution and greenhouse gases will be achieved. The Maryland Clean Cars Program should reduce the State's GHG emissions by **4.33 MMtCO$_2$e** by 2020.

5. Regional Greenhouse Gas Initiative (RGGI)

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort by nine Northeast and Mid-Atlantic States to design and implement a regional cap-and-trade program to reduce carbon dioxide emissions from power plants in the region. RGGI serves as the framework program by which the EmPOWER and RPS programs are implemented. Recent efforts to strengthen RGGI will reduce Maryland's GHG emissions by **3.60 MMtCO$_2$e** by 2020.

6. Building and Trade Codes in Maryland

Given the long life of most buildings, upgrading State and local building codes to include minimum energy efficiency requirements provides long-term GHG savings. Maryland's Building Performance Standards are updated by regulation every three years following the three-year cycle

of the International Code Council. Progressive building and trade codes adjustment in Maryland should contribute to a **3.15 MMtCO$_2$e** reduction in the State's GHG emissions by 2020.

7. Public Transportation Initiatives

For several decades, vehicle miles traveled has risen faster than the increase in population in Maryland and nationwide, and land use development over the past 40 to 50 years has put more people living beyond the reach of easy access to transit facilities. Planned transit and Transit Oriented Development (TOD) expansions in Maryland should lessen vehicle miles traveled in the State and contribute to a **2.89 MMtCO$_2$e** reduction in the State's GHG emissions by 2020.

8. Corporate Average Fuel Economy (CAFE) Standards, Model Years 2008-2011

First enacted by Congress in 1975, the purpose of the CAFE standard is to reduce energy consumption by increasing the fuel economy of cars and light trucks. Since introduction in 1975, CAFE standards have increased from the initial 18 miles per gallon standard to 35 miles per gallon by 2020, as established in the federal Energy Independence and Security Act of 2007. Projected CAFE increases should reduce GHG emissions in Maryland by **2.27 MMtCO$_2$e** by 2020.

9. Managing Forests to Capture Carbon

Managing forests to capture carbon will promote sustainable forestry management practices in existing Maryland forests on both public and private lands. The enhanced productivity resulting from enrolling unmanaged forests into management regimes will increase rates of carbon dioxide sequestration in forest biomass, increase amounts of carbon stored in harvested, durable wood products which will result in economic benefits, and increased availability of renewable biomass for energy production. Enhanced forestry management in Maryland should contribute to a **1.80 MMtCO$_2$e** reduction in the State's GHG emissions by 2020.

10. Planting Forests in Maryland

Planting trees expands forest cover and associated carbon stocks by regenerating or establishing healthy, functional forests through practices such as soil preparation, erosion control, and supplemental planting, to ensure optimum conditions to support forest growth. By 2020, the implementation goal is to achieve the afforestation and/or reforestation of 43,030 acres in Maryland by 2020. Achieving the 43,030 acre target should reduce GHG emissions in the State by **1.79 MMtCO$_2$e** by 2020.

Note on possible numerical differences in the plan

In some instances there may be discrepancies between the estimated economic and emission numbers. Over the course of the development of the GGRA Plan some policies have undergone changes to reflect updated knowledge of the ways in which they will actually be or are being implemented. Not all of these changes were reflected in the economic analysis completed by Towson University's Regional Economic Studies Institute (RESI). It is possible that there may be some programs in or omitted from Appendix E to the Report that are not seen in Chapter 6, this is a result of the changes made to the Plan after the economic analysis began. MDE is currently working with RESI to refine the economic analysis to reflect the expected impacts of the programs as they currently exist and are detailed in Chapter 6 of the Plan. The revised analysis will be included in the 2015 update of the plan.

Energy

estimated reduction of

25.31

million metric tons of CO_2e annually

The electricity supply sector accounts for GHG emissions occurring as a result of the combustion of fossil fuel at electricity generating facilities located both in and outside of the State. Electricity consumption accounted for about 41 percent of Maryland's gross GHG emissions in 2006 (about 42 $MMtCO_2e$), which was higher than the national average share of emissions from electricity consumption (34 percent).

Maryland is a net importer of electricity, meaning that the State consumes more electricity than is produced in the State. Sales associated with imported power accounted for 28 percent of the electricity consumed in Maryland in 2006. GHG emissions from power produced in-state are dominated by coal-fired generation, followed by natural gas generation and oil-fired generation.

In 2006, GHG emissions associated with Maryland's electricity consumption (42 $MMtCO_2e$) were about 10 $MMtCO_2e$ higher than those associated with in-state electricity generation (32.0 $MMtCO_2e$). The higher level for consumption-based emissions reflects GHG emissions associated with net imports of electricity to meet Maryland's electricity demand. Projections of electricity sales for 2006 through 2020 indicate that Maryland will remain a net importer of electricity.

Reductions from the energy sector are critical to achieving the 2020 goal. Four of the seventeen GHG reduction policies described in this section are designed to reduce GHG emissions from the energy sector. Full implementation of the four energy sector policies will result in an estimated GHG reduction of 15.41 $MMtCO_2e$ and 25.31 $MMtCO_2e$ with all enhanced program options implemented (Figure 6.6).

Figure 6.6 Initial and enhanced GHG reductions by policy for the Energy sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
A	EmPOWER Maryland	8.42	10.52
B	Maryland Renewable Energy Portfolio Standard (RPS)	6.86	10.96
C	Regional Greenhouse Gas Initiative (RGGI)	0.00	3.60
D	Other Energy Programs	0.13	0.23
	TOTAL REDUCTIONS FROM ENERGY	15.41	25.31

A. EmPOWER Maryland

Launched by a 2007 Executive Order and codified by the General Assembly in the 2008 Session, EmPOWER Maryland is designed to reduce per capita electricity consumption and peak demand by Maryland consumers by 15 percent by 2015. While the EmPOWER Maryland suite of energy efficiency programs is funded in part with revenue paid into the Strategic Energy Investment Fund (SEIF) from the auction of RGGI allowances, the vast majority of the revenues come from monies collected by the utilities on ratepayers' bills.

Maryland's EmPOWER statute requires at least 10 percent of the consumption target to come from utility programs, which must be approved, in advance, by the Public Service Commission (PSC) In addition to these utility managed programs, MEA's programs and other state efforts are intended to close the gap towards the overall program goal.* MEA works closely with the State's electric utilities and the PSC in program design. While MEA is the lead State agency responsible for non-utility EmPOWER programs, the PSC is responsible for ensuring the utilities meet their goal.

As of fall 2012, over 430,000 Marylander households and businesses have taken advantage of EmPOWER programs, and the State is on track to exceed its 15 percent peak demand reduction goal by 2015. However, as currently structured, EmPOWER is falling short of its 15 percent per capita energy use reduction goal—and more needs to be done to ensure greater energy conservation across the state. With its current suite of programs, EmPOWER is likely to contribute to a 13.7 percent reduction in per capita electricity consumption by 2020.

More detail on EmPOWER Maryland's programs is provided below. The methodology for estimating the reduction in GHG emissions from the programs is in Appendix C of this Plan.

EmPOWER Maryland Program enhancement options

As noted above, EmPOWER progress is currently lagging and additional programs and policy adjustments are likely to be needed to produce even a 15 percent per capita reduction by 2020. To strengthen EmPOWER, the State is working to determine the relative value of energy efficiency and conservation efforts in Maryland, and to optimize utility and non-utility managed programs and practices across the state. If approved by the General Assembly and adopted by the PSC, these program and policy adjustments (such as the removal of black liquor as a Tier 1 renewable and an enhanced target for the EmPOWER program by 2020) should allow Maryland to increase its EmPOWER's per capita reduction target by 2020 and may enable the State to achieve an additional 2.1 $MMtCO_2e$ reduction. Furthermore, if EmPOWER were expanded to target thermal fuel consumption in addition to electricity consumption, even greater reductions could potentially be achieved.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the existing EmPOWER programs in 2020 are estimated to be 8.42 $MMtCO_2e$ (Figure 6.7). Because these programs are all related, MEA has aggregated the potential emission reductions from the full set of programs. Appendix C provides a more detailed description of the process used to quantify GHG reductions.

* The SEIF fund was created by legislative act of the General Assembly, "Regional Greenhouse Gas Initiative—Maryland Strategic Energy Investment Program," Public Utility Companies Article, § 7-701 et seq., Annotated Code of Maryland *(Senate Bill 268/House Bill 368, General Assembly 2008). A portion of the fund is allocated to the MEA to administer programs in the residential, commercial and industrial sectors to reduce consumer demand for electricity and natural gas by five percent by 2015 through energy efficiency measures.* The utility-run EmPOWER programs are mandated by "EmPOWER Maryland Energy Efficiency Act of 2008," Public Utility Companies Article, § 7-211, Annotated Code of Maryland (House Bill 374, General Assembly 2008). The law requires utilities to reduce per capita electricity consumption in Maryland by 10 percent by 2015 and per capita peak demand by 15 percent by 2015 by implementing energy efficiency programs targeted to consumers. Together, the EmPOWER Maryland law and the law creating the SEIF fund target a 15 percent reduction in per capita electricity consumption and per capita peak demand by 2015.

Enhanced reductions

The potential emission reductions from the EmPOWER program enhancements in 2020 are estimated to be 10.52 $MMtCO_2e$ (Figure 6.7).

Job Creation and Economic Benefits

The EmPOWER Maryland programs are expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the EmPOWER Maryland programs, once fully operational, would support a total of about 7,551 jobs and generate $1,511,197,472 in net economic benefit and $243,040,604 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with the EmPOWER Maryland programs.

Implementation

The EmPOWER Maryland programs are mandated and funded by State law, specifically State Government Article, §9-20B of the State Government Article of the Maryland Code.

A.1 EmPOWER Maryland: Energy efficiency in the residential sector

Lead Agency: MEA

Program Description

The State's residential energy efficiency initiatives are part of the EmPOWER Maryland suite of energy efficiency programs administered primarily by MEA using SEIF revenues. Together with programs implemented by the utilities, the State's programs in all sectors, including residential, commercial and industrial, are intended to achieve the EmPOWER Maryland goal of a 15 percent reduction in per capita energy use by 2015. Programs funded and administered through other State agencies, including the DHCD, contribute to the EmPOWER goal, as do federally-funded energy efficiency programs. The State's residential energy efficiency initiatives include the following:

MEA Home Performance Rebate Program

This program offers homeowners rebates for home energy efficiency improvements. By combining a 35 percent rebate, and up to $3,100 total, from MEA with a 15 percent rebate from the utility company, homeowners can save a total of 50 percent on home energy improvements. MEA encourages homeowners to upgrade the energy efficiency of their homes to ENERGY STAR standards.

Figure 6.7 Initial and enhanced GHG reductions for EmPOWER Maryland, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
ENERGY	**A**	**EmPOWER Maryland**		**8.42**	**10.52**
	A.1	EmPOWER Maryland: Energy Efficiency in the Residential Sector	MEA	Included in A	Included in A
	A.2	EmPOWER Maryland: Energy Efficiency in the Commercial and Industrial Sectors	MEA	Included in A	Included in A
	A.3	EmPOWER Maryland: Energy Efficiency in Appliances and Other Products	MEA	Included in A	Included in A
	A.4	EmPOWER Maryland: Utility Responsibility	MEA	Included in A	Included in A
	A.5	Combined Heat and Power	MEA	Included in A	Included in A
			TOTAL REDUCTIONS	**8.42**	**10.52**

The Maryland Home Energy Loan Program offers unsecured, low-cost loans for efficiency upgrades to primary single-family detached and townhouse residences in Maryland. Replacing furnaces, heat pumps, and air conditioners that are at least 10 years old is a primary focus, as well as upgrading insulation, plugging air leaks, and sealing ducts.

EmPOWER Maryland Empowering Finance Initiative

This initiative is targeted at helping residential consumers afford clean energy improvements. MEA is working with private banks to leverage sustainable capital that will continue to serve Marylanders past the end of federal funding.

Maryland Home Energy Loan Program

Funded by a grant from MEA, the Maryland Clean Energy Center manages this program to offer unsecured, low-cost loans for efficiency upgrades to primary single-family detached and townhouse residences in Maryland. Replacing furnaces, heat pumps and air conditioners that are at least 10 years old is a primary focus, as well upgrading insulation, plugging air leaks and sealing ducts. The program launched in December 2010 and, by June 2011, had cleared $400,000 in loan commitments. More information about this program can be found at: Maryland Clean Energy Center, MHELP program, *http://MCECloans.org.*

EmPOWER Maryland Residential Incentives

These initiatives include various programs such as a grant program offered in coordination with DHCD to conduct energy efficiency retrofits in apartment units to reduce energy bills for low and moderate income families. The program has awarded $9.7 million that will benefit approximately 3,800 families by reducing their energy bills an estimated 20 percent, saving about $52.8 million over the life of the investments.

DHCD Weatherization

DHCD is awarded funding on an annual basis from the U.S. Department of Energy to improve the energy efficiency in homes owned by limited-income Marylanders. Thanks to an uptick in federal funding in 2009, DHCD has retrofitted more than 7,000 homes since 2009. When the federal funding is fully expended, DHCD Weatherization is now funded through EmPOWER Maryland.

Clean Energy Communities Grants

MEA has awarded over $9.5 million to local governments and non-profit organizations in every county in Maryland for energy efficiency projects that benefit low-to-moderate income citizens. These awards have helped more than 9,000 Marylanders reduce their energy usage through lighting improvements, energy efficient appliances, and whole home energy retrofits.

Energy Workforce Training

MEA has worked closely with DHCD and Maryland's community colleges to create a comprehensive training program for contractors working in the energy improvement field. The program has trained more than 1000 contractors to date, and the focus moving forward will be improving the skill sets of contractors already participating in the Maryland Home Performance program or DHCD Weatherization program.

More information about these programs can be found at:

http://energy.maryland.gov/Residential/index.html

A.2 EmPOWER Maryland: Energy efficiency in the commercial and industrial sectors

Lead Agency: MEA

Program Description

MEA's commercial and industrial energy efficiency programs support or compliment the EmPOWER Maryland suite of energy efficiency programs. MEA administers four programs that target energy efficiency improvements in the commercial and industrial sectors, which represent approximately 58 percent of electricity consumption in Maryland. These programs offer incentives for energy audits and funding for upgrades. The four programs are: 1) DOE Save Energy Now; 2) the Lawton Loan Program; 3) C/I Deep Retrofits; and 4) the State Agencies Loan Program. These programs receive funding from both State and federal governments.

Energy efficiency and conservation block grant program provided 130 local Maryland governments with an energy audit and financing for energy efficiency and renewable energy projects for facilities owned and/or operated by the local government.

DOE Save Energy Now

MEA offers assistance to the State's industrial sector through this program. Support includes:

- Energy assessments for industrial facilities, site visit by staff from the University of Maryland Manufacturing Assistance Program to evaluate energy use at the facility and identify opportunities for energy efficiency improvements and combined heat and power, and a report on the assessment findings and recommendations.
- Free training webinars on various industrial energy efficiency topics, including combined heat and power.
- Information on financial incentives and other resources for businesses, including those offered by Maryland's utilities, MEA and federal agencies, such as U.S. Department of Energy, and third party investors.

Jane E. Lawton Conservation Loan Program

This program is a revolving loan fund available to local governments, non-profit organizations, and businesses seeking to reduce operating expenses by implementing energy conservation measures. Lawton Loans are structured so borrowers use the cost savings generated by the conservation improvements as the primary source of revenue for repaying the loans, with a payback period of 10 years or less. The loans have low interest rates and range from $40,000 to $500,000.

Energy Efficiency and Conservation Block Grant Program

This federal program was funded by the American Recovery and Reinvestment Act through 2012. Through this grant program, MEA has used $9.593 million to provide approximately 130 local Maryland governments with an energy audit and financing for energy efficiency and renewable energy projects identified in the audit for facilities owned and/or operated by the local government.

State Energy Efficient Appliance Rebate Program

MEA worked with Maryland's five major utilities to enhance their existing appliance rebate programs for homeowners. This was a one-time program, made possible by

a $5.4 million federal American Recovery and Reinvestment Act grant in 2009. This program is covered in more detail in Section B.3., below, Energy Efficiency in Appliances and Other Equipment.

State Agencies Loan Program

This is a revolving loan program dedicated to directly assisting energy efficiency programs and improvements in Maryland State agencies. Most loans have been awarded to agencies in support of their energy performance contracts; about 20 percent support State agencies' specific energy efficiency measures such as higher efficiency lighting and HVAC systems. These loans are made at zero interest with a 1 percent administrative fee.

A.3 EmPOWER Maryland: Energy efficiency in appliances and other products

Lead Agency: MEA

Program Description

MEA administers several appliance and equipment rebate programs for homeowners. It also administers low-interest loans for residential and commercial energy efficiency improvements, which may include appliances, equipment and lighting.

State Energy Efficient Appliance Rebate Program

MEA worked with Maryland's five major utilities to enhance their existing appliance rebate programs for homeowners. This was a one-time program, made possible by a $5.4 million federal American Recovery and Reinvestment Act grant in 2009. This program provided additional rebates for super-efficient clothes washers and refrigerators, room air conditioners, freezers, electric heat pump water heaters, central air conditioners, and air source heat pumps, adding onto the amount offered by the utilities. More than 33,000 Marylanders participated in the enhanced program. Based on the program's popularity and success, Maryland's utilities are proposing to enhance their existing appliance rebate offerings in their 2012–2014 plans.

The State Energy Efficient Appliance Rebate Program provides additional rebates for super-efficient refrigerators, freezers, and other residential appliances.

Maryland Home Energy Loan Program

A primary focus of this program is to replace old furnaces, heat pumps and air conditioners through low-interest loans for efficiency upgrades in primary single-family detached and townhouse residences in Maryland. The DHCD program is covered in more detail in Section B.1., above, Energy Efficiency in the Residential Sector.

Jane E. Lawton Conservation Loan Program

This revolving loan fund program is available to local governments, non-profit organizations, and businesses seeking to reduce operating expenses by implementing energy conservation measures, which may include efficiency improvements in appliances and other equipment. The program is covered in more detail in Section B.2., above, Energy Efficiency in the Commercial and Industrial Sectors.

The State and federal governments have each enacted energy efficiency standards for certain appliances and equipment. Congress established federal energy efficiency standards for certain residential and commercial appliances and lighting in the Energy Independence and Security Act of 2007 (EISA) (P.L. 110–140, H.R. 6). The Act requires

new light bulbs to be 25 percent more efficient than current incandescent bulbs. Congress has established numerous other energy efficiency appliance standards that will contribute to reducing energy use in Maryland.

The Maryland General Assembly has enacted energy efficiency standards in areas not preempted by federal standards, in particular for bottle-type water dispensers and commercial hot food holding cabinets. Bills have been introduced in prior years to adopt a variety of new standards, such as California's standard for televisions.* Televisions alone consume over five percent of all residential electricity nationwide (and some large flat screen TVs use as much power as a common refrigerator). MEA will continue to work locally and with federal authorities and energy officials from other states to advocate for more stringent and comprehensive state and national energy efficiency appliance standards.

A.4 EmPOWER Maryland: Utility responsibility

Lead Agency: MEA

Program Description

EmPOWER Maryland mandated that the PSC require each utility to propose cost-effective energy efficiency, conservation, and demand response programs designed to achieve targeted per capita energy reductions of at least five percent by the end of 2011 and at least 10 percent by the end of 2015, in addition to a 15 percent per capita peak demand reduction.

The five participating utilities are Potomac Edison (formerly known as Allegheny Power); Baltimore Gas and Electric (BGE); Delmarva Power and Light; Potomac Electric Power Company (Pepco); and Southern Maryland Electric Cooperative (SMECO). These utilities are responsible for two thirds of the EmPOWER 15 percent energy consumption reduction goal and all of the peak demand reduction goal. Energy savings targets are spread amongst all customer classes, including low-to-moderate income customers.

The five utilities developed portfolios, based on a three-year planning cycle beginning with the Program Planning Year 2009–2011. Together, the utilities only achieved 44 percent of their 2011 interim goal. Slow progress early on in the programs, driven in part by uncertainty in quantifying cost-effectiveness standards, resulted in lower than expected results. As a consequence, even the enhanced plans that the PSC approved for the 2012–2014 program cycle that provide additional resources to meet the 2015 goal, are projected to fall short of the per capita energy reduction targets.

The utilities' portfolios include programs in the following four areas:

Residential Energy Efficiency and Conservation

These programs include discounted compact fluorescent light bulbs and appliances; heating ventilation and air conditioning (HVAC) rebates; home energy audits and incentives for energy efficiency upgrades; and low income programs.

BGE Programs

These include the Lighting and Appliance Program; Energy Star for New Homes; Home Performance with Energy Star; Quick Home Energy Check-up; Online Energy Calculator; the Residential HVAC Rebate Program; and the Limited Income Energy Efficiency Program.

Pepco Programs

These include the Lighting and Appliance Program; the Home Performance with Energy Star Program which includes Quick Home Energy Check-up and the Online Audit Calculator; the no cost appliance replacement program for Low Income; and the residential HVAC Program.

* "Maryland Energy Efficiency Standards Act," State Government Article, Sec. 9–2006, Annotated Code of Maryland (became law per Maryland Constitution, Chapter 2 of 2004 on January 20, 2004); and "Maryland Energy Efficiency Standards Act of 2007," State Government Article, Sec. 9–2006, Annotated Code of Maryland. "Maryland Efficiency Standards Act—Televisions" (House Bill 349/Senate Bill 455) was introduced in the 2010 Session but did not pass.

SMECO Programs

These include the Lighting Program; the Appliances Program; Home Performance with Energy Star; Quick Home Energy Check-up; HVAC; Energy Star New Home Construction; and the Limited Income Energy Efficiency Program.

Potomac Edison Programs

These include the Compact Fluorescent Light Rebate Program; the Energy Star Appliance Program; the Home Performance Program; the Limited Income Weatherization Program; the Air Conditioner Efficiency Program; and the Heat Pump Efficiency Program.

Delmarva Programs

These include the Lighting and Appliance Program; the Home Performance with Energy Star Program which includes Quick Home Energy Check-up and the Online Audit Calculator; a no cost appliance replacement program for Low Income; and the residential HVAC Program.

Commercial and Industrial Energy Efficiency and Conservation

These programs are designed to encourage businesses to upgrade to more efficient equipment, such as lighting, HVAC or motors, or improve their building performance through weatherization or building shell upgrades. For larger commercial buildings or industrial facilities, the utilities can customize incentives for cost-effective improvements.

BGE Programs

These include Energy Solutions for Small Business; the Small Business Lighting Solutions Program; and the Retro-commissioning Program for industrial and commercial customers.

Pepco Programs

These include the Prescriptive Program; the Heating, Ventilation, and Air Conditioning Program, the Custom Incentive Program; and the Building Commissioning and Operations & Maintenance Program.

SMECO Program

SMECO launched its Prescriptive/Custom Program in 2009, with plans to enhance it with new measures and higher incentive levels, as well as increased marketing efforts. For 2012 and beyond, SMECO plans to offer a small business lighting and retrofit program.

Potomac Edison Programs

These include the Lighting Efficiency Program; the Air Conditioning Efficiency Program; the Heat Pump Efficiency Program; Commercial and Industrial Efficient Drives; and Commercial and Industrial Custom Applications.

Delmarva Programs

These include: the Prescriptive Program; the Heating, Ventilation, and Air Conditioning Program, the Custom Incentive Program; and the Building Commissioning and Operations & Maintenance Program.

Demand Response

Demand response programs enable utilities to change electricity usage by end-use customers either in response to price changes or by providing incentive payments designed to induce lower electricity use when demand is higher. Through controls installed on the premises of customers who choose to participate, the utility has the ability to cycle electricity usage of their air conditioners and electric heat pumps during periods of high demand. Events are usually called on the hottest summer days when electricity usage is at its peak and system reliability may be jeopardized.

BGE Program

BGE launched its PeakRewards program in 2010. Participants can choose to have either a thermostat or a digital switch on their air conditioner or electric heat pump installed, which gives BGE the ability to cycle electricity usage during periods of high demand. BGE also deployed its PeakRewards water heater program in 2010.

Pepco Program

Pepco launched its EnergyWise Rewards program (similar in program design to BGE's PeakRewards) in 2009. Participants can choose to have either a thermostat or a digital switch installed on their air conditioner or electric heat pump, which gives Pepco the ability to cycle electricity usage during periods of high demand.

SMECO Program

SMECO launched its CoolSentry program in 2008. Participants can choose to have either a thermostat or a digital switch on their air conditioner or electric heat pump installed, which gives SMECO the ability to cycle electricity usage during periods of high demand.

Potomac Edison Programs

Potomac Edison does not have a residential demand response program, but developed three commercial and industrial demand response programs for the 2012–2014 EmPOWER cycle: the Conservation Voltage Reduction Program; the Customer Resources Demand Response Program; and the Distributed Generation Program.

Delmarva Programs

Delmarva began installing air conditioning measures in 2010 and has continued to install load control devices on central air conditioners and heat pumps for demand response participants in its service territory

Advance Metering Infrastructure (AMI)

Also called "Smart Grid" technology, AMI is a two-way communication system and associated equipment and software, including metering equipment installed on an electric customer's premises, that use the electric company's distribution network to provide real-time monitoring, diagnostic, and control information and services. AMI can reduce peak demand and energy consumption beyond those reductions achieved through energy efficiency and conservation and demand response programs. Additionally, advanced metering infrastructure and Smart Grid technology improves the efficiency and reliability of the distribution and use of electricity by reducing blackout probabilities and forced outage rates and restoring power in shorter time periods.

BGE Program

Following the PSC approval of BGE's AMI Initiative in 2010, BGE, in conjunction with Pepco Holdings, Inc., PSC Staff and other stakeholders established a Smart Grid Collaborative Work Group to discuss issues such as a consumer education plan and a comprehensive set of performance metrics. BGE began installing smart meters in its service territory in October 2011 and will continue this initiative through its 2011–2014 deployment period.

Pepco Program

Pepco's AMI Initiative, which was approved by the PSC in 2010, authorized Pepco to install 570,000 smart meters in its service territory. These installations began in 2011.

SMECO Program

In Phase I of its two-phase AMI Pilot Program, SMECO launched the installation of 1,000 smart meters in one section of its service territory to test the operational benefits

of deploying AMI technology—such as savings from eliminating meter readings and improved outage restoration—prior to deploying the technology across its entire service territory in Phase II.

Potomac Edison Program

Potomac Edison is currently working with the Public Service Commission to install Automated Metering Infrastructure (AMI) systems in the homes of their customers. As of June 30, 2102, 56 out of the proposed 550,000 (0%) AMI systems have been installed.

Delmarva Program

Delmarva Power began installing Automated Metering Infrastructure (AMI) systems in the homes of Delmarva gas and electric customers in March of 2013.

Implementation

This program is mandated by State law. The utilities submitted program enhancements and improvements to PSC in early September 2011 for the 2012–2014 program cycle, which will improve current programs and add new energy efficiency measures. Programs were approved in December 2011 and implementation occurred throughout 2012. In 2012, MEA began evaluating the EmPOWER Maryland goals for 2016 and beyond.

A.5 Combined heat and power

Lead Agency: MEA and MDE, in coordination with other State agencies

Program Description

Combined heat and power, also called co-generation, is a technology designed to generate both power and thermal energy from a single fuel source. A combined heat and power system recovers waste heat from thermal energy used in industrial processes and electricity generation and uses it for heating or cooling, achieving thermal efficiency levels of up to 80 percent. The increased efficiency means more useful energy is generated from a single fuel source. Therefore, GHG emissions from a combined heat and power system are less than from a typical system which produces electric and thermal energy separately. Expanding the use of these systems can greatly increase a facility's level of energy efficiency and decrease energy costs. Moreover, combined heat and power is an efficient, clean, and reliable approach to generating power while also reducing GHG emissions. The five EmPOWER utilities received approval from the PSC to run combined heat and power programs in the spring of 2012. Efforts are underway to recruit potential customers.

MEA and DNR, are actively engaged in promoting the increased use of combined heat and power at industries and institutions around the State. Currently, there are approximately 21 combined heat and power units located in Maryland, fired by fossil fuels, biomass, and waste.

Increasing the number of combined heat and power units in Maryland is a voluntary initiative. State agencies can facilitate the expansion of combined heat and power units through education and outreach about the benefits of these systems and the enactment of incentives such as: (1) direct subsidies, tax credits or exemptions for purchasing, selling or operating combined heat and power systems; and (2) tax credits for each kilowatt-hour or British thermal unit generated from a qualifying facility.

MEA has offered assistance to the State's industrial sector through the Maryland Save Energy Now program. Support offered through this program includes:

- Low cost energy assessments for industrial facilities in Maryland.
- Training webinars on various industrial energy efficiency topics, including combined heat and power.

- Information on financial incentives and other helpful resources for businesses, including those offered by Maryland's utilities, MEA, and federal agencies such as U.S. Department of Energy, and third party investors.

Additional support is available for qualifying entities through The Jane E. Lawton Conservation Loan Program, which provides loans to eligible non-profit organizations, local governments (including public school systems and community colleges), and businesses in Maryland an opportunity to reduce operating expenses by identifying and installing energy conservation improvements. Loans have a payback period of ten years or less and borrowers use the cost savings generated by added improvements as the primary source of revenue for repaying the loans. Because this is a revolving loan fund rather than a one-time grant, Maryland is able to maximize the use of the funds. Repayments and interest earned by the fund will allow the program to continue making loans for the foreseeable future.

Implementation

This is a voluntary program.

B. Maryland Renewable Energy Portfolio Standard (RPS)

The Maryland Renewable Energy Portfolio Standard (RPS) is a law that requires Maryland to obtain 20 percent of its electricity from renewable sources, as defined by statute, by 2022, with a solar carve-out which requires that two percent be obtained from solar energy generation by 2020. The RPS incentivizes the development of renewable energy by requiring electricity suppliers to meet a prescribed portion of their energy supply needs using renewable energy sources. Energy suppliers are required to purchase Renewable Energy Credits (RECs) to demonstrate compliance with the RPS. The State also runs a number of other incentive programs to support renewable energy and achieve the RPS goal. Collectively, the RPS compliance program and the State incentive programs constitute the RPS bundle of programs. The State recognizes the significant environmental and consumer benefits associated with renewable energy and is facilitating development of a diversity of renewable energy sources.

The Maryland Renewable Energy Portfolio Standard (RPS) is a law that requires Maryland to obtain 20 percent of its electricity from renewable sources by 2022.

The original RPS legislation was adopted in 2004 and has been amended a number of times, in 2007, 2008, 2010, 2011 and 2012.*

RPS Program enhancement options

Maryland's current RPS allows a number of different fuel sources to qualify as renewable sources of energy, which are eligible to generate Tier 1 RECs. Some of these fuel sources such as black liquor and other paper mill residues, emit CO_2 emissions when used to generate electricity, while others, such as wind, solar, and small hydro, do not. In addition, because the vast majority of these carbon-intensive facilities that qualify for the RPS were built decades ago, they do not contribute to reducing CO_2 or any other pollutants from fossil fuels below current levels. The only way to reduce pollution below current levels is to build new clean energy facilities to displace high-emitting fossil fuel generation. Moreover, while the RPS policy allows RECs from any qualifying technology to be used for compliance, narrowing qualifying sources to favor low- or no-carbon fuel sources would drive additional GHG emissions reductions. Substituting carbon-free wind power for black liquor and other

* Original 2004 RPS legislation:
- "Electricity Regulation - Renewable Energy Portfolio Standard and Credit Trading - Maryland Renewable Energy Fund" (SB869/HB 1308, 2004 Session).
- Subsequent legislation amending the RPS law:
- "Net Energy Metering - Renewable Energy Portfolio Standard - Solar Energy" (SB595, 2007 Session) added a provision requiring electricity suppliers to derive 2% of electricity sales from solar energy in addition to the 7.5% renewables derived from other Tier 1 resources as outlined in the initial RPS law.
- "Renewable Portfolio Standard Percentage Requirements—Acceleration" (SB209/HB375, 2008 Session) increased Maryland's RPS percentage requirements to 20 percent by 2022, including a two percent level for solar, restricted the geographic scope in which renewable resources can be obtained for compliance, and increased the fee charged to electric suppliers for shortfalls.
- "Renewable Energy Portfolio Standard—Tier 1 Renewable Source—Poultry Litter" (SB348/HB1166, 2008 Session)) added poultry litter to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.
- "Renewable Energy Portfolio Standard - Solar Energy" (HB 471/SB 277, 2010 Session) accelerated Maryland's RPS requirements for solar energy in the early years (2011–2017), while leaving unchanged the RPS's 2022 goal of two percent for solar.
- "Renewable Energy Portfolio - Waste-to-Energy and Refuse-Derived Fuel" (SB690/HB1121, 2011 Session) added waste-to-energy and refuse-derived fuel to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS, provided the source is connected with the distribution grid serving Maryland.
- "Renewable Energy Portfolio Standard - Renewable Energy Credits Solar Water Heating Systems" (SB717/HB 933, 2011 Session) added solar hot water systems to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.
- "Renewable Energy Portfolio Standard—Solar Energy and Solar Water Heating Systems" (SB791/HB1187, 2012 Session) accelerated the two percent solar carve-out compliance schedule and moved up the final target date for achieving the solar carve-out from 2022 to 2020.
- "Renewable Energy Portfolio Standard - Renewable Energy Credits - Geothermal Heating and Cooling" SB652/HB1186, 2012 Session) added geothermal heating and cooling systems that meet certain standards systems to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.
- "Renewable Energy Portfolio Standard - Renewable Energy Credits - Thermal Biomass Systems" SB 1004/HB 1339, 2012 Session) added thermal energy associated with biomass systems that primarily use animal waste (possibly supplemented by other biomass resources) to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.

mill residues would produce an additional 1.4 $MMtCO_2e$ reduction. Maryland supports achieving those additional reductions by narrowing the eligibility of high-emitting biomass fuels to only those generation facilities that are both new and efficient.

Currently, Maryland's RPS requires 18 percent of energy consumed in the State to come from qualified sources in 2020 and 20 percent by 2022. If the RPS were accelerated to require 25 percent of energy consumed in the State to come from low-carbon sources by 2020, additional GHG reduction benefits would be realized. In this scenario, the number of RECs would increase by nearly 40 percent, and the profile of RECs would be lower in carbon than the current policy.

If layered on top of the elimination of black liquor from the RPS and incremental EmPOWER reductions, increasing the RPS to 25 percent could drive an additional 2.7 $MMtCO_2e$ reduction.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the existing RPS programs in 2020 are estimated to be 6.86 $MMtCO_2e$ (Figure 6.8). Because these programs are all related, MEA has aggregated the potential emission reductions from the full set of programs. Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emissions reduction from the proposed RPS enhancements in 2020 is estimated to be 10.96 $MMtCO_2e$ (Figure 6.8).

Job Creation and Economic Benefits

The Maryland RPS programs are expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Maryland RPS programs, once fully operational, would support a total of about 3,563 jobs and generate -$3,169,618,745 in net economic benefit and $385,240,490 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with the Maryland RPS programs.

Figure 6.8 Initial and enhanced GHG reductions by policy for the Maryland Renewable Energy Portfolio Standard (RPS), in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
ENERGY	**B**	**Maryland Renewable Energy Portfolio Standard (RPS)**	-	**6.86**	**10.96**
	B.1	Maryland Renewable Energy Portfolio Standard (RPS) Program	MEA	5.86	9.96
	B.2	Fuel Switching	MEA	1.00	1.00
	B.3	Incentives and Grant Programs to Support Renewable Energy	MEA	Included in B	Included in B
	B.4	Offshore Wind Initiatives to Support Renewable Energy	MEA	Included in B	Included in B
			TOTAL REDUCTIONS	**6.86**	**10.96**

B.1 Maryland Renewable Energy Portfolio Standard (RPS) program

Lead Agency: MEA

Program Description

The RPS is implemented through the creation, sale and transfer of RECs. Each REC represents one megawatt of renewably generated electricity. Electricity suppliers are required to purchase RECs to demonstrate they have obtained specified percentages of their energy supply from renewable resources. Sources are classified as Tier 1 and Tier 2. Tier 1 sources consist of: solar; wind; qualifying biomass; qualifying methane; geothermal; ocean; qualifying fuel cell, qualifying hydroelectric power, poultry litter-to-energy; waste-to-energy; and refuse-derived fuel. Non-solar Tier 1 requirements gradually increase to 18 percent in 2020, and then peak in 2022 at 20 percent and are subsequently maintained at that level. Tier 1 includes a solar set-aside requirement which gradually increases until it peaks at two percent in 2020. Maryland's Tier 2 source (eligible hydroelectric power) requirement remains constant at 2.5 percent through 2018, after which it sunsets. The development of renewable energy sources is further promoted by requiring electricity suppliers to pay a financial penalty for failing to acquire sufficient RECs to satisfy the RPS. The penalty is used to support the development of new Tier 1 renewable sources in the State.

The RPS is designed to create a stable and predictable market for renewable energy and to foster additional development and growth in the renewable energy industry.

Implementation

The RPS is mandated by §§7–701 through §7–713 of the Public Utilities Article of the Maryland Code. MEA is the lead State agency on implementation of RPS programs.

Appendix C provides a description of the methodology used to quantify GHG reductions.

B.2 Fuel switching

For more information on Fuel switching, please refer to the introductory section of this chapter. In-state fuel switching GHG emissions reductions have been accounted for through Maryland's New Source Performance Standard program, Boiler Maximum Available Control Technology program, and GHG Prevention of Significant Deterioration Permitting Program. Out-of-state fuel switching GHG emission reductions have been estimated to account for approximately 1 $MMtCO_2e$.

B.3 Incentives and grant programs to support renewable energy

Lead Agency: MEA

Program Description

MEA administers a number of incentives and grant programs to promote and accelerate the development of renewable energy production in Maryland, from utility scale facilities to on-site distributed generation. Following is a summary of key initiatives:

Commercial Clean Energy Grant Program

This program provides financial assistance to businesses, non-profits, and government entities who install solar photovoltaic, solar water heating, geothermal heat pump and wind turbine systems at their place of business.

Figure 6.9 Clean energy purchase partnership.

Bidder	Project	Project type	State	Project capacity (MW)	Annual energy output (MWh/r)	Contract escalation	Start date	Term (yr)	Annualized project rate (c/kWh)
US Windforce	Pinnacle	Wind	WV	55	173,542	0%	Dec 2011	20	.082
Synergic-SBR	Roth Rock Phase II	Wind	MD	10	30,605	50% CPI	Dec 2011	20	.120
Constellation	St. Mary's Solar	Solar	MD	13	22,291	0%	Jan 2013	20	.224

Article I. Residential Clean Energy Grants Program

This program provides financial assistance to residents who install solar photovoltaic, solar water heating, geothermal heat pump and wind turbine systems at their residence.

Through these two programs, MEA has awarded thousands of grants (ranging from $500–$50,000) to homeowners and businesses to offset the cost of installing wind, geothermal and solar photovoltaic systems. Demand increased from 200 systems a year to 200 systems a month in 2010 and 2011, even with reduced incentives.

Article II. Clean Energy Incentive Tax Credit Program

Started in 2006, this program offers a State income tax credit to Maryland individuals and corporations that build and produce electricity generated by qualified renewable resources, in the amount of 0.85 cents per kilowatt-hour, and 0.50 cents per kilowatt-hour for electricity generated from co-firing a qualified resource with coal. The resources must be operational before 2016. MEA issues five-year credit certificates on a first-come, first-serve basis. Total program credits are capped at $25,000,000 by 2016, with individual credits ranging between $1,000 and $2,500,000 per eligible project.* As of June 30, 2011, more than $8.5 million in credits had been claimed over the past three years.

Generating Clean Horizons Program

Electricity is a significant part of the State's purchasing budget and has a considerable impact on Maryland's energy use and GHG emissions. By 2009, the State government spent approximately $160 million per year on electricity and using 1.5 billion kilowatts per year.†

In 2009 MEA and DGS, in partnership with the University System of Maryland, launched the Generating Clean Horizons program to reduce the GHG footprint of the purchased electricity of State government and the University of Maryland. Through a competitive bid process, long-term power purchase agreements were awarded to three new, utility-scale renewable energy sources that collectively will provide 78 MW, approximately 16 percent of the annual electricity needs of State agencies and University of Maryland's institutions over a 20-year period.‡ The awards were made to Constellation Energy for a 13 MW solar project on the Mount St. Mary's University campus in Emmitsburg, Maryland; Synergics for a 10 MW solar project as part of its Roth Rock development in Western Maryland; and U.S. Wind Force, LLC, for a 55 MW on-shore wind energy project at the Pinnacle Wind Farm in West Virginia. See Figure 6.9 for project details.

The Generating Clean Horizons initiative significantly advances both the purchasing and building energy usage "lead by example" policies first articulated in the 2008 Climate Action Plan and supports the development of utility-scale, commercial projects to provide clean energy to Maryland's grid.

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* Maryland Clean Energy Incentive Act of 2010" (House Bill 464) extended the existing clean energy incentive State income tax credit for 5 years, through December 31, 2015.

† Telephone conversation with Hatim Jabaji, Office of Energy Projects and Conservation, DGS, May 12, 2009.

‡ The "Generating Clean Horizons" joint request for proposal, issued in February 2009, solicited proposals for renewable and low-carbon energy projects to supply electricity and RECs to State agencies and University System of Maryland institutions. Under its terms, State government and universities can purchase up to 20 percent of their annual electricity needs through as-needed contracts, not to exceed 20 years, with providers in Maryland and surrounding states. Power must be made available by December 31, 2014.

Project Sunburst

In 2010 MEA launched Project Sunburst to install major solar photovoltaic arrays on as many as 17 government buildings around the State. Completed in 2011, the installations have a generating capacity of 9.1 MW, which at the time it was planned, would have more than doubled the amount of solar on Maryland's grid. The program, administered by MEA, leverages federal stimulus funds to award grants to selected government entities at a rate of $1,000 per kilowatt on installations. Award recipients include public school systems throughout the State, the City of Baltimore, Talbot County facilities, BWI Airport, and the Maryland Port Authority Marine Terminal. *

Biomass Programs

MEA administers several tax and other incentive programs to promote the use of organic materials such as agricultural crops and residues, household, industrial, and forestry wastes, for biofuels and energy. †

Land-based Wind Programs

The wind industry in Maryland currently produces over 120,000 kilowatts of power. MEA's efforts to expand land-based wind energy production have focused on three sectors: i) small and residential scale, ii) community, or mid-size scale, and iii) utility scale:

Residential:

MEA administers the Windswept grant program, which supports the deployment of small and residential wind energy systems. This program typically supports between 10 percent and 30 percent of the total cost of installation, leveraging private and federal funds to expand small and residential wind energy below 100 kilowatts. As of June 30, 2011, the Windswept program resulted in 72 residential wind installations and 421 kilowatts of deployed capacity. MEA also works with local planning and zoning officials to remove zoning and permitting barriers to small and residential wind energy systems. Currently, 16 counties have enacted enabling wind ordinances, and 2 more are in some phase of development.

Community and mid-size:

MEA works with local governments and entrepreneurs to facilitate development of community-scale wind projects, suitable for such facilities as wastewater treatment plants, military installations, college campuses and communities.

Utility:

MEA supports developers as they investigate State policies and incentives, navigate through local ordinance rules, Certificate for Public Convenience or Necessity or exemption processes. MEA participates in public hearings to advocate for greater renewable energy deployment in the State.

These programs range from tax incentives to grants to long term power purchase agreements and include the Commercial Clean Energy Grant Program, the Residential Clean Energy Grant Program, the Clean Energy Incentive Tax Credit Program, the Generating Clean Horizons Program, Project Sunburst, and various biomass and land-based wind programs.

Implementation

This is a voluntary incentive based program. Funding for the incentive and grant programs comes from the Strategic Energy Investment Fund.

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*"Governor O'Malley's Project Sunburst Puts Solar Energy on 31 State Buildings, Nearly Tripling Solar Energy Produced in Maryland." MEA Press Release, April 22, 2010. *http://www.energy.state.md.us/press.html*

† Biomass, along with other types of renewable energy sources, is eligible for the Maryland Clean Energy Production Tax Credit administered by the MEA. The tax credit is equal to 0.85 cents per kilowatt hour, up to $2.5 million during a five year period. The commissioning deadline to qualify for the grant was extended by five years, to December 31, 2015. Maryland Clean Energy Incentive Act of 2010 (House Bill 464).

B.4 Offshore Wind Initiatives to Support Renewable Energy

Lead Agency: MEA

Program Description

Maryland waters are part of the Mid-Atlantic Bight region, a coastal area spanning from North Carolina to Massachusetts with substantial wind resources located in close proximity to coastal population centers. In fact, this area has the greatest renewable energy potential relative to other U.S. offshore regions in the Gulf of Mexico, Pacific, and Alaska. Research indicates that the potential power supply available from offshore wind substantially exceeds the region's current energy use. Maryland, therefore, has the potential to access large energy resources off the coast that could contribute to meeting future energy demands while simultaneously displacing fossil fuel generation.

The Maryland Renewable Energy Portfolio Standard (RPS) is a law that requires Maryland to obtain 20 percent of its electricity from renewable sources by 2022.

Maryland has taken a lead among Mid-Atlantic states working to harness offshore wind resources. We are moving forward expeditiously to put in place financial support, regulatory parameters, lease conditions, and data-gathering initiatives to support the deployment of a first-phase major offshore wind project in the Maryland Wind Energy Area (WEA) by 2018.

Implementation

During the 2013 General Assembly session, lawmakers passed the Maryland Offshore Wind Energy Act of 2013. This law creates a regulatory context for including offshore wind into the State's RPS, and provides support for a 200 MW project. The PSC will now begin promulgating regulations based on the legislation—a process that should be facilitated by the legislation's clear rules and price parameters. These regulations should be ready for implementation by July 1, 2014.

During the summer of 2013, the U.S. Dept. of Interior is expected to issue a Proposed Sale Notice for the Outer Continental Shelf lease blocks in the Maryland Wind Energy Area. This will start the countdown to leasing off Maryland's shores with a 60 day notice and comment period during which project developers will have their last opportunity to register to bid. After the Proposed Sale Notice, the Dept. of Interior will issue a Final Sale Notice, and after 30 days will be ready to auction these lease blocks to developers who want to build projects.

Using the Offshore Wind Development Fund established as a result of the Merger Settlement Agreement between Exelon and Constellation Energy, MEA and DNR signed a Memorandum of Understanding to partner on gathering environmental data from the Maryland Wind Energy Area to support project development and ensure environmental protection. Under this agreement, agencies planned out surveys for marine mammals and sea turtles, studies of the ecology of the seafloor habitats and research into using new LIDAR technology to measure wind speeds with lasers.

At the same time, MEA issued a first-of-its-kind Request for Proposals for a high resolution geophysical survey of the seafloor in the proposed area, helping projects choose the right turbine foundation design and creating important scientific data for state agencies. Efforts to invest in data and research will ramp up during the summer of 2013. A vessel will be carefully transecting the Wind Energy Area gathering critical geophysical data and carrying equipment to collect improved wind speed data. Working under the partnership with MEA, DNR will be commissioning further study of habitats and environmental conditions in the Wind Energy Area.

C. Regional Greenhouse Gas Initiative

Lead Agency: MDE

Program Description

Maryland is one of nine Northeast and Mid-Atlantic States that participate in the Regional Greenhouse Gas Initiative (RGGI)—a regional market-based cap-and-trade program to reduce CO_2 emissions from fossil-fuel fired power plants in the region. RGGI reduces emissions through an emissions cap applied to the nine-state geographic region.* Under the initiative, the participating states issue "allowances" equal to the number of tons of CO_2 emissions allowed under the regional cap. A single allowance permits a source to emit one ton of carbon dioxide.

At the end of each three-year compliance period, each power plant subject to RGGI must have received or purchased, either at auction or on the secondary market, the number of allowances equivalent to the number of tons of CO_2 emitted by the power plant during the compliance period. In simple terms, the cap operates as a ceiling on regional emissions and guarantees emission reductions. By adding a cost to every ton of carbon dioxide emitted through the requirement to purchase allowances, sources have an economic incentive to minimize emissions whenever possible.

RGGI's goal is to reduce power sector CO_2 emissions from 2005 levels 10% by 2018. The initiative is designed to stabilize 2005 power plant CO_2 emissions through 2014. Beginning in 2015, RGGI requires a 2.5% CO_2 emission reduction each year through 2018.

As the first cap-and-trade GHG emission reduction program of its kind in the nation, an important secondary goal was to demonstrate that such a market-based carbon reduction program could work. RGGI has operated successfully since the first allowance auction was held in 2008 and is now mid-way through a second compliance period. Since its implementation, CO_2 emissions from the power plants subject to RGGI have declined from 165 million tons to 92 million tons in 2012. Although this significant decline is due in part to the investment of auction revenue in energy efficiency and renewable energy programs, most of the reduction is the result of the economic downturn, milder weather and a continuing trend toward fuel switching to cleaner natural gas.

* Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont currently participate in RGGI.

ALEXANDRA FRIES, IAN IMAGE LIBRARY

The Regional Greenhouse Gas Initiative (RGGI) is a market-based cap-and-trade program to reduce CO_2 emissions from fossil-fuel fired power plants in the region.

Figure 6.10 Initial and enhanced GHG reductions by policy for the Regional Greenhouse Gas Initiative, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
C	Regional Greenhouse Gas Initiative (RGGI)	MDE	0.00	3.60
		TOTAL REDUCTIONS	0.00	3.60

In 2012 the RGGI states commenced a comprehensive program review in an effort to strengthen its effectiveness. The review included an evaluation of the existing emissions cap. On February 7, 2013, the RGGI states announced the completion of the review and a consensus decision to seek a number of program changes, including a reduction in the emissions cap to 91 million tons adjusted further to account for the substantial bank of allowances privately held by compliance entities. The goal of the states is to implement the new cap on January 1, 2014, and commencing in 2015, to reduce the cap further by 2.5% each year through 2020. These changes are projected to result in a cumulative regional CO_2 emission reduction of between 80 and 90 million tons by 2020. During that same period, CO_2 emissions from Maryland power plants are projected to decline by 3.6 million tons from 2006 levels due to the RGGI program changes.

Because no control technologies exist to reduce carbon dioxide pollution at this time, most of the RGGI reductions will be achieved through fuel switching to natural gas, and the expanded implementation of energy efficiency and renewable energy programs.

The Healthy Air Act of 2006 required Maryland to join RGGI. RGGI applies to electric generating units of 25 megawatt capacity or greater. Most of the power plants in Maryland are subject to RGGI. A single industrial pulp and paper plant is also subject to the program, but may apply for an exemption from the program under certain conditions. More information on this program can be found in Appendix C of this Plan.

Estimated GHG Emission Reductions in 2020

Initial reductions

RGGI provides a framework by which emission reductions are implemented under the EmPOWER and RPS programs (Figure 6.10).

Enhanced reductions

The potential emission reductions from the RGGI program enhancements in 2020 are estimated to be 3.60 $MMtCO_2e$ (Figure 6.10).

Job Creation and Economic Benefits

The RGGI program is expected to create and retain jobs. RESI's 2012 study estimated that RGGI, once fully operational, would support a total of about 96 jobs and generate -$40,814,289 in net economic benefit and $10,701,960 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Tightening the RGGI cap to 91 million is expected to create and retain even more jobs and increase the State GDP. RGGI Inc's 2013 analysis of lowering the cap to 91 million finds that an additional 269 jobs in 2020 would be generated, supporting an additional $155.2 million in State GDP and $217.2 million in personal income from 2012 through 2020. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The RGGI program is mandated by State law and is fully implemented and enforceable through regulations (COMAR 26.09) adopted and enforced by MDE.

D. Other Energy Programs

This policy contains various other energy programs which, when fully implemented, will provide further potential emissions reductions by 2020 and will create and retain jobs and increase the State gross domestic product.

D.1 GHG Power Plant Emission Reductions from Federal Programs

Lead Agency: MDE

GHG emissions from the energy supply sector in Maryland include emissions from fossil fuel-fired electricity generation and represent a substantial portion of the State's overall GHG emissions. Electricity demand in Maryland is expected to increase over time and thus, if unmitigated, GHG emissions will also likely increase. Because approximately 30 percent of electricity consumption in Maryland is generated out-of-state in the surrounding Pennsylvania Jersey Maryland Interconnection LLC (PJM) electricity grid region, State programs alone cannot effectively control GHG emissions from power consumed in Maryland.

Existing and proposed federal rules summarized in this section (D.1.A. GHG New Source Performance Standard; D.1.B. Boiler Maximum Achievable Control Technology; and D.1.C GHG Prevention of Significant Deterioration Permitting Program) are expected to reduce GHG emissions from Maryland and out-of-state power generators.

D.1.A Boiler Maximum Achievable Control Technology (MACT)

Lead Agency: MDE

Program Description

EPA has adopted new air emissions requirements for industrial, commercial, and institutional boilers under two separate rulemakings.* The first, which took effect January 31, 2013, establishes national emission standards for Hazardous Air Pollutants (HAPs) for major sources.† The rule affects thousands of boilers and process heaters at facilities nationwide which are considered as major sources of HAPs. These facilities also emit GHGs.

The Boiler MACT rule applies to any stationary source with a boiler or group of stationary sources with boilers that emit 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs. The rule requires each boiler to meet pollution emission limits on an annual and continuous basis.

EPA also issued a Boiler MACT rule for smaller "area sources," which took effect February 1, 2013.‡

Among other things, the Boiler MACT rules require operators to conduct a boiler tune-up to improve efficiency, minimize fuel consumption and reduce emissions. EPA estimates there will be a one percent fuel savings due to the tune-ups, which equates to an equivalent one percent reduction in GHG emissions.

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* Boilers burn fuel, including natural gas, fuel oil, coal, biomass (e.g., wood), or other gas to produce steam or hot water. The steam is used to produce electricity, drive an industrial process, or provide heat. Emissions from burning the fuel can include toxic air pollutants like mercury, lead and particle pollution.

† "National Emission Standards for Hazardous Air Pollutants for Major sources: Industrial, Commercial, and Institutional Boilers and Process Heaters," 78 Fed. Reg. 7138 (January 31, 2103).

‡ "National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, commercial, and Institutional Boilers." 78 Fed. Reg. 7488 (February 1, 2013).

Figure 6.11 Initial and enhanced GHG reductions by policy for Other Energy Programs, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
ENERGY	**D**	**Other Energy Programs**	**-**	**0.13**	**0.23**
	D.1	GHG Power Plant Emission Reductions from Federal Programs	-	-	-
	D.1.A	Boiler Maximum Achievable Control Technology (MACT)	MDE	0.07	0.07
	D.1.B	GHG New Source Performance Standard	MDE	Included in D.1	Included in D.1
	D.1.C	GHG Prevention of Significant Deterioration Permitting Program	MDE	Included in D.1	Included in D.1
	D.2	Main Street Initiatives	DHCD	0.05	0.14
	D.3	Energy Efficiency for Affordable Housing	DHCD	0.01	0.02
			TOTAL REDUCTIONS	**0.13**	**0.23**

Implementation

MDE will adopt State regulations to implement the federal requirements.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Boiler MACT program in 2020 are estimated to be 0.07 $MMtCO_2e$. Appendix C provides a more detailed description of the process used to quantify GHG reductions (Figure 6.11).

Job Creation and Economic Benefits

The Boiler MACT program is expected to create and retain jobs. RESI's 2012 study estimated that the Boiler MACT program, once fully operational, would support a total of about 89 jobs and generate -$17,622,292 in net economic benefit and $7,870,760 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

D.1.B GHG New Source Performance Standard

Lead Agency: MDE

Program Description

The U.S. Environmental Protection Agency (EPA) is using the New Source Performance Standard authority under the federal Clean Air Act to promulgate new regulations to reduce GHG emissions from fossil fuel-fired power plants. The performance standards, which are expected to become final in early 2013, will apply to new electricity generating units and will be based on existing technologies. EPA is coordinating this action on GHGs with a number of other required regulatory actions for other pollutants, thereby enabling electricity generating units to develop multi-pollutant strategies to reduce pollutants in a more efficient and cost-effective way than would be possible by addressing multiple pollutants separately.

There are currently few potential projects in Maryland for new fossil fuel-fired electricity generating units. However, other states in the PJM grid region, such as Virginia and Pennsylvania, are constructing new fossil fuel-fired electricity generating units. Because Maryland imports 40 percent of its electricity from states like Pennsylvania and Virginia, Maryland will benefit from reductions in GHG emissions required by the new GHG New Source Performance Standard.

Implementation

After EPA adopts the new federal GHG New Source Performance Standard, MDE and other State agencies will implement the federal standard through State regulations. EPA is required to implement and enforce the new requirements in any state that does not implement the federal standards.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the GHG New Source Performance Standard program has been aggregated with the estimated emission reductions from the GHG Power Plant Emissions Reductions Federal Programs bundle (Figure 6.11).

Job Creation and Economic Benefits

The GHG New Source Performance Standard program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the GHG New Source Performance Standard program, once fully operational, would support a total of about 40 jobs and generate $28,342,087 in net economic benefit and $1,258,156 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

D.1.C GHG Prevention of Significant Deterioration Permitting Program

Lead Agency: MDE

Program Description

The Prevention of Significant Deterioration (PSD) program is a federal preconstruction review and permitting program applicable to new major stationary sources and major modifications at existing major stationary sources. It requires the application of Best Available Control Technology (BACT) to control emissions of certain pollutants, which now include GHGs. A BACT determination is based on consideration of a number of factors, including the cost-effectiveness of the controls and the energy and environmental impacts. The BACT requirements apply to all new major sources of GHG emissions and major modifications at GHG emitting facilities. This means that GHG sources subject to the requirements must evaluate and apply currently available measures (and later technology as it develops) to reduce GHG emissions

Implementation

Effective July 1, 2011, the federal PSD program applies to new sources with the potential to emit 100,000 tons per year of CO_2e and to modifications of existing sources that increase net CO_2e emissions by at least 75,000 tons per year.

Beginning on July 1, 2013, additional sources will be included and a possible permanent exclusion from permitting will be determined for some source categories. EPA will complete a streamlining study by April 30, 2015. No sources with GHG emissions below 50,000 tons per year of CO_2e and no modification resulting in net GHG increases of less than 50,000 tons per year of CO_2e emissions will be subject to this program's permitting requirements before April 30, 2016.

MDE has adopted regulations to implement and enforce the federal PSD program in Maryland, and has issued several PSD approvals requiring the regulated sources to implements BACTs for GHGs.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the GHG New Source Performance Standard program has been aggregated with the estimated emission reductions from the GHG Power Plant Emissions Reductions Federal Programs bundle (Figure 6.11).

Job Creation and Economic Benefits

The GHG Prevention of Significant Deterioration Permitting Program is expected to increase the State GDP. RESI's 2012 study estimated that the GHG Prevention of Significant Deterioration Permitting Program, once fully operational, would support a total of about 0 jobs and generate $223,823 in net economic benefit and $110,973 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

D.2 Main Street Initiatives

Lead Agency: DHCD

Program Description

The built environment has a large impact on the natural environment. According to the U.S. Energy Information Administration, "roughly 41% of total U.S. energy consumption in 2011 was used in buildings, or about 40 quadrillion Btu."* The residential sector uses 22% and the commercial sector uses 19%; the remainder is consumed by the transportation and industrial sectors.

Inspired by Maryland's Smart, Green & Growing initiatives to do more to address energy consumption and expenses, the Department of Housing and Community Development (DHCD) began to pursue new opportunities to help people and communities through energy efficiency retrofits for homes and small businesses. With a "Main Street" approach, DHCD competed for and won an award of $20 million from the U.S. Department of Energy's (DOE) Better Buildings/EECBG program. This Recovery Act-funded award was a three-year commitment that funded energy efficiency retrofits through a new DHCD program called BeSMART. The BeSMART investments and initiatives subsequently provided the foundation for DHCD's newly created Housing and Building Energy unit, which was launched in 2012.

DHCD's Be SMART program, funded through the US Department of Energy's Better Buildings program, provides increased comfort, safety and affordability to buildings in Maryland through energy efficiency improvements. $508 million in federal funding has allowed 41 state and local government leaders to expand the building improvement industry and pave the way for a cleaner energy future. Maryland received $20 million in funding for the Be SMART program to finance improvements to homes, businesses and multifamily buildings. DHCD is working with local partners and contractors to provide financing for energy efficiency improvements across the state. Through the Be

In 2011, it was calculated that roughly 41% of total U.S. energy consumption was used in buildings. The remainder was used by the transportation and industrial sectors.

* U.S. Energy Information Administration, Frequently Asked Questions: How much energy is used in buildings in the United States?, *http://www.eia.gov/tools/faqs/faq.cfm?id=86&t=1*, January 2, 2013

SMART program, financing is available for the purchase and installation of equipment and materials for energy efficiency measures. Such items include, but are not limited to ENERGY STAR qualified: HVAC systems, insulation, windows, draft stopping and duct sealing, appliances and fixtures, and water heating equipment. These improvements are expected to result in energy savings of 15–30%. This translates to significantly lower energy bills for consumers, more comfortable buildings and reduced consumption of fossil fuels.

The DHCD Housing and Building Energy unit now manages increasing resources and investments in energy efficiency and weatherization for low- and moderate-income households, small businesses, and sustainable communities. DHCD uses funding from a range of sources to finance measurable energy conservation activities to benefit Maryland households — thereby also helping the state of Maryland meet the requirements of the Greenhouse Gas Reduction Act of 2009 and the goals of the Maryland Commission on Climate Change.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Main Street Initiatives program in 2020 are estimated to be 0.05 $MMtCO_2e$ (Figure 6.11). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Main Street Initiatives program enhancements in 2020 are estimated to be 0.14 $MMtCO_2e$ (Figure 6.11).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the Main Street Initiatives program, once fully operational, would support a total of about -1 job and generate $166,262 in net economic benefit and $17,547 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Governor O'Malley stated on April 21, 2010, that "this increased investment means the creation of up to 5,400 jobs to benefit Maryland's economy as well the significant impact of helping 4,000 families who own or rent homes."* For example, the construction of the University of Baltimore's new John and Frances Angelos Law Center is expected to generate 1,231 jobs.†

Economic analysis of this program by DHCD was completed by May of 2011. On April 21, 2010, Governor O'Malley stated that "this initiative also assists small businesses and communities to save money and energy by improving energy efficiency in their workplaces. More importantly, this will stimulate private investment which will ensure the sustainability of these programs and help expand Maryland's burgeoning green workforce."‡ Construction of the University of Baltimore's new John and Frances Angelos Law Center is expected to provide $60 million in compensation and $7.2 million in State and local tax revenue. In all, the project will drive $174.2 million in economic activity.§

Further analyses for the economic benefits, job creation and job protection in Maryland from this program is included in Chapter 7 of this plan.

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* DHCD. "Maryland to Receive $20 Million as Part of U.S. Department of Energy's Retrofit Ramp-Up Initiative." April 21, 2010. *http://www.dhcd.maryland.gov/Website/About/PublicInfo/NewsEvents/NewsDetail.aspx?newsID=264*

† DGS. "Maryland Green Building Council 2010 Annual Report." November 1, 2010. *http://www.msa.md.gov/megafile/msa/speccol/sc5300/sc5339/000113/013000/013268/unrestricted/20110086e.pdf*

‡ DHCD. "Maryland to Receive $20 Million as Part of U.S. Department of Energy's Retrofit Ramp-Up Initiative." April 21, 2010. *http://www.dhcd.maryland.gov/Website/About/PublicInfo/NewsEvents/NewsDetail.aspx?newsID=264*

§ DGS. "Maryland Green Building Council 2010 Annual Report." November 1, 2010. *http://www.msa.md.gov/megafile/msa/speccol/sc5300/sc5339/000113/013000/013268/unrestricted/20110086e.pdf*

Implementation

This program was established as a result of a competitive grant award, from U.S. Department of Energy. It is an incentive based voluntary program.

DHCD received the $20 million competitive award from the U.S. Department of Energy in 2010 to promote energy efficiency through its Energy Efficiency and Conservation Block Grant retrofit program. Now known as Better Buildings, DHCD's award was titled "Investing in Main Street: Energy Efficiency for Economic Growth." DHCD's proposal was a holistic, community-based approach to target individual households, multifamily rental properties and commercial properties for energy efficiency retrofits that will result in significant, measurable reductions in energy consumption and accompanying savings. The program includes an overall education and outreach component to provide stakeholders and community members with information for behavior changes that reduce energy consumption. Components of the program under development include: a Green Retrofit Improvement Program which targets small business owners; a Multifamily "Preservation and Energy Efficiency" program for renters; and an Efficient Home Program for homeowners.

The $20 million in federal funds is expected to leverage more than five times that amount in other funds. Efforts will be focused in target communities where the following outcomes for homeowners, renters, and small business owners are anticipated: An estimated 2,000 homeowners will benefit from energy efficiency retrofits of their homes in the first three years; twenty buildings comprising approximately 2,000 affordable rental units will benefit from energy efficiency retrofits; a projected 900 historical commercial properties will benefit from energy audits and low-interest retrofit financing in concert with DHCD's Neighborhood BusinessWorks program; the establishment of sustainable financing resources for homeowners, rental properties and commercial properties; the creation of a Statewide Energy Efficiency Purchasing Cooperative to maximize purchasing power for retrofits; and provide funding for affordable housing, energy retrofits and energy efficiency.*

The targeted communities were selected by weighing what would benefit the greatest number of Marylanders, taking into consideration those areas that have not received an allocation of federal funding. The selected areas are all in communities where there is significant leveraging and partnership activity. Each area is a Main Street Maryland community, has numerous multi-family developments and is a target area for other funds through DHCD. The targeted communities include: Berlin, Cambridge, Chestertown, Cumberland, Denton, Easton, Elkton, Frostburg, Oakland, Princess Anne, Dundalk, Westminster, Havre De Grace, Salisbury, and Takoma Park.†

Supporting Laws and Regulations

- Energy Independence and Security Act of 2007 Title III (Appliance and Lighting Efficiency) and Title IV (Energy Savings in Building and Industry)
- Smart, Green, and Growing - The Sustainable Communities Act of 2010 (House Bill 475)
- Greywater Recycling (House Bill 224)
- Maryland's Greenhouse Gas Emissions Reduction Act of 2009

Suggested Laws and Regulations

Develop a Regional Blueprint Program to provide funds for voluntary regional sustainable growth planning efforts that emphasize transportation planning and scenario planning activities.‡

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* "Maryland to Receive $20 Million as Part of U.S. Department of Energy's Retrofit Ramp-Up Initiative." April 21, 2010. *http://www.gov.state.md.us/pressreleases/100421.asp*

† Ibid.

‡ "DHCD Receives 2009 Environmental Excellence Award." September 29, 2009. *http://www.hcd.ca.gov/USDOTAward.pdf*

D.3 Energy Efficiency for Affordable Housing

Lead Agency: DHCD

Program Description

Since inception of the federally-funded Weatherization Assistance Program (WAP) in the seventies, more than seven million homes have been weatherized across the nation. Scientific Studies and the energy industry recognize that energy efficiency is among the most viable options for decreasing fossil fuel consumption and consequently reducing GHG emissions. Energy-efficiency is cost-effective and can be implemented quickly. A weatherized household can realize up to $400 in first-year energy savings and an annual CO_2 reduction of 2.65 metric tons on average.* WAP is designed to help eligible low income households with the installation of energy conservation materials to reduce the consumption of energy and the cost of maintenance. The U.S. Department of Energy (DOE) has funded WAP since 1976, with major funding increases to the program under the American Recovery and Reinvestment Act of 2009.

Aside from lower energy bills, reduced energy consumption includes several environmental co-benefits including reduced GHG emissions and regulated air pollution. Residential buildings are responsible for 23% of the country's energy-related carbon dioxide equivalent emissions (EIA 2009). One study estimates that energy savings from insulation retrofits would result in 3,100 fewer tons of particulate matter PM2.5, 100,000 fewer tons of NOx, and 190,000 fewer tons of SO_2 per year, creating public health and economic savings of $1.3 billion and $5.9 billion per year, respectively (Levy et al. 2003).

In Maryland, the Department of Housing and Community Development (DHCD) operates WAP through its Housing and Building Energy unit. In addition to helping low-income households with energy conservation and maintenance, the program provides meaningful economic benefits to Maryland communities by supporting a network of local weatherization agencies, creating and maintaining jobs and training opportunities, and by purchasing weatherization materials.

Building on the success of WAP, DHCD's Housing and Building Energy unit created additional energy efficiency programs in support of affordable housing across the state. These include the EmPOWER Low Income Energy Efficiency Program and the Multifamily Energy Efficiency and Housing Affordability (MEEHA)-EmPOWER Program. All of these programs promote energy efficiency and affordability for low and moderate income households in Maryland.

Reducing energy usage and lowering utility bills for households that might otherwise struggle to make home improvements has the added benefit of helping the state of Maryland meet the requirements of the Greenhouse Gas Reduction Act of 2009 and the goals of the Maryland Commission on Climate Change.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Energy Efficiency for Affordable Housing program in 2020 are estimated to be 0.01 $MMtCO_2e$ (Figure 6.11). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Energy Efficiency for Affordable Housing program enhancements in 2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.11).

* U.S. Department of Energy, Oak Ridge National Laboratory, "Weatherization Assistance Program Technical Memorandum Background Data and Statistics," *http://energy.gov,* March 2010

Job Creation and Economic Benefits

The Energy Efficiency for Affordable Housing program is expected to increase the State GDP. RESI's 2012 study estimated that the Energy Efficiency for Affordable Housing program, once fully operational, would support a total of about -2 jobs and generate $3,060,709 in net economic benefit and $365,364 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This initiative is a voluntary incentive based program. It receives funding from State and federal sources, including MEA and U.S. Department of Energy.

The Green Grant Program is part of DHCD's larger affordable rental housing preservation initiative funded in part by the John D. and Catherine T. MacArthur Foundation, known as the Maryland Base Realignment and Closure Preservation Initiative. The MacArthur Foundation's support for this initiative is part of their Window of Opportunity campaign, a $150 million, 10-year effort to preserve affordable rental homes across the nation.* Maryland is one of twelve states and cities to have been awarded funding under Window of Opportunity.

Reducing energy usage and lowering utility bills for households that might otherwise struggle to make home improvements has the added benefit of helping the state of Maryland meet the requirements of the Greenhouse Gas Reduction Act of 2009.

Through the Green Grant Rental Housing Preservation Program, DHCD promotes energy efficiency in affordable rental housing developments in eight counties (Anne Arundel, Baltimore, Cecil, Frederick, Harford, Howard, Prince George's and St. Mary's) affected by the federal Base Realignment and Closure process. In partnership with MEA, the Green Grant program reimburses eligible applicants for costs associated with energy audits for multi-family rental housing or for the U.S. Green Building Council's LEED accreditation and training. The Green Grant funding comes in the form of a $75,000 grant from the MacArthur Foundation, and matching funds of $200,000 from MEA.† These are grant funds to reimburse applicants for costs incurred. Eligible applicants can receive funding for energy audits or LEED training. All property owners or individuals who receive funding are required to complete a survey at the completion of the energy audit or training, as appropriate.

The Green Grant Program is one of five programs established under the Maryland Base Realignment and Closure Preservation Initiative, with the other four including: 1) a revolving loan fund for preservation of affordable rental housing in eight Base Realignment and Closure counties ($4 million), 2) data analysis and assessment to better identify and target preservation activities ($250,000), 3) education and outreach efforts aimed at affordable rental property owners ($125,000), and 4) a preservation compact designed to streamline loan documents and underwriting procedures for affordable rental projects ($50,000).‡

DHCD implements other programs that focus on energy efficiency improvements and affordable housing preservation efforts. DHCD operates the federally-funded Weatherization Assistance Program, which helps eligible low income households with the installation of energy conservation materials in their dwelling units. DHCD Multifamily

* DHCD. "Rental Housing Preservation Program - MD-BRAC - Green Grant." *http://www.mdhousing.org/Website/programs/RHPP/Default.aspx.*

† Ibid.

‡ DHCD. "Maryland Announces Opening of "Green Grant" Energy Efficiency Program." September 2, 2009. *http://www.dhcd.maryland.gov/website/About/PublicInfo/NewsEvents/newsDetail.aspx?newsID=226*

Rental Housing programs provide incentives for sustainable development through its competitive awarding of federal Low Income Housing Tax Credits.

Funding from MEA supported the Multifamily Energy Efficiency and Housing Affordability program. MEA program funding of $9.5 million, originating from the American Reinvestment and Recovery Act of 2009 funding and the Strategic Energy Investment Fund, complements DHCD's Multifamily Energy Efficiency and Housing Affordability program and the Green Grant under the Maryland Base Realignment and Closure Preservation Initiative. The program provides grants for the purchase and installation of energy efficiency improvements, and/or renewable energy improvements in affordable multifamily rental housing developments. These grants may be used to pay for energy efficiency items included in the DHCD Development Quality Standards, including, but not limited to: HVAC systems, insulation, windows, draft stopping and duct sealing, appliances and fixtures, and renewable energy generation, and water heating equipment. The maximum grant is $500,000 per project or $2,500 per rental housing unit, whichever is less. Priority in awarding grants is given to projects that have received or are in the pipeline to receive funding, with all funds needing to be expended by April, 2012.

Through the American Recovery and Reinvestment Act, Maryland received approximately $52 million in funding for the U.S. Department of Energy's Energy Efficiency and Conservation Block Grant program. The ten largest Maryland counties and ten largest municipalities, based on population, are eligible to receive Energy Efficiency and Conservation Block Grant grants directly from the federal government. MEA received approximately $9.6 million in Energy Efficiency and Conservation Block Grant funds for projects to be implemented in the remaining Maryland counties and municipalities not eligible to receive direct federal grants.

The American Recovery and Reinvestment Act of 2009 appropriated funding for the U.S. Department of Energy to award grants under the Weatherization Assistance Program. The purpose of the program was to increase the energy efficiency of residences owned or occupied by low income persons; the priority population included persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high-energy burden.

A total of $61.4 million was awarded to Maryland. Of this, approximately $10 million was allocated to training and technical assistance; $46.7 million for weatherization/retrofit efforts; and the remaining for supporting expenses such as software acquisition, weatherization tactics and auditor classes, and vehicle purchase. Overall, the grant was to be used to scale up existing weatherization efforts in Maryland, create jobs, reduce GHG emissions, and reduce expenses for Maryland's low income families; this program is not available to commercial properties. Based on U.S. Department of Energy projections, an estimated 6,850 residences would be weatherized, with an annual reduction in gas consumption of 32 percent.

Available information on the details of the Weatherization Assistance Program, including distribution of the grant money, is summarized in the figure below. Within the web page the amount spent to date by each recipient is tabulated; however, details on what has in fact been completed could not be located. Since there was limited detailed information on what weatherization/retrofit was in fact performed, but general statements regarding the cost per weatherization/retrofit, this value was chosen as the main variable within the calculations. Since limited details on how the money was being spent were identified, it was not possible to confirm the cost per property, the number of properties, and the reduction in natural gas usage. Therefore, the main assumptions are that the values that were identified in supporting documentation, and used in the calculations, are reflective of true conditions.

Overall, the calculations are very simple, and use as a basis the cost per retrofit per property. In Figure 6.12 above, a total value of $46,702,271 was calculated to be available for weatherization/retrofit activities in Maryland. A review of available documentation from DHCD and U.S. Department of Energy provided two estimated costs for the weatherization of a single property, $5,268 per property and $6,500 per property respectively. Therefore, there are two scenarios:

Total grant: $46,702,271

- Lower boundary - $6,500 per property
- Upper boundary - $5,268 per property

Applying these values, applicable standards, and appropriate conversation values, the reduction in GHG emissions can be calculated. Both scenarios utilize the same methodology. An example for one of the scenarios is provided here:

- Upper boundary - $5,268 per property
  (Total grant) / (cost per property) = Number of properties retrofitted
  ($46,702,271) / ($5, 268 per property retrofit) = 8,865 retrofits

The following values are given:

- 32 percent reduction in natural gas usage
- 87.1 MMBtu per property, average current residential usage, annual

(Number of retrofits)*(current energy use/property)*(% reduction) = energy savings

Figure 6.12 Summary of funding available to Maryland from the Weatherization Assistance Program.

Award Recipient	Award Amount	Training and Technical Assistance	Weatherization
Allegany County human resources	$1,879,175	$319,460	$1,559,715
Baltimore, City of	$15,713,551	$2,671,304	$13,042,247
Carroll County	$917,052	$155,899	$761,153
Cecil County	$810,808	$137,837	$672,971
Frederick, City of	$1,468,005	$249,561	$1,218,444
Community Assistance Network, Inc	$3,802,661	$646,452	$3,156,209
Diversified Housing Development, Inc.	$1,800,000	$306,000	$1,494,000
Dorchester County	$626,279	$106,467	$519,812
Garrett County	$1,276,403	$216,989	$1,059,414
Howard County	$1,140,723	$193,923	$946,800
Maryland Energy Conservation, Inc.	$7,804,227	$1,326,719	$6,477,508
Montgomery County	$5,479,944	$931,590	$4,548,354
Prince George's County	$2,100,000	$357,000	$1,743,000
Shore Up, Inc.	$3,042,015	$517,143	$2,524,872
Southern Maryland Tri-County Community	$2,258,223	$383,898	$1,874,325
Timothy Jerome Kenny	$3,831,986	$651,438	$3,180,548
Upper Shore Aging, Inc.	$1,582,776	$269,072	$1,313,704
Washington County	$733,968	$124,775	$609,193
TOTAL	**$56,267,796**	**$9,565,525**	**$46,702,271**

(8,865 retrofits)*(87.1 MMBtu/property)*(32% reduction) = 247,093 MMBtu savings

The MMBtu value is converted to million metric tons of GHG using conversion factors provided by MDE. The calculations and the final values are summarized in Figure 6.13.

Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Other Environmental Benefits

Energy upgrades and sustainable development lead to an increase in air and water quality.

Supporting Laws and Regulations

- Energy Independence and Security Act of 2007 Title III (Appliance and Lighting Efficiency) and Title IV (Energy Savings in Building and Industry).
- The Sustainable Communities Act of 2010 (House Bill 475).
- Greywater Recycling (House Bill 224).
- Green Building Council (House Bill 154/Senate Bill 212).
- Baltimore City Building Code, Chapter 37 establishes a green building program.
- Maryland's Greenhouse Gas Emissions Reduction Act of 2009.

Figure 6.13 Low and High GHG Benefit Estimate.

LOW Estimate	
$6,500	Cost per retrofit
7185	Number of retrofits
0.0207	Million metric ton GHG saved/not emitted, 2012
0.0311	Million metric ton GHG saved/not emitted, 2015
0.0311	**Million metric ton GHG saved/not emitted, 2020**

HIGH Estimate	
$5,268	Cost per retrofit
8865	Number of retrofits
0.0256	Million metric ton GHG saved/not emitted, 2012
0.0383	Million metric ton GHG saved/not emitted, 2015
0.0383	**Million metric ton GHG saved/not emitted, 2020**

Transportation

estimated reduction of

13.80

million metric tons of CO_2e annually

GHG emissions from this sector are the result of fossil-fuel consumed primarily for transportation purposes, and include both on road and off road mobile sources. On road mobile sources include vehicles traditionally operated on public roadways such as cars, light-duty trucks, vans, buses, medium and heavy-duty trucks and other diesel vehicles. Off road mobile sources include other modes of transportation, such as airplanes, trains and commercial marine vessels, as well as motorized vehicles and equipment not normally operated on public roadways, such as lawn and garden equipment, and airport service equipment.

The majority of CO_2e emissions from the transportation sector are associated with on road gasoline-powered vehicles, with on road diesel-powered vehicles also representing a significant percentage. The transportation sector accounted for about 32 percent of Maryland's gross GHG emissions in 2006 (about 35 $MMtCO_2e$). In 2006, on road gasoline vehicles accounted for about 71 percent of transportation GHG emissions in Maryland. On road diesel vehicles accounted for another 14 percent of the State's transportation emissions, and air travel for roughly 5.5 percent. Marine vessels, rail, and other sources, such as natural gas and liquefied petroleum gas-fueled vehicles used in transport applications, accounted for the remaining 10 percent of Maryland's transportation emissions.

This section of the Chapter describes programs grouped under four overarching GHG reduction policy areas designed to reduce GHG emissions from the transportation sector. GHG beneficial projects adopted in the 2011–2016 CTP and MPO Plans and programs total $13.2 billion in planned or committed capital investment through 2020 and represent 2.79 $MMtCO_2e$ in potential GHG emission reductions.

As noted previously, to ensure attainment of the Plan's 2020 GHG emissions reduction goal, the State is currently considering a number of possible enhancements, including transportation sector enhancements, for possible implementation. The transportation sector enhancements have the potential to achieve additional GHG emission reductions by 2020 or contribute to progress toward the State's longer term reduction goals. A brief description of these enhancement options and, where possible, an estimate of their 2020 emissions reduction potential, is included in the program summaries below (Figure 6.14). The methodology for calculating reductions from enhancements can be found in Appendix C of this Plan.

Figure 6.14 Initial and enhanced GHG reductions by policy for the Transportation sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
E	Transportation Technologies	8.10	8.61
F	Public Transportation	2.00	2.89
G	Pricing Initiatives	0.41	2.30
H	Other Innovative Transportation Strategies/ Programs	Included in F	Included in F
	TOTAL REDUCTIONS FROM TRANSPORTATION	10.51	13.80

E. Transportation Technologies

Transportation technologies reduce GHG emissions and other tailpipe pollutants through three primary strategies: (1) cleaner fuels; (2) vehicle emissions technology; and (3) system efficiencies. Maryland's transportation technologies programs employ all three strategies and encompass passenger travel and freight movement for both on road vehicles and off road transportation modes (air, ship and rail transport). Continued technology advancements and innovations will be needed to achieve deeper reductions in the State's transportation sector emissions by 2020 and in later years.

E.1 Motor Vehicle Emission and Fuel Standards

This suite of programs reduces GHG emissions in several ways. "Upstream" fuel standards, such as the federal Renewable Fuels Standard, require transportation fuel producers to blend renewable fuels into their petroleum products. Depending on manufacturers' choices of renewable fuels, this program has the potential to reduce the per unit carbon intensity of their product inventory over time. The Maryland Clean Cars Program requires car manufacturers to meet a fleet-wide average GHG emissions standard for vehicles sold in the State. The national CAFE standards for light-duty vehicles and medium and heavy-duty vehicle standards require car and truck manufacturers to both reduce GHG emissions and increase the fuel efficiency (i.e., more miles per gallon) of their vehicle fleets over time. Maryland, California and other leadership states have played a key role in advancing more stringent national standards. In addition to achieving significant GHG reductions over time, these programs will produce public health, air quality, water quality and economic benefits for Marylanders.

E.1.A Maryland Clean Cars Program

Lead Agency: MDE

Program Description

The Maryland Clean Cars Act of 2007 required MDE to adopt regulations implementing the California Clean Car Program. This program establishes a GHG emission standard based on fleet-wide averages; it does not set specific standards for individual vehicles. It is the responsibility of the manufacturers to demonstrate compliance with the required fleet averages for each model year. The fleet GHG standard under the Maryland Clean Cars Act of 2007 began with model year 2011 vehicles.

Maryland is one of 14 states that have adopted the California standards. As the market share of vehicles subject to the alternative California standards continued to increase, car manufacturers advocated for a single national standard. On May 19, 2009, President Obama announced that new national GHG and fuel economy standards for passenger vehicles and light-duty trucks would be established through a joint rulemaking process between EPA and the National Highway Traffic Safety Administration. These new standards, which were finalized in 2010, superseded the California standards beginning with model year 2012. When fully implemented in model year 2016, they will attain the same fuel economy and GHG standards as the California Program.

In January 2012, California adopted a new more stringent set of vehicle standards for cars and light-duty trucks—the Advanced Clean Car Rules, or CALEV 3—to be phased in through 2025. On August 28, 2012, NHTSA followed suit with the adoption of new, more stringent national fuel efficiency standards for cars and light-duty trucks for model years 2017–2025. In 2013, EPA is expected to promulgate "Tier 3" GHG emissions standards for model years 2017–2025. Both the NHTSA and EPA standards will likely harmonize with CALEV 3 standards.

Enhancement options

The State is considering the following options to increase GHG emission reductions from motor vehicles by 2020 and beyond:

- Incentivize Passenger Fleet Turnover. The State could enact legislation that offers incentives in the form of grants, loans, or tax credits to accelerate new car purchases and fleet vehicle turnover in Maryland.
- Incentivize Taxi Fleet Turnover. The State could offer incentives for taxi fleets to upgrade to "best in class" vehicles for fuel efficiency or to replace older fleet vehicles.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Maryland Clean Cars Program in 2020 are estimated to be 4.33 $MMtCO_2e$. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Job Creation and Economic Benefits

The Maryland Clean Cars Program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Maryland Clean Cars Program, once fully operational, would support a total of about 1,312 jobs and generate $678,863,526 in net economic benefit and $27,200,873 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program is mandated by the Maryland Clean Cars Act of 2007 and has been fully implemented through regulations codified in COMAR 26.11.34, the Low Emissions Vehicle Program, adopted and enforced by MDE.

Figure 6.15 Initial and enhanced GHG reductions by policy for Transportation Technologies, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
TRANSPORTATION	**E**	**Transportation Technologies**	**-**	**8.10**	**8.61**
	E.1	Motor Vehicle Emission and Fuel Standards	-	-	-
	E.1.A	Maryland Clean Cars Program	MDE	4.33	4.33
	E.1.B	Corporate Average Fuel Economy Standards (CAFÉ): Model Years 2008–2011	MDOT	2.27	2.27
	E.1.C	National Fuel Efficiency and Emission Standards for Medium and Heavy-Duty Trucks	MDE	0.88	0.88
	E.1.D	Federal Renewable Fuels Standards	MDOT	0.24	0.24
	E.2	On Road, Airport, Port and Freight/Freight Rail Technology Initiatives	-	0.38	0.62
	E.2.A	On Road Technology	MDOT	Included in E.2	Included in E.2
	E.2.B	Airport Initiatives	MDOT	Included in E.2	Included in E.2
	E.2.C	Port Initiatives	MDOT	Included in E.2	Included in E.2
	E.2.D	Freight and Freight Rail Programs	MDOT	Included in E.2	Included in E.2
	E.3	Electric and Low Emitting Vehicle Initiatives	MDOT/MEA	0.00	0.27
			TOTAL REDUCTIONS	**8.10**	**8.61**

E.1.B Corporate Average Fuel Economy Standards (CAFE): Model Years 2008–2011

Lead Agency: MDOT

Program Description

Since introduction of the federal Corporate Average Fuel Economy (CAFE) standards in 1975, the standards have increased very slowly from the initial standard of 18 miles per gallon. Each year the National Highway Traffic Safety Administration (NHTSA), charged with promulgating the standards, has analyzed the effect of its proposed annual standard on the environment as well as employment.

In 2007, Congress enacted the federal Energy Independence and Security Act, which established a goal to increase the national fuel economy standard to 35 miles per gallon by 2020. This standard is the sales-weighted fuel economy average for a vehicle manufacturer for the current model year of vehicles with a gross vehicle weight rating of 8,500 lbs or less. It includes passenger vehicles and light duty trucks.

In 2010, NHTSA and EPA adopted new fuel efficiency and GHG standards for cars and light duty trucks for model years 2012–2016 through a joint rulemaking. These standards, along with a faster phase-in of fuel economy standards, replace those promulgated pursuant to the 2007 federal law. NHTSA's pre-existing 2008–2011 fuel efficiency standards remain applicable to model year 2008–2011 vehicles.

The Obama administration issued in Aug, 2012 the final version of new rules that require automakers to nearly double the average fuel economy of new cars and trucks by 2025. The standards mandate an average fuel economy of 54.5 miles per gallon for the 2025 model year.

Enhancement options

No enhancement options have been identified for this program.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Corporate Average Fuel Economy Standards (CAFE): Model Years 2008–2011 program in 2020 are estimated to be 2.27 $MMtCO_2e$. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the CAFE: Model Years 2008–2011 program, once fully operational, would support a total of about -7 jobs and generate -$7,232,665 in net economic benefit and -$151,894 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program was initially implemented through federal regulations adopted by NHTSA, which remains responsible for its enforcement. In 2010, the program was superseded by new, more rigorous national GHG and fuel economy standards for vehicles beginning in model year 2012, adopted through joint agency rulemaking by NHTSA and EPA. NHTSA's pre-existing standards for model years 2008–2011 will still be producing benefits in 2020 for those earlier year vehicles that remain in the fleet.

E.1.C National Fuel Efficiency and Emission Standards for Medium and Heavy- Duty Trucks

Lead Agency: MDOT

Program Description

Medium and heavy-duty vehicles are the transportation sector's second largest contributor to fossil fuel consumption and GHG emissions. In 2011, the Obama Administration adopted the National Fuel Efficiency & Emission Standards for Medium and Heavy-Duty Trucks, the first national program designed to reduce GHG emissions and improve fuel efficiency for this class of on road vehicles. The program is implemented through a joint rule issued by EPA and NHTSA. The joint rule is comprised of complementary standards developed by the agencies under their respective authorities and covers model years 2014–2018. Under the rule, EPA's emission standards for CO_2 and NHTSA's fuel consumption standards cover the following regulatory categories: combination tractors, heavy-duty pickup trucks and vans, and vocational vehicles. EPA's standards also cover recreational on road vehicles. The heavy-duty fleet subject to the rule includes all on road vehicles rated at 8,500 lbs or more, except those covered by the current GHG emissions and federal Corporate Average Fuel Economy standards for model years 2012–2016.

Medium and heavy-duty vehicles are the transportation sector's second largest contributor to fossil fuel consumption and GHG emissions.

Enhancement options

Requiring trucks to maintain an average fleet age to ensure fleet turnover is discussed as an enhancement option in E.2.A. On Road Technology, below.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the National Fuel Efficiency and Emission Standards for Medium and Heavy-Duty Trucks program in 2020 are estimated to be 0.88 $MMtCO_2e$. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the National Fuel Efficiency and Emissions Standards for Medium and Heavy-Duty Trucks program, once fully operational, would support a total of about -915 jobs and generate -$3,211,236,567 in net economic benefit and -$59,697,041 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The federal regulations implementing this program were finalized in August 2011. The program will be federally enforced jointly by EPA and NHTSA.

E.1.D Federal Renewable Fuels Standard

Lead Agency: MDOT

Program Description

Under the Clean Air Act, as amended by the Energy Independence and Security Act of 2007, EPA is required to set annual standards under the Renewable Fuel Standard program (RFS) based on gasoline and diesel projections from the U.S Department of Energy's Energy Information Administration (EIA). EPA is also required to set the cellulosic biofuel standard each year based on the volume projected to be available during the following year, using EIA projections and assessments of production capability from industry.

A preliminary standard was issued in the spring of 2010 for the RFS2 Program. A final rulemaking for each year will determine the applicable volume requirements of biofuel needed. The federal law (RFS2) developed new categories of renewable fuel, creating four mandated standards (Cellulosic Biofuel, Biomass-based Diesel, Advanced Biofuel, and total Renewable Fuel), and required the application of lifecycle GHG threshold performance standards to ensure that each category of renewable fuels emits fewer GHGs than the conventional fuel it replaces.

The RFS includes diesel fuel as a medium for renewable fuel. The standard required the blending of 9 billion gallons of renewable fuel in 2008 and requires the blending of 36 billion gallons by the end of 2012. A qualified renewable fuel reduces lifecycle GHG emissions by at least 20 percent; qualified advanced biofuels reduce lifecycle GHG emissions by 50 percent. The volume of ethanol was capped at 12 billion gallons in 2010 and increases to 15 billion gallons in 2015, where it remains fixed thereafter. The law included a mandate for use of 1 billion gallons of advanced biofuels in 2010 and requires the use of 21 billion gallons by the end of 2022.

To ensure that the fuel supply sold in the U.S. meets the mandated volume of renewable fuels, EPA established a system of tradable unique Renewable Identification Numbers issued by the biofuel producer or importer at the point of production or port of importation. Fuel blenders are required to include a quantity of biofuels equal to a percentage of their total annual sales. Each blender must show that it has enough Renewable Identification Numbers at the end of each year to meet its share for each of the four mandated standards.

Enhancement options

No enhancement options have been identified for this program.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Federal Renewable Fuels Standards program in 2020 are estimated to be 0.24 $MMtCO_2e$. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the Federal Renewable Fuels Standard program, once fully operational, would support a total of about -14 jobs and generate -$11,047,366 in net economic benefit and -$197,671 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This federal program has been implemented through regulations adopted by EPA, which has full responsibility for its enforcement.

E.2 On Road, Airport, Port and Freight/Freight Rail Technology Initiatives

Lead Agency: MDOT

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the On Road, Airport, Port and Freight/Freight Rail Technology Initiatives programs in 2020 are estimated to be 0.38 $MMtCO_2e$. Because these programs are all related, MDOT has aggregated the potential emission reductions from the full set of programs. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Enhanced reductions

The potential emission reductions from the On Road, Airport, Port and Freight/Freight Rail Technology Initiatives program enhancements in 2020 are estimated to be 0.62 $MMtCO_2e$ (Figure 6.15).

E.2.A On Road Technology

Lead Agency: MDOT

Program Description

Transportation technology initiatives are significant contributors to on road mobile emissions reductions and are an important element of the State's efforts to reduce GHGs. Projects under this program include intelligent transportation systems, traffic operational improvements, teleworking and engine replacements. A sample of initiatives in this program follows.

Traffic Flow Improvements

The Coordinated Highways Action Response Team (CHART) program, operated by MDOT and the Maryland State Police, focuses on non-recurring congestion, such as backups caused by incidents along the State's major roadways. The Statewide Operations Center, and the three satellite regional operations centers, monitor the State's roadways to quickly identify incidents through the use of intelligent transportation system technology and direct emergency responders to the accident scenes.

Maryland 511

Maryland 511 is Maryland's official travel information service. Maryland 511 provides travelers with reliable, current traffic and weather information, as well as links to other transportation services. Maryland 511 helps motorists reach their destination in the most efficient manner when traveling in Maryland.

Truck Stop Electrification

Truck stop electrification allows truckers to shut down their engines and obtain electric power and "creature comforts" while resting. Truck stop electrification reduces diesel emissions and noise as well as wear and tear on the truck engine.

Traffic Signal Synchronization

The Maryland State Highway Administration has instituted a program to review and retime all its signals in metropolitan areas to function as a system instead of individual signals. For example, its 1,200 traffic signals in the Baltimore region are being evaluated currently. The timing of each traffic signal system is reviewed and updated at least every three years.

Teleworking

Teleworking is working from a remote location other than the formal work place, usually home or a telework center. Teleworkers are spared the daily problems that come with a daily commute. Employers who support telework find that employee satisfaction increases. Telework programs also help reduce traffic congestion, air pollution and GHG emissions. Teleworking is directly supported by the Metropolitan Planning Organizations (MPOs) and the Maryland Department of Transportation. Two MPOs—the Baltimore Metropolitan Council and the Metropolitan Washington Council of Governments—participate in a bi-regional program, known as Telework Partnership with Employers, to assist employers in establishing home-based telecommuting programs for their employees. Since October 1999, over 25 large and small private sector employers and two nonprofit organizations have participated in the bi-regional telework partnership program.

Additional information can be found at the following websites:

http://www.baltometro.org/commuter-options/telework

http://www.mwcog.org/commuter2/commuter/teleworking/index.html

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Telework_Partnership_Webpage/Telework_Partnership_With_Employers.html

Light-Emitting Diode Traffic Signals

MDOT works with Baltimore City and other State jurisdictions to replace traditional traffic signal heads with light-emitting diode signal heads. Replacing Baltimore City's 39,000 traffic signals with light-emitting diode signal heads could result in a 90 percent power savings.

Telework programs help reduce traffic congestion, air pollution, and GHG emissions.

Enhancement Options

The State is considering the following enhancement options to achieve additional reductions in GHG emissions by 2020 and beyond:

Enhance CHART.

The State could explore enhancements to its CHART program through the utilization of emerging intelligent communications technologies, mobile apps and social media.

Provide Real Time Transit Information

The State could expand the installation of signs at transit stops for light rail and buses with real-time, next pick-up and travel destination times to encourage more people to use these methods of transit.

IncentivizeTeleworking

The State could further encourage teleworking through tax and other incentives for large employers in Maryland.

Incentivize Truck Fleet Turnover

The State could offer financial incentives to purchase 2014 or later Model Year Medium or Heavy Duty trucks to accelerate the introduction of these more fuel efficient vehicles. The State could also implement a program to replace older drayage trucks with newer used vehicles that have recently been replaced through a new truck buying program such as this. This would get newer, more fuel efficient vehicles on the road, while also providing replacement trucks for the aging drayage truck fleet.

Promote Driver Education and Training (ECO-Driving)

The State could promote outreach and public information on trip reduction, vehicle maintenance, and driving strategies that improve safety while reducing the costs and emissions associated with driving. Programs could target specific market segments—e.g., teen drivers, fleet drivers, taxi drivers, municipal vehicle drivers—modeled after successful programs in Europe (especially the Netherlands). This initiative would include enhancements to existing State-wide programs, as well as the evaluation of local and regional programs for expansion and scaling.

Promote Improved Vehicle Refrigerants

The State could explore incentives and standards to expand and accelerate use of low global warming potential refrigerants on vehicles.

Promote Black Carbon Reductions

The State could explore incentives and standards to expand and accelerate reduction in black carbon produced by diesel fuels and other mobile sources.

Promote Low Rolling Resistance Tires

The State could expand existing initiatives to achieve the level of effort and scope of other states' programs to promote low rolling resistance tires, and could integrate this eco-driving element into driver education and training programs.

Create Biodiesel Incentives and Standards

The State could offer incentives and develop standards to expand the adoption of biodiesel in light- and heavy-duty vehicles, and integrate program design and analysis with other transportation, agriculture, and waste management options.

Eco-Driving and Driver Education Programs

Driver behavior and driving habits affect fuel efficiency. Habits such as rapid starts, aggressive braking, regular acceleration and deceleration while in motion, and other similar behaviors are more intensive in their fuel requirements than are sedate starting and stopping, and the maintenance of constant speeds. Education of drivers in basic driving methods to encourage fuel-saving habits can have modest impacts on overall fuel consumption, even without affecting travel demand. The impact corresponds to 0.1 $MMtCO_2e$.

Low-Rolling-Resistance Tires

Low-rolling-resistance tires allow for modest improvements in the fuel efficiency of both light-duty and heavy-duty vehicles. Encouraging or setting standards for the adoption of tires with lower rolling resistance has been a popular choice in other state climate action plans, finding a place in six different states' plans. The policies' exact design ranges moderately between incentives and mandates, with some applying to replacement tires only and others applying to all vehicles sold as well as to replacement tires. This produces a GHG reduction estimate in 2020 of 0.04 $MMtCO_2e$.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the On Road Technology program have been aggregated with the estimated emission reductions from the On Road, Airport, Port and Freight/Freight Rail Technology Initiatives bundle (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study did not analyze the On Road Technology program. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with these programs.

Implementation

Projects that contribute to a change in vehicle miles traveled growth and/or improve system efficiency are a subset of the State's complete Consolidated Transportation Program.

Using more fuel efficient vehicles and improving energy efficiency at BWI will reduce GHG emissions.

Photo © Rudi Riet

E.2.B Airport Initiatives

Lead Agency: MDOT

Program Description

A 2011 energy audit conducted for the Maryland Aviation Administration (MAA) evaluated the potential emissions impact of reductions in consumption of electricity and conventional vehicle fuel at the Baltimore/Washington International Airport (BWI). These reductions would result in lower GHG emissions through the utilization of more energy efficient technologies and fuel conservation measures. The following initiatives are intended to reduce both GHG and criteria pollutant emissions:

Alternative Fuel Maintenance Vehicles

There are approximately 20 alternative fuel and bi-fuel vehicles in the State's airport maintenance fleet. These include vans, pick-up trucks and flatbed trucks, which use alternative fuels such as compressed natural gas (CNG) and E-85. BWI has an on-site quick-fill CNG fueling station.

BWI Utility Master Plan

The State prepared the Master Plan to provide baseline energy consumption data for BWI operations, including water and sanitary services, glycol collection, natural gas consumption, electrical power, heating and air conditioning systems, fuel use and communication networks.

BWI Energy Efficiency

The State has replaced lighting at the BWI terminal with more energy efficient fixtures. Switching from T-12 fluorescent lights to T-8 lights with electronic ballasts is expected to reduce the electricity required to illuminate the airport by 30 percent.

Enhanced Access to BWI by Other Travel Modes

As aviation demand at BWI grows, surveys indicate that many passengers choose private vehicles and other gasoline-powered vehicles to access the airport. The State is continuing to explore new ways to encourage access to BWI using other modes that reduce criteria pollutants and GHG's.

BWI's Periodic Air Quality Assessments

The State conducts periodic studies to assess air quality at, and in the vicinity of, BWI . Most recent studies for air quality include the Air Quality Assessment Update 2006 (a study that is updated every five to 10 years to support the Maryland State Implementation Plan), and a Final Draft, 2006 Greenhouse Gas Baseline Emissions Inventory (completed in 2008).

EV Charging Stations in BWI Parking Garages

The State has installed eight electric charging station areas within the Hourly and Daily Garages at the BWI terminal.

Air Quality Management Plan

A proposed Air Quality Management Plan would address future air quality requirements, including GHG emission reductions:

http://maaweb/content/facilitiesdevelopment/environmentalplanning/index.asp

Enhancement Options

The State is considering the following enhancements to airport initiatives for possible implementation to achieve additional reductions in GHG emissions by 2020 and beyond.

An Increase in Alternative Fueled Ground Support Vehicles

The State could incentivize or require all airport ground support vehicles, including buses and shuttles, to be alternative fuel vehicles. Alternative fuel vehicles could include hybrids, plug-in hybrids, CNG and biodiesel. In addition to reducing GHG emissions, an increase in alternative fuel vehicles would also improve ground level air quality.

Promotion of Preferential Parking

The State could provide preferential airport parking for hybrids, electric and other low-emitting vehicles.

Promotion of Reforestation and Afforestation at BWI

The State could promote reforestation and afforestation efforts at BWI to sequester atmospheric carbon.

Promotion of Hybrid Car Rentals and Satellite Lot Shuttle Vehicles

The State could partner with private enterprises to provide hybrid car rentals and hybrid shuttle vehicles for satellite parking lots.

Promotion of More Transit Connections

The State could partner with regional planning organizations, State/Local transit providers, and the private sector to provide more MARC, Light Rail and AMTRAK connections to BWI.

Evaluation of SmartWay Carrier Incentives

The State could evaluate incentives for EPA SmartWay carriers for cargo activities at BWI.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Airport Initiatives program have been aggregated with the estimated emission reductions from the On Road, Airport, Port and Freight/Freight Rail Technology Initiatives bundle (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study did not analyze the Airport Initiatives program. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with these programs.

Implementation

Some of the existing initiatives are voluntary; others are required to support the Environmental Impact Statement process mandated by the National Environmental Policy Act for major projects. BWI's periodic air quality assessments are required to support the Maryland State Implementation Plan under the Clean Air Act.

E.2.C Port Initiatives

Lead Agency: MDOT

Program Description

The Maryland Port Administration (MPA) has implemented an Environmental Management System, as well as other initiatives to reduce the environmental footprint associated with Maryland's deepwater seaport in Baltimore. The MPA's emission reduction strategies for GHGs and other air pollutants includes use of cleaner diesel fuel port fleet vehicles, use of diesel operated equipment, reduced truck emissions through turn time efficiency improvements, and idle reductions.

In 2006, MPA partnered with Port stakeholders to oversee various physical and operational improvements to terminal gates at the Dundalk and Seagirt Marine Terminals to reduce truck congestion and idling. Since then, MPA has used ultra-low sulfur diesel fuel blended with biodiesel in all of its "on road" as well as "off road" diesel engines. Near-zero sulfur fuels increase fuel economy and reduce emissions of GHGs and other air pollutants. Annually, more than 75 percent of MPA's fleet purchases consist of alternative fuel vehicles. Beginning in the fall of 2006 and continuing through 2010, the MPA received a series of EPA and U.S. Department of Energy grants to retrofit ship-to-shore cranes and the entire fleet of rubber tire gantry cranes with diesel oxidation catalysts, an emissions control technology which reduces GHGs and other air pollutants in diesel exhaust.

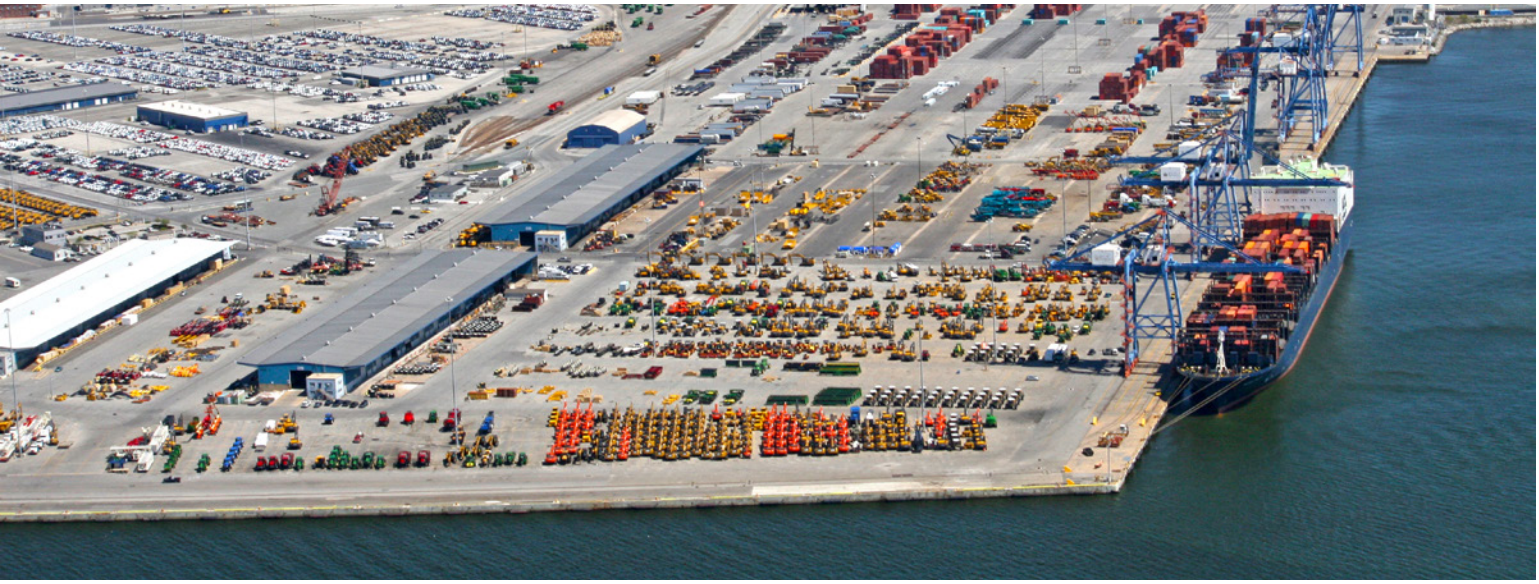
Current initiatives include the following:

Green Port Strategy

A Green Port Strategy will be developed consistent with industry trends and initiatives including EPA's Strategy for Sustainable Seaports.

Environmental Management System

In 2011, MPA's Environmental Management System (EMS) became ISO 14001:2004 certified, which is an internationally recognized standard for environmental programs. An EMS establishes the requirements for a structured management system that identifies legal requirements for identifying and eliminating or minimizing significant environmental



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The Maryland Port Administration's emission reduction strategies for GHGs and other air pollutants includes use of cleaner diesel fuel port fleet vehicles, use of diesel operated equipment, reduced truck emissions through turn time efficiency improvements, and idle reductions.

impacts. MPA's EMS includes procedures to implement energy efficiency and air quality measures, with clear goals and measurable results. These measures reduce emissions of GHGs and other air pollutants.

Port of Baltimore Clean Diesel Program

Phase I of this program, funded by an EPA grant, has provided for the installation of 79 emission reduction technologies on fleet vehicles and equipment, cargo handling equipment at terminals, cranes, harbor crafts, dray trucks, and locomotives. These installations reduce emissions of GHGs and other air pollutants.

Environmentally Preferable Purchasing

The MPA fleet now includes flex-fuel, alternative fuel, clean diesel, and hybrid vehicles and equipment. As part of the procurement process, the MPA Fleet Department considers "environmentally preferable" equipment when making a purchase.

Dray Truck Replacement Program

The MPA is working with the Mid-Atlantic Regional Air Management Association (MARAMA)* to implement a Dray Truck Replacement Program and fund an energy performance contract to implement energy efficiency improvements such as solar panels, geo-thermal heating and air conditioning systems and lighting upgrades. The Port of Baltimore Clean Diesel Program (Phase II), in cooperation with the Mid-Atlantic Dray Truck Replacement Program, will provide funding to replace older dray trucks with more efficient engines to achieve emission reductions in GHGs and other air pollutants.

Emission Reduction Demonstration Projects

The MPA applied for and received EPA grants for emission reduction demonstration projects on MPA fleet vehicles, cargo handling equipment at port terminals, and on construction equipment at Hart Miller Island and Poplar Island.

Emission Reduction Assessment for Cargo Movement

MPA applied for and received an EPA grant for a Port-wide assessment of technologies that can effectively reduce emissions associated with cargo movement.

Anti-Idling for Tugs

MPA has retrofit and repowered tugs with anti-idling technology and new engines.

Enhancement Options

The State is considering the following enhancements to MPA initiatives to achieve additional reductions in GHG emissions by 2020 and beyond:

Electrification of Power for Docked Ships

The State could install electrification for docked ships to eliminate ship idling at the ports. Docked ships could plug-in, much like electric cars, and draw power from the grid, rather than from idling engines. The Port of Los Angeles has installed this infrastructure, called "cold ironing," which improves efficiency and reduces the consumption of diesel fuel.

Electrification of Ground Support Equipment

The State could incentivize or require the electrification of all ground support equipment at the ports. Using electric trucks for short haul around the port would reduce GHG emissions and improve air quality. Maryland could begin a phase-in by requiring a certain percentage of the vehicles operating in and around the port to be all-electric or hybrid, and increase this percentage over time.

* MARAMA is a voluntary, non-profit association of ten state and local air pollution control agencies, including the Maryland Department of the Environment. www.marama.org/

Implementation of the Marine Highways Corridors Program and Barge Subsidies

The State could implement America's Marine Highway Corridors program in Maryland and subsidize local barge programs to eliminate short route trucking.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Port Initiatives program have been aggregated with the estimated emission reductions from the On Road, Airport, Port and Freight/ Freight Rail Technology Initiatives bundle (Figure 6.15).

Job Creation and Economic Benefits

The Port Initiatives program is expected to increase the State GDP. RESI's 2012 study estimated that the Port Initiatives program, once fully operational, would support a total of about -1 job and generate $46,639 in net economic benefit and $0 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This is a voluntary program. MPA has ongoing and planned administrative, management, maintenance, and operations strategies that will reduce energy consumption and GHG emissions from its transportation sector. Additional environmental information may be found at:

http://www.mpa.maryland.gov/content/green-port.php

E.2.D Freight & Freight Rail Programs

Lead Agency: MDOT

Program Description

The State is implementing initiatives to encourage and improve rail and freight transport. These initiatives focus on improving the efficiency of freight transportation to help reduce emissions of GHGs and other pollutants from the transportation sector. These efforts enhance connectivity and reliability of multimodal freight through infrastructure and technology investments, such as expansion and bottleneck relief on priority truck and rail corridors and enhanced intermodal freight connections at Maryland's intermodal terminals and ports. The following strategies are examples of State initiatives to encourage and improve rail and freight transport throughout Maryland.

Auxiliary Power Units (APUs) for Existing Locomotives

APUs have been installed on diesel locomotives to reduce the need for long idling periods. APUs eliminate emissions of GHGs and other air pollutants and conserve fuel by shutting down the main engine at idle regardless of weather conditions or operating location.

Technology Advances for Non-highway Vehicles

The State continues to analyze opportunities to incentivize retrofits or promote replacement of old, diesel-powered non-highway engines, like switch-yard locomotives, with new hybrid locomotives. Targeted engines could include State-owned switchers, like MARC. The State could also conduct outreach to private operators, such as Amtrak, CSX, Norfolk Southern, and Canton Railroad.

Roadway Capacity Improvements

The State has major roadway capacity projects impacting truck freight movement in

Maryland that are planned for opening by 2020. These will reduce tailpipe emissions of GHGs and other air pollutants by improving system efficiencies. Projects include:

- I-695 from I-95 South to MD 122
- I-695 from I-83 to I-95 North
- MD 32 grade separation and interchange at I-795
- MD 4 upgrade in Prince Georges County
- US 50 access control improvements in Wicomico County

Rail Freight Capacity Improvements

Long range projects in the Maryland State-wide Freight Plan are planned for opening by 2020 that will provide rail freight capacity improvements on railroads owned by the State. The system efficiencies will reduce emissions of GHGs and other air pollutants associated with rail freight movement.

Several State initiatives aim to improve efficiency of rail and freight transport, reducing GHG emissions from the transportation sector.

Enhancement Options

The State is considering the following enhancements to freight and rail initiatives to achieve additional reductions in GHG emissions by 2020 and beyond:

Require APUs for All Locomotives

All locomotives operating in Maryland could be required to have start/stop switches and APU engines. These measures would help to reduce unnecessary idling and reduce GHG emissions. Fuel savings would also be realized through the reduction in idling hours.

Require Truck APUs

The State could require that all new trucks purchased and registered in Maryland have an APU installed. APUs will reduce the idling hours of long haul trucks, saving the operator fuel, and reducing GHG emissions and criteria pollutant emissions.

Enforce Anti-Idling

Maryland currently has an anti-idling law in place. This law could be more stringent and enforced more consistently. The State could model it after the Washington D.C. anti-idling law which restricts idling for gasoline or diesel engines to no more than three minutes, unless certain other exemptions are satisfied. Enforcement of this law is essential to achieving GHG benefits.

Evaluate Implementation of National Gateway Initiative and Multimodal Goods Movement Strategy

The State could evaluate the feasibility and benefits of: (1) implementing the CSX National Gateway Initiative, including its expansion to ports and other rail; and (2) implementing a broadened goods movement strategy that would integrate multimodal freight, ports compact development, and other programs.

Accelerate Construction of High Speed Rail

The State could work with US DOT and applicable stakeholders (e.g., CSX, Amtrak, and Norfolk Southern) to advance the construction timetable for high speed rail projects in the North East Corridor. For example, Maryland recently received $22 Million from

the High Speed Intercity Passenger Rail Program to begin Preliminary Engineering and National Environmental Policy Act analysis for the replacement of the Susquehanna River Bridge on the Amtrak North East Corridor. This would provide additional tracks which would alleviate the chokepoint created by the current double tracked bridge and allow for expanded capacity for Amtrak, MARC and Norfolk Southern freight trains, as well as improved times. This would help alleviate current train idling and allow for the expansion of passenger and freight service that would alleviate road congestion for commuters and freight.

Assist CSX in Constructing a New Intermodal Container Facility to Address Howard Street Tunnel Challenge

The State is assisting the proposed CSX intermodal container facility, to be located south of CSX's Howard Street tunnel. This would remove a major freight bottleneck and enhance competitiveness of rail freight transport by allowing CSX to double stack containers, which will divert marginal long haul trucking and improve emissions by diverting cargo to rail.

Explore Feasibility of Replacing Long Haul Truck Freight with Rail Hauling by 2020

The State could explore the feasibility of implementing programs to achieve this goal through the Norfolk Southern Crescent Corridor and CSX National Gateway initiatives.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Freight and Freight Rail Programs have been aggregated with the estimated emission reductions from the On Road, Airport, Port and Freight/Freight Rail Technology Initiatives bundle (Figure 6.15).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the Freight and Freight Rail Programs, once fully operational, would support a total of about -11 jobs and generate -$4,531,000 in net economic benefit and -$72,132 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The State will continue to expand its ongoing effort while seeking additional funding and, where necessary, State and Federal policy adjustments. Additional information may be found at:

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Freight_Planning/Documents/Freight_Plan_Final.pdf

E.3 Electric and Low Emitting Vehicle Initiatives

Lead Agencies: MDOT/MEA

Program Description

Initiatives to encourage the use of electric and other low and zero-emitting vehicles are part of the State's efforts to reduce emissions of GHGs and other air pollutants from mobile sources by providing alternatives to conventional internal combustion engine vehicles. Maryland has assumed a leadership role in facilitating the deployment of electric vehicles (EVs) and EV charging infrastructure in the State. EVs include plug-in all-electric vehicles, called battery electric vehicles (BEVs), and plug-in hybrid electric

vehicles (PHEVs). BEVs produce zero tailpipe emissions of GHGs and other pollutants because they use battery power for propulsion rather than an internal combustion engine. PHEVs reduce tailpipe emissions by using batteries in addition to fossil fuels for propulsion. The carbon intensity of the energy used to charge the batteries from the electricity grid is decreasing over time as a result of Maryland's participation in RGGI, its Renewable Portfolio Standard program and fuel switching to cleaner natural gas. These programs are described under the Energy section of this Chapter. The State is also partnering with private fleets to accelerate fleet turnover to heavy-duty hybrid vehicles. Following is a summary of State initiatives.

Electric Vehicle Infrastructure Council (EVIC)

The General Assembly established EVIC in 2011 to evaluate and recommend strategies to facilitate the successful integration of EVs and EV infrastructure into Maryland's existing transportation infrastructure.* EVIC's 2012 final report outlines an action plan to achieve an ambitious goal of 60,000 EVs on the road in Maryland by 2020, or 2.3% of the State's passenger vehicle fleet. The report can be found at EVIC's website:

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Electric_Vehicle/Index.html

Electric Vehicle Infrastructure Program

Through grants totaling $594,000, MEA has partnered with MDOT, MDE, Baltimore City and the Baltimore Electric Vehicle Initiative to install more than 80 public EV charging stations at transit connections and other locations around the State. A list and map of public EV charging stations can be found at:

www.energy.maryland.gov/Transportation/electric.html

Additional information can be found at:

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Electric_Vehicle/Index.html

Financial and Other Incentives

The General Assembly has enacted several laws providing tax credits and other incentives to advance EV deployment in the State.†

Maryland Hybrid Truck Goods Movement Initiative

Through the Maryland Hybrid Truck Goods Movement Initiative, MEA partnered with Maryland Clean Cities and several fleets in the U.S. to implement the nation's largest deployment of heavy-duty hybrid trucks utilized in goods movement. MEA received a

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Tracking solar array to charge electric cars.

* SB176/ HB167

† 1. High Occupancy Vehicle (HOV) Lanes for EVs (HB674, 2010 Session)—permits both BEVs and PHEVs to use HOV lanes in Maryland, without restrictions on the number of passengers required to be in the vehicle.
2. Electric Vehicle Tax Credit (HB469, 2010 Session)—provides a tax credit against the State's motor vehicle excise tax for certain qualified plug-in electric drive vehicles. This is a three-year program and each vehicle is eligible for up to a $2,000 credit. This program is administered by MDOT and paid for by MEA utilizing money from the Strategic Energy Investment Fund, generated from the sale of RGGI allowances.
3. Electric Vehicle Charging Station Tax Credit (HB163, 2011 Session)—provides a State income tax credit of up to $400, for tax years 2011 through 2013, for 20 percent of the cost of qualified EV charging equipment placed in service by a taxpayer during a taxable year. This program is administered and funded by MEA utilizing money from the Strategic Energy Investment Fund.
4. Electric Vehicle Pilot Program (SB179/HB164, 2011 Session)—directs the Maryland Public Service Commission (PSC) to work with utilities and other electricity providers to establish a pilot program by June 30, 2013, which provides incentives for residential, commercial, and governmental customers to charge EVs during off-peak hours. The PSC must report to the Governor and the General Assembly on the program by February 1, 2015.

$5.9 million U.S. Department of Energy grant to assist in purchasing and deploying 143 heavy duty hybrid vehicles. The reduced fossil fuel consumption by these vehicles will reduce emissions of GHGs and other air pollutants.

More information on the initiatives in this program can be found in Appendix D of this Plan as well as at:

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Electric_Vehicle/EV_FAQ.html

http://www.mwcog.org/uploads/committee-documents/bV1cXldc20121011125334.pdf.

http://www.energy.maryland.gov/Transportation/met

Enhancement Options

The State is considering the following enhancements to electric vehicle initiatives to achieve more reductions in GHG emissions by 2020 and beyond:

Extend Tax Credits for EVs and EV Charging Equipment

The legislature should extend the State's excise tax credit for the purchase of EVs and income tax credit for the purchase of EV charging equipment (EVIC Recommendation).

Extend HOV Lane Exemption

The legislature should extend the State's HOV lane exemption for EV owners and support regional efforts to develop HOV lane reciprocity among neighboring states (EVIC Recommendation).

Adopt EV Fleet Purchasing Goal

The State should develop State fleet purchasing goals for replacing State vehicles with BEVs or PHEVs (EVIC Recommendation).

Extend EV Truck Voucher Program

The State could re-fund its Electric Vehicle Truck Voucher Program which provides up to $20,000 toward the purchase or lease of a qualifying electric truck (gross vehicle weight rating over 10,000 lbs).

Provide EV Charging for State Employees

The State could provide Level 1 and/or Level 2 EV charging for State employees at State facilities, using the EV workplace charging initiative at the National Institutes of Health in Bethesda as a model.

Extend Idle Reduction Technology Grants

The State could re-fund its Idle Reduction Technology Grant Program which provides up to $4,000 off the installed cost of a qualifying idle reduction technology (e.g., auxiliary power units, fuel-operated heaters, and automatic stop-start systems).

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Electric and Low Emitting Vehicle Initiatives program in 2020 are estimated to be 0.00 $MMtCO_2e$. Appendix C provides a more detailed description of the process used to quantify GHG reductions (Figure 6.15).

Enhanced reductions

The potential emission reductions from the Electric and Low Emitting Vehicle Initiatives program enhancements in 2020 are estimated to be 0.27 $MMtCO_2e$ (Figure 6.15).

Job Creation and Economic Benefits

The Electric and Low Emitting Vehicle Initiatives program is expected to create and retain jobs. RESI's 2012 study estimated that the Electric and Low Emitting Vehicle Initiatives program, once fully operational, would support a total of about 88 jobs and generate -$15,707,515 in net economic benefit and $2,509,378 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program is largely voluntary. Some of the measures have received federal funding. MEA has primary responsibility for administering the Electric Vehicle Infrastructure Program, Maryland Hybrid Truck Goods Movement Initiative Program, and the Electric Vehicle Charging Station Tax Credit Program. MDOT has primary responsibility for administering the Electric Vehicle Tax Credit Program. Projects funded under MDOT's current Consolidated Transportation Program (the State's six-year capital budget for transportation projects) include the Maryland Transit Administration diesel-hybrid electric bus purchases.

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Governor O'Malley recharging an electric vehicle at a solar tracking charging station.

F. Public Transportation

Public transportation contributes to GHG emission reductions in the State's transportation sector by providing alternatives to travel in personal vehicles, thus reducing vehicle miles traveled (VMT). The programs in this policy area include transit initiatives with a goal of doubling transit ridership by 2020 and intercity transportation initiatives.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Public Transportation programs in 2020 are estimated to be 2.00 $MMtCO_2e$. Because these programs are all related, MDOT has aggregated the potential emission reductions from the full set of programs. Appendices C and D provide a more detailed description of the process used to quantify GHG reductions (Figure 6.16).

Enhanced reductions

The potential emission reductions from the Public Transportation program enhancements in 2020 are estimated to be 2.89 $MMtCO_2e$ (Figure 6.16).

F.1 Public Transportation Initiatives

Lead Agency: MDOT

Program Description

For several decades, vehicle miles traveled (VMT) has risen faster than the increase in population, in Maryland and nationwide. Land use development over the past 40 to 50 years has put more people living beyond the reach of easy access to transit facilities, increasing automobile driving and tailpipe emissions of GHGs and other air pollutants. This program is designed to advance the effort to meet a goal set by the O'Malley-Brown Administration of doubling transit ridership by 2020 and the continuation of that same growth rate beyond 2020. In order to achieve this growth, actions are needed to increase the availability, attractiveness and convenience of public transportation, improve the operational efficiency of the system, and increase system capacity. Actions related to land use planning, pricing disincentives for driving cars, and bike and pedestrian access improvements, addressed in other sections of this Chapter, are also necessary to achieve the ridership goal. Initiatives in this program include the following:

Provide New Transit Service (Purple Line, Corridor Cities Transitway, Red Line)

Major projects planned for opening shortly after 2020 in the Washington region include the Purple Line, which runs from Bethesda Metro station to New Carrollton Metro station, and the Corridor Cities Transitway, which runs from Shady Grove Metro station to COMSAT Laboratories in Germantown. A major project in the Baltimore region, the

Figure 6.16 Initial and enhanced GHG reductions by policy for Public Transportation, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
F	**Public Transportation**	**-**	**2.00**	**2.89**
F.1	Public Transportation Initiatives	MDOT	Included in F	Included in F
F.2	Intercity Transportation Initiatives	MDOT	Included in F	Included in F
		TOTAL REDUCTIONS	**2.00**	**2.89**

Red Line that extends east to west in Baltimore City from the center city to Highlandtown in the east, should also open shortly after 2020. More information on Maryland's transit programs is available at:

http://mta.maryland.gov/transit-projects

Locally Operated Transit Systems

There are various locally operated bus systems around the State that provide a choice for those in suburban and rural areas. The ridership on these services has been increasing and they continue to improve their operations to serve additional riders.

http://mta.maryland.gov/content/lots

Commuter Choice

Commuter Choice Maryland is an incentive program that encourages Maryland employees to choose ridesharing or transit modes instead of driving alone to work. Commuter Choice offers employers monthly pass options which encourage employees to ride transit for less than full fare.

http://www.commuterchoicemaryland.com/ridesharing.htm

http://mta.maryland.gov/

Commuter Choice encourages Maryland employees to choose ridesharing or transit instead of driving alone to work.

Transit Oriented Development

MDOT is actively pursuing efforts to promote pedestrian and transit friendly development solutions. Throughout Maryland, MDOT is working to coordinate transportation and development, build partnerships, and leverage funds to build healthy, sustainable communities that provide transportation options for all Marylanders. A list of the Governor's priority TOD locations and current TOD projects in the State can be accessed via the following websites:

http://www.mdot.maryland.gov/News/2010/June2010/MOM-TODdesignations.htm

http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/TOD/TOD_Projects.html

Ridesharing

Rideshare matching is employed by the MPOs and the MTA to help lower commuting costs, reduce congestion and improve air quality. Assistance in finding someone to carpool with or alternative means of traveling to work is provided by the MTA through Commuter Choice efforts and the MPOs. The listing of rideshare contacts for each County is provided below:

http://www.baltometro.org/commuter-options/rideshare:

http://www.baltometro.org/rideshare/contact/regionalinfo.html

Guaranteed Ride Home

Commuters who ride bus, rail, carpool or vanpool, bicycle or walk to work several times a week are eligible to participate. The program provides an option to workers who commute with others, who must work late, or become sick to get home. It provides a "safety net" to those who are concerned about commuting with others and not being able to get home in an emergency. GRH is managed by the MPOs and MTA.

http://www.mwcog.org/commuter2/commuter/grh/index.html

http://www.mdot.maryland.gov/News/2010/October2010/GuaranteedRideHome.htm

http://www.baltometro.org/commuter-options/rideshare

Clean Air Partners

Clean Air Partners is a nonprofit partnership of the Baltimore and Washington MPOs. Since the late 1990's they have worked with businesses, organizations and individuals to raise awareness and reduce air pollution through voluntary actions. Air alerts are provided to the public and employers daily so they know if actions need to be taken to reduce emissions. Outreach efforts are also undertaken to businesses to inform them of actions they can take to reduce air emissions as well as their own carbon footprint. Educational curriculums regarding Air Pollution are also provided to the teachers and school systems in the region.

http://www.cleanairpartners.net/about.cfm

http://www.baltometro.org/content/view/343/271/

Enhancement Options

The State is considering the following enhancements to public transportation initiatives to achieve additional reductions in GHG emissions by 2020 and beyond:

Accelerate New Transit Service Expansion Implementation

The State could seek additional funding, or find other means, to accelerate implementation of such major new transit services as the Purple Line, Red Line and Corridor Cities Transitway.

Expand Local Circulator Buses and Transit

The State and local jurisdictions could expand the Charm City Circulator and other local circulator bus services and locally operated transit systems to provide transit access to more commuters.

Implement Real-Time Transit Information Technologies

The State and private sector could work together to implement real-time transit information communication technologies (e.g. "Where's my bus" smart phone apps, social media) to aid commuters in planning for their trips and reduce their wait time for transit pickup.

Evaluate Fare Curtailment and Service Enhancement

The State could evaluate the feasibility of funding increases to offset fare curtailment and service enhancement.

Expand Ridesharing through Apps and Social Marketing

The State could partner with businesses and transit agencies to expand ridesharing through the use of information technology apps and targeted marketing to special affinity groups to make ride sharing the socially preferred alternative to single occupancy vehicles.

Increase Commuter Choice Employer Incentives

The State could increase its Commuter Choice Program tax credit, deduction amounts, and explore other incentives to further encourage employers to participate in the program, which provides MTA passes to employees, and expand the program to include MARC fares.

Employer Commute Incentive

Employer commute incentives are manifold, and two present an opportunity for greater policy intensity and also provide an analytical approach which could be applied consistently to estimate the greater impact of the more-intense policy design. These two are parking & transit benefits, and alternative work schedules.

Parking and Transit Benefits

Baseline scenario for employer participation was 10 percent, with an alternative scenario of 20 percent (Appendix D, page D-21). Based on the analytical approach described in the appendices to the existing report, a more ambitious scenario of 25 percent participation would further reduce emissions by 0.01 $MMtCO_2e$ for each percentage point of additional participation. Additional GHG reduction: 0.05 $MMtCO_2e$.

Alternative Work Schedules

Baseline scenario for employer participation was 5 percent, with an alternative scenario of 10 percent participation (Appendix D, page D-21). A more ambitious scenario of 20 percent participation may be achieved through additional combinations of incentives, such as flex time, compressed 4/40 schedules, 9/80 schedules, staggered hours, and telecommuting. Based on the analytical approach described in the appendices to the existing report, the reduction in emissions from this scenario would be 0.015 $MMtCO_2e$ for each percentage point of additional participation. Additional GHG reduction: 0.15 $MMtCO_2e$.

Employer commute incentives—such as parking and transit benefits, or allowing alternative work schedules and telecommuting—could further reduce GHG emissions.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Public Transportation Initiatives program have been aggregated with the estimated emission reductions from the Public Transportation bundle (Figure 6.16).

Job Creation and Economic Benefits

The Public Transportation Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Public Transportation Initiatives program, once fully operational, would support a total of about 14,778 jobs and generate $1,537,301,316 in net economic benefit and $556,618,431 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program includes mandatory drivers, such as executive orders and laws, as well as voluntary measures. Projects that contribute to a reduction in VMT growth and/or improve transit system efficiency are a subset of the State's complete Consolidated Transportation Program (CTP). The current applicable CTP projects include all Maryland Transit Administration and Washington Metropolitan Area Transit Authority capital projects dedicated to the expansion and increased level of service of public transportation services in Maryland.

F.2 Intercity Transportation Initiatives

Lead Agency: MDOT

Program Description

Traffic congestion along the I-95 corridor between the Wilmington region, Baltimore and Washington, D.C. has been steadily increasing over the past few decades. The State is implementing strategies to reduce congestion and mobile emissions, including GHGs, by providing alternatives to single occupant vehicle use as well as improvements to Maryland's transportation systems. These strategies enhance connectivity and reliability of non-automobile intercity passenger options through infrastructure and technology investments. This includes expansion of intercity passenger rail and bus services as well as improved connections between air, rail, intercity bus, and regional or local transit systems. Initiatives include:

The state of Maryland recently announced improvements to the MARC train Red Line.

Photo: Jay Baker, Office of the Governor, Maryland.

MARC Infrastructure and Operations Improvements

Maryland Area Regional Commuter (MARC) rail services have been enhanced through construction of additional parking at stations throughout the service area, as well as additional locomotives and coaches to improve and increase service.

MARC Growth and Investment Plan

Consistent with the desire to expand and improve transit throughout Maryland, the O'Malley/Brown Administration's MARC Growth and Investment Plan is a multi-phased, multi-year plan to triple the capacity of MARC, Maryland's commuter rail system.

More information on Maryland's transit programs is available at:

http://mta.maryland.gov/transit-projects

National Gateway

The National Gateway Project is a package of rail infrastructure and intermodal terminal projects that will enhance transportation service options along three major freight rail corridors owned and operated by CSX Transportation through the Midwest and along the Atlantic coast. The improvements will allow trains to carry double-stacked containers, increase freight capacity and make the corridor more marketable to major East coast ports and shippers. Additional information can be found at:

http://www.mdot.maryland.gov/Office%20of%20Freight%20and%20Multimodalism/National%20Gateway%20Clearance%20Initiative

Northeast Corridor Improvements in Maryland with High Speed and Intercity Passenger Grants

The Federal Railroad Administration has obligated $9.4 million in high-speed stimulus funds to complete environmental and engineering work to replace the BWI Station, which serves BWI Airport, $60 million to design a replacement to the B&P tunnel under Baltimore City and $22 million for design of a replacement Susquehanna railroad bridge.

More information on this program can be found in Appendix D of this Plan.

Enhancement Options

No enhancement options have been identified for this program.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Intercity Transportation Initiatives have been aggregated with the estimated emission reductions from the Public Transportation bundle (Figure 6.16).

Job Creation and Economic Benefits

The Intercity Transportation Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Intercity Transportation Initiatives program, once fully operational, would support a total of about 354 jobs and generate $255,912,414 in net economic benefit and $17,361,727 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The majority of measures from this program are part of MDOT's Consolidated Transportation Program; some measures are federally funded.

G. Pricing Initiatives

Lead Agency: MDOT

Program Description

This program includes transportation pricing disincentives and travel demand management incentive programs. Projects are tied to commute alternatives and programs including ride sharing (Commuter Connections), guaranteed ride home, transportation demand program management and marketing, outreach and education programs (Clean Air Partners), parking cash-out subsidies, transportation information kiosks, local car sharing programs, telework partnerships, parking fees, and vanpool programs. Initiatives in this program include:

Electronic Toll Collection

Electronic toll collection systems expedite the toll collection process, reduce delays at toll plazas, decrease emissions, and are available at all eight toll facilities across the State. GHG emissions are significantly reduced when tolls are collected electronically, due to reduced queuing and idling at toll collection plazas. The Maryland Transportation Authority first implemented its electronic toll collection system at the Authority's three harbor crossing facilities in 1999. In 2011, the Authority reported collecting approximately 63 percent of all tolls collected at Maryland facilities electronically.

The Authority is a member of the E-Z Pass Inter-Agency Group, a coalition of Northeast Toll Authorities. Additional information can be found at:

http://www.i-95expresstolllanes.com/

http://www.iccproject.com/

Commuter Connections

Commuter Connections consists of a core group of regional Travel Demand Management (TDM) activities funded by the State and local jurisdictions. Since the 1970's, Commuter Connections has expanded specific strategies which fall under Commuter Connections and include employer outreach and marketing activities, including teleworking, Guaranteed Ride Home (GRH), mass transit usage, bicycling and carpooling. More information can be found at:

https://tdm.commuterconnections.org/mwcog/

http://mta.maryland.gov/mta-commuter-connections

Park and Ride Lots

There are over 300 Park and Ride lots throughout the Baltimore and Washington areas. At these locations commuters can meet with others to form carpools, vanpools or access public transit. Most of the lots are free to the public and many (25 percent) have bicycle access. The majority of lots are built by the MDOT modal administrations. More information is available at:

http://www.sha.maryland.gov/index.aspx?Pageid=248

http://www.mwcog.org/commuter2/commuter/ridesharing/prlocations.html

Additional information about TDM activities can be found in Appendices D-1 (Sections 3.3 through 3.5) and D-2 (Sections C and D) of this Plan.

More information on this program can be found in Appendices D and H of this Plan.

Enhancement Options

The State is considering the following enhancements to achieve additional reductions in GHG emissions by 2020 and beyond:

Adopt a System Benefits Charge

The State could enact legislation to implement a system benefits charge for transportation.

Increase Gasoline or Sales Tax

The State could increase Maryland's gasoline tax, or implement a sales tax phase-in to raise funds for infrastructure improvements. The price increase would also encourage commuters to explore alternative means of transportation and would reflect the true cost of gasoline consumption.

Enhance Electronic Toll Collection

By providing additional incentives and funding, the State could increase electronic toll collection to 82% of all tolls collected at Maryland facilities by 2020.

Explore Other Revenue Instruments

The State could explore the use of additional revenue instruments and pricing mechanisms to enable GHG reductions through direct price effects and indirect revenue recycling for transportation and land use programs.

Strengthen Parking Programs

The State could explore additional strategies to strengthen or scale existing parking programs and introduce new programs, and explore opportunities to collaborate with state and local governments and transit agencies to strengthen integration of programs. Examples include parking-related benefits like parking cash out or programs to manage parking availability.

Congestion Pricing

Explore the options available to alleviate congestion through pricing mechanisms.

Maryland recently enacted legislation that will lead to additional revenues for transportation projects and will also, from a pricing, congestion and transit perspective, contribute to a reduction in VMT in the State. Figure 6.18 describes Maryland's recently enacted transportation funding plan.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Pricing Initiatives program in 2020 are estimated to be 0.41 $MMtCO_2e$ (Figure 6.17). Because these programs are all related, MDOT has aggregated the potential emission reductions from the full set of programs. Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Pricing Initiatives program enhancements in 2020 are estimated to be 2.3 $MMtCO_2e$ (Figure 6.17).

Figure 6.17 Initial and enhanced GHG reductions by policy for Pricing Initiatives, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
G	Pricing Initiatives	MDOT	0.41	2.30
		TOTAL REDUCTIONS	2.00	2.89

Job Creation and Economic Benefits

The Pricing Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Pricing Initiatives program, once fully operational, would support a total of about 366 jobs and generate $559,424,116 in net economic benefit and $46,401,977 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

Initiatives identified in this program contribute to a change in VMT growth and/or improve Maryland's transportation systems efficiencies and are a subset of the State's complete Consolidated Transportation Program.

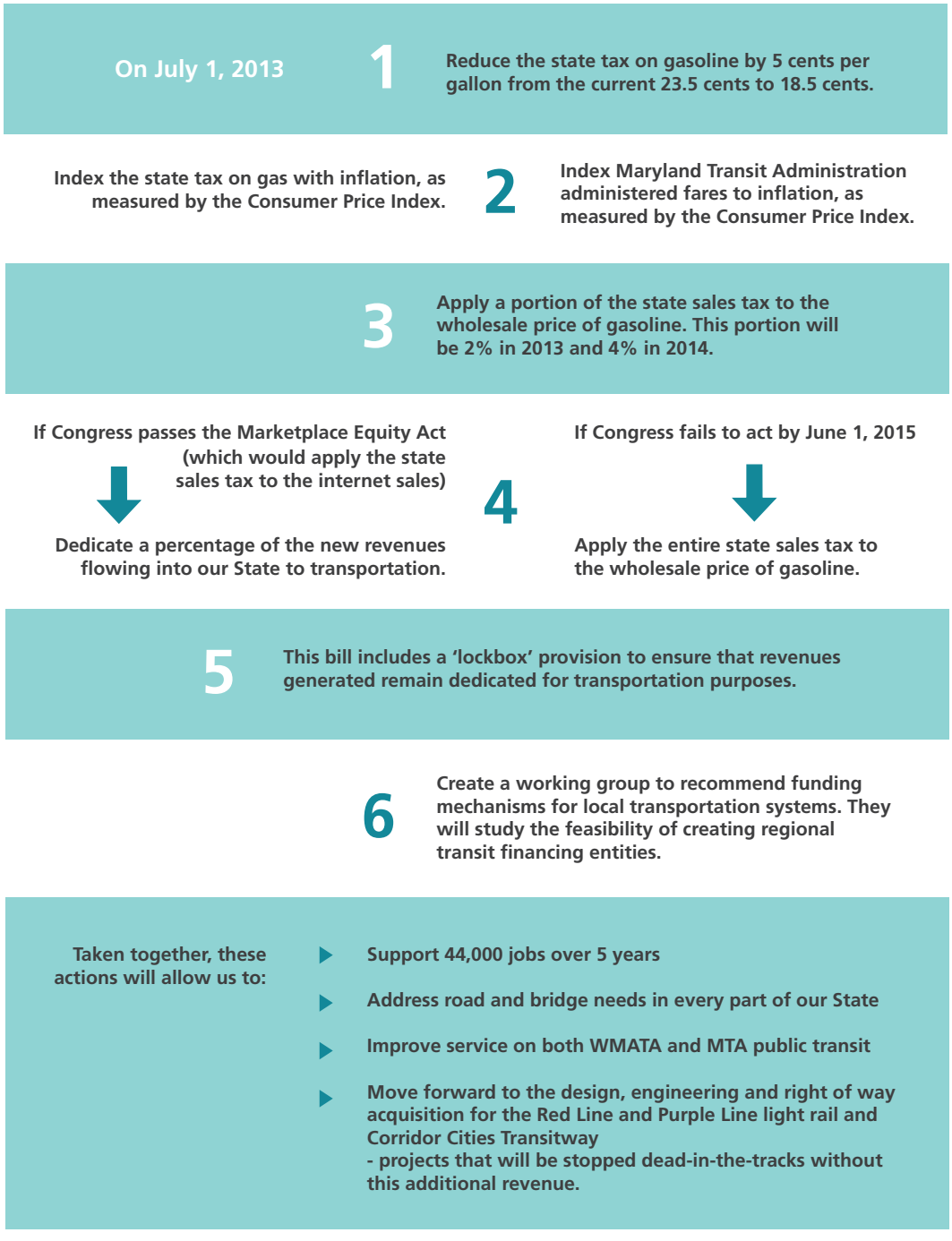


Figure 6.18 Transportation funding plan.

H. Other innovative transportation strategies/programs

H.1 Evaluating the GHG Emissions Impact of Major New Transportation Projects

Lead Agency: MDE

Program Description

This new regulatory initiative is aimed at ensuring that potential increases in GHG emissions associated with the growth and increased vehicle miles traveled (VMT) resulting from major new transportation projects and other major new projects are analyzed, considered and addressed during the transportation planning process. The primary goal of this initiative is to ensure that potential "growth related" GHG emission increases (both direct and induced) are addressed when decisions to approve and fund major projects are made.

This regulatory effort builds on and is closely linked to the existing federal transportation conformity process mandated under the Clean Air Act (*http://www.epa.gov/oms/stateresources/transconf/index.htm*). Under the federal conformity process, before a major project can be added to a transportation plan, there must be an analysis demonstrating that future emissions of certain criteria pollutants resulting from the addition of the new project will not adversely impact the State's ability to attain or maintain compliance with National Ambient Air Quality Standards. GHG emissions are not currently subject to the "transportation conformity" demonstration.

In general, decisions on new transportation projects are made in coordination with regional transportation planning bodies, called Metropolitan Planning Organizations (MPOs). MDE has developed draft regulations for adoption that will require the State's two largest MPOs—the National Capital Transportation Planning Board serving the Washington, DC area and the Baltimore Regional Transportation Planning Board serving the Baltimore area—to perform an analysis, similar to the federally mandated conformity analysis, for GHG emissions.

The proposed regulations will establish long-range transportation sector GHG emission targets for the Baltimore and Washington regions where the majority of the State's transportation sector emissions originate. The GHG emission targets, set at regular time intervals, interpolate where transportation emissions should be to achieve a 90% reduction in transportation-related GHG emissions from 2006 levels by 2050.

This proposed regulation is still being considered by the state and stakeholders as of the publication date of this report. Maryland intends to actively participate in the discussion and potential development of national policies related to reducing GHG emissions from the transportation sector.

Figure 6.19 Initial and enhanced GHG reductions by policy for Other Innovative Transportation Strategies/Programs, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
H	**Other Innovative Transportation Strategies/ Programs**	-	-	-
H.1	Evaluating the GHG Emissions Impact of Major New Transportation Projects	MDE	Included in F	Included in F
H.2	Bike and Pedestrian Initiatives	MDOT	Included in F	Included in F
		TOTAL REDUCTIONS	**2.00**	**2.89**

Enhancement Options

This regulatory initiative is envisioned as a first step toward a more robust federal conformity process for GHG emissions that would eventually tie the allocation of State and federal transportation funding to demonstrated progress toward the long-term GHG emission targets.

Estimated GHG Emission Reductions in 2020

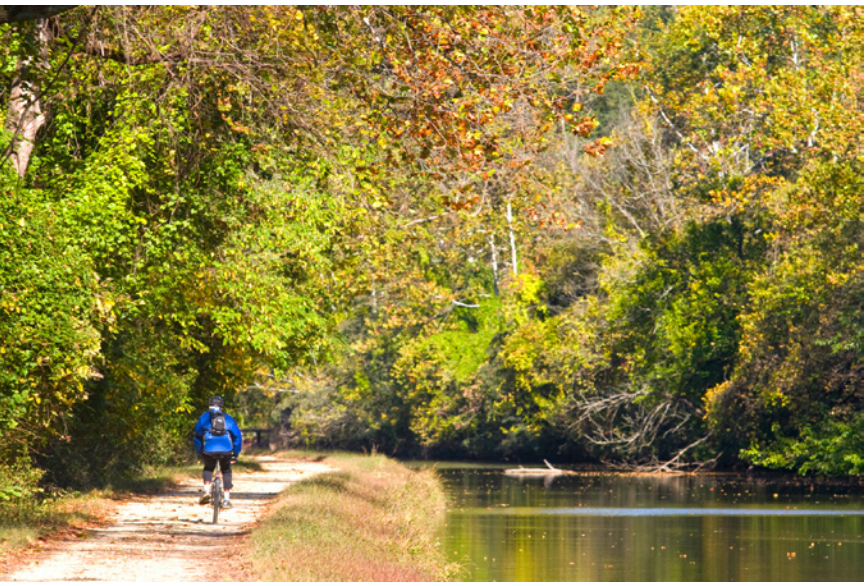
The potential emission reductions from the Evaluating the GHG Emissions Impact of Major New Transportation Projects program have been aggregated with the estimated emission reductions from the Public Transportation bundle (Figure 6.19).

Job Creation and Economic Benefits

A detailed economic analysis of this initiative was not conducted as it is a new effort that is still evolving.

Implementation

If agreement on the proposed regulation is reached, MDE hopes to move toward publication of proposed regulations to implement this initiative in 2013. The State has engaged with stakeholders and consulted the Maryland Air Quality Control Advisory Council (AQCAC) on draft regulations since March 2011. As part of the stakeholder process, MDE has been encouraging both the National Capital Transportation Planning Board and the Baltimore Regional Transportation Board to commence the GHG emission analysis using the draft long-range planning targets on a voluntary basis. It appears that both MPOs are considering this voluntary approach as of the publication date of this report.



State programs aim to encourage bike and pedestrian travel though improved infrastructure, providing bike racks on public transit, and connecting trails.

H.2 Bike and Pedestrian Initiatives

Lead Agency: MDOT

Program Description

This program is part of the State's effort to reduce GHG and other motor vehicle emissions from cars by providing alternatives to single occupant vehicle use. Building appropriate infrastructure for additional bicycle and pedestrian travel in urban areas increases access to and use of public transit and supports the State's 2020 transit ridership goal. Initiatives in this program include:

Bicycle/Pedestrian Enhancements

The Maryland State Highway Administration has worked to engineer, implement, and promote new and improved bicycle and pedestrian facilities.

Bike Racks on Buses, MARC, Subway, Light Rail

In Maryland, public transportation accommodates bicycles to encourage bicyclists to travel longer distances.

Construction of Bike Lanes and Bike Paths

Additional bicycle paths being considered include the Capital Crescent Trail, Patuxent Branch, Rock Creek, B & A, BWI, North Central Rail, and Fair Hill Trails.

East Coast Greenway

The East Coast Greenway is the planned backbone of an emerging network of bicycle trails along the eastern seaboard from Maine to Florida.

Cycle Maryland

Governor O'Malley's Cycle Maryland initiative is an effort to make bicycling a true transportation alternative. Cycle Maryland includes the recently initiated Maryland Bikeways Program and Maryland Bikeshare Program, which both provide funding to build new bikeways and study and implement bikeshare programs throughout Maryland. More information on Cycle Maryland is available at:

http://www.mdot.maryland.gov/Office_of_Planning_and_Capital_Programming/Bike/Cycle_Maryland.html/

Bike and pedestrian initiatives

Bike and pedestrian initiatives include infrastructure design and construction policies; funding; regulatory, and land use strategies; and education and marketing measures. These initiatives result in improved bike and pedestrian amenities, resulting in an increase in the number of trips made on foot or bicycle, particularly in urban areas adjacent to Maryland's trail networks. MDOT is currently updating the Maryland Bicycle and Pedestrian Master Plan. More information on this program can be found in Appendix D of this Plan as well as at:

http://www.mdot.maryland.gov/Office%20of%20Planning%20and%20Capital%20Programming/Bicycle/Documents/FINALB.PDF

Enhancement Options

The State is considering the following enhancements to bike and pedestrian initiatives to achieve additional reductions in GHG emissions by 2020 and beyond:

Bike shelters and bike sharing

Increase the number of bike shelters located in Baltimore City and incentivize local bike sharing and rental programs to promote more biking.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Bike and Pedestrian Initiatives program have been aggregated with the estimated emission reductions from the Public Transportation bundle (Figure 6.19).

Job Creation and Economic Benefits

The Bike and Pedestrian Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Bike and Pedestrian Initiatives program, once fully operational, would support a total of about 1,330 jobs and generate $911,920,810 in net economic benefit and $91,631,803 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The measures that comprise this program are included in the Consolidated Transportation Program.

Agriculture & Forestry

estimated reduction of

5.24

million metric tons of CO_2e annually

The agriculture and forestry sectors are a source of GHG emissions, contributing a small percentage of Maryland's overall GHG emissions, but these sectors also offer unique opportunities to remove carbon dioxide from the atmosphere. Forests, grasslands, croplands, and wetlands all possess carbon-reducing and energy-related benefits that are extensive and complex. Activities in Maryland that can contribute to the increase in net GHG emissions include clearing an area of forest to create cropland, tilling and fertilizing crop lands, or draining a wetland.

More significantly, agriculture and forest lands offer carbon sequestration opportunities that are not possible in other sectors. Through appropriate management, technology and energy conscious choices, the potential for carbon sequestration from the atmosphere can be optimized and the net GHG emissions from the agriculture and forestry sector reduced. Trees and plants remove carbon dioxide from the air and store carbon in their trunks and branches.

Maryland's forests have had net growth for decades, adding to carbon stocks as the trees grow. Forests covered 40.2% of Maryland's 6.2 million acres in 2007.* In 2011, Maryland's forests were storing 89.4 million tons of carbon, adding an average of 1.4%, or 1.25 million tons of carbon per year since 1998.† Beyond the rural forests, urban and community tree cover adds an estimated 520,000 metric tons of carbon annually, based on data from 2000.‡

Sustainable forest and urban forest management is essential for healthy productive forests. Sustainably managed natural resources can maximize carbon sequestration and reduce GHG

* Lister, T.W.; Perdue, J.; McWilliams, W.; Meneguzzo, D.; Barnett, C.; O'Connell, B. 2010. Maryland's forest resources, 2007. Res. Note NRS-68. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 5 p.

† Lister, T.W.; Perdue, J. 2012. Maryland's forest resources, 2011. Res. Note. NRS-153. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 4 p.

‡ Nowak, David J.; Greenfield, Eric J. 2009. Urban and community forests of the Southern Atlantic region: Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia. Gen. Tech. Rep. NRS-50. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 85 p.

Figure 6.20 Initial and enhanced GHG reductions by policy for the Agriculture & Forestry sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
I	Forestry and Sequestration	4.56	4.56
J	Ecosystems Markets	0.20	0.68
TOTAL REDUCTIONS FROM AGRICULTURE & FORESTRY		4.76	5.24

levels in the atmosphere. Increasing the acreage and enhancing the condition of forests and urban trees is a critical component of mitigating climate change.

Lower surface temperatures of sidewalks and roads resulting from the shade of tree canopies reduce the need for air conditioning in buildings, thereby reducing the need for the production and transmission of electricity. Reduced energy production, in turn, reduces GHG emissions from power plants. Shade and lower surface temperatures reduce maintenance to roadway infrastructure which, in turn, reduces the need for conversion of raw materials to asphalt and concrete which reduces the production of GHGs from manufacturing plants, transportation and heavy equipment. Shade and lower surface temperatures reduce the evaporation of chemicals from car engines and reduce the need for air conditioning in cars. All of the examples above reduce the combustion of fossil fuels and emissions of GHGs from cars and power plants.

Agricultural lands both sequester carbon dioxide from the atmosphere and release GHGs through tilling and fertilizer applications. Agricultural practices in Maryland contribute 2.3 $MMtCO_2e$ (5 percent below the national average). Even though this is a small percent of Maryland's total GHG emissions, there are opportunities for reducing energy use and climate-affecting factors.

Agricultural GHG emissions include methane and nitrous oxide emissions from enteric fermentation (digestion), manure management, agricultural soils, and combustion of agricultural residue. Emissions from agricultural soils account for the largest portions of agricultural emissions. The agricultural soils category includes nitrous oxide emissions resulting from fertilizer application (synthetic, organic, and livestock) and production of nitrogen-fixing crops. No-till farming and precision fertilization are among the most effective management practices that reduce GHG emissions during the production of crops.

Opportunities for GHG mitigation in the agriculture and forestry sector involve measures that reduce emissions across other business sectors. For example, production of liquid fuels from biomass can offset emissions from the transportation sector, while biomass energy can replace fossil-fuel generated power and the associated emissions in the energy supply sector.

Two of the GHG reduction policies that are described in detail in this section, are designed to reduce GHG emissions from the agriculture and forestry sector and through carbon sequestration. Full implementation of the two agriculture and forestry sector policies results in potential GHG reductions of 4.76 $MMtCO_2e$ (Figure 6.20).

I. Forestry and Sequestration

I.1 Managing Forests to Capture Carbon

Lead Agency: DNR

Program Description

This program will promote sustainable forestry management practices in existing Maryland forests on public and private lands to capture carbon. The enhanced productivity resulting from enrolling unmanaged forests into management regimes will increase rates of carbon dioxide sequestration in forest biomass, increase amounts of carbon stored in harvested, durable wood products which will result in economic benefits, and increased availability of renewable biomass for energy production.

By 2020, the implementation goal is to improve sustainable forest management on 30,000 acres of private land annually; improve sustainable forest management on 100 percent of State-owned resource lands; and achieve third party certification of sustainable management on 50 percent of State-owned forest lands. Additional potential initiatives include the establishment of a carbon credit market aggregation service with private entities, and the pursuit of legislation to amend the Woodland Incentive Program to allow use with federal cost-share programs. These strategies will be accomplished through the development and adoption of the Statewide Forest Assessment and Response plan, a 5-year strategic planning document required by the 2008 Farm Bill as a condition of access to federal forestry funds.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Managing Forests to Capture Carbon program in 2020 are estimated to be 1.80 $MMtCO_2e$ (Figure 6.21). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Managing Forests to Capture Carbon program is expected to create and retain jobs. RESI's 2012 study estimated that the Managing Forests to Capture Carbon program,

Figure 6.21 Initial and enhanced GHG reductions by policy for Forestry and Sequestration, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
FORESTRY	**I**	**Forestry and Sequestration**	**-**	**4.56**	**4.56**
	I.1	Managing Forests to Capture Carbon	DNR	1.80	1.80
	I.2	Planting Forests in Maryland	DNR	1.79	1.79
	I.3	Creating and Protecting Wetlands and Waterway Borders to Capture Carbon	DNR	0.43	0.43
	I.4	Biomass for Energy Production	DNR	0.33	0.33
	I.5	Conservation of Agricultural Land for GHG Benefits	MDA	0.18	0.18
	I.6	Increasing Urban Trees to Capture Carbon	DNR	0.02	0.02
	I.7	Geological Opportunities to Store Carbon	DNR	Included in I	Included in I
			TOTAL REDUCTIONS	**2.00**	**2.89**

once fully operational, would support a total of about 368 jobs and generate -$12,135,552 in net economic benefit and $2,557,928 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

Since 2006, DNR has implemented 60,000 acres of forest stand improvements; prepared 125,000 acres of new private forest management plans. DNR has successfully retained third-party certification 200,000 acres of sustainably managed publicly owned forests; over 1,300 private landowners retain 142,000 acres of forest certified by American Tree Farm System. In 2009, DNR implemented a Carbon Sequestration Pilot project to assess forest planting and management techniques for approximately 174 acres of Maryland forests. The Woodland Incentive Program statute, Natural Resources Article §5-304, was amended in 2010 and a Statewide Forest Assessment was completed.

Establishing a carbon credit aggregation service with private entities continues to be explored.

I.2 Planting Forests in Maryland

Lead Agency: DNR

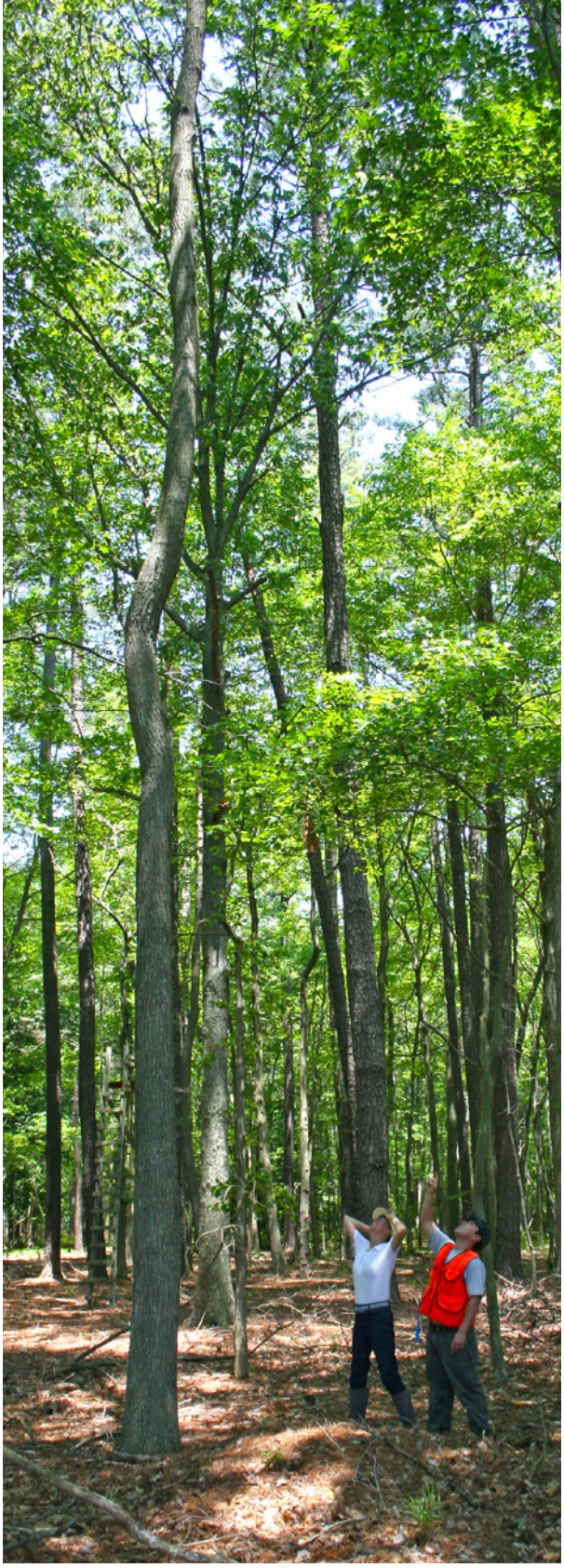
Program Description

Increasing forest and tree cover provides benefits for GHG reduction in addition to carbon sequestration. This program promotes forest cover and associated carbon stocks by regenerating or establishing healthy, functional forests through afforestation (on lands that have not, in recent history, been forested, including agricultural lands) and reforestation (on lands with little or no present forest cover) where current beneficial practices are not displaced. Successful establishment requires commitment for as long as twenty years. Forest patches should be of sufficient size to function as a community of trees and related species.

This program promotes practices, such as soil preparation, erosion control, and supplemental planting, to ensure optimum conditions to support forest growth. Included is identification of areas in need of physical intervention to return forest habitats to full vigor. Additional concerns include linking islands of fragmented forests to restore function, recovering severely disturbed lands, and reversing the effects of continued toxicity on those disturbed lands.

By 2020, the implementation goal is to achieve afforestation and/or reforestation of 43,030 acres for Years 2011–2020. To accomplish this goal, DNR will work with federal and state partners, local governments, and non-profits to create, restore, and enhance forests.

More information on this program can be found in the appendix of this report.



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Private landowners currently own 76% of all forestland in Maryland. The state of Maryland aims to encourage landowners to capture carbon, and increase forest cover to further increase carbon capture capacity.

Estimated GHG Emission Reductions in 2020

As Initially Designed

The potential emission reductions from the Planting Forests in Maryland program in 2020 are estimated to be 1.79 $MMtCO_2e$. Appendix C provides a more detailed description of the process used to quantify GHG reductions (Figure 6.21).

Job Creation and Economic Benefits

The Planting Forests in Maryland program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Planting Forests in Maryland program, once fully operational, would support a total of about 92 jobs and generate $3,418,540 in net economic benefit and $1,351,097 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

Under this program, DNR has achieved 3,894 acres of afforestation and 6,469 acres of reforestation, since 2006. DNR is implementing this policy through a suite of efforts, policies and programs, including:

Public Lands:

- State Forest System Annual Work plan Implementation
- Natural Filters

Private Lands:

- Technical Assistance
- Forest Stewardship Plan Implementation
- Financial Assistance
- State and Federal Cost Sharing
    - Woodland Incentive Program (WIP – State/MDFS)
    - Environmental Quality Incentive Program (EQIP – Federal/NRCS)
    - Conservation Reserve Enhancement (CREP – Federal/NRCS)

1.3 Creating and Protecting Wetlands and Waterway Borders to Capture Carbon

Lead Agency: DNR

Program Description

In addition to forests, wetlands and marshlands are known to be very efficient at sequestering carbon. Therefore, DNR is planting forested stream buffers and pursuing the creation, protection and restoration of wetlands to promote carbon sequestration through several means, including undertaking on-the-ground wetland restoration projects through its Coastal Wetlands Initiative, the development of a terrestrial carbon sequestration protocol; a DNR Power Plant Research Project wetland study in Dorchester County, and the Sea level Affecting Marshes Model.

Targets for forested buffers and on the ground wetland restoration, as established under Maryland's Phase II Watershed Implementation Plan (WIP) for the Chesapeake Bay

TMDL, include the restoration of 1,142 acres of wetlands on state and public land and planting 645 acres of streamside forest buffers on state and public lands.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Creating and Protecting Wetlands and Waterway Borders to Capture Carbon program in 2020 are estimated to be 0.43 $MMtCO_2e$ (Figure 6.21). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Creating and Protecting Wetlands and Waterway Borders to Capture Carbon program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Creating and Protecting Wetlands and Waterway Borders to Capture Carbon program, once fully operational, would support a total of about 62 jobs and generate $11,529,223 in net economic benefit and $1,367,743 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Living shoreline project on Church Creek will help to stabilize the shoreline and allow swamp, shoreline, and floodplain forest species to migrate to higher elevations.

Photo © South River Federation

Implementation

This program is being implemented through a suite of programs and strategies, as well as on-the-ground wetland restoration and streamside buffer projects by DNR.

Additionally, DNR is working on three projects to advance, promote and assess potential wetland carbon sequestration opportunities in the State. The first is a DNR Power Plant Research Program project with the University of Maryland to study carbon sequestration processes in selected marsh segments in the Blackwater National Wildlife Refuge. The aim of this project is to develop a terrestrial carbon sequestration protocol that is generally applicable to estuarine wetlands and tidal marshes, and which will lead to projects that produce carbon offsets that can be used to compensate for greenhouse gas emissions.

The second is a study of wetlands in Dorchester County to estimate gross sequestration and net accumulation based on the current understanding of carbon dynamics in coastal wetlands. The final project is a DNR study, completed in 2011, which used the Sea level Affecting Marshes Model to identify areas projected to convert into new wetlands under future sea-level rise conditions. Using this modeling, the State is now working to target lands that may support coastal wetland establishment; these areas are otherwise known as wetland migration areas. Future carbon sequestration can be achieved through wetland establishment and restoration activities that enhance these targeting areas for wetland migration. Modeling results are accessible on DNR's Coastal Atlas:

http://www.dnr.state.md.us/ccp/coastalatlas/index.asp

I.4 Biomass for Energy Production

Lead Agency: DNR

Program Description

Maryland is working to promote the use of locally produced woody biomass for generation of thermal energy and electricity. Energy from forest by-products can be used to offset fossil fuel-based energy production and associated GHG emissions. There are many end users that could potentially benefit from such a program, including Maryland's public schools which could enjoy wood heating and cooling; hospitals which could utilize wood as primary heating/cooling source; municipalities which could utilize local fuel markets as key component of their urban tree management programs; and all rural landowners which would have access to a wood fuel market.

Thousands of potential sites exist within Maryland, such as schools, hospitals, and college campuses, which would be prime candidates for wood-fired combined-heat-and-power systems. These systems provide the heating and cooling needs for the facilities they serve and utilize excess thermal capacity to generate electricity. Thousands of additional sites exist, such as residential communities, businesses, and institutions, throughout Maryland ideally suited for simple thermal-only systems, which are designed to provide only the heating and cooling needs of the facility.

DNR continues to work to eliminate the numerous barriers that exist to advancing wood energy in Maryland: awareness of wood as a viable, and preferred, energy source; State procurement systems that currently do not recognize wood energy systems as an option for consideration in HVAC design; lack of emission standards reflecting the state-of-art emission controls, etc. The favorable economic structure of wood energy systems would likely lead to the development of wood energy market in Maryland, if not for the many barriers currently existing hindering facilities from taking advantage of these systems.

Removing, or at least reducing, these barriers would enable residential and commercial stakeholders to pursue adopting wood energy systems. DNR is working within State government to insure that wood energy is comparable to wind and solar as a viable and desirable form of renewable energy.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Biomass for Energy Production program in 2020 are estimated to be 0.33 $MMtCO_2e$ (Figure 6.21). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Biomass for Energy Production program is expected to create and retain jobs. RESI's 2012 study estimated that the Biomass for Energy Production program, once fully operational, would support a total of about 51 jobs and generate -$75,128,175 in economic net economic benefit and $1,159,668 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

Key actions to support this program include the development of policies that recognize wood as preferable renewable resources and the largest source of energy consumption in Maryland. DNR will also be working to offer incentives for the utilization of locally

produced wood to meet thermal energy needs. The goal of this program is to foster the development of 18 wood energy projects by the 2020.

Various grants, loans, and cost-share programs offered by MEA, MDE, and other agencies will support implementation. Amendments to a number of existing laws and regulations would offer additional implementation assistance, including:

- Amending Renewable Fuels Standard to accommodate renewable thermal energy.
- Recognizing modern emission control technologies utilized by wood energy systems in air quality permitting regulation.
- Specifically including wood energy systems as option for HVAC design in State buildings.

Additionally, DNR is working with several outside groups to promote and advance implementation, including:

- US Forest Service — Woody Biomass Utilization Program

  http://www.fs.fed.us/woodybiomass/index.shtml
- Fuels for Schools — a venture between public schools, State Foresters, and Regional Foresters of the Forest Service to helps public schools retrofit their current fuel or gas heating system to small-scale biomass heating systems.

  http://www.fuelsforschools.info/
- Biomass Energy Resource Center — assists communities, colleges and universities, State and local governments, businesses, utilities, schools, and others in making the most of their local energy resources.

  http://www.biomasscenter.org/
- Alliance for Green Heat — promotes high-efficiency wood combustion as a low-carbon, sustainable, local and affordable heating solution.

  http://www.forgreenheat.org/

I.5 Conservation of Agricultural Land for GHG Benefits

Lead Agency: MDA

Program Description

Land conservation offers an important mechanism for mitigating and adapting to climate change. Healthy and vigorous forests and grasslands provide both direct benefits to GHG reductions and also serve as the preferred land-use for avoiding emissions and capturing GHGs. Wetlands and marshlands provide one of the best ways to prevent property damage and maintain healthy environments in coastal areas as well as reduce nutrient, sediment, and other pollution into the Chesapeake Bay and other bodies of water. Deforestation and other land-use changes account for as much as 25 percent of global GHG emissions. In addition, the increasing rate of sea-level rise and associated erosion threaten Maryland's shoreline and associated coastal wetlands, removing another natural sink for GHGs. For these reasons and more, MDA is working to safeguard Maryland's network of natural areas, agricultural lands and coastal lands through the MDA's established conservation programs and practices.

MDA will decrease the conversion and development of agricultural lands through the protection of productive farmland and will continue to pursue policies and programs that complement those of DNR and MDP by preserving existing forested, grassed, and wetland areas on agricultural land. MDA and its partners will also collaborate to implement policies,

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Agricultural soils, when managed correctly, can be a sink for greenhouse gases. This program aims to protect agricultural lands from urban development, and retain farmland and woodland as a viable local base of food production, open space, and wildlife habitat.

programs, and strategies to sequester additional carbon and avoid or reduce GHG emissions associated with growth and development.

Established in 1977 and one of the first programs of its kind in the country, the Maryland Agricultural Land Preservation Foundation retains prime farmland and woodland as a viable local base of food and fiber production in the State through the purchase of permanent preservation easements. The preservation of agricultural land limits the expansion of random urban development, maintains agricultural and forest lands as open space and wildlife habitat, and enhances the environmental quality of the Chesapeake Bay ecosystem. By the end of the 2010 fiscal year, the Foundation had permanently protected more than 280,000 acres on approximately 2,100 farms located across Maryland's 23 counties. By 2020, the State's forward reaching goal is to protect 962,000 acres of productive farmland from development.

Maryland has also partnered with U.S. Department of Agriculture since 1997 in the national Conservation Reserve Enhancement Program to offer rental payments for long-term, leased easements, along with other cash incentives, to encourage agricultural producers to protect environmentally sensitive lands and improve wildlife habitat. When fully implemented, this federal program will have planted up to 16,000 acres of marginal land into grass, shrubs, and trees, established 77,000 acres of riparian buffers and 5,000 acres of water and wetland habitat, and restored 2,000 acres for declining, threatened, or endangered species.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Conservation of Agricultural Land for GHG Benefits program in 2020 are estimated to be 0.18 $MMtCO_2e$ (Figure 6.21). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Conservation of Agricultural Land for GHG Benefits program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Conservation of Agricultural Land for GHG Benefits program, once fully operational, would support a total of about 378 jobs and generate $1,196,196,262 in net economic benefit and $29,296,875 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

Senate Bill 297 creating the Maryland Agricultural Land Preservation Foundation in its present form was enacted and signed into law in 1977. Since the Maryland Agricultural Land Preservation Foundation is closely tied to State statute, different aspects of the program are subject to review and revision every legislative session.

As a national initiative, the Conservation Reserve Enhancement Program receives its authorization pursuant to the 1996 Federal Agriculture Improvement and Reform Act. Memoranda of Agreement incorporating the Conservation Reserve Enhancement Program proposals and renewals are signed by the U.S. Secretary of Agriculture and the governor of each participating state.

Although participation in both programs is voluntary, the financial incentives provided by the purchase of easements through the Maryland Agricultural Land Preservation Foundation guarantees that the land will permanently preserved for agricultural use and helps to keep Maryland's agricultural base intact. Similarly, Maryland landowners participating in the Conservation Reserve Enhancement Program can receive five types of payments that incentivize the installation and maintenance of eligible conservation practices.

Urban trees shield buildings from cold winds and lower ambient summertime temperatures, reducing heating and cooling costs and the demand for energy production.

I.6 Increasing Urban Trees to Capture Carbon

Lead Agency: DNR

Program Description

Efforts are currently in place to maintain and improve the health and longevity of trees in urban areas and increase the urban tree canopy cover throughout Maryland. Trees in urban areas help absorb GHG emissions from power production, vehicles and the operation and maintenance of the built environment. Urban trees shield buildings from cold winds and lower ambient summertime temperatures, reducing heating and cooling costs and the demand for energy production. Reduced heat slows the formation of ground level ozone as well as the evaporation of fuel from motor vehicles.

The Urban Tree Canopy Initiative targets Maryland counties, particularly counties with significant urban areas. Through this program, DNR is currently working to establish urban canopy goals for 50 percent (74 communities) of the area developed primarily before 1984. By 2020, the overall goal is to plant 12,500,000 trees through the FCA Marylanders Plant Trees, Tree-Mendous Maryland and 5–103 planting programs. For measurement purposes, trees include 450 container grown seedlings per acre.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Increasing Urban Trees to Capture Carbon program in 2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.21). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Increasing Urban Trees to Capture Carbon program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Increasing Urban Trees to Capture Carbon program, once fully operational, would support a total of about 375 jobs and generate $286,946,969 in net economic benefit and $8,456,144 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The Urban Tree Canopy Initiative is an overarching program for the Maryland Forest Service Urban & Community Forestry program. The program has been designed to meet the goals established by both the Maryland Commission on Climate Change, as well as is a goal of the Chesapeake Executive Council Riparian Forest Buffer Directive No. 03-01.

To date, thirty-seven municipalities are participating in the Urban Tree Canopy Initiative, including: Annapolis, Baltimore, Bowie, Cumberland, Edmonston, Greenbelt, Hyattsville, and Rockville as well as Baltimore County's 29 communities. All of these communities have received tree canopy assessments performed by the University of Vermont and funded by the Chesapeake Bay Trust's Urban Greening Initiative grant program and DNR's Maryland Forest Service. Of these communities, three have developed goals: Annapolis 50 percent, City of Baltimore 40 percent and Frederick County Board of Education 20 percent.

The following statutes and regulations authorize the State and/or local jurisdictions to review development projects (from subdivisions, road construction to individual houses) with regard to their impact on existing trees and forest and require tree and forest mitigation:

- Forest Conservation Act, NRA 5-1601—5-1613 Annotated Code of Maryland
- Forest Conservation Regulations, COMAR 08.19.01 — 08.19.06
- Reforestation Law, NRA 5-103, Annotated Code of Maryland
- Roadside Tree Law, NRA 5-401—5-406, Annotated Code of Maryland
- Roadside Tree Care Regulations, COMAR 08.07.02.01 — .10

The following statute and regulations give DNR the authority to license tree care workers to ensure that tree care work is conducted consistent with industry standards:

- Tree Expert Law, NRA 5-415—5-423, Annotated Code of Maryland
- Licensed Tree Experts, COMAR 08.07.07.01 — .08

The Maryland DNR Forest Service assists local jurisdictions through the implementation of the above statutes and regulations and also via requests for assistance from local jurisdictions. Tree planting assistance for local governments and citizens is also provided through the Tree-Mendous Maryland, Marylanders Plant Trees and §5-103 programs. Funding to implement the urban canopy implementation plan's tree plantings can be obtained from the local jurisdiction's Forest Conservation ordinance fee-in-lieu fund.

A working commitment exists with local communities to secure funding for conducting urban tree canopy assessments and adoption and implementation of urban tree canopy goals by local communities. DNR provides outreach and education on the role of trees in the built environment and control methods for invasive species.

DNR is working to encourage policies requiring tree canopies around schools (Green Schools Program), nursing homes, shelters and public buildings located in proximity to at-risk populations.

I.7 Geological Opportunities to Store Carbon

Lead Agency: DNR

Program Description

Natural geologic reservoirs have held oil, natural gas, water, and even carbon dioxide, for millions of years with no or minimal leakage. These same natural geologic systems are thought to offer both near-term opportunities and longer-term possibilities for future storage of man-made carbon dioxide emissions. This program is designed to identify the

location and extent of these reservoirs in Maryland to determine their integrity through a series of test injections, and finally to develop an appropriate regulatory environment for safe deployment.

The U.S. Department of Energy has a carbon sequestration partnership program to develop regionally appropriate approaches for carbon sequestration. The Midwest Regional Carbon Sequestration Partnership, of which Maryland is a member, is analyzing potential geological carbon sequestration. Ultimately, test injections of carbon dioxide in target geologic formations will be monitored. One option in Maryland may be the use of carbon dioxide in enhanced oil and gas recovery.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Geological Opportunities to Store Carbon program have been aggregated with the estimated emission reductions from the Forestry and Sequestration bundle (Figure 6.21).

Job Creation and Economic Benefits

The Geological Opportunities to Store Carbon program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Geological Opportunities to Store Carbon program, once fully operational, would support a total of about 218 jobs, and generate $311,945,021 in net economic benefit and $5,654,075 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program is voluntary.

Pursuit of geological sequestration projects is not presently underway in any eastern state. As technology improves, geologic carbon sequestration should be considered as a near term possibility requiring further analysis, research and engineering development. Due to the costs involved, geologic sequestration may require cooperative studies, partnerships, and funding at the federal level and with industry.

Phase I and II of the Midwest Regional Carbon Sequestration Partnership's program has been completed, which involved compiling information on potential reservoir characteristics and mapping their extent in the region. Extensive reservoirs were identified including in the western counties and areas of the Delmarva Peninsula in Maryland. Ultimately, test injections of carbon dioxide in target geologic formations will be monitored for migration of the injected gas, geochemical alterations in the subsurface and the containment integrity. Regulations relating to underground injection will need to be developed prior to these techniques coming into routine use. Developing a beneficial use program for the stored carbon dioxide will be important to manage associated costs. Phase III of the effort is currently underway which will involve further refinement of geologic storage potential in the region by incorporating new data as it becomes available. A particular area of focus will be directed at characterizing the opportunities for enhanced gas recovery from organic shales.

J. Ecosystems Markets

J.1 Creating Ecosystems Markets to Encourage GHG Emission Reductions

Lead Agency: DNR

Program Description

Increased attention to the benefits and cost efficiencies that ecosystem markets could provide has spurred evaluation of the potential its programs and policies may have for fostering carbon market development. Maryland's Forest Conservation Act and Critical Area Act require mitigation for natural resource impacts generated through land development, and mitigation banking is an option to address these mitigation requirements

As ecosystem markets develop and more mitigation is addressed through a market system, then greenhouse gas reduction benefits could begin to be calculated. Benefits could be categorized as avoidance/minimization benefits and net environmental enhancements.

In fall 2010, DNR convened the Ecosystem Services Working Group, which consisted of representatives from State agencies, the private sector, and a non-profit organization. The Working Group assessed existing programs to determine which practices and programs could play a role in promoting private sector involvement in developing ecosystem markets. Ecosystem services programs, policies, and current or potential markets assessed by the Ecosystem Services Working Group include wetlands, streams and waterways, forests, critical areas, species and habitats, nutrients, carbon and biomass.

The Ecosystem Services Workgroup released its final report in October 2011 with recommendations identified for expanding the role of ecosystem markets in Maryland. As the next step in this process, Governor O'Malley has directed his Chesapeake Bay cabinet agencies to work together to review the recommendations and propose an action plan and timeline for expanding ecosystem markets in Maryland.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

GHG reductions for nutrient trading, under Maryland's Nutrient Trading Program, are treated separately in this plan because this market has been established as an administratively funded and staffed program. The GHG reduction benefits from the remaining ecosystem markets cannot be quantified until an active set of markets has been established and protocols to assess GHG benefits have been developed.

With the exception of the GHG reduction benefits for nutrient trading, under Maryland's Nutrient Trading Program, potential reductions from ecosystem markets cannot be

Figure 6.22 Initial and enhanced GHG reductions by policy for Ecosystems Markets, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
FORESTRY	**J**	**Ecosystems Markets**	**-**	**0.20**	**0.68**
	J.1	Creating Ecosystems Markets to Encourage GHG Emission Reductions	DNR	0.11	0.11
	J.2	Nutrient Trading for GHG Benefits	MDA	0.09	0.57
			TOTAL REDUCTIONS	**0.20**	**0.68**

quantified until an active set of markets has been established and protocols to assess GHG benefits have been developed. In order to account for similarities across programs, all emission benefits and costs associated with the Nutrient Trading program are discussed and aggregated under the Nutrient Trading for GHG Benefits program.

The potential emission reductions from the Creating Ecosystems Markets to Encourage GHG Emission Reductions program in 2020 are estimated to be 0.11 $MMtCO_2e$ (Figure 6.22). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

Job creation and economic benefits for nutrient trading are treated separately in the Nutrient Trading for GHG Benefits program. Benefits related to other ecosystem markets are not quantifiable at this time.

Implementation

This program is still under development. Based on interagency review of recommendations, ecosystem markets may be enhanced through new legislation, as needed, adoption of new regulations or amendment of existing regulations by the appropriate State agencies, including DNR, MDE and MDA or alterations to existing program operations.

J.2 Nutrient Trading for GHG Benefits

Lead Agency: MDA/ MDE

Program Description

Since many of the agronomic, land use, and structural practices promoted by the Maryland Nutrient Trading Program administered by MDA also store carbon and lower other GHG emissions, the existing nutrient marketplace provides a platform for the addition of a voluntary carbon component. Just like the nutrient market, carbon trading offers entities under regulatory requirements a potentially more cost-effective means to meet their obligations while providing farmers and landowners the opportunity to receive compensation for implementing and maintaining conservation practices.

MDA will add carbon credits and enhanced nutrient credits to the Maryland Nutrient Trading Program. Carbon and enhanced nutrient credits would be "stacked" onto existing nutrient credits as tradable commodities, thereby increasing the potential value of the total credit package and taking an incremental step in creating a comprehensive environmental marketplace.

The Maryland Nutrient Trading Program developed by MDA maintains the embedded capacity to stack carbon and sediment on the existing platform. Through a federal grant awarded to the World Resources Institute in 2010, MDA joined with agencies from four other Bay states in the development, testing, and rollout of an interstate trading model, as well as a farm profit calculator to help landowners, producers, and service providers conduct cost benefit analyses of trading participation.

State soil conservation staff and other interested third parties continue to be trained in the use of the Nutrient Trading Program's online assessment tool, marketplace, and registry. MDA periodically holds public meetings across the State to provide an overview of both point and nonpoint source policies, the salient features of the Nutrient Trading Program, and future carbon stacking opportunities. By 2020, MDA aims to achieve participation by 10 percent of farms and landowners in providing nutrient and carbon credits to an active environmental market in Maryland and establish commonalities among Bay State trading programs and create a shared platform to facilitate interstate trades.

More information on this program can be found in the appendix of this report.

Enhancement Options

The State is currently working to establish an Accounting for Growth (Bay restoration related) program that will likely accelerate the establishment of a robust nutrient trading market in Maryland.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Nutrient Trading for GHG Benefits program in 2020 are estimated to be 0.09 $MMtCO_2e$ (Figure 6.22). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Nutrient Trading for GHG Benefits program enhancements in 2020 are estimated to be 0.57 $MMtCO_2e$ (Figure 6.22).

Job Creation and Economic Benefits

The Nutrient Trading for GHG Benefits program is expected to increase the State GDP. RESI's 2012 study estimated that the Nutrient Trading for GHG Benefits program, once fully operational, would support a total of about -1,673 jobs and generate $56,174,991 in net economic benefit and $36,682,128 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

These enhancements to the Nutrient Trading for GHG Benefits program are still under development, and like the nutrient marketplace, participation will be voluntary.

Buildings

estimated reduction of

3.15

million metric tons of CO_2e annually

A worker installing recycled blue jean denim insulation.

Since buildings require large amounts of energy to heat, cool, maintain, and operate, it is not a surprise that buildings account for almost a third of the total energy use and carbon dioxide emissions in the U.S. Given the long lifetime of most buildings, it is necessary that both existing and new buildings achieve the greatest energy efficiency possible. This includes all aspects of buildings, including site location and design, the design of the building itself, how the building is constructed, and the type of materials used, among others.

Increasing energy efficiency in Maryland State government's buildings has the potential to reduce Maryland's GHG emissions through decreasing the need for power generation from fossil fuel-fired sources. In addition to reducing GHG emissions, this will create reductions in nitrogen oxides, sulfur dioxide and mercury, all of which are harmful to the environment.

One of the GHG reduction policies, which is described in detail throughout this section, is designed to reduce emissions from the building sector. Full implementation of this building sector policy results in GHG reductions of potentially 3.15 $MMtCO_2e$ (Figure 6.23).

The range of GHG benefits are likely to fluctuate in the face of the following: continued refinement for quantifying GHG benefits, future program decisions on the level of funding, and future advances in technology.

Figure 6.23 Initial and enhanced GHG reductions by policy for the Buildings sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
K	Building and Trade Codes in Maryland	3.15	3.15
	TOTAL REDUCTIONS FROM BUILDINGS	3.15	3.15

K. Buildings and Trade Codes in Maryland

Lead Agency: DHCD

Program Description

Given the long lifetime of buildings, updating state and local building codes on a periodic basis will provide long-term greenhouse gas emissions reductions. The statewide building code in Maryland is adopted by the Maryland Codes Administration, which is within the Department of Housing and Community Development (DHCD). The statewide building code is called the Maryland Building Performance Standards (MBPS) and is updated every three years following the International Codes Council (ICC) cycle. The MBPS is based primarily on the international codes books (I-Codes) published by the ICC; the core code books adopted by Maryland are the International Building Code (IBC), the International Residential Code (IRC), and the International Energy Conservation Code (IECC). In January of each third year, the Maryland Codes Administration adopts the latest codes into the MBPS, as required by law; subsequently, the local building code authorities must adopt and implement the MBPS by July of that same year. Local code authorities may amend the MBPS to meet the specific conditions and needs of their jurisdiction—with a few exceptions. For example, the energy code (IECC) and the accessibility code (Maryland Accessibility Code or MAC) cannot be weakened. Other codes, such as the recently authorized International Green Construction Code (IgCC), are a voluntary option for local jurisdictions.

The adoption and implementation of the most recently updated energy codes leads to significantly reduced energy usage and greenhouse gas emissions in new or retrofit buildings. The energy code in place in 2012 in Maryland is the IECC 2012. This recently adopted energy code is estimated to result in buildings that are 15% more energy efficient than structures built using the prior energy code, which was the IECC 2009. The IECC 2009 was estimated to result in 15% more energy efficiency over the 2006 IECC. As building codes and building practices continue to improve, the built environment will become more energy and resource efficient and will perform better overall. In addition, these high-performing buildings will help the state of Maryland meet the requirements of the Greenhouse Gas Reduction Act of 2009 and the goals of the Maryland Commission on Climate Change.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Building and Trade Codes in Maryland program in 2020 are estimated to be 3.15 $MMtCO_2e$ (Figure 6.24). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Building and Trade Codes in Maryland program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Building and Trade

Figure 6.24 Initial and enhanced GHG reductions by policy for Building and Trade Codes in Maryland, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
K	Building and Trade Codes in Maryland	DHCD	3.15	3.15
		TOTAL REDUCTIONS	3.15	3.15

Codes in Maryland program, once fully operational, would support a total of about 115 jobs and generate $125,699,190 in net economic benefit and $4,879,789 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

The Maryland Building Performance Standards (Code of Maryland Regulations 05.02.07) adopted most recently (January 1, 2010) includes the 2009 International Energy Conservation Code, which is the latest energy code published by the International Code Council. Local jurisdictions were required to adopt the 2010 standard by July 1, 2010. The most recently adopted standard has been estimated to achieve 15 percent energy efficiency improvements over the prior 2006 energy code. The next energy code will be released in 2012 and is expected to achieve an additional 15 percent in energy efficiency improvements over the 2009 codes.

In 2011, approximately 60 local jurisdictions are required to adopt the current Maryland Building Performance Standards and DHCD will track local jurisdictions on the Maryland Codes Administration website. In 2020, Maryland will have adopted the latest, nationally-accepted, building and trade codes into the Maryland Building Performance Standards, which will be from the 2018 International Code Council.

One of the ways DHCD continually helps to reduce energy consumption in new or renovated buildings is through the timely adoption of the latest Statewide building codes, by incorporating the most recently published energy code into the Maryland Building Performance Standards. The most recently adopted standard has been estimated to achieve 15 percent energy efficiency improvements over the prior 2006 energy code. The next energy code will be released in 2012 and that code is expected to achieve an additional 15 percent in energy efficiency improvements over the 2009 codes.

DHCD will continue to provide training on the newest version of the Maryland Building Performance Standards to local jurisdictions, architects, engineers, green building professionals, and other stakeholders. DHCD will also continue to improve, assess, and adopt the latest building codes following the International Code Council three-year cycle of development; participate in the process to improve and develop building codes on a national level, including participation in annual conferences and code development hearings, as funding permits; and identify opportunities to improve and expand much-needed training on building codes, especially those that will continue to be developed relating to energy efficiency and other green building standards.

Supporting Laws and Regulations

- Energy Independence and Security Act of 2007 Title III (Appliance and Lighting Efficiency) and Title IV (Energy Savings in Building and Industry).
- The Sustainable Communities Act of 2010 (House Bill 475)
- The Green Building Council (House Bill 154/Senate Bill 212)
- Baltimore City Building Code, Chapter 37 establishes a green building program
- Maryland's Greenhouse Gas Emissions Reduction Act of 2009

Suggested Laws and Regulations

Funding for DHCD training programs to ensure that suitable training remains available Statewide to local code authorities and other stakeholders.

Zero Waste

estimated reduction of

4.80

million metric tons of CO_2e annually

Increased recycling of packaging is part of the State's strategy to eliminate solid waste.

Recycling converts used or waste products into new materials. Plastics, paper, metal, glass, electronics, cloth, batteries and biodegradable waste are commonly recycled into new materials. In addition to reducing GHG emissions, recycling helps the environment in other ways. Recycling saves energy when materials are recycled instead of new materials being manufactured. Coal, gasoline, and diesel fuel are often used in manufacturing processes, and resulting GHG emissions are avoided through recycling. Additionally, recycling reduces the amount of material ending up in landfills today.

GHG emissions generated from waste in landfills are projected to increase in Chapter 3's Inventory and Forecast. GHG emissions associated from waste include solid waste management, solid waste combustion, and wastewater management. Recycling reduces waste emissions. Actions taken to increase waste recycling can reduce GHG emissions not only in the State, such as landfill methane gas emissions, but also outside the State, such as emissions associated with the energy used to make products from virgin materials versus recycled materials.

One of the GHG reduction policies is designed to reduce GHG emissions from the recycling sector. Full implementation of this recycling sector policy results in GHG reductions of potentially 2.80 $MMtCO_2e$ and 4.80 $MMtCO_2e$ with all program enhancement options implemented (Figure 6.25).

Figure 6.25 Initial and enhanced GHG reductions by policy for the Zero Waste sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
L	Zero Waste	2.80	4.80
	TOTAL REDUCTIONS FROM ZERO WASTE	2.80	4.80

L. Zero Waste

Lead Agency: MDE

Program Description

Background

In Maryland, waste diversion is defined as the volume of waste that is diverted from entering the waste stream through recycling or source reduction activities. Source reduction activities are those that reduce or prevent the creation of waste. Maryland estimates the source reduction rate using a checklist for counties to document their source reduction activities, including backyard composting, reuse programs, and technical assistance. The counties' responses are tallied and correspond with a source reduction credit, up to a maximum of 5%, which is added to the recycling rate to produce the waste diversion rate.

Reducing the generation and disposal of waste has many benefits. It saves energy and natural resources, preserves the capacity of existing solid waste disposal facilities and reduces greenhouse gases and other pollutants generated by landfills and manufacturing processes.

MDE has developed a "Zero Waste" Action Plan—a comprehensive strategy comprised of short and longer term measures designed to nearly eliminate the need for waste disposal facilities by 2030 by reducing the generation of waste and increasing reuse and recycling. The long-term strategy aims to achieve an 85% reduction in the generation of solid waste by 2030.

In 2006, Maryland achieved a State-wide recycling rate of 41.26% and a State-wide waste diversion rate of 44.7%. In 2010, the recycling rate was 41.0% and the waste diversion rate was 44.6%. The Action Plan establishes the following future State-wide recycling and waste diversion rate goals (Figure 6.26).

Progress toward our waste diversion goals is achieved through recycling and source reduction activities. In that regard, Maryland's goal is to maintain per capita annual waste generation at its current level of 1.26 tons. In addition, expansion of existing recycling and product re-use programs are critical to achieving a related State goal—to reduce the amount of waste disposed 11% by 2015 and 29% by 2020 (from 2006 levels).

The Action Plan

The Action Plan is the State's roadmap to achieve these goals and includes specific initiatives designed to increase recycling of key wastes such as food scraps, beverage containers and other forms of packaging. The Action Plan expands on current single-family residential recycling programs to increase recycling at commercial, institutional, State government and multi-family residential properties. It emphasizes product stewardship and extended producer responsibility policies that place the life-cycle environmental and economic cost of products on the producers of those products. The Plan provides estimated timeframes for each action.

Figure 6.26 Future State-wide Recycling and Waste Diversion Rate Goals.

Year	2015	2020	2030
Waste Diversion Goal	54%	65%	85%
Recycling Goal	50%	60%	80%

Most of the initiatives identified in the Action Plan are projected to take effect by 2020. Many of the items in the Action Plan will require enabling legislation or new MDE regulations. The Action Plan has four phases—near term initiatives in the 2013/2014 time frame, and longer term initiatives in three later phases — the 2015/2016, 2017/2018 and 2019/2020 time frames.

Near-term 2013–2016 Initiatives

Facilitating Development of Food Scrap Composting

Developing food scrap composting facilities will be one of MDE's highest near-term priorities. Food scraps and yard trimmings comprise an estimated 27.28% of the waste stream.* In 2010, Maryland recycled 68.51% of yard trimmings but only 5.1% of food scraps. Capturing additional organics, especially food scraps, would provide a significant portion of the additional recycling needed to meet the State's Zero Waste goals. Figure 6.27 depicts scenarios under which the State could meet its 2020 Zero Waste 60% recycling goal with increased composting.

Figure 6.27 Scenarios for Meeting 2020 Zero Waste Goals with Composting.

	No Increase in Composting	Small Increase in Composting	Medium Increase in Composting	Large Increase in Composting
Recycling Rate, Food	5.1% (2010 rate)	50%	68.51%	90%
Recycling Rate, Yard Trim	68.5% (2010 rate)	90%	90%	90%
Recycling Rate Needed for All Other Waste	**67.1%**	**54.89%**	**51.44%**	**47.44%**

While there is significant interest in food scrap composting, there are a number of regulatory challenges that must be addressed in order to facilitate expansion of food scrap composting. A Composting Workgroup was formed in May 2012 in response to 2011 legislation.† The law required MDE, MES and MDA to assess barriers to expansion of composting in the State and to make recommendations to the General Assembly on measures needed to develop a robust composting industry in the State. The Department intends to move forward promptly with regulatory changes that are necessary to clarify the State's regulatory environment in order that the food composting industry can expand appropriately to meet demand.

In addition, the State should build on existing limited capacity by supporting new and expanded pilots and voluntary programs. Howard County is currently piloting residential collection of food scraps. As capacity becomes available to process additional food scraps, Maryland should consider ways to ensure that an increasing supply of compostable material is available and that markets in the State for compost are expanded. The longer term goal, discussed below, is to mandate universal segregated collection of food scraps and other organics for composting.

Reducing and Ultimately Eliminating Use of Plastic Carry-out Bags

Although plastic bags comprise only 0.3% (by weight) of the U.S. waste stream, they

* EPA, Municipal Solid Waste Generation, Recycling, and Disposal in the United States Tables and Figures for 2010 (2011), *http://www.epa.gov/osw/non-haz/municipal/pubs/2010_MSW_Tables_and_Figures_508.pdf* (last accessed January 2, 2013).

† 2011 Md. Laws ch. 36

represent a significant portion of the State's litter, and are easily blown into storm drains and waterways. Legislation is needed to require recovery and recycling, and ultimately (by at least 2020) a ban the use of plastic carry-out bags in Maryland.

Increasing Recycling of Beverage Containers

More than 60% (by weight) of the 4.7 billion aluminum, glass, and plastic beverage containers generated in Maryland each year are disposed or littered along the State's roadways, in its waterways or in its neighborhoods.* In 2010, 60.45% of the waste disposed in Maryland was landfilled and 39.55% was incinerated. The State proposes beverage container recycling goals of 80% by 2020 and 90% by 2030. Achieving these goals will require enactment of some version of a beverage container recycling law.

Implementing Residential Recycling at Multi-Family Dwellings

Recent legislation signed into law by Governor O'Malley expands residential recycling systems in the State by requiring recycling at apartment and condominium buildings with 10 or more units, effective October 1, 2014. The requirements apply to property owners and managers. This is an important expansion of the State's recycling program that will boost State-wide recycling rates. MDE has provided assistance and model language to counties for inclusion in county recycling plans to address requirements for multifamily residential recycling.

Strengthening State Agency Recycling and Waste Diversion Goals and Strategies to Lead by Example

State agency recycling targets will be increased and recycling strategies strengthened to include food scraps, composting, materials procurement, and product content requirements.

Waste-To-Energy as a Solid Waste Management Tool

In 2010, the most recent year for which data has been compiled, more than 1.5 million tons of solid waste was landfilled by municipal solid waste landfills in Maryland.

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* Beverage container generation is converted from tons (238,539.67 tons in 2010) to containers using an average of values yielded from two sets of conversion factors: The Container Recycling Institute, 2006 Beverage Market Data Analysis (2008); CalRecycle, 2013 Refund Value per Segregated Pound, Refund Value per Commingled Pound and Containers Per Segregated Pound Rates, *http://www.calrecycle.ca.gov/BevContainer/Notices/2012/2013ComRates.htm.*

JAY BAKER, OFFICE OF THE GOVERNOR, MARYLAND

Governor O'Malley looks on as students learn about the new solar powered trash compactors installed at a local Maryland school.

Anaerobic decomposition of municipal solid waste in landfills produces landfill gas in the form of methane and CO_2. Of the two gases—methane, which comprises approximately half of landfill gas—is significantly more potent. The global warming potential of methane over 100 years is at least 21 times greater than an equivalent amount of CO_2. In a shorter 20-year horizon the global warming potential of methane is 70 times greater than an equivalent amount of CO_2. Early reductions in emissions of greenhouse gases are vitally important to slow the rate at which global temperatures are rising.

Waste-to-energy facilities can reduce GHG emissions through generation of electricity that displaces higher carbon fossil fuel-fired generation, and through recovery of ferrous and non-ferrous metals not ordinarily captured by residential recycling programs. The recovered metals avoid the GHG emissions associated with the less energy efficient production of metals from raw materials.

Both US EPA and internationally adopted climate policy recognize the role of waste-to-energy as a greenhouse gas mitigation strategy. According to EPA, when compared to landfilling, WTE is often the better disposal option for generation of cleaner electricity. *(http://www.epa.gov/sciencematters/april2010/scinews_energy-from-waste.htm)*. Waste-to-energy incinerators produce virtually no methane and generally produce less greenhouse gas emissions than landfills equipped with flares or gas-to-energy systems that generate electricity from the combustion of methane. See, "Is it Better to Burn or Bury Waste for Clean Electricity Generation? *http://pubs.acs.org/doi/abs/10.1021/es802395e*. Many European countries have adopted solid waste management polices that shift reliance from landfills to recycling and recovery of energy from waste.

The State's long term goal is to minimize the need for waste disposal facilities through implementation of enhanced waste minimization, recycling, reuse, and composting initiatives. Unfortunately, however, because of projected population growth and other factors, we expect a continuing need for post-recycling disposal facilities for some years to come. Because of its carbon benefits, there is a role for WTE as a bridge technology in the State's greenhouse gas mitigation strategy.

Quantifying the Extent of Existing Commercial Recycling

Many Maryland businesses already divert recyclables from the waste stream to reduce waste disposal costs. Unlike residential recycling, however, business recycling does not generally take place through county or municipal programs and businesses are not currently required to report waste generation or recycling activities to the counties. As a consequence, counties lack accurate information on the extent of commercial waste generation and recycling. This lack of information is an impediment to quantifying and managing and increasing waste diversion by the State's commercial sector. Maryland businesses should be required to report on the amount of waste generated, recycled and diverted by their facilities and operations.

Encouraging Local Governments to Adopt "Pay-As-You-Throw" (PAYT) Fee Systems

PAYT provides individuals with incentives to change their behavior with respect to recycling and disposal. In most existing systems, trash pickup is funded by flat fees or taxes. In a PAYT system, an individual pays a variable rate for trash pickup that is based on the amount of trash the individual generates. Recycling is typically "free" to the individual, although its cost is actually internalized into the price for trash pickup. The PAYT rate can be imposed by volume (the number of waste containers) or by weight. Under either approach, consumers will seek to minimize the volume of waste they produce for disposal. In this way, PAYT encourages both source reduction and recycling.

Longer Term 2017–2020 Initiatives

Achieving Recycling and Diversion Rates of 60% and 65% by 2020

In 2015, mandatory recycling rates will increase to 35% for larger counties and to 20% for smaller counties. In order to achieve the required 2020 greenhouse gas emission reduction and the longer term 2050 reduction goal, State-wide rates for waste recycling and diversion should increase to 60% and 65%, respectively, by 2020, and further to 80% and 85% by 2030. In the years following 2015, counties should be subject to more stringent minimum mandatory recycling rates sufficient to achieve the necessary reductions. State agency recycling rates should increase as well. State agencies currently underperform when compared to local jurisdictions (33% recycling rate for State agencies compared to 41% for counties).

Expanding Product Stewardship and Extended Producer Responsibility (EPR) in Maryland

Maryland already has an EPR law in effect for mercury switches in automobiles. The mercury law, passed in 2009, requires vehicle manufacturers to submit a plan for the removal and recovery of mercury switches from "end-of-life" vehicles. Vehicle manufacturers fund the program and pay scrap vehicle processors for each switch returned to the manufacturer. EPR shifts responsibility for end-of-life management of products, including disposal, from consumers and taxpayers to producers, thereby encouraging waste minimization, recycling and reuse. EPR also creates a funding stream to enhance recycling programs for specific materials and can hold producers accountable for achieving specific recycling or recovery rates. Most of Europe and several Canadian provinces have implemented EPR programs and Maryland should expand EPR to additional products.

Considering Additional Product Disposal Bans

Bans on product disposal prohibit landfills and incinerators from accepting certain items for disposal and prohibit individuals from discarding those materials in the trash. Disposal bans are often used for items that are easily recyclable, constitute a large volume of the waste stream, or contain harmful constituents that are best kept from landfills. The prohibition can be imposed on a waste hauler, a landfill or incinerator and an individual or household. Maryland has already banned several products from disposal and should consider instituting bans on additional waste materials.

Considering Bans on Additional Products

Product bans may be appropriate for items or materials that are not readily recycled for technical or economic reasons. This approach is consistent with Zero Waste principles, which encourage recycling of items that can be recycled efficiently, redesign of items that are not easily recyclable, and the elimination of items that cannot be redesigned. Product bans prohibit the sale or distribution of the covered product within the jurisdiction. Maryland should consider product bans on a range of materials, including expanded polystyrene packing materials, containers and food packaging, and non-recyclable and non-compostable service-ware.

Adopting a Universal Recycling Requirement

Universal recycling laws require recycling services to be provided to all residences, businesses and institutional establishments, making recycling as easy as disposal for the generator. Most Marylanders already have the opportunity to recycle at home and recent legislation will increase this availability for people living in apartments and condominiums. Businesses, including restaurants, and institutions are not currently required to recycle and present important targets for waste recycling and diversion.

Adopt Universal Collection of Organic Materials for Composting

When the capacity to compost food scraps and other organic feed-stocks expands sufficiently, the State should adopt mandatory segregated collection of organics wherever trash is collected. Universal collection of organics would require any private hauler or local government offering waste collection to also offer separate collection of organics, including food, for composting.

Estimated GHG Emission Reductions in 2020

Consideration of Short Term CO_2e Potency

While this GGRA plan is focused on a relatively short term goal to achieve a 25 percent reduction in State-wide GHG emissions by 2020, the longer term 2050 goal envisioned by the law is a 90 percent reduction in GHG emissions. With the longer term goal in mind, Maryland has utilized an emission inventory approach that is consistent with the work of the IPCC, the EPA, and the majority of interest groups/ organizations that develop GHG emission inventories. Because there are seven significant greenhouse gases, each with a different global warming potential, the international community uses "CO_2e" or "carbon dioxide equivalent" over a 100-year lifecycle as a common metric. Over a 100-year life cycle, the global warming potential of methane, for example, is 21 times greater than carbon dioxide, i.e., one molecule of methane in the atmosphere is equivalent to 21 molecules of CO_2.

For each of the seven major greenhouse gases that are included in this inventory, Maryland used 100-year lifecycle CO_2 equivalents to calculate global warming potential. Research has shown, however, that the emissions impact of some GHGs, such as methane, should also be considered over a shorter timeframe. Methane, in particular, is as much as 70 times more potent than CO_2 over a 20-year horizon, according to international research. Calculation of emissions based on a 100-year lifecycle does not depict the significant near-term methane emissions from landfills that are due to the decomposition of food waste and other organic materials. That Maryland did not calculate the emissions inventory based on short term global warming potential, is in no way intended to diminish the importance of securing reductions of methane and other greenhouse gases in the near term to slow the rate at which global temperatures are rising.

Initial reductions

The potential emission reductions from existing recycling and waste diversion requirements in 2020 are estimated to be 2.80 $MMtCO_2e$ (Figure 6.28). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from achieving the 60 percent recycling and 65 percent waste diversion in MDE's Zero Waste Strategy targets in 2020 are estimated to be 4.80 million $MMtCO_2e$ (Figure 6.28).

Figure 6.28 Initial and enhanced GHG reductions by policy for Zero Waste programs, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
L	Zero Waste	MDE	2.80	4.80
		TOTAL REDUCTIONS	2.80	4.80

Other Environmental Benefits

Recycling of materials that would otherwise be disposed can result in significant energy savings. The EPA Waste Reduction Model* has produced the following comparative energy life-cycle analyses for common recyclable materials that demonstrates the energy benefits associated with recycling and source reduction (Figure 6.29).

Use of recycling or source reduction in lieu of landfilling as a solid waste management tool results in energy savings. Only combustion of certain recyclable materials results in an increase in energy consumption.

Figure 6.29 Energy benefits for common recyclable materials per Ton Energy Use (BTU).** Values vs. the landfilling of the material. Assigns BTU (million) – Landfilled a value of 0. A negative value (i.e., a value in parentheses) indicates a reduction in energy consumption, while a positive value indicates an increase in energy consumption compared to the landfilling of a material.

Material	BTU (million) Landfilled	BTU (million) Source Reduced	BTU (million) Recycled	BTU (million) Combusted
Aluminum Cans	0	(126.75)	(206.95)	0.12
PET Plastic Bottles	0	(71.28)	(53.36)	(10.57)
Newspaper	0	(36.87)	(16.91)	(8.59)
Glass	0	(7.46)	(2.66)	0.02

Other benefits associated with the recycling of materials include conservation of natural resources and preservation of landfill space. Consider the following:

- According to EPA, recycling 1 ton of paper saves an average of 7,000 gallons (26 liters) of water; 3.3 cubic yards (2.5 cubic meters) of landfill space; and enough energy to power an average American home for 6 months.†
- Recycling aluminum saves 4 pounds of bauxite ore for every pound of aluminum recycled.‡
- Each ton of crushed glass that is recycled in the manufacturing of new glass saves 1.2 tons of raw materials, 9 gallons of fuel oil and enough energy to light a 100-watt light bulb for 4 hours. Manufacturing glass from recycled glass also saves half the water used during manufacturing from raw materials.§
- According to EPA, one cubic yard in the average municipal solid waste landfill will hold 1,000 pounds (0.5 tons) of solid waste.¶ In 2010, the United States recycled or composted 85.1 million tons of municipal solid waste, thereby preserving 170.2 million cubic yards of landfill space.***

Job Creation and Economic Benefits

Studies have found the recycling industry to be a significant employer across many states. In 2007, five states in the Northeast United States (Delaware, Maine, New York, Massachusetts, and Pennsylvania) together employed almost 105,000 people as a direct

* EPA, Waste Reduction Model (WARM), *http://www.epa.gov/climatechange/waste/calculators/Warm_home.html* (last accessed January 2, 2013).
** BTU = 1 British Thermal Unit is a unit of power that is equal to the amount of energy needed to heat 1 pound of water 1° F. It is also used to describe the heat value (energy content) of fuels.

† EPA, Paper Recycling: Basic Information Details, *http://www.epa.gov/osw/conserve/materials/paper/basics/index.htm#benefits* (last accessed January 2, 2013).

‡ University of Massachusetts Amherst, Office of Waste Management, *http://www.umass.edu/recycle/recycling_benefits.shtml* (last accessed January 2, 2013).

§ Ohio Department of Natural Resources, Recycling in Ohio: Glass Recycling, *http://ohiodnr.com/tabid/17878/Default.aspx* (last accessed January 2, 2013).

¶ EPA, Measuring Recycling, A Guide for State and Local Governments (1997), *http://www.epa.gov/wastes/conserve/tools/recmeas/docs/guide.pdf* (last accessed January 2, 2013).

*** EPA, Municipal Solid Waste Generation, Recycling, and Disposal: Facts and Figures for 2010, (2010), *http://www.epa.gov/osw/nonhaz/municipal/pubs/msw_2010_rev_factsheet.pdf* (last accessed January 2, 2013).

result of recycling. This represents an annual payroll of over $4.2 billion. Pennsylvania alone employed over 52,000 with $2.2 billion in recycling-related payroll. Additional positive indirect and induced jobs impacts were seen across 26 different sectors in these States.* An Iowa report found that in 2005, 15,684 jobs were directly related to the recycling industry in the State, for a labor income of over $800 million. When the study accounted for indirect and induced jobs, recycling-related employment more than doubled to 34,162 jobs.†

A 2006 South Carolina Study using the IMPLAN model found 15,600 direct recycling-related jobs and 37,400 total jobs (including indirect and induced jobs) in the State, with an average jobs multiplier of 2.4 across sectors. In other words, each job directly related to recycling in South Carolina was found to yield an additional 1.4 jobs in the State.‡

According to a 2001 nationwide study, the recycling and reuse industry consists of approximately 56,000 establishments that directly employ over 1.1 million people, generate an annual payroll of nearly $37 billion, and gross more than $236 billion in annual revenues.§ Local recycling and reuse activities also result in indirect "downstream" economic benefits. Recycling creates jobs in accounting firms, office supply companies and other support industries. The recycling and reuse industry supports 1.4 million jobs in these support industries on a payroll of $52 billion and generates $173 billion in receipts.¶ Spending by employees of the recycling and reuse industry also results in indirect economic benefits by supporting an additional 1.5 million jobs with an annual payroll and revenue of $41 billion and $146 billion, respectively.**

The Zero Waste program is expected to create and retain jobs. RESI's 2012 study estimated that the Recycling & Source Reduction program, once fully operational, would support a total of about 4 jobs and generate -$10,009,769 in net economic benefit and -$1,825,506 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

- Jurisdictions with populations greater than 150,000 are required to recycle 35 percent or more of their waste and jurisdictions with populations less than 150,000 are required to recycle 20 percent or more of their waste beginning December 2015. In no case is the recycling rate to be less than 15 percent for the larger counties and 10% for smaller counties.
- State Government must reduce by recycling the amount of the solid waste stream generated for disposal by at least 30 percent or an amount that is determined practical and economically feasible, but in no case may the amount to be recycled be less than 15 percent. This requirement begins in July 2014.
- A State Agency Recycling Plan was developed and implemented as a result of 2009 legislation that requires recycling of glass, paper, metal, and plastic at State-owned or State-operated buildings.†† Agencies are now revising their plans to meet the higher goal (30%) established in 2012 legislation.‡‡ MDE has encouraged all agencies to strive to attain a recycling rate of 40% by 2015.
- Scrap tires are banned from disposal in a landfill.

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* Northeast Recycling Council, Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania p.34 (2009), available at *http://www.nerc.org/documents/recycling_economic_information_study_update_2009.pdf* (last accessed January 2, 2013)

† Id.

‡ Hefner, Frank and Calvin Blackwell, "The Economic Impact of the Recycling Industry in South Carolina," (2006), available at *http://www.epa.gov/osw/conserve/tools/localgov/docs/economic-impact-of-recycling-sc.pdf* (last accessed January 2, 2013).

§ National Recycling Coalition, U.S. Recycling Economic Information Study (Prepared by R.W. Beck) (2001), available at *http://www.epa.gov/wastes/conserve/tools/rmdl/rei-rw/pdf/n_report.pdf* (last accessed January 2, 2013).

¶ Id. at ES-9.

** Id.

†† 2009 Md. Laws ch. 408.

‡‡ 2012 Md. Laws ch. 692.

- Counties must address the feasibility of composting mixed solid waste when developing their 10-year solid waste management plans.
- Separately collected yard waste is banned from disposal at solid waste acceptance facilities.
- Mercuric oxide battery manufacturers are responsible for the collection, transportation, and recycling or disposal of these batteries sold or offered for promotional purposes in the State.
- State law requires a program or system for the collection, recycling, or disposal of each cell, rechargeable battery or rechargeable product sold in the State.
- Electronics manufacturers who sell or offer for sale their product in Maryland must register and pay a fee to MDE. Fees may be used to provide grants to counties and municipalities for computer and video display device recycling activities.
- Electronics manufacturers are encouraged to implement takeback programs for reuse and recycling of electronic products.
- Motor vehicle manufacturers are required to develop and submit to MDE a mercury minimization plan that includes information on mercury switch removal from motor vehicles.
- A county is required to submit a revised recycling plan to MDE. A county's recycling plan is required to address the collection, processing, marketing, and disposition of recyclable materials from county public schools. By October 1, 2013, counties must address multi-family residential recycling in their county recycling plans. By October 1, 2014, apartments and condominiums with 10 or more units must provide recycling opportunities for residents.
- Pursuant to 2011 legislation, MDE was required to study composting in the State and make recommendations to the General Assembly by January 2013 on ways to promote composting. These recommendations were to include any necessary legislative, regulatory, or programmatic changes. MDE convened a stakeholder workgroup to develop these recommendations, which include proposed statutory changes to provide MDE with authority to regulate composting of source-separated organics (food scraps, yard trim, etc.) separately from the solid waste requirements.*

* 2011 Md. Laws ch. 363.

Innovative Initiatives

estimated reduction of

2.00

million metric tons of CO_2e annually

Maryland's innovative initiatives will reduce carbon emissions by 2.0 $MMtCO_2e$.

In addition to the different sectors that contribute directly to Maryland's GHG emissions, it is possible to lay the foundation for previously unavailable GHG reduction opportunities in the future. These opportunities may originate through the expansion of existing programs or through the creation of new ones. Regardless of their source, innovative thinking today is required to lay the path to achieving future reductions. This can be accomplished through State and federal leadership, public education and training, and the continued examination of existing programs.

Three of the GHG reduction policies, which are described in detail throughout this section, are designed to reduce emissions through innovative initiatives in Maryland. Full implementation of the three initiative policies results in GHG reductions of potentially 1.68 $MMtCO_2e$ and 2.00 $MMtCO_2e$ with all enhanced program options implemented (Figure 6.30).

Figure 6.30 Initial and enhanced GHG reductions by policy for the Innovative Initiatives sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
M	Leadership-by-Example	1.45	1.77
N	Maryland's Innovative Initiatives	0.21	0.21
O	Future or Developing Programs	0.02	0.02
TOTAL REDUCTIONS FROM INNOVATIVE INITIATIVES		1.68	2.00

M. Leadership-by-Example

M.1 Leadership-by-Example: State of Maryland Initiatives

Lead Agency: DGS

Program Description

Through lead-by-example programs, state government in Maryland aims to improve energy efficiency, reduce waste, and integrate renewable energy practices in all of it's agencies' operations and facilities, as well as their purchasing practices. DGS currently manages the following lead-by-example programs:

- Maryland Green Building Council
- Maryland Green Purchasing Committee
- State Energy Database
- Renewable Energy Portfolio

The first two, The Maryland Green Building Council, and Maryland Green Purchasing Committee are addressed in this Section. Collectively, the programs significantly advance the policy recommendations of the Maryland Commission on Climate Change for the State and local governments to lead-by-example by reducing their carbon footprints in the construction and operation of their buildings and facilities and in their purchasing practices.

Implementation

The State's lead-by-example programs in high performance buildings and procurement are statutorily driven. DGS shares responsibility with the Board of Public Works, MDE, the Department of Budget and Management, Maryland Green Building Council, and Maryland Green Purchasing Committee for administering them. Programmatic progress is tracked in annual reports which both the Maryland Green Building Council and the Maryland Green Purchasing Committee are required to submit to the General Assembly.

Supporting Laws and Regulations

- Executive Order 01.01.2001.02, "Sustaining Maryland's Future with Clean Power, Green Buildings, and Energy Efficiency."
- State Buildings Energy Efficiency and Conservation Act of 2006 (Senate Bill 267).
- Maryland Green Building Council (Senate Bill 332/House Bill 94).
- EmPOWER Maryland Executive Directive.
- High Performance Buildings Act of 2008 (Senate Bill 208), summarized above.
- High Performance Buildings Act - Applicable to Community College Capital Projects (Senate Bill 234/House Bill 1044), summarized above.
- Green Maryland Act of 2010 (Senate Bill 693/House Bill 1164), summarized above.

Existing Programs – High Performance "Green" Buildings

1. Design/Construction

Two laws are driving the design and construction of high performance State buildings and schools. The first, the High Performance Buildings Act of 2008, requires all new and significantly renovated State buildings over 7,500 square feet, and all new public schools

that receive State construction funds, to meet the LEED Silver building standard. The second, High Performance Buildings Act - Applicable to Community College Capital Projects, requires community college capital projects that receive State funds to meet or exceed the LEED Silver standard required under the High Performance Buildings Act. The Maryland Green Building Council makes recommendations about the State's High Performance Building Program, which requires all new or substantially renovated State owned or funded buildings 7,500 gross square feet or larger to achieve USGBC LEED Silver certification.

State capital projects completed or in the pipeline include the following:

- 2008 and 2009 – Two pilot projects were completed and certified LEED Silver.
- Fiscal Year 2009 – Nine projects were funded for design; they are located in five counties and Baltimore City. Several are under construction and one, Pharmacy Hall at the University of Maryland Baltimore Campus (renovations and additions), was completed with LEED certification pending at the time of the 2010 Annual Report.
- Fiscal Year 2010 - 17 projects were funded for design or design/construction, in nine counties and Baltimore City. Most are in the design phase; several are under construction.
- Fiscal Year 2011 – Three local county projects were funded for design.
- Fiscal Year 2012 – At the time of the Maryland Green Building Council 2012 Annual Report, twenty-two (22) public school projects with LEED certification have been completed, twenty (20) are under construction, and twenty-four (24) are in the design/planning phase. All sixty-six (66) projects are LEED Silver or Gold certified or the LEED certification Silver or Gold status is pending (Figure 6.30).

In addition, the State will, through Fiscal Year 2014, contribute 50 percent of the extra costs incurred by public schools meeting a LEED Silver rating or comparable standard required under the High Performance Buildings Act of 2008, up to 1% of the eligible building and site costs.

2. Operation

DGS administers energy performance contracts to reduce electricity consumption in a number of State agency buildings. As of March 2011, 27 projects were under development with energy service companies. Project costs are to be paid from cost avoidance from guaranteed annual energy savings, which are significant. DGS oversees the measurement and verification of actual savings throughout the payback period to ensure that the guaranteed savings are met. This initiative is financed in part by the State Agency

Figure 6.31 GHG reductions from LEED certified public school projects (two scenarios: Silver and Gold Certification of 66 total projects).

				Metric Tons GHG Reductions		Estimated benefits Metric Tons		Low estimate $MMtCO_2e$
Fiscal Year	Projects	Certification	Points	2015	2020	2015	2020	2020
2012	66	Silver	33	2,000	3,200	132,000	211,200	0.21
							TOTAL	**0.21**

				Metric Tons GHG Reductions		Estimated benefits Metric Tons		High estimate $MMtCO_2e$
Fiscal Year	Projects	Certification	Points	2015	2020	2015	2020	2020
2012	66	Gold	39	2,600	4,000	171,600	264,000	0.26
							TOTAL	**0.26**

Loan Program, a revolving loan program through which MEA provides zero-interest loans to State agencies for energy efficiency improvements.

In the Maryland Consolidated Capital Bond Loan of 2012, the Public School Construction Program was approved for a total of $326.393 million in new bond authorization, with $25 million of this amount dedicated to an Energy Efficiency Initiative for projects that improve the energy efficiency of schools, including improvements to HVAC systems, lighting, and any other type of improvement that is specifically designed to improve the energy efficiency of a school building, per standards approved in July 2012 by the Interagency Committee (IAC) in collaboration with the Maryland Energy Administration. To date, 199 Energy Efficiency Initiative projects have been approved by the Board of Public Works and another 21 have been recommended for approval by the IAC. MEA projects that these improvements will generate an annual GHG savings of 13,000 tons and will save the school systems approximately $40 million in energy costs over the life of the measures.

Maryland Environmental Footprint (eFootprint) Initiative

The Maryland Environmental Footprint program was launched by Governor O'Malley in 2009 to calculate, reduce, track and report the environmental footprint of State agencies and universities in five areas: 1) electricity and building energy; 2) water use; 3) vehicle fuel; 4) waste/recycling; and 5) aggregate GHG emissions. The program is part of the Governor's Smart, Green and Growing initiative to "…strengthen the State's leadership role in fostering smarter, more sustainable growth and to inspire action among all Marylanders to achieve a more sustainable future."

Existing Program

In consultation with the Governor's Delivery Unit, three agencies—the Maryland Environmental Services, DGS and DNR—co-led the development of the Maryland Environmental Footprint program through a series of meetings with State agencies and the University System of Maryland in 2009. Energy, fuel, and waste data were collected from State agencies. From this, energy expenditure calculations were made and a baseline and reduction goals for State government were established. The State Government Environmental Footprint Reduction Goals policy statement was issued June 10, 2009. It established goals in four overarching areas: 1) electricity and building energy; 2) fleet vehicle fuel; 3) waste reduction, reuse, recycling; and 4) water use. The interagency group collected and reviewed existing executive orders, directives and laws in order to harmonize and assimilate previously established goals—in some cases conflicting or overlapping—into the Footprint goals.

The annual progress of each agency and university, and the State government as a whole, is tracked on the Maryland Environmental Footprint page of Maryland's Smart, Green and Growing website. Since the development of this program the State Energy Database has been enhanced to provide GHG accounting for energy and water use in State Facilities. In order to enhance government efficiency and reduce redundancy, the Smart Green and Growing website

now directs users to the information found in the State Energy Database, along with information for MDE's recycling efforts and the Green Registry Program.

Supporting Laws and Regulations

- Executive Order 01.01.2001.02, "Sustaining Maryland's Future with Clean Power, Green Buildings, and Energy Efficiency"
- Executive Order 01.01.2001.06 (set goals for reducing water consumption by State agencies by 10 percent from 2000 to 2010)
- State Buildings Energy Efficiency and Conservation Act of 2006: Senate Bill 267, Chapter Number 427
- EmPOWER Maryland – 2007 Executive initiative

Ongoing Implementation

DGS is working with DNR and the Maryland Environmental Services to adopt and implement as Maryland Environmental Footprint reduction goals:

- A schedule for the State government's purchase of electricity from renewable sources that exceeds the State's RPS interim and final (2022) targets; and
- A strategy to encourage State purchasing agents to consider the end-of-life disposal stage of equipment and goods when making purchasing decisions.

eFootprint Enhancements include:

- Training of State agency staff and university students.
- Identifying additional targets for Footprint reductions.
- Considering adding additional Footprint parameters, including stormwater management, nitrogen sources, forest canopy cover, reduction of impervious surfaces and others.

Estimated GHG Emissions Reductions in 2020

This program references a specific Governor's Initiative and the quantification of potential GHG reductions is aggregated in the quantification of the State's Lead-by-Example Initiatives (Figure 6.32).

Existing Programs – "Greener" Procurement

State government has massive purchasing power to select efficient goods from companies that practice energy reduction and sequestration of carbon dioxide as a powerful market stimulant for green businesses and jobs. The Maryland Green Purchasing Committee provides assistance to State units in developing strategies and best practices for implementing environmentally preferable purchasing practices, maintains a Best Practices Purchasing Manual, and maintains Purchasing Guidelines. The General Assembly established a legislative framework under the Green Maryland Act of 2010 for environmentally preferable purchasing throughout State government. The law establishes the Maryland Green Purchasing Committee and annual reporting requirements for State agencies and directs DGS and MDE to develop implementing strategies, best practices and specifications. It boosts the State's required purchase of recycled paper from 40 percent to 90 percent of total volume purchase and increases the price preference for recycled products from five percent to eight percent. It also establishes preferential purchasing and goal setting to increase the use of compost as fertilizer in public lands and programs.

Initial reductions

The potential emissions reductions from the Leadership-by-Example: State of Maryland Initiatives program in 2020 are estimated to be 0.56 $MMtCO_2e$ (Figure 6.32). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Leadership-by-Example: State of Maryland Initiatives program enhancements in 2020 are estimated to be 0.88 $MMtCO_2e$ (Figure 6.32).

Enhancements: Green Building and Procurement Programs Under Consideration

DGS will work with the Governor and General Assembly to amend the State's high performance buildings standards to:

- DGS will benchmark State buildings to compare efficiency among similar buildings to set priorities for improvement.
- DGS will work with State agencies to provide meters, energy accounting systems, and trained staff to measure and verify energy consumption and account for improvements and implementation of energy efficiency programs.
- DGS will develop and administer education and outreach programs to local governments, businesses, and institutions to promote widespread adoption of the State's lead-by-example practices in buildings, operations and purchasing.
- DGS will develop strategies to encourage State and local government agencies, businesses and industry, and citizens to consider at the purchase stage, the end-of-life disposal stage of equipment and goods.

Other Environmental Benefits

Increasing energy efficiency in Maryland State government's facilities operations and purchasing practices reduces the need for power generation from fossil fuel sources. In addition to reducing GHG emissions, this will create reductions in nitrogen dioxide, sulfur dioxide and mercury.

- Nitrogen dioxide emission reductions will help Maryland meet air quality standards for ground level ozone and fine particulate matter. The reductions will also significantly help Maryland reduce nitrogen pollution in the Chesapeake Bay.
- Sulfur dioxide emission reductions will help Maryland further reduce fine particulates and also help achieve the visibility improvements required to comply with federal regional haze requirements.
- Mercury, a toxic pollutant, is primarily released by air pollution sources but ultimately affects water quality and bioaccumulates in fish tissue. Mercury reductions will help improve water quality in Maryland.

Job Creation and Economic Benefits

The Leadership-by-Example: State of Maryland Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the

Figure 6.32 Initial and enhanced GHG reductions by policy for Leadership-by-Example, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
INNOVATION	**M**	**Leadership-by-Example**	-	**1.45**	**1.77**
	M.1	Leadership-by-Example: State of Maryland Initiatives	DGS	0.56	0.88
	M.2	Leadership-by-Example: Maryland Colleges and Universities	MDE	0.37	0.37
	M.3	Leadership-by-Example: Federal Government	MDE	0.27	0.27
	M.4	Leadership-by-Example: Local Government	MDE	0.25	0.25
			TOTAL REDUCTIONS	**1.45**	**1.77**

Leadership-by-Example: State of Maryland Initiatives program, once fully operational, would support a total of about 1,063 jobs and generate $907,166,738 in net economic benefit and $43,827,113 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

M.2 Leadership-by-Example: Maryland Colleges and Universities

Lead Agency: MDE

Governor O'Malley cuts the ribbon on Chesapeake College's wind turbine in November, 2011.

Photo © Richard Lippenholz, Office of the Governor, Maryland.

Program Description

In Maryland, the presidents' of 23 colleges and universities—including all USM schools, Morgan, SMCM, 4 community colleges and 4 independent institutions— have signed the American College and University Presidents Climate Commitment, which requires each school to complete a GHG inventory, develop a climate action plan and implement strategies to reduce GHG emissions to achieve a set target. Schools are encouraged to commit to become climate neutral by a certain date, meaning GHG emissions sourced from the school be reduced or mitigated from a base year, with remaining emissions offset by purchasing carbon credits or other means.

All of the Maryland institutions have committed to other tangible actions in addition to the general requirements of the American College and University Presidents Climate Commitment, including:

- Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
- Adopt a policy requiring purchase of Energy Star certified products in all areas for which such ratings exist.
- Establish a policy offsetting all GHG emissions generated by air travel paid for by the institution.
- Encourage use of and provide access to public transportation for all faculty, staff, students and visitors to the institution.
- Within one year of signing this document, begin purchasing or producing at least 15 percent of the institution's electricity consumption from renewable sources.
- Establish a policy or a committee that supports climate and sustainability shareholder proposals at companies where endowment is invested.
- Participate in the Waste Minimizations component of the national RecycleMania competitions, and adopt three or more associated measures to reduce waste.

Of the 23 Maryland institutions, 22 have completed a GHG inventory and 20 have completed a climate action plan thus far. The targets vary by institution, with some target dates as soon as 2012. For more ambitious reductions, the target dates are extended to 2030 and beyond.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Leadership-by-Example: Maryland Colleges and Universities program in 2020 are estimated to be 0.37 $MMtCO_2e$ (Figure 6.32). Appendix C provides a more detailed description of the process used to quantify GHG reductions

Job Creation and Economic Benefits

The Leadership-by-Example: Maryland University Lead by Example Initiatives program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Leadership-by-Example: Maryland University Lead by Example Initiatives program, once fully operational, would support a total of about 182 jobs and generate $50,729,651 in net economic benefit and $5,104,758 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

M.3 Leadership-by-Example: Federal Government

Lead Agency: MDE

Program Description

Federal agencies with facilities located in Maryland are implementing suites of lead-by-example programs to improve efficiency, reduce waste, and integrate renewable energy and sustainable practices into their operations, facilities and fleets. These programs include tools to benchmark and track energy use and GHG emissions in order to report progress. Examples of programs include energy reduction in public buildings, facilities and lands, improved efficiencies in fleet vehicles and fuels, water conservation, waste reduction and recycling, purchasing of products and services with lower life-cycle impacts, and greater use of renewable energy.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Leadership-by-Example: Federal Government program in 2020 are estimated to be 0.27 $MMtCO_2e$ (Figure 6.32). Appendix C provides a more detailed description of the process used to quantify GHG reductions

Job Creation and Economic Benefits

The Leadership-by-Example: Federal Government program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Leadership-by-Example: Federal Government program, once fully operational, would support a total of about 1,347 jobs and generate $138,921,359 in net economic benefit and $11,039,040 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

In 2009 President Obama signed an executive order, "Federal Leadership in Environmental, Energy, and Economic Performance," which calls on the federal government to reduce its GHG emissions from direct sources to 28 percent below 2008 levels by 2020 and implement aggressive energy and water efficiency programs (Executive Order 13514, issued October 8, 2009). Federal agencies are specifically directed to set

agency-wide reduction targets for Scopes 1, 2 and 3 GHG emissions and to develop and implement Strategic Sustainability Performance Plans designed to meet the targets. In July 2010 the President expanded the federal government-wide target to require a 13 percent reduction by 2020 for GHG emissions from indirect sources, such as employee travel and commuting.

Data available for FY09 shows that the federal government nationally decreased energy consumption per square foot of building space by approximately 13.1 percent compared with FY03, surpassing the FY09 goal of 12 percent. The federal government also purchased or produced 2,331 gigawatt-hours of electricity from renewable sources—approximately 4.2 percent of its electricity use—surpassing the goal of 3 percent for FY09. EPA continues to provide assistance in determining the amount of federal reductions which have occurred in Maryland.

M.4 Leadership-by-Example: Local Government

Lead Agency: MDE

Program Description

Maryland county and municipal governments, together with State agencies, are adopting policies and practices to obtain high performance and energy-efficient buildings, facilities and vehicle fleets, and reduce the carbon footprint in purchasing, procurement and other government operations. Some jurisdictions have conducted GHG inventories, adopted climate action plans and targets, and implemented tracking protocol, such as those provided by the International Council for Local Environmental Initiatives. Where local government protocols for tracking quantifiable reductions exist, MDE conducted a survey to track actual and projected success in GHG emissions reductions. Results from a statewide survey conducted by MDE provide a 2010 snapshot of local government GHG reduction programs.

In 2010, MDE launched a comprehensive survey to gain a statewide view of local government's actions that will contribute to Maryland's sustainability and GHG reduction goals. Data collection will be finalized and survey results will be shared toward the end of 2011. Survey results to date show many local governments have GHG emissions reduction efforts underway. Some are identifying significant GHG reductions; others are in planning stages of conducting GHG inventories, adopting reduction targets, developing and implementing climate action plans, and tracking progress.

MDE and DNR continue to collaborate to provide forums for local governments and universities in the State to network and share best practices for implementing climate programs. MDE's survey results will inform this process and will also build on DNR's online Sustainability Network, where citizens, businesses and organizations can share sustainability and GHG projects and connect with others across the State interested in starting sustainability plans, energy reduction programs, rain gardens, and other green projects.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Leadership-by-Example: Local Government program in 2020 are estimated to be 0.25 $MMtCO_2e$ (Figure 6.32). Appendix C provides a more detailed description of the process used to quantify GHG reductions

Job Creation and Economic Benefits

The Leadership-by-Example: Local Government program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Leadership-by-Example: Local Government program, once fully operational, would support a total of about 1,982 jobs and generate $186,047,686 in net economic benefit and $17,001,065 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program combines both voluntary and mandatory initiatives. There are a wide range of implementation tools being used at the local level including ordinances, resolutions, and voluntary sustainability plans.

Six counties and three cities have prepared climate plans using the methods developed by the International Council for Local Environmental Initiatives. Part of these plans identifies emissions that result from government operations. Using base line data in the plans, the benefits are calculated for a 25 percent reduction from the base year and 50 percent reduction from the base year (Figure 6.33).

Figure 6.33 Summary of County Data with a 25 Percent GHG Reduction.

County	Base Year	Base Year Emissions		25% Reduction from Base	Low Estimate	50% Reduction from Base	High Estimate
		Metric tons of CO_2-equivalent	$MMtCO_2e$				
Baltimore City	2007	608,988	0.61	0.46	0.15	0.30	0.30
Frederick	2007	134,667	0.13	0.10	0.03	0.07	0.07
Montgomery	FY2005		0.45	0.34	0.11	0.23	0.23
Howard	2007	340,042	0.34	0.26	0.09	0.17	0.17
Prince Georges	FY2007	95,877	0.10	0.07	0.02	0.05	0.05
Baltimore County	2006	142,701	0.14	0.11	0.04	0.07	0.07
Annapolis	FY2006	11,991	0.01	0.01	0.00	0.01	0.01
Chevy Chase	2007	162	0.00	0.00	0.00	0.00	0.00
Takoma Park	1990	1,901	0.00	0.00	0.00	0.00	0.00
					0.45		**0.89**

N. Maryland's Innovative Initiatives

N.1 Voluntary Stationary Source Reductions

Lead Agency: MDE

Program Description

GGRA provides two paths for sources in the State's manufacturing sector to follow to potentially get credit for any voluntary programs that they are implementing. Either companies may simply take totally voluntary action and provide a good faith estimate of potential reductions, which if appropriate, included in the plan as a reduction, or a company can implement an early voluntary GHG emissions reduction plan, which must be approved by MDE before January 1, 2012 and secure a formal "credit."

Since a future GHG program could be one required by either State or federal law, it is important for a Maryland voluntary early reductions program to comply with federal, regional and State programs currently in existence. This creates an incentive for companies to implement GHG reduction measures before the advent of a mandatory program. Offering a program resulting in credits for early voluntary reductions is consistent with proposed federal GHG legislation. Although implementation of an early reduction program in Maryland is still under development, participation in such a program would be voluntary.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Voluntary Stationary Source Reductions program in 2020 are estimated to be 0.17 $MMtCO_2e$ (Figure 6.34). Appendix C provides a more detailed description of the process used to quantify GHG reductions

Job Creation and Economic Benefits

The Voluntary Stationary Source Reductions program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Voluntary Stationary Source Reductions program, once fully operational, would support a total of about 4 jobs and generate $4,961,957 in net economic benefit and $162,298 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Figure 6.34 Initial and enhanced GHG reductions by policy for Maryland's Innovative Initiatives, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
INNOVATION	**N**	**Maryland's Innovative Initiatives**	-	**0.21**	**0.21**
	N.1	Voluntary Stationary Source Reductions	MDE	0.17	0.17
	N.2	Buy Local for GHG Benefits	MDA	0.02	0.02
	N.3	Pay-As-You-Drive® Insurance in Maryland	MIA	0.02	0.02
	N.4	Job Creation and Economic Development Initiatives Related to Climate Change	DBED	Included in N	Included in N
			TOTAL REDUCTIONS	**0.21**	**0.21**

Implementation

This is a voluntary program.

MDE is working with sources in the manufacturing sector to make sure that early, voluntary programs to conserve energy or in other ways reduce GHG emissions have the potential to become a credit if and when some form of a national GHG reduction program is finalized.

A survey is being completed that will provide more detail on the voluntary reduction efforts. This information will be available in later versions of the 2012 GGRA Plan.

N.2 Buy Local for GHG Benefits

Lead Agency: MDA

Program Description

MDA's "Buy Local" campaign remains successful in promoting local farms as preferred sources of food to Marylanders by helping agricultural producers market their products directly to supermarket, food service, institutional, and other wholesale buyers, as well as consumers. Increasing the sale and consumption of locally grown products increases the sequestration of carbon dioxide on Maryland's agricultural lands. The enhanced productivity resulting from increased agricultural production yields increased rates of carbon sequestration in agricultural biomass, increased amounts of carbon stored in harvested crops, and increased availability of renewable biomass for energy production.

Maryland's "Buy Local" campaign promotes local farms as preferred sources of food to Marylanders.

In the past two years the growth of the public's interest in the source of their food coupled with MDA programs has sparked unprecedented consumer preference for locally-grown and locally-made agricultural products. Agriculture provides a traceable and healthy supply of local foods. Buying locally-grown products strengthens local economies and the health of the environment, keeps land open and productive and improves quality of life. Farmers' markets provide an important source of income for farmers as more consumers seek the freshness, quality, and wide selection of locally-grown produce. By talking one-on-one with farmers, consumers develop a bond of trust in the integrity and accountability of Maryland's growers.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Buy Local for GHG Benefits program in 2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.34). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Buy Local for GHG Benefits program is expected to create and retain jobs and increase the State GDP. RESI's 2012 study estimated that the Buy Local for GHG Benefits program, once fully operational, would support a total of about 36 jobs and generate $87,290,957 million in net economic benefit and $2,985,174 in wages on average annually.

Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This is a voluntary initiative.

MDA received legislative authority under House Bill 421, "Advertising or Identifying Agricultural Products as Locally Grown" in the 2010 Session to regulate the use of the terms "locally grown" and "local" when advertising or identifying agricultural products. In cooperation with the University of Maryland and Maryland farmers' market managers, MDA was awarded a federal matching grant to assess the economic impact of farmers' markets, identify ways to expand customer base and increase sales, and explore the formation of a statewide market association. U.S. Department of Agriculture funding was received to promote the use of locally-produced, sustainable protein foods in the healthcare facilities and institutions.

By 2020, MDA aims to raise the number of farmers' markets by 20 percent, establish a State farmers' market association, and increase direct sales (buy/grower) by 20 percent. The web site Maryland's Best has been created as an online tool to find local products from Maryland farmers.

N.3 Pay-As-You-Drive® Insurance in Maryland

Lead Agency: MIA

Program Description

Pay-As-You-Drive® automobile insurance is also known as use-based insurance. Generally, use-based insurance plans are designed to align the amount of premium paid with actual vehicle usage. The distance an automobile is driven, the speed at which it is driven, and the time of day it is driven all are factors that can be used to determine premiums under a use-based plan.

Under traditional automobile insurance plans, insurance companies rely on the consumer to provide information at the time the policy is written about the number of miles the consumer expects to drive during the policy period. In contrast, under use-based plans, the consumer generally uses a telematics device to provide information about actual mileage and other driving behaviors to the insurance carrier. The carrier can use that information to adjust the price of coverage based on the degree of risk posed by the insured's actual driving behaviors.

In the fall of 2008, Progressive Insurance Group started offering its "MyRate" use-based program in Maryland. Consumers who elect to participate in this program receive a wireless device that plugs into their car. This device measures "how, how much and when the car is being driven" (Progressive News Release, September 15, 2008). "Cars driven less often, in less risky ways and at less risky times of day can receive a lower premium (Progressive News Release, September 15, 2008). Customers signing up for the program could receive up to a 10% discount and at renewal could earn up to a 25% discount. There is a thirty dollar technology expense for the cost of the wireless device and transmission of the data. This is imposed each policy period.

As of 2008, the GMAC Insurance Group also offered a Pay-As-You-Go insurance program to OnStar subscribers in Maryland. It works as a discount program: the fewer miles driven, the higher the discount earned. Customers driving less than 2500 miles annually may be eligible for up to a 50% discount. All information is transmitted through the OnStar Vehicle Diagnostic reports, so it is necessary to have an OnStar equipped vehicle with an active OnStar subscription.

As of August 2011, the Progressive and GMAC Insurance Groups were the only insurers offering a use-based insurance program for private passenger automobiles in Maryland. Some carriers are offering programs or pilot programs similar to Pay-As-You-Drive® in other states.

MIA led a workgroup with MDE, MDOT, the insurance industry, consumer advocacy groups and other stakeholders to review the opportunities and barriers to expanding the Pay-As-You-Drive® program to other companies. An analysis of Pay-As-You-Drive® insurance was conducted by the group and a Review of Pay-As-You-Drive® Programs in Maryland was issued in September 2009. The Review of Pay-As-You-Drive® Programs in Maryland concluded:

> *"Even though it is unclear to what extent the Pay-As-You-Drive® Program will reduce GHG production, it is beneficial to encourage the expansion of these programs in the state in that they offer more options to consumers. Based on this, it is recommended that meetings be held with insurance carriers to discuss whether they would consider offering Pay-As-You-Drive® programs in the state."*

In keeping with that recommendation, MIA conducted a survey of the major carriers writing private passenger automobile insurance in the State to determine whether they offer or intend to offer use-based insurance in Maryland in the future. These carriers wrote policies for approximately 74 percent of the premiums in calendar year 2009.

Survey results were published on September 22, 2010 an MIA report entitled 2010 Carrier Survey Results for Pay-As-You-Drive®. While a number of the carriers where considering use-based programs in Maryland, survey participants indicated that did not intend to offer such programs any sooner than 2012. Carriers who were not considering offering use-based programs in Maryland cited the cost of developing the product and the regulatory environment as the reason. MIA continues to work with carriers interested in offering such products in Maryland on a long-term or pilot basis.

Program Enhancement

Within the current policy design (fully voluntary adoption of PAYD by industry and drivers), there is a basis for a larger estimate of GHG reduction. There is potential for a small additional congestion-relief effect we are not sure is fully accounted for in the existing analysis. The current analysis projects that 10% of the population will adopt PAYD as an option. That 10% of the driving population will adjust its VMT downward by 5% in response to the savings incentive that PAYD offers. Our review indicates that the 5% number is consistent with other estimates and research. However, existing research (primarily a study done by Texas A&M University, in partnership with Progressive County Mutual Insurance) also projects that drivers will reduce mileage by 3.2% specifically during peak-commute times. This allows for a small efficiency benefit received by other drivers remaining on the road, and provides for a small additional GHG reduction from the policy.

The current language describes little policy action by MD state agencies. Departing from the current entirely-voluntary-adoption approach to implement significant support through marketing assistance, coordination with insurance companies on implementation, and persuading or requiring PAYD to be sensitive to risks associated with peak travel (thus incentivizing alternative travel times) can reasonably be expected to increase the adoption rate from 10% while capturing the congestion-relief benefit as well.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Pay-As-You-Drive® Insurance program in

2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.34). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Pay-As-You-Drive® Insurance program enhancements in 2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.34).

Job Creation and Economic Benefits

The Pay-As-You-Drive® Insurance program is expected to create and retain jobs. RESI's 2012 study estimated that the Pay-As-You-Drive® Insurance program, once fully operational, would support a total of about 1 job and generate -$122,067 in net economic benefit and $2,774 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This is a voluntary program.

N.4 Job Creation and Economic Development Initiatives Related to Climate Change

Lead Agency: DBED

Developing and fostering clean, local energy production is a key part of this program.

Program Description

This program promotes economic development opportunities associated with reducing GHG emissions in Maryland. It is based on Governor O'Malley's aggressive goal of creating, retaining or placing 100,000 green jobs by 2015. To support this goal, the Department of Business and Economic Development (DBED) formed a Green Jobs & Industry Task Force. The Green Jobs and Industry Task Force issued recommendations to Governor O'Malley in July, 2010 and made six recommendations: Strengthen coordination and communication across State agencies, partners and stakeholders to provide strategic vision for advancing a green economy; promote energy and resource efficiency efforts; develop and foster clean, local energy production and industrial capacity; capitalize upon economic opportunities to restore and protect Maryland's natural resources; promote sustainable development practices that create jobs, generate prosperity and make Maryland more self-reliant; and increase access to capital for green businesses and projects.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Job Creation and Economic Development Initiatives Related to Climate Change program have been aggregated with the estimated emission reductions from the Maryland's Innovative Initiatives bundle (Figure 6.34).

Job Creation and Economic Benefits

Although the Job Creation and Economic Development Initiatives Related to Climate

Change program will provide both economic output and job creation, the benefits of this program are accounted for in the other programs detailed in this chapter of the GGRA plan. Listing the benefits of this program in both this section and in the other programs would result in double counting of the benefits. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This is a voluntary initiative.

DBED works with public and private sectors to create job opportunities in Maryland and aims to attract new businesses, stimulate private investment, create jobs and encourage the expansion and retention of existing companies by providing workforce training and financial assistance to businesses relocating to or expanding within Maryland. To spur economic development in Maryland, DBED participates on both multi-agency initiatives and green business organization activities.

The Green Jobs and Industry Task Force issued its next steps, including:

- Prioritize recommendations, placing greatest emphasis on those with the most potential to create jobs and promote economic recovery immediately; develop an action plan to implement these recommendations;
- Outline the budgetary and workforce resources necessary to implement these changes; draft legislation for consideration at future General Assembly sessions to implement recommendations requiring legislative action; and
- Convene short-term public-private working groups to handle specific issues raised within the recommendations.

O. Future or Developing Programs

O.1 The Transportation and Climate Initiative

Lead Agency: MDE/MDOT

Program Description

The Transportation and Climate Initiative (TCI) is a regional effort of Maryland and 10 other Northeast and Mid-Atlantic states and Washington, D.C. to reduce GHG emissions in the region's transportation sector, minimize the transportation system's reliance on high-carbon fuels, promote sustainable growth to address the challenges of vehicle-miles traveled, and help build the clean energy economy across the region.

Recognizing that the transportation sector currently accounts for approximately 30 percent of GHG emissions in the Mid-Atlantic and Northeastern U.S., the energy, environment and transportation agency heads from the region convened a summit in Wilmington, Delaware in June 2010 to launch TCI. On June 16, 2010 they signed a Declaration of Intent, affirming their intent to work collaboratively to reduce GHG emissions from the region's transportation sector.

TCI's work is carried out by agency staff in the 12 jurisdictions, with support from the Georgetown Climate Center. The work is focused in four program areas: 1) Clean Vehicles and Fuels; 2) Sustainable Communities; 3) Freight Efficiency; and 4) Information and Communications Technologies.

Clean Vehicles and Fuels

In 2011 TCI launched the Northeast Electric Vehicle Network to promote electric vehicles (EVs) and EV infrastructure planning and deployment in the Northeast/Mid-Atlantic region. This work has been supported by a nearly $1 million competitive EV planning grant awarded by the U.S. Department of Energy (DOE) to TCI and its grant partners. 2012 grant deliverables include guidance documents for the siting, design and permitting of EV supply equipment (charging infrastructure or EVSE) and best practices for building and electrical codes and zoning and parking regulations pertaining to EVSE, as well as public outreach and education materials and events conducted by TCI.

Links to the guidance documents can be found at:

www.northeastevs.org

TCI is also exploring opportunities for regional collaboration on programs to promote compressed natural gas (CNG) as a transportation fuel.

Sustainable Communities

TCI has completed a survey and report on existing programs and policies in TCI states that support sustainable community objectives. At the 2011 Summit, TCI agency heads adopted a set of Sustainable Communities Principles and agreed to use state-level transportation policies to promote sustainable communities throughout the region, and to work in partnership with community development, economic growth, housing, and land use agencies at the federal, local, and regional levels. TCI is developing indicators to support the advancement of the Sustainability Principles, designed to provide states with simple and effective ways to measure the environmental, economic, and societal benefits of state-level sustainable communities programs and policies.

Freight Efficiency

TCI released a study in 2012 on the quantities and characteristics of freight movement through the TCI region by truck, rail and ship. The study found that more than 80 percent

of all freight is transported in the region by heavy trucks, which often produce more GHG emissions than other transportation modes. TCI is pursuing funding for follow-up studies on the energy and emissions impacts of freight movement and identification of routes by vehicle miles traveled and time-to-market, as tools to inform the region's decision-makers in improving freight efficiency and reducing climate impacts through mode shifting, congestion relief, and other strategies. TCI works collaboratively with the I-95 Corridor Coalition in this area.

Information and Communications Technologies (ICT)

Recognizing that powerful new technologies like smart phones, GPS and wireless sensors can improve the operational efficiency of the region's transportation system, TCI has launched several ICT initiatives to promote public transit use and EV travel and reduce travel times and congestion through the expanded use of real-time information. These include: 1) the creation of a portfolio of smart phone applications allowing EV travelers to find EV charging stations and reserve and pay by phone; and 2) effective challenges to "patent troll" legal threats and suits against public transit agencies for their use of real time information applications that encourage transit use, such as "Where's My Bus?." TCI is also developing ICT tools to support community sustainability and transportation planning;

Although TCI has not formulated specific reduction goals, its strategic work plan builds on reduction targets established in the climate action plans and statutes adopted by most participating states.

More information on this program can be found at:

www.transportationandclimate.org

www.georgetownclimate.org/

Implementation

The Transportation and Climate Initiative is a multi-state collaborative and voluntary initiative.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Transportation and Climate Initiative program in 2020 are estimated to be 0.02 $MMtCO_2e$ (Figure 6.35). Appendices C and D provide a more detailed description of the process used to quantify GHG reductions.

Job Creation and Economic Benefits

The Transportation and Climate Initiative program is expected to increase the State GDP. RESI's 2012 study estimated that the Transportation and Climate Initiative program, once fully operational, would support a total of about 0 jobs and generate $154,659 in net economic benefit and $22,195 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Figure 6.35 Initial and enhanced GHG reductions by policy for Future or Developing Programs, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
O	**Future or Developing Programs**	**-**	**0.02**	**0.02**
O.1	The Transportation and Climate Initiative	MDE/ MDOT	0.02	0.02
O.2	Clean Fuels Standard	MDE	0.00	0.00
		TOTAL REDUCTIONS	**0.02**	**0.02**

Fuel burned for transportation accounts for approximately one-third of GHG emissions for the Northeast and Mid-Atlantic states.

O.2 Clean Fuels Standard

Lead Agency: MDE

Program Description

The Clean Fuels Standard program is a cooperative effort being undertaken by eleven Northeast and Mid-Atlantic States to design and implement a regional low carbon fuel standard to reduce the carbon intensity of transportation fuels. The Clean Fuels Standard program is a collaboration of commissioners from the environmental and energy agencies in those 11 states. This effort is still in the analysis stage and there are no specific plans on implementation at this time.

Transportation fuels account for approximately one-third of GHG emissions from the Northeast and Mid-Atlantic states. A Clean Fuels Standard is designed to reduce the GHG emissions from these fuels. This program would be a market-based program to address the carbon content of fuels by lowering their carbon intensity through the use of low-carbon fuel alternatives. Carbon intensity is defined as the total GHG emissions released per unit of energy produced by the fuel over its full lifecycle. By analyzing the total GHG emissions released during the full lifecycle, including production, transport, and consumption, the fuels can be measured and compared with respect to their carbon intensity. The nation's first clean fuel standard was initiated by California in 2007.

The Memorandum of Understanding signed by the eleven Northeast and Mid-Atlantic Governors in December 2009 committed the states to conduct an economic analysis, develop preliminary recommendations on program elements, and draft a program framework based on this previous work

A preliminary analysis suggests that a Clean Fuels Standard could reduce GHG emissions from the transportation sector, promote a more diverse fuel mix that would diminish the region's reliance on imported oil, and help protect consumers from price volatility in the global oil market. Results of the preliminary analysis indicate that as the price of gasoline and diesel increases, consumers would see greater savings under a Clean Fuels Standard.

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Clean Fuels Standard program in 2020 are estimated to be 0.00 $MMtCO_2e$ (Figure 6.35). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Clean Fuels Standard program enhancements in 2020 are estimated to be 0.00 $MMtCO_2e$ (Figure 6.35).

Job Creation and Economic Benefits

RESI's 2012 study estimated that the Clean Fuels Standard program, once fully operational, would support a total of about -97 jobs and generate -$583,693,698 in net economic benefit and -$11,027,943 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This program is still under development. At this time, the eleven states involved in the partnership have not made any decisions about program design or implementation. If finalized, this program would be implemented through regulations adopted by MDE. MDE will be reevaluating this program as part of the 2015 status report required by the GGRA.

Land Use

estimated reduction of

1.14

million metric tons of CO_2e annually

When forests and agricultural lands are converted to housing developments, greenhouse gas emissions increase due to loss of carbon storage when vegetation is removed, emissions from construction of roads and buildings, and increased dependence on motor vehicles

Photo © Ben Fertig, IAN Image Library

All land uses contribute GHG emissions. Clearing forests to further development or create cropland, building buildings, roads, and other infrastructure, and how we travel on land, all impact Maryland's GHG emissions. One way to reduce GHG emissions is to develop and implement incentives and requirements that promote greater land use and location efficiency (i.e., Smart Growth). Better planning and smarter development lead to a reduction in vehicle miles traveled (VMT)—resulting in lower GHG emissions. To maximize GHG reductions, governments in Maryland are working to reduce motor vehicle travel in the State by reforming prevailing land use patterns in ways that reduce the travel distance between homes, jobs and other destinations, and increase accessibility to alternative transportation.

The Plan's Land Use section is comprised of two programs designed to minimize GHG emissions from future land development. These programs, described below, are projected to reduce 2020 GHG emissions in Maryland by 0.54 $MMtCO_2e$ (Figure 6.35). However, as is the case with all other GGRA related programs, GHG benefits are likely to vary, depending on advances in technology, levels of investment, and legislative action. The State is also working to implement one land use program enhancement and possibly several others to achieve even greater GHG reductions by 2020. Although benefits through 2020 will be modest, GHG reductions from land use and location efficiency strategies will increase after 2020. For example, California expects a reduction of statewide transportation emissions by 5 $MMtCO_2e$ in 2020 through land use measures aimed at limiting the growth in GHG emissions, but this will increase to 30 $MMtCO_2e$ in 2050 (AB32 Scoping Plan, California Air Resources Board, see *http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm*).

A brief description of the enhancement options and, where possible, an estimate of their emissions reduction potential is included in the program summaries below. The methodology for calculating reductions from enhancements can be found in Appendix C, "Land Use Programs," of this Plan.

Estimates of 2020 GHG reductions from existing Land Use programs and enhancements are found in Figure 6.36 below.

Figure 6.36 Initial and enhanced GHG reductions by policy for the Land Use sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
P	Land Use Programs	0.54	1.14
	TOTAL REDUCTIONS FROM LAND USE	0.54	1.14

P. Land Use programs

The two programs designed to minimize GHG emissions from future land development are P1. Reducing Emissions through Smarter Growth and Land Use/Location Efficiency and P2. Priority Funding Area (Growth Boundary) Related Benefits. MDP is the lead agency for these efforts, which involve the private sector and various agencies and commissions at all levels of government within the State.

By better managing growth, local communities can minimize harmful sprawl development and contribute to a reduction in Maryland's GHG emissions. Smart growth is characterized by compact, transit-oriented, bicycle-friendly land use, with neighborhood schools, walkable streets, mixed-use development and a wide range of housing choices. Smart growth concentrates new development and redevelopment in areas with existing or planned infrastructure to avoid sprawl, which is generally characterized as the increased development of land in suburban and rural areas outside of their respective urban centers. This increased development on the outskirts of towns, villages and metropolitan areas is often accompanied by a lack of development, redevelopment or reuse of land within the urban centers themselves and results in a marked increase in GHG emissions.

It should be noted that many local governments in Maryland are already implementing smarter, more sustainable land use policies and programs that are: promoting green building and compact, transit-oriented development; reducing aggregate VMT; preserving vegetated/forested lands (which sequester carbon); and protecting agriculture.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Land Use Programs in 2020 are estimated to be 0.54 $MMtCO_2e$ (Figure 6.37). Appendix C provides a more detailed description of the process used to quantify GHG reductions.

Enhanced reductions

The potential emission reductions from the Land Use Programs enhancements in 2020 are estimated to be 1.14 $MMtCO_2e$ (Figure 6.37).

P.1 Reducing emissions through smart growth and land use/location efficiency

Lead Agency: MDP

Program Description

This program reduces Marylanders' dependence on motor vehicle travel, especially single-occupant vehicles, by developing incentives and requirements for development projects and regional land use patterns that achieve land use/location efficiency with regard to

Figure 6.37 Initial and enhanced GHG reductions by policy for Land Use Programs, in $MMtCO_2e$.

	Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
LAND USE	**P**	**Land Use Programs**	**-**	**0.54**	**1.14**
	P.1	Reducing Emissions through Smart Growth and Land Use/ Location Efficiency	MDP	Included in P	Included in P
	P.2	Priority Funding Area (Growth Boundary) Related Benefits	MDP	Included in P	Included in P
			TOTAL REDUCTIONS	**0.54**	**1.14**

transportation. The purpose is to reduce VMT and the combustion of fossil fuels. Land use/location efficiency means that residences, jobs, shopping, schools, and recreational opportunities are in close proximity to each other and that alternative transportation modes (walking, biking and mass transit) are convenient and easily accessed. The Smart Growth development pattern, together with land use/location efficiency, results in shorter trip lengths, less need for automobile and truck travel, and greater use of alternative transportation modes.

Between 2009 and 2030, VMT in Maryland is expected to increase by 42 percent while population is expected to grow by only 19 percent. This trend is primarily the result of dispersed land use patterns in Maryland, which have resulted in suburban sprawl over the past five decades. A primary method to ensure a reduction in overall transportation emissions over time is to sharply reduce the rate of growth in VMT, which will require a significant adjustment away from automobile-oriented land use development patterns.*

In addition to implementing current smart growth programs and policies, MDP and sister agencies have begun to implement PlanMaryland, the State's first comprehensive plan for sustainable growth and development, as well as recommendations from the Maryland Sustainable Growth Commission.

PlanMaryland will positively alter Maryland's transportation sector and is already promoting better collaboration between State agencies, local government and Metropolitan Planning Organizations to facilitate this change. PlanMaryland establishes three overarching goals for the State:

- The concentration of development and redevelopment in communities where there is existing and planned infrastructure
- The preservation and protection of environmentally sensitive and rural lands and resources from the impacts of development
- The preservation of a desirable quality of life for Marylanders

To achieve these goals, and the associated outcomes envisioned for each goal, PlanMaryland is driving the establishment of "Planning Areas" and the implementation of coordinated strategies. Planning Areas help direct State and local government, as well as the private sector, with regard to planning, management and resource allocation decisions. In addition to the overarching goals and visions of PlanMaryland, the plan establishes visions for each Planning Area. A description of the collaborative process between State agencies, local governments and Metropolitan Planning Organizations to develop the Planning Areas and to implement coordinated strategies, is provided in Appendix C of this Plan.

In supporting compact development, PlanMaryland seeks to address affordable housing concerns, the job/housing balance, and commuting times. More compact development can shorten commute times.† PlanMaryland establishes a priority for more affordable, desirable housing near existing job centers and public transit. A state housing plan that works in conjunction with PlanMaryland will help accomplish this, in tandem with efforts by the Maryland Department of Transportation to improve efficiency and availability of mass transit in the State. Additionally, a State housing plan, supported by PlanMaryland, will work in conjunction with other State and local land use policy initiatives to help create opportunities for homeownership and rental housing that ensure the provision of a range of housing choices to meet the needs of a diverse and changing population across all income ranges.

More information about PlanMaryland can be found in "Progress Report 2012:"

http://plan.maryland.gov/implementPlan/implementPlan.shtml

* Ewing, Reid, Bartholomew, Keith, etc. "Growing Cooler—The Evidence on Urban Development and Climate Change." The Urban Land Institute. October, 2007.

† Basu, A. 2005. Smart Growth Towards Economic Performance. Urban & Regional Planning Economic Development Handbook. Taubman College of Architecture and Urban Planning, University of Michigan. www.umich.edu/~econdev/smartgrowth/index.html

Conventional transportation models have focused on speed, distance, and the number of vehicles accommodated, but to measure GHG reductions from land use/location efficiency, transportation models must also emphasize access, proximity and VMT.* Until an updated transportation model is in place that can adequately take into account the GHG reduction benefits of land use/location efficiency factors, MDP recommends additional metrics to determine progress. Examples include tracking the number of people and businesses within a certain distance from transit stations and bus stops, and the percentage of land use within Maryland that supports alternative transportation modes.

Implementation

Additional statutory or regulatory authority, along with new State policies, will be needed to implement some of the Smart Growth provisions and recommendations mentioned above. New programs will include a mix of incentives and requirements.

New State policies might be needed to implement any new funding mechanisms developed as a result of PlanMaryland or recommended by the Maryland Sustainable Growth Commission. The Smart Growth Subcabinet, MDP and sister agencies will work to implement these funding mechanisms.

Other existing policies that support this program include the following:

- DHCD implements the Sustainable Communities Act of 2010. This law strengthens reinvestment and revitalization in Maryland's older communities and promotes equitable, affordable housing by expanding energy-efficient housing choices for people of all ages, incomes, races, and ethnicities.
- The 2009 Smart, Green and Growing legislative suite (HB294/SB273, HB297/SB280 and HB295/SB276) requires implementation of the following: incorporation of the 12 new planning visions in local comprehensive plans, development of local land use goals, consistency of local land use ordinances with comprehensive plans, and submittal of local annual reports.
- MDP works with other State agencies to support existing local programs and policies that reduce GHGs as well as community planning efforts that link GHG reductions, land use changes, smart transportation investments, and efficient energy management/distribution systems.

Smart Growth and Location Efficiency Enhancement Options

By the end of 2015, the State will give higher priority to local transportation plans and projects that integrate transportation and land use to achieve GHG reductions.

Also, by the end of 2015, the State expects to complete its determination of the feasibility of the following options to enhance existing programs to achieve further reductions in the land use sector:

- Implementing a GHG reduction initiative similar to that contained in California's Senate Bill 375.†
- Adapting "Rule 9510" of the San Joaquin Valley Air Pollution Control District to limit GHG emissions from mobile source activity associated with large development projects.‡

The implementation of these enhancements is expected to increase 2020 GHG reductions to 0.64 $MMtCO_2e$. This estimate assumes in part that the measures will result in 75 percent of

* The data problem that holds back climate action and smart growth, Philip Langdon, New Urban Network, *http://newurbannetwork.com/article/data-problem-holds-back-climate-action-and-smart-growth-13218*

† California enacted SB 375 in 2008 to reduce GHG emissions from automobiles and light trucks through integrated transportation, land use, housing and environmental planning. Under the law, Metropolitan Planning Organizations (MPOs) are tasked with including in their regional long-range transportation plans a Sustainable Communities Strategy (SCS) for achieving regional GHG emissions reduction targets established by the California Air Resources Board.

‡ Rule 9510, also known as the Indirect Source Review, was adopted by the San Joaquin Air Pollution Control District in California to cap NOx and PM10 emissions from mobile source activity "generated or attracted by" large residential, commercial and industrial development projects.

Maryland's new development between 2011 and 2020 being compact development.

As noted earlier, the State is working to establish an Accounting for Growth program that will address nutrient pollution from increased population and new development.* An outcome (co-benefit) of this program will be smarter, more sustainable growth (more efficient land use), which will contribute to a reduction in Maryland's GHG emissions.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Reducing Emissions through Smart Growth and Land Use/Location Efficiency program have been aggregated with the estimated emission reductions from the Land Use Programs bundle (Figure 6.37).

Job Creation and Economic Benefits

All job creation and economic benefits for the Land Use sector have been incorporated into this program.

The Reducing Emissions through Smart Growth and Land Use/Location Efficiency program is expected to create and retain jobs. RESI's 2012 study estimated that the Reducing Emissions through Smart Growth and Land Use/Location Efficiency program, once fully operational, would support a total of about 4,006 jobs and generate -$138,680,956 in net economic benefit and $529,858,676 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

P.2 Priority funding area (growth boundary) related benefits

Lead Agency: MDP

Program Description

Maryland has established Priority Funding Areas to preserve existing communities, to target State resources to build on past investments, and to reduce development pressure on critical farmland and natural resource areas. By encouraging projects in already developed areas, PFAs reduce the GHG emissions associated with sprawl.

Priority Funding Areas are geographic growth areas defined under Maryland law and designated by local jurisdictions to provide a map for targeting State investment in infrastructure. A map of the Priority Funding Areas in Maryland is available on MDP's website at: *http://planning.maryland.gov/OurProducts/pfamap.shtml*.

Maryland law directs the use of State funding for roads, water and sewer plants, economic development and other growth-related needs toward Priority Funding Areas, recognizing that these investments are the most important tool the State has to influence smarter, more sustainable growth and development.

As required by Maryland law, many State agencies provide funding for "growth related" development and infrastructure only within Priority Funding Areas. Rather than requiring additional outlays beyond current funding to support compact development, the Priority Funding Areas law instead requires a reallocation of existing funding. Maryland's Smart Growth Subcabinet provides an Annual Report on the Implementation of the Smart Growth Areas Act, which describes the State agency programs that are restricted to Priority Funding Areas and the amount of funds allocated within the fiscal year—see MDP's website at:

http://planning.maryland.gov/OurProducts/PublicationsPlain.shtml#annual.

* More information about Maryland's Water Implementation Plan and the Accounting for Growth strategy can be found at *http://www.mde.state.md.us/programs/Water/.../TMDLImplementation/*

Some examples of PFA-restricted State agency programs that reduce GHG emissions by supporting compact development patterns include:

- DHCD's "State funded neighborhood revitalization projects," which include funding from Community Legacy, Community Investment Tax Credit, Maryland Capital Access Program, and Neighborhood Business Works.
- The Maryland Department of Business and Economic Development's Maryland Economic Development Assistance Authority and Fund, which provides both loans and grants to businesses and local jurisdictions.
- MDE's Maryland Water Quality Revolving Loan Fund, which provides financial assistance to public entities and local governments for wastewater treatment plant upgrades.
- MDOT "growth related" projects, which include all major capital projects (unless granted an exception) and are defined as "any new, expanded, or significantly improved facility or service that involves planning, environmental studies, design, right-of-way, construction, or purchase of essential equipment related to the facility or service."

Implementation

Based on the evaluation of existing programs and procedures, additional statutory or regulatory authority, along with new State policies, might be needed to implement the recommendations of PlanMaryland that relate to Priority Funding Areas.

Estimated GHG Emission Reductions in 2020

The potential emission reductions from the Reducing Emissions through Smart Growth and Land Use/Location Efficiency program have been aggregated with the estimated emission reductions from the Land Use Programs bundle (Figure 6.37).

Job Creation and Economic Benefits

Job creation and economic benefits for the Priority Funding Area (Growth Boundary) Related Benefits program are accounted for under P.1. Reducing Emissions through Smart Growth and Land Use/Location Efficiency. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Potential Additional Enhancements to Land Use Policies:

The following enhancements could add an additional 0.50 mmt of CO_2e reductions to the land use policy package:

- Reduce Transportation Sector GHG Emissions through Land Use and Location Efficiency/ GHG Benefits from Priority Finding Areas (PFAs) and Other Growth Boundaries: Disaggregate and specify polices to enhance the new PlanMaryland land use designations, septic bill effects, and affordable housing.
- Transportation GHG Targets for Local Governments and Metropolitan Planning Organizations: Clarify specific actions that encourage collaboration between state agencies and local and regional planning organizations to develop integrated transportation and land use strategies. These may include policy frameworks, voluntary GHG and VMT reductions goals and plans, and incentives.
- Funding Mechanisms for Smart Growth: Provide funding for local actions to implement GHG beneficial land use actions.

estimated reduction of

0.03

million metric tons of CO_2e annually

The Maryland Climate Change Summit, in July 2013.

Photo © Jay Baker, Office of the Governor, Maryland.

Outreach

Some programs relating to reducing Maryland's GHG emissions cut across multiple or all sectors. Public sector recommendations typically encourage, enable, or otherwise support GHG mitigation activities and other GHG reduction actions. The programs considered for this sector are not always easily quantifiable in terms of GHG reductions and cost-effectiveness. Nonetheless, if successfully implemented, they will likely contribute to GHG reductions and enhance the economic benefits described for each of the other 65 programs that were quantified.

One of the GHG reduction policies, which is described in detail throughout this section, is designed to ultimately reduce GHG emissions from areas that extend across multiple sectors. Full implementation of this public or multi-sector approach could result in GHG reductions of approximately 0.03 $MMtCO_2e$ (Figure 6.38).

Figure 6.38 Initial and enhanced GHG reductions by policy for the Outreach sector, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Initial reductions	Enhanced reductions
Q	Outreach and Public Education	0.03	0.03
	TOTAL REDUCTIONS FROM OUTREACH	0.03	0.03

Q. Outreach and Public Education

Lead Agency: A multi-agency effort coordinated by MDE

Program Description

State-sponsored public education and outreach combined with community actions form the foundation for behavioral and life style changes necessary to reduce GHG emissions. This program is designed to promote new actions and encourage continuation of existing efforts such as the educational efforts and action campaigns of State agencies, such as MDE, DNR, Maryland State Department of Education, and University of Maryland; electric utilities; non-profit organizations; faith communities; and others. This combination of efforts insures that scientifically based factual information is made available through public education and outreach efforts and reaches all segments of the public. Many of these activities are already underway, including:

- Maryland-Delaware Climate Change Education, Assessment and Research
- College Climate Action Group
- Maryland Department of Education Environmental Literacy Curriculum
- The Governor's Regional Environmental Education Network

More information on this program can be found in the appendix of this report.

Estimated GHG Emission Reductions in 2020

Initial reductions

The potential emission reductions from the Outreach and Public Education program in 2020 are estimated to be 0.03 $MMtCO_2e$ (Figure 6.39). Appendix C provides a more detailed description of the process used to quantify GHG reductions

Job Creation and Economic Benefits

The Outreach and Public Education program is expected to increase the State GDP. RESI's 2012 study estimated that the Outreach and Public Education program, once fully operational, would support a total of about 0 jobs and generate $130,092 in net economic benefit and $5,549 in wages on average annually. Chapter 7 and Appendix E provide more detail on the RESI studies and the job creation and economic benefits associated with this program.

Implementation

This is a voluntary program. Outreach and public education are supporting efforts to other programs. It does not exist as a separate, quantifiable entity. In the 2008 Climate Action Plan, these activities were presented as part of the cross-cutting group of programs which were not quantified for GHG reductions.

All programs to reduce GHG emissions should include an educational component to ensure that people understand what is trying to be accomplished. Extending the traditional methods to include social media and other evolving communication techniques must be considered for successful education and outreach.

Figure 6.39 Initial and enhanced GHG reductions by policy for Outreach and Public Education, in $MMtCO_2e$.

Policy I.D.	Policy (Program)	Lead Agency	Initial reductions	Enhanced reductions
Q	Outreach and Public Education	MDE	0.03	0.03
		TOTAL REDUCTIONS	0.03	0.03

Chapter 7

Maryland jobs and the economy

Climate change and mitigation strategies are important factors for many elements of the economy and society in general: the rising costs of energy and transportation, threats to the environment, and the health of the greater population (and, by extension, the labor pool). Energy, transportation, agriculture and forestry, recycling, buildings, land use, and many other areas are affected by climate change. As such, mitigating climate change is a vital concern.

Maryland State government agencies are doing their part to mitigate the negative effects of climate change by creating and implementing climate change mitigation strategies designed to reduce GHG emissions in The State. The strategies under various state government agencies have been organized into eight subject areas: energy, transportation, agriculture and forestry, recycling, multi-sector, buildings, land use, and innovative initiatives.*

This report is a refinement of the Regional Economic Studies Institute of Towson University (RESI) 2011 results, taking into account the short-term job creation, economic activity, and wage effects from these strategies. The 2011 report was a preliminary analysis of the potential economic impacts of mitigation strategies for the 2012 GGRA report. During this refinement, RESI used a dynamic model known as the REMI model PI+ to assist in determining cumulative benefits and annual impacts to the region. This model allowed RESI to review the interactions among agencies within the region from the strategies and changes that would result from the interaction of those agencies. The results of this report are considered to be a more accurate representation of the possible outcomes from these reduction strategies and provide a potential estimation of economic activity through 2020.

* At the time the RESI analysis began there were 65 strategies in the GGRA plan. Since that time the plan has evolved to include 17 policy bundles and 60 individual programs.

Summary of findings

RESI analyzed data collected in collaboration with state agencies and MDE in order to estimate the economic impacts of climate action strategies and their subprograms. Using data contained in strategy write-ups provided by MDE as well as external research from a variety of sources, including the implementing agencies, RESI estimated the impacts of each strategy and subprogram.

RESI coordinated with state agencies to develop a methodology. The agencies assisted in the development and finalization of all assumptions used in the economic modeling for RESI's analysis. Through this coordinated effort, RESI built upon their original design in 2011 creating an investment and operation phase. A detailed explanation of the investment and operation phases and what they entail can be found in Appendix B.1 of Appendix E of the GGRA plan.

To quantify the economic and fiscal impacts of climate action strategies and their subprograms, RESI utilized the REMI PI+ input/output model. For more information regarding REMI PI+, please refer to Appendix B.2 of Appendix E, which presents *The Refined Economic Impact Analysis for the Greenhouse Gas Emissions Reduction Act 2012 Plan* hereafter referred to as the full report in this Chapter.

A summary of RESI's findings, including the total economic impacts (employment, output, and total net benefits) of all strategies within a subject area can be found in Figure 7.1. Figure 7.2 presents the total fiscal impacts (state and local tax revenues) resulting from the investment and operation phases of the strategies. The total wage impacts can be found in Figures 7.3 and 7.4. Total net benefits can be found in Figures 7.5 and 7.6.

For more detailed impacts and further explanation, please refer to Section 3.0 and Appendix A of the full report. Information regarding the modeling assumptions and procedures used to derive impacts for each strategy within the subject areas can be found in Appendix C of the full report. Appendix D provides a discussion of the general occupations most likely to be associated with each subject area.

As shown in Figure 7.1, during the investment and operation phases of these strategies, the total economic benefits would include approximately 37,195 jobs maintained in 2020

Table 7.1 Total annual and economic impacts by strategy subject area–investment and operation phases 2010–2020.* Source: RESI

Subject area	Employment†	Output	Total cost	Total net benefit
Energy	11,337.5	$12,242,280,276	$13,927,345,250	-$1,685,064,974
Transportation	17,279.8	$11,904,907,243	$11,211,193,536	$693,713,707
Agriculture and Forestry	-128.0	$2,437,255,843	$658,308,564	$1,778,947,279
Buildings	115.2	$133,572,384	$7,873,194	$125,699,190
Zero Waste	4.4	-$10,009,769	$0	-$10,009,769
Innovative Initiatives	4,517.8	$1,093,518,987	$302,061,745	$791,457,242
Land Use	4,006.4	$6,130,798,344	$6,269,479,300	-$138,680,956
Outreach	0.1	$152,592	$22,500	$130,092
Other Programs	62.0	$42,968,750	$10,750,000	$32,218,750
Total	**37,195.2**	**$33,975,444,650**	**$32,387,034,089**	**$1,588,410,561**

* The Transportation and Innovative Initiatives subject areas exhibit impacts from 2020 to 2025. However, those impacts were excluded in Figure 7.1 and Figure 7.2. For the specific distribution of impacts over time, refer to Section 3.0 of the full report. In addition, summed impacts throughout the report may not add up exactly to totals due to rounding.
† Employment figures reflect net employment impacts in the year 2020.

and $34.0 billion in output between 2010 and 2020. The total cost of all strategies in all subject areas is approximately $32.4 billion. The results in Figure 7.1 are point estimates. However, given that costs could vary in the future and the model is a best representation based on current economic climate, it is useful to present a range of estimated benefits. The expected net benefits range from $1.5 and $1.7 billion and the jobs maintained in 2020 would range from 35.3 to 39.0 thousand jobs. The net benefit includes public and private costs. It is important to note that employment impacts are not cumulative, and therefore annual impacts are jobs created above the baseline forecast. For more information on interpreting the results, please review the REMI PI+ model overview in Appendix B.2. All employment impacts in this report represent the number of jobs created or maintained in a given year as compared to the baseline.

RESI also found that the strategies would generate a significant fiscal impact (state and local tax revenues). From Figure 7.2, the total state and local tax revenues for all subject areas, strategies, and subprograms would range from approximately $3.5 to $3.9 billion for the investment phase and decrease by $223.0 to 247.0 million for the operation phase.

A summary of the wage impacts is represented in Figures 7.3 and 7.4. The investment phase generates more jobs than the operation phase because the public and private sectors must hire workers to implement the strategies. However, once policies are in place, growth stabilizes, and maintenance and monitoring are the primary employment needs of a program.

These strategies result in a wage impact that ranges from of $17.6 to $19.5 billion in the investment phase and $3.5 to $3.8 billion in operation phase. The strategies generate approximately 23.0 to 25.0 thousand jobs in the investment phase and 13.0 to 14.0 thousand jobs in the operation phase.

RESI also calculated the total net benefits from these strategies. A summary of these findings can be found in Figures 7.5 and 7.6. Although some of these policies may generate negative net impacts, the programs are still generating other benefits that are not accounted for in the market. These benefits include environmental improvements to ecosystems and improvements to human health from reduced pollution and greenhouse gases. Additionally, the program as a whole has net economic benefits.

Total net benefit during the investment phase totals a negative -$4.0 billion and a positive $5.6 billion during the operation phase. Total net benefit is the difference between output impact and total cost. Total net benefit is analogous to "profit" in the business sense. Positive total net benefit values recognize desireable policy outcomes for Marylanders. The total net benefit from both the investment and operation phases totals $1.6 billion, a desireable outcome.

Table 7.2 Total fiscal impacts by strategy subject area—investment and operation phases 2010–2020.* Source: RESI

Subject area	Investment phase	Operation phase
Energy	$3,435,021,531	$111,359,797
Transportation	$185,284,221	-$525,209,485
Agriculture and Forestry	$4,647,510	$37,095,041
Buildings	$398,903	$1,757,245
Zero Waste	$0	$5,953,398
Innovative Initiatives	$8,794,107	$67,464,639
Land Use	$90,658,021	$53,063,002
Outreach	$0	$6,541,298
Other Programs	$2,257,570	$7,193,094
Total	**$3,727,061,863**	**-$234,781,971**

* For an explanation of negative impacts, please refer to Section B.1 of the full report.

Table 7.3 Wage impact by strategy subject area—investment phase 2010–2020. Employment figures reflect net employment impacts in the year 2020. Source: RESI

Subject area	Employment	Wages
Energy	8,197.5	$6,178,131,686
Transportation	14,835.7	$6,924,636,851
Agriculture and Forestry	578.4	$116,210,952
Buildings	18.6	$10,284,428
Zero Waste	0.0	$0
Innovative Initiatives	201.2	$83,431,854
Land use	-5.7	$5,255,615,232
Outreach	0.0	$0
Other Programs	6.3	$3,189,076
Total	**23,832.0**	**$18,571,500,079**

Table 7.4 Wage impact by strategy subject area—operation phase 2010–2020. Employment figures reflect net employment impacts in the year 2020. Source: RESI

Subject area	Employment	Wages
Energy	3,140.0	$957,412,703
Transportation	2,444.1	$570,053,108
Agriculture and Forestry	-706.4	$835,571,286
Buildings	96.6	$43,393,251
Zero Waste	4.4	-$20,080,566
Innovative Initiatives	4,316.6	$676,849,368
Land use	4,012.1	$572,830,202
Outreach	0.1	$61,039
Other Programs	55.7	$18,127,439
Total	**13,363.2**	**$3,654,217,830**

Figure 7.5 Total net benefit by strategy subject area—investment phase 2010–2020.

Subject area	Output	Total cost	Total net benefit
Energy	$9,489,686,268	$12,044,765,750	-$2,555,079,482
Transportation	$11,347,991,974	$11,211,193,536	$136,798,438
Agriculture and Forestry	$155,548,074	$217,827,506	-$62,279,432
Buildings	$17,364,501	$7,688,994	$9,675,507
Zero Waste	$0	$0	$0
Innovative Initiatives	-$103,166,811	$301,848,895	-$405,015,706
Land use	$5,099,060,054	$6,254,479,300	-$1,155,419,246
Outreach	$0	$0	$0
Other Programs	$6,103,515	$10,750,000	-$4,646,485
Total	**$26,012,587,575**	**$30,048,553,981**	**-$4,035,966,406**

Figure 7.6 Total net benefit by strategy subject area—operation phase 2010–2020.

Subject area	Output	Total cost	Total net benefit
Energy	$2,752,594,008	$1,882,579,500	$870,014,508
Transportation	$556,915,269	$0	$556,915,269
Agriculture and Forestry	$2,281,707,769	$440,481,058	$1,841,226,711
Buildings	$116,207,883	$184,200	$116,023,683
Zero Waste	-$10,009,769	$0	-$10,009,769
Innovative Initiatives	$1,196,685,798	$212,850	$1,196,472,948
Land use	$1,031,738,290	$15,000,000	$1,016,738,290
Outreach	$152,592	$22,500	$130,092
Other Programs	$36,865,235	$0	$36,865,235
Total	**$7,962,857,075**	**$2,338,480,108**	**$5,624,376,967**

Chapter 8

Adaptation

Climate Change Adaptation

Climate change will affect Maryland in a variety of ways. More obvious impacts could include an increased risk for extreme events such as drought, storms, flooding, and forest fires; more heat-related stress; the spread of existing or new vector-born disease; and increased erosion and inundation of low-lying areas along the State's shoreline and coast. In many cases, Maryland is already experiencing these problems to some degree, today. Climate change raises the stakes in managing these problems by changing the frequency, intensity, extent, and magnitude of these problems.

As the State moves forward with actions that will reduce greenhouse gases and ultimately result in increased energy efficiency, a more sustainable economy, and cleaner air; climate impacts will still be felt into the future. Therefore, adaptation, together with mitigation, is necessary to address climate change. It is noted, however, that these actions are by no means independent of each other and any program or policy to mitigate the effects of climate change will complement steps to reduce the state's risk to climate impacts.

Climate change adaptation is an extremely complex process and there is no single means of response. As stressed in a recent report by the National Academies,* climate change adaptation must be a highly integrated process that occurs on a continuum, across all levels of government, involving many internal and external partners and individual actions, and often evolves at different spatial and temporal scales. That said, the State is already taking steps to enhance the resilience of a broad spectrum of natural and human-based systems to the consequences of climate change.

Raising a house to mitigate the impacts of future flooding.

Photo © Jane Hawkey, IAN Image Library

* National Research Council. 2010. Adapting to the Impacts of Climate Change. National Academies Press, Washington, DC

Key recommendations for communities*

Take action now to protect human habitat and infrastructure from future risks.

Minimize risks and shift to sustainable economies and investments.

Guarantee the safety and well-being of Maryland's citizens in times of foreseen and unforeseen risk.

Retain and expand forests, wetlands, and beaches to protect us from coastal flooding.

Give State and local governments the right tools to anticipate and plan for sea-level rise and climate change.

***Determined by the Maryland Commission on Climate Change**

The State has produced several documents on its strategy for adapting to climate change. These products are available through the Maryland Department of Natural Resources.

Maryland's strategy for increasing resilience of its ecosystems and built infrastructure

Maryland's Climate Action Plan includes two climate change adaptation strategies that are currently being used to guide state-level adaptation planning efforts. The first strategy (Phase I), released in 2008, addresses the impacts associated with sea-level rise and coastal storms. The second strategy (Phase II), released in 2011 as a compendium to the Climate Action Plan, addresses changes in precipitation patterns and increased temperature and the likely impacts to human health, agriculture, forest and terrestrial ecosystems, bay and aquatic environments, water resources, and population growth and infrastructure. Together, the strategies are the product of the work of more than 100 experts from the governmental, nonprofit, and private sectors that held a series of meetings for the purpose of interpreting the most recent climate change literature, evaluating adaptation options, and recommending strategies to reduce Maryland's overall climate change vulnerability.

The strategies provide the basis for guiding and prioritizing state-level activities with respect to both climate science and adaptation policy over the near and longer terms. Implementation of a variety of projects designed to implement components of the strategies is well underway and additional efforts have been identified as high-priorities for early action. Summaries of Maryland's Phase I and II adaptation strategies, including current and planned near-term implementation efforts are outlined below.

Leading by Example

Maryland Department of Natural Resources initiatives

"Lead by Example" Policy: Building Resilience to Climate Change

The DNR has the lead role among state agencies in advancing the scientific understanding of Maryland's vulnerability to climate change, and advocating for sound planning to avoid or minimize the anticipated impacts. In October 2010, the DNR issued a new policy to direct its investments in and management of land, resources, and assets so as to better understand, mitigate and adapt to climate change. The policy establishes practices and procedures related to new land investments, facility siting and design, habitat restoration, government operations, research and monitoring, and resource planning. The goal of the policy is to lead by example; and along the way, encourage and educate others in the methods for managing natural resources and designing facilities with an understanding of the effects of climate change.

SOUTH RIVER FEDERATION

This wetland restoration project at Beards Creek organized by the South River Federation will restore habitat for wildlife, trap nutrients and sediment run-off during storm events, and help to capture and store carbon in the soil.

TODD, FUTURE15PIC

Flooded streets in Fells Pt, Baltimore, following Hurricane Isabel in 2003. Total property damage following this storm was estimated at $945 million for Maryland and Washington D.C.

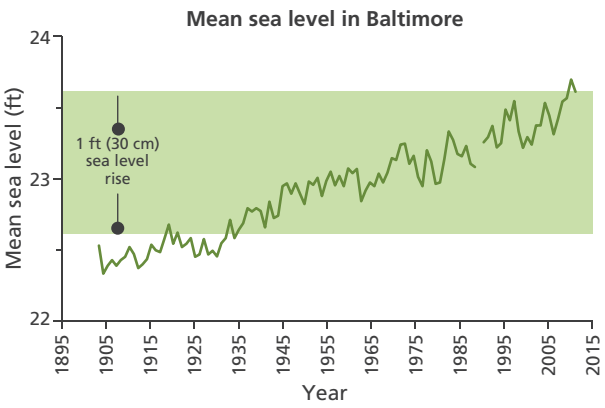

Figure 8.1 The long-term tide gauge in Baltimore Harbor shows a steady rise in sea level since the early 1900s. Source: Permanent Service for Mean Sea level (2013) Mean sea level for Baltimore. *http://www.psmsl.org/data/obtaining/stations/148.php* Accessed March 11, 2013

Sea-level rise and coastal storms

Background

The Chesapeake Bay region's geography and geology make the state one of the three most vulnerable areas of the country to changes resulting from sea-level rise—only Louisiana and Southern Florida are more susceptible. Historic tide records show sea level increased approximately one foot in the Chesapeake Bay over the last 100 years (Figure 8.1). According to a 2013 report,* scientists agree that sea level in Maryland will continue to rise 1.6 feet by 2050 and as much as 4.6 feet by 2100.

The Phase I Strategy, produced by the Maryland Commission on Climate Change's Adaptation and Response Working Group, detailed the actions necessary to protect Maryland's future economic well-being, environmental heritage, and public safety in the face of climate change and sea-level rise.

Implementation Status

In 2008 Maryland passed two pieces of key legislation called for in the Strategy: The Living Shoreline Protection Act, and amendments to the Chesapeake and Coastal Bays Critical Area Act. Both will reduce Maryland's vulnerability over time, and protect natural resources from the impacts of sea-level rise by restoring natural shoreline buffers such as grasses and wetlands, helping to limit new growth in vulnerable areas. In addition to these two pieces of legislation, a variety of other projects designed to implement the Strategy have been completed or are currently underway.

State of Maryland initiatives

Climate Change and CoastSmart Construction Executive Order

On December 27, 2012, Governor O'Malley signed the Climate Change and CoastSmart Construction Executive Order, enacting a number of policy directives, including directing all State agencies to consider the risk of coastal flooding and sea-level rise when they design capital budget projects and charging the Department of General Services with updating its architecture and engineering guidelines to require new and rebuilt State structures be elevated two or more feet above the 100-year base flood level.

The EO also charges the Maryland Department of Natural Resources to work with the Maryland Commission on Climate Change, local governments and other parties as appropriate, to develop additional CoastSmart guidelines within nine months, for the siting and construction of new and rebuilt State structures, as well as other infrastructure improvements such as roads, bridges, sewer and water systems, and other essential public utilities. Recommendations for applying the new construction guidelines to non-state infrastructure

* Boesch, D.F., L.P. Atkinson, W.C. Boicourt, J.D. Boon, D.R. Cahoon, R.A. Dalrymple, T. Ezer, B.P. Horton, Z.P. Johnson, R.E. Kopp, M. Li, R.H. Moss, A. Parris, C.K. Sommerfield. 2013. Updating Maryland's Sea-level Rise Projections. Special Report of the Scientific and Technical Working Group to the Maryland Climate Change Commission, 22 pp. University of Maryland Center for Environmental Science, Cambridge, MD.

projects that are partially or fully funded in the State's capital budget will also be developed.

Additionally, the EO requests that the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays evaluate existing regulations and policies for State Agency Actions Resulting in Development on State-Owned Lands and consider the adoption of new or revised provisions that address climate change and the risk of sea-level rise and other extreme weather-related impacts.

Lastly, the EO tasks the Scientific and Technical Working Group of the Maryland Climate Change Commission with providing updated sea-level rise projections for Maryland. In 2013, the Scientific and Technical Working Group published sea-level rise projections for Maryland, with a high end range of 4.6 feet by the year 2100.

Department of Natural Resources (DNR) initiatives

Local Government Technical and Financial Assistance: CoastSmart Communities

DNR's CoastSmart Communities Initiative supports local level implementation of the adaptation strategy. Under the initiative, the DNR administers a competitive grant program to provide financial and technical assistance to local governments looking to reduce their vulnerability to the effects of coastal hazards and sea-level rise through planning and permitting activities. Grants of up to $75,000, drawn from the state's federal Coastal Zone Management Act funds, are awarded on an annual basis and may be renewed for up to three additional years. A community self-assessment tool currently in development will allow for improved targeting of grants to help address coastal hazards in the most vulnerable communities.

Adaptation Toolbox: The Coastal Atlas

Maryland is using the latest technology, and detailed information to undertake state-of-the-art sea-level rise mapping and research. Results acquired by both the DNR and individual Maryland counties is housed on the Coastal Atlas (*http://dnr.maryland.gov/ccp/coastalatlas/index.asp*), an online toolbox of resources available to assist local governments with becoming ready, adaptive, and resilient to the impacts of sea-level rise and coastal storms. Data products and technical tools currently available on the Coastal Atlas include: statewide sea-level rise vulnerability mapping, historic shoreline position and erosion rate calculations, a

LIZ ROLL, FEMA

Spectators and emergency crews checking out the flooded streets and businesses in Annapolis following Hurricane Isabel in 2003. With sea-level rise and increased severity of coastal storms, these kinds of flood events will become more common.

comprehensive coastal inventory, and the Erosion Vulnerability Assessment Tool. The Coastal Atlas mapping application will be continuously updated as new data becomes available or as updates to existing data are made.

Sustainable Shoreline and Buffer Area Management

Through the Shoreline Conservation Services and Natural Filters Program, DNR is working to implement buffer reforestation, wetland restoration, and shoreline practices to enhance ecosystem resilience to the impacts of climate change. Practices include on-the-ground habitat restoration projects such as stream and shoreline buffer plantings, stream-floodplain reconnection, marsh hydrology restoration, and living shorelines. DNR Staff provide various technical assistances (site visits and evaluations, problem assessments and recommended solutions) for different stakeholders (private citizens, local government, non-profit organizations, state and federal agencies). Assistances also include various outreach and educational programs including pamphlets and other educational materials, workshops, etc. All of these practices increase ecosystem resiliency by improving water quality, reducing erosion, and enhancing habitat condition and connectivity. Due to the fact that most living shoreline projects involve a channelward encroachment with sand fill, these shoreline restoration techniques provide space for potential marsh migration in response to sea-level rise.

Living shorelines, such as this one planted on Church Creek, stabilize the shoreline, reduce erosion, and provide a buffer during flood events.

Photo © South River Federation

Maryland Department of Transportation (MDOT) initiatives

The MDOT is working to assess Maryland's critical transportation facilities and systems' vulnerability to projected sea-level rise and extreme weather damage. This assessment will provide the information necessary to evaluate options for dealing with potential impacts to infrastructure and connectivity, as well as aid in the development of adaptation policies for existing and planned transportation facilities. The assessment will ultimately influence long-term strategic planning for system adaptation that can account for the uncertainty of future climactic conditions.

Maryland State Highway Administration (SHA) Transportation Vulnerability Assessment

Among Maryland agencies, SHA has the largest and most geographically dispersed network of facilities requiring the most complex long-term action plan. SHA is studying the effects of severe weather and climate change to the infrastructure on the highway system. Initial mapping has been developed to document road closures in 2011 which include flooding (especially after storms Irene & Lee) on SHA maintained roads. This data along with inundation modeling and floodplain mapping will be incorporated into a vulnerability assessment currently in progress.

SHA with Maryland Transportation Administration (MDTA) developed a climate change adaptation strategy and implementation plan to address severe weather and climate change impacts to the state maintained highway network. This plan was drafted in early 2012 and is in the process of being finalized for use when addressing the results of the vulnerability assessment. SHA will need to assess the entire network and analyze areas locally where multiple flooding locations may be caused by the same source to determine the best solution for resolving the problem.

Maryland Port Administration (MPA) Climate Change Vulnerability Assessment and Recommendations

As a component of the overall Maryland Transportation Initiative described above, the Maryland Port Administration prepared the report, "Climate Change Vulnerability Assessment and Recommendations" in 2010. The report provides recommendations for future capital investments based on the findings of the vulnerability assessment. In response, the MPA developed a policy titled "Incorporating Climate Change and Sea-level Rise Information into the Public Marine Terminal and Harbor Development Process." The policy identifies the need for the MPA to make infrastructure and facility improvement decisions that consider climate change and sea-level rise.

As the MPA reviews its Strategic Plan and Marine Terminal Development Plans, it plans to factor sea-level rise and potential storm surge inundation into its evaluation of proposed projects. Additionally, the MPA proposes, as a participant in the Maryland Dredged Material Management and Federal Dredge Material Management Programs, to work with its partners to incorporate climate change vulnerability analysis into decision-making processes.

Maryland Department of Planning, Maryland Historical Trust (MHT) initiatives

Historical, Archaeological, and Cultural Resources Vulnerability Study

Rising sea-levels, erosion, and major storms pose a significant threat to historic and archaeological sites, districts, and landscapes. In 2010, the MHT completed a preliminary vulnerability assessment of historical and cultural resources in Maryland. The study was completed using inundation level data from the DNR. The results from this assessment raise awareness of this issue, which will be addressed through the PreserveMaryland planning process, and included in the forthcoming long-range historic preservation comprehensive plan.

In 2011–2012, MHT was awarded a Coastal Zone Management Grant, through DNR, to complete a pilot project focusing on the Choptank River watershed to develop a methodology for an in-depth analysis of vulnerable sites that provides details for management prioritization. In this phase, sea-level rise layers and additional shoreline data from DNR and their partners were incorporated, including erosion rates and other shoreline risk data. These layers were used to construct a general model of areas within the pilot project zone which are subject to various levels of impact from coastal hazards and sea-level rise. As a pilot in-depth cultural resource vulnerability analysis, MHT analyzed the recorded historic buildings and districts which are located in the pilot area impact zone. A methodology was developed to characterize each resource according to its level of recordation, extent of survey, extent and nature of potential impact, and the property's significance. This analysis will allow MHT to begin to identify and prioritize high value historic resources that are most threatened in the pilot area for documentation and/or mitigation.

Assateague Historic National Seashore subject to considerable flooding, erosion, and infrastructure damage following Hurricane Sandy in 2012.

Photo © ASIS NPS

TOM NAPPI, OFFICE OF THE GOVERNOR, MARYLAND

Emergency vehicle drives along the flooded beachfront in Ocean City following Hurricane Sandy in 2012. While Maryland escaped the brunt of this particular storm, total property damage from Hurricane Sandy in the US is estimated at $65 billion, with 24 states affected in total.

Maryland Insurance Administration (MIA) initiatives

Climate Change Insurance Advisory Committee

In the fall of 2008, the Maryland Insurance Commissioner convened a Climate Change Insurance Advisory Committee. The committee was charged with:

- Reviewing the adequacy of the data available to insurers to assess the risk imposed by climate change;
- Examining whether adaptive options are available to help mitigate losses and whether rating can be structured to provide an incentive for these options; and
- Reviewing ways to promote partnerships with policyholders for loss mitigation.

The committee released its final report in December 2010.

Maryland Department of the Environment (MDE) initiatives

Living Shoreline Regulation Development

In 2008, the Maryland legislature enacted the Living Shoreline Protection Act. The Act requires riparian property owners to rely upon "living shorelines" defined as nonstructural shoreline stabilization measures such as marsh creation, whenever feasible, to protect shorelines from erosion while also providing critical wildlife habitat. A variety of state agencies are involved in implementing the program and related efforts. MDE issued draft implementing regulations on November 7, 2012. Final regulations are scheduled to be effective on February 4, 2013.

Higher Regulatory Standards for Floodplain Management

Flood Insurance Rate Maps (FIRMs) are being updated throughout Maryland by the Federal Emergency Management Agency (FEMA). Part of this process requires communities that currently participate in the National Flood Insurance Program (NFIP) to update their local floodplain management regulations by the map effective date. At a minimum, these regulations must be consistent with federal regulatory requirements, but communities can choose to adopt higher regulatory standards. As the State Coordinating Office for the NFIP, MDE is assisting communities with this by providing a Maryland Model Floodplain Management Ordinance as a template containing higher regulatory standards such as a 2' freeboard requirement. Freeboard can be a community tool to respond to sea-level rise, and to achieve lower flood insurance premiums for property owners. Many communities are implementing these higher regulatory standards in order to gain additional points for the Community Rating System (CRS), a flood insurance discount program for communities that go beyond the minimum NFIP requirements.

Department of Housing and Community Development (DHCD) initiatives

Review of Current Statewide Building Codes and Recommendations for Enhancement in Coastal Regions of Maryland

As required under Section 2 of the Omnibus Coastal Property Insurance Reform Act of 2009 (Act), Chapter 540 (House Bill 1353), DHCD conducted reviews and prepared a report to members of the Senate Finance Committee and House Economic Matters Committee (Members) on "…enhanced building codes for coastal regions of the State that promote disaster-resistant construction in the coastal regions of the State...." The report was delivered to Members in October, 2010. The report was also provided to planning boards of the counties in the coastal areas of the State.

In 2012, as required by Public Safety Article, 12-501– 12-507, Annotated Code of Maryland, DHCD adopted the 2012 International Building Code (IBC), the 2012 International Residential Code (IRC) and the 2012 International Energy Conservation Code (IECC) under the Maryland Building Performance Standards on January 1, 2012. In October of 2012, DHCD adopted the 2012 International Green Construction Code (IgCC) as part of the Maryland Building Performance Standards.

MICK CHESTER PHOTOGRAPHY

Building damage in Ocean City following Hurricane Sandy.

Maryland Emergency Management Agency (MEMA) initiatives

State Hazard Mitigation Plan

Maryland's 2011 State Hazard Mitigation Plan was approved by Governor Martin O'Malley in September 2011. Vulnerability to climate change, coastal hazards and sea-level rise issues was evaluated as part of the State risk assessment and specific adaptation strategies were included in the overall mitigation plan. Future iterations of the State Hazard Mitigation Plan are expected to include risks associated with non-coastal impacts of climate change as prioritized in the mitigation plan.

Human Health

Background

Climate change poses serious health risks to people in Maryland, including heat-related stress and cardiovascular mortality and morbidity, respiratory illness, altered infectious disease patterns (both vector-borne and water-borne diseases), impacts to water supply and quality, and direct or mental harm from extreme storm events and flooding. There is a need to manage these preventable impacts, particularly in a system that historically has been able to adapt to and reduce the vulnerability of health risks. But without appropriate action, highly preventable mortality and health complications that are influenced by climate are likely to increase.

Climate change represents an overlying stressor that changes the environmental context of health, and disproportionately affects certain populations and communities. Many of these health issues will result from interactions between climate change, ecological changes, and the characteristics of existing infrastructure (e.g., lack of shade or air conditioning; old or unsuitable water supply and treatment facilities). Other impacts to nutrition and mental health may occur, though these are less certain, and include increased food-borne illness or psychological effects from extreme events. Harmful algal blooms and water-borne diseases also may affect the health of Maryland's citizens. The vulnerability of Maryland's citizens to climate risks is shaped by the degree to which they are exposed to these influences and also by a number of factors affecting their sensitivity and adaptive capacity

Maryland Department of Health and Mental Hygiene (DHMH) initiatives

State Climate Change Environmental Health Capacity Building

To ensure that risks, costs, and benefits are evaluated in a systematic manner, Maryland successfully competed for and was awarded a 2012 capacity building grant from the U.S. Centers for Disease Control and Prevention (CDC), "Maryland Public Health Strategy for Climate Change." The four-year award will enable DHMH to address identified needs in the following areas: (1) epidemiologic capacity in injuries/disasters and vector-borne disease; (2) short, intermediate, and long-term climate change modeling and integration capacity; (3) training in health impact assessment (HIA); and integration of information management tools related to disasters with routine DHMH functions. The strategy is outlined in Figure 8.2, below.

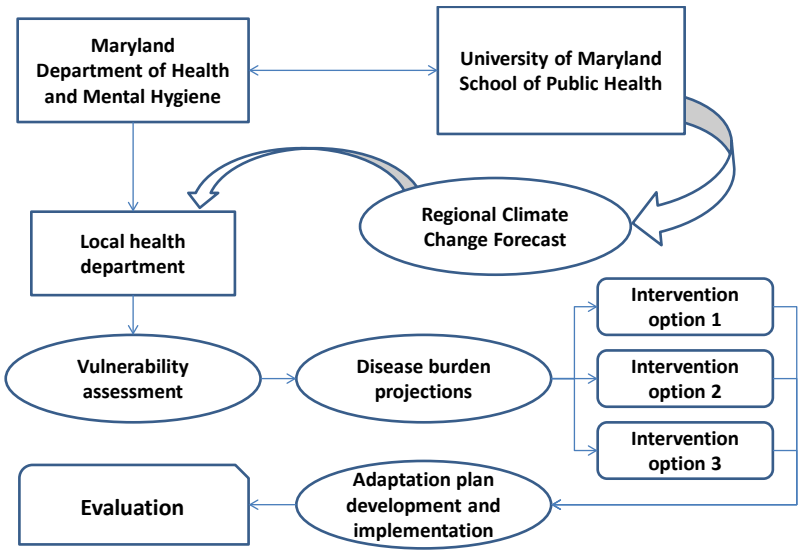

Figure 8.2 Overall framework of proposed Maryland project on public health and climate change.

Enhanced Environmental Public Health Tracking infrastructure

A combined effort is needed in order to minimize the public health risks of climate change. Through continued coordination between the DHMH and other state agencies, preemptive measures can be taken to both prevent and minimize the impact of climate change on public health. In 2002, the DHMH received Center for Disease Control funding to plan for a statewide Environmental Public Health Tracking Network that will be part of the national tracking network. Maryland used the funding to build capacity and enhance infrastructure. The results range from starting or improving surveillance to enabling faster responses to environmental public health questions and faster action to prevent disease. These enhancements will be achieved through the CDC project on capacity building, integrating them with the environmental public health tracking project.

Development of Climate Health Indicators

The DHMH is working with the Commission on Environmental Justice and Sustainable Communities, the MDE, and the MDP on the introduction of health indicators that could be used by the MDP and other agencies to evaluate the potential impacts of climate change adaptation or mitigation strategies, as well as the potential health consequences of projects related to adaptation to sea-level rise. The DHMH has strengthened its coordination with the DNR and the MDE related to monitoring and reporting of Chesapeake Bay-related health concerns, specifically with respect to harmful algal blooms.

State Heat Plan

In May, 2012, DHMH released the Maryland State Heat Emergency Plan which guides state actions during an Extreme Heat Event: a weather condition with excessive heat and/or humidity that has the potential to cause heat-related illnesses. An Extreme Heat Event is defined as a day or series of days when:

- The heat index is forecasted to be approximately 105 degrees or higher, or;
- The National Weather Service has issued a Heat Advisory, or;
- Weather or environmental conditions are such that a high incidence of heat-related illnesses can reasonably be expected.

DHMH has also activated the State Heat Emergency web site (*http://dhmh.maryland.gov/extremeheat*) which includes links to the State Heat Plan, Facts about Heat Related Illness, and weekly Heat Reports that provide guidance and information about deaths and illness caused by extreme heat in the region.

Climate impacts affecting human health

Heat waves will become more frequent, particularly in urban areas, exacerbating heat stress.

Weather extremes such as floods and storms can cause individual death and injury, as well as damage to public health infrastructure.

Sea-level rise may potentially displace vulnerable populations.

Air quality in urban areas and those where ozone and particulate matter levels are already high will likely worsen, resulting in increased asthmatic allergic response.

Geographic range and incidence of vector-borne diseases will change. Beaches will close more frequently due to pathogens (e.g., from combined sewer overflows and stormwater).

Altered local ecology of water and food-borne infective agents will result from diminished water quality.

LIZ ROLL, FEMA

Delivering emergency medical supplies in Bowleys Quarters, following Hurricane Isabel in 2003.

Agriculture

Background

Agriculture is the largest commercial industry in Maryland, employing about 350,000 people, primarily in the north-central and Eastern Shore regions. Farms occupy about two million acres, or about one-third of the State's land, though individually the farms are, on average, much smaller than those in other states. Maryland's agriculture is diverse, including nursery plants, dairy products, beef cattle, vegetables, wheat, horses, and fruit. Poultry, fed by largely locally produced corn and soybeans, maintains the largest market value. Projected increases in temperature, precipitation variability, and frequency of extreme events associated with climate change are likely to affect the conditions upon which farming has been established. Many of the stressors farms already face are likely to intensify or become less predictable: drought frequency, winter flooding, pests and disease, and ozone levels. These changes occur in the current context of the high economic uncertainty and small profit margins, and are likely to result in increased costs to both farmers and consumers.

To adapt to a changing climate, farmers will require guidance on climate smart crop species and strategies to reduce poultry and livestock loss and stress associated with heat. More intense water management will be needed to offset the impacts of growth and uncertainty in water supplies on agricultural production and water resources.

It is the broad goal of these strategies to help reduce stress on agricultural operations and to build the resilience of Maryland farms, despite changes they may face in the future, and to improve the quality of the Chesapeake Bay and its watershed. As climate change may affect the intensity of how farmers manage, alter effectiveness of agricultural BMPs, and affect the implementation of relevant regulations, farmers need to be prepared and supported for adjustments that may be required.

Figure 8.3 Climate impacts affecting agricultural products (ranked by 2007 market value, USDA Census) and possible adaptation strategies.

Agricultural product	Climate impact	Adaptation strategy
Poultry	• Increased cooling costs • Decreased production • Changing disease presence	• Improve energy efficiency of housing • Bioenergy use • Improve ability to monitor disease and quarantine
Grains, oilseeds, dry beans, peas	• Water stress: increased irrigation use • Winter flooding • Changes in crop yield quantity and quality	• Diversify cultivar and crop types • Improve water management systems • Improve pest forecasting
Nursery, greenhouse, floriculture, sod	• Increased cooling costs • Water stress	• Establish emergency response systems • Improve energy efficiency of housing
Milk and dairy	• Decreased milk productivity • Changing disease presence • Low-quality pasture during drought	• Increase shade and cooling • Improve ability to monitor disease and quarantine • Manage pastures for drought
Cattle and calves	• Changing disease presence • Heat stress • Low-quality pasture during drought	• Increase shade and cooling • Improve ability to monitor disease and quarantine • Manage pastures for drought • Farm heat-tolerant breeds
Vegetables, melons, potatoes, other crops, hay	• Water stress • Increased irrigation use • Winter flooding • Changes in crop yield quantity and quality	• Diversify cultivar and crop types • Improve water management systems • Improve pest forecasting
Horses, ponies, mules, burros, donkeys	• Heat stress • Low-quality pasture during drought	• Increase shade and cooling • Manage pastures for drought • Education about heat stress
Fruit trees, nuts, berries	• Water stress • Increased irrigation use • Increased pest damage	• Diversify cultivar and crop types • Improve water management systems • Improve pest forecasting

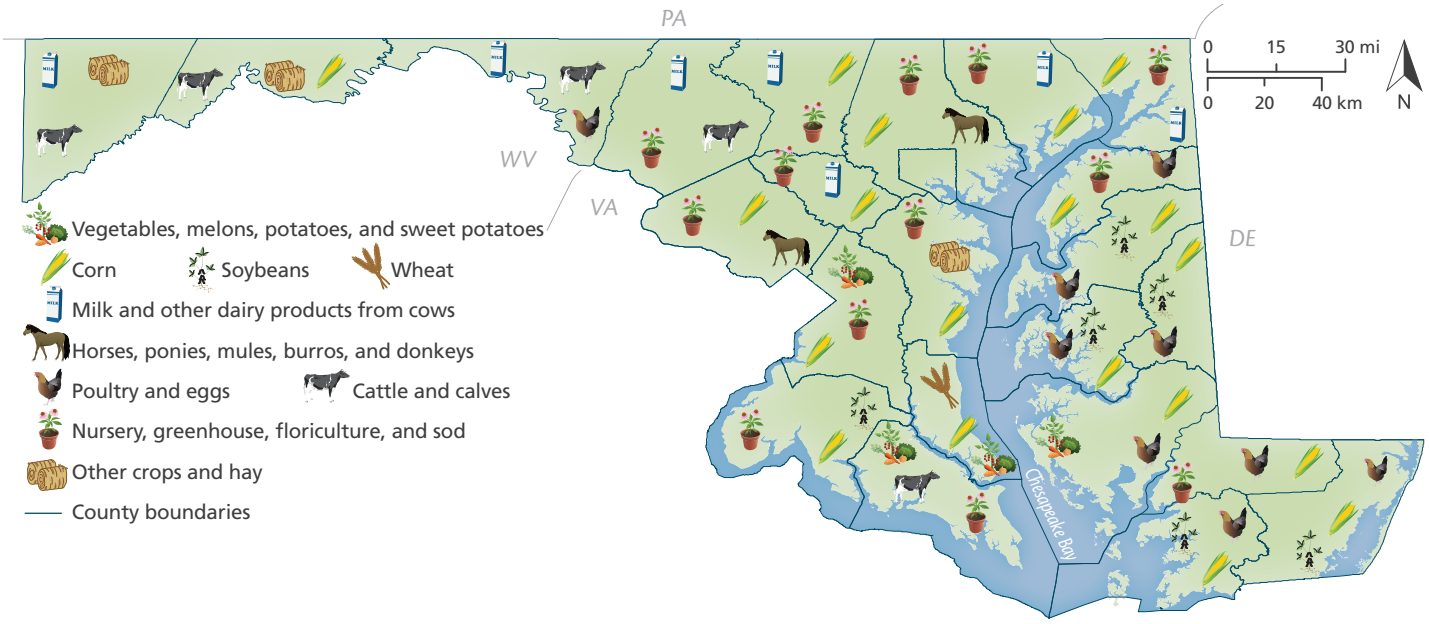

Figure 8.4 The top three agricultural commodities for each Maryland county based on 2007 value of sales. Adapted from Tom Rabenhorst and Joe School, Department of Geography and Environmental Systems, University of Maryland Baltimore County 2010.

Maryland Department of Agriculture initiatives

Invasive Plants Advisory Committee

Signed by the Governor on April 12, 2011, invasive plant bill HB 831 provided a mechanism to reduce the negative impacts of an increase in invasive species expected to occur as a result of changes in temperature and rainfall patterns. The bill established the Invasive Plants Advisory Committee (IPAC) in the Department of Agriculture and mandated that in its first year of activity, the IPAC would advise the Secretary of Agriculture in adopting a comprehensive, science-based risk assessment protocol to assess the invasive risk of selected plants. IPAC submitted regulations to the Secretary, which will become effective January 21 2013, adopting the USDA APHIS Weed Risk Assessment tool. The WRA tool documents the economic, ecological, and health impacts of invasive species and aims to identify their character and potential for damage. It will support IPAC's designation of assessed species as Tier 1 (banned) and Tier 2 (still marketable but with specific caveats and signage) plants. IPAC is seeking funding to support the work of assessing more than 200 invasive and potentially invasive plants. Publication of an initial list of 30 assessments and Tier designations is anticipated in the fall of 2013.

Maryland Department of Health and Mental Hygiene/DNR/MDA initiatives

Vector-borne disease surveillance and control

Maryland State officials continue to track the spread of West Nile Virus and other arboviral activity in the State in vector species, host animals, and humans. This allows for ongoing enhancement and deployment of effective tools to support surveillance, prevention, and control of West Nile virus and other arthropod-borne viruses, including novel or emerging pathogens that threaten the health of Maryland residents. In addition, the Mid-Atlantic Zoonotic and Vector Borne Disease Inter-Agency Workgroup (MAZV), a collaboration between DHMH, DNR, MDA, and researchers, practitioners, and federal agency partners meets regularly to monitor and discuss vector borne disease activities in Maryland and the surrounding regions.

Forests and Terrestrial Ecosystems

Background

The diversity of Maryland's forests and terrestrial ecosystems reflects the wide variety of environmental conditions found across the State's five major physiographic provinces. Not only do forested systems regulate climate and sequester carbon, but they play a major role in any adaptation plan to reduce the impacts of urban heat, enhance migration corridors, mitigate flooding, protect drinking water supplies, and reduce nutrient and sediment runoff. From the mountains to the sea, one can hike through western Maryland's thick groves of hemlock lining deep gorges, across grassy serpentine barrens supporting the unique purple-flowered fringed gentian, by vernal pools inhabited by salamanders, and through the pine forests and hardwood swamps of the Eastern Shore. The State's forests are mostly privately owned and only 27% are permanently protected from development. These habitats and their plant and animal communities are shaped mainly by geology, climate, and interactions with other species. They also are subject to many existing stressors such as development, pests, and pollution, limiting their capacity to adapt.

Forests and terrestrial ecosystems contribute an estimated $2.2 billion to Maryland's economy and $24 billion in ecological services. The condition of these ecosystems and the services they provide is likely to be altered by climate change. Climate change will alter distributions of species and habitats and exacerbate existing stressors at an uncertain rate and degree. Native species populations may decline, increase, or migrate from the State while new species may migrate in due to habitat shifts. Services provided by forests such as temperature regulation, water filtration, aesthetic value, and habitat may be altered. Existing stressors on species and habitats may be exacerbated by climate change.

Maryland Department of Natural Resources initiatives

GreenPrint Update

Maryland's GreenPrint initiative identifies the most ecologically valuable areas in the State and designates these lands and waters as "Targeted Ecological Areas (TEAs)." TEAs are the "best of the best" natural resources across the State. TEAs were first defined in 2008 and included

MARK TWERY, US FOREST SERVICE

Forests and terrestrial ecosystems contribute an estimated $2.2 billion to Maryland's economy and $24 billion in ecological services such as temperature regulation, water filtration, aesthetic value, and habitat.

the most ecologically important large blocks of forests and wetlands; wildlife and rare species habitats; aquatic biodiversity areas; and forests for protecting water quality. In 2011, DNR updated the TEA designations to include coastal ecosystems; habitats for climate change adaptation and marsh migration, and areas for supporting commercial and recreational fisheries. Together, these areas are identified as conservation priorities for natural resources protection. DNR is now using these updated conservation priorities to target Stateside Program Open Space land conservation projects.

Wildlife Vulnerability Assessment

The DNR has conducted a vulnerability assessment of GCN species using Nature Serve's Climate Change Vulnerability Index. The DNR is also participating in an expert panel effort in the northeast headed by the Manomet Center for Conservation Science to assess the likely impacts of climate change on northeastern fish and wildlife habitats and species of greatest conservation need. All of this information is planned for incorporation into the next version of the Maryland's State Wildlife Action Plan.

Forest Management Plans

In 2011 DNR's Forest Service included climate change and adaptation information as a required element in forest management plans. These plans are required by any forest landowner who participates in State property tax abatement programs or USDA forestry programs and thus will reach a wide audience.

Maryland Forest Resource Assessment and Strategy

The DNR Forest Service has incorporated climate change into their 2010 Forest Resource Assessments as an additional stressor. Climate change was also identified as one of the top five areas for action in their five year strategy. As part of this, the Forest Service is working with other local, state, and federal agencies to incorporate adaptation into existing forestry programs.

Urban Tree Canopy Assessment

DNR is currently working to maintain and improve the health and longevity of trees in urban areas and increase the urban tree canopy cover throughout Maryland. Urban trees shield buildings from cold winds, lower ambient summertime temperatures, reduce heating and cooling costs, decrease the demand for energy production and reduce vulnerability to the effects of heat waves on at risk populations. Reduced heat slows the formation of ground level ozone as well as the evaporation of fuel from motor vehicles. Thirty-seven communities in Maryland have committed to participation in the UTC Goal effort to date. Baltimore City, Annapolis, and the Frederick County Board of Education have already adopted goals; the other communities are in the process of assessing their existing and potential UTC. Communities like Baltimore City have also begun to prioritize plantings for urban heat reduction and water quality improvement.

EDUARDO INFANTES

US FISH & WILDLIFE SERVICE

Seagrasses trap sediments and nutrients, and provide nursery habitat for juvenile fish and other commercial fisheries; however, they are also vulnerable to extreme events and poor water quality.

Trout are dependent on a specific range of coldwater temperatures to reproduce. With climate change, some streams may no longer be cold enough for successful trout reproduction, DNR and MDE have collaborated to assess which streams are most likely to remain as coldwater systems to ensure they are protected.

Chesapeake Bay and aquatic ecosystems

Background

The Chesapeake Bay is the largest estuary in the United States, fed by a watershed that stretches from mountains to sea, across 64,000 square miles (166,000 square kilometers), spanning six states—Maryland, Delaware, Virginia, West Virginia, Pennsylvania, New York, and the District of Columbia. Within its watersheds and oceanfront, Maryland's extensive aquatic ecosystems range from freshwater swamps and bogs, tidal and non-tidal freshwater rivers and marshes, tidal brackish and saline rivers and marshes, and coastal bays. These ecosystems are influenced by precipitation, temperature, tropical storms, and human activity. Currently, the services provided by the Bay are estimated to be approximately $1 trillion, annually. However, human development and pollution have degraded their natural resilience, leaving them more vulnerable to extreme events. Climate change will likely exacerbate this problem, creating a greater threat to these ecosystems. The Bay has already warmed by 3 degrees Fahrenheit and additional temperature increases could change the composition of commercial fisheries and increase anoxia in the Bay (Prasad et al 2011). To protect its marine, estuarine and aquatic ecosystems against future damage, the action is needed to alleviate existing stressors and to strategically conserve and restore critical bay and aquatic habitats.

Maryland Department of Natural Resources initiatives

Climate Change Criteria for Conservation

The DNR recently completed a project, "Coastal Land Conservation in Maryland: Targeting Tools and Techniques for Sea-level Rise Adaptation and Response." The purpose of the project was to develop new conservation criteria to identify coastal habitats that may help Maryland proactively adapt to sea-level rise and increased storm events associated with climate change. Climate change targeting criteria resulting from this project was used to develop new conservation areas for "GreenPrint" and a parcel-level scorecard used to review land acquisition projects. Trainings have been held with state land managers and conservation planners to share the new tools and datasets, and to implement them into current land conservation targeting and review processes.

Temperature Sensitive Stream Regulations

In 2011, the DNR and the MDE collaborated to create an update to Use Class III (naturally-reproducing trout) streams. Future coldwater protections are being assessed for contributing watersheds to these streams and for the protection of streams that harbor coldwater dependent invertebrate species. Future models may address those streams that will be most sensitive to climate change and those that will remain coldwater systems.

Guidelines and mapping for vulnerable ephemeral and headwater systems

The DNR has identified ephemeral and intermittent freshwater habitats that are highly sensitive to changes in precipitation regimes and ultimately climate change. These habitats include ephemeral, intermittent, and headwater stream systems and vernal pools. Headwater streams support rare and endangered species, serve as migratory corridors, and process and store proportionally larger amounts of nutrients and sediment than larger streams. Mechanisms are now being explored to increase mapping of these systems, to develop model ordinances, and develop model field protocol for their identification and protection by local governments and organizations.

MARK TWERY, US FOREST SERVICE

Ephemeral and intermittent freshwater habitats that are highly sensitive to changes in precipitation regimes and ultimately climate change.

Water Resources

Background

Generally, Maryland citizens are blessed with an abundant supply of water. However, many water systems are already stressed during droughts, and infrastructure damage and water contamination occurs during floods. Future population growth will combine with more uncertain weather patterns to place more communities at risk of property damage, regulatory liabilities, and uncertain access to drinking water. For example, the eastern shore is particularly susceptible to salt water intrusion as demand increases and sea-level rise, while the growing population in central and western Maryland stresses aquifers with inherently short-term storage capacities and risk of contamination.

Many of Maryland's water systems are already stressed from either drought, or the infrastructure damage and water contamination that occurs during floods. Here, Seneca Creek is shown in flood on 27 June 2006.

Photo © Aaron Skolnik, FEMA

In the past 30 years, Maryland's climate has become wetter and hotter, resulting in more runoff and longer heat waves. The state is currently experiencing higher precipitation in September and January. With a changing climate, Marylanders should expect more rain in the winter and spring and less in the summer, and more frequent and intense storm events. This will result in more frequent flooding and more numerous droughts. Current projections indicate that flooding will increase: 100-year floods will increase by 10–20 % and 10-year storms will increase by 16–30 %. There is a greater likelihood that more powerful rain and windstorms will strike Maryland as ocean waters warm, accompanied by higher storm surges and rainfall.

Maryland Department of the Environment (MDE) initiatives

Coastal Plain and Fractured Rock Studies

The MDE has two long-term water supply studies that are g conducted with the assistance of the Maryland Geological Survey, the U.S. Geological Survey, and the Department of Natural Resources Monitoring and Non-Tidal Assessment Division. The Coastal Plain and Fractured Rock studies were initiated in 2006 and 2009, respectively. These studies will develop information and tools to help the MDE make sound science-based decisions about water allocations, ensure ongoing sustainability of the resource, and evaluate the potential impacts of withdrawals on aquatic habitat. In addition, the studies will provide valuable information to assist local governments as they plan for future growth and water use needs.

The Coastal Plain study involves a complex aquifer model, which will be capable of modeling various management scenarios as well as potential impacts of climate change. The MDE is already using two important tools developed as part of these studies known as the Coastal Plain and Fractured Rock Aquifer Information Systems. These geographically-referenced tools provide MDE's permit project managers with up-to-date and easily accessible data, including geophysical logs, aquifer test information, water levels, well locations, and selected water quality data. Funding to continue the studies beyond SFY 2012 has not been identified to date.

Developing source water protection implementation measures for vulnerable communities

The MDE has delineated areas around each public water supply well or intake where measures should be taken to protect the water supplies from water quality impacts. More than three hundred communities around the State have adopted land use ordinances or other measures

to protect their water sources. In 2011, MDE contracted with two private consultants to assist twenty vulnerable groundwater communities to assist them in developing and implementing protection measures. This project will be complete in 2013.

Tools for water utilities

The MDE has produced a publication for public drinking water systems that provides the systems with information about the possible impacts of climate change on utilities and recommends a variety of adaptation measures to help water systems prepare for and/or avoid these impacts. The publication has been distributed by mail to all community water systems in the State.

Environmental Site Design

Current Maryland law and regulations require that Environmental Site Design (ESD) be used to the maximum extent practicable (MEP) to control stormwater from new and redevelopment. The goal is that ESD planning techniques and practices are to be implemented to replicate runoff characteristics similar to "woods in good condition." These practices reduce runoff and improve water quality and ultimately help buffer communities from the impacts of climate change.

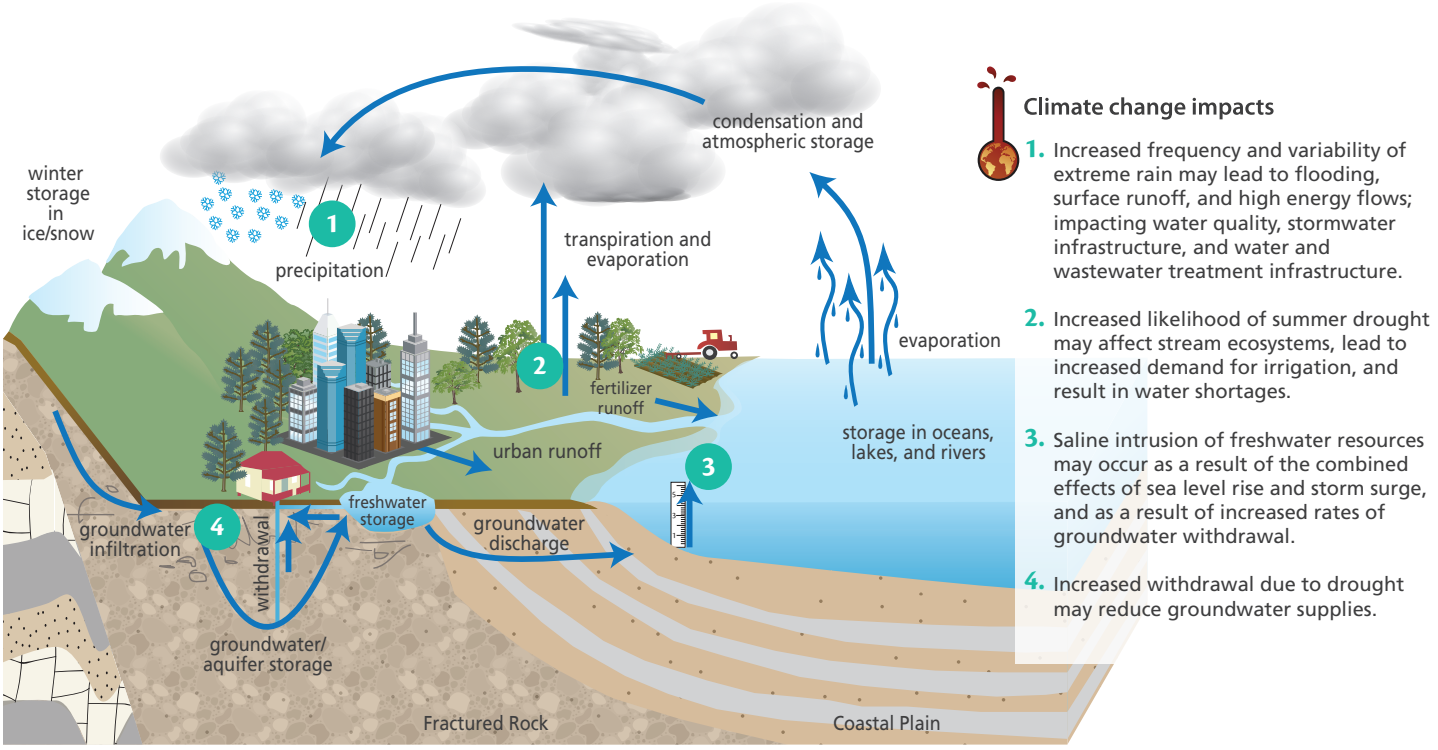

Figure 8.5 Climate change impacts on water resources.

Population Growth and Infrastructure

Background

Maryland's growing population lives and works primarily in a built environment and is reliant on transportation, water, and communication and energy networks, spanning a wide range of landscapes, from cooler Appalachian Mountains in the west, to low-lying areas of the Eastern Shore. These systems, regulated in part at the state level, but more directly influenced by local decision-making—are subject to pressures of shifting population and often—unreliable sources of funding support to address needed maintenance, planning and upgrade. The projected effects of climate change, including increases in precipitation variability and extremes, winter precipitation and temperature, are likely to affect the frequency, severity and timing of many existing problems, such as stormwater, or buckling of roads and malfunctioning train systems due to heat waves. Historical and current climate conditions will no longer be adequate to guide planning, design, operation and maintenance decisions.

For sustainable development, planning efforts must reflect and address projections for both population growth and the effects of climate change. Many areas in Maryland are expected to experience increased growth and development. Decisions about growth need to factor in climate impact projections. Temperature and precipitation extremes will likely harm infrastructure and affect human health. Increases in precipitation and the intensity of storm events will likely exacerbate existing problems, particularly in urban areas. Problems associated with stormwater, flooding, heat stress and air quality will likely worsen. Building codes, infrastructure design, emergency management and planned development should be oriented to reduce impacts caused by increased climate variability and extremes. Maryland's built environment needs to be reinforced to prepare for new temperature and precipitation regimes. Over time, changes to the system including the operation, maintenance, design and management of much of the State's built infrastructure may become necessary.

Maryland Department of Planning initiatives

State Development Plan - PlanMaryland

Governor Martin O'Malley on Dec. 19, 2011 accepted "PlanMaryland," the State's first long-range plan for sustainable growth, from Secretary Richard E. Hall of the Maryland Department of Planning, achieving a vision first laid out by the General Assembly a half-century ago. The Governor also filed an Executive Order to provide an overview of the process for implementation of the plan. Climate Change Impact Areas were identified as one of Plan Maryland's Areas of Special Designation. Climate Change Impact Areas include: projected 50 and 100-year Sea-level Rise Inundation Zones, 50-Year Erosion Vulnerable Zones, Category 2 Storm Surge Inundation Zones, Marsh Transition Zones, Temperature Sensitive Streams, Drought Hazard, and Wildfire Risk Areas. The intent of these designations is to ensure that the State and local governments make wise decisions about how we protect our natural resources, and where and how we develop and redevelop in light of climate change induced hazards and risks. Guidelines for reducing climate change impacts within these areas include:

- Promoting the safety and well-being of Maryland's citizens by avoiding infrastructure capacity improvements that increase human exposure to natural disasters; avoid assumption of the financial risk of development and redevelopment in vulnerable or hazardous coastal areas;
- Ensuring the wise and sound public investments in Maryland's sea-level rise inundation zone. However, appropriate conservation efforts along Maryland's shorelines should not preclude important investment in the State's water-dependent infrastructure, such as our seaports;

- Analyzing climate change impacts on historical and cultural resources and prioritize necessary recovery, documentation, and protection efforts; and
- Protecting critical natural environments from impacts of climate change (i.e., sea-level rise, temperature increase, precipitation change) and climate-induced natural hazards.

Department of Natural Resources initiatives

Community Connections Protocol Development

DNR has developed an additional protocol for assessing land conservation projects based on their value and ability to connect people to the land. The assessment includes a Climate Change Resilience component, which considers on-site adaptation benefits including community storm surge protection, shoreline stabilization and restoration, urban tree canopy protection, and future planned abandonment and relocation facilitation. The community connections protocol and scorecard will be used for appropriate proposed projects to be funded by Program Open Space.

State-wide Land Preservation and Recreation Plan

DNR is currently developing the 2014 State-wide Land Preservation and Recreation Plan (LPRP) in coordination with the Maryland Department of Planning, local governments, a wide range of stakeholders, and public input. This will be the first iteration of the LPRP to provide an analysis of how climate change may impact Maryland's natural and cultural resources, open space, recreation and tourism, as well as provide strategies for ensuring sustainability and increasing resilience. The LPRP will be a working resource and tool for state-wide outdoor recreation and open space planning.

University of Maryland, Environmental Finance Center

The Sustainable Maryland Certified Program (*http://www.efc.umd.edu/SustainableMaryland.html*) was launched in June 2011. Certification criteria for a Climate Change Adaptation Element was developed by the Planning and Built Environment Task Force and is included in the program elements.

LEIF SKOOGFORS, FEMA

Dorchester County, Md., June 2, 2006—Members of a Preliminary Damage Assessment Team (PDA) survey the damage to this road and bridge on Maryland's eastern shore. The teams, made up of State, County, and FEMA, evaluate damage and make a recommendation for a Federal disaster declaration. The damage to Maryland's roads, bridges, and housing was caused by severe rain and flooding.

Tools, research, and education to inform sound decisions

Background

Maryland managers and decision-makers need the right tools to anticipate and plan for climate change. Long-term monitoring and research efforts are critical. As Maryland experiences a new suite of hydrologic and temperature conditions, the State will need to gain a better understanding of these conditions. Financial, educational, scientific and political support will also be necessary in order to assess conditions and to research new ways to build up the resilience of natural and built infrastructure to the impending impacts of climate change.

Investment in education is also essential to teach public officials, planners, and other decision makers how to use the tools to formulate and implement specific actions. Coordination with the public is necessary, particularly those most vulnerable and without the necessary resources to respond. In the short-term, there is a critical need to establish and disseminate state-specific climate data and information in order to develop a common understanding of future planning needs at both state and local scales. This is an important first step to ensuring climate issues are during infrastructure planning, design, construction and budget processes.

Maryland Department of Natural Resources/University of Maryland, Center for Environmental Science initiatives

Information Dissemination

Information on both the Phase I and II adaptation strategies have been widely disseminated and presented at a variety of conferences, workshop and stakeholder events. Topic and sector-based fact sheets have been developed and are available online (*http://www.dnr.maryland.gov/climatechange/*). DNR and UMCES are both working to widely disseminate climate change-related data and information to agencies, stakeholders, and the public via existing networks and social media outlets.

Incorporation of climate change into education initiatives

In 2011, the DNR assembled a series of talking points on climate impacts in Maryland to be utilized by its education staff. The next step will involve incorporating climate change into existing education and outreach programs. Messages of most relevance to citizens will be used as appropriate in outreach programs aiming to encourage stewardship actions; while more direct coastal education programs and materials are being developed for use in classroom settings.

University of Maryland/Maryland State Department of Education

MADE-CLEAR

The recently funded Maryland and Delaware Climate Change Education, Assessment and Research (MADE CLEAR) program will bring together university faculty, middle school and high school teachers and informal educators to develop training opportunities in climate education across Maryland and Delaware. The goal will be to ensure that students graduating from Maryland schools understand the science behind climate change, the choices available to mitigate and adapt to a changing climate, and professional opportunities related to the green job market. For more information on MADE-CLEAR, visit:

http://www.madeclear.org/

Department of Natural Resources initiatives

Climate Change Adaptation Needs Assessment, Training and Technical Assistance

In 2012, the Chesapeake Bay National Estuarine Research Reserve's Coastal Training Program, DNR's Chesapeake and Coastal Program and Maryland Sea Grant initiated a needs assessment to better understand the training and technical needs of local governments to help them adapt to the impacts of climate change. The needs assessment was completed in the spring of 2012. Results of the needs assessment will be used to deliver targeted training and technical assistance to communities in order to better prepare them for climate change, coastal flooding and storm inundation through the CoastSmart Communities Initiative.

Conclusions

The information presented in this Chapter is not intended to be a final work product or strategy on climate change adaptation for the State of Maryland. It should be viewed as "living document" that provides a snapshot of where the state currently stands in terms of implementing its broad scale climate change adaptation planning efforts. The chapter is intended to provide the basis for guiding and prioritizing future state-level activities with respect to both climate science and adaptation policy within short to medium-term timeframes (i.e., 1–5 years). It is also envisioned that it will also serve as a framework not only to direct state-action, but also to engage policy-makers and stakeholders, and facilitate collaboration among federal, regional and local partners.

Adaptation planning efforts at the state-level will be routinely reviewed and updated new climate science and information becomes available and we gain a better understanding of how to adapt to climate change. State agencies leads, as well as internal and external partners will remain key to advancing climate change adaptation planning here in Maryland. In closing, it goes without saying that further detailed planning, stakeholder engagement, and funding will be required to build Maryland's ecological, societal and economic resilience to the impacts of climate change.

Chapter 9

Legislative priorities

Legislative Priorities for 2013

There were three major legislative initiatives that passed during the 2013 Legislative Session that are linked to the proposed GGRA plan: offshore wind, transportation funding and composting. Each of these initiatives is described below.

The Maryland Renewable Energy Portfolio Standard (RPS) is a law that requires Maryland to obtain 20 percent of its electricity from renewable sources by 2022.

The Maryland Offshore Wind Energy Act of 2013

Background:

In 2008, the General Assembly doubled Maryland's Renewable Portfolio Standard, requiring electricity suppliers to purchase 20 percent of the electricity they sell from renewable sources by 2022. In order to meet this requirement with home grown generation, Maryland will need to markedly increase its generation of electricity from wind, solar, geo-thermal and biomass energy sources. The most compelling source at present is off-shore wind. Last year, the General Assembly chose to put off a decision on offshore wind energy and to take a harder look at its variable policy considerations. Though the offshore wind industry has been operating in Europe for more than two decades, with 3,620 MW of installed capacity, there is currently no offshore wind energy generation in the United States. A number of states, however, have taken steps to promote the development of this industry.

Description:

The Maryland Offshore Wind Energy Act of 2013 will incentivize and support the construction of a roughly 200 megawatt major offshore energy project off of Maryland's coast. A project of this size could create almost 850 manufacturing and construction jobs for 5 years and an additional 160 supply and operations and maintenance jobs on an ongoing

basis thereafter. The project would supply electricity in enough capacity to power a third of the homes on the Eastern Shore of Maryland, or almost a quarter of the homes in Baltimore City. An offshore wind farm would reduce emissions of the greenhouse gas, CO_2, by over 378,000 tons per year and promise improved public health outcomes, cleaner air and cleaner water. The bill protects ratepayers. The Public Service Commission can only approve an offshore wind farm if it is projected to cost the average residential ratepayer $1.50 or less per month, and impact non-residential ratepayers by 1.5% or less of their total annual bill. Finally, the developer must show that the project will provide positive net economic, environmental and health benefits to the citizens of Maryland. There will be no impact to ratepayers until 2017 at the earliest.

Transportation Infrastructure Investment Act of 2013

Description:

Transportation Infrastructure Investment Act of 2013 (SB 1054/HB 1515) will index the state tax on gas with inflation, as measured by the Consumer Price Index. It will also index the Maryland Transit Administration administered fares to the Consumer Price Index. The bill applies a portion of the state sales tax to the wholesale price of gasoline. This portion will be 2% in 2013 and 4% in 2014. If Congress passes the Marketplace Equity Act (which would apply the state sales tax to internet sales) a percentage of the new revenues flowing into our State would be dedicated to transportation. If Congress fails to act by June 1, 2015 the entire state sales tax would be applied to the wholesale price of gasoline. This bill includes a "lockbox" provision to ensure that revenues generated remain dedicated for transportation purposes. The bill also creates a working group to recommend funding mechanisms for local transportation systems. The work group will study the feasibility of creating regional transit financing entities.

- Support 44,000 jobs over 5 years
- Address road and bridge needs in every part of our State
- Improve service on both WMATA and MTA public transit
- Move forward on the design, engineering and right of way acquisition for the Red Line and Purple Line light rail and Corridor Cities Transitway—projects that will be stopped dead-in-the-tracks without this additional revenue

Recycling - Composting Facilities

Background:

Composting, particularly food composting, is increasingly viewed as an efficient way in which to manage organics and remove these valuable materials from the solid waste stream. Organic or compostable wastes, including food wastes, compose approximately 30 percent of the solid waste stream and only about 11 percent of this material is currently recycled. In order to meet the goals of the Maryland Climate Action Plan, Maryland will need to significantly reduce the amount of solid waste disposed and emissions of greenhouse gases by 2020. Current goals require the State to divert 60 percent of the solid waste stream and recycle 55 percent of the waste stream by 2020. Composting, particularly of food scraps, is a high priority for MDE in its efforts to ensure that the counties can meet the current recycling and waste diversion goals.

Description:

The legislation requires MDE to adopt regulations that establish design and operational conditions for composting facilities and a new composting facility permit system. The legislation also gives MDE authority to exempt certain facility types from the new composting facility permit requirement. Finally, the legislation gives MDE authority to exempt certain organic materials from being considered "solid wastes" when composted. The definition of "solid waste" in Environment Article, §9-101(j) is amended to exclude from "solid waste" organic materials that are composted in accordance with the new composting facility provisions. Other organic materials will remain solid wastes.

Future Legislation

There are several pieces of legislation that did not pass during the 2013 legislative session but are anticipated to be reintroduced in the coming years:

Statewide Container Recycling Incentive Program

Four billion beverage containers are sold in Maryland each year, and fewer than 25% are reused or repurposed—the remainder end up in our landfills and litter our environment. More than 2 decades of data from deposit states point to the economic and environmental benefits of integrating beverage container deposit incentive programs with curbside recycling. Deposit systems are a proven policy tool for increasing beverage container recycling rates and protecting the environment—the 10 deposit states currently recycle more than 50% of all beverage containers in the United States, leading to reductions in greenhouse gas emissions and litter pollution.

Community Clean-up and Greening Act of 2013

The use of disposable carryout bags has garnered a lot of legislative attention over the last few years. Proponents of disposable bag restrictions emphasize that plastic bags clog waterways, harm wildlife, consume valuable landfill space, and lead to greater fossil fuel consumption. Proponents of paper bag restrictions argue paper bag manufacturing results in a significant loss of trees and generates substantial air and water pollution. Due to concerns associated with both plastic and paper bags, reusable bags are gaining popularity, despite their additional cost.

Dozens of jurisdictions have adopted fees, bans, or other programs to discourage the use of disposable bags or to promote bag recycling. In March 2007, San Francisco became the first city in the United States to ban nonbiodegradable bags from large grocery stores and pharmacies. North Carolina enacted a ban on plastic bags in the Outer Banks region, and Delaware requires stores to establish at-store recycling programs. The National Conference of State Legislatures notes that while no state has enacted a statewide ban, fee, or tax, Hawaii does have a defacto statewide ban, as all four counties in the state ban nonbiodegradable plastic bags at checkout and paper bags that are less than 40% recycled.

On January 1, 2010, a law took effect in the District of Columbia banning the use of disposable, nonrecyclable plastic carryout bags and requiring specified stores to charge a fee of 5 cents for each disposable bag a shopper is given. During its first two years of implementation, approximately $2.0 million in annual revenue was generated and used to protect the Anacostia River and other impaired waterways. In addition, it is estimated that the program reduced bag consumption by at least 50%.

Recent Legislative Actions Supporting the GGRA Plan—2006 to 2012

The remainder of this Chapter summarizes key legislative initiatives that are directly, or indirectly, supporting elements of the GGRA.

2006 Legislation

1. *"Healthy Air Act" (SB 154/ HB 189, Ch. 23 and 301, 2006 Laws of Maryland)* set annual emissions limits for designated coal-fired power plants in Maryland for nitrogen, sulfur dioxide, and mercury. The law was designed to bring the state into attainment with the National Ambient Air Quality Standards (NAAQS) for ozone and fine particulate matter by the federal deadline of 2010. The law also required Maryland to join the Regional Greenhouse Gas Initiative (RGGI), the Northeast regional cap-and-trade program designed to reduce greenhouse gas emissions from the power generating sector.
2. *"State Buildings Energy Efficiency and Conservation Act" (SB 267, Ch. 427, 2006 Laws of Maryland)* required State agencies to reduce their energy consumption by 5% by 2009 and 10% by 2010, using energy performance standards established by the Department of General Services in cooperation with the Maryland Energy Administration (MEA) for each agency. Agencies were required to conduct an analysis of their buildings to determine gas and electric usage and consumption costs, and to submit an Energy Conservation Plan to MEA in 2008 to include Energy Conservation Measures (ECM) to achieve the reduction goals. ECMs cited in the law include energy performance contracting, energy efficient lighting retrofits, water conservation devices, weatherization, efficient heating and cooling devices, and employee training.

2007 Legislation

1. *"Maryland Clean Cars Act of 2007" (SB 103/ HB 131, Ch. 111 and 112, 2007 Laws of Maryland))*. This Administration bill established a low emission vehicles program using California's CA LEV II emissions standards, to be phased in beginning with model year 2011.
2. *"Net Energy Metering - Renewable Energy Portfolio Standard - Solar Energy" (SB 595, Ch. 119, 2007 Laws of Maryland)* added a provision to the original 2004 Renewable Portfolio Standard (RPS) law requiring electricity suppliers to derive 2% of electricity sales from solar energy in addition to the 7.5% renewables derived from other Tier 1 resources as outlined in the 2004 law, *"Electricity Regulation - Renewable Energy Portfolio Standard and Credit Trading - Maryland Renewable Energy Fund" (SB 869/ HB 1308, Ch. 487 and 488, 2004 Laws of Maryland)*.
3. *"Environment - Statewide Electronics Recycling Program" (HB 488, Chapter 239, 2007 Laws of Maryland)* expanded the existing Statewide Computer Recycling Pilot Program *(HB575, Ch. 384, 2005 Laws of Maryland)* to apply to "covered electronic devices." The law increased registration fees for manufacturers, established prohibitions related to the sale of certain electronic devices, and established a new penalty. It required Maryland Department of the Environment to maintain a list of registered electronics manufacturers and to provide the list to the Comptroller for the purpose of assessing penalties, and authorized counties to address methods for the separate collection and recycling of electronic devices. The law also modified the revenue sources for the State Recycling Trust Fund to include all fines and penalties collected under *Title 9, Subtitle 17 – The Office of Recycling* and provided that the first $2M of any unspent or unencumbered funds would not be subject to reversion to the general fund.

2008 Legislation

1. *"Regional Greenhouse Gas Initiative - Maryland Strategic Energy Investment Program" (SB 268/ HB 368, Ch. 127 and 128, Laws of Maryland)*. This Administration bill created a publicly administered fund for investments in energy efficiency, renewables, and other climate protection programs, using revenues generated from the sale of carbon allowances under the Regional Greenhouse Gas Initiative (RGGI) program.
2. *"EmPOWER Maryland Energy Efficiency Act of 2008" (HB 374, Ch. 131, 2008 Laws of Maryland)*. This Administration bill requires utilities to reduce per capita electricity consumption by 10% by 2015 and peak demand by 15% by 2015 by implementing energy efficiency programs targeted to consumers. Working together with demand-side management programs implemented by the Maryland Energy Administration under *SB 268/ HB 368*, summarized in #1, this legislation is intended to achieve a 15% reduction in per capita reductions by 2015.
3. *"High Performance Buildings Act of 2008" (SB 208, Ch. 124, 2008 Laws of Maryland)*. This Administration bill requires all new and significantly renovated State buildings over 7,500 square feet, and all new public schools that receive state construction funds, to meet the LEED Silver building standard.
4. Renewable Energy Legislation
    a. *"Renewable Portfolio Standard Percentage Requirements - Acceleration" (SB 209/ HB 375, Ch. 125 and 126, 2008 Laws of Maryland)*. This Administration bill increased Maryland's renewable portfolio standard (RPS) percentage requirements to 20% by 2022, including a 2% level for solar, and increased the fee charged to electric suppliers for shortfalls.
    b. *"Renewable Energy Portfolio Standard - Tier 1 Renewable Source - Poultry Litter" (SB 348/ HB 1166, Ch. 135 and 136, 2008 Laws of Maryland)* encourages the use of poultry litter as a source of energy by making it a Tier 1 renewable source within the RPS.
    c. *"Solar and Geothermal Tax Incentive and Grant Program" (HB 377, Ch. 132, 2008 Laws of Maryland)*. This Administration bill increased grant awards and tax incentives for both solar and geothermal systems.
5. *"Maryland Transit Administration - Transit-Oriented Development" (HB 373 /SB 204, Ch. 122 and 123, 2008 Laws of Maryland)*. This Administration bill supports and promotes transit–oriented development throughout the state through the support and coordination of the Mass Transit Authority with local governments in land use planning around transit stations.
6. *"Maryland Clean Energy Center" (HB 1337, Ch. 137, 2008 Laws of Maryland)* promotes and assists the development of clean energy jobs and industry in the state and establishes the Maryland Clean Energy Technology Incubator Program to: (1) advocate and promote clean energy industries and green jobs in Maryland; and (2) drive development of the state's energy efficiency and renewable energy resources.
7. *"The Jane E. Lawton Loan Program" (SB 885/ HB 1301, Ch. 466 and 467, 2008 Laws of Maryland)* consolidated the Community Energy Loan Program and Energy Efficiency and Economic Development Loan Program into the Jane E. Lawton Loan Program to provide financial assistance in the form of low interest loans to nonprofit organizations, local jurisdictions, and eligible businesses for projects to conserve energy, reduce consumption of fossil fuels and improve energy efficiency.
8. *"The Chesapeake and Atlantic Coastal Bays Critical Area Protection Program – Administrative and Enforcement Provisions" (HB 1253, Ch. 119, 2008 Laws of Maryland)*. This Administration bill updated the program to: account for sea-level rise

in its jurisdictional boundaries; increase the required vegetated buffer requirement from 100 to 200 feet for new development; and include coastal flood hazards as a factor to consider during "growth allocation" decisions.

9. *"The Living Shoreline Protection Act" (HB 973, Ch. 304, 2008 Laws of Maryland)* requires the use of nonstructural, "living shoreline" stabilization measures that preserve the natural environment, except in areas mapped by the State as being appropriate for structural stabilization measures.

2009 Legislation

1. "*Greenhouse Gas Emissions Reduction Act of 2009" (SB 278/ HB 315, Ch. 171 and 172, 2009 Laws of Maryland)*. This Administration bill established a mandatory goal of reducing the state's GHG emissions 25% below 2006 levels by 2020. It found it to be in the state's best interest to act aggressively on the interim targets of 10% reduction by 2012 and a 15% reduction by 2015 but did not make these targets mandatory goals. Other features:
    a. MDE required to develop and implement a final plan by 2012 to achieve the 2020 goal, with recognition of the need to meet the longer-term goal of reducing emissions by up to 90% of 1990 levels by 2050
    b. MDE required to publish a statewide GHG inventory and projection
    c. MDE's authority to require monitoring, record keeping and reporting of GHGs retained
    d. Credit given for voluntary early reductions by GHG sources
    e. Offset credits given for in-state carbon sequestration and other projects
    f. Net economic benefit to the state and net increase of jobs
    g. Separate pathway for manufacturing sector
    h. Progress report on 2020 plan and economic impact study to Governor and General Assembly in 2015
    i. 2020 statewide reduction requirement terminates in 2016 unless General Assembly acts to continue or revise it

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Reducing air pollution will also improve the health of the Chesapeake Bay, as many pollutants released into the air are washed by rain and snow into streams and rivers which flow into the Chesapeake Bay.

2. Smart Growth Legislation

   a. *"Smart, Green and Growing - Local Government Planning - Planning Visions" (SB 273/ HB 294, Ch. 176 and 177, 2009 Laws of Maryland)*. This Administration bill revised the State and local comprehensive planning visions; provides for the proceeds from the transfer of development rights into a priority funding area (PFA) to be used to fund transit-oriented development and other infrastructure in the PFA; and requires local jurisdictions to report to the Department of Planning any restriction that an adequate public facilities ordinance places on development in a PFA and to propose a resolution to the restriction.

   b. *"Smart, Green and Growing - Annual Report - Smart Growth Goals, Measures and Indicators and Implementation of Planning Visions" (SB 276/ HB 295, Ch. 178 and 179, 2009 Laws of Maryland)*. This Administration bill requires Maryland Department of Planning (MDP) to develop smart and sustainable growth measures and indicators in conjunction with the National Center for Smart Growth Research and Education at the University of Maryland College Park; adopted a statewide goal to increase the percentage of growth located in PFAs and decrease growth outside PFAs; requires local jurisdictions to develop incremental goals toward achieving the statewide goal; and requires local jurisdictions and MDP to file annual reports on measures and indicators which include information about the resources needed for infrastructure inside the PFA and land preservation outside the PFA.

   c. *"Smart, Green and Growing - Smart and Sustainable Growth Act of 2009" (SB 280/ HB 297, Ch. 180 and 181, 2009 Laws of Maryland)*. This Administration bill clarified that local land use ordinances must be consistent with local comprehensive plans and overturned the Court of Appeals' ruling in Terrapin Run that a special exception can be granted even if it does not strictly conform to the comprehensive plan; requires local planning commissioners and board of appeals members to take a course on the role of comprehensive plans, special exceptions and variances, and local zoning ordinances; and requires the Critical Area Commission to decide whether local alternative standards for growth allocations et al. are consistent with local comprehensive plans.

   d. *"Tax Increment Financing and Special Taxing Districts - Transit-Oriented Development" (HB 300, Ch. 182, 2009 Laws of Maryland)*. This Administration bill provided new funding mechanisms for local governments to finance transit-oriented development and supporting infrastructure improvements.

3. *"Budget Reconciliation and Financing Act of 2009" (HB 101, Ch. 487, 2009 Laws of Maryland)*. This Administration budget bill adjusted the distribution formula established in the 2008 legislation creating the Strategic Energy Investment Fund or SEIF (see 2008 Legislation, Item 1) for proceeds from the Regional Greenhouse Gas Initiative (RGGI) allowance auctions for fiscal 2010 and 2011 as follows in Figure 9.1:

Figure 9.1 Adjustments to distribution formula for proceeds from the Regional Greenhouse Gas Initiative.

	2008 SEIF law	2009 budget reconciliation
Low income energy assistance	17%	50%
Residential rate relief	23%	23%
Energy efficiency, conservation and demand response	at least 46%	at least 17.5 %
Renewable and clean energy; public education and outreach; climate change	up to 10.5%	at least 6.5%
Administrative costs	up to 3.5%*	up to 3.0%*

* But not more than $4 million

4. *"Environment - Green Building Council" (SB 212/ HB 154, Ch. 224 and 225, 2009 Laws of Maryland)* expanded the scope and responsibilities of the Green Building Council to make annual recommendations to the General Assembly on how to expand green building in the state and report on progress made during the previous year.
5. Renewable Energy Tax Incentives
    a. *"Sales and Use and Property Tax - Exemptions - Solar Energy Equipment and Property" (SB 621, Ch. 574, 2009 Laws of Maryland)* expanded the sales and property tax exemption for solar energy equipment and property to systems that sell electricity to the grid.
    b. *"Alternative Energy Tax Incentive Act of 2009" (HB 1171, Ch. 444, 2009 Laws of Maryland)* expanded the sales and property tax exemption for alternative energy systems to residential wind energy systems, and expanded the property tax exemption to solar systems used to provide hot water or electricity to structures (these were already exempt from sales tax).
6. Forests and Agricultural Lands Protection Legislation
    a. *"Sustainable Forestry Act of 2009" (SB 549, Ch. 175, 2009 Laws of Maryland)* established an advisory Sustainable Forestry Council; promotes improved forestry practices through approved forest stewardship plans; promotes the sustainable use of forest products for fuel; requires local advisory boards to advise local governments on agricultural preservation measures; established funding to, inter alia: 1) protect forests from natural disasters and development; 2) offset Forest Service costs for overseeing plan approvals; 3) promote expansion of urban tree canopy cover; 4) develop a trading program for forest carbon credits and other environmental services; and 5) promote markets for value-added wood products.
    b. *"Natural Resources - No Net Loss of Forest Policy - Forest Conservation Act" (SB 666, Ch. 298, 2009 Laws of Maryland)* closed some loopholes in the Forest Conservation Act by reducing the square footage of exempt properties, tripling the in-lieu fee, expanding the use of the Forest Conservation Fund to include urban tree canopy goals, and requiring that certain species, sensitive areas and contiguous forest be left undisturbed absent a variance or demonstration that protective measures are not feasible.
7. *"State Government - Recycling Program - Aluminum, Glass, Paper and Plastic" (HB 595, Ch. 408, 2009 Laws of Maryland)* required Maryland Department of the Environment to include in the State recycling program by July 1, 2010 a system to recover aluminum, glass, paper, and plastic generated for disposal by State government and to place recycling bins in State office buildings.
8. *"Maryland Building Performance Standards - Energy Conservation and Efficiency" (SB 625, Ch. 294, 2009 Laws of Maryland)* required the Department of Housing and Community Development (DHCD) to adopt the International Energy Conservation Code (IECC) and to consider changes to the International Building Code (IBC) to enhance energy conservation and efficiency before adopting a subsequent version of the Maryland Building Performance Standard (MBPS). The law authorized DHCD to adopt energy conservation requirements that are more stringent than in the IECC and required local governments to implement and enforce the most current MBPS and any modifications thereto, within six months of State adoption.

2010 Legislation

1. *"Maryland Clean Energy Incentive Act of 2010" (HB 464, Ch. 493, 2010 Laws of Maryland)*. This Administration bill extended the existing clean energy incentive State income tax credit for 5 years, through December 31, 2015, for electricity generated by

qualified Maryland facilities from renewable energy resources, such as such as solar, wind and geothermal.

2. Plug-in Vehicle Legislation

   a. *"Motor Vehicle Excise Tax - Tax Credit for Electric Vehicles" (HB 469, Ch. 490, 2010 Laws of Maryland)*. This Administration bill created a 3-year vehicle excise tax exemption for the purchase of plug-in electric vehicles (PHEV), capped at $2,000 per vehicle. Exemptions are limited to one per individual and 10 per business entity.

   b."*High Occupancy Vehicle (HOV) Lanes - Use by Plug-In Vehicles" (HB 674, Ch. 491, 2010 Laws of Maryland)* permits plug-in vehicles, both hybrid and electric, to use high occupancy vehicle (HOV) lanes, without restrictions on the number of passengers required to be in the vehicle.

3. *"Renewable Energy Portfolio Standard - Solar Energy" (SB 277, Ch. 494, 2010 Laws of Maryland)*. This Administration bill accelerated Maryland's Renewable Portfolio Standard (RPS) requirements for solar energy in the early years (2011–2017), while leaving unchanged the RPS's 2022 goal of 2% for solar. The original bill would have increased the alternative compliance fee charged to electric suppliers for shortfalls in meeting the solar requirement, but was amended to leave the fee unchanged.

4. *"Smart, Green, and Growing - The Sustainable Communities Act of 2010" (HB 475, Ch. 487, 2010 Laws of Maryland)*. This Administration bill re-established the Heritage Structure Rehabilitation Tax Credit Program as the Sustainable Communities Tax Credit Program. It extended the program's termination date through FY14, authorized the Governor's Smart Growth Subcabinet to designate specified areas as sustainable communities eligible for specified funding and tax credits, and requires Maryland Department of Transportation to consult with the Subcabinet and consider designated sustainable communities in its annual Consolidated Transportation Program (CTP) revisions.

5. Net Metering Legislation

a. *"Net Metering - Payment for Accrued Generation Credit" (SB 355, Ch. 438, 2010 Laws of Maryland)* requires an electric company to pay customers who generate energy primarily for their own onsite use for any excess generation, at the same retail electric rate the customer pays for the consumption of electricity. It also repealed the one-year limitation for accrual of a customer-generator's generation credits.

b. *"Electricity - Net Energy Metering - Credits" (HB 801, Ch. 437, 2010 Laws of Maryland)* changed the accrual of credits for a customer-generator from a kilowatt-hour (kWh) basis to a dollar basis.

c. *"Net Energy Metering - Fuel Cell" (SB 529/ HB 821, Ch. 573 and 574, 2010 Laws of Maryland)* added fuel cells as a source of generation eligible for net energy metering.

6. *"Green Maryland Act of 2010" (SB 693/ HB 1164, Ch. 593 and 594, 2010 Laws of Maryland)* increased recycled paper from 40% to 90% of the total volume of paper purchasing by the Department of General Services (DGS), boosted preferential purchasing for all recycled products, requires State agencies to report to Maryland Department of the Environment (MDE) annually on their recycled materials procurement, established preferential purchasing of compost as fertilizer in public lands and publicly-funded activities, and requires DGS in consultation with MDE to develop strategies, best practices and specifications to implement environmentally preferable purchasing.

7. *"Solid Waste Management - Recycling and Source Reduction - Study" (HB 982, Ch.*

719, 2010 Laws of Maryland) requires Maryland Department of the Environment to evaluate the solid waste management processes that might be used by the State to reduce the waste stream through recycling and source reduction, as well as examining long-term funding for solid waste management and recycling in the State.

8. Forests and Agricultural Lands Protection Legislation

a. *"Forest Conservation Fund - Contribution Rates - Priority Funding Areas" (HB 1352, Ch. 466, 2010 Laws of Maryland)* altered the rates for contributions to the State Forest Conservation Fund and local forest conservation funds by establishing higher rates for projects located outside priority funding areas (PFAs).

b. *"Maryland Agricultural Preservation Foundation - Farmland Preservation Partnership Program" (SB 95, Ch. 36, 2010 Laws of Maryland)* authorized the Maryland Agricultural Land Preservation Foundation to establish a Farmland Preservation Partnership Program to preserve productive agricultural and forested lands, to develop criteria for qualifying properties and to form partnerships to purchase easements on such properties.

c. "*Woodland Incentives Program - Prohibition on Use of Federal Funds - Repeal" (SB 69, Ch. 215, 2010 Laws of Maryland)*. This legislation, introduced by the Department of Natural Resources, repealed a condition that applicants for the State's Woodland Incentives Program (WIP) not receive or use federal funds for the same land described in the WIP application. The WIP program provides cost sharing assistance for tree planting, site preparation and timber stand improvement practices on properties that have the potential to be harvested for forest products.

d. *"Department of Agriculture - Advertising Agricultural Products as Locally Grown - Regulatory Authority" (HB 421, Chapter 413, 2010 Laws of Maryland)* authorized the Secretary of Agriculture to adopt standards to regulate the use of the terms "locally grown" and "local" to advertise or identify an agricultural product and prohibits a person from violating those standards. Before adopting the standards, the Secretary must convene and consult with an advisory group of interested stakeholders

e. *"Nutrient Trading - Voluntary Agricultural Nutrient Credit Certification Program" (HB 974, Chapter 447, 2010 Laws of Maryland)* gave the Maryland Department of Agriculture the authority to implement a nutrient credit trading program by verifying and certifying tradable agricultural credits, reviewing technical elements and approving those practices subject to additional procedures, and facilitating transactions between participating parties by reviewing contracts and establishing a web-based registry to post trades, track credits, and assist users in the management of their accounts.

9. "Budget Reconciliation and Financing Act of 2010" (SB 141, Ch. 484, 2010 Laws of Maryland). This Administration budget bill kept in effect for FY11 the distribution formula adopted by the General Assembly in the 2009 Session, which adjusted the distribution formula established in the 2008 law creating the Strategic Energy Investment Fund (SEIF) for proceeds from the Regional Greenhouse Gas Initiative (RGGI) allowance auctions for fiscal 2010 and 2011. (See 2009 Legislation, Item 3, for the adjusted formula.)

10. "Smarter Transportation Choices for Maryland" Legislative Suite

a. *"Transportation - Consolidated Transportation Program - Evaluation and Selection of Proposed Capital Projects" (HB 1155, Ch. 725, 2010 Laws of Maryland)* requires Maryland Department of Transportation's Consolidated Transportation Program (CTP) to include, in its expenditure account for each major capital project, a general summary ensuring that the project satisfies State Transportation goals, State Development Plan goals, and Climate Action Plan goals required by the Greenhouse

Gas Emissions Reduction Act of 2009 (GGRA, SB 278/ HB 315, Ch. 171 and 172, 2009 Laws of Maryland). The law also requires that before a major capital project is considered for inclusion in the CTP, a request must be submitted justifying the project based on State planning and climate protection goals.

b. *"Vehicle Laws - Bicycles, EPAMDs, and Motor Scooters - Rules of the Road" (SB 51, Ch. 517, 2010 Laws of Maryland)* requires that a driver of a vehicle, when overtaking a bicycle, an Electric Personal Assistive Mobility Device (EPAMD), or a motor scooter, pass safely at a distance of not less than 3 feet, with a specified exception; requires a driver of a vehicle to yield the right-of-way to a person who is riding a bicycle, an EPAMD, or a motor scooter in a bike lane or shoulder under specified circumstances; etc.

c. *"Vehicle Laws - Bicycles and Motor Scooters - Rules of the Road" (SB 624, Ch. 518, 2010 Laws of Maryland)* authorizes a person operating a bicycle to ride the bicycle in or through a crosswalk in specified locations under specified circumstances; requires a vehicle to yield the right-of-way under specified circumstances to a bicycle that is in a crosswalk; authorizes, under specified circumstances, a person who is operating a bicycle or motor scooter to use the roadway even if a shoulder is present; etc.

11. *"Transportation Projects - Bicycle and Pedestrian Access - Funding and Reporting" (HB 282, Ch. 145, 2010 Laws of Maryland)* declared that it is the policy of the State that, in developing the annual Consolidated Transportation Program, the Maryland Department of Transportation shall work to ensure that there is a balance between funding for specified transportation projects for pedestrians and bicycle riders and specified highway construction projects.

12. *"Real Property – Restrictions - Clotheslines or Other Similar Laundry Drying Devices" (SB 224, Ch. 253, 2010 Laws of Maryland)* authorizes the governing body of a condominium, homeowners association, or housing cooperative or a landlord to adopt reasonable rules and regulations regarding use of clotheslines and other similar laundry drying devices. (According to the U.S. Department of Energy, appliances account for 17% of the average household's energy consumption, with refrigerators, clothes washers, and clothes dryers among the highest users of electricity).

2011 Legislation

1. *"Budget Reconciliation and Financing Act of 2011" (HB 72, Ch. 395, 2011 Laws of Maryland)*. This Administration budget bill adjusted the distribution formula established in the "Budget Reconciliation and Financing Act of 2009" (See 2009 Legislation, Item 3) for proceeds from the Regional Greenhouse Gas Initiative (RGGI) allowance auctions (the SEIF fund) for fiscal years 2012 through 2014 as follows in Figure 9.2:

Figure 9.2 Adjustments to distribution formula for proceeds from the Regional Greenhouse Gas Initiative.

	2009 budget reconciliation	2011 budget reconciliation
Low income energy assistance	50%	up to 50%
Residential rate relief	23%	covered in same 50%
Energy efficiency, conservation and demand response	at least 17.5%	at least 20%
Renewable and clean energy; public education and outreach; climate change	at least 6.5%	at least 20%
Administrative costs	up to 3.0%*	up to 10%*

* But not more than $4 million

2. Plug-in Vehicle Legislation

    a. *"Income Tax - Tax Credit for Electric Vehicle Recharging Equipment" (HB 163, Ch. 402, 2011 Laws of Maryland)*. This Administration bill created a 20% state income tax credit for up to 20% of the purchase price of electric vehicle charging equipment for tax years 2011–2013.

    b. *"Electric Companies - Pilot Program for Charging Electric Vehicles" (SB 179/ HB 164, Ch. 403 and 404, 2011 Laws of Maryland)*. This Administration bill directed the Public Service Commission to lead development of a pilot program to incentivize off peak charging of electric vehicles.

    c. *"Maryland Electric Vehicle Infrastructure Council" (SB 176/ HB 167, Ch. 400 and 401, 2011 Laws of Maryland)*. This Administration bill established the Council to develop a plan and report to the Governor and the General Assembly by December 1, 2012 regarding integration of electric vehicles into the State's transportation network.

3. Renewable Energy and Net Metering Legislation

    a. *"Renewable Energy Portfolio - Waste-to-Energy and Refuse-Derived Fuel" (SB 690, Ch. 519, 2011 Laws of Maryland)* added waste-to-energy and refuse-derived fuel to the State's list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's Renewable Portfolio Standard (RPS), provided the source is connected with the distribution grid serving Maryland.

    b. *"Renewable Energy Portfolio Standard - Renewable Energy Credits Solar Water Heating Systems" (SB 717/ HB 933, Ch. 407 and 408, 2011 Laws of Maryland)*. This Administration bill added solar hot water systems to the State's list of Tier 1 renewable energy sources, making the systems eligible for inclusion in meeting the State's RPS.

    c. *"Electricity - Net Energy Metering" (SB 380/ HB 860, Ch. 405 and 406, 2011 Laws of Maryland)*. This Administration bill altered the period during which electricity customers who generate energy primarily for their own onsite use may accrue net excess generation, requires utilities to carry forward net excess generation until consumption eliminates the net excess generation or the accrual period expires, altered how the dollar value of a specified net excess generation is calculated, and repealed a requirement that generation credit appear on the bill in a dollar amount.

    d. *"Public Service Commission - Certificate of Public Convenience and Necessity - Renewable Source Generator Lead Line" (SB 691/ HB 590, Ch. 83 and 84, 2011 Laws of Maryland)* requires a certificate of public convenience and necessity (CPCN) prior to beginning construction in the State of an overhead transmission line designed to carry an out-of-state tier 1 or Tier 2 renewable source of energy above a certain threshold into Maryland.

4. *"State Vehicle Fleet and Gasoline Service Facilities - Use and Selling of Biofuels" (SB 961, Ch. 567, 2011 Laws of Maryland)* added biofuels as an alternative fuel the state may use to meet a percentage blend requirement for its vehicle fleet.

5. *"Public Service Commission - Customer Education on Customer Choice" (SB 244/ HB 597, Ch. 202 and 203, 2011 Laws of Maryland)* requires the Public Service Commission to host a section on its website to educate Marylanders on consumer options for energy purchases.

6. *"Environment - Composting" (HB 817, Ch. 363, 2011 Laws of Maryland)* requires Maryland Department of the Environment to maintain information on its website to educate the public about composting and, in consultation with the Maryland

Department of Agriculture and Maryland Environmental Services, to study composting and make recommendations to the General Assembly on how to promote composting in the State, including any necessary programmatic, legislative, or regulatory changes.

7. *"Building Codes - International Green Construction Code" (HB 972, Ch. 369, 2011 Laws of Maryland)* authorized the Department of Housing and Community Development to adopt by regulation the International Green Construction Code (IGCC). The law also authorized local governments to adopt and make amendments to the IGCC.

2012 Legislation

1. Renewable Energy Legislation
   a. *"Renewable Energy Portfolio Standard - Solar Energy and Solar Water Heating Systems" (SB 791/ HB 1187, Ch. 583 and 584, 2012 Laws of Maryland)* accelerated the two percent solar carve-out compliance schedule in the State's RPS, moved up the final target date for achieving the solar carve-out from 2022 to 2020, and authorized an equivalent certification for measurement for energy generated by solar water heating systems. .
   b. *"Renewable Energy Portfolio Standard - Renewable Energy Credits - Geothermal Heating and Cooling" (SB 652/ HB 1186, Ch. 556 and 557, 2012 Laws of Maryland)* added geothermal heating and cooling systems that meet certain standards systems to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.
   c. *"Renewable Energy Portfolio Standard - Renewable Energy Credits - Thermal Biomass Systems" (SB 1004, Ch. 635, 2012 Laws of Maryland)* added thermal energy associated with biomass systems that primarily use animal waste (possibly supplemented by other biomass resources) to the list of Tier 1 renewable energy sources eligible for inclusion in meeting the State's RPS.
2. Plug-in Vehicle Legislation
   a. *"Public Utilities - Electric Vehicle Users and Charging Stations - Exclusions" (SB 997 /HB 1280, Ch. 631 and 632, 2012 Laws of Maryland)* altered the definitions of "electricity supplier" and "public service company" to exclude a person that owns or operates equipment used for charging electric vehicles, and altered the definition of "retail electric customer" to exclude a person that charges an electric vehicle at an electric vehicle charging station.
   b. *"Motor Vehicle Administration - Plug-in Vehicles - Disclosure of Personal Information" (SB 998/ HB 1279, Ch. 334 and 335, 2012 Laws of Maryland)* requires the MVA to disclose information describing plug-in vehicles and the addresses of their registered owners to electric companies for the purpose of planning for the availability and reliability of the electric power supply, and prohibits the use or re-disclosure of this information for solicitation purposes.
3. Agricultural Lands Protection Legislation
   a. *"Sustainable Growth and Agricultural Preservation Act of 2012 (SB 236, Ch. 149, 2012 Laws of Maryland).* This Administration bill limits the disproportionate land consumption and pollution impacts to the Bay and local waterways from development on septic systems by providing an option for local governments to adopt a Growth Tier map to identify the following: areas designated for sewer development (Tier I and Tier II); areas for large-lot septic development, both major and minor subdivisions (Tier III); and preservation and conservation areas (Tier IV), where only minor subdivisions can occur. Jurisdictions that

do not elect to map Tiers may not approve major subdivisions outside of areas currently served by public sewerage systems.

b. *"Sediment Trading - Agricultural Nutrient and Sediment Credit Certification Program" (SB 118,Chapter 25, 2012 Laws of Maryland)* authorized the Maryland Department of Agriculture to establish requirements for the certification and registration of sediment credits on agricultural land under the 2010 law creating the Voluntary Agricultural Nutrient Credit Certification Program. (See 2010 Legislation, Item 8.e.)

4. Recycling Legislation

a. *"Environment - Statewide Electronics Recycling Program" (HB 879, Ch. 400, 2012 Laws of Maryland)* made various changes to the Statewide Electronics Recycling Program (see 2007 Legislation, Item 3), including altering registration exemptions, fees, and penalties for electronic device manufacturers, requiring certain sales data to be treated as confidential and proprietary, and requiring manufacturers with takeback programs to provide information relating to the destruction and sanitization of data. The law also requires Maryland Department of the Environment to: 1) maintain a list of registered manufacturers on its website; 2) take over the Comptroller's penalty enforcement authority; and 3) convene a workgroup to review and assess the impact of registration fee for manufacturers that do not have takeback programs and report to specified legislative committees by December 31, 2015.

b. *"Procurement - Preferences - Purchasing and Recycling Electronic Products" (HB 448, Ch. 372, 2012 Laws of Maryland)* requires State agencies to purchase only electronic products that meet nationally recognized and consensus-based standards and to procure electronic recycling services that are certified or meet comparable standards approved by Maryland Department of the Environment in consultation with the Department of General Services.

c. *"Environment – Recycling Rates and Waste Diversion – Statewide Goals" (HB 929, Ch. 692, 2012 Laws of Maryland)* increases waste diversion through recycling targets from 20% to 35% for counties with a population of over 150,000, from 15% to 20% for counties with a population of less than 150,000, and from 20% to 30% for State government. Counties must include the new target in their recycling plan by July 1, 2014 and fully implement the plan by December 31, 2015. Each unit of State government must implement a recycling plan with the new target by July 1, 2014. The law also establishes a voluntary statewide recycling goal of 55% by 2020 and a voluntary statewide waste diversion goal of 60% by 2020.

d. *"Environment – Recycling – Apartment Buildings and Condominiums" (SB 208/ HB 1, Ch. 191 and 192, 2012 Laws of Maryland)* requires owners or managers of apartment buildings or councils of unit owners of condominiums containing 10 or more units to provide for the collection and removal of recyclable materials by October 1, 2014. The law authorizes counties to require property owners, managers, and councils of unit owners to report to the county on recycling activities and established a penalty for noncompliance with the county recycling plan. Enforcement of the law, including the authority to conduct inspections, is to be provided by a local government, and any penalties collected are paid to the jurisdiction that brought the enforcement action. Effective October 1, 2013, each county must address the law's requirements in its recycling plan. The law does not preempt any other laws or ordinances, including civil penalties, that are more stringent.

e. *"Prince George's County Board of Education – Recycling Program – School Facilities" (HB 805, Ch. 396, 2012 Laws of Maryland)* requires the Prince George's County Board of Education to develop and implement a recycling program for all facilities under its jurisdiction and, by September 1, 2012, to submit to the County's legislative delegation a report which includes the program's implementation status and the methods used to promote and determine compliance with the program requirements.

5. *"Maryland Building Performance Standards - Hotels - Mandatory Master Control Device" (SB 869/ HB 940, Ch. 606 and 607, 2012 Laws of Maryland)* requires each hotel guest room in a newly constructed hotel to be equipped with a master control device that automatically turns off the power to all of the lighting fixtures in the guest room no more than 30 minutes after the room has been vacated. The law directs the Department of Housing and Community Development to adopt the law's provisions as part of the Maryland Building Performance Standards.

2013 Legislation

1. Renewable Energy Legislation

   a. *"Maryland Offshore Wind Energy Act of 2013" (HB 226, Ch. 3, 2013 Laws of Maryland)*. This Administration bill created a "carve-out" for offshore wind energy in the State Renewable Energy Portfolio Standard (RPS), beginning in 2017, and extending beyond 2022. The law established an application and review process for proposed offshore wind projects by the Public Service Commission and specified a window of maximum rate impacts for both residential and nonresidential electric customers. The law established a Maryland Offshore Wind Business Development Fund and Advisory Committee in the Maryland Energy Administration to promote emerging businesses related to offshore wind and also established a Clean Energy Program Task Force. The law established specified funding sources including transfers from the Strategic Energy Investment Fund (SEIF) and developer payments.

   b. *"Thermal Energy - Task Force and Regulation" (SB 797/ HB 1084, Ch. 322 and 323, 2013 Laws of Maryland)* established a Maryland Thermal Renewable Energy Task Force to study and make recommendations regarding the inclusion of thermal energy in the State's Renewable Portfolio Standard (RPS).

   c. *"Public Utilities - Solar Photovoltaic Systems" (SB 887, Ch. 572, 2013 Laws of Maryland)* requires persons who construct generating stations that produce electricity from solar photovoltaic systems that are exempt from having to obtain certificates of public convenience and necessity to apply for approval from the Public Service Commission at least six months before construction begins and pay a refundable deposit of 1% of the total installed costs of the project to ensure timely construction. Forfeited deposits are transferred to the Maryland Strategic Energy Investment Fund (SEIF).

   d. *"Renewable Energy Portfolio Standard - Solar Water Heating Systems" (HB 1534/ SB 1034, Ch. 341 and 342, 2013 Laws of Maryland)* expanded the definition of "solar water heating system" for the purpose of compliance with the State's Renewable Portfolio Standard (RPS) to include concentrating solar thermal collectors as defined and certified to the OG-100 standard of the Solar Ratings and Certification Corporation (SRCC).

   e. *"School Buildings - Solar Technology - Design Development Documents" (SB 245/ HB 103, Ch. 216 and 217, 2013 Laws of Maryland)* requires the design development documents submitted by local boards of education for the

construction or major renovation of a public school building to include an evaluation of the use of solar technology, including photovoltaic or solar water heating, based on life-cycle costs. If an evaluation determines that solar technology is not appropriate, the local board must submit a report explaining why it is not appropriate.

f. *"Garrett County - County Commissioners - Industrial Wind Energy Conversion Systems" (SB 370, Ch. 463, 2013 Laws of Maryland)* requires that industrial wind energy systems comply with setback rules equal to no less than two and a half times the structure height. Permit applicants must ensure that decommissioning and site restoration costs will be covered by paying for a cost estimate by a professional engineer and posting bond.

g. *"Maryland Energy Administration - Regulated Sustainable Energy Contract Program" (HB 621, Ch. 625, 2013 Laws of Maryland)* authorized the Maryland Energy Administration (MEA) to create a Regulated Sustainable Energy Contract Program whereby qualified contractors install residential renewable energy installations and residential energy efficiency measures on residential property under regulated sustainable energy contracts of up to $30,000 that are recorded in land records and enforceable by imposition of a lien on the property. MEA must perform a feasibility study before developing and implementing the program and may develop and implement a test or pilot program and must provide a progress report to the General Assembly by December 31, 2013.

2. *"Transportation Infrastructure Investment Act of 2013" (HB 1515, Ch. 429, 2013 Laws of Maryland)*. This Administration bill: (1) imposed additional motor fuel taxes on all fuels except aviation gasoline and turbine fuel based on the retail price of gasoline and inflation; (2) placed restrictions on transfers from the Transportation Trust Fund (TTF) and use of TTF monies; (3) increased the vehicle registration fee surcharge, the revenue from which is credited to the Maryland Emergency Medical System Operations Fund; (4) requires the Maryland Transit Administration to increase base fare prices beginning in fiscal 2015; (5) requires the Governor to include in the capital or operating budget specified appropriations to the State Highway Administration for use in complying with the Watershed Implementation Plan; and (6) established a Local and Regional Transportation Funding Task Force and requires Maryland Department of Transportation to conduct specified studies.

3. Plug-in Vehicle Legislation

   a. *"Vehicle Laws - Electric Vehicles" (SB 600/ HB 836, Ch. 64 and 65, 2013 Laws of Maryland)* extended by two years the termination date for the Maryland Electric Vehicle Infrastructure Council and by four years the authorization for plug-in electric drive vehicles to use high occupancy vehicle (HOV) lanes. The law also altered and harmonized variations of the defined term "plug-in electric drive vehicle" in the Maryland Vehicle Law.

   b. *"Tax Credits - Electric Vehicles - Extensions" (HB 791, Ch. 389, 2013 Laws of Maryland)* extended the State income tax credit for qualified electric vehicle recharging equipment through tax year 2016 and the qualified electric vehicle excise tax credit through June 30, 2014, subject to available funding. The law requires funds from the Strategic Energy Investment Fund to be transferred to the general fund and the Transportation Trust Fund in order to offset revenue losses caused by the tax credits.

4. *"Recycling - Composting Facilities" (HB 1440, Ch. 686, 2013 Laws of Maryland)*. Filed by request of the Administration, this law requires Maryland Department of the Environment to adopt regulations governing the permitting and operation of

composting facilities and prohibits a person from operating a composting facility that is not in accordance with the regulations or any permit or order issued under the composting laws in Title 9 of the Environment Article. The law altered several definitions in order to treat compost and composting separately from the regulation of solid waste.

5. *"Natural Resources - Forest Preservation Act of 2013" (HB 706, Ch. 384, 2013 Laws of Maryland)* established that it is the policy of the State to achieve no net loss of forest. "No net loss of forest" means 40% of all public and private land in Maryland is covered by tree canopy. The bill also made various changes aimed at preserving forest land in the state.
6. *"State Personnel - Teleworking - Statewide Program and Goals" (HB 136, Ch. 83, 2013 Laws of Maryland)* established a goal of having 15% of eligible Executive Branch employees, including those in agencies with independent personnel management systems, participate in a statewide telework program. The law requires the Secretary of Budget and Management to establish the program as well as a statewide telework policy and guidelines.
7. *"Sustainable Communities - Designation and Financing" (HB 613, Ch. 624, 2013 Laws of Maryland)*. Filed by request of the Administration, this law authorized specified local governments to finance the costs of infrastructure improvements which are located in or support "sustainable communities," including the cost for operation and maintenance of infrastructure improvements in the same manner as transit-oriented development (TOD) districts. The law authorized the Maryland Economic Development Corporation (MEDCO) to enter into agreements with specified local governments to issue bonds supported by tax increment financing (TIF) or other similar financing instruments on behalf of sustainable community infrastructure investments. The law requires Maryland Department of Planning, by October 1, 2013, to produce a report on TIF best practices and, in consultation with MEDCO, develop an online TIF education course with a certification component. The law prohibits local governments from using the TIF authority established under the bill until a specified individual employed by the local government completes the education course.
8. *"Maryland Smart Growth Investment Fund Workgroup" (SB 965/ HB 1170, Ch. 592 and 593, 2013 Laws of Maryland)* requires the Secretary of the Department of Housing and Community Development to convene a workgroup to evaluate and make recommendations relating to creating the Maryland Smart Growth Investment Fund.
9. *"Wetlands and Riparian Rights - Licenses and Permits for Nonwater-Dependent Projects on State or Private Wetlands" (SB 524, Ch. 492, 2013 Laws of Maryland)* generally altered the conditions for issuance of a license or permit by the Board of Public Works, Maryland Department of the Environment, or a local government for a nonwater-dependent project to be located on a pier in State or private wetlands. The law established separate standards for projects involving small-scale renewable energy systems and a process for approving projects through an after-the-fact license.


telecommute
improved public health
carpool
economic benefits
cycle
greenhouse gas reductions
Maryland leadership
adaptation
public transit
multi-pollutant benefits
Zero
extreme event mitigation
reduce
Waste
increased resilience
green buildings