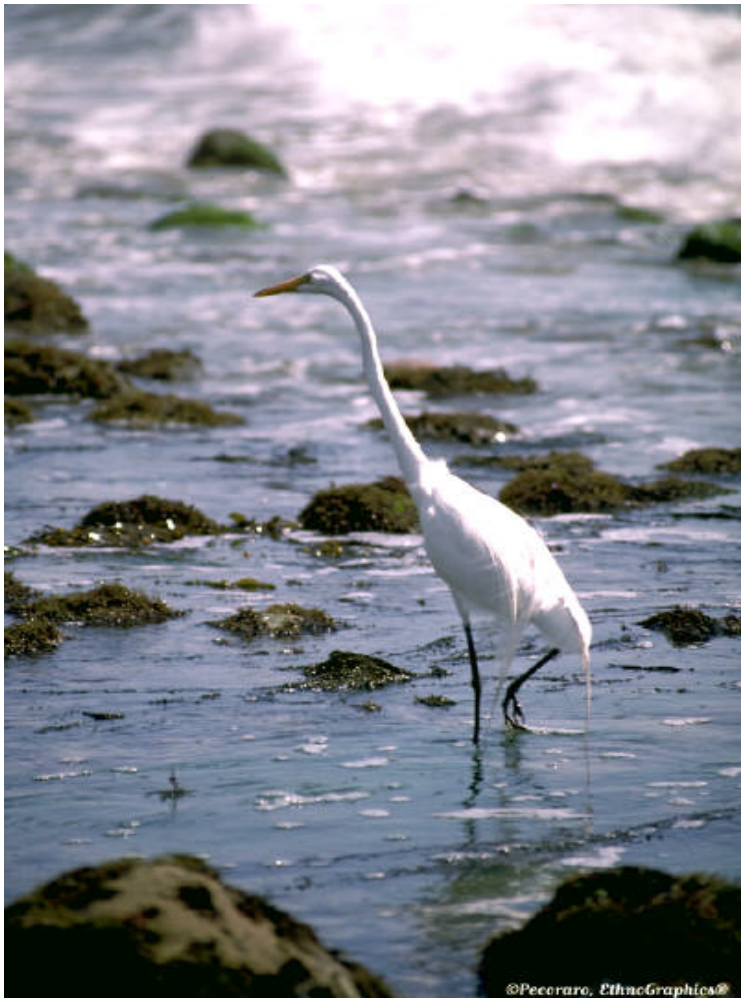
GHG Emissions Reductions in Maryland, Volume II:
Voluntary Strategies



Presented by the

Maryland Energy Administration

March 2004

Contents

I. Project Background & Goals

Volume II of the two volume report entitled *GHG Emissions Reductions in Maryland*, provides some examples of voluntary initiatives that should be considered as a first step to reduce greenhouse gas (GHG) emissions. Because climate change policies can affect all sectors of the economy, it is important to carefully identify and evaluate policies to ensure that they are feasible, cost effective, and will address both the environmental and economic needs of the citizens of Maryland. All of the recommended initiatives also reduce other pollutants such a sulfur dioxide (SO2) and nitrogen oxides (NOx). The report lays out possible modes of action, and provides stakeholders and the public with an understanding of the local, regional, national and global context for enacting climate change policies, as well as the specific considerations, motivations, and attributes behind individual policy options.

Preparation of this report was partially funded by a grant from the U.S. Environmental Protection Agency, State and Local Climate Change Program. Development of this report began in July 2003 and was guided by the State's Climate Change Working Group consisting of representatives from the Maryland Department of Environment, Maryland Department of Agriculture, Maryland Department of Transportation, Maryland Department of Planning, Maryland Department of Natural Resources, Maryland Public Service Commission and chaired by the Maryland Energy Administration (MEA). In addition to input from State government representatives, MEA's sought input from stakeholders at a public workshop held in early May 2003, and working group teleconferences held during the subsequent month with workshop attendees. Analytic support was provided through a consulting contract awarded via competitive solicitation.

To guide development of these voluntary strategies, the MEA established a set of principles for selecting policies and programs to be reviewed. Because climate change is such a far reaching, cross-sectoral issue, both in terms of its causes and impacts, and because the costs of addressing climate change can be substantial—to the State, it's citizens and its businesses—the following principles were established:

- **Address Multiple Environmental Issues.** Climate change policies should simultaneously address multiple environmental issues (reduction of NOx, VOCs, etc.) wherever possible.

- **Minimize the Cost Burden on the Private Sector.** Ideally, policies should tap those areas where GHG reductions can take place at low or no cost.

- **Exhibit Fiduciary Responsibility.** Climate change policies should take into account the realities of the State budget and exhibit fiduciary responsibility. Ideal policies will involve cost sharing (or savings) between the State, businesses, and consumers.

- **Coordinate with Existing State Environmental Efforts.** Climate change policies should leverage and coordinate with the State's extensive suite of existing environmental initiatives.

- **Take the Form of Voluntary Actions.** Organizations and individuals to reduce GHG emissions in the most cost effective manner and encouraging mitigation efforts beyond what otherwise might be an arbitrary regulatory standard.

- **Consider Regional Efforts.** Policies and programs should recognize the (a) global nature of climate change, (b) the regional nature of air pollutants such as NOx, SOx, and particulate matter that are associated with the same processes that produce GHGs, and (c) greater effectiveness of regional actions when compared to those of an individual state.

The MEA then conducted a series of analyses on a range of different greenhouse gas (GHG) emission reduction policies, in light of the principles outlined above, in order to identify at the most prudent set of actions.

Because Maryland is among the most energy efficient and least carbon intensive states in the country (see Appendix A. *Maryland's GHG* Emissions), the challenge of reducing GHG emissions further is significant and potentially expensive. For example, in those states where heavy industry dominates, significant reductions are often available by encouraging energy efficiency within specific industries. Service-dominated economies such as Maryland's, on the other hand, tend to be less energy intensive, with business typically consuming less energy to produce their final product (for example, producing a dollar of revenue from legal services is less energy intensive than from the production of steel).

Another challenge that is not unique to Maryland, is the amount of State funding available during lean economic times when tax revenues are relatively low. Like many states, Maryland is grappling with sizeable budget deficits that are forcing State lawmakers to carefully allocate their limited

budgets. The downward trend in the economy for 2001 and 2002 led to an overall decrease in Maryland's General Fund revenues, creating a $1.3 billion deficit for the 2004 fiscal year. Aggressive cuts across State programs reduced the budget deficit to $800 million for Fiscal Year 2005. With fewer State dollars available to fund robust energy and climate change programs, programs and policies must be designed to realize the State's energy, environmental, and climate change goals as efficiently and cost effectively as possible. Further, this should be done without increasing the cost to Maryland residents and businesses which may hamper the economic recovery.

II. Broad Based Initiatives

A. Voluntary Industry Commitments

According to the Maryland GHG emissions inventory, the industrial sector makes up approximately 10 percent of Maryland's GHG emissions. Assuming a nearly direct correlation between energy use and GHG emissions, a strategy to promote energy efficiency will both reduce GHG emissions and save industries money by reducing utility bills.

The national Climate Vision program calls on industry associations and their members to voluntarily commit to specific intensity-based GHG reduction targets.[1] For example, the Portland Cement Association, in cooperation with the Department of Energy and the Environmental Protection Agency, has committed to reduce carbon dioxide emissions by 10% per ton of cement produced, from a 1990 baseline by 2020. Other industries that have made commitments under Climate Vision include the Automobile, Steel, Semiconductor, Magnesium, Aluminum, Railroad, Pulp and Paper, Chemical, and Oil and Gas industries. Table lists a summary of the industry targets.

Table 1. Climate Vision Industry-wide Targets for Energy Use and GHG Reductions

Industry	Association	Target
Aluminum	Aluminum Association	Continue to reduce PFC emissions between now and 2005.
Automotive	Alliance of Automobile Manufacturers. (AAM)	Reduce CO2 emitted per vehicle manufactured by 10% between 2002 and 2012
Cement	Portland Cement Association (PCA)	Reduce CO2 emitted per ton of cement produced by 10% between 1990 and 2020
Chemicals	American Chemistry Council (ACC)	Reduce CO2 emitted per dollar of revenue earned by 18% between 1990 and 2012.
Coal Mining	National Mining Association (NMA)	10% increase in the efficiency of those systems that can be further optimized with processes and techniques developed by DOE and made available through the pending NMA-DOE Allied Partnership.
Petroleum Refining	American Petroleum Institute (API)	Increasing energy efficiency of members' U.S. refinery operations by 10% from 2002 to 2012.
Pulp & Paper	American Forest and Paper Assoc. (AF&PA)	Reduce CO2 emitted per dollar of revenue earned by 12% between 2000 and 2012.
Steel	American Iron and Steel Institute (AISI)	Reduce energy consumed per dollar of revenue earned by 10% between 1998 and 2012.

Source: Climate Vision Fact Sheet. EPA Newsroom. http://www.epa.gov/newsroom/headline_021203a.htm. (December 1, 2003)

[1] "Intensity-based" emissions refers to emissions per unit output (such as electricity produced, or revenue generated). Process or efficiency improvements, or fuel switching to less carbon-intensive fuels like natural gas, will lower the GHG emissions in the production of the given unit of output. Therefore, if increased demand causes a company's production to increase, the company can still be recognized for reducing its GHG intensity, even if absolute emissions increase.

The State of Maryland will seek Federal funds to develop a Maryland version of the Climate Vision program. Through this program the Maryland Energy Administration along with the Maryland Department of the Environment will encourage companies within the State to voluntarily comply with or surpass the national industry targets.

This new program would build on and enhance existing programs that strive to encourage energy efficiency in the traditional and energy intensive manufacturing sectors, specifically the Maryland Industries of the Future Program. Through this program, Maryland companies can receive free energy efficiency assessments, training, and technical assistance.

A Maryland Climate Vision program would provide additional resources to Maryland manufacturers, including assistance for the quantification of emissions reductions and encourage these entities to voluntarily register their emissions reductions in the U.S. Department of Energy's Voluntary Greenhouse Gas Reporting Program.

B. Linking to Regional Efforts

Greenhouse gas emissions—as with many other airborne emissions—are a concern that extends beyond the local level, and developing a state strategy in isolation of other neighboring states is far less effective than a regional or national strategy. Since greenhouse gas emissions are most appropriately addressed at the national level, Maryland will follow the leadership of the Federal government when considering regulations on carbon or other greenhouse gases. However, there exists an opportunity for coordinating voluntary programs for reducing GHG emissions among neighboring States.

Over the years Maryland has participated in several regional environmental issues, notably the Chesapeake Bay Program and the Ozone Transport Commission. The Ozone Transport Commission (OTC) is a multi-state organization whose main focus is to develop regional solutions to the ground-level ozone problem in the Mid-Atlantic and Northeast region of the U.S. Many of the initiatives underway through the OTC may also help to reduce greenhouse gas emissions. It should be considered whether an accounting of GHG emissions reductions achieved through the OTC is appropriate, and in the best interest of participating States. These emissions reductions could subsequently be entered into the National Voluntary Greenhouse Gas Reporting Program.

In another regional environmental program, the Chesapeake 2000 Bay Agreement calls for an evaluation of "the potential impacts of climate change on the Chesapeake Bay watershed, particularly with respect to its wetlands, and consider potential management options." Given this objective, it is appropriate to include activities related to terrestrial carbon sequestration within the Bay Programs. An assessment of the sequestration potential of wetlands and forests surrounding the Chesapeake Bay would be best achieved if it were a regional effort with a common methodology and approach.

In addition to the pursuit of regional efforts on reducing greenhouse gas emissions describe above, Maryland should also monitor the actions of other regional efforts, considering the costs and benefits of the voluntary and regulatory programs designed within. For example, in the past year we have witnessed the formulation of two multi-state coalitions addressing GHG emissions at a regional level. The first is the North East Regional Greenhouse Gas Initiative (RGGI) which includes New York, New Jersey, Delaware, Connecticut, Massachusetts, Rhode Island, New Hampshire, Vermont, and Maine, with Pennsylvania and Maryland participating as observers. RGGI calls for the development of a regional cap and trade program limiting the total amount of GHG emissions for those participating states. While Maryland does not support this regulatory approach to reducing CO2, we should continue to monitor the design and details of the regional initiative as it develops.

The second regional effort includes California, Oregon and Washington. The intent of this regional initiative is to first recognize the existing efforts among the individual states and then discuss how to best coordinate the efforts of all states in the respective regions to most effectively reduce emissions of GHGs. This approach may provide an example for regional coordination among the Mid-Atlantic states.

C. Carbon Sequestration

Carbon sequestration refers to one of two general processes for either absorbing existing carbon dioxide (CO_2) or capturing and storing CO_2 emissions that would otherwise be released. The process of absorbing CO_2 from the atmosphere and storing it in sinks (e.g. plant matter and soil) is called "terrestrial" or "biotic" sequestration. The process of capturing and storing CO_2 underground is generally referred to as "geologic" sequestration, referring to the fact that the captured CO_2 is transported and stored in a suitable underground geologic formation.

In the event of future national regulations on greenhouse gas emissions, carbon sequestration could play a significant role in helping to reduce the State's CO_2 emissions. Carbon sequestration could allow Maryland to continue to make use of the State's abundant and cheap coal reserves while simultaneously delivering deep and sustained reductions in CO_2 emissions.

Thus far, Maryland has not participated in the federally funded research partnerships on carbon sequestration and research, and activities for sequestration projects have been limited. Acknowledging the likelihood of future policies on climate change, a strategy to further explore Maryland's potential for terrestrial and geologic sequestration is an important component of any strategy addressing greenhouse gas emissions.

Terrestrial Sequestration

Terrestrial sequestration is a natural process that takes place during plant photosynthesis, and becomes a human activity when the rate of plant growth or the manner in which soil is managed is altered to maximize carbon sequestration. For example, reforesting an area that had previously been deforested will increase the carbon uptake from the atmosphere and store that carbon in the plant matter and the soil. Alternative agricultural practices such as reducing plowing through no-till farming, growing winter cover crops and forest buffer crops, and minimizing the use of commercial fertilizers are all methods that can increase the quantity of carbon stored in agricultural soils.

A study completed by the Maryland Power Plant Research Program used the Graz-Oak Ridge Carbon Accounting Model to estimate the potential for managed forest carbon sequestration in Maryland. The model estimated that 3 metric tons of carbon may be sequestered per hectare per year in managed forests. As an example, a reduction in annual CO_2 emissions of 1.75 million metric tons, or 2.3 percent of the total amount of CO_2 emitted in 1999, would require that 25 percent of the land area in Maryland be converted to forest areas managed to maximize carbon sequestration. While this is not impossible, it does provide an indication of the scale and size of projects required to achieve significant reductions.[i]

The cost of terrestrial sequestration will vary depending on the local conditions and specific measures pursued, but terrestrial sequestration efforts are generally considered low cost methods for removing atmospheric CO_2. The cost of aforestation and reforestation efforts on forestland, cropland and grazing land range from less than $1 to $10 per ton of CO_2 sequestered.[ii] Agriculture-related efforts may cost even less, since activities such as reduced tilling and conservation tilling incur less operating costs

resulting from the lower level of required labor. Studies in Indiana and Iowa confirm that the lower costs involved with reduced tilling increase profitability per acre over standard plowing practices.[iii] A co-benefit of the practices that increase carbon sequestration in agricultural soils is that a number of them are also effective in reducing nutrient runoff.

The Maryland Department of Natural Resources will work with electric power generating companies and other industrial partners to identify opportunities for forest sequestration activities in Maryland. Several of the electricity generating companies in Maryland have been involved in forest sequestration activities in other states and internationally.

Geologic Sequestration

Carbon capture and storage (CCS) technologies, while promising, are only just beginning to make the leap from the drawing board to the boardroom. To date, there are only a handful of industry driven CCS projects that have made the transition from prototypes to fully functioning projects. Hands-on, practical research will be required to expand our knowledge of carbon sequestration and bring us closer to the large-scale CCS demonstration projects envisioned for future power plants. Fortunately, Maryland is already a pioneer in carbon capture technology. The Warrior Run power plant, a 180 MW coal-fired power plant located in Cumberland, MD, is one of a small number of power plants in the world that are already capturing CO_2 from their flue gases.

Because carbon dioxide injection is already used to help increase oil production, compression and injection of the CO_2 are both mature technologies. The key issue facing storage operations is the concept of retention. In order for a site to be suitable for CO_2 storage, it must possess a porous layer of rock that is capable of holding injected fluid, overlain by a nonporous layer of rock that will prevent injected CO_2 from migrating upward, out of the storage formation. There are two types of formations found in Maryland for which this is true: deep saline formations (DSF) and depleted gas basins. Coalbed methane basins, which can chemically trap CO_2, are also found in Maryland.

Of the 21 major deep saline formations in the US, 2 underlie Maryland. These are the Oriskany and the Lower Potomac, which taken together contain about 53,700 million tons of potential storage volume, enough to store the CO_2 emissions of all large point sources in Maryland for more than 800 years. Not all of this capacity is directly beneath Maryland, but it much of it is within a few hundred miles, a reasonable distance for transport of CO_2 via pipeline.

Maryland is also home to the Appalachian gas basin, one of the 31 gas basins in the continental U.S. The Appalachian Gas Basin may be able to store as many as 800 million tons of CO_2, or around 12 years of Maryland's emissions from large CO_2 sources. Additionally, the western part of the State sits atop the Northern Appalachian Coal Basin. This is one of 23 coal provinces in the 48 contiguous United States. The Northern Appalachian Coal Basin contains 3.4 gigatons of capacity, which is enough capacity to store Maryland's CO_2 emissions for the next five decades. Again, only a small part of the Appalachian Gas Basin and coal basins are actually located in Maryland.

To better prepare for the future, Maryland should participate in the federally funded research activities such as the Regional Carbon Sequestration Partnerships. These consortia of industrial, research, and non-governmental organizations are tasked with characterizing the carbon capture and sequestration potential for each region of the U.S., and using these characterizations to identify potential opportunities for new projects.

The costs associated with CO_2 capture and storage in geologic formations are estimated to range from $40 to $80 per ton of CO_2 sequestered —for the additional equipment required to capture and separate the CO_2, and then transport and inject the CO_2 into the final geologic storage formation[iv]— according to a paper presented at the Intergovernmental Panel on Climate Change (IPCC) Workshop on Carbon Capture and Storage, held in Regina, Canada on November 18-21, 2002. These costs will be mitigated if the injected CO_2 yields enhanced resource recovery as it does in EOR and coal bed methane applications.

III. Specific Policies and Programs

The Climate Change working group, with input from Maryland Stakeholders, identified a series of GHG emission mitigation policies that could be categorized as either low cost or no cost, and which conformed with the larger set of climate change policy guiding principles outlined in Section I., *Project Background and Goals.* These policies and programs are described below and cover a range of different sectors and technologies.

A basic description and objectives are included for each policy, followed by an estimate of the projected annual reductions in GHG emissions and representative costs incurred both by the private sector and the State. Finally, the ancillary benefits associated with each policy are listed. Most of these benefits result from the displacement of fossil fuels, which yield avoided emissions of air pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NOx), mercury (Hg), and particulate matter (PM), and improved regional air and water quality. The projected results of these policies are summarized in Table 1. Note that this table does not include any reductions achieved from the broad based initiative described in the previous section.

Table 1. Summary of Recommended Low or No-Cost Policy

Policy	Annual GHG Reductions	Annual State Outlays	Annual Private Costs	Supplemental Benefits
	tons CO_2	$	$	
A. Promote Wind Power	150,000	High	voluntary	FF, Re, Ec
B. Improve Power Plant Efficiency	155,000	Medium	offset by savings	FF
C. Enforcement of Building Codes	230,000	Low	offset by savings	FF, Ec
D. Efficiency of Calvert Cliffs Nuclear Plant	98,000	0	offset by revenues	FF
E. Green Power Marketing	35,500	0	Medium	FF, Re, Ec
F. Truck Stop Electrification	9,000	Low	low/offset by savings	FF
G. Public Benefits Fund for Energy Efficiency	4,000	0	low/offset by savings	FF, Ec
H. Energy Star Promotion	770	Medium	offset by savings	FF, Ec
I. HVAC Efficiency Program	861	Medium	offset by savings	FF, Ec
J. Advanced Transportation	100	offset by savings	none	FF
K. Biomass Waste-to-Energy	207,500	Medium	offset by revenues	FF, Re, Ec
L. Low NOx Boilers	18,000	Medium	offset by savings	FF, Ec
Annual Reductions	**908,731**			

Key:

High: > $1,000,000
Medium: $100,000 to $999,999
Low: < $100,000

FF = Avoided fossil fuel use
Re = Increased use of renewable energy
Ec = May enhance economic growth

A. Promote Wind Power Purchases

Description: "Wind Power" refers to electricity produced from large, power-plant scale wind turbines. There are two proposed wind power projects that have received permits for construction in Western Maryland. The two projects would provide a 140 MW of wind power.

The proposed policy for this Action Plan includes a combination of incentives and direct purchases to increase the demand for wind power while driving down the cost of wind electricity so that it is more competitive with traditional gas and coal power plants. The State will increase demand by requiring "green power," including wind, as part of its electricity purchase. In addition to the State's purchase of green power, the Maryland Energy Administration will also provide information and resources to other purchasing cooperatives and local governments who wish to consider purchasing green power as part of their electricity procurement.

In addition to the increased demand for green power, and therefore wind power, the MEA will introduce legislation to extend the production tax credit for wind power and will make the tax credit additive to any federal production tax credit. By offering tax credits for every kilowatt hour of electricity produced in the first ten years of the project's life, the cost of wind power will be reduced thus making this source of power more competitive during the early stages of the market development. The tax credit provides $0.0085 cents for each kilowatt hour produced.

Finally, MEA will aggressively pursue Federal funding through DOE programs such as Wind Powering America to support outreach on wind energy. MEA will also champion the development of a Maryland Public Benefits Fund to help create appropriate financial incentives for wind developers looking to construct projects in Maryland.

GHG Reductions: Assuming that the two wind projects permitted in Western Maryland are constructed as a result of these policies, this policy would result in the reduction of 150,000 metric tons of CO_2 per year in the form of avoided CO_2 emissions from power plants. This amounts to 0.5% of Maryland's power sector CO_2 emissions, and 0.2% of Maryland's statewide CO_2 emissions. Furthermore, the policy would provide the necessary financial signals to further encourage the development of additional wind power and biomass projects.

Costs: It is estimated that the cost of this policy to the State would be high, with the potential lost tax revenues of over $3 million per year. There are no private sector costs associated with this policy.

Supplemental Benefits: The ancillary benefits of such a program would be those associated with the displacement of fossil fuels and the development of renewable energy, including an estimated annual reduction of over 1,500 tons of SO_2 and 520 tons of NOx.

B. Power Plant Efficiency

Description: The intent of this policy is to encourage the use of technology that can improve the thermal efficiencies at existing power plants within the State. Under the proposed policy, the State will provide no or low interest loans to power generating companies for the installation of controllable loss monitors—a technology that is expected to identify efficiency losses at older coal or gas power plants. Experts estimate that efficiency gains of at least one percent are possible using a combination of the controllable loss monitors and more efficient technology. Implementation would take place over a six-year period. Loans will be repaid over 36 months, and loan recipients will receive training in the use of controllable loss monitors and improved operation and maintenance, paid for by the State.

Eligible plants include all coal and gas plants in Maryland that came on line prior to 1970. This amounts to about 3,100 MW of generating capacity. Improving the efficiency of generation will allow the plants to continue to produce and sell power at current levels, while using less fuel to do so.

GHG Reductions: Assuming a 1% improvement in efficiencies at qualifying plants, this policy will result in a reduction of 155,000 metric tons of CO_2 emissions from Maryland power plants annually. This is 0.5% of Maryland's power sector CO_2 emissions, and 0.2% of Maryland's statewide CO_2 emissions.

Costs: The State will incur two sets of costs. First, the State will finance the no/low-interest loans by absorbing the cost of below-market interest rates. Second, the State will make direct outlays to generating plants for training.

Electric power generators will pay for the equipment itself. However, with the no-interest financing, and the potential savings in the form of avoided fuel costs, the measure will typically pay for itself within the 36-month period of the loan. Once the loan is repaid, the measure is expected to result in aggregated savings of over $2 million per year. This policy is therefore considered 'no-cost' from the perspective of the private sector.

Supplemental Benefits: The ancillary benefits of such a program would be those associated with the displacement of fossil fuels, including an estimated annual reduction of just under 1,000 tons of SO_2 and 330 tons of NOx.

C. Energy Efficiency Building Codes

Description: Over the past ten years, the Maryland Building Energy Code has gone through several upgrades to ensure that new buildings are more and more energy efficient. Most recently, the State adopted, with modifications, the International Building Code (IBC) 2000 and the International Residential Code (IRC) 2000 as the Maryland Building Performance Standards, which require buildings to be designed and constructed in accordance with the International Energy Conservation Code (IECC) 2000. This is an upgrade from the 1995 Model Energy Code, which was adopted in Maryland in 1997.

While the codes have increased the standard level of energy efficiency for residential and commercial buildings throughout the State, it is likely that many buildings do not comply with the standards that were applicable for the year they were built. A recent study from the State of Massachusetts[v] found that only about half of new buildings are in compliance with the energy code in that State. Because Maryland and Massachusetts share a similar code upgrade history, it is likely that Maryland also has a substantial portion of buildings out of compliance.

Although new codes influence the energy use of all buildings (the effect of the code is to reduce the mean energy use sectorwide), energy use is higher than it would be if the rate of compliant buildings were higher. To foster an increased incidence of code compliance, the State of Maryland proposes to work with local governments to hire and train local energy efficiency codes personnel. Increased enforcement and awareness will ensure that more buildings are built to proper code specifications and that the energy efficiency of residential buildings will improve. Under this proposed policy, the State would make grants available to local governments to hire and train energy efficiency codes personnel.

GHG Reductions: To estimate the reduced energy use and resulting GHG reductions that would result from this policy, it was assumed that the energy savings in compliant houses relative to non-compliant houses in Maryland will be proportional to those realized in the Massachusetts study. These savings would apply to all new houses in the twenty municipalities in the State with the largest number of housing starts, which covers over 99% of projected new housing starts.

Given these assumptions, it is estimated that the CO_2 emission reductions resulting from this project would be 230,000 metric tons per year. This equals 3.2% of Maryland's residential sector CO_2 emissions, and 0.3% of Maryland's statewide CO_2 emissions.

Costs: The only costs associated with the policy are those incurred by the State in providing the grants. There may be private costs associated with the additional effort in building to code or savings associated with reduced energy bills, but these costs and savings are difficult to estimate and likely to be offset by energy savings.

Supplemental Benefits: The supplementary benefits of such a program would be those associated with the displacement of fossil fuels, the magnitude of which—in terms of criteria pollutant emission reductions—are difficult to estimate. It would also create direct economic benefits by lowering energy bills for homeowners and tenants, which would in turn increase the disposable income available for residents of the buildings in question, especially among lower income tenants. Statewide energy savings are estimated to be on the order of three trillion Btu per year.

D. Increased Efficiency for Calvert Cliffs

Description: The Calvert Cliffs nuclear facility is a 1,700 MW power plant located in Lusby, MD, on the Chesapeake Bay. The plant came online in 1975 and is wholly owned by Constellation Energy Group. Analysis has shown that through the replacement of older equipment and technology the potential exists to increase the power output of the plant by about 30 MW. Replacing a low pressure turbine and redesigning the connection between the low pressure and high pressure turbines will result in greater efficiency, largely through improvements in turbine integration and system design. The replacement does not require any action on the part of the Nuclear Regulatory Commission as it does not affect the use of nuclear fuels or produce additional waste. While relatively small, the added baseload electrical capacity would displace other new baseload capacity from the PJM grid, most of which is forecasted by the U.S. Energy Information Administration (EIA) to come from natural gas combined cycle (NGCC) plants.

GHG Reductions: GHG reductions would take place as a result of displaced fossil fuel-fired generation. To calculate the amount of displaced generation, it was assumed that the 30 MW of capacity would operate for 86% of the year (the default value used by the EIA in its National Energy Modeling System) and displace electricity from new NGCC plants with an emissions

intensity equal to 0.43 kg CO2 per kWh. This yields an annual average reduction in GHGs equal to 98,000 metric tons of CO2.

Costs: There are no costs borne by the State for this option. However, it is estimated that the cost of the technology replacement and redesign could be significant. However, the increased electricity sales, with negligible marginal costs for additional generation, would repay this within one year.

Supplemental Benefits: The supplementary benefits of such a program would be those associated with the displacement of fossil fuels, including an estimated annual reduction of less than 980 tons of SO_2 and over 340 tons of NOx.

E. Green Power Marketing

Description: To further increase the development of "green" power technology (defined in this context as any renewable, carbon-neutral power source) in Maryland, the State proposes that a green power option be made available as a choice for customers in the deregulated retail electricity system. Such a choice would enable those customers interested in purchasing a more environmentally benign electricity product to do so. The resulting increase in demand for renewable-specific electricity could then act to spur new renewable energy development within the region, which would in turn reduce air pollution and greenhouse gas emissions associated with the use of fossil plants.

GHG Reductions: Assuming that 0.25 to 0.5 percent of the population will switch to a green power option and that the green power consumed will displace the current grid-average mix of electricity generation, which has an emissions intensity of 1.0 lb CO_2/kWh, CO_2 emission reductions resulting from this policy would range from 35,500 metric tons to 76,000 metric tons per year This amounts to 0.12% to 0.24% of Maryland's power sector CO_2 emissions, and 0.05% to 0.10% of Maryland's statewide CO_2 emissions.

Costs: This policy would impose no costs on the State. Private costs would be the premium customers voluntarily agree to pay for the green power, or the price differential between green and conventional power times the amount of power purchased.

Supplemental Benefits: The ancillary benefits of such a program would be those associated with the displacement of fossil fuels and the development of renewable energy, including an estimated annual reduction of 7,500 tons of SO_2 and 2,600 tons of NOx.

F. Truck Stop Electrification

Description: Currently, truck drivers allow their engines to idle, to provide for heat and electricity for the cab while they sleep. This is an extremely inefficient way to provide heat and electricity, and it also leads to degraded air quality in the vicinity of the idling trucks. It is also very costly, truck idling consumes 1.2 billion gallons of fuel annually and at $1.75 per gallon of diesel, truck idling costs trucking companies $2 billion per year. To remedy this problem, the State of Maryland proposes to install a new technology at its highway rest stops that can provide the energy needs of an idling truck using an electrical hookup.

GHG Reductions: Assuming that a truck idles 8 hours per day for 300 days a year and that through this effort the infrastructure is installed to provide 500 "hook-ups" for truck electrification, this simple technology solution could reduce about 9,000 metric tons of CO_2 emissions per year. This amounts to 0.03% of Maryland's transportation sector CO_2 emissions, and 0.01% of Maryland's statewide CO_2 emissions.

Costs: The cost associated with this project would take the form of the capital investment to install the necessary equipment at highway rest stops throughout the State. The only private sector cost would be that of the truckers paying to use the service, and that cost would be negative (savings) since the cost of the electricity would likely be less than the cost of the fuel.

Supplemental Benefits: This policy could substantially reduce NOx emissions from mobile sources.

G. Public Benefits Fund for Energy Efficiency

Background: Public benefits funds would be collected through a minimal charge to support the development and implementation of energy efficiency programs in Maryland. These funds would replace the funds previously provided through Maryland's electric utility companies prior to electricity restructuring. The market for energy efficient products and services is not yet robust and the phasing out of the utility managed energy efficiency programs gave way to a decrease in the use of energy efficient equipment and the construction of energy efficient homes.

Proposed Action: Similar to the funds available in 17 of 19 deregulated states, a public benefits fund in Maryland would provide information and incentives for the use of more efficient products. A small charge of 0.025

cents would be collected on each kilowatt hour consumed by a residential customer. The fund created by collecting these charges would then be allocated to support energy efficiency programs that are determined to be cost effective by the Maryland Public Service Commission. These programs would include the promotion of ENERGY STAR® products and the use of more efficiency home appliances and technologies.

Similar programs administered by the Wisconsin Energy Conservation Corporation and the New York Energy State Energy Research and Development Authority promote the building of energy-efficient homes and apartment buildings, the installation of energy-efficient equipment in existing homes and apartment buildings, and the sale and distribution of energy-efficient ENERGY STAR® products (e.g., compact fluorescent light bulbs, washing machines, dishwashers, and other appliances).

Cost: The proposed rate of 0.025 cents/kWh would cost the average residential consumer an estimated $7 per year, depending on the amount of energy consumption, and would create a fund of approximately $7,000,000 per year. There would be no cost to the State.

Benefits: To estimate the benefits of this policy, we examined the information available for the New York and Wisconsin Programs. Table 6, below, provides a summary of expenditures and energy savings to date. In Maryland, assuming proven energy savings of 1.3 kWh/$ (the lower and more conservative estimate when looking at the two surrogate markets) spent, a program funded at $7 million per year would save approximately 9,000 megawatt-hours per year. In the Wisconsin program, participating households save an average of $54 per year on electricity and fuel costs.

Table 6. Energy Savings Per Dollars of Funding for Energy Efficiency Programs in Wisconsin and New York

Program	Program Length to Date	Annual Spending	Energy Savings to Date	Annual Energy Savings	Energy Savings per $ Funding
	Years	Million$/ year	GWH	GWH/yr	kWH/$
NYSERDA Residential EE	4.5	$ 20.65	-	-	-
NYSERDA Low Income	4.5	$ 14.95	-	-	-
NYSERDA Residential & LI Subtotal	**4.5**	**$ 35.60**	**207***	**46.0**	**1.3**
Wisconsin Focus on Energy Residential Programs	**3**	**$ 22.1**	**177**	**59.0**	**2.7**

* Measurable energy savings only. Total energy savings may be as much as two times greater.

GHG Emission Reductions: Using Maryland's current grid emissions intensity of 1.0 lb CO_2/kWh, the annual energy savings of 9 million kWh would translate into a GHG emission reduction of just over 4,000 metric tons of CO_2 per year.

Supplemental Benefits: Benefits from reduced electricity consumption include cleaner air quality, increased electric system reliability, reduced household spending on energy and the economic benefits that follow from increased disposable income.

H. Energy Star Promotion

Background: A recent national study prepared by the nonprofit Consortium for Energy Efficiency (CEE)[vi] cataloged residential appliance energy efficiency programs and found over 40 city, state, utility and nonprofit entities have budgeted over $83 million to promote and fund incentives for ENERGY STAR® Appliances. CEE noted that nearly every appliance program provided retail field support including Energy Star labeling and training to sales staff. In addition, almost all programs have a marketing campaign that includes some sort of paid media component. The author of the report (via personal communication) indicated that training sales staff was a major indicator of program success. Partnerships with appliance manufacturers and retail chains for both training and cooperative advertising made a significant impact on the outcome of the ENERGY STAR® campaign.

Proposed Action: The goal of this program is to increase the market share of ENERGY STAR® standard refrigerators, room air conditioners, and clothes washers to a minimum of two percentage points above the national sales figures. To do so, the Residential ENERGY STAR® Program will focus on educating the retail businesses on the merits of ENERGY STAR® products and how to sell these products. A cooperative marketing and advertising effort will be launched with Maryland retailers to expand the market share of energy efficient appliances, heating and air conditioning equipment and energy efficient homes. The marketing campaign will educate Maryland consumers about ENERGY STAR® products and emphasize the availability of the tax incentives from the Clean Energy Incentive Act, while it is still in effect.

Cost: The cost to the State is zero. Funding for this program will come from utility settlements that provided funds specific to energy efficiency programs for the residential sector. The proposed programs are expected to save Maryland homeowners $195,000/yr in total.

Energy Savings: The calculation of program benefits is based upon increasing the sales of three appliances covered in the Maryland Clean Energy Incentive Act. The expanded marketing of a wide variety of other ENERGY STAR® labeled products by this pilot program will undoubtedly increase the sales of these products; however, these other products are not included in these calculations.

This program is expected to increase the sale of ENERGY STAR® refrigerators, clothes washers, and room air conditioners by at least two percentage points over 2001 sales figures, yielding an estimated 1.7 million kWh in electricity savings with annual savings to consumers estimated at approximately $195,000. Refrigerators are expected to account for 371,000 kWh ($27,500 in annual savings); clothes washers 1.2 million kWh ($159,000 in annual savings); and room air conditioners 109,000 kWh ($8,000 in annual savings).

GHG Emission Reductions: Using Maryland's current grid emissions intensity of 1.0 lb CO_2/kWh, the annual energy savings of 1.7 million kWh would translate into a GHG emissions reduction of 770 metric tons CO_2 per year.

Supplemental Benefits: Many of supplemental benefits of this program would be those associated with the reduction of fossil fuel fossil fuel combustion, including reduced pollution, improved air and water quality, and improved health. Additional benefits from reduced electricity consumption include increased electric system reliability, reduced household spending on energy and the economic benefits that follow from increased disposable income.

I. HVAC Efficiency Program

Background: Heating and cooling consumes approximately 42 percent of the energy used in an average Maryland household. Therefore, the efficiency and performance of the heating, ventilation, and air conditioning (HVAC) equipment can have a significant impact on the overall annual energy bill of a home. In addition, the proper sizing, matching of components, correct system air flow, duct system tightness, and installation quality are critical to the overall performance, energy efficiency and cost-effectiveness of the HVAC system.

A recent study on the "Impact Analysis of the Massachusetts 1998 Residential Energy Code"[vii] showed the average heating system was oversized by 35% over what was required by the Energy Code. The study also indicated that more than 80 percent of the duct systems were not

sealed properly. Nationally, as well as in Maryland, central air conditioners are over sized by an average of one ton.[viii] The result of this air conditioner over sizing practice is (1) higher initial cost for the consumer, (2) higher on-going operating costs, (3) higher consumption of electricity and (4) reduced comfort and higher humidity levels in a house in humid or mixed climates.

Another recent study conducted by the Consortium for Energy Efficiency (CEE)[ix] found that current HVAC sizing and installation practices often result in over or undersized systems (systems are often installed that are 150% to 300% of the correct size), leaky ducts and comfort problems for homeowners. Yet another study[x] found that energy savings of 17 to 35 percent were realized by addressing a range of air conditioner installation issues, including air conditioner charging, air flow, sizing, and duct leakage.

Proposed Action: One of the key obstacles to the implementation of properly sized and accurately tuned equipment is the high opportunity cost of training for contractors. Therefore, this program—the Energy Advantage HVAC Pilot Program—will provide advanced training to HVAC contractors to upgrade their technical skills and understand the benefits of energy efficient products available for their customers. In addition, the program will provide customers with information on how to choose a qualified contractor, what installation standards should be expected from their contractor and how to operate their heating and cooling system.

The Energy Advantage HVAC Pilot Program will properly size and install Energy Star HVAC equipment in 500 existing residences. The heating equipment will have a minimum AFUE of 0.90 and the air conditioning equipment will have a minimum SEER of 13.0 (for split air conditioning systems). These installations will improve the energy efficiency of the HVAC systems by 29 percent.[2] It is estimated that the program will improve the energy efficiency of 1500 air conditioning systems by 5 to 15 percent during HVAC services calls. A total of two thousand homes are expected be served by this program.

The program will consist of four components: (1) training for sales or field estimators in how to properly size central heating and air conditioning systems and recommend energy efficient equipment; (2) training for technicians that will demonstrate specific installation and testing techniques for air conditioning systems; (3) the sizing and installation of HVAC equipment meeting Energy Star standards in 500 existing residences; and (4) consumer marketing and on-site consumer training in the operation and maintenance of their HVAC system.

[2] the efficiency calculation is based solely on AC upgrades so actual savings will be larger when new heating systems are installed.

Cost: The cost to the State is zero. Funding for this program will come from utility settlements that provided funds specific to energy efficiency programs for the residential sector. Homeowners are expected to save $170,022/yr.

Energy Savings: The program's projected energy saving benefits are based on the installation of 500 central air conditioning units with a minimum SEER of 13, and the servicing of 1500 additional units. The annual savings from moving consumers from an average 10 SEER unit to a properly installed 13 SEER air conditioner unit would total 877,821 kWhs and would save 500 participating homeowners a total of $79,004 annually.[3]

Further energy savings are expected to result from the servicing and maintenance of 1500 additional AC systems (e.g. providing the correct system charge and proper air flow for these existing AC systems). Correct implementation of these items in 1500 homes will generate 1,011,315 kWhs in annual savings and will provide homeowners with a total of $91,018 in energy savings.

The total estimated energy savings of the 500 new installations and the 1500 serviced systems is 1.9 million kWhs, with a total saving for all homeowners of $170,022/yr, with a payback period of approximately 2.2 years.

GHG Emission Reductions: Using Maryland's current grid emissions intensity of 1.0 lb CO_2/kWh, the annual energy savings of 1.9 million kWh would translate into a GHG emission reduction of 861 metric tons CO_2 per year.

Supplemental Benefits: Many of supplemental benefits of this program would be those associated with the reduction of fossil fuel fossil fuel combustion, including reduced pollution, improved air and water quality, and improved health. Additional benefits from reduced electricity consumption include increased electric system reliability, reduced household spending on energy and the economic benefits that follow from increased disposable income.

J. Advanced Transportation Technologies

Description: Transportation efficiency projects are funded and administered by a partnership including Maryland Department of the Environment (MDE), US Department of Energy (DOE), the Maryland Department of

[3] Although this program will allow HVAC contractors to receive credit for the installation of heating or cooling equipment, the energy savings calculations are based only on the installation of 500 air conditioner installations.

Transportation (MDOT), and the Maryland Energy Administration. "Partner" members of the Metropolitan Baltimore Clean Cities Program (MBCC) provide general oversight and technical assistance for the State's Alternative Fuel Vehicles (AFV) and transportation efficiency program. The MEA Clean Cities program provides funding and technical assistance for vehicle purchases, refueling infrastructure, and public awareness. Specific projects include: tax credits for hybrid vehicle purchases; rebates for CNG and other alternative fuel vehicle purchases; funds for CNG school buses; funds for feasibility study and design of a station car project in the Baltimore/Washington D.C. area; funds for CNG shuttle buses at BWI Airport and Johns Hopkins University; funds for CNG and ethanol refueling stations across the State; funds for training mechanics for alternative fuel vehicles; and public outreach and information programs.

In addition to the existing efforts to encourage the use of cleaner alternative fuels, such as compressed natural gas, ethanol, and bio diesel, the Departments of Transportation and the Maryland Energy Administration will be working to encourage the use of electric hybrid vehicles in state and local government fleets. A study on the lifecycle costs and benefits to the State from purchasing more efficient hybrid-electric vehicles is underway.

GHG Reductions: Carbon dioxide emissions are directly proportional to fuel use. In 2003, both Honda and Toyota offered commercial hybrid electric vehicles (the Honda Civic Hybrid and the Toyota Prius) that achieved fuel economies of about 48 mpg, and the 2004 Toyota Prius has an improved fuel economy of 55 mpg.[4] Other manufacturers are in the process of developing new hybrid models. The volume of emission reductions are dependent on the vehicles that are displaced: reductions would be lower if the baseline vehicle is efficient, and greater if it is inefficient. In general, annual GHG reductions range from one to 10 metric tons of CO_2 equivalent per year per vehicle, based on 15,000 miles of driving per year. Assuming that the reductions per vehicle per year are 5 metric tons of CO_2, purchasing 20 new vehicles per year to replace older vehicles in the State fleet would achieve an annual reduction of 100 metric tons of CO_2.

Cost: The Honda Civic Hybrid and Toyota Prius both cost on the order of $20,000. In terms of the cost of the vehicle itself, this is slightly more than an equivalent model (e.g. the conventional Honda Civic, which costs about $17,000), although it may be less expensive than the vehicle that might have been purchased otherwise. The hybrid vehicles will realize significant savings in terms of fuel costs, and will more than pay for their premiums over the life of the vehicle.

[4] US Department of Energy website: www.fueleconomy.gov

Supplementary Benefits: The supplementary benefits would be those associated with the reduction of fossil fuel consumption. What's more, by taking a leadership role in developing the hybrid market, the State would be encouraging the use of hybrid vehicles in the private sector, where the benefits would be amplified.

K. Biomass Waste-To-Energy

Two biomass energy options are particularly relevant for the State of Maryland, given its strong agricultural presence. The first deals with the anaerobic digestion of farm animal waste to produce biogas, and the second involves the direct combustion of chicken litter.

The appeal of animal-waste derived electricity production is that it is an integrated approach to both waste management and power generation. Utilizing animal waste for power generation not only reduces the consumption of fossil fuels and the associated negative effects, but it also offers an excellent strategy for managing the solid waste from the agriculture sector. This nutrient-rich waste has the potential to compromise the health of the State's rivers, streams, and lakes, and ultimately the Chesapeake Bay.

Description, Anaerobic Digestion: Anaerobic bacteria produce biogas by breaking down the organic material of animal wastes in an oxygen-deprived digester or covered waste lagoon. Biogas, composed primarily of methane (50-80 percent) and carbon dioxide (20-50 percent) can be used for a variety of purposes, including cooking, heating, and electricity generation. Controlled anaerobic digestion systems can be used for primary organic waste treatment, odor control, or nutrient recycling. The nutrient-rich effluent (or sludge) from the digester can be used as a soil conditioner or as a livestock feed additive. Where it is cost effective to do so, the biogas can be captured and combusted to generate heat or electricity.

Most electricity generating systems fueled by biogas are located at larger facilities; cost effective electricity generation typically requires manure from 150 large animals (or equivalent). Of the 40 farm-scale digesters operating nationwide, 35 of them use the captured biogas to generate electricity. Together, these digesters represent the equivalent of four megawatts generating capacity, and prevent the release of about 20,000 tons of methane gas (124,000 tons of carbon equivalent) into the atmosphere. In 1997, Maryland's agriculture sector generated some 4.4 million tons of animal waste, but there is currently only one digester plant, and it is used in a waste management capacity rather than for electric power generation.

First operational in 1994, this plant digests manure from some 190 dairy cattle, and flares the captured biogas.

An example of the possibilities offered by biogas exists at the Tinedale Farm in Wisconsin, which installed an anaerobic digester[5] for the waste from the farm's 2,500 dairy cattle. The biogas produced from the animal waste is used to run two 375-kilowatt electrical generators. The renewable energy-derived electricity that is generated is sold back into the power grid for approximately $60 per Megawatt-hour. In addition to being a more cost effective system for managing animal wastes, Tinedale Farm's biogas recovery arrangement eliminates over 32,000 tons of carbon dioxide-equivalent emissions by offsetting electricity demand and avoiding methane emissions from animal wastes.

Description, Chicken Litter Combustion: Another biomass energy possibility that is relevant for Maryland is the direct combustion of chicken litter (a mix of chicken waste and forestry residues) to produce electricity. Preliminary studies[6] suggest that the quantity and characteristics (e.g. moisture and energy content) of the chicken litter in the Delmarva peninsula (the portion of Delaware, Maryland, and Virginia located between the Chesapeake Bay and the Atlantic Ocean) is suitable for power generation. Furthermore, a 40 MW power plant has been proposed for construction on the peninsula that would consume an estimated 300,000 tons of poultry waste and 100,000 tons of forestry residues per year. The State is currently investigating the economic feasibility, permitting issues, and policy incentives that would help make the project a reality.

Ongoing Research: The Maryland Energy Administration (MEA) is administering a variety of projects that will provide information on the feasibility and costs of in-state, biomass-fueled generation. The MEA is partnered with the Maryland Department of Agriculture and the Department of Natural Resources to evaluate the costs of alternative waste management practices, including anaerobic digestion and gasification. The MEA is also funding an experiment at the University of Maryland's Wye Research & Education Center to explore the costs of using small-scale combustion systems to heat farm buildings. The ultimate goal of this project is to identify affordable, biogas-fueled systems. The MEA is also administering a project to develop a fluidized bed system that will co-fire poultry litter with a variety of other biomass feedstocks. Moving ahead, MEA will continue to

[5] The project was made possible in part by a a low interest loan offered by the State government.

[6] Harter-Dennis, Jeannine. Poultry Litter And Forest Residue Testing and Availability Assessment, Final Report. Department of Agriculture, University of Maryland Eastern Shore. Sponsored by the US Department of Energy and the Coalition of Northeast Governors (CONEG) Policy Research Center, and the Northeast Regional Biomass Program. www.nrbp.org/pdfs/pub30.pdf

investigate the possibility of creating incentives for biomass-fueled energy projects throughout the State.

GHG Reductions Potential: GHG reductions from the anaerobic digestion of dairy cattle waste or the combustion of poultry litter result from (a) reduced fossil fuel consumption—which yields a reduction in CO_2 emissions, and (b) reduction in methane emissions from the decomposition of the organic matter. The proposed 40 MW chicken litter-fired power plant, operating 85% of the year, would reduce about 207,000 tons of carbon equivalent GHG emission per year. And Maryland's 84,000 dairy cows make for an ideal fuel source for anaerobic digestion into biogas. The amount of GHG emissions that could be reduced would depend on the number of dairy cows on large farms that could justify the costs of digesters, assuming that only a small number of projects would be implemented over the next 15 years, the digesters could support another 500 kW of electrical generating capacity for an additional reduction of 562 tons of carbon equivalent. It should be stressed however, that these are rough estimates, and further feasibility studies are necessary before any definitive conclusions can be made.

L. Low NOx Boilers

Background: One of the major sources of nitrogen oxide emissions in Maryland are boilers used to produce heat for industry and buildings. The Maryland Department of the Environment ranks industrial boilers as the fourth largest source of NOx emissions in the State following electrical generating equipment, light-duty gasoline vehicles, and heavy-duty diesel trucks.[xi] NOx is a significant pollutant in Maryland as it is one of the precursors to the formation of ground level ozone, or smog, and also causes acid rain. Nearly all of Maryland is classified by the U.S. Environmental Protection Agency as an ozone nonattainment area.

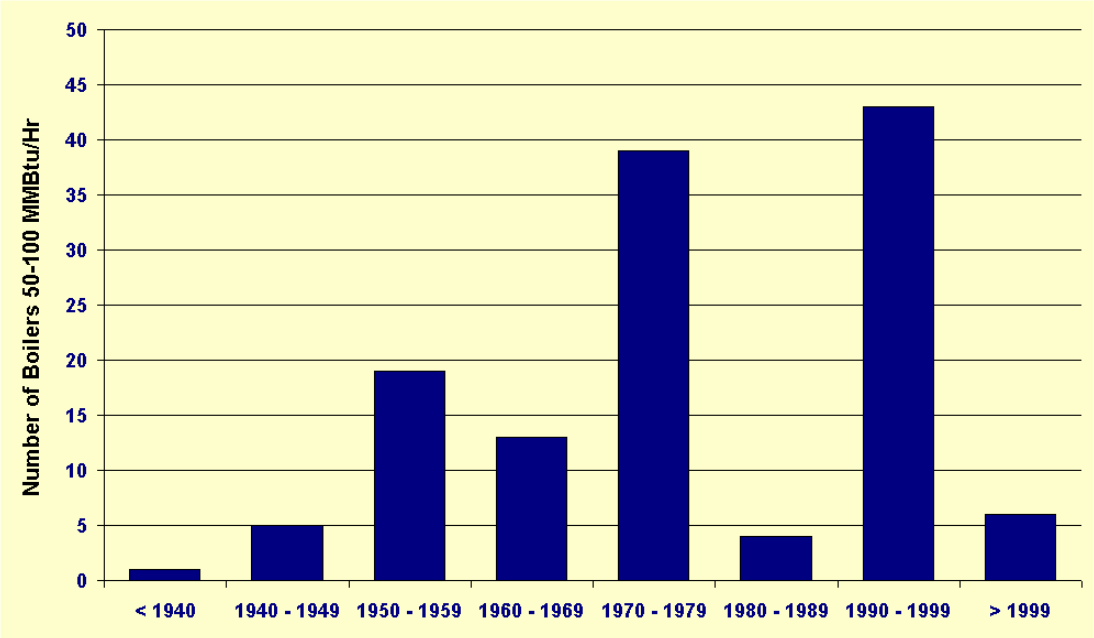
Currently, there are on the order of 1,500 non-electrical boilers in Maryland, the majority of which (about 1,350) are smaller, 10-50 MMBtu/hr units, while the remainder are larger 50-100 MMBtu/hr units. Most of these boilers use natural gas and fuel oil, although a very small number of boilers use solid fuel (biomass or coal). The larger boilers, which have a combined capacity of 9600 MMBtu/hr, date from 1940 to the present, with the mean and median inception years being 1978 (see Figure 1).[xii]

Annual NOx emissions from these 1,500 boilers are approximately 3,000 tons per year, with the smaller class accounting 58% and the larger class accounting for 42%.[xiii] Natural gas-fired boilers have NOx emission factors that range from 16 to 24 to 49 g/MMBtu, depending on the level of pollution

control. Oil fired boilers range from 65 to 178 g/MMBtu, depending on the type of oil used (use of lighter fuels cause fewer NOx emissions).[xiv]

While the primary area of environmental concern regarding these boilers are emissions of NOx, they also emit significant amounts of CO_2 (in 1999, 16% of Maryland's combustion-related CO_2 emissions came from the industrial and commercial sectors – see Appendix A. *Maryland's GHG Emissions*). Upgrading to new boilers, even if the primary motivation is to realize fewer NOx emissions, represents a significant opportunity to reduce CO_2 emissions and save money by replacing the older boilers with new units that are energy efficient or use less carbon intensive fuels. It should be noted, however, that the traditional strategies to reduce NOx emissions through combustion control and end of pipe technologies do not reduce CO_2 emissions. Instead, some techniques may increase CO_2.

Figure 1. Age Distribution of 50-100 MMBth/Hr Boilers in Maryland



Source: Maryland Department of the Environment

Proposed Action: To help transition the current boiler stock in Maryland to one that is more efficient and emits less NOx, the MEA will implement a low-interest loan program to help finance the replacement of older equipment and provide operator training to ensure that the new equipment is properly used and maintained. Loans will be made for the purchase of 50-100 MMBtu/hr boilers, since these larger boilers produce far more emissions per individual unit than do the smaller boilers.

In addition, the MEA proposes to conduct on site assessments of existing boilers, paid for by the State, to identify energy efficiency upgrades that may be achieved. The assessments would most likely target boilers used for creating steam and any steam efficiency opportunities. The CO_2 and NOx emissions reductions would come from the increased efficiency of the systems and the resulting decrease in fossil fuels required. This program will not promote the use of NOx control technologies that do not result in higher fuel efficiency.

GHG Reductions: GHG reductions will result from those practices that improve boiler efficiencies. Federal standards require new boilers to operate with Annual Fuel Utilization Efficiency (AFUE)[7] of 79% or higher. ENERGY STAR® boilers are those that have AFUE ratings of at least 85%.[xv] Older boilers, on the other hand, typically have AFUE ratings of 70% to 75%. Therefore, if older boilers are replaced by new, low-NOx, high efficiency models, the reductions in energy use and GHG emissions can be as high as 10% to 20%.

To estimate the potential energy savings from switching to new, efficient boilers, assume that all 50-100 MMBtu/hr boilers that were put in operation in Maryland prior to 1980 (75 units in all) are replaced with new efficient models. Assuming a capacity factor of 25% (reflecting the fact that industrial boilers are often online only a fraction of the day and the year), and an efficiency improvement of 15%, the energy reductions would be on the order of 1,800,000 MMBtu/year (roughly 530 million kWh/year). Given that about 25% of these boilers are oil-fired and 75% are gas-fired, the GHG emission reductions resulting from these energy savings would be 18,000 metric tons of CO_2 per year. It should be noted that these figures are on one hand conservative since they only include boilers installed prior to 1980, and on the other hand ambitious, given that many NOx improvements may not yield efficiency improvements or fuel switching and the corresponding reductions in GHG emissions.

Supplemental Benefits: The benefits of this program would be a reduction in NOx and CO_2 emissions and an improvement of the State's overall air quality. If total NOx emissions are reduced by 22% from 50% of the operating units between 50-100 MMBtu/hr, NOx would be reduced by 143 tons per year. In addition, the efficiency improvements made available by the boiler upgrades will save money in the long term in the form of energy savings for the industries and building owners that participate in the program.

[7] The Annual Fuel Utilization Efficiency (AFUE) measures the amount of fuel converted to space heat in proportion to the amount of fuel entering the boiler. This is commonly expressed as a percentage.

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