ECO-CITY ALEXANDRIA

City of Alexandria
Energy and Climate Change Action Plan
Local Actions to Save Energy, Reduce Greenhouse Gas Emissions, and Prepare for the Impacts of Climate Change
2012 – 2020

March 14, 2011

Office of Environmental Quality
Department of Transportation and Environmental Services

DRAFT

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Acronyms and Abbreviations

ASA	Alexandria Sanitation Authority
BAU	Business-as-Usual
BTU	British Thermal Unit
CACPS	Clean Air and Climate Protection Software
CNG	Compressed Natural Gas
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
EAP	Environmental Action Plan
GHG	Greenhouse Gas
GWP	Global Warming Potential
ICLEI	International Council on Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
KWh	Kilowatt hours
LEED	Leadership in Energy and Environmental Design
LPG	Liquefied Petroleum Gas
MMBtu	Million British Thermal Units
MSW	Municipal solid waste
MWCOG	Metropolitan Washington Council of Governments
MWh	Megawatt hours
NAS	National Academy of Science
NERC	North American Electric Reliability Council
N_2O	Nitrous Oxide
OEQ	Office of Environmental Quality, City of Alexandria
T&ES	Transportation and Environmental Services, City of Alexandria
Therm	A unit of heat equal to 100,000 British thermal units
Tonnes	Metric Tons (equivalent to 1,000 kilograms or 2,204.6 pounds)
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
VADEQ	Virginia Department of Environmental Quality
VMT	Vehicle Miles Traveled

ECO-CITY ALEXANDRIA

City of Alexandria Energy and Climate Change Action Plan

Local Actions to Save Energy, Reduce Greenhouse Gas Emissions, and Prepare for the Impacts of Climate Change

2012 - 2020

The Issue

Climate change is a phenomenon of critical concern. While there are a variety of opinions, most in the scientific community have reached a consensus that the world is warming, and that most of the warming is the result of emissions of carbon dioxide (CO_2) and other greenhouse gases (GHG) from human activities. The impacts of climate change can already be observed in many places, from rising sea levels to melting ice to changing weather patterns. Climate change is already affecting ecosystems, water supplies, and human health. Although climate change cannot be avoided entirely, the most severe impacts of climate change can be avoided by substantially reducing the amount of GHG released into the atmosphere. A key strategy is the push to conserve energy – which reduces the demand of fossil fuels and lowers emissions of CO_2 emitted into our air. Even with emission reductions, however, some warming will still occur. Adaptation planning is needed to limit the damage caused by climate change and the long-term costs of responding to climate-related impacts.

All levels of government, the private sector, and ordinary citizens have roles to play in addressing climate change. Some aspects of the climate problem are best addressed at the local government level, such as greenhouse gas reductions through smart growth, transportation planning and conserving energy in government buildings. Other aspects are best addressed at higher levels of government, such as through increasing national vehicle fuel economy standards. A growing number of businesses are committed to reducing their GHG emissions and exploring emerging low-carbon market opportunities. We will all live in a carbon-constrained world, and businesses which adapt will fare better than those which do not. Citizens can take simple yet important actions such as changing light bulbs, auditing the energy usage in their homes to reduce energy consumption and reducing car travel to reduce GHG emissions. Many such steps pay for themselves by saving money while reducing emissions.

"As Mayor and a lifelong resident of Alexandria, I am concerned about the potential impacts climate change may have on a coastal city like Alexandria and our 141,000 residents … In Alexandria, we recognize the quantity and sources of energy used by local government, businesses and residents affect our environment and quality of life, and we have committed to managing our energy supply and usage in a sustainable manner … Local governments play a critical role in improving energy efficiency, shifting the country to cleaner sources of energy, and reducing greenhouse gas emissions."

Mayor William Euille
Senate Hearing on Clean Energy Jobs, Climate Related Polices and Economic Growth
July 21, 2009

The Plans

The City of Alexandria's Environmental Action Plan 2030 (EAP) serves as the broad road map for city leaders, staff, and citizens to implement the sustainability visions set forth in Alexandria's Eco-City Charter. It sets out principles, goals, targets and actions that explain how Alexandria can lead the new green economy, address the challenges of climate change, and continue its high quality of life while decreasing the city's carbon and ecological footprints.

The City of Alexandria Energy and Climate Change Action Plan 2012-2020 (*eCAP*) builds on the work done in developing the EAP by providing information on policies and measures that the City is already undertaking, as well as possible new measures under consideration, to achieve the City's climate change goals.

The Principle

"Alexandria must be adaptive and responsive to emerging or unforeseen environmental threats – such as climate change – that could strain infrastructure, deplete natural resources, disrupt the economy, or threaten public health. Failure to respond quickly and appropriately to such threats will likely have severe consequences for the health and economy of Alexandria and its citizens."

Environmental Action Plan FY2009-2030
Principle 9: Global Climate Change and Emerging Threats
June 18, 2009

The Goals

With respect to the Global Climate Change Principle, the goals are:

Goal 1: Adopt targets and establish implementation framework for reducing GHG emission reductions for 2012, 2020 and 2050

Goal 2: Institutionalize the consideration of the effects of possible climate changes into long-term planning

Goal 3: Prepare and educate city residents and business owners for a carbon-constrained economy and other climate change impacts

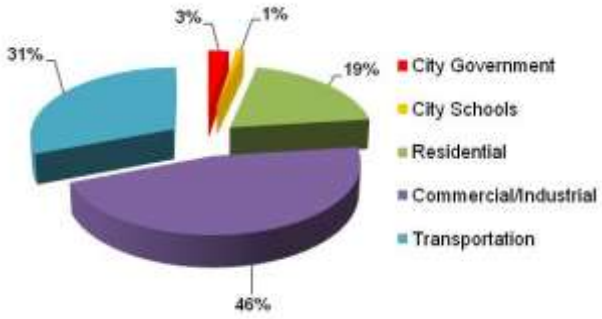
Goal 4: Increase the City's preparedness to respond to the possible effects of climate change and environmental emergencies

Some of the short-term actions described in the EAP to support these goals are already underway, as the City has already taken many voluntary GHG reduction actions and implemented various energy savings programs over the past several years. The measures described in this report build on the City's continuing GHG reduction actions and suggests additional measures to reduce GHG emissions and prepare for the potential impacts of climate change.

The Greenhouse Gas Emission Inventory

The City prepared a GHG emission inventory that shows the carbon footprint of the City government's operations as well as the footprint of the residents, businesses and commuters. As shown to the right, the City government operations accounted for only 3 % of the total emissions. City schools contributed about 1% of the total. Most of the GHG emissions are generated by the commercial/ industrial, transportation, and residential sectors.

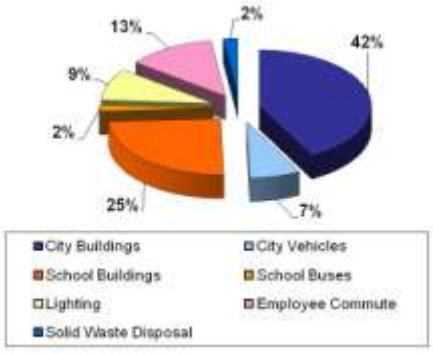
GHG Emissions by Sector (% of total)



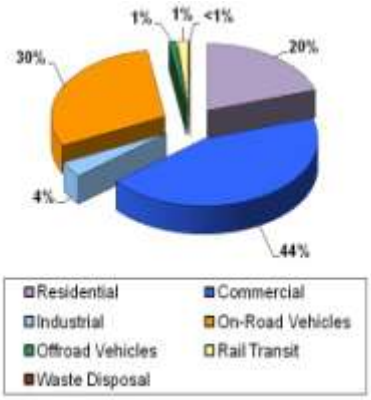
GHG emissions from city government operations totaled 79,820 metric tons (tonnes) of carbon dioxide equivalents (CO_2e) in fiscal year 2006. 42% of the emissions are from the operation of City government buildings, 25% from City school buildings, and 13% from employees commuting to work.

GHG emissions from community-wide activities totaled 2.2 million tonnes of CO_2e in calendar year 2005. 30% of the emissions are from vehicle traffic in the city, while the operation of commercial and residential buildings accounts for 44% and 20% of the total, respectively.

FY06 Government CO_2e Emissions by Sector (80,000 tonnes)



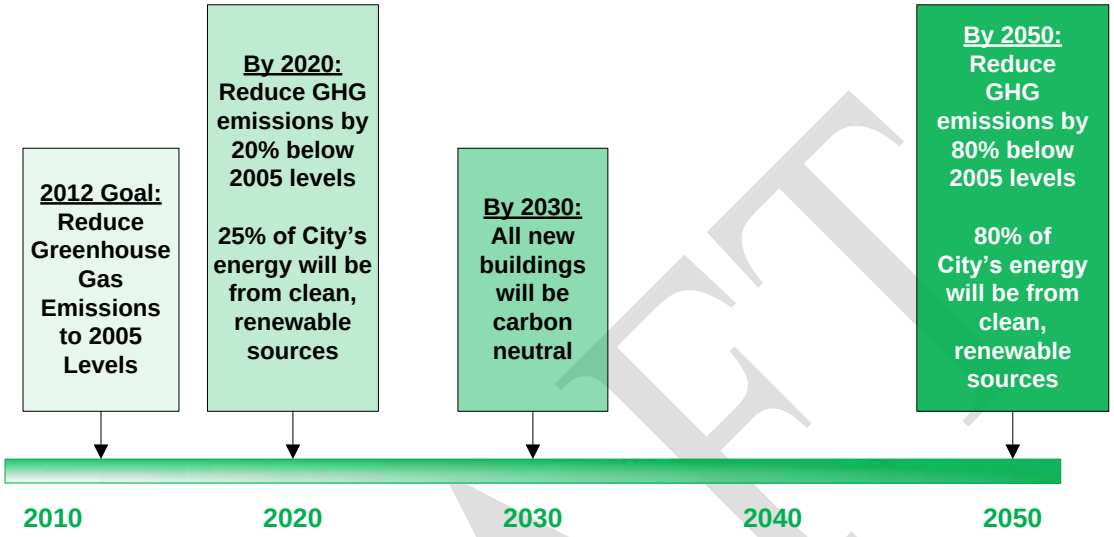
2005 Community CO_2e Emissions by Sector (2.2 million tonnes)



The GHG inventory summarized above is based on fossil fuel and electricity *consumption*. Electricity is also *generated* in the city by the Mirant Potomac River Generating Station and the Covanta Energy-from-Waste plant. The GHG emissions from electricity generation totaled 1.8 million tonnes in 2005. Based on guidance from the International Council on Local Environmental Initiatives (ICLEI), we have subtracted grid-based generation emissions from the City's total emissions to avoid double counting and to assign responsibility for electricity usage to the end-user, which will help in targeting policies to reduce emissions.

The Targets

The EAP sets out the following targets to accelerate the commitment and level of activity necessary to meet the critical challenges of reducing emissions and preparing for climate change impacts:



Significant Mitigation Measures Are Already Underway

The City already has in place a number of progressive policies and programs that are reducing energy use, promoting renewable energy and alternative transportation, and lowering GHG emissions. The City's EAP identifies a number of principles, goals, and actions governing climate change, transportation, energy, waste management and other environmental issues in the City. While many of the EAP actions were not developed explicitly to address climate change, they will help reduce GHG emissions by reducing fossil fuel consumption. In addition, the City's "constellation of plans" (e.g., Transportation Master Plan, Urban Forestry Plan, Pedestrian and Mobility Plan, Land Use Plan, Open Space Plan, Water Quality Plan, Solid Waste Management Plan, Capital Improvement Plan) include specific activities that help reduce GHG emissions.

For example, the City's Green Building Policy sets the stage for greening the city's buildings, which account for 65% of the City's GHG emissions. The City's recycling program and the Covanta Energy-from-Waste facility divert millions of tons of trash from landfills, reducing the amount of harmful methane gas released into the atmosphere. The City is using $1.37 million under the federal Energy Efficiency and Conservation Block Grant (EECBG) program to assist residents and businesses begin to develop and implement sustainable energy efficiency and conservation programs that will lower GHG emissions by decreasing dependence on energy generated from fossil fuels. The City has identified a number of proposed transportation investments and priorities that will reduce vehicle traffic and promote public transit. And the Eco-City Challenge on the City's web site is a tool for encouraging citizens to

make individual lifestyle changes and take actions to reduce their carbon footprint. These and other on-going climate change mitigation measures are described in this report.

Long-Term Solutions Are Needed

The short- and mid-term measures can help the City achieve stabilization of GHG emissions with currently available technology. Meeting the long-term GHG emission reduction targets set for 2020 and beyond will likely require accelerated development of new, affordable technologies and beneficial behavioral changes. Programs and policies related to district energy, alternative transportation fuel infrastructure, and affordable renewable energy technologies can have positive climate and energy results to meet the long-term goal of reducing GHG emissions by 80% by 2050.

However, most of these long-term measures are not quantifiable under currently available standard emission reduction protocols. Long-term measures will need continuing evaluation in order to design programs and policies that remove barriers to implementation of climate-friendly, commercially viable technologies, and consider the feasibility of prospective technologies that are not yet commercially viable.

A key role of the City leadership will be to encourage regional, state, and federal officials to support long-term measures and practices. This will not only accelerate the deployment of desirable measures across the City, it will also enhance Alexandria's leadership.

Adapting to Climate Change

Although climate scientists think that the pace of climate change can be slowed by substantially reducing GHG emissions, they also agree that some climate change will occur and will, therefore, require adaptation. Adaptation presents a complementary approach to mitigation. While mitigation measures can help reduce the likelihood of adverse conditions, adaptation strategies may be able to reduce the severity of many potential impacts if adverse conditions prevail.

City staff has begun to take a preliminary look at potential climate change risks and vulnerabilities in Alexandria. They have also begun identifying common adaptation goals and suggestions for preparedness actions. Sea-level rise and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change. Decreased water availability is very likely to affect the City's economy as well as its natural systems. Increases in air and water temperatures will cause heat-related stresses for people, plants, and animals. Quality of life will be affected by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties. These impacts, some of which are already being observed, will likely have a significant effect on Alexandria's ecosystems, infrastructure, residents and economy.

Potential adaptation strategies currently being evaluated include measures to reduce the potential impacts of rising sea level and flooding in Alexandria, reducing water demand and increasing water conservation, reduce impacts of extreme heat events, and mitigating damage to natural ecosystems. For example, the City's Waterfront Small Area Plan addresses the need to improve the condition of Alexandria's shoreline: to naturalize it where possible, to improve the condition and function of seawalls, and to reduce the need

for dredging and debris removal. The City would also monitor climate change and explore consensus science to help address sea-level rise issues in order to protect against the most extreme flood events.

Challenges and Uncertainties

The City of Alexandria will face many challenges and uncertainties in mitigating and adapting to climate change. They can be classified as economic, institutional, psychological, and informational. They include, but are not limited to, the following:

- Mitigation and adaptation efforts are hampered by a lack of solid information about the benefits, costs, and effectiveness of various strategies, and by uncertainty about increases in the risk of future climate impacts.
- Meeting the previously discussed goals and targets will require a major departure from business-as-usual (BAU). For example, energy efficiency may reduce short-term energy consumption from specific appliances or other infrastructure; such measures are not likely to realize the longer-term need for a very large reduction in energy generated by fossil fuels.
- The City must make a coordinated effort to reduce GHG-producing activities across all levels of government. For example, the City must coordinate regional transportation issues that involve dozens of local governments. Likewise, national policies will be necessary to encourage large-scale switching to cleaner fuels.
- City budgets may constrain the flexibility of officials to invest in GHG reduction projects, which sometimes require upfront capital costs to finance long-term energy cost savings.

Despite the challenges and uncertainties, many critical actions can be successfully initiated locally to begin to address GHG emissions. These same climate change mitigation and adaptation measures generate broader non-climate related benefits, such as saving on energy costs, reducing local air pollution, enhancing alternative transportation and increasing the "livability" and "sustainability" of the City.

1. Introduction

1.1 What is the Purpose of the *Energy and Climate Change Action Plan*?

This *Energy and Climate Change Action Plan* (*eCAP*) is a complement to the EAP and is intended to further define the City's path to achieving significant GHG emission reductions. It presents options for emission reduction strategies that touch all aspects of the City's operations and life in the community at large. The actions proposed in this plan are a starting point, rather than a comprehensive blueprint for how the City will achieve significant GHG emission reductions. This *Energy and Climate Change Action Plan* is focused on near and medium term action that City staff, elected officials, residents, and businesses can take to reduce GHG emissions. For the purpose of this document, short-term is being used to refer to a 2009-2011 year time horizon, while medium-term refers to a 2012-2020 year time frame.

Section 1 of the *eCAP* provides a brief summary of the potential local impacts of climate change on the City of Alexandria. It summarizes the actions that the City has already undertaken to address climate change. And it summarizes actions under consideration by regional, state, national, and international governmental bodies.

Section 2 provides the baseline emission inventory results for City government and community-wide operations. It describes how emissions are projected to grow under a business-as-usual scenario. And it identifies emission reduction targets that are needed to help lessen the impacts of climate change.

Many emission reduction measures are described in detail in Section 3 (Municipal Operations) and Section 4 (Community). In addition, Section 5 (Adaptation) identifies measures for responding to potential consequences of GHG emissions from decades past. These sections are intended to identify current and potential new GHG emission reduction measures and associated costs (or cost savings). Many of the emission reduction strategies have significant unknowns and, therefore, some uncertainty associated with the quantification emission reductions and costs. In the future, as the rigor of the methods and protocols for accounting for GHG emissions improves and moves towards standardization, the number and variety of emission reduction strategies that can be quantified will expand. Quantifying these emissions will also expand the ways in which the City can reduce emissions, more realistically portraying the cause and effect between actions and emissions.

Section 6 identifies some of the implementation steps and challenges facing the City Council, the Environmental Policy Commission, and City staff as they consider these measures and work to put them into action in the upcoming years. Section 7 identifies key references. Section 8 is a glossary of commonly used climate change terms.

1.2 What are the Local Impacts of Climate Change?

The Earth's climate has changed many times during the planet's history, with events ranging from ice ages to long periods of warmth. Historically, natural factors such as volcanic eruptions, changes in the Earth's orbit, and the amount of energy released from the Sun have affected the Earth's climate. The evidence shows, however, that human activities are accelerating climate change by dramatically increasing the amount of greenhouse gases in the environment. The consensus of the Intergovernmental Panel on Climate Change (IPCC, 2007), the National Academy of Sciences (NAS, 2008), and other scientific organizations is that there is little doubt climate will continue to change in the 21st century and the change is likely to bring harmful effects across the globe and, in particular, to people in coastal communities. In general, the larger and faster the changes in climate are, the more difficult it will be for human and natural systems to adapt.

The Virginia Commission on Climate Change (VGCCC, 2008) and the U.S. Global Change Research Program (USGCRP, 2009) identified potential effects of climate change on the built environment, natural systems, and human health. The major findings include the following:

- *Sea-level rise* and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change.
- *The built environment* may be affected by sea-level rise, a major concern for coastal Virginia with predicted sea levels in the Chesapeake Bay region of 2.3-5.2 feet higher by 2100. Sea-level rise and storm surge will pose serious and growing threats to Alexandria's historic buildings, homes, roads, railways, utility systems, and other critical infrastructure in low-lying areas.
- *Natural systems* may be affected as wetlands are threatened by sea-level rise and saltwater intrusion. These wetlands serve as a critical habitat for many plants and animals.
- *Human health* may also be affected by extreme weather events that can directly affect health through injuries or drowning. Climate change may lead to the alteration or disruption of natural systems, making it possible for vector-borne diseases to spread or emerge in areas where they previously had been limited or non-existent.
- *Quality of life will be affected* by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties.

These impacts, some of which are already being observed, could dramatically affect Alexandria's ecosystems, infrastructure, residents and economy. Section 5 of this report provides additional information on the risks to Alexandria associated with climate change.

1.3 What is Alexandria Doing About Climate Change?

In February 2005, Mayor Euille endorsed and signed the 2005 U.S. Mayors Climate Protection Agreement. This agreement committed Alexandria to take action to reduce GHG emissions through a variety of methods, including energy efficiency and conservation, use of local land use planning, urban forest restoration, public outreach campaigns, and other reduction strategies. As of July 2009, nearly 1,000 U.S. cities have signed on to the Agreement. Climate change is an important component of the City's overall strategic planning process.

The Environmental Policy Commission (EPC) developed the *Eco-City Charter*, outlining the City's guiding principles, vision, and overall environmental future. The *Charter* identifies 10 guiding principles to serve as a guide for moving the city towards a sustainable future. The 10 principles relate to land use and open space, water resources, air quality, transportation, energy, green buildings, health, solid waste, climate change, and implementation. The *Eco-City Charter* was adopted by City Council on June 14, 2008.

In 2008, Alexandria joined with more than 500 cities around the world to participate in the Cities for Climate Protection campaign, sponsored by the ICLEI. As part of the campaign, member cities have committed to: inventory their emissions of GHG; set reduction targets; describe local actions required to meet these targets; implement the actions to reduce emissions; and measure the results.

City of Alexandria Leading by Example: Eco-City Charter

Eco-City Alexandria is a strategic collaborative planning process designed by the City of Alexandria in partnership with Virginia Tech's Department of Urban Affairs and Planning to create an Eco-City Charter and Environmental Action Plan that will guide Alexandria toward sustainability.

The City used ICLEI software and methodologies (ICLEI, 2008) to create a GHG emissions inventory, a critical first step in determining the City government's GHG contribution as well as the contribution from the community. The City completed a *Greenhouse Gas Emission Inventory Report* (OEQ, 2009) in April 2009. The report contains estimates of GHG emissions and energy consumption by City government operations as well as for the entire community. See Section 2 of this report for a summary of the GHG inventory.

City of Alexandria Leading by Example: Environmental Action Plan

The EAP 2030 will serve as the road map for City leaders, staff, and citizens to implement the sustainability visions and principles set forth in Alexandria's Eco-City Charter (adopted by City Council on June 14, 2008). It explains how Alexandria can lead the new green economy, address the challenges of climate change, and continue its high quality of life while decreasing the city's carbon and ecological footprints.

The City started to develop the *Environmental Action Plan* (EAP) in 2008. The *EAP* explains how Alexandria can address climate change, lead the new green economy, and continue its high quality of life while decreasing the City's carbon and ecological footprints. The final *EAP* (EPC, 2009) consists of goals and action steps focusing on the short-term (FY 2009-2011) and the mid- and long-term (FY 2012-2030). The Alexandria City Council unanimously approved the *EAP* at the legislative meeting held Tuesday, June 23, 2009.

In FY 2008, a new Energy Manager position was created in the Department of General Services to analyze, develop and implement the City's energy conservation efforts, including changes in operating procedures and contracts to save on future energy costs, as well as, reduce GHG emissions. The City's goal is to reduce energy consumption in the City's facilities by as much as 3% per square foot per year. This includes electricity, water, and natural gas, with a goal of reducing energy consumption by 20% by the year 2015. In FY 2009, continued emphasis was placed on energy consumption analysis, the development of strategies to address the largest consumers of energy; promoting energy awareness, such as turning off lights and office electrical equipment; adjusting and adhering to space temperature settings and implementing energy conservation initiatives. A new Energy Conservation Committee has also been created to develop strategies to conserve energy.

The *EAP* includes targets for reducing GHG emission for 2012, 2020 and 2050. One of the short-term actions identified in the EAP was to "assign the Environmental Coordinating Group (ECG) to propose methods to achieve the emission reduction targets and begin drafting a climate action plan that will include exploring methods for making the targets binding." Sections 3, 4, and 5 of this *eCAP* identify specific actions that the City and the community might implement over a several year period to reduce GHG emissions.

In 2010, the City of Alexandria was honored by ICLEI – Local Governments for Sustainability with a milestone award for completing a GHG emissions inventory and setting sustainability improvement goals as a part of the Eco-City Alexandria initiative. ICLEI commended the City on its continued progress towards reducing GHG, increasing energy efficiency and clean energy use, developing the local green economy, and improving local quality of life.

ICLEI USA Honors the City of Alexandria and 19 Other Cities and Counties for Achieving Milestones in Reducing GHG Emissions

"*The Milestone Awards recognize the great work of cities, towns and counties that are actively engaged in reducing greenhouse gas emissions and want a better quality of life for their residents*" said Mayor Patrick Hays, City of North Little Rock, AR, and President of the Board of Directors, ICLEI USA. September 27, 2010

"*It's incredibly rewarding to see so many cities, towns and counties actively engaged in our Five Milestone process and being recognized for their accomplishments,*" said Martin Chávez, Executive Director, ICLEI USA and three-term Mayor of Albuquerque, NM. "*Through the success of the Five Milestone process, local governments are on track to reduce GHG emissions by 1.36 billion metric tons by 2020—the equivalent of taking 25 million passenger vehicles offs the road for 10 years—an incredible achievement being led by our local governments.*" September 27, 2010

1.4 What are Regional, State, Federal and International Governments Doing?

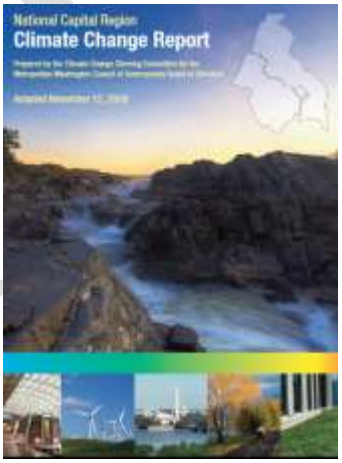
In pursuing action to combat climate change, Alexandria is not acting in a vacuum. Climate change is a global problem and all levels of government have roles to play. Some aspects of the climate problem must be addressed at the local level, such as GHG reductions through smart growth and adaptation to climate impacts. State governments have decision-making authority over many issues and economic sectors – such as power generation, agriculture and land use – that are critical to addressing climate change. Other aspects, such as vehicle fuel economy standards, are national in scope and require federal action. Ultimately, international action must be taken to reduce GHG emissions worldwide and avoid the potentially dangerous effects of climate change.

It is important to recognize that a major determinant in the City of Alexandria's success in reducing its GHG emissions will be the actions taken by regional, state, and national bodies across all sectors. While these strategies will be important, it is beyond the scope of this study to make estimates as to what these efforts will mean in terms of emissions reductions for Alexandria.

1.4.1 Regional Actions

In November of 2008, the Metropolitan Washington Council of Governments (MWCOG) voluntarily adopted stringent goals for reducing the region's GHG emissions. MWCOG's decision, one of the few in the country to affect a multi-state region, proposes to return to 2005 levels of regional GHG emissions by 2012. The mid-range goal is for a reduction of 20% below the 2005 levels by 2020, and the long-term goal is for a reduction of 80% below the 2005 levels by 2050. MWCOG made specific recommendations to improve energy efficiency in buildings, reduce demand for energy, promote clean energy sources, increase fuel efficiency and use of clean fuel vehicles, reduce vehicle miles travelled, and other efforts to reduce fossil fuel energy consumption and GHG emissions.

In 2009, MWCOG formed the Climate, Energy and Environment Policy Committee (CEEPC). The new committee will provide leadership on climate change, energy, green building, alternative fuels, solid waste and recycling issues, and will help support area governments as they work together to meet the goals outlined in the National Capital Region Climate Change Report. This responsibility includes development of a regional climate change strategy to meet the regional GHG reduction goals adopted by the MWCOG Board.



1.4.2 State Actions

The Commonwealth of Virginia is currently developing plans for reducing energy consumption and GHG emissions. The *Virginia Energy Plan* (VDMME, 2007) contains four broad goals. One of the goals is to reduce GHG emissions by 30% by 2025, bringing emissions back to 2000 levels. The second goal is to reduce the rate of growth of energy use by 40% by emphasizing conservation and clean fuel technologies. The third goal is to expand consumer education to overcome barriers to implementing energy efficiency and conservation actions. The final goal is to capitalize on economic opportunities in developing green energy technologies.

The Virginia Governor's Commission on Climate Change released its *Final Report: Climate Change Action Plan* in December of 2008 (VGCCC, 2008). Based on the Governor's Executive Order 59, the Commonwealth set a GHG emission target of 30% below the business-as-usual projection of emissions by 2025 (e.g., the targeted emissions in 2025 will be equivalent to the 2000 emission level). The Commission identified the actions (beyond those identified in the Energy Plan) that need to be taken to achieve the 30% reduction goal. The Commission also recommended strategies that will guide Virginia's response to climate

change, including how the state should plan for and adapt to changes that are likely unavoidable.

The Virginia Division of Energy supports a number of federally-funded programs and projects designed to reduce dependence on fossil fuels and associated GHG emissions. The Division of Energy provides a broad range of energy-related programs to business and industry, state and local governments, schools, and residential consumers that focus on energy efficiency measures that promote energy cost and dollar savings. Examples of Virginia's energy incentive programs range from appliance and energy efficiency rebates to biomass energy grants to local government and school facility renewable energy utilization programs.

1.4.3 Federal Actions

For over 20 years, the federal government has been implementing a wide array of public-private partnerships to reduce U.S. GHG emissions and GHG emissions intensity. These voluntary programs focus on energy efficiency, renewable energy, agricultural practices and implementation of technologies to achieve GHG reductions. For example, the Environmental Protection Agency (EPA) and the Department of Energy (DOE) have operated the ENERGY STAR program since 1996. This voluntary labeling program is designed to identify and promote energy-efficient products to reduce GHG emissions. Today, more than 1,400 manufacturers use the ENERGY STAR label in over 40 product categories.

On February 17, 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (Recovery Act). The Recovery Act seeks in part to spur technological advances in science and health and to invest in environmental protection and other infrastructure that will provide long-term economic benefits. Among the programs funded by the Recovery Act is the Energy Efficiency and Conservation Block Grant (EECBG) Program. The EECBG Program is intended to assist state, local, and tribal governments in implementing strategies to:

- Reduce fossil fuel emissions;
- Reduce total energy use; and
- Improve energy efficiency in the transportation, building, and other appropriate sectors.

The City of Alexandria received $1,372,800 under the EECBG to fund a variety of energy efficiency and conservation efforts that will reduce energy consumption and GHG emissions. The City is currently using EECBG funds to facilitate energy audits at seven City facilities. The City is also develop a Green Building Virtual Resource Center and performing other green building promotional activities, installing a green roof on the two lower courtyard roofs at City

Hall, and partnering with Dominion VA Power to retrofit approximately 34 streetlights with energy efficient light-emitting diodes (LEDs).

In April 2009, the EPA issued a proposed finding that GHGs contribute to air pollution that may endanger public health and welfare (also known as the endangerment finding). The proposal stems from the U.S. Supreme Court decision in which the Supreme Court found that GHGs are air pollutants covered by the Clean Air Act. The endangerment finding was finalized on December 7, 2009.

"*These long-overdue findings cement 2009's place in history as the year when the United States Government began addressing the challenge of greenhouse-gas pollution and seizing the opportunity of clean-energy reform.*

Today's finding is based on decades of research by hundreds of researchers. The vast body of evidence not only remains unassailable, it's grown stronger, and it points to one conclusion: greenhouse gases from human activity are increasing at unprecedented rates and are adversely affecting our environment and threatening our health.

EPA Administrator Lisa P. Jackson
December 7, 2009

Based on the endangerment finding, the EPA has finalized three rules regarding GHG emissions:

- EPA and the National Highway Safety Administration finalized standards that will dramatically reduce GHG emissions and improve fuel economy for new cars and trucks sold in the U.S., requiring passenger vehicles to meet the equivalent of 35.5 miles per gallon.
- EPA issued new thresholds for GHG emissions that define when Clean Air Act permits under the New Source Review program would be required. Nearly 70% of the nation's largest stationary source GHG emitters – including the Mirant Potomac River Generating Station – will be subject to GHG permitting requirements under the rule.
- EPA issued the Final Mandatory Reporting of Greenhouse Gases Rule. The rule requires reporting of GHG emissions from large sources and suppliers in the U.S., and is intended to collect accurate and timely emissions data to inform future policy decisions. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of vehicles and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions are required to submit annual reports to EPA.

Congress seemed to have momentum to act on climate change and clean energy in 2009. The federal stimulus was enacted in February 2009 and designated billions of dollars to support clean energy. In June, 2009, the House passed the *American Clean Energy and Security Act of 2009*, a comprehensive approach that would set renewable energy requirements and establish a cap and

trade program to limit carbon emissions. But the Senate version of the bill stalled as legislators turned their focus to health care legislation and the bill was not enacted.

1.4.4 International Actions

The United Nations Framework Convention on Climate Change (UNFCCC) is the governing body for international research and agreements on climate change. The ultimate objective of the UNFCCC is to stabilize GHG concentrations at a level that will prevent dangerous human interference with the climate system. The UNFCCC is complemented by the 1997 Kyoto Protocol, which has 176 parties. Under this treaty, which entered into force in 2005, 36 industrialized countries and the European Union have committed to reducing their emissions by an average of 5 per cent by 2012 against 1990 levels. The U.S. signed onto the Kyoto Protocol but did not ratify it primarily because the Protocol exempted countries such as China and India, who are two of the top five emitters of GHGs in the world, and because of concerns about the potentially significant repercussions for the global economy.

The Kyoto Protocol expires in 2012. The UNFCCC conference in Copenhagen in December 2009 was intended to develop a "Copenhagen Protocol" to replace the "Kyoto Protocol" as the international mechanism to prevent global warming and climate change. However, an internationally binding agreement could not be reached to compel and motivate the nations of the world to address the climate crisis in a meaningful way.

The 2010 UNFCCC conference took place in Cancun, Mexico, from 29 November to 10 December 2010. The Cancun conference aims to agree on funds and approaches to preserve rainforests and prepare for a hotter world, and to formalize existing targets to curb GHG emissions. Cancun met with high expectations from many parties, but produced what some critics believe to be a weak, non-binding outcome, labeled the Cancun Agreement.

2. Emission Inventory Summary

The first step toward reducing GHG emissions in Alexandria is to identify baseline levels and sources of emissions in the city, as well as the sectors of government operations and community that are responsible for the bulk of these emissions. This information aids in the selection of possible reduction measures and ability to achieve emission reduction targets. Complete details of the inventory development data, methodologies, and results can be found *Eco-City Alexandria: Greenhouse Gas and Criteria Air Pollutant Emissions Inventory*. The emission inventories for government operations and community-wide were developed using protocols and software provided by the ICLEI, including the *Local Government Operations Protocol*, which sets the national standard for quantifying and reporting GHG emissions. The City plans on updating the GHG emission inventory every 3-5 years to gauge progress towards meeting emission reduction goals.

2.1 City Government Operations Inventory, Forecast, and Targets

The City government operations inventory provides an estimate of GHG emissions produced by City government activities, including fuel use, electricity use, and waste production resulting from City government operations. The emissions inventory includes both direct emissions (for example, emissions within the city from fossil fuel combustion at City buildings) and indirect emissions (emissions generated outside the city by City employees commuting to Alexandria to work).

As shown in Exhibit 1, City government operations in FY2006 resulted in the production of about 79,820 tonnes of GHG emissions, primarily from fossil fuel and electricity consumption in City buildings and schools. Exhibits 2 and 3 summarize the City government operations inventory by type of operation and energy source, respectively.

The consumption of electricity and the combustion of natural gas in City government buildings resulted in the majority of emissions in FY2006 – approximately 33,729 tonnes of CO_2e. School buildings were the second largest source and made up 25% of the total government CO_2e emissions. Gasoline fuel used by City government employees commuting to work was the third largest category of emissions. ***Note that the City government operations and schools are a subset of the city-wide community total GHG emissions discussed in Section 2.2, and represent only 4% of the city-wide total of 2.2 million tonnes***.

A BAU emissions forecast scenario was developed for local government operations. Projections were made and emission reduction targets were set for the short-term (2010, 2012), medium-term (2020, 2030), and long-term (2040, 2050). As shown in Exhibit 1, it was estimated that by 2020, if energy use continued to follow existing patterns, City government operations would result in approximately 91,767 tonnes, or a 15% increase from the baseline year emissions.

The MWGOG Climate, Energy, and Environment Policy Committee (formally known as Climate Change Steering Committee) recommended goals to reduce regional GHGs. These targets represent the consensus of U.S. scientists who state that GHG emissions must be reduced by 50-85% by 2050 to avoid the possible consequences of global warming. The City has adopted the MWCOG emission reduction percentage targets for reducing the City's government operations GHG emissions. The short-term goal for 2012 is to reduce GHG emissions to 2005 levels. The mid-term goal for 2020 is to reduce GHG emissions by 20% below 2005 levels. The long-term goal for 2050 is to reduce GHG emissions by 80% below 2005 levels. Exhibit 4 compares the projected BAU emissions and the MWCOG emission reduction targets.

Exhibit 1
Baseline and Business-as-Usual Emission Forecasts for the Government Operations Inventory

	CO_2e Emissions (tonnes)			
Source Category	**FY2006**	**2012**	**2020**	**2050**
Scope 1 Emissions – All direct emissions sources located within the city's boundary				
City Buildings - Fossil Fuel	4,486	4,798	5,157	6,779
Schools – Fossil Fuel	3,240	3,465	3,725	4,896
City Fleet	5,146	5,504	5,916	7,776
Fire Dept. Vehicles	675	722	776	1,020
School Buses	1,435	1,535	1,650	2,168
Solid Waste Disposal	1,671	1,787	1,921	2,525
Scope 1 Emissions	**16,653**	**17,812**	**19,146**	**25,163**
Scope 2 Emissions – Indirect emissions limited to electricity consumption within the city, but the associated emissions occur outside of the city's boundary				
City Buildings - Electricity	29,243	31,278	33,620	44,187
Schools – Electricity	16,413	17,555	18,870	24,801
Lighting - Electricity	7,406	7,921	8,514	11,191
Scope 2 Emissions	**53,062**	**56,755**	**61,004**	**80,179**
Scope 3 Emissions – Indirect emissions that result as a consequence of activity within the city, but the associated emissions occur outside of the city's boundary				
Employee Commute	10,105	10,808	11,617	15,269
Scope 3 Emissions	**10,105**	**10,808**	**11,617**	**15,269**
Total for All Government Operations	**79,820**	**85,375**	**91,767**	**120,611**

Note: The Government operation emissions are a subset of the city-wide community total GHG emissions, representing approximately 4% of the city-wide total of 2.2 million tonnes.

Exhibit 2
FY06 Government CO_2e Emissions by Sector (80,000 tonnes)

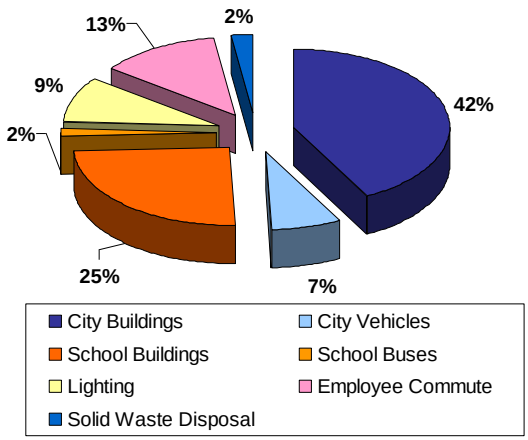


Exhibit 3
FY06 Government CO_2e Emissions by Energy Source (80,000 tonnes)

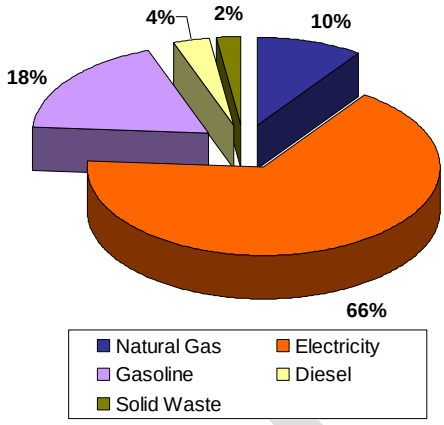
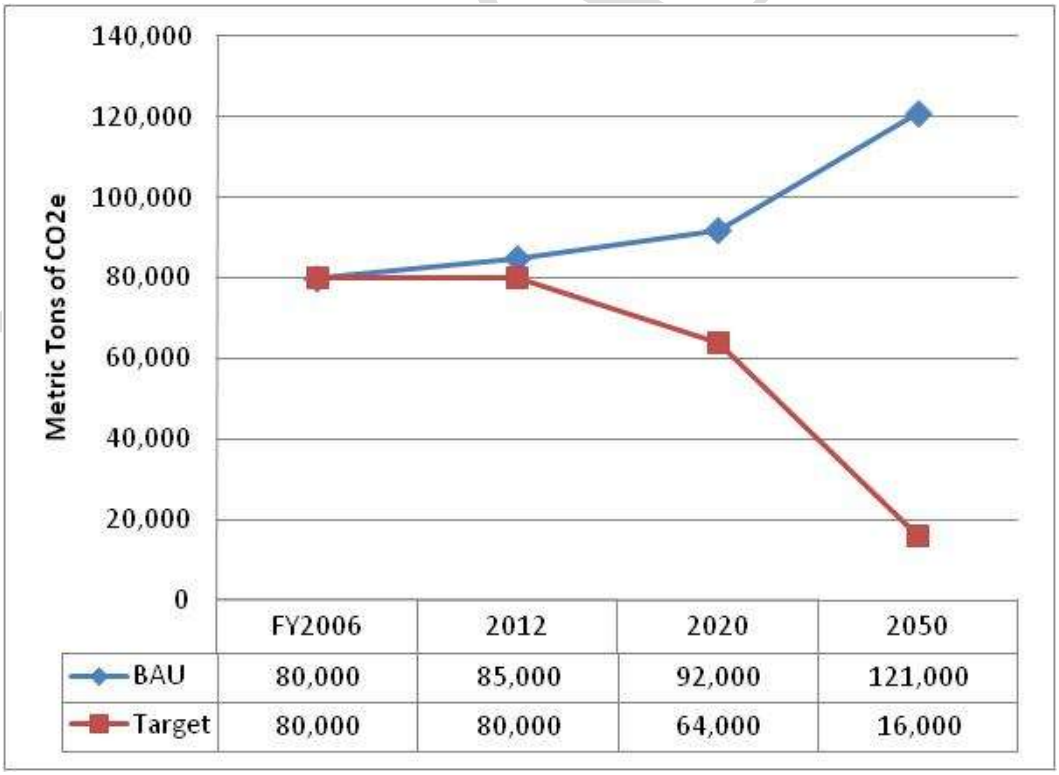


Exhibit 4
Government Operations CO_2e Emissions Forecast and Targets



	FY2006	2012	2020	2050
BAU	80,000	85,000	92,000	121,000
Target	80,000	80,000	64,000	16,000

Values rounded to nearest 1,000 metric tons

2.2 Community Inventory, Forecast, and Targets

The community inventory includes emissions produced by residents, by businesses/agencies, and by residents and commuters traveling within the city. The community inventory includes the essential sources that are the most significant in scale and are most easily impacted by local policy making. It includes direct emissions from sources located within the city, as well as most, but not all, indirect emissions that result from activity within the city but the associated emissions occur outside of the city's boundary (e.g., electricity consumed in the city that is imported from coal-fired power plants outside of the city). However, the inventory does not include all indirect emission sources, such as air or land travel by residents outside of the City's boundaries nor "upstream" emissions generated in the production and transportation of materials (food, fuel, consumer products, materials) used in the community.

It is most useful for public awareness and target setting to frame emissions based on energy consumption. As shown in Exhibit 5, the GHG emissions for fossil fuel and electricity consumption in Alexandria in 2005 totaled 2.2 million tonnes. Electricity is also generated in the City by the Mirant Potomac River Generating Station and the Covanta energy-from-waste facility. The GHG emissions from electricity generation totaled 1.8 million tonnes in 2005. Some of this electricity is consumed within the City, while most is transmitted for sale in other areas. The total electricity demand within the City, therefore, differs from the total generation. To avoid double counting, we have subtracted grid-based generation to assign responsibility for electricity usage to the end-user, which will help in targeting policies to reduce emissions. Using this formula, the total GHG consumption-based emissions for Alexandria in 2005 were 2.2 million tonnes, which does not include emissions from Mirant and Covanta.

Exhibit 6 shows that 30% of the 2.2 million tonnes result from onroad vehicle traffic in the City. The operation of commercial and residential buildings accounts for 44 and 20% of the total, respectively. Exhibit 7 shows that 55% of the 2.2 million tonnes result from electricity consumption in buildings within the City. Transportation fuels – gasoline and diesel – account for 31% of the total. The remainder of the emissions is from fossil fuel combustion in residential, commercial, and industrial buildings.

The City has adopted the MWCOG emission reduction targets for reducing the City's GHG emissions. The short-term goal for 2012 is to reduce GHG emissions by 10% below the 2012 forecast BAU. The mid-term goal for 2020 is to reduce GHG emissions by 20% below 2005 levels. The long-term goal for 2050 is to reduce GHG emissions by 80% below 2005 actual levels. Exhibit 8 compares the projected BAU emissions and the MWCOG emission reduction targets. Exhibit 9 shows that BAU per capita emissions are projected to increase slightly from 16.0 to 16.4 tonnes per person by 2020, with a further increase to 18.1 tonnes by 2050. The targeted per capita emission rate in 2050 is 2.1 tonnes.

Exhibit 5
Baseline and Business-as-Usual Emission Forecasts for the Community Inventory

	CO_2e Emissions (tonnes)			
Source Category	**2005**	**2012**	**2020**	**2050**
Scope 1 Emissions – All direct emissions sources located within the City's boundary				
Fossil Fuel – Residential	169,816	181,633	195,233	256,599
Fossil Fuel – Comm/Govt	67,520	70,588	77,599	122,485
Fossil Fuel - Industrial	74,020	77,383	85,070	134,276
Onroad Vehicles	644,896	720,134	806,120	1,084,715
Offroad Equipment	19,766	21,142	22,724	29,867
Locomotives – Diesel	145	155	167	219
Scope 1 Consumption Based Emissions:	**976,163**	**1,071,035**	**1,186,913**	**1,628,161**
Mirant Potomac River Generating Station	1,478,301	2,433,417	2,433,417	2,433,417
Covanta energy-from-waste facility	318,092	371,107	371,107	371,107
Scope 1 Generation Based Emissions:	**1,796,393**	**2,804,525**	**2,804,525**	**2,804,525**
Scope 2 Emissions – Indirect emissions limited to electricity consumption within the City, but the associated emissions occur outside of the City's boundary				
Electricity – Residential	264,490	282,896	304,078	399,655
Electricity – Commercial	889,242	929,644	1,021,988	1,613,135
Electricity – Industrial	8,737	9,134	10,041	15,849
Electricity - Rail Traffic	29,310	31,350	33,697	44,289
Scope 2 Emissions:	**1,191,779**	**1,253,023**	**1,369,804**	**2,072,927**
Scope 3 Emissions – Indirect emissions that result as a consequence of activity within the City but the associated emissions occur outside of the City's boundary				
Municipal Solid Waste sent to landfills outside of Alexandria	1,388	1,457	1,485	1,596
Wastewater Sludge sent to landfill or incinerator, or used as fertilizer outside of Alexandria	3,481	3,654	3,723	4,002
Scope 3 Emissions:	**4,869**	**5,110**	**5,208**	**5,598**
Total Scope 1 Consumption + Scope 2 + Scope 3	**2,172,811**	**2,329,168**	**2,561,925**	**3,706,686**

Exhibit 6
2005 Community CO_2e Emissions by Sector (2.2 million tonnes)

Exhibit 7
2005 Community CO_2e Emissions by Energy Source (2.2 million tonnes)

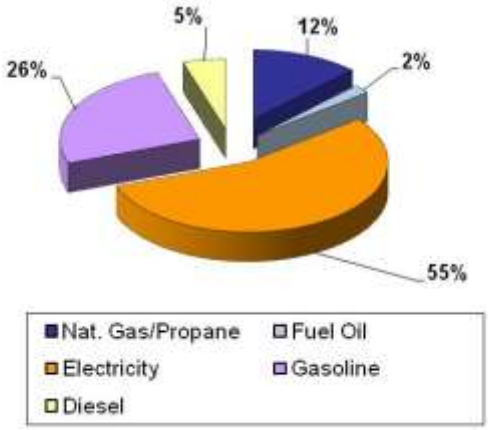


Exhibit 8
Community CO_2e Emissions Forecast and Targets

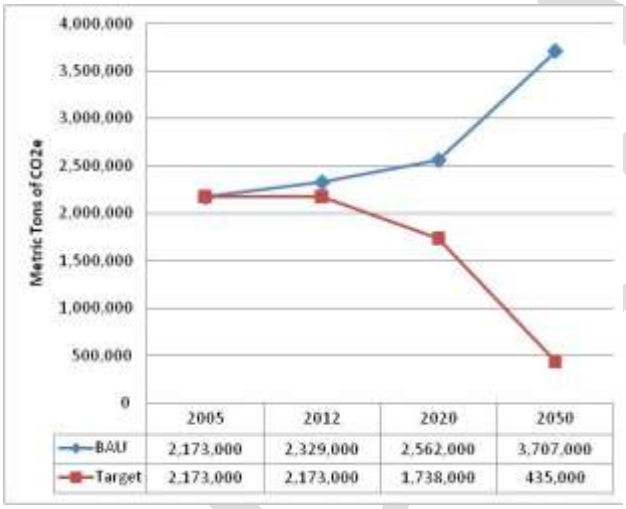
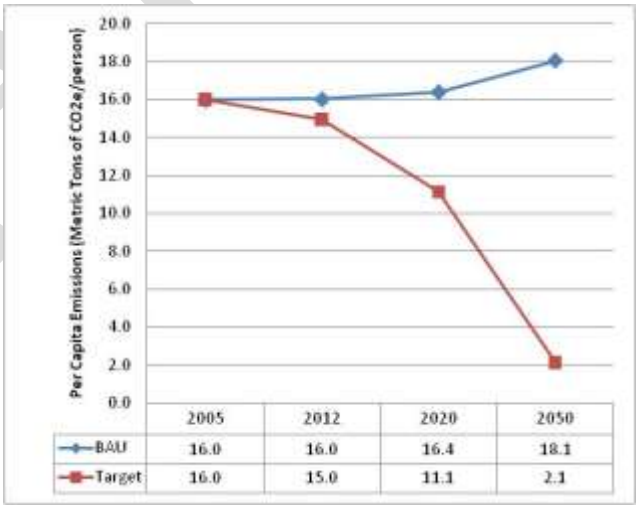


Exhibit 9
Community Per Capita CO_2e Emissions Forecast and Targets



The GHG inventory summarized above is based on fossil fuel and electricity *consumption*. Electricity is also *generated* in the city by the Mirant Potomac River Generating Station and the Covanta energy-from-waste plant. The GHG emissions from electricity generation totaled 1.8 million tonnes in 2005. Based on guidance from ICLEI, we have subtracted grid-based generation emissions from the City's total emissions to avoid double counting and to assign responsibility for electricity usage to the end-user, which will help in targeting policies to reduce emissions.

3. City Government Operations Emission Reduction Measures

3.1 Introduction

Section 3 describes how the City of Alexandria is working to achieve its GHG emissions reduction targets for City government operations for 2012 and 2020. In order to meet these ambitious goals, a comprehensive set of actions must be set in motion. The City has already enacted numerous energy saving and GHG emission reduction projects for its City facilities and has plans for additional projects which are in various stages of development. This section discusses efforts, completed projects and activities which are already reducing emissions, as well as continuing and new initiatives that further reduce GHG emissions from City government operations.

Exhibit 10 lists many of the GHG emission reduction strategies that are described in this section. The list of action items was drawn from several sources of information:

- The City's EAP identifies a number of principles, goals, and actions governing climate change, transportation, energy, waste management and other environmental issues in the City. While many of the EAP actions were not developed to explicitly reduce GHG emissions (e.g. increasing energy efficiency, improving transit options), they will help reduce GHG emissions.
- The City's "constellation of plans" (e.g., Transportation Master Plan, Urban Forestry Plan, Pedestrian and Mobility Plan, Land Use Plan, Open Space Plan, Water Quality Plan, Solid Waste Management Plan, Capital Improvement Plan), which include specific activities that help reduce GHG emissions.
- The City's GHG emission inventory report identifies the most significant sectors contributing to the City's carbon footprint.
- The *Climate Protection Manual for Cities* (NCS, 2007) provides resources, tools, programs and case studies of how cities and communities have worked to reduce their GHG emissions.
- Several climate action plans from across the U.S. were reviewed to draw upon the ideas and experiences of other local governments.

Section 3.2 identifies and describes many of the City's continuing and new emission reduction strategies. Many of the strategies have significant unknowns and, therefore, some uncertainty associated with the assumptions made regarding costs, energy savings, and emission reduction estimates.

Given the resources allocated for this project, Section 3.3 attempts to estimate the emission reduction and cost implications of several strategies for which sufficient information is available to allow quantification.

Exhibit 10
List of Existing, Planned, and Potential City Government GHG Emission Reduction Measures

Measure Name	Status
Green Buildings	
Green Building Projects for New Buildings (Charles Houston Recreation Center, DASH Maintenance Facility, Potomac Yard Fire Station, TC Williams High School)	On-going
Green Building Policy for Existing Buildings	Planned
Energy Efficiency and Conservation	
Street/Traffic Light LED Replacement Program	On-going
Energy Conservation and Audit Program	On-going
Employee Shutdown of Computers at Night	Planned
Energy Audits/Retrofits in City Buildings (ESPC)	Under Consideration
Energy Audits/Retrofits in City Schools (ESPC)	On-going
Renewable Energy	
Covanta Energy-from-Waste Facility	On-going
Renewable Energy Purchase for City Buildings	On-going
Renewable Energy Purchase for City Schools	On-going
Pilot Renewable Energy Technology on a City Building	Planned
Pilot Solar Illuminated Bus Shelters	Planned
Alternative Forms of Transportation for City Employees	
Alexandria Local Motion	On-going
Commuter Connections	On-going
Carshare Alexandria!	On-going
Transit Incentives for City Employees	On-going
Green Vehicle Fleet	
Hybrid Vehicle Purchase Program	On-going
Diesel Retrofits for City School Buses	Existing
Green Vehicle Fleet (20% Better than CAFE standards)	Under Consideration
Biodiesel for City Diesel Fleet Operations	Under Consideration
Land Use Planning and Other Measures	
Urban Forestry Master Plan (Tree Plantings)	On-going
Sustainability Principles in Small Area Plans	On-going

Some of the above measures have been in existence for years, while other are in the planning stages. And several are under consideration as a means to achieving emission reduction targets in 2020. The programs are being implemented by the Environmental Policy Commission (EPC), in collaboration the community and members of the Environmental Coordination Group from City Departments (Planning & Zoning, General Services, Health, Code Enforcement, and Transportation & Environmental Services).

City of Alexandria Leading by Example: T.C. Williams HS

In 2002, the City committed to planning, building, and maintaining a green high school. In 2009, T.C. Williams High School became the first K-12 school in Virginia to achieve a LEED® Gold certification by the U.S. Green Building Council (USGBC).

Rick Fedrizzi, president, CEO and founding chair of the USGBC, remarked "The T.C. Williams project efficiently uses our natural resources and makes an immediate, positive impact on our planet, which will tremendously benefit future generations to come."

The school's notable green features include

- a 450,000-gallon cistern that provides non-potable water for flushing, cooling and irrigation;
- structured parking to reduce the urban heat island effect;
- a 10,000-square-foot vegetated roof to aid in storm water management;
- a permanent system to track water and energy usage.

3.2 On-going and Future Actions

3.2.1 Green Buildings

The Department of General Services developed a Green Building Policy in 2004 to "provide a comprehensive outline and strategy for developing an integrated program of design, construction, renovation and operations practices for City facilities that recognizes the interdependence of natural and built environments".

The City's goal is to obtain a LEED-Silver rating or the equivalent for all new City facilities. The Department of General Services is also offering facility maintenance staff training so that they will fully understand and be able to implement the green building policy during building maintenance. In addition, General Services is striving to have all staff be knowledgeable of energy saving initiatives and sustainable design and practices. The City has committed to build new City facilities as green buildings in order to increase energy efficiency, save city financial resources, reduce GHG emissions, and create healthy, productive workplaces for city employees and visitors. The list of public buildings that include green elements is long and includes:

- Duncan Library
- Alexandria Health Department
- T.C. Williams High School
- Charles Houston Recreational Center
- DASH Maintenance facility
- Potomac Yard fire station housing
- Public Safety Center

Staff has established LEED-Silver as the requirement for new municipal building construction, and three buildings are on track to meet or exceed that goal—the Charles Houston

Recreation Center (LEED Silver), the DASH Bus Maintenance Facility (LEED Silver), and the Alexandria Police headquarters building (LEED Gold). The Charles Houston Recreation Center and the DASH Bus Administration and Maintenance Facility have already achieved LEED Silver certification. The Alexandria Police headquarters building is on track to meet or exceed LEED Gold. Moreover, 2525 Mount Vernon Avenue (Human Services) has achieved LEED-EB Silver certification. The General Services Department Capital Projects Division Chief and Energy Manager are already LEED accredited, and two project managers are training for the LEED accreditation – one in Commercial Interiors and one in Existing Buildings.

3.2.2 Energy Efficiency and Conservation

The EAP set a goal for existing City buildings to become 25% more energy efficient by 2025. This will be accomplished in part by the Green Buildings program mentioned previously, the adoption of more energy efficient building codes, and by implementing no cost or low cost energy conservation steps and using capital improvement project funding for energy conservation initiatives. An Energy Manager was recently hired to implement energy conservation projects in City buildings. Energy savings from reducing fossil fuel combustion translate directly into a reduction of GHG emissions. The projects selected for EECBG funding will assist residents and businesses begin to develop and implement sustainable energy efficiency and conservation programs that will GHG emissions by decreasing dependence on energy generated from fossil fuels. Projects currently being implemented using the EECBG grant funds includes:

City of Alexandria Leading by Example: $1.37 Million Funding for Energy Efficiency and Conservation Projects

- Energy Conservation Program (Green Buildings Phase II)
- Street/Traffic Light LED Replacement Pilot Program
- Installation of Renewable Energy Technology on a City Building
- Energy Efficiency Retrofit Program for City Buildings
- Energy Audit Program for City Buildings

- **ENERGY AUDITS** are being facilitated for seven City facilities, including City Hall, the Courthouse, and Chinquapin Recreation Center.
- **ENERGY CONSERVATION (GREEN BUILDING PHASE II)** training and outreach activities are being implemented (see Section 4.3.8 for more details).
- **ENERGY EFFICIENCY RETROFITS** are being implemented, such as green roof installation on the two lower courtyard roofs at City Hall.

- **LED TRAFFIC SIGNALS/LED STREET LIGHTS** are being tested under a partnership between the Department of Transportation and Environmental Services and Dominion Power.

In 2009, Alexandria City Public Schools (ACPS) launched the energy awareness program which could potentially save an estimated $11 million over the next 10 years. The comprehensive energy conservation and management program is conducted in partnership with a private energy company and all expenses for the program will be paid from the savings in utility costs. The program includes performing energy surveys, monitoring energy use, retrofitting schools with energy-conserving equipment and systems, and expansion of the existing recycling and composting programs.

3.2.3 Renewable Energy

Alexandria City Public Schools (ACPS) and City government has shown a commitment to clean energy by purchasing renewable energy certificates (RECs). RECs prevent the emission of GHGs from entering the atmosphere by purchasing electricity that is generated by renewable sources. ACPS has chosen to have 10% of its energy supplied renewable energy company, which supports more than 55 different wind farms across the U.S. In addition, the City will purchase 5% of its electricity needs through green certificates, which promote the use of renewable power in City government buildings.

The Alexandria/Arlington Resource Recovery Facility, operated by Covanta Energy, converts solid waste into up to 23 megawatts of renewable energy that is sold to Dominion Virginia Power Company. Disposing of solid waste in this manner

City of Alexandria Leading by Example: Solar Illuminated Bus Shelters

The City has already installed eight solar illuminated bus shelters. The City received a $500,000 federal grant for bus shelter design, procurement, and installation. Currently, there are approximately 121 bus shelters (not including those at Metro stations) in the City. Solar illuminated shelters and stops offer numerous benefits – there is no need to connect them to the electrical grid; they are powered by reusable energy; and they do not increase the City's utility costs. Solar illumination kits are highly reliable; each contains an LED lighting element that has a lifetime of 100,000 hours, or 5-7 years. During the day, the solar panel charges the battery, providing approximately 10 hours of illumination throughout the night.

helps reduce GHG by:

City of Alexandria Leading by Example: Transit Incentives for City Employees

The City Office of Transit Services and Programs established the Transit Incentive Program for City employees as part of its efforts to meet the region's air quality standards. This program encourages transit use and vanpooling by providing a transit incentive, effective July 1, 2005, of up to $75 per month. There is an up to $150 additional pre-tax option to employees who commute to and from work via bus, rail or qualified vanpool. The program was begun as an incentive to encourage staff commuters to use public transportation and qualified van pools. Alexandria offers this benefit to City employees to reduce the negative consequences of single occupancy vehicle commuting and to serve as a positive example for other Alexandria businesses.

1) avoiding methane production that would occur if the waste was sent to a landfill;
2) generating cleaner energy and reducing the amount of electricity generated from fossil fuels; and
3) recovering steel from the waste stream, which reduces the quantity of fossil fuels and energy used in mining raw materials and manufacturing.

It is estimated that for every ton of trash combusted, nearly one ton less of CO_2e is released into the air due to avoided methane from land disposal, fossil fuel power generation, and metals productions.

3.2.4 Initiatives to Promote Alternative Forms of Transportation

The City initiated a number of marketing and communications efforts promoting alternative forms of transportations to decrease mobile source fuel consumption and GHG emissions. Some of these programs are highlighted below.

Local Motion is the City's transportation demand management (TDM) program to promote bike, walk, rideshare, and public transit options among City employees, residents, commuters, businesses, and visitors. The program uses a web site, monthly e-mails, newsletters, special events like Bike-to-Work day, and other efforts to promote the use of alternative travel modes to non-single occupancy vehicles commuting trips.

Commuter Connections utilizes the regional carpool and vanpool matching program to assist residents seeking others to ride with for the work commute who live and work near them and have a similar work schedule. It includes a Guaranteed Ride Home program, a free service provided to commuters who regularly carpool, vanpool, bike, walk or take transit

to work. In the event of an emergency or unexpected overtime, commuters may receive a free ride home.

Carshare Alexandria! provides a monetary incentive to residents and businesses to encourage use of carsharing services in the City. Carsharing is similar to car rental with the main differences being that an individual can use the carsharing vehicle for as little as one hour and the cars are located in the communities rather than at a central car rental location. The benefits of carsharing include reduction of personal vehicle usage up to 50%, discouragement of single destination trips, and; improvement in air quality

3.2.5 Green Vehicle Fleet

The City continues to build a green vehicle fleet. In FY07, the City's sedan fleet consisted of 48 4-cylinder, 85 6-cylinder, 14 hybrid, and 270 8-cylinder (police cruiser) sedans. As the vehicle fleet turns over, the EAP calls for purchasing new sedans or hybrids with an average city fuel economy 20% greater than Corporate Average Fuel Economy (CAFE) requirements. The City normally purchases about 15 sedans per year. The City has received EECBG funding to cover the incremental cost of conventional vehicle replacement with approximately 12 hybrid vehicles.

In 2008, the City partnered with ACPS to obtain a grant for $70,000 to retrofit approximately 40 school buses with clean air technology that reduces pollutants emitted by diesel engine school buses. The Diesel Oxidation Catalyst System—an EPA-approved technology—breaks down into less harmful components pollutants released into the exhaust stream. The retrofitted buses are expected to achieve approximately 20% reduction in particulate matter emissions, 50% reduction in hydrocarbon emissions and 40% reduction in carbon monoxide emissions.

3.2.6 Urban Forestry Planning

The overarching goal of the Alexandria Urban Forestry Master Plan is to increase the tree canopy throughout the City by better maintaining our existing trees and adding a significant number of new trees. Urban forests can be an effective way to combat climate change in two ways. Trees absorb CO_2 from the atmosphere through photosynthesis as they grow, and "sequester" or store the carbon as biomass in their trunks, branches, roots and leaves. However, the primary benefit from urban trees is usually from energy savings not carbon sequestration. Well-placed urban trees can shade buildings and surfaces, significantly reducing heating and cooling needs. And deciduous trees can provide shade in summer and allow passive solar heating in winter.

The Urban Forestry Master Plan includes specific recommendations for improving each part of the urban forest: public trees along streets, in parks, on school grounds, and as part of other open

spaces; private trees in residential areas and on institutional grounds; and trees within stream valleys and other natural areas. Adopted in 2009, the Urban Forestry Master Plan aims at protecting and enhancing the City's tree canopy by setting a goal of 40% tree canopy for the City. The City continues to be recognized as a Tree City USA and conducted two successful tree sales in 2009.

3.2.7 Land Use Planning

The City's Department of Planning and Zoning works closely with the Alexandria community to develop and implement land use policies which reduce urban sprawl, preserve and create walkable communities that maximize use of transit options, and encourage mixed use development. "Brownfields" reclamation projects, such as Carlyle and Potomac Yards, have been the cornerstone of the City's plan for future growth and have not only restored environmentally challenged areas, but have also served as models of transit-oriented development.

In the past several years, the City has approved small area plans for the Braddock Metro, Landmark/Van Dorn, and North Potomac Yard communities. Each of these plans has emphasized use of transit – including existing Metrorail stations, high-capacity transit ways, and planning for the construction of a new infill Metrorail station in Potomac Yard. Planned development has been clustered near transit nodes, with a mixture of uses to encourage a pedestrian environment that will reduce the use of cars and the accompanying GHG emissions.

Additionally, the City is taking the lead on innovative parking strategies that not only maximize opportunities for open space and increased

City of Alexandria Leading by Example: North Potomac Yard Small Area Plan

The Plan includes environmental sustainability recommendations to incorporate long-term progressive goals in successive phases:

Green Building Standards: minimum LEED Silver or comparable

Green Neighborhood Standards: LEED-Neighborhood Development label to emphasize smart growth principles of density, proximity to transit, mixed use, mixed housing type, and pedestrian- and bicycle-friendly design

Sustainable Features: green roofs, community gardens, stormwater management, and water conservation

Carbon Neutrality by 2030: for the entire plan area

Sustainability Plan: initial plan and periodic amendments to demonstrate compliance with district-wide sustainability measures

perviousness by implementing reduced parking ratios and shared parking in development projects, but also incentivize more use of transit. These parking strategies are accompanied by vigorous Transportation Demand Management tools that are a part of every new major development project.

Best practices in terms of stormwater management, low-impact development, and green building technology are encouraged through small area plans and implemented through the development process and the Green Building Policy. In addition to numerous green roofs, the City has reviewed and approved projects that incorporate wind turbines for generation of onsite electricity and "rain garden" planting areas. In the past several year, numerous City staff have become LEED accredited and can provide guidance and expertise in the review of new projects that incorporate green elements.

Another very important way in which the City supports sustainability is through its long-standing historic preservation and open space conservation efforts. As stated by the National Trust for Historic Preservation: "The conservation and improvement of our existing built resources, including re-use of historic and older buildings, greening the existing building stock, and reinvestment in older and historic communities, is crucial to combating climate change." Alexandria's two historic districts help to maintain and preserve walkable, transit-oriented neighborhoods, while also encouraging the preservation and reuse of the historic building materials that comprise the buildings in these neighborhoods.

Throughout the City, there is a great emphasis on preserving existing open space and creating new publicly-accessible parks and open spaces. Many development projects provide a significant amount of new open space – much of which is publicly accessible. A major example of a new public space achieved through planned development is the recently completed John Carlyle Square Park. In addition, the City acquires new open space through acquisition and through working with the Northern Virginia Conservation Trust to obtain conservation easements on private property.

3.2.8 Community Outreach

Effective community engagement is essential for Alexandria to reach its climate protection goals. Several successful environmental education and outreach events took place in 2009 and 2010 involving more than 2,000 Alexandria residents and increasing environmental awareness. Continuing outreach efforts include events such as Alexandria Earth Day, the Eco-Friendly Restaurant Expo and Eco-City open houses, activities such as stream cleanup and tree planting days, interactive tools such as the Eco-City Challenge survey, and videos such as the *Consumer Guide to Home Energy Audits*.

3.3 Quantifiable Measures

All of the activities mentioned in the previous section will help reduce GHG emissions from City government operations and help the City reach its GHG emission reduction targets. Sufficient resources, information and protocols are not available to quantify the emission reductions and costs/savings associated with all of the measures identified in Section 3.2. However, preliminary quantification of emission reductions and costs associated with selected measures can be made for measures where sufficient information is available, portraying the relationship between the proposed actions and their cost and emission reduction effects. (Please see appendix A for a detailed overview of costs and savings.)

Based on the City's GHG emission inventory, the consumption of electricity and the combustion of natural gas in buildings owned and leased by the City government resulted in the majority of emissions in FY2006. These buildings were responsible for the emission of approximately 33,729 tonnes of CO_2e, or 42% of the total emissions from City government operations. Emissions of CO_2e from school buildings were the second largest source and made up 25% of the total government CO_2e emissions. Gasoline fuel used by City employee vehicles during their commute to work accounted for the third largest contribution of emissions at 13%, producing 10,105 tonnes of CO_2e. Electricity consumption for street lighting and traffic signals accounted for 9% of the CO_2e emissions.

Selected actions associated with the City government operations are organized into four categories – Energy Consumption in Buildings, Street Lighting/Traffic Signals, Transportation, and Other. Selected measures were evaluated according to six criteria:

- **Annual CO_2e Reductions**: refers to the estimated reduction in CO_2e emissions from the measure.
- **Energy Savings**: refers to the estimated energy savings from the measure.
- **Initial Investment Outlay**: refers to the capital cost needed to implement the measure.
- **Annual Operation and Maintenance (O&M) Costs**: refers to the costs associated with ongoing implementation expenses for the measure.
- **Annual Energy Savings Benefit**: refers to the cost savings from reduced energy and/or maintenance costs associated with ongoing implementation expenses for the measure.
- **Annual Administrative Costs**: refers to the amount of City staff resources needed to complete the initial implementation and support ongoing maintenance of the given measure.
- **Simple Payback Period**: in capital budgeting; the length of time needed to recoup the cost of a capital investment. The payback period is the ratio of the initial investment (cash outlay) to the annual cash inflows (Energy Cost Savings - O&M Costs - Administrative Costs) for the recovery period.

Exhibit 11 summarizes the measures for which sufficient data were available to quantify the above parameters. It also lists whether the measure is an *on-going* mitigation program the City is already implementing, a *planned* program that has been funded, or an *under consideration* program that may or may not be implemented in the future.

Assumptions and methodologies used to evaluate each of the City government operations measures shown in Exhibit 11 are provided in Appendix A. The estimated emission reductions and associated costs for each of these strategies are summarized in Exhibit 12. Exhibit 13 graphically shows how the reductions from this set of measures compares to the emission reduction targets identified in Section 2.

If fully implemented, the strategies identified in this section appear to be sufficient to meet the GHG emission reduction targets for City government operations for both 2012 and 2020. However, many of the emission reduction measures have significant unknowns and, therefore, some uncertainty associated with the emission reduction estimates. In the future, the City should continue to periodically quantify the GHG emissions and potential reductions to more realistically portray progress towards meeting the GHG emission reduction goals.

Exhibit 11
Description of Quantifiable City Government Operation Reduction Measures

Measure ID	Action Name/Description/Co-benefits
G.1.1 and G.1.2	**Renewable Energy Purchase for City Buildings and Schools** **Description:** The purchase of RECs can be accomplished through the Virginia Energy Purchasing Governmental Association (VEPGA). The purchase of credits allows the City to legally claim to have purchased energy produced by renewable energy sources such as the sun, wind, geothermal hydro-electrical, wave or tidal energy. These credits are sold by the producers and traded to subsidize renewal energy production. **Co-benefits:** Reduces emissions of SO_2 and NO_x generated by distant coal-fired power plants, which will help City attain and maintain ozone and fine particle NAAQS. Provides a means for the City to directly support production of renewable energy.
G.1.3	**Renewable Energy Installation on City Buildings** **Description:** The City is using EECBG funding for a comprehensive analysis of a suitable location for a renewable energy project on a City building. The project will include site assessments that will bring renewable energy experts to selected sites to evaluate and provide a basic analysis of energy needs. They will evaluate renewable energy resource availability at each location, provide energy efficient suggestions and make recommendations on specific renewable energy systems. The site assessments will also provide information on the best place to locate a system and will offer general cost estimates for installation at each site. Once a site has been selected, funds from this project will be used to procure, install, operate, and maintain the renewable energy system. Additional renewable energy projects could occur after successful implementation of the EECBG project. **Co-benefits:** Solar panels and other distributed renewable energy sources can reduce the risk of brownouts and help avoid the need for expensive new generating capacity to meet

Measure ID	Action Name/Description/Co-benefits
	peak electricity demands.
G.1.4	**Employees Shut Down Computers at the End of Workday** **Description:** Many PCs available today come with a power-down or sleep mode feature for the CPU and monitor. ENERGY STAR® computers power down to a sleep mode that consume 15 watts or less power, which is around 70% less electricity than a computer without power management features. For non-ENERGY STAR computers, employees could be required to manually shut down their computers when leaving the office at the end of the workday. **Co-benefits:** Savings on energy costs to power computers at night. Increases security of government information.
G.1.5 and G.1.6	**Energy Savings Performance Contract for City Buildings and Schools** **Description:** An energy savings performance contract (ESPC) is an option to reduce energy use. An ESPC is a form of third-party financing that funds upgrades using the savings from future utility bills. This mechanism will allow the City to obtain energy-efficient technologies without having to commit capital funds. An energy services company (ESCO) pays all costs involved in identifying, installing, operating and maintaining new or upgraded energy-efficient equipment. The ESCO is compensated by receiving a share of the cost savings resulting from these improvements over a set term. At the end of the ESPC, the City owns all of the improvements and receives all of the continuing savings. Note that the City schools acquired ESPC services. **Co-benefits:** • City's building infrastructure is modernized. There may be a decreased overall time to complete projects and a long-term reduction in annual maintenance and energy costs.
G.1.7	**Energy Conservation and Audit Program** **Description:** The project involves the assessment of energy consumption at City facilities, evaluation of energy efficiency measures, and the development of strategies to target high-consumption facilities. The City's energy conservation program will be used to conduct employee education, develop measurement and verification protocols, identify and implement energy efficient technologies. The City's Capital Improvement Plan provides for energy conservation improvements and the use of energy efficient technology in existing City buildings in order to achieve greater efficiency. In FY 2008, a new Energy Manager position was created in the Department of General Services to analyze, develop and implement the City's energy conservation efforts, including changes in operating procedures and contracts to save on future energy costs and enhance the environment. **Co-benefits:** • City's building infrastructure is modernized. There may be a decreased overall time to complete projects and a long-term reduction in annual maintenance and energy costs.
G.2.1 and G.2.2	**LED Street Light and Traffic Signal Replacement Program** **Description:** The EAP established a target to replace all publically-owned street lights in the city with energy-efficient (such as LEDs) or renewable energy lights by 2020. Although they cost more upfront than the bulbs they replace, LED lights use half the energy (or less) and last longer than conventional bulbs, resulting in big savings and short payback periods. LED traffic signals are extremely energy efficient and reliable devices offered by many leading manufacturers. LEDs are brighter, making them more visible in foggy conditions. **Co-benefits:** LEDs have a long life span which reduces maintenance costs and saves in disposal of used light bulbs. LED street lights can be very directional, thus reducing light pollution. Unlike all other alternative street lighting technologies, LED fixtures contain no mercury.

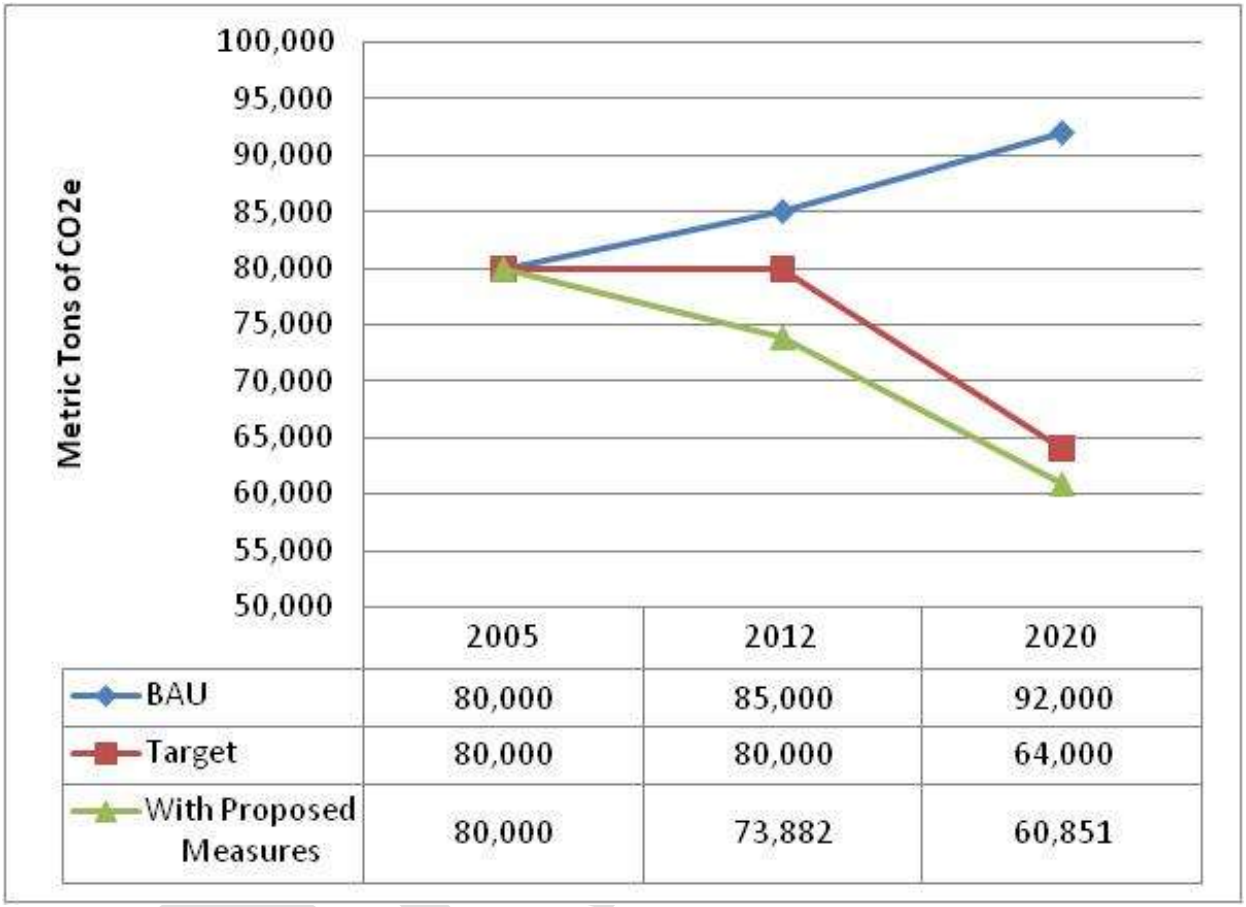
Measure ID	Action Name/Description/Co-benefits
G.3.1	**Green Vehicle Fleet (20% Better than CAFE standards)** **Description:** The City will expand its existing green fleet program. The EAP states that "the sedans or hybrids purchased by the city in 2009 will have an averaged city fuel economy 20% greater than Corporate Average Fuel Economy (CAFE) requirements." In FY07, the City's sedan fleet consisted of 48 4-cylinder, 85 6-cylinder, 14 hybrid, and 270 8-cylinder (police cruiser) sedans averaging 10.5 mpg. The City normally purchases about 15 sedans per year. This action calls for the City to purchase 15 new sedans each year that average 20% greater mpg than federal CAFE requirements. New DASH hybrid buses are not included in this measure. **Co-benefits:** Promotes energy independence and national security be reducing dependence on foreign oil. Sets example for residents and showcases Alexandria as an environmental leader.
G.3.2	**Biodiesel for City Diesel Fleet Operations** **Description:** The City plans to use biodiesel for its diesel fleet operations if in the future, biodiesel prices fall within the operating budget, fiscal allowance. Biodiesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is safe, biodegradable and reduces most criteria air pollutants (there is a small increase in oxides of nitrogen). Blends of 20% biodiesel with 80% petroleum diesel (B20) can generally be used in unmodified diesel engines. Biodiesel can also be used in its pure form (B100), but it may require certain engine modifications to avoid maintenance and performance problems and may not be suitable for wintertime use. This action will require the use of sustainable B20 biodiesel for all of the City diesel fleet operations. **Co-benefits:** Biodiesel can be produced locally from waste cooking oil or locally grown crops, reducing dependence on foreign oil and infusing dollars back into the Virginia economy.
G.3.3	**Transit Incentives for City Employee Commuters** **Description:** The City established the Transit Incentive Program for City employees as part of the City's efforts to meet the region's air quality standards. This program encourages transit use and vanpooling by providing a transit incentive effective July 1, 2005 of up to $150 pre-tax option to City employees and $30 per month to school employees who commute to and from work via bus, rail or qualified vanpool. This action will promote expansion of the transit incentive program for City government employees, along with other voluntary efforts such as telecommuting and walking/biking to work, to reduce the gasoline consumed by employees commuting to work by 5% by 2012 and 15% by 2020. **Co-benefits:** Reduces traffic congestion on City streets. Can serve as an employee recruitment or retention tool.
G.4.1	**Tree Planting to Sequester CO2 and Provide Shade** **Description:** Urban forests have a role to play in reducing levels of GHGs in the atmosphere. Urban trees reduce atmospheric CO2 through sequestration and reducing GHG emissions by conserving energy used for space heating and cooling. Carbon sequestration is the process by which CO2 is transformed into above- and belowground biomass and stored as carbon. Tree shade reduces summer air conditioning demand, but can increase heating energy use by intercepting winter sunshine. Lowered air temperatures and wind speeds from increased tree cover can decrease both cooling and heating demand. The EPA established an action to "work with community partners to add 500 street trees a year throughout the city to achieve full street tree stocking levels by 2020." **Co-benefits:** Adds aesthetic value and possibly increase in real estate values. Can help slow down water run-off and reduce soil erosion.

Exhibit 12
Order-of-Magnitude Emission Reductions and Capital/Operating Costs for Selected Government Operations Strategies

ID	Measure Description	Annual CO2e Reduction (tonnes)		Annual Energy Savings (MWh)		Initial Investment Outlay ($1000)		Annual Operating Costs ($1000)		Energy Reduction Savings ($1000)		City Staff Administrative Costs ($1000)		Simple Payback Period
		2012	2020	2012	2020	2009-12	2013-20	2012	2020	2012	2020	2012	2020	
Energy Use in Government Buildings														
G.1.1	RECs for City Buildings	1,286	5,318	n/a	n/a	0	0	55	226	0	0	5	5	n/a
G.1.2	RECs for City Schools	1,414	3,039	n/a	n/a	0	0	60	129	0	0	5	5	n/a
G.1.3	Renewable Energy	23	231	44	438	200	2,000	0	0	4	41	5	5	49
G.1.4	Turn-off Computers at	220	238	417	448	0	0	0	0	39	42	0	0	n/a
G.1.5	ESPC for City Buildings	2,385	5,123	5,971	12,813	0	0	0	0	0 to	0 to	5	5	n/a
G.1.6	ESPC for City Schools	1,744	3,746	4,487	9,628	0	0	0	0	0 to	0 to	5	5	n/a
G.1.7	Conservation/Audit	1,401	6,018	3,500	15,022	Unknown	Unknown	0	0	255	1,097	Unknown	Unknown	n/a
Electricity Use for Street Lighting and Traffic Signals														
G.2.1	LED Street Lights	77	2,969	146	5,619	188	6,914	0	0	18	694	5	5	14
G.2.2	LED Traffic Signals	1,339	1,363	2,533	2,578	212	4	0	0	281	286	5	5	1
Energy Use for Transportation														
G.3.1	Green Vehicles	16	51	1,643 gal	5,151 gal	0	0	0	0	4	12	0	0	n/a
G.3.2	Biodiesel	590	634	0 gal	0 gal	0	0	100	108	0	0	0	0	n/a
G.3.3	Transit Incentives	548	1,766	56,249 gal	181,364 gal	0	0	195	585	0	0	5	5	n/a
Other														
G.4.1	Tree Planting	75	655	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5	5	n/a
	Total CO2e Reduction	**11,118**	**31,149**											
	Targeted CO2e Reduction	**8,537**	**27,911**											

Exhibit 13

Comparison of Emission Reduction Targets and Estimated Emission Reductions for Selected Government Operations Strategies



	2005	2012	2020
BAU	80,000	85,000	92,000
Target	80,000	80,000	64,000
With Proposed Measures	80,000	73,882	60,851

4. Community-Wide Emission Reduction Measures

4.1 Introduction

Section 4 describes how Alexandria can achieve its city-wide GHG emissions reduction targets for 2012 and 2020. In order to meet these ambitious goals, a comprehensive set of actions must be set in motion. The City has already enacted numerous energy saving and GHG emission reduction projects within the community and has plans for additional projects which are in various stages of development. This Section discusses efforts completed projects and activities which are already reducing emissions, as well as continuing and new initiatives that further reduce GHG emissions from community-wide activities. The list of action items was drawn from several sources of information:

- The City's Environmental Action Plan (EAP) identifies a number of principles, goals, and actions governing climate change, transportation, energy, waste management and other environmental issues in the City. While many of the EAP actions were not developed to explicitly reduce GHG emissions (e.g. increasing energy efficiency, improving transit options), they will help reduce GHG emissions.
- The City's "constellation of plans" (e.g., Transportation Master Plan, Urban Forestry Plan, Pedestrian and Mobility Plan, Land Use Plan, Open Space Plan, Water Quality Plan, Solid Waste Management Plan, Capital Improvement Plan) which include specific activities that help reduce GHG emissions.
- The City's GHG emission inventory report identifies the most significant sectors contributing to the City's carbon footprint.
- The *Climate Protection Manual for Cities* (NCS, 2007) provides resources, tools, programs and case studies of how cities and communities have worked to reduce their GHG emissions.
- Several climate action plans from across the United States were reviewed to draw upon the ideas and experiences of other local governments.

Section 4.2 identifies many of the EAP goals/actions that will help reduce GHG emissions and provides suggestions for citizens and businesses to do their part to help reduce their individual carbon footprint. Section 4.3 identifies and describes many of the City's continuing and new strategies for further reducing emissions throughout the Alexandria community. Many of the strategies have significant unknowns and therefore, some uncertainty associated with the assumptions made regarding costs, energy savings, and emission reduction estimates. Given the resources allocated for this project, Section 4.4 attempts to accurately estimate the emission reduction and cost implications of several strategies for which sufficient information is available to allow quantification.

4.2 Citizens Actions to Reduce GHG Emissions

While it's important for governments to take action to reduce GHG emissions, citizens making every day personal choices can be an effective method of fighting climate change. Individual actions can add up and become a powerful force for change. Residents and business make choices every day that can provide real, positive changes to our environment, right in the Alexandria community. Citizens can learn about a variety of actions they can take to reduce their carbon footprint by taking the Eco-City Challenge on the City's web site.

In addition to the Eco-City Challenge, there are numerous other web sites that offer suggestions for actions that residents and businesses can take to reduce their carbon footprint.

- EPA's *What You Can Do* web site: http://www.epa.gov/climatechange/wycd/index.html
- EPA's *Energy Star* web site: https://www.energystar.gov
- DOE's *Energy-Related Publications for Consumers:* http://www.energysavers.gov/information_resources/index.cfm/mytopic=60002
- Virginia Department of Mines, Minerals, and Energy's *Energy Savers Handbook*: http://www.dmme.virginia.gov/DE/ConsumerInfo/energysaverhandbook.shtml
- Dominion's *Everyday Energy-Saving Tips For Every Day Of The Year* web site: http://www.dom.com/about/conservation/daily-tips.jsp
- Dominion's *Energy Saving and Green Office Tips* web site: http://www.dom.com/about/conservation/easiest-energy-savers.jsp

Exhibit 14 lists many (but certainly not all) possible actions that can be taken by residents and businesses to both reduce GHG emissions and help the City of Alexandria achieve its environmental sustainability targets and goals as identified in the EAP. Exhibit 15 lists City-sponsored community reduction measures.

Exhibit 14
Ways for Citizens and Businesses to Both Reduce GHG Emissions and Help Achieve the City's Environmental Action Plan Targets and Goals

EAP Target/Goal That Also Help Reduce GHG Emissions	Suggestions for Citizen and Business Actions to Reduce Their Carbon Footprint
EAP Principle 1: Transportation	
Target for 2020: Reduce the number of daily Vehicle Miles Traveled (VMTs) on a per capita basis by 5% every five years **Target for 2020:** Increase the number of commuters who use public transportation by 25%	**Carpool** when you can with friends and co-workers **Bundle Your Errands** to make fewer trips **Walk or Bike** to work, school or shopping **Try Telecommuting from Home** to reduce the number of miles you drive every week **Drive Less** by choosing alternatives such as public transit and encourage your employer to offer transit benefits
EAP Principle 2: Green Building	
Target for 2030: All new buildings will be carbon neutral **Goal 1:** Building on the City's Green Building Policy, advance energy-efficient green construction, sustainable building location, site design, and emerging technologies **Goal 3:** Promote green building practices, share information and provide educational, technical, and financial assistance to the building industry, businesses, and residents	**Get a Home or Building Energy Audit** to find where your home or office is poorly insulated or energy inefficient **Weatherize or Insulate Your Home** by caulking and weather stripping your doorways and windows and making sure your walls and ceilings are insulated **Switch to Double Pane Windows** and keep more heat inside your home **Install a Programmable Thermostat** to automatically lower the heat or air conditioning at night and raise them again in the morning **Install Lighting Occupancy Sensors** or timers in rooms that aren't used often **Consider Roofing Materials with Reflective Coatings** and/or choose light-colored roofing to greatly reduce heat absorption **Consider Solar-Powered Accent Lighting** for yard and garden.
EAP Principle 3: Air Quality	
Goal 2: Reduce off-road/mobile emissions by promoting more environmentally efficient lawn care and construction equipment **Goal 4:** Promote and support high mileage/low emissions vehicles to reduce emissions and improve local air quality	**Use a Push Mower** instead of gas or electric powered lawnmower **Plan Your Landscaping** to help to reduce need for energy consuming lawn care equipment **Don't Idle in Your Car,** turn your engine off if you must wait for more than 30 seconds **Buy a Hybrid or Fuel Efficient Car** to reduce emissions from fossil fuel combustion **Inflate Your Tires** as adequately inflated tires reduce gasoline consumption
EAP Principle 4: Water Resources	
Target for 2015: Reduce per-capita water consumption by 10% **Goal 3:** Promote water conservation infrastructure by improving public outreach to promote efficient use of available water resources	**Install a Low-Flow Showerhead** to use less water and reduced energy to heat the water **Fill The Dish or Clothes Washer** and run only with a full load **Plan Your Landscaping** to help reduce water consumption **Get a Water Barrel** to collect rain water which you can later use to water your plants.

EAP Target/Goal That Also Help Reduce GHG Emissions	Suggestions for Citizen and Business Actions to Reduce Their Carbon Footprint
EAP Principle 5: Environment and Health	
Goal 4: Encourage active, healthy lifestyles by providing safe opportunities to walk and cycle in order to reduce obesity and chronic diseases **Goal 5:** Educate citizens about and increase equitable access to safe, healthy, and organic food, particularly for children and pregnant women, and encourage local and regional food production	**Drive Less** by choosing alternatives such as biking or walking while doing errands or shopping **Use a Rake** instead of a leaf blower to tidy up your yard **Buy Products Locally** and reduce the amount of energy required to drive your products to your store **Buy Organic Food** which use fewer chemicals that pollute the water supply and require energy to produce **Build an Organic Garden** and harvest your own in-season vegetables
EAP Principle 6: Energy	
Target for 2015: Reduce per-capita energy use by 15% **Goal 2:** Reduce energy consumption through conservation and the adoption of more energy efficient technologies and practices by the City, its residents, and businesses **Goal 4:** Encourage the use of clean renewable energy resources, such as wind, geo-thermal, and solar, to reduce the City's carbon footprint	**Use Compact Fluorescent Bulbs** to replace frequently used light bulbs **Turn off Your Computer** when not in use **Keep Shades Closed** when the air conditioner is on as sunny windows account for 40% of unwanted heat **Adjust Your Thermostat** by moving your settings down two degrees in winter and up two degrees in the summer **Check Your Water heater** and keep your water heater thermostat no higher than 120°F **Insulate Your Water Heater** to reduce energy **Replace Old Appliances** with products with the Energy Star label, which identifies the most efficient appliances **Enroll in Smart Cooling Rewards Program** and Dominion will install a "smart switch" on your outdoor air-conditioning unit or heat pump system to reduce peak energy use **Participate in Dominion's Green Power Program** that gives you a practical way to support renewable energy
EAP Principle 7: Land Use and Open Space	
Goal 5: Conduct outreach and education on sustainable land use practices, policies, and programs	**Plant Deciduous Trees** that let the sun through to warm your home in winter, shade your home in summer, suck up carbon dioxide and clean the air **Install a Green Roof** using vegetation to reduce run-off and provide habitats for plants, insects, and animals that otherwise have limited natural space in cities
EAP Principle 8: Solid Waste	
Target for 2020: Exceed the goal of 35% diversion through increased waste reduction and reuse **Target for 2020:** Increase the recycling rate to achieve a goal of 50%	**Buy Minimally Packaged Goods** and reduce your trash output **Take Your Own Bag** or basket to the grocery and market and reuse instead of accumulating plastic bags **Say No to Junk Mail** which will reduce the amount of paper that goes to waste **Reuse Containers** by buying things in plastic or glass containers that can be reused or used instead of disposable boxes, plastic wrap, foil, or sandwich bags. **Recycle More** by using recycling bins and encouraging neighbors, colleagues, and businesses to do likewise

Exhibit 15
List of Existing, Planned, and Potential Community-Wide GHG Emission Reduction Measures

Measure Name	Status
Green Buildings	
Green Building Policy for New Commercial Buildings	Existing
Green Building Policy for Existing Buildings	Planned
Energy Efficiency and Conservation	
Green Revolving Loan Program for Residents and Businesses	Under Consideration
Green Jobs Training for Weatherization Techs/Auditors	On-going
Tier 1 Energy Audit – Easy Direct Install	Under Consideration
Tier 2 Energy Audit – ENERGY STAR Appliances	Under Consideration
Commercial Food Service Energy Conservation Program	Under Consideration
Commercial Energy Audit and Conservation Program	Under Consideration
Renewable Energy	
Covanta Energy-from-Waste Facility	On-going
Alexandria Sanitation Authority Use of Biofuels	On-going
Geothermal Energy and Solar Panels at Minnie Howard Campus	On-going
Geothermal Energy at James Polk Elementary	On-going
Alternative Forms of Transportation	
Alexandria Local Motion	On-going
Commuter Connections	On-going
Carshare Alexandria!	On-going
Air Quality Action Days	On-going
High Occupancy Vehicle Lanes	On-going
Pedestrian and Bicycle Mobility Plan	Existing
Safe Route to School Program	Existing
Green Taxis	Planned
Alternative Fuel Sources for Vehicles	Under Consideration
Green Vehicle Fleet	
DASH Hybrid Bus Purchase Program	Existing
Vehicle Anti-Idling Enforcement	On-going
Outreach	
Energy Audit Workshops	Existing
Green Building Forum	Existing
Solid Waste	
Residential and Commercial Recycling Program	On-going
Expanded Recycling Program at City Hall	On-going
Other Measures	
Urban Forestry Master Plan	Existing
Wise Water Use Campaign	On-going
Purchase of Recycled Paper Products	On-going
Expanded Community Education and Outreach	On-going

4.3 On-Going and Future Actions

4.3.1 Green Building Policy

Green Buildings have been identified by the City as a major component of its commitment to sustainable development. The City has required that its own buildings meet high environmental standards for several years. The recent Green Building Policy asks private developers to look to green solutions for their buildings. In general, green buildings:

- Consume 30% to 50% less energy;
- Produce 35% less CO2 emissions;
- Consume 40% less water; and,
- Produce 70% less solid waste

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ will typically be the green building guide and rating system used as a standard for development in the City because it has become the industry preference, especially for commercial construction. LEED is a third-party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings. The LEED rating system assigns a numerical rating or "points" for certain design features based on accepted energy and environmental principles and strike a balance between known, established practices and emerging concepts. LEED 2009 for New Construction and Major Renovations certifications are awarded according to the following scale:

- Certified 40–49 points
- Silver 50–59 points
- Gold 60–79 points
- Platinum 80 points and above

Points are assigned based on certain design features. For example, a project will receive 6 LEED points if located within 1/2-mile walking distance (measured from a main building entrance) of an existing or planned and funded commuter rail, light rail or subway station. The more points accumulated results in increased green performance and higher ratings.

City of Alexandria Leading by Example: Green Buildings Policy

At its April 18, 2009 public hearing, the City Council unanimously voted to adopt the proposed Green Building Policy.

Phase I of this Policy calls for all ***new*** development requiring a Development Site Plan or Development Special Use Permit will achieve a LEED Silver or an equivalent rating for non-residential development and LEED Certified or an equivalent rating for residential development.

Phase II is anticipated to identify methods that will encourage ***existing*** buildings to incorporate green improvements, such as through improved outreach and incentives.

On October 31, 2010, government officials from across the nation including the City of Alexandria's delegation voted to support historic gains in the energy efficiency of building energy codes at the Final Action Hearings for the 2012 International Energy Conservation Code. As a result, the energy efficiency of America's 2012 model energy code for new homes and commercial buildings is expected to achieve the 30% boost sought by the U.S. Department of Energy, the U.S. Conference of Mayors, the National Association of State Energy Officials, the Energy Efficient Codes Coalition (EECC), and the Metropolitan Washington Council of Governments. Moreover, adoption of the code partially fulfills the Eco-City Alexandria Environmental Action Plan 2030 goal of increasing energy efficiency in the building codes.

A BIG WIN FOR MORE ENERGY EFFICIENT BUILDING CODES

The International Energy Conservation Code® (IECC) is a national model energy code that states and local agencies use as the starting point for their own codes. The code contains minimum energy efficiency provisions for residential and commercial buildings, offering both prescriptive- and performance-based approaches. The recent set of improvements will result in a 2012 IEEC that's over 30% more energy efficient than the 2006 IECC. The next steps are for states and localities to adopt and implement the 2012 IECC. The state of Virginia will begin reviewing the 2012 international codes for adoption in late 2012.

A study by U.S. DOE's National Renewable Energy Laboratory found that an average home that's 30% more energy-efficient returns $511 a year in energy savings to homeowners after the consideration of the capitalized cost of the efficiency improvements. Note that the average homeowner spends approximately $2000 a year on energy bills. In addition, because new buildings last for decades and are costly to retrofit, many of the efficiency improvements made today will benefit current and future home and building owners for generations to come.

The next steps are for states and localities to adopt and implement the 2012 IECC. The state of Virginia will begin reviewing the 2012 international codes for adoption in late 2012.

4.3.2 Renewable Energy

In Fiscal Year 2010, City staff and other interested parties will convene workshops to identify issues and develop questions for a feasibility study on the potential for renewable power generation within the city. Speakers will include experts in engineering, law, and economics with experience in the potential and feasibility of renewable-powered local electricity generation networks.

There are already two substantial facilities in Alexandria using renewable energy sources. The City of Alexandria and Arlington County co-own an energy-from-waste facility which is operated under contract by Covanta Energy. The facility uses the energy potential of municipal waste to generate renewable electricity. The Alexandria Sanitation Authority (ASA) uses

methane gas generated during the wastewater treatment process to reduce the amount of fossil fuels needed to power its steam boilers.

City of Alexandria Leading by Example: Alexandria Sanitation Authority

ASA completed a $275 million upgrade in June 2005, including an anaerobic digestion facility that processes the plant's solids during which a portion of the organic material is decomposed and converted to methane gas, a potent greenhouse gas. The plant upgrades incorporated a system that burns digester gas in low-pressure steam boilers, thereby reducing the amount of fossil fuel needed and GHG emissions generated. This approach not only saves more than $800,000 a year – the equivalent natural gas consumption of 780 homes annually – but provides a renewable source of energy.

Alexandria / Arlington Energy-from-Waste Facility

Residential trash is delivered to the Energy-from-Waste Facility operated by Covanta Energy where it is burned and the heat is converted into electricity, which is sold to the Dominion Virginia Power grid and supplies enough electricity to power approximately 20,000 homes in Northern Virginia. Not only does the burning of refuse reduce landfill size, it reduces the amount of harmful methane gas released from landfills into Earth's atmosphere. Energy-from-waste processing also reduces CO2 emissions that would have been generated by the burning of fossil fuels to produce the energy generated by the waste burning process. For every one million tons of trash processed at the facility, the need to use nearly 1.67 million barrels of oil is avoided.

4.3.3 Energy Efficiency and Conservation

The Alexandria Environmental Action Plan set a goal to reduce the per capita energy use in Alexandria by 15% by 2015. This will be accomplished by in part by the Green Buildings program mentioned previously, by providing outreach and incentives to residents and businesses, and by implementing no cost or low cost energy and conservation steps. Energy savings from fossil fuel combustion translate directly into a reduction of GHG emissions.

In 2009, the City received $1.37 million in eligible funding to develop and begin to implement a comprehensive Energy Efficiency and Conservation Strategy (EECS) under the federal Energy Efficiency and Conservation Block Grant (EECBG) program funded for the first time under the American Recovery and Reinvestment Act of 2009. The projects selected for EECBG funding will assist residents and businesses begin to develop and implement sustainable energy efficiency and conservation programs that will GHG emissions by decreasing dependence on energy generated from fossil fuels. Projects currently being implemented using the EECBG grand funds include:

City of Alexandria Leading by Example: Energy Efficiency and Conservation Projects

- Green Buildings Phase II
- Energy Audits for 7 City Facilities
- Green Roofs at City Hall
- LED Traffic Signals/Street Lights

- **ENERGY AUDITS** are being facilitated for seven City facilities, including City Hall, the Courthouse, and Chinquapin Recreation Center. The results of these energy audits will be used to prioritize facility capital improvement which reduces energy consumption and the City's operating budget.
- **ENERGY CONSERVATION (GREEN BUILDING PHASE II)** training and outreach activities are being implemented (see Section 4.3.8 for more details).
- **ENERGY EFFICIENCY RETROFITS** are being implemented, such as green roof installation on the two lower courtyard roofs at City Hall. Additional retrofit funds will be leveraged to implement additional energy efficiency retrofit opportunities.
- **LED TRAFFIC SIGNALS/LED STREET LIGHTS** are being tested under a partnership between the Department of Transportation and Environmental Services and Dominion VA Power. Approximately 34 streetlights with be retrofitted with LEDs. The pilot project will help the City and Dominion VA Power better understand operational and performance factors such as equipment life cycle costs, lighting performance, and energy usage.

4.3.4 Sustainable Transportation Options

During the FY 2011 budget process, City Council requested that staff develop a proposal to identify City transportation priorities and funding opportunities. City staff has worked with the City's Transportation Commission to create a prioritization process for needed transportation projects and services, and identify local, reliable funding mechanisms to support a fiscally constrained transportation plan. This process has included articulating and drafting a vision for proposed transportation investments and priorities over the next ten years that are compatible with Eco-City Alexandria and the Transportation Master Plan.

Exhibit 16
Draft List of Priority Transportation Projects

Project / Description	Reduces Per Capita VMT	Increases Use of Public Transit
Eisenhower Avenue Metrorail Platform Extension. Construction of north Metro station entrance to provide direct pedestrian access to the station without the need to cross Eisenhower Avenue.	✓	✓
Transit Corridor 'C' Beauregard/Van Dorn Street. Construction of high-capacity transit facilities in dedicated lanes along corridor between the Van Dorn Metro station and the border with Arlington to the north.	✓	✓
Transit Corridor 'A' Route 1- CCPY Streetcar. Conversion of Crystal City-Potomac Yard dedicated busway along Route 1 corridor to a streetcar system.	✓	✓
Landmark Transit Station. Construction of intermodal transit station near the intersection of transit corridors 'B' and 'C' in the vicinity of Landmark Mall.	✓	✓
Transit Corridor 'B' Duke Street. Construction of high-capacity transit facilities in dedicated lanes along the Duke Street corridor.	✓	✓
DASH Bus Service Enhancements System-Wide. Provision of urban bus service with 15-minute headways, including new bus routes and new types of bus service that may include circulators and express or limited-stop service.	✓	✓
Trolley service to Del Ray. Expansion of trolley service to connect the Del Ray neighborhood to Metro station(s) and Old Town.	✓	✓
Holmes Run Greenway/Eisenhower East Shared-Use Path Improvements. Road improvements and construction of a trail connection.	✓	
Redesign Intersection of Mt. Vernon & Russell Road. Intersection improvements including pedestrian upgrades.	✓	
High priority multi-use paths. Provision of increased bicycle connectivity including a trail along Backlick Run and a shared use path between Boothe Park west to the Fairfax County line.	✓	
Complete Streets Project- Van Dorn Street, Holland Lane, Duke Street. Provision of multimodal facilities for all users.	✓	
Multimodal bridge from Van Dorn Metro to Pickett. Construction of multimodal bridge and roadway, from Van Dorn Metro to Pickett Street.	✓	✓

As noted previously, the City initiated a number of marketing and communications efforts promoting alternative forms of transportations to decrease mobile source fuel consumption and GHG emissions. Some of these programs are highlighted below.

The *Local Motion* program promotes and markets non-drive-alone transportation options to City employees, residents, commuters, businesses, and visitors.

Commuter Connections utilizes the regional carpool and vanpool matching program to assist residents seeking others to ride with for the work commute who live and work near them and have a similar work schedule.

Carshare Alexandria! provides a monetary incentive to residents and businesses to encourage use of carsharing services in the City.

Air Quality Action Days is the title for a workplace-based public outreach program, sponsored by Clean Air Partners, aimed at changing individual behavior to reduce ozone production. The program is composed of more than 250 companies, government agencies, educational institutions, and individuals. Participants are notified of forecasted unhealthful air days, so that employers can make an announcement to your employees to encourage them to use an alternative form of transportation, including using buses on Code Red Days. Using alternative forms of transportation helps reduce all types of air pollution emissions, included the emission of greenhouse gases.

City of Alexandria Leading by Example: DASH Hybrid Bus Replacements

Alexandria Transit Company's (ATC) DASH local bus system operates 64 conventional diesel buses . ATC has a scheduled bus replacement program with six of its oldest buses anticipated to be replaced in 2010.

ATC has obtained $810,000 in federal funding through the Mid-Atlantic Diesel Emission Reduction Campaign for the purchase of six hybrid buses. This stimulus funding will supplement the $600,000 in Alexandria's Capital Improvement Program for bus replacement and the $2.4 million provided through Virginia's Department of Transportation State Urban Funds grant program.

The new hybrid technology will accelerate the goal of reducing fossil fuel use, greenhouse gas and particulate matter emissions, and environmental noise pollution.

High Occupancy Vehicle (HOV) lanes promote more efficient use of roadways by restricting certain lanes at certain times to vehicles that carry multiple passengers, allowing the roadway to move more people at a faster rate than the regular lanes because fewer vehicles are present. The HOV locations in Alexandria are Washington, Henry, and Patrick Streets. Using carpools and vanpools instead of driving alone can cut harmful auto emissions up to 85%.

Alexandria's Pedestrian and Bicycle Mobility Plan is under development and will provide a blueprint for pedestrian and bicycle infrastructure improvements over the next 10 years as funds become available. It builds on the policy-level recommendations in the 2008 Transportation Master Plan and provides a blueprint for physical improvements to make walking and bicycling more attractive transportation choices in Alexandria.

Safe Routes to School (SRTS) is a program initiated in 2003, when Alexandria City Public Schools students participated in the annual International Walk to School Day for the first time. Since that time, the City has been working on several initiatives to encourage students to walk and bicycle to school. The City also has been working on safety improvements such as new sidewalks, crosswalk improvements, speed limit reductions and bicycling parking and bicycle lanes near local schools. Alexandria partnered with the Washington Area Bicycle Association, Trips for Kids and BikeWalk Virginia to provide in-school pedestrian and bicycle safety lessons for students. School walking maps are provided to students and city staff is coordinating with school administrators, parents and PTA groups to promote safety and fitness through walking and bicycling to school. These efforts also help Alexandria school communities to reduce traffic, fuel consumption and air pollution.

Anti-Idling Enforcement will specifically focus on the idling practices of motor coaches throughout Alexandria. Motor coaches parked in designated spots must turn off their engines. The Alexandria Police Department will focus violations involving buses idling for longer than 15 minutes, which is prohibited by Virginia Code §46.2-1224.1 subject to a $50 fine. Reducing the amount of time that motor coaches idle their engines saves fuel and reduces GHG emissions

No Idling!
Please respect our historic structures and narrow streets.
Idling is prohibited by ordinance and is strictly enforced.
Thank You!

4.3.5 Transportation Management Plans (TMPs) - Special Use Permits

> ***Water conservation slows Climate Change***
>
> Electricity is required to deliver water. Each "billing unit" of water on residential water bills or HCF (100 cubic feet = 748 gallons) of water which is conserved prevents emission of about 5 pounds of carbon dioxide from power plants into the atmosphere.

Transportation Management Special Use Permits was enacted by City Council on May 16, 1987 to offset the traffic impact of new developments. The ordinance requires that projects that exceed certain size thresholds submit a special use permit application which must include a traffic impact analysis and a transportation management plan. A TMP fund is established to finance the transportation strategies to induce people to use public transportation. Some of these strategies are: discounted fare media, shuttle bus service, registration fees for car sharing, bus shelter maintenance, bicycle lockers and parking facilities, and some administrative costs of the plan. The Office of Transit Services & Projects (OTS&P) administers the TMPs. City staff verifies compliance with the conditions of TMPs.

4.3.6 Water Conservation

Alexandria is a partner in the EPA's WaterSense program which helps protect the future of our nation's water supply by promoting water efficiency and enhancing the market for water-efficient products, programs, and practices. By using water efficient products and practices, consumers save natural resources, reduce water consumption, and save money. In order to realize these savings, consumers need to be able to identify products and services that use less water while performing as well as or better than conventional models.

WaterSense makes it easy to find and select water efficient products and ensures consumer confidence in those products with a label backed by third party, independent, testing and certification. Certifying organizations help maintain the WaterSense integrity and credibility by verifying and testing products for: conformance to WaterSense specifications, efficiency, performance, label use and also conduct periodic market surveillance.

WaterSense also recognizes some professional service programs that meet WaterSense specifications by incorporating a strong water efficiency component.

4.3.7 Solid Waste Management

Alexandria's recycling program is an everyday way to fight climate change. Recycling saves natural resources, energy and money. The energy used in the industrial processing of virgin

materials and in their transportation, involves burning fossil fuels such as gasoline, diesel, and coal, all major sources of GHG emissions. While manufacturing goods from recycled materials still requires energy, it is much less than extracting, processing, and transporting virgin raw materials. Recycling and waste reduction also avoids emissions caused by landfills which produce large amounts of carbon dioxide and methane (21 times more potent than carbon dioxide).

As part of the Eco-City Alexandria Initiative, the Eco-City Action Plan sets a goal for the City of Alexandria to exceed a 35% waste diversion rate by the year 2020. There are three ways to meet this goal - reduce, reuse and recycle. The City has a number of on-going programs to minimize the amount of waste generated at single family homes, multi-family properties, and businesses. Exhibit 17 summarizes the on-going programs to reduce solid waste generation and increase recycling in the City.

Exhibit 17
Alexandria's Fiscal Year 2011 Recycling Program

Program	Description
Curbside Recycling Collection Programs	**Curbside Recycling Cart Collection Program**: over 60% of the average residents' trash is recyclable through a curbside recycling program. In order to increase ease and convenience of setting out recycling, and to reduce litter, the curbside recycling program initiated a cart recycling program in late fall of 2010. The new wheeled and lidded containers have more capacity and increase the ease and convenience of maneuvering recycling to the curb. **Yard Waste Recycling Program**: yard waste can make up more than 20% of the average homeowner's trash. Currently, only leaves during fall Leaf Season and Christmas trees are being recycled. The rest of the curbside yard waste is sent to Covanta and burned for energy. Staff recommends piloting a yard waste recycling collection program to deal with excess yard waste that would save the City money in disposal costs and also increase the City's recycling rate.
Educational and Outreach Programs	**Solid Waste Division Brochure:** to provide better residential education about City solid waste services, staff is working with a graphic design intern to create a new and improved Solid Waste Guide to Services brochure. The brochure will be limitedly printed to save resources and trees. Residents will be able to request a brochure, while staff will try to target new residents specifically. **Additional Outreach:** Staff will also be attending additional public events, such as farmers markets and civic association meetings. Staff will provide residents with information about the cart collection program, as well as, available recycling programs. Further, additional recycling information will be posted on social media outlets, the recycling web pages, and Channel 70.
City Facility Recycling Collection Programs	**Rechargeable Battery Recycling Program:** The Solid Waste Division will continue to work with City facilities to ensure all City generated rechargeable batteries are recycled. **Interior Recycling Collection Containers:** To increase recycling collected from City facilities, the Solid Waste Division will continue to work with other departments to improve interior recycling collection containers.
Public Recycling Programs	**Recycling at Parks:** The Solid Waste Division will study the possibility of piloting recycling collection at City parks or athletic fields. **Recycling at Special Events:** Staff will continue to encourage recycling at special events, with a goal of having recycling at all events in the City.
Multi-family and Commercial Recycling Programs	**Business Recycling Partnership:** this program recognizes businesses with outstanding recycling programs. A new Business Recycling Partner will be highlighted each month on the City's Recycling web page. The goal is to encourage other businesses to improve or expand their recycling efforts by promoting successful recycling programs at all types of commercial properties. **Recycling Expos and Outreach**: On September 28, 2010 the Solid Waste Division will begin its outreach program at the Eco-Friendly Restaurant Expo to be held at the Lee Center in Alexandria. Roundtable discussions and presentations will provide restaurant managers with ideas to improve their solid waste and recycling systems.

4.3.8 Community Education and Outreach

Public education and outreach is one of the most important initiatives that the City can use to address its GHG emissions. Through education and outreach, the city gains greater engagement

and support from the community for City programs and at the same time encourages citizens to take steps in their own lives to reduce GHG emissions.

The City has stressed the importance of public education and outreach in all of its activities. Throughout the Eco-City strategic planning process, the City held numerous public work sessions, community open houses, and meetings to increase environmental awareness. More than 200 local residents participated at different EAP events between November 2008 and May 2009, sharing their ideas and insights and offering feedback on the Environmental Action Plan.

Currently, many City departments are already working actively on education campaigns that help reduce GHG emissions, such as the City's annual Earth Day celebration, home energy audit workshops, Eco-Friendly Restaurant Expo, LocalMotion web site and the City's Office of Environmental Quality web site. In addition, the City's Environmental Action Plan identifies a number of education and outreach actions to encourage community participation in reducing energy consumption, achieving GHG emission reduction goals, and preparing for climate change impacts. Some of these actions are highlighted in the following table.

Civic Sustainability Provide education and outreach to citizens and schools and increase community participation to help achieve environmental goals and objectives.	**Business Sustainability** Provide education and outreach to local businesses and related organizations to help achieve environmental goals and promote the development of green jobs and businesses within the city.
• Hire a staff person to work on environmental education and outreach on Eco-City objectives • Establish Internet education and participation resources and tools, including an Eco-City blog • Draft an Eco-City Outreach Plan • Conduct face-to-face meetings with major community and neighborhood groups • Design and develop an Outreach and Education Center to house workshops for home owners to learn about sustainable home practices • Work with schools to focus on the greening of school facilities and operations • Identify 2-3 civic/home owner associations to work as Eco-City Adopt-a-Neighborhood to test innovative elements/aspects of the EAP	• Establish a series of Open House events for businesses to showcase their application of green practices to other businesses and citizens • Establish internet education and participation resources and tools for providing information on green business practices • Examine the feasibility of establishing a Green Business certification program for one or more business sectors within the city • Establish a green business network through the Alexandria Economic Development Partnership Inc., Chamber of Commerce, and others, that is designed to market green businesses • Establish green business certification, standards, and awards programs
See Chapter 10 of the Environmental Action Plan FY 2009-2030 for a complete list of the City's planned short-term and mid-term education and outreach actions.	

City of Alexandria Leading by Example: Green Building Program Outreach Initiative

Phase II, currently under development, will target ***existing*** buildings and homes in the City in addition to new development. The City is using EECBG funding to implement the following Phase II activities:

1) Development of a virtual Green Building Resource Center targeted at reducing water and energy use in existing residential and commercial buildings;
2) Preparation and conduct of green building workshops, lectures, and seminars for City staff and citizens on topics such as home energy audits, energy efficiency for homes, and renewable energy technology;
3) Preparation of green building and energy conservation informational materials for distribution to homeowners, renters, contractors, and businesses;
4) Identification and evaluation of initiatives to promote green buildings in the City, including programs such as reduced permit fees, revolving loan funds, and separate real estate brackets for energy efficient buildings;
5) Organization of an energy audit program for single-family, multi-family, commercial, and office buildings; and
6) Provide training for City staff on various green building rating systems and energy conservation techniques.

4.4 Quantifiable Measures

All of the activities mentioned in the previous section will help reduce GHG emissions from the community at-large. Sufficient resources, information and protocols are not available to quantify the emission reductions and costs/savings associated with all of the measures identified in Section 4.3. However, preliminary quantification of emission reductions and costs associated with selected measures can be made for measures where sufficient information is available, portraying the relationship between the proposed actions and their cost and emission reduction effects. (Please see appendix B for a detailed overview of costs and savings.)

The city-wide baseline greenhouse gas emission inventory shows that 30% of the 2.2 million tonnes emitted result from onroad vehicle traffic in the city. Energy consumption in commercial buildings accounts for 44%, while energy consumption in residential buildings accounts for 20% of the total. The remaining 6% of the emissions are generated by industrial sources, offroad equipment, rail transit, and waste disposal activities.

Selected actions associated with the community-wide activities are organized into three categories – Energy Consumption in Residential Buildings, Energy Consumption in Commercial Buildings, and Transportation. Selected measures were evaluated according to six criteria:

- **Annual CO2e Reductions**: refers to the estimated reduction in CO2e emissions from the measure;
- **Energy Savings**: refers to the estimated energy savings from the measure;
- **Initial Investment Outlay**: refers to the capital cost needed by the community to implement the measure.
- **Annual Operation and Maintenance (O&M) Costs**: refers to the costs associated with ongoing implementation expenses for the measure.
- **Annual Energy Savings Benefit**: refers to the cost savings from reduced energy and/or maintenance costs associated with ongoing implementation expenses for the measure.
- **Annual Administrative Costs**: refers to the amount of City staff resources needed to complete the initial implementation and support ongoing maintenance of the given measure.
- **Simple Payback Period**: in capital budgeting; the length of time needed to recoup the cost of a capital investment. The payback period is the ratio of the initial investment (cash outlay) to the annual cash inflows (Energy Cost Savings - O&M Costs - Administrative Costs) for the recovery period.

Exhibit 18 summarizes the measures for which sufficient data were available to quantify the above parameters. It also provides an as to whether the measure is an *on-going* mitigation program the City is already implementing, a *planned* program that has been funded, or an *under consideration* program that may or may not be implemented in the future.

Assumptions and methodologies used to evaluate each of the community-wide measures shown in Exhibit 18 are provided in Appendix B. The estimated emission reductions and associated costs for each of these strategies are summarized in Exhibit 19. Exhibit 20 graphically shows how the reductions from this set of measures compares to the emission reduction targets identified in Section 2.

Exhibit 18
Description of Quantifiable City Government Operation Reduction Measures

Measure ID	Action Name/Description/Co-benefits
C.1.1	**Tier 1 Energy Audit - Easy Direct Install** **Description:** This program provides residents with a checklist and other resources for conducting a quick, visual home energy audit. The audit is intended to identify simple, low-cost measures that residents can directly install, such as CFLs, hot water heater wraps, pipe insulation, and low-flow showerheads. **Co-benefits:** Some homeowners may follow-up with more comprehensive energy efficiency improvements, such as air and duct sealing or appliances retrofits, or request a more comprehensive energy audit from a qualified contractor; these customers should be referred to the Tier 2 HPwES program.
C.1.2	**Tier 2 Energy Audit - ENERGY STAR** **Description:** The Tier 2 residential energy audit program provides a more comprehensive audit and includes a wide range of measures for all end-uses, and at many price points. This market-based program motivates homeowners to use highly skilled home energy analysts and contractors that offer a whole-house approach for reducing energy use. These contractors provide comprehensive energy audits for qualified homeowners and provide incentives from the state/utility program sponsor (often either rebates and/or low-interest loans) for qualifying energy efficiency projects. Typical projects might include: insulation, duct sealing and repair, high-efficiency HVAC systems, windows, lighting, and appliances. **Co-benefits:** Helps create a "green job" workforce involved in energy conservation and efficiency auditing and retrofits.
C.1.3	**Energy Conservation Program (Green Building Phase II)** **Description:** The goal of the Energy Conservation and Green Building Program is to reduce energy and water consumption in government and privately-owned buildings and homes which will also translate into a reduction in the City's overall carbon footprint. Per this Policy, the City expects that all new development requiring a Development Site Plan or Development Special Use Permit will achieve a LEED Silver or an equivalent rating for non-residential development and LEED Certified or an equivalent rating for residential development. The City has obtained EECBG funding to develop the Green Building Phase II program which will target existing buildings and homes in the City in addition to new development. **Co-benefits:** There are significant paybacks from increased employee productivity, health, and ergonomics in commercial buildings.
C.1.4	**Green Jobs Training for Weatherization Technicians/Energy Auditors** **Description:** Approximately 40 residents will be trained as energy auditors, solar installers, and weatherization technicians. The training will be conducted in concert with industry and community collaborators to meet the growing demand for "Energy Efficiency/Clean Energy Consultants" professionals by training members of the community and matching them with waiting employers. **Co-benefits:** By making improvements to local housing, weatherization programs can increase property values and improve community pride and aesthetics. Providing green jobs workforce will help stimulate the local economy and help improve resident's quality of life.
C.1.5	**Green Revolving Loan Program** **Description:** Revolving loan programs provide sources of money from which loans are

Measure ID	Action Name/Description/Co-benefits
	made for installation of green technologies such as energy efficient windows, weatherization, or solar panels. Energy audits may also be a component of this program. A revolving energy fund is a sum of money dedicated to energy efficiency, clean energy, or other energy reduction measures, that is loaned out to qualified applicants. Money borrowed from the fund is replenished via loan and interest (if relevant) repayments for a predetermined set of time. **Co-benefits:** By making improvements to local housing, weatherization programs can increase property values and improve community pride and aesthetics. Providing green jobs workforce will help stimulate the local economy and help improve resident's quality of life.
C.2.1 and C.2.2	**Commercial Food Service Audit & Conservation Program** **Description:** A Commercial Food Service (CFS) program provides incentives for energy-efficient commercial food service equipment such as refrigerators, freezers, steamers, fryers, hot food holding cabinets, ice machines, dishwashers, ovens, and other technologies, primarily aiming to influence the buyer to purchase more efficient equipment when their existing equipment has failed. The commercial conservation and audit program encourages all commercial customers to upgrade or retrofit working equipment with new, energy efficient equipment. **Co-benefits:** Sustained programs could also persuade restaurant chains to specify energy efficient products in their franchise agreements resulting in more widespread market transformation.
C.3.1	**Pedestrian and Bicycle Mobility Plan** **Description:** The City of Alexandria is working to reduce dependence on private automobiles and provide citizens with transportation choices. One way to accomplish this goal is to improve access for persons with disabilities, pedestrians, and bicyclists. The Pedestrian and Bicycle Mobility Plan provide a blueprint for 10 years of on-the-ground safety, mobility and connectivity improvements. Implementation of this Plan will make walking and bicycling more attractive transportation choices in the City, and reduce the number of vehicle miles travelled. **Co-benefits:** Reduces traffic congestion on City streets. Can improve public health via increase in exercise. Reduces other air pollutant emissions that contribute to smog and health problems.
C.3.2	**Transportation Master Plan Implementation** **Description:** The City's Transportation Master Plan envisions a transportation system that encourages the use of alternative modes of transportation, reducing dependence on the private automobile. This system will lead to the establishment of transit-oriented, pedestrian friendly village centers, focused on neighborhood preservation and increased community cohesion, forming a more urban, vibrant and sustainable Alexandria. The City will promote a balance between travel efficiency and quality of life, providing Alexandrians with transportation choice, continued economic growth and a healthy environment. **Co-benefits:** Reduces traffic congestion on City streets. Improves public health via increase in exercise. Reduces other air pollutant emissions that contribute to smog and health problems.

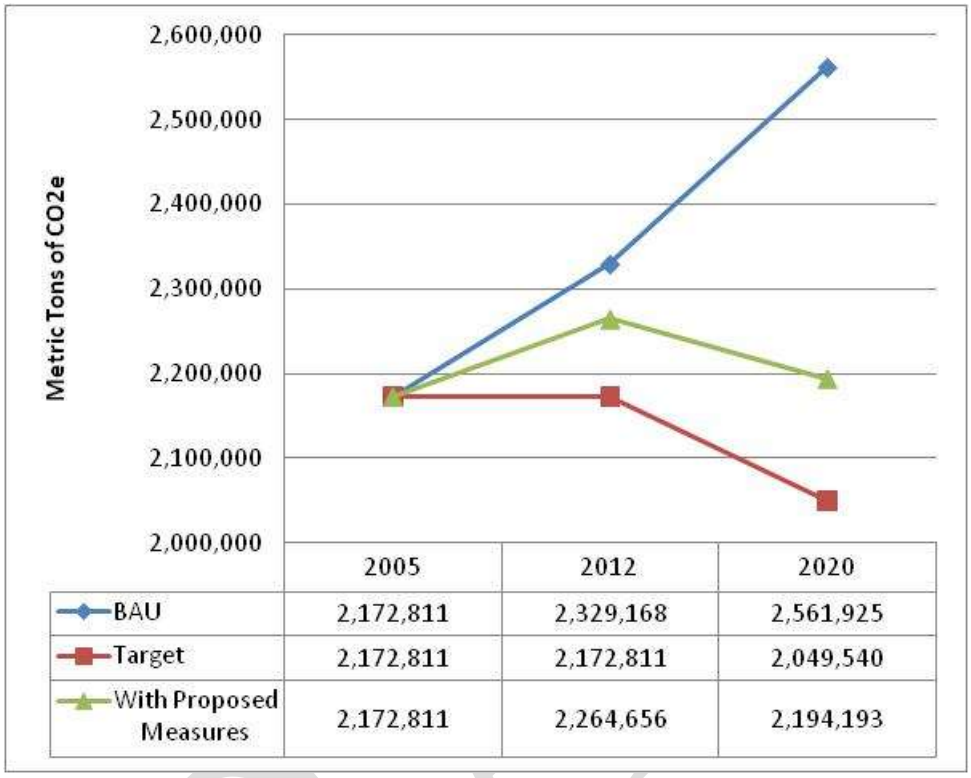
Exhibit 19
Order-of-Magnitude Emission Reductions and Capital/Operating Costs for Selected Community-Wide Strategies

ID	Measure Description	Annual CO2e Reduction (tonnes)		Annual Energy Savings (MWh)		Initial Investment Outlay ($1000)		Annual Operating Costs ($1000)		Energy Reduction Savings ($1000)		City Staff Administrative Costs ($1000)		Simple Payback Period
		2012	2020	2012	2020	2009-12	2013-20	2012	2020	2012	2020	2012	2020	
Residential Energy Use														
C.1.1	Tier 1 Energy Audit	685	2,946	1,297	5,575	2,282	9,812	0	0	120	517	50*	50*	19
C.1.2	Tier 2 Energy Audit	2,350	10,102	4,446	19,114	4,335	18,636	0	0	413	1,774	50*	50*	11
C.1.3	Green Building Phase II	46,827	241,575	88,604	457,095	Unknown	Unknown	0	0	8,222	42,418	50*	50*	n/a
C.1.4	Green Jobs Training	1,431	1,538	2,708	2,910	Unknown	Unknown	0	0	251	270	106*	106*	n/a
C.1.5	Green Revolving Loans	116	1,561	152	624,024	46	624	0	0	22	293	50*	50*	2.1
Commercial Energy Use														
C.2.1	Commercial Food Service Energy Efficiency	120	540	226	1,017	56	254	0	0	22	101	50*	50*	2.5
C.2.2	Commercial Buildings Energy Efficiency	1,256	5,666	82,486	372,037	82	372	0	0	221	997	50*	50*	0.4
Transportation														
C.3.1	Pedestrian and Bicycle Mobility Plan	3,596	7,727	369,150 gal	793,500 gal	18,000	18,000	0	0	831	1,785	50*	50*	20
C.3.2	Transportation Master Plan Implementation	8,131	96,078	834,600 gal	9,867,000	Unknown	Unknown	0	0	1,878	22,201	50*	50*	n/a
	Total CO2e Reduction	**64,512**	**367,732**											
	Targeted CO2e Reduction	**156,357**	**512,385**											

Notes: * The estimated annual costs for City staff to administer the various programs.

The initial investment outlay will be borne by both the City and the community at large, depending on the program. Initial costs for the residential and commercial energy programs will be borne primarily by the consumer, who will also realize the annual operating savings. The initial capital costs for the transportation programs will be borne by the City, while the resulting annual operating savings will accrue to consumers.

Exhibit 20
Comparison of Emission Reduction Targets and Estimated Emission Reductions for Selected Community Wide Strategies



	2005	2012	2020
BAU	2,172,811	2,329,168	2,561,925
Target	2,172,811	2,172,811	2,049,540
With Proposed Measures	2,172,811	2,264,656	2,194,193

The strategies identified in this section are not sufficient to meet the GHG emission reduction targets for community-wide activities. As mentioned above, most of the city-wide emissions come from the transportation and electricity consumption sectors. While the City can promote energy efficiency and conservation as one means to reduce GHG emissions, fundamental changes in the transportation and electric generation sectors will be needed in order for Alexandria to meet its community-wide GHG emission reduction target.

Quantifying the emission reductions and associated costs have some degree of uncertainty and several assumptions have been made regarding participation rates and other factors. However, by quantifying the emission reductions, the City and community has a realistic portrayal of the relationship between the proposed actions and their cost and emission reduction effects. Of course, there are many challenges associated with implementing these measures and actually achieving the targets, some of which are discussed in Section 6 of this report.

5. Climate Adaptation and Preparedness

5.1 Introduction

The purpose of this section is to begin the process of preparing the City for potential climate change impacts by identifying who and what will be affected, and proposing how to manage these changes – good or bad. This process is often referred to as 'adaptation.' Although most climate scientists think that the pace of climate change can be slowed by substantially reducing GHG emissions, they also agree the world will still experience a warming climate for decades to come. Climate adaptation is a sister strategy to climate change mitigation efforts. While mitigation measures may reduce the likelihood of adverse conditions, adaptation strategies may be able to reduce the severity of many potential impacts if adverse conditions prevail.

In some ways adaptation strategies are similar to buying "insurance" for an uncertain future. Waiting to act until changes have occurred can be more costly than making proactive responses. It is important to anticipate the impacts of climate change, especially with respect to human health and long-lived assets and infrastructure such as roads and bridges, shoreline and historic buildings, and floodplains (PEW, 2004).

The City's Environmental Action Plan established a goal to "increase the City's preparedness to respond to the possible effects of climate change and environmental emergencies." The section provides a preliminary look at potential climate change risks and vulnerabilities in Alexandria, as well as an identification of common adaptation goals and suggestions for preparedness actions. Further work is recommended to assess the risks associated with each potential impact in terms of both likelihood an impact occurring (almost certain, likely, possible, unlikely) and consequence (catastrophic, major, moderate, minor, insignificant). This type of risk assessment will help the City better prepare and adapt to possible climate change impacts.

5.2 Potential Climate Change Impacts and Risks in Alexandria

In June, 2009, the U.S. Global Change Research Program issues a report summarizing the science of climate change and the impacts of climate change on the United States, now and in the future (USGCRP, 2009a). The report included a six-page summary of specific climate impacts for the Southeastern U.S., including Virginia. Specific impacts were identified as:

- *Sea-level rise* and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change
- *Decreased water availability* is very likely to affect the region's economy as well as its natural systems
- *Increases in air and water temperatures* will cause heat-related stresses for people, plants, and animals

- *Ecological disruptions* are to ecosystems and to the benefits they provide to people
- *Quality of life will be affected* by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties.

These impacts, some of which are already being observed, could be dramatically have an effect on Alexandria's ecosystems, infrastructure, residents and economy. Given that the City has experienced repeated and increasingly frequent flooding events, the City has initiated a project is to analyze flooding issues, identify problem areas, develop and prioritize solutions, and provide support for public outreach and education.

One of the first tasks of this project was to provide the City of Alexandria with potential of changes in intensity, duration, and frequency (IDF) values based on the results of global climate models paired with a range (low to high) in greenhouse gas emission scenarios (CH2MHILL, 2009a). As shown in Exhibit 21, this analysis projected that annual precipitation would increase from the 39-40 inches observed during the 1990-2008 period, to 47 inches in 2100 under the low GHG emission scenario. Under the high GHG emission scenario, annual precipitation is projected to increase to about 56 inches, or about a 40% increase in annual precipitation from 2000 to 2100. For most scenarios, the analysis projected that precipitation events in 2100 will be more intense, will last longer, and will occur more frequently.

A second task evaluated potential sea-level rise based on appropriate climate change scenarios (CH2MHILL, 2009b). Exhibit 22 summarizes the results from five global climate models using low, medium, and high greenhouse gas emission scenarios were used to generate projected changes in mean high water and hide tides at the Washington, D.C., gauge near the City for the years 2050 through 2100. The projected median sea-level rise ranges from 1.33 to 3.35 feet (0.4 to 1.2 meters), while the projected median sea-level rise during high tide ranges are 2.94 and 4.96 feet (0.9 to 1.5 meters).

A recent EPA study (USGCRP, 2009b) corroborates the sea-level rise projections developed in the Alexandria study. Exhibit 23 is a map drawn from the EPA study which shows elevation maps to illustrate vulnerability to sea-level rise. The maps show elevations relative to spring high water, the average tide during new and full moons. Areas in green in Exhibit 23 would be vulnerable to the projected sea-level rise of 0.9 to 1.5 meters. These areas include much of Dangerfield Island, the Waterfront, and the Hunting Creek area.

Exhibit 21
Projected Changes in Annual Precipitation at Ronald Reagan National Airport Under Three GHG Emission Scenarios for the Years 1990 to 2100

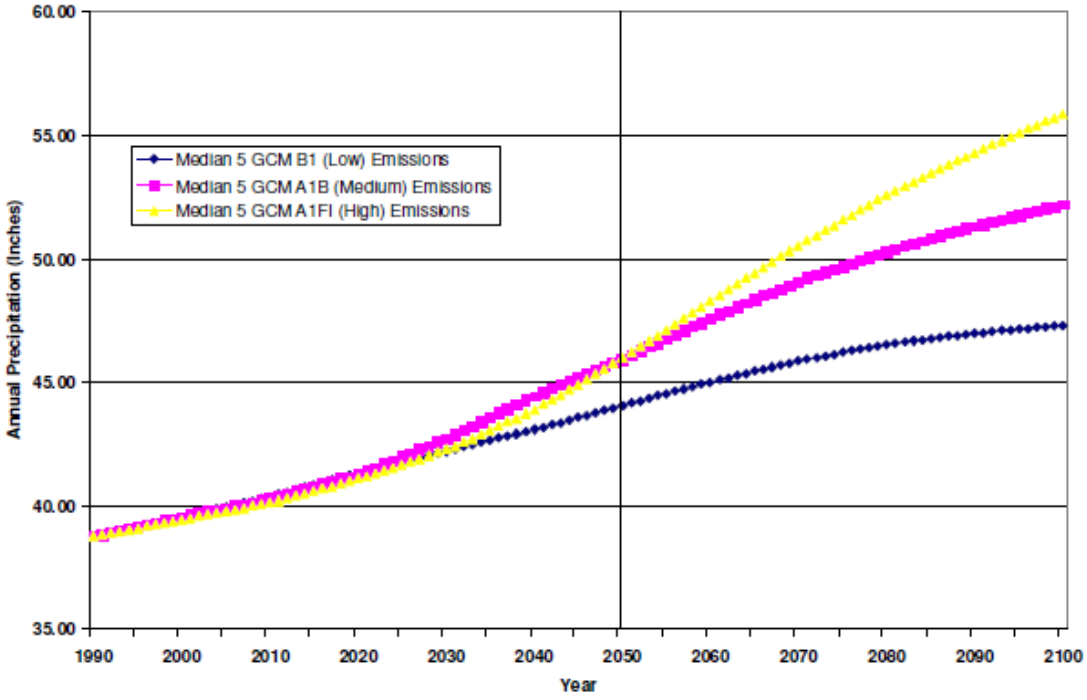


Exhibit 22
Projected Mean Higher High Water (High Tide) Relative to Historic Trends

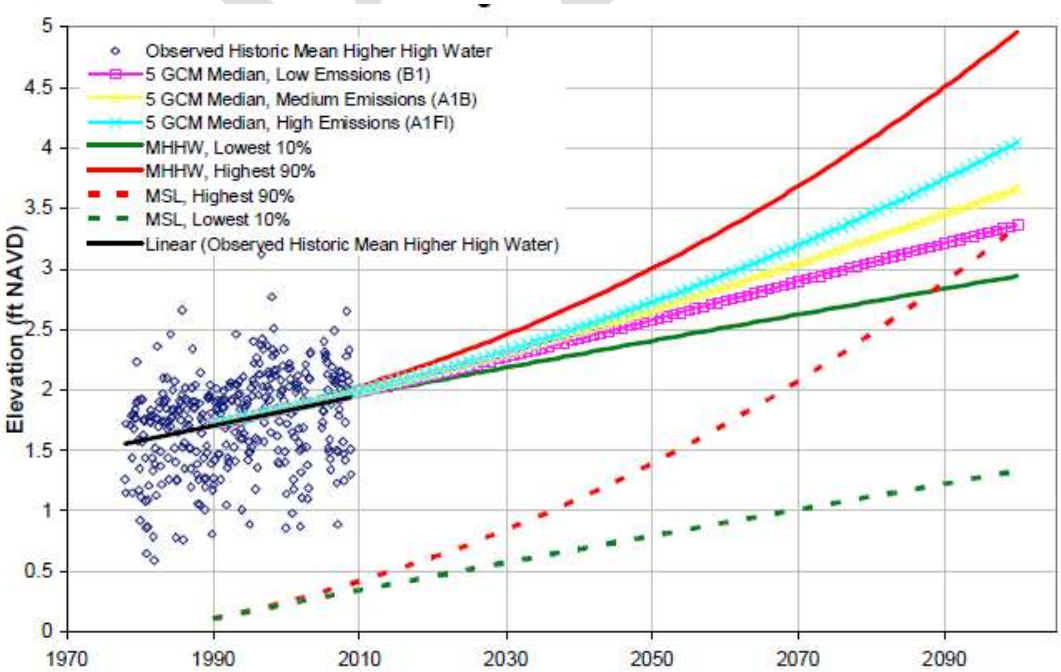
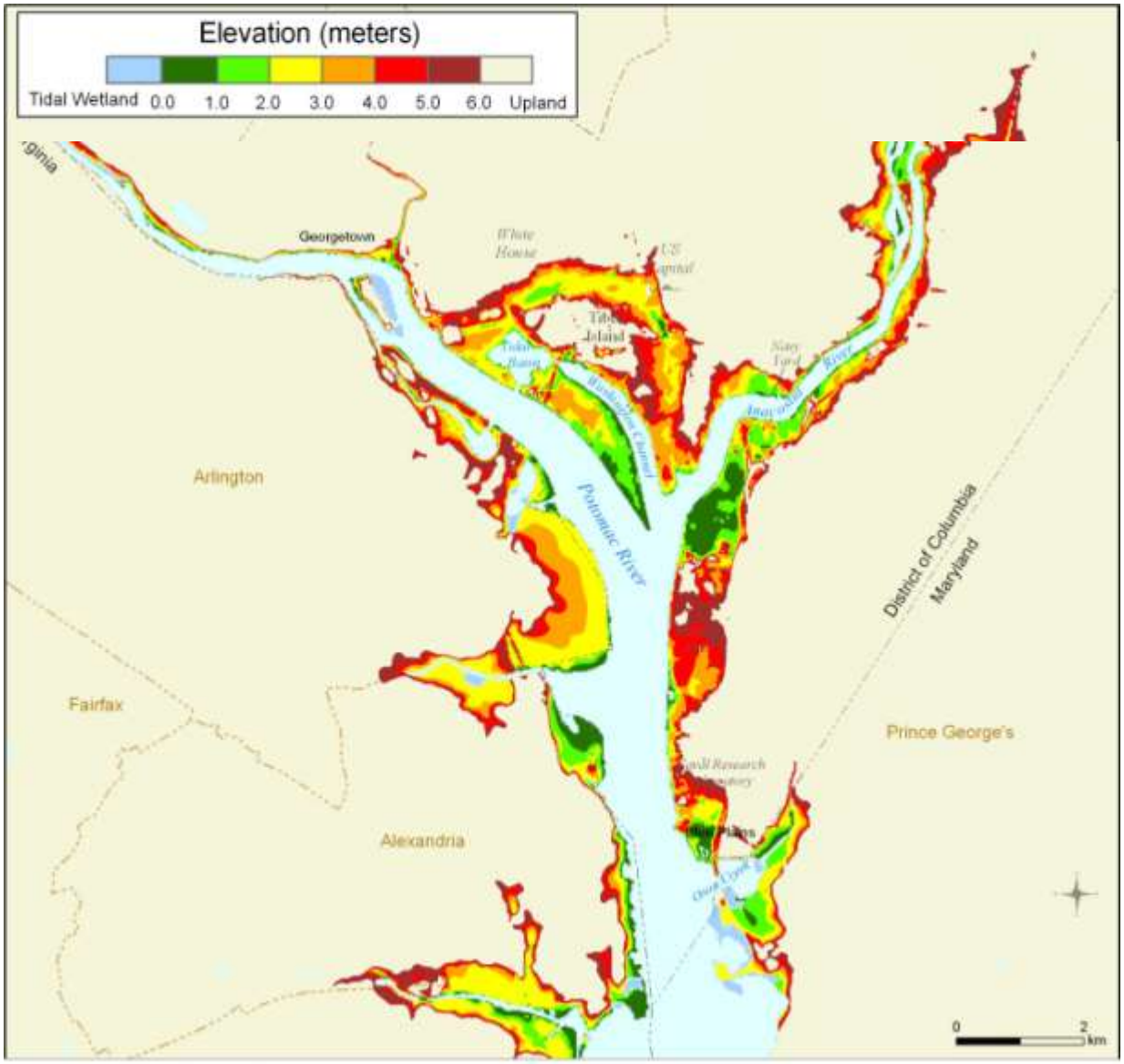


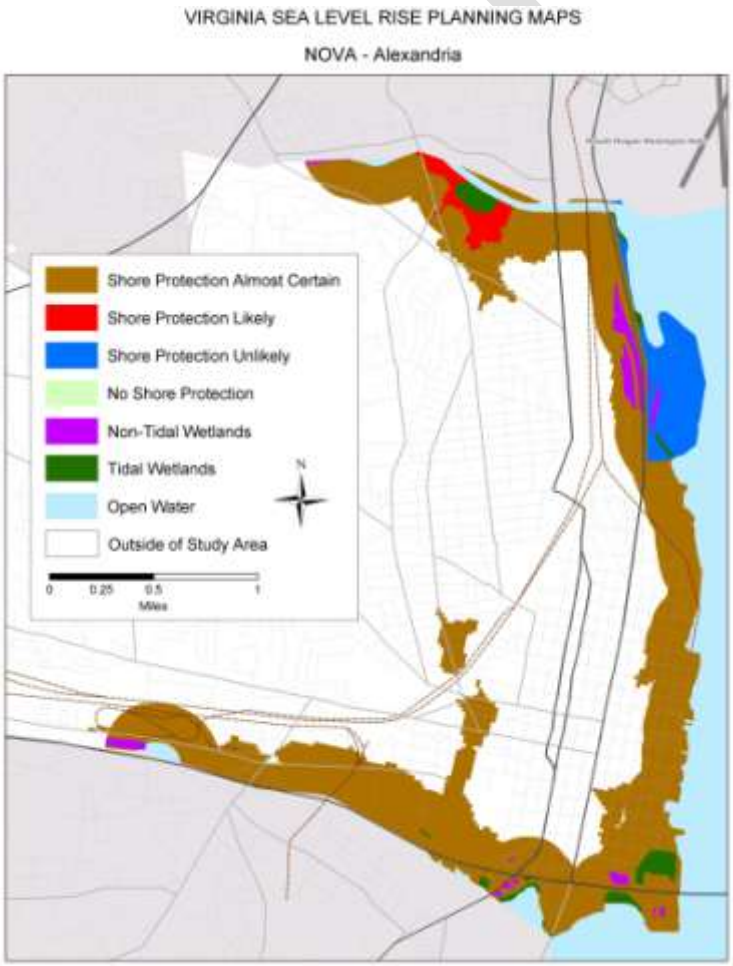
Exhibit 23
Areas of Alexandria Vulnerable to Impacts of Sea-Level Rise



Elevations of Land Close to Sea Level
Elevations are above spring high water, which is the average high tide during new and full moons, and approximately the inland boundary of tidal wetlands. This map is a general graphical representation of elevations in the area depicted, not designed to estimate the precise elevations at specific locations. Due to the use of a variety of data sources, actual elevations at specific locations may be 50 cm above or below the elevation shown for Washington, but 150 cm for Maryland and Virginia.
Source: J.G. Titus and J Wang. 2008. "Maps of Lands Close to Sea Level along the Mid-Atlantic Coast". US Environmental Protection Agency.

A recent $2 million effort (Titus, 2010) to map the likelihood of shore protection as sea level rises is summarized in a new article entitled *State and Local Governments Plan for Development of Most Land Vulnerable to Rising Sea Level Along the U.S. Atlantic Coast*. The maps divide coastal low lands into four categories: developed (shore protection almost certain), intermediate (shore protection likely), undeveloped (shore protection unlikely), and conservation (no shore protection). The maps distinguish shores that are likely to be protected from the sea from those areas that are likely to be submerged, assuming current coastal policies, development trends, and shore protection practices. The maps represent neither a recommendation nor an unconditional forecast of what will happen, but simply the likelihood that shores would need protected if current trends continue. This study also does not analyze the timing of possible shore protection; it simply examines whether land would be protected once it became threatened. The study defines "shore protection" as activities that prevent dry land from converting to either wetland or water. Areas needing shore protections are shown below in Exhibit 24.

Exhibit 24
Areas of Alexandria Needing Shore Protection



NVRC Sustainable Shorelines and Community Management Project

The Northern Virginia Regional Commission (NVRC), through the Sustainable Shorelines and Community Management project, assesses areas most vulnerable to long-term and episodic sea level rise and quantifies impacts to the natural and built environments.

Staff from the City of Alexandria along with other Northern Virginia municipalities participate as members of the project's diverse workgroup, which provides valuable input by identifying key targeted planning areas; provides data and information; and shapes strategies and recommendations.

The project, initiated and managed by the Northern Virginia Regional Commission (NVRC) since 2009 with funding in part by the Virginia Coastal Zone Management Program and the National Oceanic and Atmospheric Administration (NOAA), is a collaborative effort to assess the risk and vulnerability of Northern Virginia's tidal shorelines to coastal hazards, including episodic and permanent inundation caused by storm surge and projected relative sea level rise, respectively.

Relative sea level rise inundation scenarios mapped using high resolution Light Detection and Ranging (LIDAR) topographic data suggest that while the City will not experience wide-scale inundation due to projected relative sea level rise rates, the areas most at risk are those that are lowest lying to current mean sea level, including portions of the City's shorelines that experience flooding on a regular basis.

The City will continue to work with the workgroup to identify common strategies and recommendations most applicable for the region and the City to address critical infrastructure located in areas at risk. Examples of common strategies may include educating the public as to their risk and vulnerability to future conditions, integrating vulnerability assessment and adaptation options into Hazard Mitigation planning processes, increasing freeboard and/or setback requirements, encouraging the transfer of development rights, or creating rolling easements or specific overlay districts for areas that may experience inundation.

5.3 Preliminary Climate Adaptation Goals and Actions

Exhibit 25 presents a preliminary list of possible preparedness goals and actions for the five impact areas listed above. Many of the adaption goals and actions were drawn from the City's Environmental Action Plan as they address similar issues. For example, stormwater management is both a water quality and a climate change issue. Additional goals and actions were based on information provided in ICLEI guidance (ICLEI, 2007a; ICLEI, 2007b).

Exhibit 25

Preliminary List of Climate Change Impacts and Preparedness Goals and Actions

Impact 1*: Sea-level rise and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change	
Goal:	**Preparedness Action:**
Reduce property damage from erosion, flooding events, sea-level rise, high wind events	• Update the flood management program to take into account anticipated rises in Potomac River levels and the increased intensity of storm-related flooding • Fund and implement the Four Mile Run Master Plan and demonstration project and continue implementation of Cameron Run/Holmes Run feasibility study to maintain flood protection infrastructure • Move or abandon infrastructure in hazardous areas • Change zoning to discourage development in flood hazard areas • Update building codes to require more flood resistant structures in floodplains • Use optimal waterfront locations and infrastructure to avoid or minimize damage that will result from sea/river level changes or surges • Investigate building design standards for buildings that currently experience high wind events (i.e., Gulf Coast states) similar to events that Alexandria may experience in the future • Identify areas that would allow for burial of existing power lines to avoid interruptions due to increased rain or wind events
Increase capacity to safely manage storm water	• Support and provide information regarding mechanisms to finance infrastructure improvements • Establish long-term dedicated funding mechanisms such as storm water utility fees or other taxes to improve and maintain stormwater infrastructure • Require developers of new buildings to build separate sanitary sewer and stormwater infrastructure as a condition of development approval • Consider use of permeable surfaces to reduce stormwater runoff
Reduce flooding and erosion impacts on road s and bridges	• Conduct vulnerability assessment of major roadways and bridges in the city to projected rises in Potomac River levels • Increase capacity of stormwater collection systems to accommodate projected changes in precipitation • Use permeable surface treatments wherever possible
Impact 2*: Decreased water availability is very likely to affect the region's economy and natural systems	
Goal:	**Preparedness Action:**
Expand and diversify water supply	• Coordinate with regional water authorities on groundwater resources, surface water reservoirs, and water quality • Facilitate installation of water reclamation techniques as part of development and redevelopment projects
Reduce demand and improve efficiency	• Modify building codes to require low flow plumbing fixtures or other water conservation measures • Provide financial incentives for switching to more efficient processes and appliances • Promote best management practices for using stormwater (e.g., rain barrels, rain gardens, "water wise" gardening and landscaping • Promote individual water conservation opportunities through incentives (i.e., rebates and taxes), and outreach to the general public (e.g., EPA's Water-Sense Program)

	• Educate businesses that have intensive water uses about retrofits and upgrades to promote water recycling and conservation
Increase drought preparedness	• Increase authority to implement water restrictions and other emergency measures • Update drought management plans to recognize changing conditions
Impact 3*: Projected increases in air and water temperatures will cause heat-related stresses for people, plants, and animals	
Goal:	**Preparedness Action:**
Reduce impacts of extreme heat events	• Open additional cooling centers during extreme heat events and extend hours for public wading pools during extreme heat events • Increase use of shade trees to reduce temperatures in urban areas • Continue to design and develop shaded parking lots through existing Special Use Permit/Development process and the retrofitting of existing parking lots • Expand and enhance outreach on air quality hazards such as ozone pollution associated with high temperature days
Improve disease surveillance and protection	• Enhance monitoring of known diseases and potential diseases moving into the area • Maintain a strong Mosquito Control Program and be prepared to develop additional vector control programs as needed • Enhance community emergency planning for disease outbreaks and emerging public health threats
Design and reconstruct roadways and bridges to handle changes in temperature and precipitation	• Increase maintenance frequency of asphalt roads that may be adversely affected by high temperatures. • Investigate potential of using other road surfaces on most heavily used roads that are more tolerant to changes in temperature • Change design requirements for new or refurbished roadways and bridges to include different pitches combined with stormwater design to effectively remove water from roadways and bridges

Impact 4*: Ecological thresholds are expected to be crossed throughout the region, causing major disruptions to ecosystems and to the benefits they provide to people	
Goal:	**Preparedness Action:**
Reduce shore erosion	• Preserve ecological buffers to allow for inland beach migration • Enhance shoreline protection where retreat and accommodation are not possible • Restore and stabilize stream banks of all urban streams to minimize erosion
Maintain or enhance shoreline habitat	• Preserve ecological buffers to allow for inland migration of wetlands, salt marshes, and other habitat systems • Restore and stabilize stream banks of all urban streams to promote healthy habitat and biotic integrity • Preserve, protect, and enhance existing wetlands in the city
Protect and enhance tree canopy and	• Engage citizens to assist in the improvement of riparian buffers through continued efforts toward invasive species eradication and enhanced planting programs

terrestrial habitats	• Utilize low impact landscape practices where possible, such as perennial and native plant species, rain gardens, and encouraging the removal of invasive species • Promote and expand program s where individuals or organizations can purchase trees through the City and have them planted and maintained throughout the city • Ensure that all City plantings are non-invasive, flood- and drought-tolerant, 80% perennial plants, and that native plants are used wherever possible
Impact 5*: Quality of life will be affected by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties	
Goal:	**Preparedness Action:**
Increase preparedness to respond to possible climate change emergencies	• Support emergency plans that take into account climate change-related emergencies such as water and food supply disruptions caused by severe drought, loss of electricity, damage to or contamination of the water distribution system, climate change-related outbreaks of diseases, and other public health threats • Identify alternative routes and modes for goods transport and evacuation efforts during emergency situations • Connect emergency centers with onsite renewable energy sources to reduce susceptibility to lapses in conventional energy supply • Increase public awareness about the public health risks associated with climate change and the need for emergency preparedness

* Reference: (USGCRP, 2009a)

6. Challenges in Responding to Climate Change

This report quantifies the sources of Alexandria's GHG emissions and lays out near- and mid-term strategies to meet proposed GHG emissions reduction targets. Alexandria has displayed leadership and foresight in its Environmental Action Plan, which already includes a number of important measures to reduce GHG emissions. The measures in the EAP and this Climate Action Plan will help Alexandria mitigate its contribution of greenhouse gases. Alexandria stands to benefit in many other ways from the proposed measures outlined in this report. By undertaking these measures, Alexandria will save money, improve air quality and public health, enhance community livability, boost the local economy, and showcase the City's commitment to climate protection.

Meeting these targets will present many challenges. It will require the cooperation and enthusiasm of the residents and businesses, and the participation of other local governments and regional, State and federal agencies. The remainder of this section begins to outline the challenges the City will face to ensure the GHG emission reduction target is met, coordination is established, resources are sustainable, and progress is monitored and reported.

6.1 Administration and Staffing

A key part of effectively implementing this Climate Action Plan is assigning and defining management responsibilities for each of the individual components of the plan. The City has already established a new Energy Manager position in the Department of General Services to analyze, develop and implement the City's energy conservation efforts, including changes in operating procedures and contracts to save on future energy costs, as well as, reduce GHG emissions. In addition to an Energy Manager, designated officials and staff members must be identified to serve as the initial points of contact and the drivers of the Climate Action Plan initiatives in order to make this process effective and efficient. These roles need to be defined and carried out going forward.

Successfully implementing the climate action plan will affect all parts of Alexandria's operations. For example, fleet operators will need to work to improve fleet fuel efficiency, energy planners will need to develop energy efficiency policy and provide outreach to residents, and transportation planners will need to develop VMT reduction program. For this reason, it is important that policymakers and senior staff provide clear and consistent direction to all staff members that implementing the Climate Action Plan is plan is a priority and that they will be required to examine how they can incorporate the outlined strategies into their regular work. It is important that the City maintains a culture of sustainability, where greenhouse gas considerations are aligned with other priorities.

6.2 Public Involvement and Education

To reduce emissions from businesses, vehicles and homes, the City will need to engage the public at all stages of future work. Employers, commuters and residents will not only be responsible for reducing their own emissions, but they can serve as messengers to the people with whom they live and work. It is important to identify a clear and accessible network of not only City employees and officials, but also community members to help carry out the implementation process. The City will need to provide education and outreach to business, citizens, local schools and related organizations to increase community participation and to help achieve GHG emission reduction goals.

6.3 Funding and Budgeting

Implementation of this Plan will require a significant investment of time and resources, both of which are very scarce in light of the recent economic downturn. The City must be strategic in its adoption of these measures, focusing on low-risk projects that have the highest emissions reductions per dollar spent, the lowest capital outlay, or those that result in cost savings in the near term. For example, some municipal operations measures could be incorporated into existing practices with minimal costs, and many energy efficiency upgrades (for example LED streetlights) have a relatively quick payback period.

The City must continually look for opportunities to incorporate the strategies outlined in the plan as part of the annual budget process. For example the American Recovery and Reinvestment Act (ARRA) included a number of programs to save energy and reduce GHG emissions. The City has already applied for funding under a number of these programs, including $1.4 million as part of the Energy Efficiency and Conservation Block Grant Program. The City should also continue to seek additional funding in the form of State and federal grants and low interest loans to help finance more expensive measures, as well as sustainable and strategic public investments by the City, State, federal and regional government agencies. In addition, The City must continue to explore partnerships that can help to leverage resources, both financial and staff, to help implement appropriate measures.

Finally, the City should identify and promote action steps for increasing financial investment in GHG emission reduction strategies. This will allow the City to have a more stable funding source for GHG emissions reductions programs rather than relying on competitive and infrequent grants. Many localities and the State are already devising these innovative funding approaches. For example, Montgomery County provides revolving loan funds to fund energy, GHG emission and cost-saving projects with a minimal amount of startup capital.

6.4 Coordination with City Planning Activities

Alexandria has numerous plans that range from the City's overall Master Plan (e.g., its comprehensive land use plan) to special program master plans (e.g., Open Space, Parks and Recreation, Urban Forestry, Transportation, Water Quality, and Solid Waste). It also has several policy and development plans that focus on particular projects or areas along roughly 20 Small Area Plans administered by Planning and Zoning. Added to this constellation of plans is this Climate Action Plan. The City may want to consider creating a full or –part-time Sustainability Coordinator's position to help coordinate with all City departments in the implementation of the Climate Action Plan.

6.5 Coordination with Other Units of Government

As noted earlier in this document, achieving the GHG emission reduction targets will require action by all levels of government. The City should establish policies and processes that foster regional collaboration on sustainability programs and projects. The City should establish regular communications for information sharing and action with state, regional, and federal partners (e.g., Metropolitan Washington COG, Northern VA Transportation Authority, and Northern VA Regional Commission, ICLEI, Commonwealth of Virginia, U.S. agencies) and adjacent jurisdictions (e.g., Fairfax and Arlington Counties). Coordination with regional governments is especially important with respect to transportation planning, as any emission reduction strategy would affect the integrated, multi-jurisdictional transportation network. Coordination with the Commonwealth of Virginia might involve issues such as a statewide green building code, a renewable energy portfolio standard, and utility energy efficiency programs. Coordination with federal agencies might involve lobbying for improved fuel economy standards for vehicles, programs to reduce or sequester GHG emissions from fossil fuel-fired power plants, and funding for local energy conservation and efficiency efforts.

6.6 Monitoring of Implementation

In order to begin to implement the strategies outlined in the plan, the City will need to set priorities by creating a timeline for implementation of the plan. The City should also set up an evaluation mechanism which assesses both the success of the implemented measures and the progress against the implementation timeline. This will allow the City to respond to existing financial and political realities and it will increase accountability for implementing departments and provide an incentive for quicker progress. It will also allow for consistent and transparent reporting to the community and other stakeholders, further building the relationship between the City and the community.

One of the most important ways that the City can evaluate its progress is through updating their GHG emissions inventory and measuring progress against the 2005 baseline. The City should re-inventory at least every 3-5 years from the baseline year.

6.7 2020 and Beyond

In developing the Energy and Climate Change Action Plan, one of the initial decisions was to define the time horizon for the plan. OEQ decided to focus the Plan on actions the City can take to achieve its city-wide GHG emissions reduction targets for 2012 and 2020 and to begin to prepare for possible climate change impacts that cannot be mitigated. Meeting the long-term emission reduction targets beyond 2020 will almost certainly need to include actions that are beyond the control of the City. To a large degree, the City is dependent on higher levels of government to be responsible for a majority of the emission reductions needed to reach the 2020 and beyond targets.

While no individual ‘‘Silver Bullet” strategy exists that can achieve the long-term targets, a portfolio of strategies involving all levels of government could yield success. Research, regulatory and market-based programs at the national/international level will be needed to help transition to low- or no-carbon electricity and transportation fuels. Many of the Federal and international programs are likely to be developed and implemented five to ten years in the future. At the same time, State and local governments will need to continue to promote sustainable urban development and educate their communities on actions that can reduce an individual’s GHG footprint.

The City should continue to incorporate more mid- and long-term strategies into an updated version of the Climate Action Plan. Further analysis is need to support a definitive and quantifiable proposals for long-term (i.e., post-2020) actions. Some of the potential long-term strategies that should be further evaluated are described in the following subsections.

6.7.1 Distributed Generation

Distributed energy consists of a range of smaller-scale and modular devices designed to provide electricity, and sometimes also thermal energy, in locations close to consumers. They include fossil and renewable energy technologies (e.g., photovoltaic arrays, wind turbines, microturbines, reciprocating engines, fuel cells, combustion turbines, and steam turbines); energy storage devices (e.g., batteries and flywheels); and combined heat and power systems.

6.7.2 District Energy

- District energy systems produce steam, hot water or chilled water at a central plant. The steam or water is then piped underground to individual buildings for space heating, domestic hot water, or heating and air conditioning. As a result, individual buildings served by a

district energy system do not need their own boilers or furnaces, chillers or air conditioners. The district energy system provides valuable benefits including: improved energy efficiency; enhanced environmental protection, and fuel flexibility (fossil vs. renewable). When electricity is also generated, the system becomes a combined heat and power system (often referred to by the acronym "CHP") - generating both heating and cooling plus electricity for customers. A CHP system may have nearly double the fuel efficiency of an electric generation plant and can also lower the emissions typically associated with conventional fossil-fuel powered electrical production. The less energy used, the less sulfur dioxide and carbon dioxide and other emissions are emitted into the environment. High-density areas, such as the North Potomac Yard development, Landmark Mall, or areas near Covanta should be evaluated for potential deployment of district energy.

6.7.3 Building Energy Performance Labeling

Building owners could voluntarily disclose, or be required to disclose, the energy performance of their buildings using a common rating or label. Rating systems typically use a combination of energy use records and in-person audits to develop a performance "score" (sometimes accompanied by a more detailed assessment) that enables comparison of buildings. Ratings typically must be performed at either building time-of-sale or by a certain date and then disclosed to prospective buyers or tenants or to the general public. Performance-based rating systems exist for both residential and commercial buildings, and several options are currently used in a pilot phase around the country.

6.7.4 Participation in Carbon Offset Markets

If and when the U.S. carbon market emerges, the City could consider a program for purchasing carbon offsets as a means of achieving carbon neutrality goals. Markets for carbon offsets are designed to cancel out emissions from one jurisdiction by causing equivalent GHG reductions in another jurisdiction. For example, project developers could be required to purchase verified carbon credits to offset the GHG emissions from their project, thus achieving carbon neutrality.

6.7.5 Transition to Alternative Transportation Fuels

Most would agree that the current transportation model is not sustainable – there is a long-term need for low- or zero-emitting vehicles. The widespread deployment of plug-in electric vehicles offers one way for the U.S. to reduce GHG emissions and improve its energy security. Electric vehicles produce no tailpipe emissions and, when charged using electricity generated from renewable resources, virtually no GHG emissions. The City could begin to evaluate issues associated with the widespread deployment of plug-in electric vehicles so that the proper infrastructure and support systems can be created and implemented.

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8. Glossary

Alternative Fuel: A popular term for "non-conventional" transportation fuels made from natural gas (propane, compressed natural gas, methanol, etc.) or biomass materials (ethanol, methanol).

British thermal unit (Btu): The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit; equal to 252 calories. British thermal unit is abbreviated as Btu.

Business-as-Usual: The term used to describe forecasts of emissions assuming that emissions will continue to grow at the same rate as they did prior to the 2005 inventory and that neither governments or individuals will take actions that result in emission reductions. This represents a "worst-case" scenario that provides a means for comparing 2005 emissions and the results of implementing recommended strategies.

Carbon Dioxide (CO_2): Carbon dioxide is a greenhouse gas that 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., manufacture 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.

Carbon Dioxide Equivalent (CO_2e): This is a common unit for combining emissions of GHGs with different levels of impact on climate change. It is a measure of the impact that each gas has on climate change and is expressed in terms of the potency of carbon dioxide. For carbon dioxide itself, emissions in metric tons of CO_2 and metric tons of CO_2e are the same, whereas for nitrous oxide and methane, stronger GHGs, one tonne of emissions is equal to 310 tonnes and 21 tonnes of CO_2e respectively.

Carbon Footprint: A metric used to measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

Carbon Sequestration: The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned.

Climate Adaptation. A term that refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. This is in distinction to the mitigation of global warming.

Climate Change: A term that refers to any significant change in weather patterns (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). The term climate change is often used interchangeably with the term global warming, but according to the National Academy of Sciences, "the phrase 'climate change' is growing in preferred use to 'global warming' because it helps convey that there are changes in addition to rising temperatures."

Climate Mitigation. A term that refers to initiatives and measures to reduce the emissions of greenhouse gases that are considered to be the main cause of climate change. This is in distinction to the mitigation of global warming.

Criteria Air Pollutants: A group of common air pollutants regulated by the EPA. These pollutants are carbon monoxide, lead, nitrogen oxide, ozone, particulates and sulfur dioxide.

Department of Transportation and Environmental Services (T&ES) – The City Department responsible for multimodal transportation services and facilities and protection and enhancement of natural environment to improve the quality of life for those who live in, work in, and visit the City of Alexandria." T&ES is responsible for the engineering, design, construction, inspection, surveying and maintenance of streets, bridges, sewers, fire hydrants and traffic control mechanisms. The department also oversees environmental regulation and management, including air and water quality, transit and refuse and recycling collection

Direct Emissions: Emissions from sources within the reporting entity's organizational boundaries that are owned or controlled by the reporting entity, including stationary combustion emissions, mobile combustion emissions, process emissions, and fugitive emissions. All direct emissions are Scope 1 emissions.

District Energy: Systems that produce electricity, steam, hot water or chilled water at a central plant. The electricity, steam or water is then piped underground to individual buildings for or space heating, domestic hot water heating and air conditioning. As a result, individual buildings served by a district energy system don't need their own boilers or furnaces, chillers or air conditioners, or connection to the electricity grid.

Ecological Footprint: A metric used to measure how much land and water area a human population requires to produce the resource it consumes and to absorb its wastes, using prevailing technology.

Electricity Generation: The process of producing electric energy or the amount of electric energy produced by transforming other forms of energy, commonly expressed in kilowatt-hours (kWh) or megawatt hours (MWh).

Energy Efficiency: Refers to activities that are aimed at reducing the energy used by substituting technically more advanced equipment, typically without affecting the services

provided. Examples include high-efficiency appliances, efficient lighting programs, high-efficiency heating, ventilating and air conditioning (HVAC) systems or control modifications, efficient building design, advanced electric motor drives, and heat recovery systems.

Fluorinated Gases: Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful GHGs that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). These gases are typically emitted in smaller quantities, but because they are potent GHGs.

Fossil Fuels: Fuels (coal, oil, natural gas, etc.) that result from the compression of ancient plant and animal life formed over millions of years.

Global Warming: A term describing the average increase in the temperature of the atmosphere near the Earth's surface which can contribute to changes in global climate patterns.

Global Warming Potential (GWP): The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one mass-based unit of a given GHG compared to one equivalent unit of carbon dioxide (CO_2) over a given period of time.

Greenhouse Effect - The effect of the Earth's atmosphere, due to certain gases, in trapping heat from the sun; the atmosphere acts like a greenhouse.

Greenhouse Gases (GHGs): Any of the atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth's surface. They include carbon dioxide (CO2), methane (CH4), nitrous oxide (NO2), fluorinated gases, and water vapor. Although GHGs occur naturally in the atmosphere, the elevated levels especially of carbon dioxide and methane that have been observed in recent decades are directly related, at least in part, to human activities such as the burning of fossil fuels and the deforestation of tropical forests.

Indirect Emissions: Emissions that are a consequence of activities that take place within the organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity. For example, emissions of electricity used by a manufacturing entity that occur at a power plant represent the manufacturer's indirect emissions.

Intergovernmental Panel on Climate Change (IPCC): The international body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change.

Methane (CH4): Methane is a greenhouse gas 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.

Metric Ton (tonne): A common international measurement for the quantity of greenhouse gas emissions. A metric ton is equal to 2205 lbs or 1.1 short tons.

Metropolitan Washington Council of Governments (MWCOG): The regional planning organization for 21 Washington area governments, including Alexandria. MWCOG works to resolve regional problems such as growth, transportation, air pollution, water supply, water quality, economic development, and other environmental issues.

Nitrous Oxide (N2O): Nitrous oxide is a greenhouse gas emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Office of Environmental Quality – An office within T&ES responsible for monitoring and maintaining environmental quality thus preserving and protecting public health and welfare and the environment.

Virginia Department of Environmental Quality (VA DEQ): VA DEQ, though it's Division of Air Quality, is responsible for carrying out the mandates of the Virginia Air Pollution Control Law, as well as meeting Virginia's federal obligations under the federal Clean Air Act.

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APPENDIX A

DATA AND ASSUMPTIONS FOR QUANTIFYING EMISSION REDUCTIONS FROM CITY GOVERNMENT MEASURES

Action Name:	Renewable Energy Purchase for City Buildings						
Action ID:	G.1.1						
Sector:	Government	Buildings					
Action Origin:	EAP, Energy Principle, Goal 3						
Energy Savings:	2012	n/a	Units	**CO2e Reductions:**	2012	1,286	tonnes
	2020	n/a	Units		2020	5,318	tonnes
Capital Costs:	2012	$0		**Operating Costs:**	2012	$55,000	
	2013-2020	$0			2020	$226,417	
Payback Period:	n/a	years					

Action Description:

The purchase of renewable (green) energy can be accomplished through the Virginia Energy Purchasing Governmental Association (VEPGA), a steering committee of the Virginia Municipal League Association, which was formed to purchase electricity. The VEPGA contract actually provides for the purchase of "renewable energy credits". The purchase of credits allows the City to legally claim to have purchased energy produced by renewable energy sources such as the sun, wind, geothermal hydro-electrical, wave or tidal energy. These credits are sold by the producers and traded to subsidize renewal energy production.

Energy Assumptions and Calculations:

The EAP indicated that in FY 2009 and 2010, the City will purchase 5% of its electricity needs through green certificates, which promote the use of renewable power. The EAP further called for the Purchase renewable energy credits generated for compliance with state-level renewable portfolio standard requirements equivalent to 5% of the City's operational needs in 2010 rising steadily to 25% in 2020. In FY 2006, the City's actual electricity consumption was approximately 35,000 MWh in City-owned buildings, libraries, and leased facilities.

Year	Consumption (MWh)	Renewable Percentage	Renewable Energy Consumed (MWh)
FY2006	35,000		
Projected 2012	37,450	6.5	2,434
Projected 2020	40,250	25	10,063

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Purchasing 2,434 MWh of renewable energy in 2012 will reduce CO2e emissions by 1,286 tonnes.
Purchasing 10,063 MWh of renewable energy in 2020 will reduce CO2e emissions by 5,318 tonnes.

Cost Assumptions and Calculations:

In FY 2006, the City's actual electric consumption was approximately 35,000 MWh, or a total cost of $3,300,000, which is an average of $0.0928 per KWh. The new VEPGA contract has established a green energy purchase rate of $0.0225 per KWh, in addition to the average actual costs per KWh ($0.0928). (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council)

The incremental cost for purchasing 6.5% renewable energy in 2012 is estimated to be $55,000.

The incremental cost for purchasing 25% renewable energy in 2020 is estimated to be $226,417.

Co-Benefits:

- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- Provides a means for the City to directly support production of renewable energy

Action Name:	Renewable Energy Purchase for City Schools						
Action ID:	G.1.2						
Sector:	Government	Schools					
Action Origin:	ACPS Web Site: http://www.acps.k12.va.us/news2008/nr2007071302.php						
Energy Savings:	2012	n/a	Units	**CO2e Reductions:**	2012	1,414	tonnes
	2020	n/a	Units		2020	3,039	tonnes
Capital Costs:	2012	$0		**Operating Costs:**	2012	$60,188	
	2013-2020	$0			2020	$129,375	
Payback Period:	n/a	years					

Action Description:

The purchase of renewable (green) energy can be accomplished through the Virginia Energy Purchasing Governmental Association (VEPGA), a steering committee of the Virginia Municipal League Association, which was formed to purchase electricity. The VEPGA contract actually provides for the purchase of "renewable energy credits". The purchase of credits allows the City to legally claim to have purchased energy produced by renewable energy sources such as the sun, wind, geothermal hydro-electrical, wave or tidal energy. These credits are sold by the producers and traded to subsidize renewal energy production.

Energy Assumptions and Calculations:

Alexandria City Public Schools has shown a commitment to clean energy by purchasing Renewable Energy Certificates (RECs). About 10% of the electricity used by ACPS is now be generated by wind farms. This measure assumes that ACPS will continue to purchase renewable energy credits equivalent to 10% of the City's operational needs in 2012 rising steadily to 25% in 2020. In FY 2006, the ACPS's actual electricity consumption was approximately 25,000 MWh in City schools and facilities.

Year	Consumption (MWh)	Renewable Percentage	Renewable Energy Consumed (MWh)
FY2006	25,000		
Projected 2012	26,750	10	2,675
Projected 2020	28,750	25	7,188

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Purchasing 2,675 MWh of renewable energy in 2012 will reduce CO2e emissions by 1,414 tonnes.
Purchasing 7,188 MWh of renewable energy in 2020 will reduce CO2e emissions by 3,799 tonnes.

Cost Assumptions and Calculations:

The City's average cost for electricity was $0.0928 per KWh in FY2006. The new VEPGA contract has established a green energy purchase rate of $0.0225 per KWh, in addition to the average actual costs per KWh ($0.0928). (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council)

The incremental cost for purchasing 10% renewable energy in 2012 is estimated to be $60,188.

The incremental cost for purchasing 25% renewable energy in 2020 is estimated to be $161,730.

Co-Benefits:

- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- Provides a means for the City to directly support production of renewable energy
- Teaches students to be responsible stewards of the environment

Action Name:	Renewable Energy Installation on City Buildings						
Action ID:	G.1.3						
Sector:	Government Buildings						
Action Origin:	EECBG Program						
Energy Savings:	2012	n/a	Units	**CO2e Reductions:**	2012	23	tonnes
	2020	n/a	Units		2020	231	tonnes
Capital Costs:	2012	$200,000		**Operating Costs:**	2012	($4,064)	Cost Savings
	2013-2020	$2,000,000			2020	($40,646	Cost Savings
Payback Period:	n/a	years					

Action Description:

The City will receive EECBG funding for a comprehensive analysis of a suitable location for a renewable energy project on a City building. The project will include site assessments that will bring renewable energy experts to selected sites to evaluate and provide a basic analysis of energy needs, evaluate renewable energy resource availability at each location, provide energy efficient suggestions and make recommendations on specific renewable energy systems. The site assessments will also provide information on the best place to locate a system and will offer general cost estimates for installation at each site. Once a site has been selected, funds from this project will be used to procure, install, operate, and maintain the renewable energy system. Additional renewable energy projects could occur after successful implementation of the EECBG project.

Energy Assumptions and Calculations:

For the purposes of estimating the metrics associated with this project, we have assumed that a 25kw solar energy system could be installed with the EECBG funds available for this project. The size of the system was based on available EECBG funding and the average installation cost for solar energy systems of about $8000/kw capacity (Lawrence Berkeley National Laboratory report http://www.theenergydaily.com/Assets/Whitepapers/solar_cost_study.pdf), A 25kw system will replace about 43,800 kWh per year that would otherwise be generated from fossil fuels. Energy savings and costs for other renewable energy systems (wind, biomass) may vary. For 2020, we have assumed that about 1% of the City's energy consumption could be generated local distributed renewable energy systems.

Year	Consumption (MWh)	Renewable Percentage	Renewable Energy Consumed (MWh)
FY2006	43.8		
Projected 2012	43.8	100	43.8
Projected 2020	438.0	100	438

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Generating 43.8 MWh of renewable energy in 2012 will reduce CO2e emissions by 23 tonnes.
Generating 438 MWh of renewable energy in 2020 will reduce CO2e emissions by 231 tonnes.

Cost Assumptions and Calculations:

Capital costs are estimated to be $8000/kw installed, based on the report cited above. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council)

The capital cost for installing a 25kw solar system by 2012 is about $200,000; annual electricity cost savings are $4,064.

The capital cost for installing 250 kw in solar system capacity by 2020 is about $2,000,000; annual electricity cost savings are $40,646.

Co-Benefits:

- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- Provides a means for the City to directly support production of renewable energy

Action Name:	Employees Shut Down Computers at the End of Workday						
Action ID:	G.1.4						
Sector:	Government	Buildings					
Action Origin:	EAP, Energy Principle, Goal 2						
Energy Savings:	2012	417	MWh	**CO2e Reductions:**	2012	220	tonnes
	2020	448	MWh		2020	238	tonnes
Capital Costs:	2012	$0		**Operating Costs:**	2012	($38,698)	Cost Savings
	2013-2020	$0			2020	($41,574)	Cost Savings
Payback Period:	n/a	years					

Action Description:

Many PCs available today come with a power-down or sleep mode feature for the CPU and monitor. ENERGY STAR® computers power down to a sleep mode that consume 15 Watts or less power, which is around 70% less electricity than a computer without power management features. ENERGY STAR monitors have the capability to power down into two successive "sleep" modes. In the first, the monitor energy consumption is less than or equal to 15 Watts, and in the second, power consumption reduces to 8 Watts, which is less than 10% of its operating power consumption. (Reference: DOE/EIA http://www.energysavers.gov/your_home/appliances/index.cfm/mytopic=10070) For non-ENERGYSTAR computers, employees could manually shut down their computers when leaving the office at the end of the workday.

Energy Assumptions and Calculations:

The City employs about 2,600 full-time equivalents (Reference: City of Alexandria – FY 2009 Approved Budget). For the purpose of this analysis, we have assumed that 50% of the employees (1,300) regularly use an office computer at work. Energy consumption and savings were calculated using EPA's ENERGY STAR energy savings calculator (file: http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/Calc_computers.xls). It was assumed that of 36% of computers are currently turned off each night, based upon 2004 Lawrence Berkeley National Lab Report entitled "After-hours Power Status of Office Equipment and Inventory of Miscellaneous Plug-Load Equipment". It was further assumed that this percentage could be increased to 90% through an employee outreach program.

Year	Energy Consumption (MWh) at Current 36% Turn Off Rate	Energy Consumption (MWh) at Estimate 90% Turn Off Rate	Energy Savings (MWh)
FY2006	705		
Projected 2012	754	337	417
Projected 2020	811	362	448

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Saving 417 MWh by turning off computers at night will reduce CO2e emissions by 220 tonnes in 2012.
Saving 448 MWh by turning off computers at night will reduce CO2e emissions by 238 tonnes in 2020.

Cost Assumptions and Calculations:

The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council)

The cost savings for saving 417 MWh of electricity in 2012 by turning off computers at night is $38,698

The cost savings for saving 448 MWh of electricity in 2020 by turning off computers at night is $41,574

Co-Benefits:

- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- Teaches employees to be responsible stewards of the environment

Action Name:	Energy Savings Performance Contract for City Buildings						
Action ID:	G.1.5						
Sector:	Government Buildings						
Action Origin:	EAP, Green Building Principle, Target of 20% energy consumption reduction in City Buildings						
Energy Savings:	2012	5,971	MWh	**CO2e Reductions:**	2012	2,385	tonnes
	2020	12,813	MWh		2020	5,123	tonnes
Capital Costs:	2012	$0		**Operating Costs:**	2012	($434,902)	Cost Savings
	2013-2020	$0			2020	($934,002)	Cost Savings
Payback Period:	n/a	years					

Action Description:

The EAP established a target for existing City buildings to be 25% more efficient in the aggregate by 2025. Energy Savings Performance Contracting (ESPC) is one option to reduce energy use. An ESPC is a form of third-party financing that funds upgrades using the savings from future utility bills. This mechanism will allow the City obtain energy-efficient technologies **without** having to commit capital funds. An energy services company (ESCO) pays all costs involved in identifying, installing, operating and maintaining new or upgraded energy-efficient equipment. The ESCO is compensated by receiving a share of the cost savings resulting from these improvements over a set term. At the end of the ESPC, the City owns all of the improvements and receives all of the continuing savings.

Energy Assumptions and Calculations:

In FY 2006, City-owned buildings consumed about 35,000,000 KWh of electricity and 710,000 therms of natural gas. A report issued in 2008 by Lawrence Berkeley National Laboratory (http://eetd.lbl.gov/EA/EMP/reports/lbnl-1202e.pdf) indicates that energy savings of about 10% could be achieved within 3-5 years, and up to 25% in 10 years. Assuming that all City-owned buildings, City-leased buildings, and schools were included, the City could realize potential 10% energy savings in 2012 and 20% savings in 2020.

Year	Energy Consumed (MWh)	ESPC Savings (%)	Energy Savings (MWh)	Energy Consumed (therms)	ESPC Savings (%)	Energy Savings (therms)
FY2006	35,000			710,000		
Projected 2012	37,450	10	3,745	759,700	10	75,970
Projected 2020	40,250	20	8,050	812,879	20	162,576

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.00534 tonnes per therm.
Savings of 3,745 MWh and 75,970 therms will reduce CO2e emissions by 2,385 tonnes in 2012.
Savings of 8,050 MWh and 162,576 therms will reduce CO2e emissions by 5,123 tonnes in 2020.

Cost Assumptions and Calculations:

There is no up-front cost for the City for the ESPC. During the contract, the City achieves savings due to energy improvements and pays either the entire savings or a portion of the savings to the ESCO. At the end of the ESPC, the City receives all of the savings, enjoying reduced energy costs for the continued life of the equipment. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council); DOE/EIA data shows natural gas cost an average of $1.15 per therm in 2003-2008.

The potential cost savings from the ESPC is $434,902 in 2012, a portion of which will be paid to the ESCO.

The potential cost savings from the ESPC is $934,002 in 2020, a portion of which will be paid to the ESCO.

Co-Benefits:

- Modernization of City's building infrastructure
- Long-term reduction in operating costs

Action Name:	Energy Savings Performance Contract for City Schools						
Action ID:	G.1.6						
Sector:	Government Schools						
Action Origin:	EAP, Green Building Principle, Target of 20% energy consumption reduction in City Buildings						
Energy Savings:	2012	4,487	MWh	**CO2e Reductions:**	2012	1,744	tonnes
	2020	9,628	MWh		2020	3,746	tonnes
Capital Costs:	2012	$0		**Operating Costs:**	2012	($319,363)	Cost Savings
	2013-2020	$0			2020	($685,803)	Cost Savings
Payback Period:	n/a	years					

Action Description:

The EAP established a target for existing City buildings to be 25% more efficient in the aggregate by 2025. Energy Savings Performance Contracting (ESPC) is one option to reduce energy use. An ESPC is a form of third-party financing that funds upgrades using the savings from future utility bills. This mechanism will allow the City obtain energy-efficient technologies **without** having to commit capital funds. An energy services company (ESCO) pays all costs involved in identifying, installing, operating and maintaining new or upgraded energy-efficient equipment. The ESCO is compensated by receiving a share of the cost savings resulting from these improvements over a set term. At the end of the ESPC, the City owns all of the improvements and receives all of the continuing savings.

Energy Assumptions and Calculations:

In FY 2006, City-owned buildings consumed about 25,000,000 KWh of electricity and 578,000 therms of natural gas. A report issued in 2008 by Lawrence Berkeley National Laboratory (http://eetd.lbl.gov/EA/EMP/reports/lbnl-1202e.pdf) indicates that energy savings of about 10% could be achieved within 3-5 years, and up to 25% in 10 years. Assuming that all City-owned buildings, City-leased buildings, and schools were included, the City could realize potential 10% energy savings in 2012 and 20% savings in 2020.

Year	Energy Consumed (MWh)	ESPC Savings	Energy Savings (MWh)	Energy Consumed (therms)	ESPC Savings	Energy Savings (therms)
FY2006	25,000			578,000		
Projected 2012	26,750	10	2,675	618,460	10	61,846
Projected 2020	28,750	20	5,750	661,752	20	132,350

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.00534 tonnes per therm.
Savings of 2,675 MWh and 61,846 therms will reduce CO2e emissions by 1,744 tonnes in 2012.
Savings of 5,750 MWh and 132,350 therms will reduce CO2e emissions by 3,746 tonnes in 2020.

Cost Assumptions and Calculations:

There is no up-front cost for the City for the ESPC. During the contract, the City achieves savings due to energy improvements and pays either the entire savings or a portion of the savings to the ESCO. At the end of the ESPC, the City receives all of the savings, enjoying reduced energy costs for the continued life of the equipment. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council); DOE/EIA data shows natural gas cost an average of $1.15 per therm in 2003-2008.

The potential cost savings from the ESPC is $319,363 in 2012, a portion of which will be paid to the ESCO.

The potential cost savings from the ESPC is $685,803 in 2020, a portion of which will be paid to the ESCO.

Co-Benefits:

- Modernization of City's building infrastructure
- Long-term reduction in operating costs

Action Name:	Energy Conservation and Audit Program						
Action ID:	G.1.7						
Sector:	Government Buildings						
Action Origin:	EAP, Green Building Principle						
Energy Savings:	2012	3,500	MWh	**CO2e Reductions:**	2012	1,401	tonnes
	2020	15,022	MWh		2020	6,018	tonnes
Capital Costs:	2012	Unknown		**Operating Costs:**	2012	($255,385)	Cost Savings
	2013-2020	Unknown			2020	($1,096,948)	Cost Savings
Payback Period:	n/a	years					

Action Description:

The project involves the assessment of energy consumption at City facilities, evaluation of energy efficiency measures and the development of strategies to target high-consumption facilities. The City's energy conservation program will be used to conduct employee education, develop measurement and verification protocols, identify and implement energy efficient technologies. The City's Capital Improvement Plan provides for energy conservation improvements and the use of energy-efficient technology in existing City buildings in order to achieve greater efficiency. In FY 2008, a new Energy Manager position was created in the Department of General Services to analyze, develop and implement the City's energy conservation efforts, including changes in operating procedures and contracts to save on future energy costs, as well as, enhance the environment.

Energy Assumptions and Calculations:

The energy currently consumed in City-owned and leased buildings, libraries, and schools in FY 2006 was 68,651,379 KWh of electricity and 1,378,362 therms of natural gas. The City's target is to reduce energy consumption in the 60% of City facilities by 20% by 2020. We gave assumed a 3% reduction by 2012 and a 12% reduction by 2020.

Year	Energy Consumed (MWh)	Energy Savings (%)	Energy Savings (MWh)	Energy Consumed (therms)	Energy Savings (%)	Energy Savings (therms)
FY2006	68,651			1,378,362		
Projected 2012	73,457	3	2,204	1,474,847	3	44,245
Projected 2020	78,949	12	9,474	1,578,087	12	189,370

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.00534 tonnes per therm.
Savings of 2,204 MWh and 44,245 therms will reduce CO2e emissions by 1,165 tonnes in 2012.
Savings of 9,474 MWh and 189,370 therms will reduce CO2e emissions by 5,007 tonnes in 2020.

Cost Assumptions and Calculations:

Capital costs for building retrofits have not yet been developed. As projects are implemented, the City will achieve savings due to energy improvements The City will receive reduced energy costs for the continued life of the equipment. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council); DOE/EIA data shows natural gas cost an average of $1.15 per therm in 2003-2008.

Capital costs are currently unknown. The potential cost savings from reduced energy consumption is $255,385 in 2012.

Capital costs are currently unknown. The potential cost savings from reduced energy consumption is $1,096,948 in 2020.

Co-Benefits:

- Modernization of City's building infrastructure
- Decreased overall time to complete a project
- Long-term reduction in operating costs

Action Name:	LED Street Light Replacement Program						
Action ID:	G.2.1						
Sector:	Government Street Lights						
Action Origin:	EAP, Global Climate Change Principle, Goal 1						
Energy Savings:	2012	146	MWh	**CO2e Reductions:**	2012	77	tonnes
	2020	5,619	MWh		2020	2,969	tonnes
Capital Costs:	2009-2012	$188,250		**Operating Costs:**	2012	(18,247)	Cost Savings
	2013-2020	$6,913,889			2020	(694,011)	Cost Savings
Payback Period:	14.2	years					

Action Description:

The EAP established a target to replace all publically-owned street lights in the city with energy-efficient (such as LEDs) or renewable energy lights by 2020. Although they cost more upfront than the bulbs they replace, LED lights use half the energy (or less) and last longer than conventional bulbs, resulting in big savings and short payback periods. There are four principle advantages to upgrading street lights to LEDs: 1) LEDs are brighter, increasing public safety; 2) LEDs last about 10 times longer than incandescent bulbs, reducing maintenance; 3) LEDs consume less energy; and 4) LEDs are 100% recyclable.

Energy Assumptions and Calculations:

The City currently has approximately 9,581 street lights that consumed about 8,130 MWh of electricity in FY 2007 (average of 850 KWh per light). A DOE study (http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/gateway_sf-streetlighting.pdf) determined that energy reductions averaging 60% over the current system can be achieved. With EECBG and other funding, we have assumed that Alexandria can retrofit about 300 street lights with LEDs will result in energy savings of per 146 MWh in 2012. Retrofitting all existing lights and install new LED lights by 2020 will result in energy savings of 5,619 MWh.

Year	Energy Consumed (MWh)	# of LED Lights Installed	Energy Savings (MWh)	
FY2006	8,130			
Projected 2012	8,699	300	146	# of lights projected to grow by 7% by 2012
Projected 2020	9,350	11,018	5,619	# of lights projected to grow by 15% by 2020

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Savings of 146 MWh will reduce CO2e emissions by 77 tonnes in 2012.
Savings of 5,619 MWh will reduce CO2e emissions by 2,969 tonnes in 2020.

Cost Assumptions and Calculations:

According to a DOE-sponsored LED street lighting study in San Francisco referenced above, the estimated cost of the LED luminaire, including installation costs, ranged from $410 to $825, with an average of $627.50 per luminaire. Average maintenance savings were $15.66 per fixture. The City's average cost for electricity was $0.0928 per KWh in FY2006, so each light replaced with an LED would have a cost savings of $45.26 annually.

Capital costs in 2009-2012 will be about $188,250 for installing 338 LEDs; maintenance and energy savings will be $18,247.

Capital costs in 2013-2020 will be about $6.9 million for 11,018 LEDs; annual maintenance and energy savings will be $694,011. The DOE study referenced above determine an average simple payback period of 14 years.

Co-Benefits:

- Long life span reduces maintenance costs and saves in disposal of used light bulbs
- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- LED street lights can be very directional, thus reducing light pollution
- Unlike all other alternative street lighting technologies, LED fixtures contain no mercury

Action Name:	LED Traffic Signal Replacement Program						
Action ID:	G.2.2						
Sector:	Government Traffic Signals						
Action Origin:	EAP, Global Climate Change Principle, Goal 1						
Energy Savings:	2012	2,533	MWh	**CO2e Reductions:**	2012	1,339	tonnes
	2020	2,578	MWh		2020	1,363	tonnes
Capital Costs:	2009-2012	$212,155		**Operating Costs:**	2012	($281,000)	Cost Savings
	2013-2020	$3,775			2020	($286,000)	Cost Savings
Payback Period:	0.7	years					

Action Description:

Alexandria has begun replacing old traffic lights with much more energy efficient and durable LED traffic lights. LED traffic signals are extremely energy-efficient and reliable devices offered by many leading manufacturers. LEDs are brighter, making them more visible in foggy conditions. LED traffic lights last longer, generally lasting 100,000 hours compared to incandescent bulbs which have filaments that may last only 8,000 hours before needing to be replaced. LEDs consume less energy, about 60% less than incandescent bulbs. LEDs cost considerably more to purchase, but are much cheaper to operate.

Energy Assumptions and Calculations:

The City maintains about 286 intersections with an average of 10 heads per intersection equipped with traffic and pedestrian signals that consumed 3,005,304 KWh of electricity in FY 2007. About 25 traffic signals currently use LED technology. With EECBG funding, Alexandria can alternatively retrofit about 50 intersections with LEDs will result in energy savings of per 601 MWh per year. By 2020, it is assumed that all 200 intersections will be retrofitted with LEDs, resulting in an energy savings of 2,404 MWh.

Year	Energy Consumed (MWh)	# of Intersections with LEDs	Energy Savings (MWh)	
FY2006	3,005			
Projected 2012	3,215	281	2,533	# of lights projected to grow by 7% by 2012
Projected 2020	3,456	286	2,578	# of lights projected to grow by 15% by 2020

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.
Savings of 2,533 MWh will reduce CO2e emissions by 1,338 tonnes in 2012.
Savings of 2,578 MWh will reduce CO2e emissions by 1,362 tonnes in 2020.

Cost Assumptions and Calculations:

According to a recent study in New York (http://www.osc.state.ny.us/localgov/audits/swr/2009/led/led_final.pdf), the average capital cost to replace incandescent bulbs with LEDs was $58.45 per bulb (or about $755 per intersection depending of the number of signals at each intersection). The annual projected savings in labor and electricity costs averaged $1,000 per intersection. The payback period averaged 0.7 years.

Capital costs in 2009-2012 will be about $212,155 for retrofitting 281 intersections; maintenance and energy savings will be $281,000.
Capital costs in 2013-2020 will be about $3,775 for the remaining 5 intersections; annual maintenance and energy savings will be $286,000. The NY State study referenced above determined an average simple payback period of 0.7 years.

Co-Benefits:

- Long life span reduces maintenance costs and saves in disposal of used light bulbs
- Reduces emissions of SO2 and NOx, which will help City attain and maintain ozone and fine particle NAAQS
- Public safety is enhanced because LEDs are very unlikely to fail all at once.
- Unlike all other alternative street lighting technologies, LED fixtures contain no mercury

Action Name:	Green Vehicle Fleet (20% Better than CAFÉ standards)						
Action ID:	G.3.1						
Sector:	Government Vehicle Fleet						
Action Origin:	EAP, Energy Principle, Goal 2						
Energy Savings:	2012	1,642	gallons	**CO2e Reductions:**	2012	16	tonnes
	2020	5,151	gallons		2020	51	tonnes
Capital Costs:	2009-2012	$0		**Operating Costs:**	2012	$3,695	Cost Savings
	2013-2020	$0			2020	$11,591	Cost Savings
Payback Period:	n/a	years					

Action Description:

The City will expand its existing green fleet program. The EAP stated that "the sedans or hybrids purchased by the city in 2009 will have an averaged city fuel economy 20% greater than Corporate Average Fuel Economy (CAFÉ) requirements." In FY07, the City's sedan fleet consisted of 48 4-cylinder, 85 6-cylinder, 14 hybrid, and 270 8-cylinder (police cruiser) sedans that averaged 10.5 miles per gallon (mpg). The City normally purchases about 15 sedans per year. This action calls for the City to purchase 15 new sedans each year that average 20% greater mpg than Federal CAFE requirements. New DASH hybrid buses are not included in this measure.

Energy Assumptions and Calculations:

In FY2007, Alexandria's sedan fleet averaged 6,650 miles per year per vehicle and 10.5 mpg. The National Highway Traffic Safety Administration (NHSTA) estimates that model year 2011 passenger cars will by 30.2 miles per gallon. NHSTA has proposed a 35.5 mpg CAFE standard for 2012 to 2016. Alexandria's target for new vehicle purchases would be about 6 mpg greater than the CAFE requirement, or 36.2 mpg in 2012 and 42.6 mpg after 2012. Assuming each new sedan would achieve a savings of 6 mpg and traveled 6,650 miles per year, each new sedan would save 36 gallons of gasoline per year.

Year	Cumulative New Sedans Purchased	Gasoline Savings per Vehicle: mpg	Gasoline Savings per Vehicle: gallons/ year	Gasoline Savings (gallons)
FY2006				
Projected 2012	45	6	36	1,642
Projected 2020	165	7	31	5,151

GHG Emission Reduction Calculations:

GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software.
Reducing gasoline consumption by 1,642 gallons per year in 2012 will reduce CO2e emissions by 16 tonnes of CO2e.
Reducing gasoline consumption by 5,151 gallons per year in 2020 will reduce CO2e emissions by 51 tonnes of CO2e.

Cost Assumptions and Calculations:

While there currently is a cost premium for purchasing hybrid electric vehicles such as Toyota Prius, this analysis assumes that the City's new sedan purchases will consist of available smaller, more fuel-efficient vehicles without the capital cost premium of a hybrid. Without a purchase cost premium, the City will experience a cost savings from reduced gasoline consumption by the new vehicles. The U.S. Department of Energy estimates that gasoline prices will average about $2.25 for the next few years. If gasoline prices rise to the $3-4 per gallon levels experienced in 2008, then the City would save even more money.

In 2012, the City will save 1,642 gallons of gasoline at an average price of $2.25, for annual savings of $3,695.

In 2020, the City will save 5,151 gallons of gasoline at an average price of $2.25, for annual savings of $11,591.

Co-Benefits:

- Reduces emissions of VOC and NOx, which will help City attain ozone NAAQS
- Promotes energy independence and national security be reducing dependence on foreign oil
- Sets example for residents and showcases Alexandria as an environmental leader

Action Name:	Biodiesel for City Diesel Fleet Operations						
Action ID:	G.3.2						
Sector:	Government Vehicle Fleet						
Action Origin:	EAP, Energy Principle, Goal 3						
Energy Savings:	2012	0	gallons	**CO2e Reductions:**	2012	590	tonnes
	2020	0	gallons		2020	634	tonnes
Capital Costs:	2009-2012	$0		**Operating Costs:**	2012	$100,409	
	2013-2020	$0			2020	$107,916	
Payback Period:	n/a	years					

Action Description:

The City plans to use biodiesel for its diesel fleet operations if in the future, biodiesel prices fall within the operating budget, fiscal allowance. Biodiesel is a domestically produced, renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled restaurant greases. Biodiesel is safe, biodegradable and reduces most criteria air pollutants (there is a small increase in oxides of nitrogen). Blends of 20% biodiesel with 80% petroleum diesel (B20) can generally be used in unmodified diesel engines. Biodiesel can also be used in its pure form (B100), but it may require certain engine modifications to avoid maintenance and performance problems and may not be suitable for wintertime use. This action will require the use sustainable B20 biodiesel for all of the City diesel fleet operations.

Energy Assumptions and Calculations:

The City's diesel fleet includes pickup trucks, heavy duty trucks, school buses, and fire and rescue vehicles. In FY2006, the City purchased about 276,000 gallons of diesel fuel. Most B20 users report little or no noticeable difference in performance or fuel economy.

Year	Diesel Use (gallons)
FY2006	276,000
Projected 2012	295,320
Projected 2020	317,400

GHG Emission Reduction Calculations:

Biodiesel and petroleum diesel produce comparable carbon emissions. However, GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software. However, the carbon in biomass is of a biogenic origin—meaning that it was recently contained in living organic matter—while the carbon in fossil fuels has been trapped in geologic formations for millennia. Another major benefit of biodiesel is the fact that plants used to manufacture biodiesel absorb CO2 from the atmosphere in the growing process. They literally use solar energy and turn CO2 into stored energy. This effectively recycles CO2 in the atmosphere because the same CO2 released from biodiesel combustion is taken up in the next crop. For this reason, most GHG reporting schemes provide a CO2 credit for using biodiesel instead of petroleum diesel. GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software.

In 2012, using 295,320 gallons of biodiesel instead of petroleum diesel will result in a CO2e reduction of 590 tonnes.

In 2020, using 317,400 gallons of biodiesel instead of petroleum diesel will result in a CO2e reduction of 634 tonnes.

Cost Assumptions and Calculations:

Data from the U.S. Department of Energy shows that the January 2009 price for biodiesel averages $0.34 per gallon higher than the price of regular diesel (http://www.afdc.energy.gov/afdc/pdfs/afpr_apr_09.pdf). For this analysis, it is assumed that this price differential will remain constant through 2020.

In 2012, the City will spend an additional $100,409 for the price differential between biodiesel and petroleum diesel.

In 2020, the City will spend an additional $107,916 for the price differential between biodiesel and petroleum diesel.

Co-Benefits:

- Reduces emissions of VOC, which will help City attain ozone NAAQS
- Promotes energy independence and national security be reducing dependence on foreign oil

Action Name:	Transit Incentives for City Employee Commuters						
Action ID:	G.3.3						
Sector:	Government	Employee Commute					
Action Origin:	EAP, Transportation Principle, Goal 2						
Energy Savings:	2012	56,249	gallons	**CO2e Reductions:**	2012	548	tonnes
	2020	181,364	gallons		2020	1,766	tonnes
Capital Costs:	2009-2012	$0		**Operating Costs:**	2012	$195,000	
	2013-2020	$0			2020	$585,000	
Payback Period:	n/a	years					

Action Description:

The City established the Transit Incentive Program for City employees as part of the City's efforts to meet the region's air quality standards. This program encourages transit use and vanpooling by providing a transit incentive effective July 1, 2005 of up to $150 pre-tax option to City employees and $30 per month to school employees who commute to and from work via bus, rail or qualified vanpool. Currently, about 11% of 2,600 City government employees and 2,100 school employees are enrolled in the program. This action will promote expansion of the transit incentive program for City government employees, along with other voluntary efforts such as telecommuting and walking/biking to work, to reduce the gasoline consumed by employees commuting to work by 5% by 2012 and 15% by 2020.

Energy Assumptions and Calculations:

In FY2006, it was estimated that City employees consumed 1 million gallons of gasoline commuting to work (http://alexandriava.gov/uploadedFiles/tes/oeq/GHG%20CAP%20Inventory%20Report%2020090422.pdf). It is assumed that this consumption can be reduced by 5% by 2012 and 15% by 2020 through the use of the transit incentive program and voluntary measures such as telecommuting and walking/biking to work.

Year	Gasoline Use (gallons)	Percent Reduction	Gasoline Saved (gallons)
FY2006	1,051,387		
Projected 2012	1,124,984	5	56,249
Projected 2020	1,209,095	15	181,364

GHG Emission Reduction Calculations:

GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software.

In 2012, saving 56,249 gallons of gasoline will result in a CO2e reduction of 548 tonnes.

In 2020, saving 181,364 gallons of gasoline will result in a CO2e reduction of 1,766 tonnes.

Cost Assumptions and Calculations:

The program currently provides up to $150 per month to City employees who commute to and from work via bus, rail or qualified vanpool (about a $1,300 incentive per year). Increasing enrollment in the transit incentive program by 5%, or about 150 employees, would cost the City about $195,000. In addition to the transit incentive, employees will also benefit by the reduced costs for purchasing gasoline, which averages 330 gallons per employee per year. At an average price of $2.25, each employee will save $742 in fuel costs and possibly more in parking fees. These additional savings could be used to supplement the City provided incentive in defraying transit costs.

In 2012, the City will spend about $195,000 in increased transit subsidies.

In 2020, the City will spend about $585,000 in increased transit subsidies.

Co-Benefits:

- Reduces traffic congestion on City streets
- Can serve as an employee recruitment or retention tool
- Reduces other air pollutant emissions that contribute to smog and health problems

Action Name:	Tree Planting to Sequester CO2 and Provide Shade						
Action ID:	G.4.1						
Sector:	Government	Urban Forest					
Action Origin:	EAP, Land Use and Open Space Principle, Goal 3						
Energy Savings:	2012	93	MWh	**CO2e Reductions:**	2012	75	tonnes
	2020	886	MWh		2020	655	tonnes
Capital Costs:	2009-2012	Unknown		**Operating Costs:**	2012	Unknown	
	2013-2020	Unknown			2020	Unknown	
Payback Period:	n/a	years					

Action Description:

Urban forests have a role to play in reducing levels of GHGs in the atmosphere. Urban trees reduce atmospheric CO2 through sequestration and reducing GHG emissions by conserving energy used for space heating and cooling. Carbon sequestration is the process by which CO2 is transformed into above- and belowground biomass and stored as carbon. Tree shade reduces summer air conditioning demand, but can increase heating energy use by intercepting winter sunshine. Lowered air temperatures and wind speeds from increased tree cover can decrease both cooling and heating demand. The EPA established an action to "work with community partners to add 500 street trees a year throughout the city to achieve full street tree stocking levels by 2020."

Energy Assumptions and Calculations:

Assuming 500 trees planted per year beginning in 2010, the cumulative new street tree stock will total 1500 and 5500 trees in 2012 and 2020, respectively. The Center for Urban Forest Research Tree Carbon Calculator (http://www.fs.fed.us/ccrc/topics/urban-forests/ctcc) is a tool approved by the California Climate Action Registry's Urban Forest Project Reporting Protocol for quantifying energy savings from tree planting projects. Although designed for California, the tool provides a reasonable estimate for possible energy savings from tree planting in Alexandria. As the trees age, they provide more shade and greater energy savings per tree.

Year	Cumulative # of Trees Planted	Energy Reduction (KWh/tree)	Average Tree Age	Energy Saved (MWh)
FY2006	0			
Projected 2012	1,500	62	8	93
Projected 2020	5,500	161	16	886

GHG Emission Reduction Calculations:

GHG emission reductions were calculated using the Carbon Calculator tool mentioned above.

In 2012, planting a total of 1500 trees between 2010-2012 will result in a 75 tonne reduction in CO2e from reduced energy needs due to shading and sequestration of carbon in the trees

In 2020, planting a total of 5500 trees between 2010-2020 will result in a 655 tonne reduction in CO2e from reduced energy needs due to shading and sequestration of carbon in the trees

Cost Assumptions and Calculations:

Cost savings will result from reduced energy consumption. This will be offset by the costs of purchasing, planting, and maintaining the trees. These costs have not been determined at present.

Co-Benefits:

- Reduces other air pollutant emissions that contribute to smog and health problems
- Adds aesthetic value and possibly increase in real estate values
- Can help slow down water run-off and reduce soil erosion

APPENDIX B

DATA AND ASSUMPTIONS FOR QUANTIFYING EMISSION REDUCTIONS FROM COMMUNITY-WIDE MEASURES

Action Name:	Tier 1 Energy Audit - Easy Direct Install						
Action ID:	C.1.1						
Sector:	Community Residential						
Action Origin:	EAP, Energy Principle, Goal 2						
Energy Savings:	2012	1,297	MWh	**CO2e Reductions:**	2012	685	tonnes
	2020	5,575	MWh		2020	2,946	tonnes
Capital Costs:	2010-2012	$2,282,335		**Operating Costs:**	2012	($120,341)	Cost Savings
	2013-2020	$9,811,907			2020	($517,355)	Cost Savings
Payback Period:	19.0	years					

Action Description:

This program provides residents with a checklist and other resources for conducting a quick, visual home energy audit. The audit is intended to identify simple, low-cost measures that residents can directly install, such as CFLs, hot water heater wraps, pipe insulation, and low-flow showerheads. Some homeowners may follow-up with more comprehensive energy efficiency improvements, such as air and duct sealing or appliance retrofits, or request a more comprehensive energy audit from a qualified contractor; these customers should be referred to the Tier 2 HPwES program.

Energy Assumptions and Calculations:

In 2005, Alexandria had 69,254 housing units (31% single family, 24% condominiums, 45% rental apartments). According to EPA's Rapid Development Energy Efficiency (RDEE) Guide, an aggressive Tier 1 program could reach 3.5% of eligible homes after three years (i.e., by 2012). It is further assumed that about 14% of eligible homes will have participated by 2020. The RDDE Guide estimates an energy savings of about 2.5% or 500 KWh per unit.

Year	# of Eligible Homes	Cumul. Participation Rate	Cumul. Participants	Per Unit Energy Savings (KWh)	Total Savings (MWh)
FY2006	69,254				
Projected 2012	74,102	3.5%	2,594	500	1,297
Projected 2020	79,642	14%	11,150	500	5,575

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.

Saving 1,297 MWh of electricity in 2012 will reduce CO2e emissions by 685 tonnes.

Saving 5,575 MWh of electricity in 2020 will reduce CO2e emissions by 2,946 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $880 for directly installing energy efficient devices. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Each household will save $46 annually for reduced energy costs, for a payback period of 19 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $2.3 million with annual savings in energy costs of $120,341 per year.

Capital costs in 2013-2020 will be $9.8 million with annual savings in energy costs of $517,355 per year.

Co-Benefits:

• A Tier 1 Audit home energy checkup may spur homeowner interest in larger energy efficiency investments

Action Name:	Tier 2 Energy Audit - ENERGY STAR						
Action ID:	C.1.2						
Sector:	Community Residential						
Action Origin:	EAP, Energy Principle, Goal 2						
Energy Savings:	2012	4,446	MWh	**CO2e Reductions:**	2012	2,350	tonnes
	2020	19,114	MWh		2020	10,102	tonnes
Capital Costs:	2010-2012	4,334,954		**Operating Costs:**	2012	($412,599)	Cost Savings
	2013-2020	18,636,251			2020	($1,773,789)	Cost Savings
Payback Period:	10.5	years					

Action Description:

The Tier 2 residential energy audit program provides a more comprehensive audit and includes a wide range of measures for all end-uses, and at many price points. This market-based program motivates homeowners to use highly skilled home energy analysts and contractors that offer a whole-house approach for reducing energy use. These contractors provide comprehensive energy audits for qualified homeowners and provide incentives from the state/utility program sponsor (often either rebates and/or low-interest loans) for qualifying energy efficiency projects. Typical projects might include: insulation, duct sealing and repair, high-efficiency HVAC systems, windows, lighting, and appliances.

Energy Assumptions and Calculations:

In 2005, Alexandria had 69,254 housing units (31% single family, 24% condominiums, 45% rental apartments). According to EPA's Rapid Development Energy Efficiency (RDEE) Guide, an aggressive Tier 2 program could reach 1.0% of eligible homes after 3 years (i.e., by 2012). It is further assumed that about 4% of eligible homes will have participated by 2020. The RDDE Guide estimates an energy savings of about 30% or 6,000 KWh per unit.

Year	# of Eligible Homes	Cumul. Participation Rate	Cumul. Participants	Per Unit Energy Savings (KWh)	Total Savings (MWh)
FY2006	69,254				
Projected 2012	74,102	1%	741	6,000	4,446
Projected 2020	79,642	4%	3,186	6,000	19,114

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.

Saving 4,446 MWh of electricity in 2012 will reduce CO2e emissions by 2,350 tonnes.

Saving 19,114 MWh of electricity in 2020 will reduce CO2e emissions by 10,102 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $5,850 for retrofitting residences with energy efficient windows, HVAC systems, appliances, insulation, etc. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Each household will save $557 annually for reduced energy costs, for a payback period of 10.5 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $4.3 million with annual savings in energy costs of $0.4 million per year.

Capital costs in 2013-2020 will be $18.6 million with annual savings in energy costs of $1.8 million per year.

Action Name:	Energy Conservation Program (Green Building Phase II)						
Action ID:	C.1.3						
Sector:	Community Residential						
Action Origin:	EAP, Green Building Principle, Goal 1. EECBG Project #1.						
Energy Savings:	2012	88,604	MWh	**CO2e Reductions:**	2012	46,827	tonnes
	2020	457,095	MWh		2020	241,575	tonnes
Capital Costs:	2010-2012	Unknown		**Operating Costs:**	2012	($8,222,406)	Savings
	2013-2020	Unknown			2020	($42,418,395)	Savings
Payback Period:	n/a	years					

Action Description:

The goal of the Energy Conservation and Green Building Program is to reduce energy and water consumption in government and privately-owned buildings and homes which will also translate into a reduction in the City's overall carbon footprint. At its April 18,2009 public hearing, City Council unanimously voted to adopt the proposed Green Building Policy. Per this Policy, the City expects that all new development requiring a Development Site Plan or Development Special Use Permit will achieve a LEED Silver or an equivalent rating for non-residential development and LEED Certified or an equivalent rating for residential development. The City has obtained EECBG funding to develop the Green Building Phase II program which will target existing buildings and homes in the City in addition to new development.

Energy Assumptions and Calculations:

Energy consumed in private buildings and homes totaled 11,301,523 million Btu in 2005. This energy consumption is equivalent to 3, 313,169 MWh electric equivalent. The energy savings were calculated assuming that this program will reduce energy consumption in privately-owned buildings/homes by 2.5% in 2012. This results in equivalent electricity savings of 88,604 MWh. By 2020, we have assumed that this program can reduced city-wide energy consumption by 12%, or 457,095 MWh electric equivalents.

Year	Energy Consumed (MWh)	Energy Savings (%)	Energy Savings (MWh)
Actual in 2005	3,312,281		
Projected 2012	3,544,141	2.5	88,604
Projected 2020	3,809,123	12	457,095

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.

Saving 88,604 MWh of electricity in 2012 will reduce CO2e emissions by 46,827 tonnes.

Saving 19,114 MWh of electricity in 2020 will reduce CO2e emissions by 241,575 tonnes.

Cost Assumptions and Calculations:

The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Reducing energy consumption by the amounts shown above will result in annual energy cost savings of $8 million in 2012 and $42 million in 2020 for city residents and businesses. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 are unknown.

Capital costs in 2013-2020 are unknown.

Action Name:	Green Jobs Training for Weatherization Technicians/Energy Auditors						
Action ID:	C.1.4						
Sector:	Community Residential						
Action Origin:	EAP, Green Building Principle, Goal 3. EECBG Project #7.						
Energy Savings:	2012	2,708	MWh	**CO2e Reductions:**	2012	1,431	tonnes
	2020	2,910	MWh		2020	1,538	tonnes
Capital Costs:	2010-2012	Unknown		**Operating Costs:**	2012	($251,277)	Savings
	2013-2020	Unknown			2020	($270,064)	Savings
Payback Period:	n/a	years					

Action Description:

Approximately 40 residents will be trained as energy auditors, solar installers, and weatherization technicians. The training will be conducted in concert with industry and community collaborators to meet the growing demand for "Energy Efficiency/Clean Energy Consultants" professionals by training members of the community and matching them with waiting employers. Training will cover many occupations in the "Energy Efficiency/Clean Energy/Weatherization Consultants" sector from "solar sales, weatherization, design and installation, energy auditors, and remediators".

Energy Assumptions and Calculations:

Energy consumed in private buildings and homes totaled 11,301,523 million Btu in 2005. This energy consumption is equivalent to 3, 313,169 MWh electric equivalent. The energy savings associated with this program were calculated using the Department of Energy's Estimated Expected Benefits Calculator and are estimated to reduce city-wide energy consumption by about 0.076%.

Year	Energy Consumed (MWh)	Energy Savings (%)	Energy Savings (MWh)
Actual in 2005	3,312,281		
Projected 2012	3,544,141	0.076	2,708
Projected 2020	3,809,123	0.076	2,910

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh.

Saving 2,708 MWh of electricity in 2012 will reduce CO2e emissions by 46,827 tonnes.

Saving 2,910 MWh of electricity in 2020 will reduce CO2e emissions by 241,575 tonnes.

Cost Assumptions and Calculations:

The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Reducing energy consumption by the amounts shown above will result in annual energy cost savings of $251,277 in 2012 and $270,064 in 2020 for city residents and businesses. The program will require an initial outlay of $106,000 for the job training program.

Capital costs in 2010-2012 are unknown.

Capital costs in 2013-2020 are unknown.

Action Name:	Commercial Food Service Program							
Action ID:	C.2.1							
Sector:	Community	Commercial						
Action Origin:	EAP, Energy Principle, Goal 2							
Energy Savings:	2012	226	MWh	**CO2e Reductions:**	2012	120	tonnes	
	2020	1,017	MWh		2020	540	tonnes	
Capital Costs:	2010-2012	56,379		**Operating Costs:**	2012	($22,448)	Savings	
	2013-2020	254,287			2020	($101,246)	Savings	
Payback Period:	2.5	years						

Action Description:

A Commercial Food Service (CFS) program provides incentives for energy-efficient commercial food service equipment such as refrigerators, freezers, steamers, fryers, hot food holding cabinets, ice machines, dishwashers, ovens, and other technologies, primarily aiming to influence the buyer to purchase more efficient equipment when their existing equipment has failed. The program is targeted at commercial food service equipment distributors, and dealers who are the key access points for delivery of efficient products to restaurants, schools, hotels and motels, and hospitals. Independent restaurant chains are also a good target for direct outreach as influencing the way they specify equipment in their franchising requirements can result in a large number of installations over the long-term.

Energy Assumptions and Calculations:

In 2006, Alexandria had 116 food and beverage stores and 378 food services and drinking places. According to EPA's Rapid Development Energy Efficiency (RDEE) Guide, an aggressive program could reach 8% of establishments after three years (i.e., by 2012). It is further assumed that about 32% of establishments will have participated by 2020. The RDDE Guide estimates an energy savings of about 39 mmBtu for electric units and 17 mmBtu for natural gas units per participant.

Year	# of Food Service Facilities	Cumul. Participation Rate	Cumul. Participants	Per Participant Energy Savings (KWh)	Total Electric Savings (MWh)	Per Participant Gas Savings (mmBtu)	Total Gas Savings (mmBtu)
FY2006	494						
Projected 2012	503	8%	40	3,900	157	17	685
Projected 2020	568	32%	182	3,900	708	17	3088

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.0534 tonnes per mmBtu.

Saving 157 MWh of electricity and 685 mmBtu of gas in 2012 will reduce CO2e emissions by 120 tonnes.

Saving 708 MWh of electricity and 3,088 mmBtu of gas in 2020 will reduce CO2e emissions by 540 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $1,400 for retrofitting establishments with energy efficient equipment. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. DOE/EIA data shows natural gas cost an average of $1.15 per therm in 2003-2008. Each establishment will save $561 annually for reduced energy costs, for a payback period of 10.5 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $56,379 with annual savings in energy costs of $22,448 per year.

Capital costs in 2013-2020 will be $254,287 with annual savings in energy costs of $101,246 per year.

Action Name:	Green Revolving Loan Program							
Action ID:	C.1.5							
Sector:	Community	Residential						
Action Origin:	EAP, Energy Principle, Goal 2. EECBG Project #2.							
Energy Savings:	2012	152	MWh	**CO2e Reductions:**	2012	116	tonnes	
	2020	2,050	MWh		2020	1,561	tonnes	
Capital Costs:	2010-2012	46,200		**Operating Costs:**	2012	($21,677)	Cost Savings	
	2013-2020	624,024			2020	($292,792)	Cost Savings	
Payback Period:	2.1	years						

Action Description:

Revolving loan programs provide sources of money from which loans are made for installation of of green technologies such as energy efficient windows, weatherization, or solar panels. Energy audits may also be a component of this program. A revolving energy fund is a sum of money dedicated to energy efficiency, clean energy, or other energy reduction measures, that is loaned out to qualified applicants. Money borrowed from the fund is replenished via loan and interest (if relevant) repayments for a predetermined set of time. Revolving energy funds (REFs) can be structured in a variety of ways with an array of overarching objectives. Regardless of their structure, REFs provide a unique opportunity for municipalities to guarantee a continual stream of funds for energy efficiency, conservation, and clean energy work without tapping into existing capital cycles.

Energy Assumptions and Calculations:

In 2006, there are 21,754 single family housing unit and 17,039 condominium apartments in Alexandria. EPA estimates that average household energy consumption in the South can be reduced by about 4,600 kWh of electricity and 200 therms of natural gas at an average cost per participant of about $6,000. With $200,000 available in the revolving loan fund, it is estimated that 33 homes (0.08% of all Alexandria single family homes and condos) can be retrofitted. Retrofitting 33 units will result in energy savings of 151,800 KWh and 6,600 therms.

Year	# of Single Family Homes	Cumul. Participation Rate	Cumul. Participants	Per Participant Energy Savings (KWh)	Total Electric Savings (MWh)	Per Participant Gas Savings (mmBtu)	Total Gas Savings (mmBtu)
FY2006	38,793						
Projected 2012	39,530	0.08%	33	4,600	152	20	660
Projected 2020	44,573	1.0%	446	4,600	2,050	20	8,915

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.0534 tonnes per mmBtu.

Saving 152 MWh of electricity and 669 mmBtu of gas in 2012 will reduce CO2e emissions by 116 tonnes.

Saving 20,504 MWh of electricity and 89,146 mmBtu of gas in 2020 will reduce CO2e emissions by 15,606 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $5,850 for retrofitting residences with energy efficient windows, HVAC systems, appliances, insulation, etc. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. (Reference: Budget Memo #113: Green Energy; dated April 22, 2008; from James K. Hartman, City Manager, to the Mayor and Members of City Council). Each household will save $557 annually for reduced energy costs, for a payback period of 10.5 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $46,800 with annual savings in energy costs of $22,000 per year.

Capital costs in 2013-2020 will be $0.624 million with annual savings in energy costs of $0.29 million per year.

Action Name:	Commercial Energy Audit & Conservation Program						
Action ID:	C.2.2						
Sector:	Community Commercial						
Action Origin:	EAP, Energy Principle, Goal 2						
Energy Savings:	2012	2,377	MWh	**CO2e Reductions:**	2012	1,256	tonnes
	2020	10,720	MWh		2020	5,666	tonnes
Capital Costs:	2010-2012	82,486		**Operating Costs:**	2012	($221,009)	Savings
	2013-2020	372,037			2020	($996,820)	Savings
Payback Period:	0.4	years					

Action Description:

The commercial conservation and audit program encourages commercial customers to upgrade or retrofit working equipment with new, energy efficient equipment. Focusing on easy opportunities to produce verifiable energy savings, such as lighting upgrades , efficient HVAC equipment, and products like motors and refrigerators, this program will provide a simple, expedited solution for non-residential customers to save energy. The majority of incentives are geared towards customers who are in the market for new equipment when their old equipment burns-out.

Energy Assumptions and Calculations:

In 2006, Alexandria had 2,891 commercial establishments. According to EPA's Rapid Development Energy Efficiency (RDEE) Guide, an aggressive program could reach about 2% of establishments after 3 years (i.e., by 2012). It is further assumed that about 80% of establishments will have participated by 2020. The RDDE Guide estimates an energy savings of about 400 mmBtu for electric units and 3.4 mmBtu for natural gas units per participant.

Year	# of Commercial Facilities	Cumul. Participation Rate	Cumul. Participants	Per Participant Energy Savings (KWh)	Total Electric Savings (MWh)	Per Participant Gas Savings (mmBtu)	Total Gas Savings (mmBtu)
FY2006	2,891						
Projected 2012	2,946	2%	59	40,000	2,357	3.4	200
Projected 2020	3,322	8%	266	40,000	10,630	3.4	904

GHG Emission Reduction Calculations:

ICLEI's *Local Government Operations Protocol*, Table G.7 shows that to CO2e emission factor for electricity generated in Virginia is 0.5285 tonnes per MWh; Table G.1 shows the factor for natural gas combustion is 0.0534 tonnes per mmBtu.

Saving 2,357 MWh of electricity and 200 mmBtu of gas in 2012 will reduce CO2e emissions by 1,256 tonnes.

Saving 10,630 MWh of electricity and 904 mmBtu of gas in 2020 will reduce CO2e emissions by 5,666 tonnes.

Cost Assumptions and Calculations:

The RDEE estimates that the average cost per participant will be $3,600 for retrofitting establishments with energy efficient equipment. This cost will be offset by the energy savings realized. The City's average cost for electricity was $0.0928 per KWh in FY2006. DOE/EIA data shows natural gas cost an average of $1.15 per therm in 2003-2008. Each establishment will save $3,746 annually for reduced energy costs, for a payback period of 0.4 years. Operating costs to administer the program is estimated to be $50,000 per year.

Capital costs in 2010-2012 will be $82486 with annual savings in energy costs of $221,009 per year.

Capital costs in 2013-2020 will be $372,037 with annual savings in energy costs of $996,820 per year.

Action Name:	Pedestrian and Bicycle Mobility Plan						
Action ID:	C.3.1						
Sector:	Community	Transportation					
Action Origin:	EAP, Transportation Principle, Goal 2						
Energy Savings:	2012	369,150	gallons	**CO2e Reductions:**	2012	3,596	tonnes
	2020	793,500	gallons		2020	7,727	tonnes
Capital Costs:	2009-2012	$18,000,000		**Operating Costs:**	2012	(830,588)	Cost Savings
	2013-2020	$18,000,000			2020	(1,785,375)	Cost Savings
Payback Period:	20.0	years					

Action Description:

The City of Alexandria is working to reduce dependence on private automobiles and provide citizens with transportation choices. One way to accomplish this goal is to improve access for persons with disabilities, pedestrians, and bicyclists. The Pedestrian and Bicycle Mobility Plan provides a blueprint for 10 years of on-the-ground safety, mobility and connectivity improvements. Implementation of this Plan will make walking and bicycling more attractive transportation choices in the City, and reduce the number of vehicle miles travelled.

Energy Assumptions and Calculations:

In 2005, the City's GHG inventory estimated that local roads in the city accounted for about 172,000 VMT , or roughly 13.8 million gallons of gasoline. The Pedestrian/Bicycle Plan calls for the proportion of people walking to work in Alexandria to increase from 3% to 5% by 2011, and the proportion of people bicycling to work in Alexandria shall increase from 0.5% to 3% by 2011. It is assumed that VMT on local roads will be reduced by 2.5% in 2012 and 5.0 % by 2020 due to increase pedestrian and bicycle modes of transportation.

Year	Gasoline Use (gallons)	Percent Reduction	Gasoline Saved (gallons)
FY2006	13,800,000		
Projected 2012	14,766,000	2.5	369,150
Projected 2020	15,870,000	5.0	793,500

GHG Emission Reduction Calculations:

GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software.

In 2012, saving 350,425 gallons of gasoline will result in a CO2e reduction of 3,414 tonnes.

In 2020, saving 753,250 gallons of gasoline will result in a CO2e reduction of 7,335 tonnes.

Cost Assumptions and Calculations:

The Pedestrian and Bicycle Mobility Plan has a total program cost of $36 million at full implementation. The proposed sidewalk, shared-use path network, and bicycle network will be 50% complete by 2011. In addition to the capital costs for network improvements, citizens will also benefit by the reduced costs for purchasing gasoline. At an average price of $2.25, total fuel cost savings will be substantial. The payback period will be about 20 years. Operating costs to administer the program is estimated to be $25,000 per year.

Between 2009 and 2012, the City will spend about $18 million on infrastructure improvements; citizens will experience $0.8 million in reduced costs for gasoline.

Between 2013 and 2020, the City will spend about $18 million on infrastructure improvements; citizens will experience $1.7 million in reduced costs for gasoline.

Co-Benefits:

- Reduces traffic congestion on City streets
- Can improve public health via increase in exercise.
- Reduces other air pollutant emissions that contribute to smog and health problems

Action Name:	Transportation Master Plan Implementation						
Action ID:	C.3.2						
Sector:	Community	Employee Commute					
Action Origin:	EAP, Transportation Principle, Goal 2						
Energy Savings:	2012	834,600	gallons	**CO2e Reductions:**	2012	8,131	tonnes
	2020	9,867,000	gallons		2020	96,078	tonnes
Capital Costs:	2009-2012	Unknown		**Operating Costs:**	2012	(1,877,850)	Cost Savings
	2013-2020	Unknown			2020	(22,200,750)	Cost Savings
Payback Period:	n/a	years					

Action Description:

The City's Transportation Master Plan envisions a transportation system that encourages the use of alternative modes of transportation, reducing dependence on the private automobile. This system will lead to the establishment of transit-oriented, pedestrian friendly village centers, focused on neighborhood preservation and increased community cohesion, forming a more urban, vibrant and sustainable Alexandria. The City will promote a balance between travel efficiency and quality of life, providing Alexandrians with transportation choice, continued economic growth and a healthy environment.

Energy Assumptions and Calculations:

In 2005, the City's GHG inventory estimated that there were 958,000 vehicle miles travelled VMT on city streets, consuming roughly 78 million gallons of gasoline. The EAP calls for reducing the daily VMT by 5% every five years beginning in 2012. It is assumed measures in the Transportation Master Plan will reduce VMT by 1% in 2012 and by 11% by 2020 due to increased transit opportunities, parking policies, and pedestrian and bicycle modes of transportation.

Year	Gasoline Use (gallons)	Percent Reduction	Gasoline Saved (gallons)
FY2006	78,000,000		
Projected 2012	83,460,000	1.0	834,600
Projected 2020	89,700,000	11.0	9,867,000

GHG Emission Reduction Calculations:

GHG emission reductions were calculated using ICLEI's Clean Air and Climate Protection software.

In 2012, saving 0.8 million gallons of gasoline will result in a CO2e reduction of 8,131 tonnes.

In 2020, saving 9.9 million gallons of gasoline will result in a CO2e reduction of 96,078 tonnes.

Cost Assumptions and Calculations:

The capital costs for transportation plan implementation are not currently known. In addition to the capital costs for transportation improvements, citizens will also benefit by the reduced costs for purchasing gasoline. At an average price of $2.25, total fuel cost savings will be substantial. Operating costs to administer the program is estimated to be $25,000 per year.

Capital costs are not currently known. Citizens will experience a cost savings $1.9 million in 2012 in reduced costs for gasoline.

Capital costs are not currently known. Citizens will experience a cost savings $22 million in 2012 in reduced costs for gasoline.

Co-Benefits:

- Reduces traffic congestion on City streets
- Can improve public health via increase in exercise.
- Reduces other air pollutant emissions that contribute to smog and health problems

APPENDIX C

IMPLEMENTING THE CITY'S GREEN BUILDING POLICY

When the City Council adopted its green building policy in April 2009, Alexandria memorialized its expectation for green buildings and clearly identified this goal so that it can be considered from the outset of the development process. The policy requires LEED Certified or equivalent for residential developments and LEED Silver or equivalent for non-residential developments. Monitoring and annual reporting to track the effectiveness of the policy is also a component.

As of February 2011, there have been a number of projects that were reviewed and approved since adoption of the policy. In most cases, the applicants agreed to comply with the standards set by the policy. The summary below lists the major projects approved since adoption of the Green Building Policy and describes how they complied with the policy.

- Lane/ATA Project at 2200/2250 Mill Rd – LEED Certified for residential portion & LEED Silver for office
- Institute for Defense Analysis (IDA) at 4880 Mark Center Drive – LEED Silver
- Restaurant Depot at 4600 Eisenhower Avenue – Applicant requested flexibility but will achieve LEED Certification instead of LEED Silver
- Church of God at 630 N. Patrick Street – Applicant requested flexibility but will incorporate green building design elements into the project
- Polk Elementary School at 5000 Polk Avenue – Applicant will seek LEED Silver but at a minimum will attain LEED Certification
- Hoffman Blocks 11 & 12 at 2210 Eisenhower Avenue – Green Globes (LEED equivalent)
- The King Building at 923 - 923 King Street – Applicant requested flexibility but will incorporate green building design elements into the project
- The Calvert at 3110 Mt. Vernon Avenue – LEED Certified

What Can You Do to Conserve Energy and Reduce Your Carbon Footprint?

TAKE THE ECO-CITY CHALLENGE

http://alexandriava.gov/EcoCityChallenge

Help the City of Alexandria achieve its environmental sustainability goals by completing the survey and becoming an Eco-City Champion today!!!

Perform an energy audit on your home or place of business

Replace ordinary lamps with energy efficient compact fluorescent bulbs (CFL)

Heat and cool wisely by using programmable thermostats

Shutdown computers and monitors at the end of each work day

Unplug electrical equipment not in use (For example: T.V., , Radio, Coffee Maker, etc)

Calculate your carbon footprint at www.carbonfootprint.com

Purchase a fuel-efficient car and drive less

Buy products with the EPA "Energy Star" label

Turn off unused appliances and electronic devices

Plant a tree

Reduce, Reuse, and Recycle

Use water wisely and purchase products with the EPA “Water Sense” label