TAKOMA PARK, MARYLAND

Proposed

LOCAL ACTION PLAN

FOR

REDUCING GREENHOUSE GAS EMISSIONS

February, 2000

ACKNOWLEDGMENTS

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A special thanks must be given to all those cites that went before....
The authors of this draft plan followed on the paths previously blazed by the
CITY OF BERKLEY, CA
CITY OF CHULA VISTA, CA
CITY OF FORT COLLINS, CO

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS USED THROUGHOUT DOCUMENT

APCD	Air Pollution Control District
Btu	British thermal unit
CH_4	Methane
CO_2	Carbon Dioxide
CO_2e; eCO_2	Carbon Dioxide Equivalent
EPA	U.S. Environmental Protection Agency
DOT	Department of Transportation
FCCC	Framework Convention Climate Change
ICLEI	International Council for Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
KWh	Kilowatt-hour
lbs	Pounds
M-NCPPC	Maryland-National Capital Park and Planning Commission
MM	Million
MMBtu	Million Btu
mpg	Miles per gallon
MW	Megawatt
MWh	Megawatt-hour
NOx	Nitrous Oxides
PV	Photovoltaics (Solar Power Panels)
Mo. Co.	Montgomery (County)
SOx	Sulfur Oxides
WACOG	Washington Metropolitan Area Council of Governments
WMATA	Washington Metropolitan Area Transit Authority
PEPCO	Potomac Electric Power Company
VMT	Vehicle miles traveled

EXECUTIVE SUMMARY

by

Bob Gibson (Energy Subcommittee)

Background

This plan was developed upon the request of the City Council, which recognizes that the burning of carbon-based fossil fuels is contributing to climate change on a global scale and is causing deterioration of environmental conditions on a local scale. Left unchecked, the local impacts of climate change could include higher electricity consumption (to cool buildings in longer, hotter summers), local flooding, potable water contamination, increased air pollution, and resulting greater human health problems. The Council opted to develop a plan to reduce carbon dioxide (CO_2) emissions in Takoma Park, with the hope that this plan may serve as a model for other communities in the region and beyond.

With the support of the ICLEI grant, the authors (collectively referred to as the Global Warming Action Plan Task Force) focused on establishing a baseline of energy use for purposes of measuring change, forecasting energy usage in 2010 if no action was taken to reduce emissions, and outlining of a series of pragmatic, measurable steps that might be taken to favorably impact energy use and reduce CO_2 and other greenhouse gas emissions.

Past Action

In the past, Takoma Park has taken concrete steps to conserve energy and introduce the use of alternative energy sources that do not contribute to air pollution and climate change. These steps included energy efficiency upgrades at the municipal building in 1996, the pilot use of compressed natural gas for city vehicles, an aggressive recycling program (reducing contribution to waste stream), and progressive efforts to maintain tree cover and preserve green space (providing local natural absorption of CO_2 as well as other pollutants).

In the early and mid-1990s, utility rebates to encourage the use of energy efficient heating and cooling systems and other demand side management programs had a positive impact throughout the city. While these steps, combined with municipal action, caused a measurable drop in the consumption

of energy in Takoma Park from 1990 to 1995, (revealed in research conducted for this study), that reduction has since been erased as utility conservation efforts lapsed and the appetite for energy in all sectors continues to rise.

Where We Are Today

Excluding the (unfortunately significant) contribution from flow-through traffic, which is outside the immediate control of the City, Takoma Park currently produces about 350,000 tons of CO_2 a year from energy consumption, or nearly 15 tons per resident.

The single greatest source of CO_2 is the use of electricity (51 percent of the total), followed by gasoline (30 percent) and the use of natural gas (12 percent). Other measurable energy sources of CO_2, ranging from three to less than one percent, are diesel, heating oil, propane and compressed natural gas.

The greatest sources of CO_2 by end-use are the commercial sector (which includes municipal use and the tiny industrial activity within the City) at 40 percent; followed by transportation at 34 percent and residential at 25 percent. A fourth category, waste, produced less than one percent.

Goals and Objectives

The goal of the plan now presented to Council is to reduce CO_2 emissions in Takoma Park to 80 percent of 1990 levels by 2010. The task force believes this goal can be achieved through action primarily in the following areas:

- Continued and renewed efforts to conserve energy use;
- Leadership in switching from a reliance on coal-fired electricity generation to cleaner natural gas and very low or emission-free renewable generation from fuel cells, biomass, wind and solar;
- Increased use of transportation alternatives to the internal combustion engine, including mass public transportation, walking, bicycles, and low-emission and alternatively fueled vehicles;
- Increased protection of green spaces and tree planting; and

- Increased recycling, perhaps through as Pay-As-You-Throw program.

Near-term Priorities

For the plan to be successful, the City Council should consider taking action on two fronts: 1) launching a high-visibility, high-impact CO_2 reduction initiative, and, 2) supporting that initiative and the ongoing work of the volunteer committee with a public information campaign. It is suggested that the city pursue grant funding to support these actions.

The area for the greatest positive impact of municipal and citizen action is in changing the way we make and use electricity. It is the single largest contributor of greenhouse gas emissions in Takoma Park (and the U.S.) and is produced by the sectors that the municipal government, independently and working with citizens and private business, can make the greatest near-term impact.

Two potential CO_2 reduction actions offer particular reward. If successful, both will reduce energy use, lower carbon emissions and save money for the consumer and the city:

1. Creation of a municipal electric utility to take advantage of the deregulation and competition opening in Maryland in 2000. Among the steps a municipal utility in Takoma Park could take are to: 1) purchase electricity for municipal loads from sources that offer power from cleaner generation than PEPCO currently does; and 2) to provide access to renewable power and energy conservation/efficiency technologies for citizens.

2. Offer the commercial sector (which includes apartment buildings) attractive access to cost-effective energy efficiency improvements in buildings. These might include energy service performance contracting and group purchases of energy efficiency upgrades.

Finally, we must build public awareness. Educating the public about the choices and consequences of energy use is critical to success of individual initiatives and the ability to meet the 2010 goal. Achieving this ambitious goal of reducing CO2 emissions to 80% of the 1990 baseline is doable, but only if everyone comprehends the problem and the potential consequences and puts in an honest sincere effort to do their part.

Chapter 1 -- INTRODUCTION AND BACKGROUND

by

Karen Rindge (Energy Subcommittee)

Takoma Park, Maryland

Takoma Park is located in the southeastern corner of Montgomery County, Maryland, on the border with Washington, DC. The City was first established in 1883 as a "sylvan suburb" to the Nation's Capitol. Today, Takoma Park is still a suburb of Washington, with many mature oaks, maples, sycamores and other trees that tower over homes. Takoma Park has a reputation as a progressive community with strong citizen views on issues such as nuclear power, social justice, and environmental quality. It is these values, and the courageous support of Takoma Park's City government, that allows our community to exhibit leadership in issues such as taking action to reduce greenhouse gas emissions. It is hoped that the actions proposed in this plan can be integrated into City and citizen activities that will help mitigate the negative effects of climate change.

Why Have a Plan for Reducing Greenhouse Gas Emissions?

The world's population is burning carbon-based fossil fuels faster then the earth's natural systems can absorb the resulting carbon-dioxide (CO_2) gas. Increased CO_2 emissions are trapped in the atmospheric "greenhouse" that keeps the planet warm, raising concern about greenhouse gas levels and resulting climate change. There is broad international agreement that reducing CO_2 emissions is a sensible precaution until more is known about these greenhouse gases' effect on climate and weather.[3]

Global climate change is perhaps the greatest environmental challenge facing the planet because of the vast potential impacts. Since the 1980s, virtually all international investigations have confirmed that human activity is changing the atmosphere at an unprecedented rate, and that these

[3] CO_2 is the gaseous product of combustion of fossil fuels, such as gasoline and natural gas. Of the seven major greenhouse gases, the highly heat absorbing characteristic of CO_2 causes it to have the most direct impact on global climate. Research has estimated that approximately 75% of the global greenhouse effect is attributable to CO_2 emissions. In this document, we use the terms greenhouse gas and CO_2 interchangeably.

changes constitute major threats to the economic and environmental health of communities worldwide. If allowed to continue, global warming could potentially impact metropolitan Washington in several significant ways: rising ocean level and flooding of coastal areas; higher prices for water, electricity, and farm products; adverse changes in fragile ecological systems; poorer air quality; increases in certain illnesses; and jeopardized economic health. For these reasons, Takoma Park, Maryland is taking action to reduce CO_2 and other greenhouse gas emissions city-wide in order to improve the local environment and hopefully serve as a role model for other municipalities and counties.

What Is Takoma Park's Contribution?

Takoma Park's greenhouse gas emissions analysis, based on 1990 data, with regional flow-through traffic excluded from the baseline data[4], each person in Takoma Park is responsible for creating about 14.4 tons of carbon dioxide emissions every year, which adds up to a total of about 347,679 tons of emissions annually. About one third (34.3%) of this comes from automobile driving and gasoline; another 25.3% comes from energy use in homes, much of that in electricity: and the bulk of the remainder (40.4%) comes from energy use in stores, offices, institutions, waste and municipal government.

The Task Force decided to exclude regional flow-through traffic from the transportation estimates since there was little that the city could do, short of lobbying for smart growth policies at the regional level, to change the regional daily commuting patterns. The Task Force proposes that Takoma Park attempt to attain a target of reducing CO_2 emissions to 80% of 1990 baseline year.

The Debate on Global Climate Change: Should Cities Take Action?

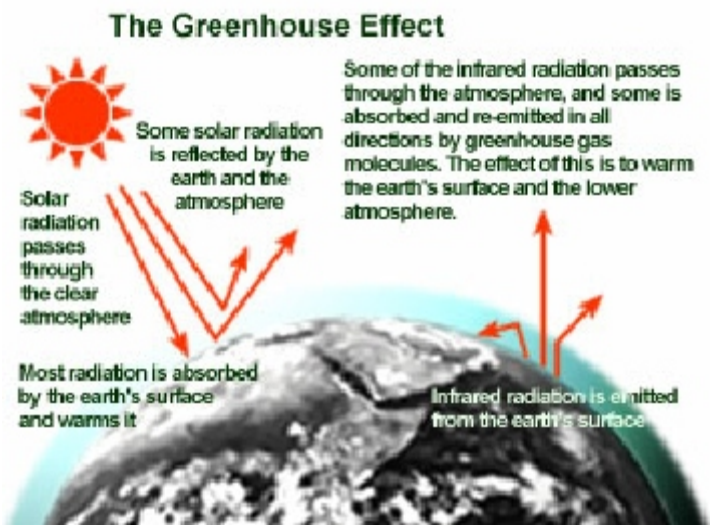
Until recently, the scientific community debated whether global climate change was a natural phenomena, and if so, what the effects would be. Uncertainty has provided skeptics with ammunition to

[4]Based on 1990 data, with regional flow-through traffic counted in the baseline data, the Takoma Park per capita CO_2 emissions are about **32.3** tons every year, which adds up to a total of about **540,341** tons of emissions annually for the City as a whole. About half (56.4%) of this comes from automobile driving and gasoline; another 16.2% comes from energy use in homes, much of that in electricity: and the bulk of the remainder (25.8%) comes from energy use in stores, offices, industries, and municipal government.

argue against taking steps to reduce the 'potential' impacts. However, the United Nations International Scientific Panel on Climate Change (IPCC), a respected U.N.-sponsored body made up of more than 1,500 leading climate experts from 60 nations, released an unprecedented report stating that global warming can be blamed, at least partially, on human activity. This report is critical in that the IPCC had been reluctant to make such a connection until consistent and agreed-upon scientific evidence demonstrated this to be true.

> "We are certain of the following….Emissions resulting from human activities are substantially increasing the atmospheric concentrations of greenhouse gases: CO2, methane, CFC's, and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface." -- IPCC, 1990.

This shift in the scientific consensus is not so much based on new data but on improvements in the complex computer models climatologists use to test these theories. Additionally, new studies have added to the scientists' confidence that they can generally predict what can happen if greenhouse gases continue to be released into the atmosphere unchecked (excerpt from *Time* Magazine, October 2, 1995). This information helped prompt leaders of over 160 nations to meet in 1997 to approve the Kyoto Protocol. The U.S. became the sixtieth and last industrial nation to sign the treaty, agreeing to a 7% reduction in greenhouse gas emissions below 1990 levels between 2008 and 2012.

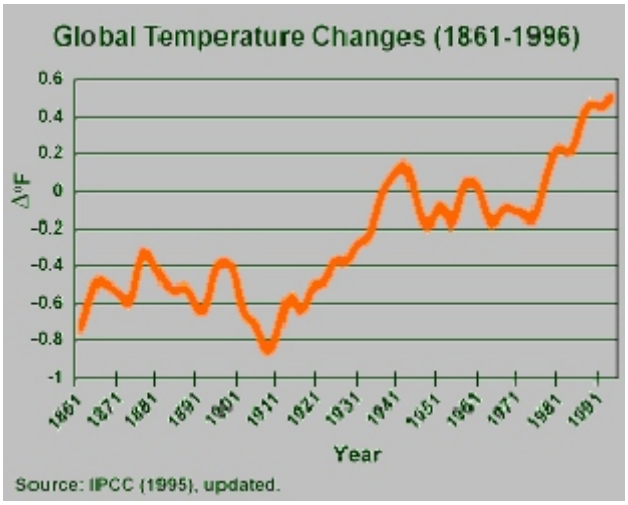


Many nations, businesses and local municipalities are responding. Cities are recognized for their role in contributing to, and conversely, their potential to reduce carbon dioxide emissions by addressing how cities are designed (Smart Growth Initiatives), what materials are used in building (Green Buildings), where cities place roads, and how local decisions affect the way citizens live, where they work, how they play and the interaction between these elements. Action by cities is

especially important because more than half the world's population live in urban areas. Much of the world's population is also concentrated in coastal zones, putting added pressure on critical watersheds, such as the Chesapeake Bay region of which Takoma Park is a part. Further, most of the world's 500 million internal combustion engine (ICE) powered vehicles are in cities, and cars produce about 60% of smog-forming emissions.

Why Is the Impact of Global Climate Change Called the Greenhouse Effect?

The greenhouse effect keeps Takoma Park (and the earth) warm. Sunlight passes through the atmosphere and warms the earth's surface, and the earth then radiates infrared energy. Trace gases and water vapor absorb part of the infrared radiation and emit some back, further warming the atmosphere. The problem is that concentrations of these gases are increasing at higher than historical rates, and most scientists now agree that these increases will significantly affect the global climate.



Naturally occurring gases in the atmosphere trap heat in the physical process termed the "greenhouse effect." As shown in Figure 1, surface temperatures on earth are determined by radiation from the sun and the physical properties of atmospheric gases. Solar radiation passes through the earth's atmosphere to heat the earth's surface. This heat is then re-radiated from the earth in the form of infrared energy and is partially absorbed by the gases. It is this absorption by the "greenhouses gasses" that causes the atmospheric warming effect.

Five naturally occurring atmospheric gases are responsible for the greenhouse effect: carbon dioxide (CO_2), methane (CH_4), nitrous oxide ($N0_2$), tropospheric ozone, and water vapor. These gases are naturally transferred between the land, atmosphere and ocean. For example, plants absorb carbon dioxide through photosynthesis as they grow, store it in solid form during the life of the plant, and release it again as a gas when plants die and decompose. Carbon can be stored for longer periods of time, sometimes for millions of years, in the form of coal, oil, and natural gas. The greenhouse problem arises

with human activity upsetting the equilibrium of gas concentrations by releasing carbon, methane, and other gases into the atmosphere faster than oceans, plant matter, and soils can absorb them. For example, the carbon in oil would be released very slowly under natural circumstances, but because we are driving gasoline-powered automobiles in ever increasing numbers, the release of carbon occurs more quickly. This rising build-up of greenhouse gases is leading to warmer global temperatures, or the effect known as global warming or climate change.

What Are Potential Global Economic Impacts?

Studies of the economic impact of climate change by the Intergovernmental Panel on Climate Change (IPCC) are being carefully examined by the international insurance and banking industries. The insurance industry believes that an unprecedented series of hurricanes, floods and fires may be the first real effects of human-induced climate change. These companies are paying for climate studies because of the millions of dollars in insurance claims paid, resulting from weather-related disasters. Also the Federal Emergency Management Agency (FEMA) is very concerned about the impact of global climate change because of the risk to human life and the financial burden of hurricanes, flooding and drought. Over the last 100 years, the worst natural disasters and largest insurance claims occurred in just the last few years. 1998 was the hottest global year on record and it follows a string of record-breaking years. Although it may seem contradictory, even record-breaking cold weather is potentially a result of more solar energy trapped in the earth's atmosphere by greenhouse gases.

Major natural disasters caused by extreme climate events could literally bankrupt the insurance industry in the next decade, and U.S. business interests are beginning to see their stake in the debate. The *Washington Post* reported January 21, 1996 on a memorandum prepared by the Assistant Director of the British Bankers' Association for the Bankers' annual meeting, warning that more than half of all current bank lending is "affected by environmental factors" and that within the 20 to 40 year "life-time of loans granted today, climate change is forecasted to have dramatic impacts". Also, acting out of concern about global climate change, several major corporations -- including BP Amoco, Motorola, IBM, and Dow among many others -- are voluntarily taking action to reduce CO_2 emissions and are urging other corporations to do the same.

What Are Other Potential Impacts of Global Climate Change?

While it is not possible to predict with certainty what exactly will happen locally due to global climate change, research does predict some potential impacts resulting from global warming. In addition to the specific economic impacts discussed above, increased CO_2 emissions could affect energy usage, ocean levels, water needs, air quality, natural habitats and species migration, outdoor recreation opportunities, human health, agriculture, and forestry. Of these impact areas, the following subsections describe some of those that could impact Maryland and the Washington metropolitan area.

Energy Impacts

Temperature increases projected from global warming may raise summertime electricity demand while reducing electricity supply. As demand for electricity increases, associated carbon emissions from electric generation also increase. The exact amount of the increase depends on the fuel mix used to generate the additional electricity. Potomac Electric Power Company (PEPCO), the investor-owned electric utility that serves Takoma Park, uses mostly coal-fired power.

Ocean Level Impacts

Sea level rise is expected to occur as a result of three phenomena: thermal expansion of the ocean surface, melting of the earth's glaciers and polar ice fields, and mixing of now stratified ocean waters. A recent US EPA study estimates that if temperatures rise 3° C by 2050, a one-meter (or approximately 3 foot) sea level rise could result by 2100. Maryland, with over 3,000 miles of shoreline, would most likely experience at least a two foot rise in sea level. This would lead to flooding of low-lying property, loss of coastal wetlands, erosion of beaches, saltwater contamination of drinking water and decreased longevity of low-lying roads, causeways and bridges. Maryland's eastern shore of the Chesapeake Bay and beach development would be seriously affected. Higher seas provide a higher base for storm surges and have the potential for more destructive storm activity. In Washington, DC, this could mean that Hains Point Park would be under water and Georgetown's Flood control walls would most likely be deployed continuously.

Water Impacts

Global warming and resulting drought conditions may decrease water supplies from surface and groundwater sources, increase water demand, increase the occurrence of winter flooding, and make water pollution more severe. Global warming may also magnify water quality and quantity problems in the metropolitan areas of Baltimore and Washington, D.C. by reducing spring and summer flow in rivers and their ability to dilute existing and anticipated pollutant loading. The agriculture industry in Maryland (a $1.3 billion industry) is dependent on water–yield of major crops could be reduced by 24-43% due to loss of water for irrigation causing negative economic impacts.

Air Quality Impacts

Climate change may adversely affect regional air pollution levels because of higher temperatures, increased ultraviolet radiation, and possible increases in precipitation. However, changes in wind patterns could worsen pollution problems, or they could help flush pollutants from urban areas. The potential impacts of global warming on major air pollutants are:

- Ozone - Higher temperatures and increased ultraviolet radiation accelerate the chemical rates of reaction in the atmosphere, leading to higher ozone concentrations. Higher temperatures also cause increases in emissions of oxides of nitrogen (NOx) and hydrocarbons, the two precursors for ozone. More electricity demand in summer months could lead to higher SOx and NOx emissions from utilities. Evaporative emissions of hydrocarbons from motor vehicles, refueling, and pine trees also increase with temperature.

- PM10[5] - Increased rates of energy production due to higher temperature and increased ultraviolet radiation lead to higher coincident PM10 concentrations. Emissions of soot and ash from stationary and transportation sources may rise in summer because of increased energy demand for air conditioning. In winter, changes in the frequency and intensity of inversions may work to reduce trapping of vehicle exhaust. Since human

[5]PM-10 is particulate matter less than 10 microns in diameter. This particulate matter is a lung irritant and can cause human health problems.

outdoor activity is greater in summer than in winter, longer warm seasons and less intense winters may increase the comparative importance of summer-type exposure in major urban areas.

- Acid Disposition - Possible increases in acid deposition due to more electricity demand (higher Nox and SOx emissions), higher temperatures and drier, warmer conditions.

- Carbon Monoxide (CO) - CO is a product of incomplete combustion. Air pollution levels may improve due to increases in warming-induced atmospheric ventilation (winds) at night. A shorter winter season and possible reduced frequency of inversions may reduce frequency, but not necessarily severity, of CO 'hot spots" due to motor vehicles.

Natural Habitat Impacts

Warmer temperatures, sea level rise, and changes in water availability could result in substantial impacts to natural habitats, particularly in coastal wetlands and for the 2,700 animal and plant species of the Chesapeake Bay region. Changes in temperature, rainfall, or other significant climatic effects could have devastating effects on sensitive species, including threatened and endangered species. Global warming could affect estuaries and low-lying wetlands through sea level rise by causing greater variation in seasonal freshwater in-flow and salt-water intrusion. Intruding salt water and increasing sedimentation are already choking many marshes. Marine habitats could also be adversely affected if global warming shifts ocean upwelling patterns and associated nutrient transport. This could precipitate a change in fish populations along the coast and in the Chesapeake Bay.

Human Health Impacts

Increased warming would endanger the health of thousands of citizens. First, increased temperatures make the local environment more hospitable to diseases such as malaria, dengue fever and Lyme disease, and could cause increased outbreaks of cryptosporidiosis and giardia. Also, major air pollutants in the U.S. are associated with a set of health problems. In the eastern mind-Atlantic region, a 4 degree (Fahrenheit) warming, with no other change in weather or emissions, could increase concentrations of ozone by 4%. Currently, ground-level ozone

concentrations exceed the national ozone health standard throughout Maryland. Global warming could increase concentrations of the pollutants listed below, and the CO_2 increase presently projected would likely result in both increased morbidity (illness) and mortality (death) among citizens. The elderly and the very young would be most vulnerable.

Ozone - Ozone exposures of several hours cause airway constriction in as many as 20% of healthy exercising adults and children. Other lung changes indicative of actual lung injury also occur. Increased duration and level of ozone exposure increases both the severity of the response and the number of individuals who respond. Years of ozone exposure can result in structural alterations in the lung and contribute to a cumulative lifetime decrease in lung function. Increased frequency and severity of ozone exposure will most likely increase the rate at which these long-term changes occur and also increase the total ozone lifetime lung injury.

PM10 - Adverse health effects of fine particles include chronic reduction of lung function and specific toxic effects of various components of the aerosol mass. Clinical and epidemiologic studies indicate PM-10 contributes to increased incidence of emphysema, aggravation of asthma, and transmission of airborne pathogens.

Carbon Monoxide - CO is a toxic gas that acts by blocking transport of oxygen by the blood. Exposure has been shown to aggravate chest pain in patients with coronary heart disease. Individuals with chronic heart disease and respiratory problems are at greater risk.

Is Takoma Park The Only City Taking Action To Reduce Greenhouse Gas Emissions?

Takoma Park is undertaking a CO_2 reduction plan as part of the Cities for Global Climate Protection Campaign sponsored by the International Council for Local Environmental Initiatives (ICLEI). This campaign includes a group of cities worldwide committed to demonstrating local leadership on climate change. Takoma Park is a member of ICLEI and the campaign, along with sixty-seven (as of this writing) other U.S. municipalities and counties.

The concept of reducing CO_2 emissions is not new. At the Toronto Conference on the Changing Atmosphere in 1988, the international scientific community initially proposed that a global reduction of 1988 CO_2 emissions of 20% by the year 2005 should be a target if a 50% reduction of 1988 emissions is to be achieved by 2050. The United Nations Environment Program and the World Meteorological Organization established the Intergovernmental Panel on Climate Change (IPCC) to develop further understanding of the problem and formulate policy options for the international community. Following the 1990 World Climate Conference in Geneva, a Framework Convention on Climate Change (FCCC) was signed by more than 150 countries at the 1992 United Nations Conference on Environment and Development.

Following the Berlin Mandate on emissions targets made in1995, the signatories to the FCCC met in Kyoto, Japan in 1997 where nations agreed to emissions reductions goals into the 21st century. Industrial nations signing the Kyoto treaty committed to cut emissions of their greenhouse gases an average of five percent below 1990 levels beginning in 2008. The U.S. became the 60th and last industrial nation to sign the treaty, agreeing to a seven (7%) percent reduction in greenhouse gas emissions below 1990 levels between 2008 and 2012. These international efforts and commitments reflect broad agreement that reducing the output of greenhouse gases is a sensible precaution until more is known about their effect on the global climate.

Many cities are following suit by setting emissions reduction targets and developing and implementing action plans to reach those goals.

What is Takoma Park's Goal?

At ICLEI's recommendation, the Takoma Park goal is proposed to be a reduction of 20 percent below the City's 1990 CO_2 emissions by 2010. This is significantly more ambitious than the US goal. Still, many climate change experts believe that even a 20% reduction of CO_2 emissions by 2010 is not enough to adequately mitigate climate change impacts. The Task Force believes that this goal is achievable if the City were to undertake the action measures described in Chapter 5.

How Was the Action Plan Developed?

The development of this plan is the culmination of more than a year of work by a task force of key city staff and citizens of Takoma Park and three years of participation in the International Council of

Local Environmental Initiative's (ICLEI) Cities for Climate Protection Campaign (CCPC). Takoma Park was responsible for developing this local action plan for community implementation. The task force, comprised of city officials, citizen volunteers, energy consultants and the Takoma Park Committee on the Environment, spear-headed the process. The plan is to be reviewed and approved by the City Council.

Initially, the task force inventoried past and existing CO_2 emissions to establish a baseline and then projected emissions growth to 2010 using several nonintervention and intervention scenarios. Emissions data were analyzed and broken down by sectors and type of energy use. On June 5, 1999, the Task Force held a town meeting was held to solicit citizen comments and action recommendations. A 2010 goal for greenhouse gas reductions was established. The task force developed and examined an extensive list of action proposals and other recommendations and then evaluated a wide range of CO_2 and methane reduction measures to identify those most suitable for local implementation. Another town meeting is currently being planned for early in 2000. The task force will invite response and comments on the draft plan from local leaders at this meeting.

This review process is expected to culminate in a CO_2 reduction strategy that is based on the proposed policies and implementation measures described in the following document. The Task Force will request the adoption of these proposals by City Council.

Organization of This Report

Following this introduction and background, the data on CO_2 emissions for the 1990 baseline year are presented. Then a forecast of CO_2 emissions for the year 2010, absent any actions to reduce emissions is presented. This data is used to inform the dialogue regarding the actions needed to meet Takoma Park"s proposed goal of reducing greenhouse gas emissions to 80% of the 1990 baseline year emissions by 2010. Following the presentation of the 1990 data and forecast, chapter 4 presents a list of actions already taken to both develop this plan and initiate reduction of greenhouse gas emissions since the receipt of the grant from ICLEI in 1999. Chapter 5 presents proposed action items for reducing CO_2 emissions through each of six sectors:

- Municipal Government;
- Commercial;

- Residential;
- Natural Resources;
- Waste; and
- Transportation.

The Task Force conclusions are presented in Chapter 6, followed by detailed appendices of various data sets.

Chapter 2 -- GREENHOUSE GAS EMISSIONS INVENTORY

1990 Baseline Emissions Inventory

The first step in developing a plan to reduce Takoma Park's greenhouse gases is to establish a baseline to measure reductions against: What are the sources of Takoma Park's CO_2 emissions and how large were they, are they, and will they be? 1990 Is the agreed upon base-year. It was selected because it is a year for the U.S. decennial census, which provides essential population-related information. In addition, 1990 is consistent with the baselines used by most of the International Council for Local Environmental Initiatives (ICLEI) cities.

CO_2 Emission Sources

The sources of Takoma Park's CO_2 emissions are categorized as follows:

Energy consumption

- Petroleum use in autos, trucks, and other equipment
- Electricity and natural gas use in homes and businesses

Energy production

- Electric power generation
- Natural gas distribution
- Petroleum refining

Each of these components are summarized below. The details of the Takoma Park CO_2 emissions inventory, including data sources and assumptions used, can be found in Appendices A and B.

Energy Consumption

CO_2 emissions are directly created by energy consumption when fuel is combusted by end-users

such as motorists using gasoline or homes and businesses heating with natural gas. CO_2 emissions are indirectly created by electrical use, which requires generation at a power plant that burns fuel (mostly coal for the power plants that produce Takoma Park's electricity), which causes emissions of CO_2, SOx, and NOx.

The Task Force's inventory of Takoma Park's community-wide energy consumption is organized into five end-use sectors: residential, commercial (includes municipal[6], institutional and industrial), natural resources, waste, and transportation. Municipal government consumption is included in the community-wide commercial sector but is also analyzed separately since there are specific renewable energy and energy efficiency/efficiency measures, such as high efficiency induction street lighting, available to the municipality as a discrete entity.

The local utilities, PEPCO for electricity and Washington Gas for natural gas, provided the end-use data that was the basis for this baseline data analysis.

Municipal Government

Takoma Park's municipal government consumes energy in three ways: fueling municipally-owned vehicles; space-conditioning and powering municipal-owned buildings; and powering certain pubic services, such as street lighting. Municipal energy use accounts for slightly less than ½% of total community energy use. This energy consumption generated about 1,901 tons of CO_2 emissions annually, 75.5% of which comes from electric use.

Although municipal government energy consumption is a small end-use sector, it nonetheless is most directly subject to public policy and can therefore be used to set a leadership example for other sectors. It also represents a $230,109 annual expense in the municipal budget. Using energy more efficiently not only reduces CO_2 emissions, but also saves money that can be redirected to other critical public service needs.

[6]The municipal sector is referred to as "corporate" in the Torrie Smith Associate's emissions analysis software.

Residential

In total, the residential sector accounted for 30.2% of the community's total energy use. About seventeen percent of the residential energy consumption is from electrical power, sixty-eight percent is natural gas and the remaining 15% is split from heating oil and propane. This consumption creates approximately 87,838 tons of CO_2 or 25.3% of the city-wide total emissions.

The community's residential sector included 7,133 housing (dwelling) units within the city proper in 1990 with 43.75% (3121) detached single-family homes, 44.1% (3,147) apartment buildings with five or more units and the remaining 12.5% comprised of buildings with more than one unit but less than five or a mobile home trailer or other. Takoma Park's housing stock is relatively old: 47% built prior to 1950, another 50.3% between 1950 and 1980 and only 2.66% built since 1980.

Note that since the utility data was collected by 5 digit zip code (20912), which does not correlate perfectly with the City's border, the 1990 Zip Code data was used to adjust the utility data for a more accurate portrait of per household and per capita characteristics. The census data showed the zip code population at 24,083 (44.21% higher than municipal population) and a household count of 9,530 (40.62% higher than municipal households).

Commercial

After transportation and residential, the third largest energy user was Takoma Park's commercial sector dominated by retail and service trades. These were estimated to consume about 20.1% of total community energy, and to produce approximately 139,731 tons (40.2% of total) of CO_2 emissions every year.

The commercial data included institutional, master-metered multi-family residential and industrial sector accounts. This combined data made it necessary to estimate the commercial share of the total. This estimate can be refined if and when actual commercial sector data becomes available. Methodologies used to reconcile these data category differences are discussed in Appendix C.

Industrial

Takoma Park's industrial sector was so small that it was considered as part of the commercial sector for the purposes of this report.

Transportation

Takoma Park municipal residents use approximately 9,800 automobiles and trucks to travel over one-hundred forty-eight-million miles annually. Total estimated (zip code) CO_2 emitted from this transportation use was 119,341 tons. This excludes commuter travel to other parts of the Washington metro region. This sector represented slightly over 34.3% of the community's 1990 annual CO_2 emissions.

Takoma Park, which is an early Washington, D.C. trolley suburban community, had a total population of 16,724 in 1990. Based upon 1990 census zip code household data, 8,409 (50.3%) Takoma Park residents commuted to work outside of Takoma Park. As an inside-the-beltway bedroom community, an inner suburb to Washington, D.C., the inventory identifies Takoma Park's transportation sector as the largest consumer of energy (49.7% of total), contributing over thirty-four and three-tenths percent (34.3%) of the total emissions. There are five major arterial roads that skirt or pass directly through Takoma Park feeding into Washington, D.C.[7]

Surveys taken by the Washington Metropolitan Area Transit Authority (WMATA) and reported in the 1990 Census indicated that 2,715 (27.4%) of the 9,904 Takoma Park commuters used the Metro Rail or Bus Systems to get to work on a daily basis, another 1,370 (13.8%) car-pooled, but 4,803 (48.5%) still drove alone. The average commuting time to work was 29.5 minutes with a total aggregate of travel time to work for all Takoma Park citizens in minutes equal to 271,816 (4,530.6 hrs) every day, twice a day. Further, 1.3% (126) used a taxi (62) or bicycle (64). It should also be noted that 8.5% walked (435) or worked at home (405).

Unfortunately, Takoma Park's air quality is greatly affected by the region's overall sprawl

[7] The total transportation sector figure excludes "flow-through traffic." Many of the vehicle miles traveled (VMT) are due to commuters that neither live nor work in Takoma Park proper but rather pass through it on their way to and from work each business day. These data were excluded because Takoma Park has very limited influence on CO_2 emissions from these vehicles.

development patterns and the resultant low occupancy auto traffic that flows through and along its borders every day. Short of putting up a wall or toll booth there is little the City can do to change this situation.

Waste

Waste, particularly decomposing waste, is another potential greenhouse gas source (methane) justifying consideration. It is estimated the CO_2 released from solid waste that was land filled is responsible for ~0.2% of the 1990 CO_2 emissions.

In 1990 in Montgomery County, the Oaks Sanitary Land Fill (SLF) Site was actively receiving waste material.[8] Most of the non-recycled waste generated by Takoma Park from 1990 up to 1997, the year that the Oaks facility closed, was deposited at Oaks.

After Oaks closed in '97 all municipal solid waste was and is taken to the Montgomery County Transfer Station which bundles the material and ships it via rail to the Dickerson Incinerator where it is consumed as fuel for power production. Incineration is considered to be greenhouse gas neutral. Thus, this process currently has negligible impact on climate change. This facility reduces the volume over 90% with the remaining ash being removed to the Oaks SLF site for heavy metal removal processing. The remaining slag is then shipped to a Virginia site for interment. There are also trials being conducted in Pennsylvania to test the suitability of using this ash material in cement mix for building highways.

Energy Production

The second portion the 1990 inventory includes those emissions created during energy production and distribution.

Electricity

[8] The Gude site, outside Rockville had already been closed (1982) and capped for methane recovery and power production.

Electricity was and is presently provided in Takoma Park solely by Potomac Electric Power Company (PEPCO), the local investor-owned utility. There are a few situations where facility owners use emergency generators as small power plants for their own internal use to lower power purchased during peak usage (and higher-cost) times. PEPCO generates electricity from mostly coal-fired generation plants that it owns and operates throughout Maryland and Washington, D.C. PEPCO also purchases power from other utility producers throughout the Mid-Atlantic region as well as from other utilities outside the region.

Natural Gas

Prior to Maryland deregulation in 1996, Washington Gas exclusively provided the natural gas service in Takoma Park. All natural gas is imported via underground pipelines that distributes methane (CH_4) to virtually every parcel within the municipality. In Montgomery County, all Washington Gas supplies were purchased from out-of-region sources and piped into the County. Estimates of CO_2 emissions from pipeline deliveries to direct-use consumers are included in the usage data provided in Appendix ___. Actual direct CH_4 pipeline/meter venting values were not available from Washington Gas at the time of this report preparation.

Transportation Fuels

All petroleum transportation fuels used in Takoma Park were produced and refined outside the region. All gasoline and diesel supplies were shipped by truck into Takoma Park and the surrounding area. The estimated transportation emissions are based upon traffic caused by the city's own population. Approximately 119,341 tons of CO_2 emissions per year were estimated for Takoma Park's share of transportation sector related petroleum distribution.

Traffic flowing through Takoma Park (but not initiating or ending in the City) on New Hampshire Avenue (state highway 650); University Boulevard (state highway 193); Piney Branch Road (state highway 320); Philadelphia Avenue- Ethan Allen Avenue- East West Highway (state highway 410) and lastly Carroll Avenue (state highway 195) that travels through the City was initially included in the

calculations because the only available traffic count data[9] which provides annual traffic counts for arteries.[10] This flow-through portion increases the total CO_2 emissions dramatically, but there is no practical way for Takoma Park to affect flow through commuter habit change except lobbying for regional "Smart Growth" policies and increase use of public transportation as well as ride share/car pooling programs and telecommuting. For the purposes of emissions calculations for this section, the authors excluded transportation related emissions resulting from flow-through commuter traffic.

Data Summary

In total, Takoma Park was responsible for emitting about 119,341 tons of CO_2 annually. About two fifths (40.2%) of the emissions came from the commercial institutional and municipal sectors, 25.3% from residences, and the remaining 34.3% from transportation. Of the fuels used by these sectors, gasoline accounted for nearly 30.2% of the CO_2 emissions, about fifty percent (50.1%) resulted from electricity use and natural gas was 12.1%. The remaining 7.6% is split between waste, propane, fuel oil and diesel. From a source view point, electricity generation is the largest contributor to the greenhouse gas mix from Takoma Park. A little over one half (50.1%) of the total CO_2 emissions result from electricity consumption. The majority of the local utility's power is coal-fired.[11] The inventory is fully detailed in Appendices A and B and C.

1990 Emissions Inventory

The 1990 inventory of consumption emissions is summarized by end-use sector and fuel type in Table 2.1.

[9] Source of the data is the Maryland State Highway Administration.

[10] Transportation emissions estimates based upon traffic moving 1) within, by and /or through Takoma Park 2) originating from Takoma Park or 3) ending in Takoma Park equaled approximately 45,169 tons of CO_2 emissions per year.

[11] This inventory does not cover a small subset of emissions that are not readily controlled by local government actions including large engine sources (aircraft) and landscape/agricultural sources (fertilizer).

Table 2.1-

Takoma Park Total Community

End Use Sector	(MMBtu)	%	CO2e tons	%
Residential	921,198	30.23	87,838	25.26
Commercial	612,188	20.09	139,731	40.19
Transportation	1,513,704	49.68	119,341	34.32
Waste			770	0.22
Total	**3,047,090**	100.00	**347,680**	100.00

E/CO2e by Source	(MMBtu)	%	CO2e tons	%
Electricity	676,858	22.21	174,125	50.08
Natural Gas	711,457	23.35	41,976	12.07
Heating Oil	119,373	3.92	9,669	2.78
Gasoline	1,330,264	43.66	105,091	30.23
Diesel	146,546	4.81	11,870	3.41
Propane	44,145	1.45	3,090	0.89
CNG	18,447	0.61	1,088	0.31
Paper Products	0		687	0.20
Food Waste	0		501	0.14
Plant Debris	0		-291	-0.08
Wood/Textiles	0		-127	-0.04
Total	**3,047,090**	100.00	**347,679**	100.00

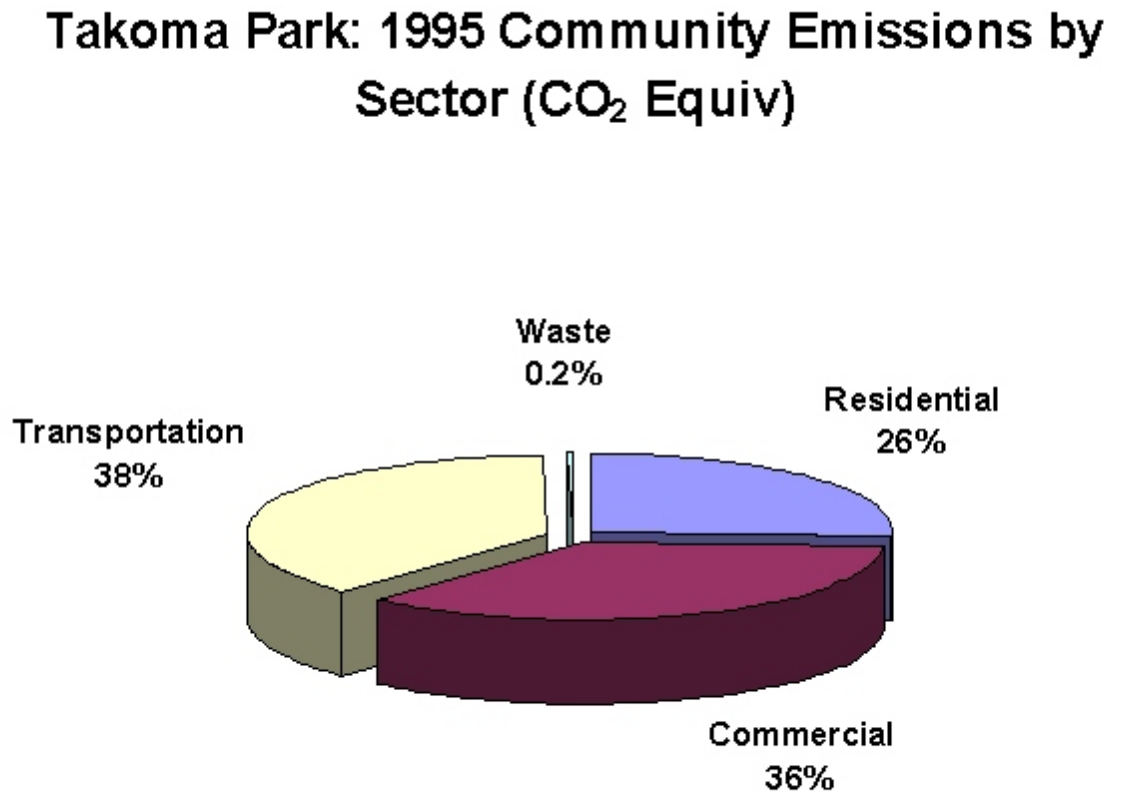


Figure 3. Takoma Park's 1990 Greenhouse Gas Emissions by End Use Sector

Figure 2 shows CO_2 emissions by source. The largest source of local CO_2 emissions is 40.2% from the Commercial, next 34.3% from the Transportation Sector, and then 25.3% from the Residential Sector.

Takoma Park 1990 Baseline CO2e by Source
Figure 2

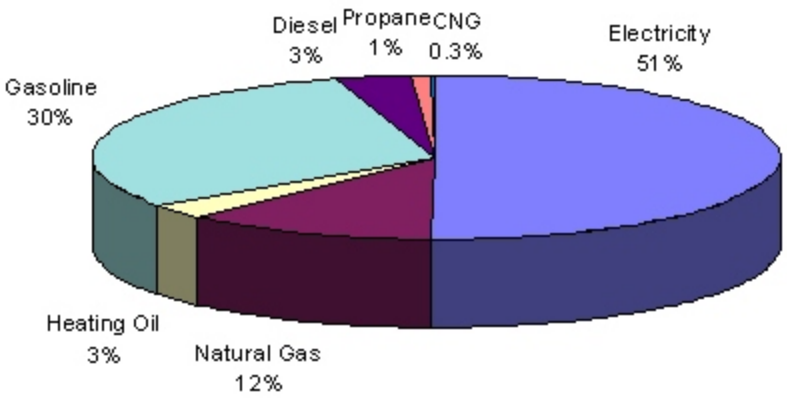
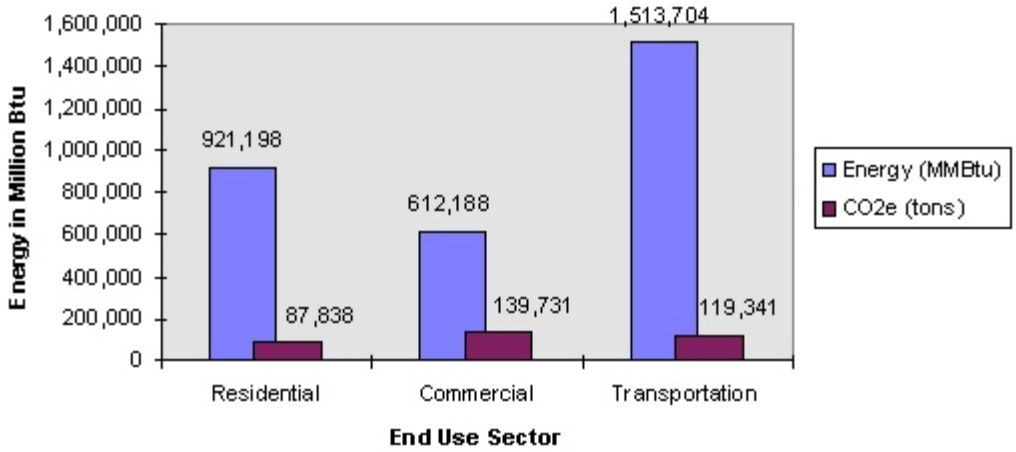
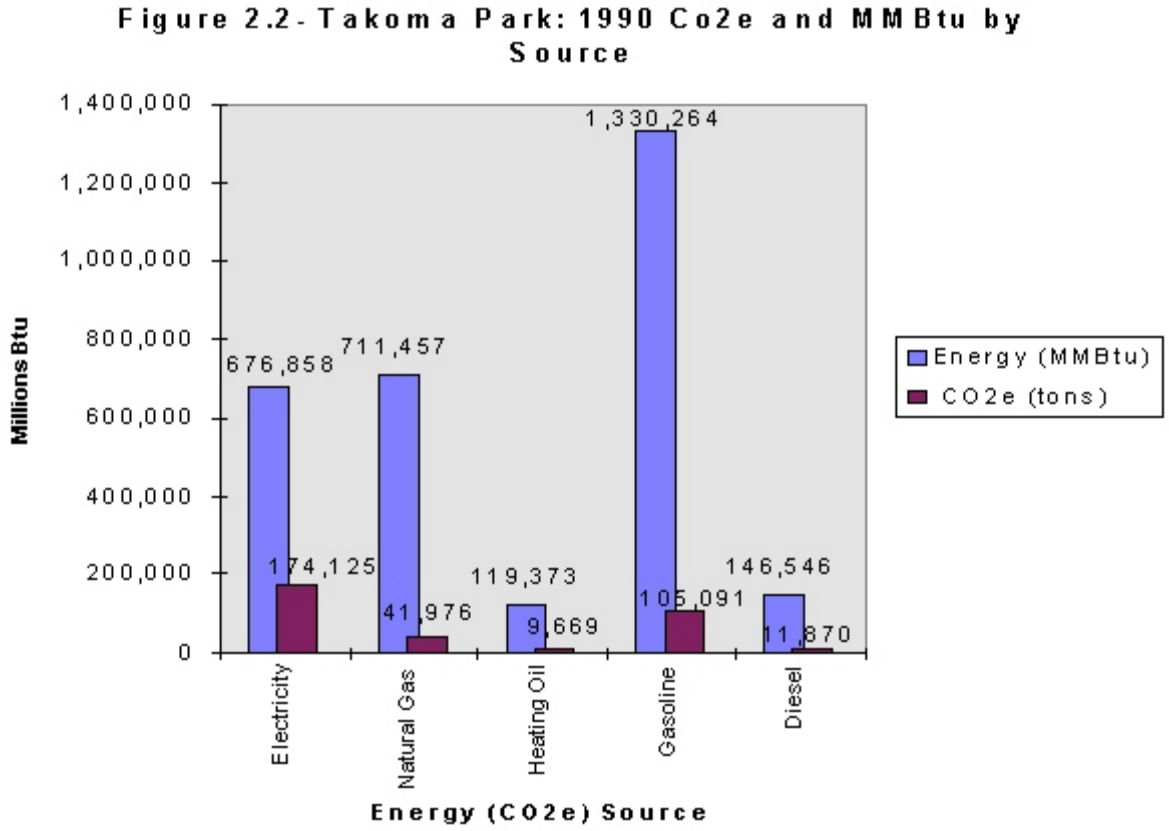


Figure 2.1 - Takoma Park 1990 CO2e and MMBtu by End Use Sector



Figures 2.1 and 2.2 provide graphic illustrations of the data contained in Table 2.1, including energy consumption and emissions by end-use sector in Figure 2.1 and energy consumption and CO_2 emissions by fuel type in Figure 2.2. Figure 2.3 summarizes these emissions on a variety of personal and community levels in order to illustrate the relative magnitude of different end-use contributions to global warming.



Takoma Park's conditions are compared to other ICLEI cities in Figure 4 (p.23). Takoma Park appears to compare favorably with these cities in terms of lower per capita emissions, but it should be remembered that Takoma Park is much smaller and more dense in population than other ICLEI cities, and as a rule, energy intensities per capita are markedly greater in cities larger than 250,000 persons. Alternatively, Takoma Park does not compare favorably to European cities that are less reliant upon automobile travel and are very densely packed.

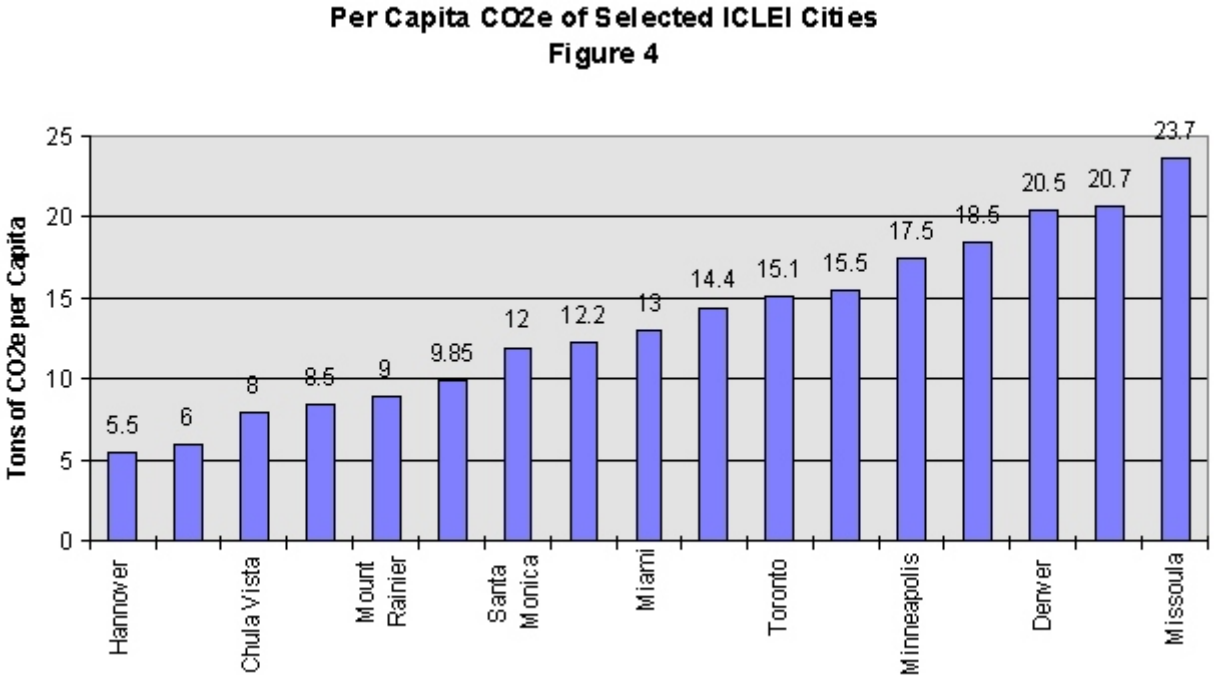
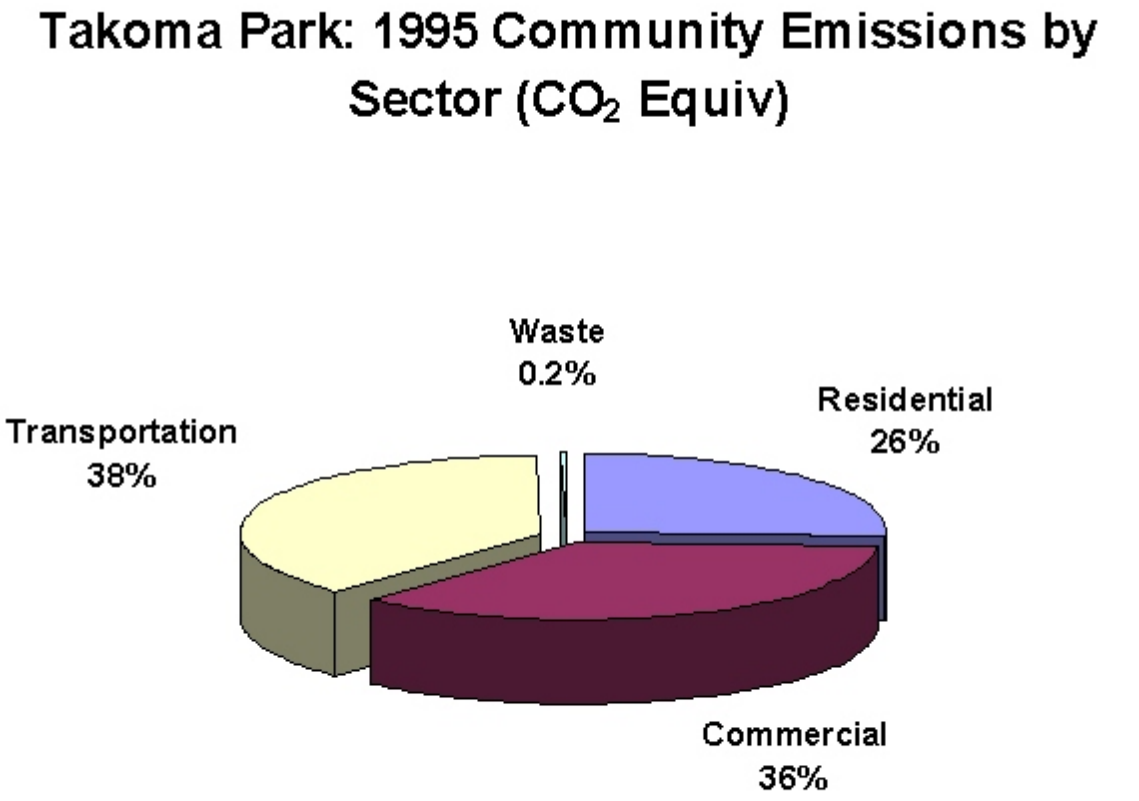


Figure 4. Select Cities for Climate Protection US Cities 1990 Per Capita Emissions

In 1990, Takoma Park had 16,724 citizens, each responsible for 14.4 tons CO_2e including transportation (5.0 tons). Figure 4 shows Takoma Park per capita emissions relative to selected Cities for Climate Protection cites. Generally, CO_2 emissions are lower in temperate climates and areas of high urban density. CO_2 emissions are higher in areas of temperature extremes where more energy is spent on heating or cooling.



Source: Tons Equivalent CO_2 Calculated Using ICLEI Software and Mount Rainier Baseline Energy Consumption Data

City Government Work on the 1990 Baseline Emissions Inventory

On June 10, 1996, City Council adopted Resolution 96-34, which authorizes work of the Climate Change Task Force. It also expresses the desire for the City government to set a good example:

> "WHEREAS, the Council intends for the City to take a leadership role in increasing energy efficiency and reducing greenhouse gas emissions from municipal operations..."

In order to gain an understanding of greenhouse gas emissions resulting from municipal operations, a 1990 emissions inventory for the City government was prepared. Because the City government historically did not track all the information needed to prepare this analysis, a number of

underlying assumptions were made to arrive at a CO_2 emissions estimate for 1990. These are summarized here and discussed in greater detail in Appendix B.

The emission inventory for City government covers buildings, streetlights, fleet fuel consumption, and waste generation. The Washington Suburban Sanitary Commission (WSSC), a by-county water and sewer authority, provides all of Takoma Park's potable and sanitary sewer water treatment processes. In 1990, it is estimated that City government operations were responsible for the consumption of 12,300 million BTUs, disposal of eight tons of waste, with 1 tons of CO_2 emissions. Figure 9 and Table 2 show the various City operations' share of CO_2 emissions.

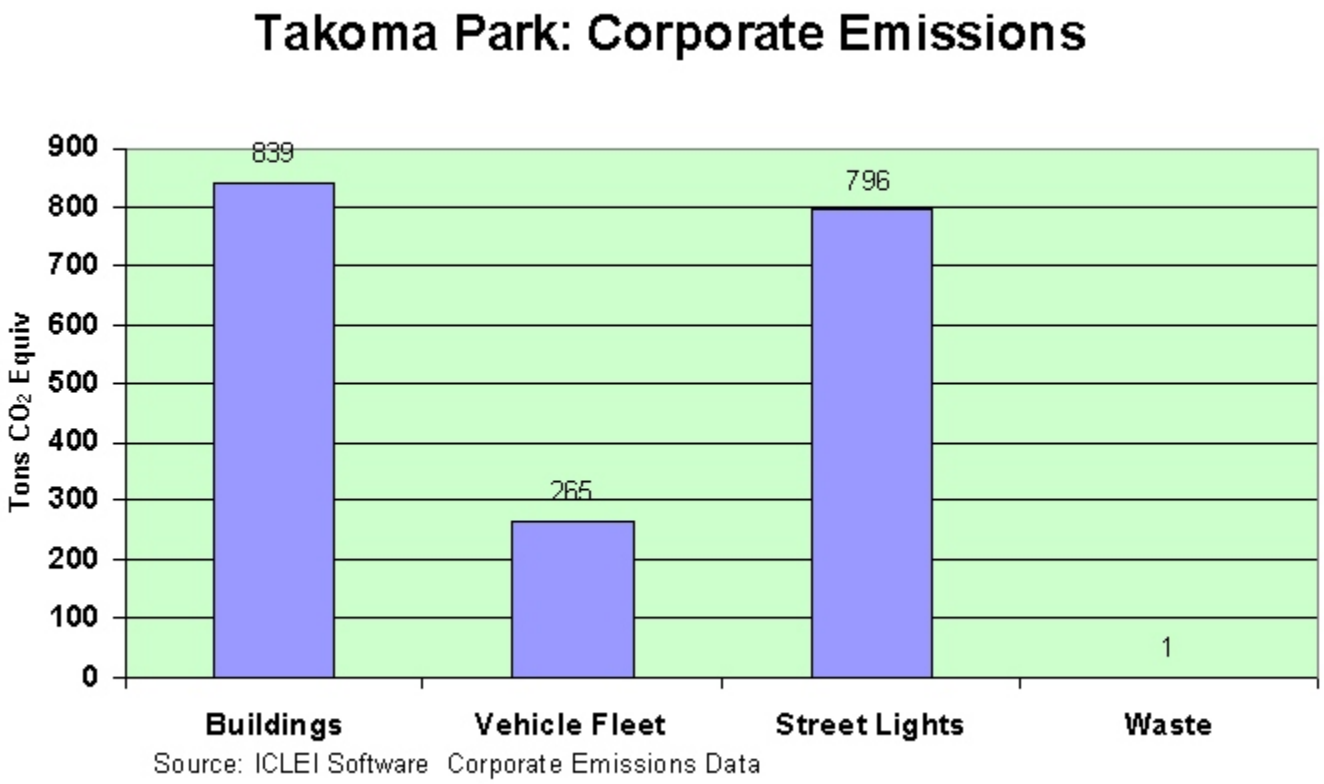


Figure 9. 1990 City Government CO_2 Emissions

1990 Municipal Government Energy Consumption / CO2e

Corporate by Sector	E - MMBtu	CO2e tons
Buildings	5,873	839
Vehicle Fleet	3,333	265
Street Lights	3,094	796
Waste	0	1
Total	12,300	1,901

Table 2. 1990 City Government CO_2 Emissions

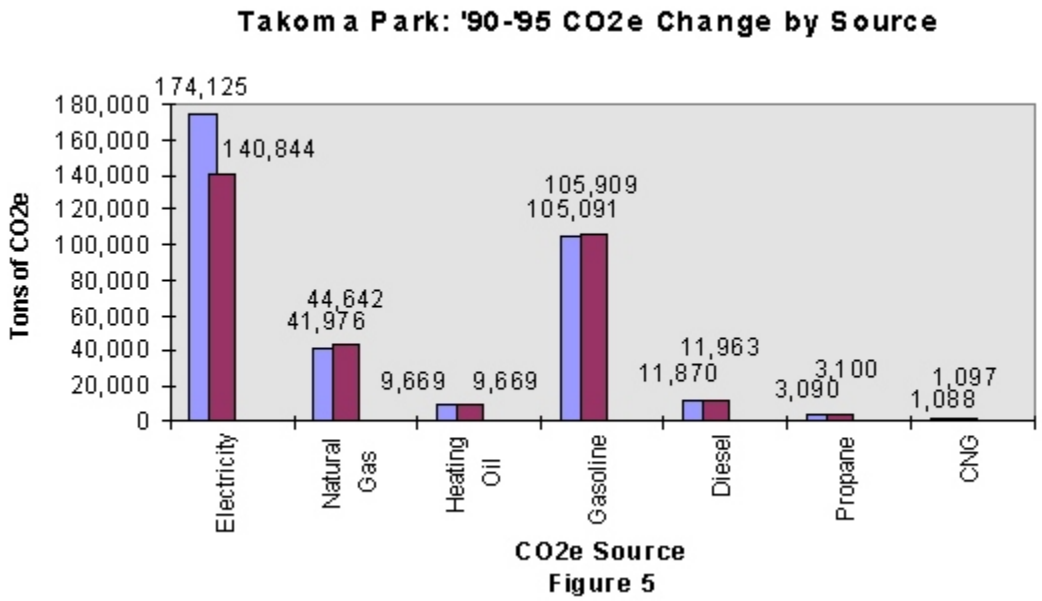


Figure 5

1995 Interim Emissions Inventory

A greenhouse gas emissions inventory was also conducted for 1995. In 1995, ('95, '96, '97, '98 utility-supplied data sets were available). In Takoma Park, total CO_2 emissions were estimated at 317,993.3 tons, an 8.5% decrease over 1990 levels. Even per capita CO_2 emissions decreased by nearly fifteen and half percent (13.2%) from 14.4 tons in 1990 to 12.5 tons in 1995. Figures 5 and 6 show how

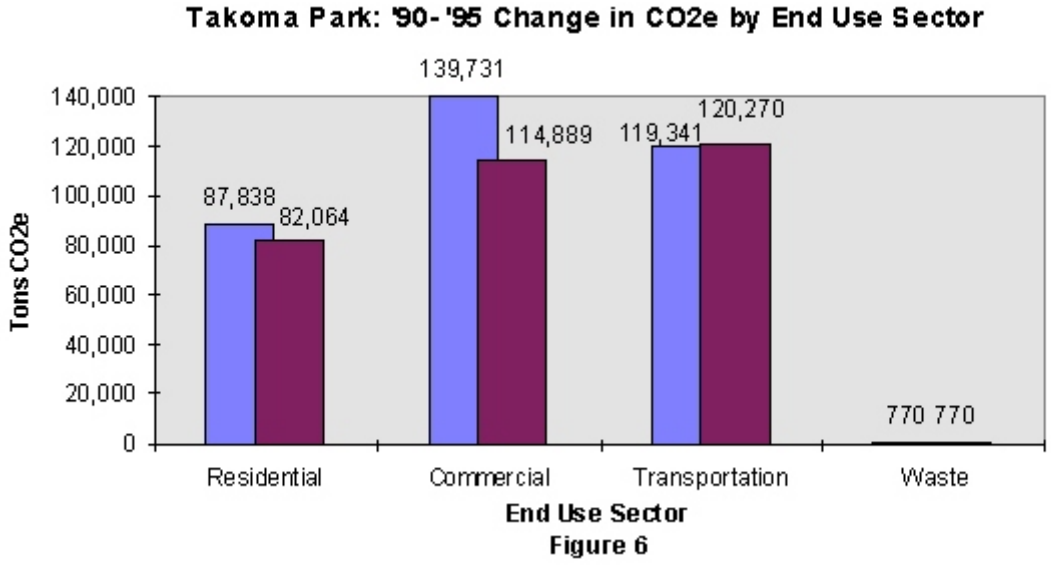


Figure 6

Takoma Park CO_2 emissions changed, by source and end-use sector between 1990 and 1995.

It typically would be expected that energy consumption would increase over time; but the data shows a decrease. Why? There have been numerous efficiency measures and programs launched in all sectors during the time frame from 1990 to the present (1999) which have caused the reduction in overall consumption and resulting greenhouse emissions. This trend is demonstrated by the 1995 data. For example, during the early 1990s, both PEPCO and Washington Gas aggressively promoted energy conservation and energy efficiency measures in both the residential and commercial sectors. This was done with significant rebate buy-down programs to stimulate the introduction of new technologies, such as compact fluorescent bulbs and LED exit signs, to the marketplace. These rebates in essence eliminated the incremental cost difference for higher efficiency equipment and other conservation measures. In the early 90's the U. S. Environmental Protection Agency (EPA) Green Lights Program was also kicking into high gear as well as the U. S. Department of Energy's Renew America Program were widely promoted. The Takoma Park Municipal Government and some the residents and businesses that live and operate in the city participated in these programs.

Further, federal appliance efficiency thresholds went into effect insuring that a minimum level of efficiency for major appliances must be reached if a product is to make it into the marketplace.

Probably most significant were the pollution production levels for the regions electrical energy mix decreased markedly. See Table 3.2- Maryland Electricity Coefficients (in tons per million Btu) for a comparison.

In the transportation sector, the new Greenbelt section of METRO Rail Green Line that connected to the Red Line at Fort Totten opened its doors on December,1993 and helped to lessen the traffic load of the arteries. Many more people established home-based offices in today's personal computer age. Telecommuting is becoming more commonplace. Acceptance and the use of the Internet and local area networks are growing at a phenomenal rate.

In the waste area, Montgomery closed one section of Oaks landfill and plans to cap it for methane collection by 2001. Fuel oil and propane-fueled space conditioning equipment continued to be converted to more efficient natural gas-fired heating systems in both the residential and commercial sectors. All these improvements in efficiency contributed to the improved performance reflected by the 1995 inventory numbers.

Unfortunately, most of the utilities' rebate programs have been curtailed due to the economic pressures on the utilities as a result of deregulation, and there are even discussions of PEPCO selling off its generating capacity and specializing in marketing electric power. Also, there is the constant addition of new loads that reduce and, in some cases even reverse, prior conservation/efficiency efforts. The bottom line is that cutting demand and improving efficiency alone is not likely to achieve the Takoma Park goal of reducing CO_2 emissions to 80% of the 1990 baseline. It is estimated that the City will hold CO_2e levels steady at 1990 levels by 2010. Additional energy efficiency actions will probably be needed to overcome the escalating use of energy over time.

Chapter 3 -- 2010 EMISSIONS FORECAST

Having established a baseline inventory of Takoma Park's current CO_2 emissions, the next step in the planning process is forecasting of emissions growth under various future conditions. The purpose of such forecasting is to:

- Illustrate the increased global warming that may be caused by Takoma Park's per-capita energy consumption growth if CO_2 emission reduction actions are not taken.

- Quantify the amount of CO_2 emissions that must be eliminated in order for Takoma Park to meet its goal of 80% of the 1990 baseline.

The year 2010 is used as a planning horizon consistent with the international community for meeting the CO_2 reduction goal of 80% of 1990 levels. A set of forecasts have been prepared using differing assumptions about conditions that may occur. Each forecast scenario is based on combinations of community characteristics that affect emissions. These characteristics include:

- Projected Population Growth[12] - Takoma Park's population is predicted to increase slightly by 2010 to 18,600. This yields a per capita emission rate of 15.7 tons CO_2 e in 2010. The net emissions decrease between 1990 and 2010 is projected at a negligible 0.1657%, with a slight per capita increase of 1.3% (15.4 to 15.7). The City as previously stated is composed mostly of older housing /building stock and is fully built out. Most remaining vacant land is either currently designated as park or is proposed to be made into neighborhood parks with just a few exceptions.

- Projected Vehicle miles traveled (VMT) and transit passenger miles traveled[13]- These include all resident trip origins and destinations inside and outside the City consistent with the 1990 baseline inventory. VMT is increasing at a faster rate than population growth throughout Maryland, and in

[12]Source of population projection is Suzanne Ludlow, Coordinator, Economic and Community Development, Takoma Park Department of Housing and Community Development.

[13]Source of the transportation projections is the Maryland Department of Transportation.

Takoma Park a significant 22% increase is projected by 2010.

- Average fuel efficiency of vehicles on the road-- This variable is influenced by federal fuel efficiency standards for new vehicles and the overall age of the region's vehicle stock. This efficiency was 18 mpg in the Washington, D.C. region [WHEN?]. A gradual improvement in baseline fuel efficiency is assumed consistent with MD-DOT projections that reach 21 mpg in 2010.

- Fuel Mix Used to Produce Electricity-- This, together with the amount of electricity used, will determine the amount of CO_2 emissions produced from the use of electricity. This variable is influenced by the carbon intensity of fuels used in the future to generate the community's electricity, i.e., renewables or natural gas versus other fossil fuels (coal and oil). A gradual reduction in the baseline CO_2 intensity of PEPCO's electric fuel mix is assumed consistent with industry and regulatory trends. However, given the significant changes expected from electric industry restructuring , it is unclear how CO_2 emissions will be impacted.

Table 3.1- Takoma Park City-Wide Emissions Forecasts (in tons of CO_2e)

	Population/VMT	Population/VMT Cleaner Power	Population/VMT Higher Vehicle MPG	Combination of all three
2010	347,102 Tons	313,764 Tons	332,354 Tons	299,016 Tons
% '90	99.8%	90.2%	95.6%	86.0%

Note: Federal target is 7% below (93% of)1990; International target is 20% below (80% of)1990

The forecasts are shown in Table 3.1 according to four cases: 1) population and VMT growth only; 2) population and VMT growth with less carbon-intensive electric generation fuels; 3) population and VMT growth with vehicle fuel efficiency improvements that exceed the baseline trend; and 4) a combination of all three previous cases. All four forecasts represent scenarios of what could happen without any special municipal action to reduce Takoma Park's CO_2 emissions. Table 3.2 details the assumptions used for the improved electric resource mix scenario. CO_2 factors are shown in tons per million-Btu used for 1990 were 0.257; 2010 = 0.20854. SOx ; NOx; CO; VOC and PM10 factors as

equivalent CO_2 units are also imbedded in the ICLEI model and detailed in the table. All forecasts include projected methane emissions expressed in equivalent CO_2 units.

Table 3.2- Maryland Electricity Coefficients (in tons per million Btu)

	CO2	SOx	NOx	CO	VOC	PM10
1990	2.57E-1	1.21E-3	3.19E-3	3.63E-5	6.04E-6	2.71E-5
1995	2.08E-1	9.78E-4	2.58E-3	2.93E-5	4.89E-6	2.19E-5
2010*	2.57E-1	1.21E-3	3.19E-3	3.63E-5	6.04E-6	2.71E-5
2010	2.08E-1	9.78E-4	2.58E-3	2.93E-5	4.89E-6	2.19E-5

* note that these match 1990 so as to maintain consistency.

As a final step in projecting emissions, the average of the four 'no municipal action' forecasts has been used in **Figure 3.2** as a basis for comparison to the federal and international reduction goals as follows:

- Expected CO_2 emissions if Takoma Park takes no municipal action to reduce its emissions is the average of the four cases equates to 323,059 tons/yr of emissions in 2010 (that is 92.9% of 1990). To be conservative, the 347,102 tons of CO2 e figure was used for the 2010 figure in the analysis.
- CO_2 emissions that would occur if Takoma Park achieves the current federal reduction goal of stabilizing emissions at 7% below 1990 levels. This would equate to 322,805 tons/yr of emissions in 2010, which would require a reduction of 24,297 tons/year (24,297 = 347,102 - 322,805).
- CO_2 emissions that would occur if Takoma Park achieves the international goal of 2010 emissions equaling 80% of 1990 levels. This would equate to 277,682 tons/yr of emissions in 2010, which would require a reduction of 69,420 tons/year (69,420 = 347,102 - 277,682).

Figure 3.3 expresses the forecasts in terms of CO_2 savings that must be achieved to reach either the federal or international goals. It should be noted again that electricity-related emission estimates in Tables 3.1 and 3.2, and Figures 3.1 through 3.3, are based on previous PEPCO resource planning which may be altered by the electric industry restructuring currently underway.

City-wide Greenhouse Gas Emissions Forecast to 2010

The 2010 CO_2e emissions forecast is intended to reflect CO_2 emissions in the absence of any additional conservation/efficiency measures implemented since 1990. Under this Scenario, Takoma Park CO_2 emissions are predicted to decrease slightly - 576.4 tons (0.166%) below 1990 base years' level.

Figure 7. 2010 Forecast Greenhouse Gas Emissions by Source

The growth assumptions used to create this forecast and the resulting emissions growth rates are outlined in Table 1. The assumptions are discussed in greater detail in Appendix B. "Takoma Park Greenhouse Gas Emissions Analysis".

Table 1. Takoma Park 2010 Emissions Forecast Assumptions

Chapter 4 -- LOCAL ACTIONS TAKEN IN 1999

The Takoma Park Climate Change Task Force, at times working in conjunction with the Mount Rainier Task Force, took a number of analytical and public process steps from November 1998 through November 1999 as a part of the work of developing this plan of local action for reducing greenhouse gas emissions. These steps and actions included:

1. Street lighting study (in conjunction with Mount Rainier). Fred Sissine of Mount Rainier took the lead in engaging energy consultant Debra Sachs of Vermont to spend four days in our two communities. The Sachs study entailed: 1) a survey of street lighting uses in both jurisdictions; 2) an assessment of where and how the two Cities might improve lighting and reduce energy use; and 3) presentations on her findings to both city councils. (February, 1999)

2. Site visit to Montgomery County Incineration Power Plant facility at Dickerson. (March, 1999)

3. In-depth analysis of PEPCO and Washington Gas records of energy consumption in Takoma Park and Mount Rainier to develop baseline data, by Albert Nunez and Caterina Hatcher of the TPCoE.

4. In-depth analysis of transportation impacts on Takoma Park by James Sebastian and Dean Menke of the TPCOE.

5. A Takoma Park-Mount Rainier Town Meeting on Energy and the Environment on June 5 in Takoma Park. The event attracted 50 people and produced a detailed list of ideas and priorities for local action in each sector discussed in this report.

6. Led by Catherine Tunis, with the generous assistance of Takoma Park resident Steve Whitney, the TPCOE set up micro-climate monitoring stations in two Takoma Park locations a mile apart — the first in a treed backyard and the second on a rooftop in the midst of a shopping center parking lot. Initial readings showed a dramatic temperature difference. In 2000, the TPCOE will be able to monitor the two sites over the course of the entire summer to better establish the cooling effect of trees. The City of Takoma Park invested over $1,400 in equipment and software.

7. Takoma Park's efforts to ameliorate the local environment, including the positive effect of trees, was featured on a Maryland Public Television program in September, 1999. TPCoE members Catherine Tunis and Albert Nunez were interviewed.

8. Prepared successful application by the Takoma Park Middle School to the Maryland Energy Administration's Solar Schools program for a demonstration solar electric (photovoltaic) rooftop system. The school was one of six selected for a system in October 1999 by BP Amoco, major source of funding and supplier of the solar panels.

Chapter 5 -- ACTION MEASURES FOR REDUCING GREENHOUSE GAS EMISSIONS

Introduction

This chapter presents the proposed actions to reduce greenhouse gas emissions that were suggested at the June, 1999 Town Meeting and developed by the Task Force. There are actions proposed for each sector.

The first section of the chapter proposes actions the municipal government can take to develop programs that will reduce CO_2 emissions. There are several potential ways that the city can influence lowering the municipal contribution as well as the residential and commercial sectors. Takoma Park has already begun to improve the energy efficiency of its own facilities over the past five years by taking advantage of utility rebate programs and federally-sponsored energy efficiency initiatives like the US EPA Green Lights / Energy Star Buildings Program. But there is still much more that can be done, particularly now that the electric utility industry is undergoing deregulation in Maryland. This report lists the options currently available to the City for reducing Takoma Park's greenhouse gas emissions resulting from the use of electricity. This municipal section contains two proposed actions in reports by guest consultants.

A section on Natural Resources deals with the potential for improving the natural environment by maintaining and adding to our mature urban forest. The City's urban forest aids in reducing CO_2 emissions by reducing the "Urban Heat Island Effect"[14] in our City, thus reducing the need for summer-time air-conditioning which in turn reduces electric power consumption. Trees also sequester carbon as part of their photosynthesis and wood-producing processes.

[14]"Urban Heat Island Effect" occurs when the heat due to warm air and solar radiation warms buildings, streets, and parking lots. These areas absorb and hold heat significantly more than green areas, thus making these areas warmer, even at night. This increases the need for air-conditioning during the summer months. For more information, see the web page for the Heat Island Group at the Berkley National Laboratory: http://www.EETB.LBL.gov/HeatIsland/LEARN.

The section on Waste Measures describes potential actions for this sector. Municipal solid waste (MSW) can be a significant contributor to the total municipal CO_2 emissions, particularly if MSW is landfilled without any methane recovery in place. Montgomery County is one of the Nation's leaders in trying to convert MSW to useful energy with its Dickerson Incineration Power Plant Facility.[15]

Transportation is the most difficult sector for a fully developed inner suburb to be able to change. The dilemma stems from the fact that there are several major arterial roads that either pass through or skirt Takoma Park. These arterial roads carry a major amount of outer suburban commuter traffic on a daily basis. There are currently no easy local methods for curbing this flow since most of it travels through Takoma Park on State or US highways. The Task Force decided to consider only the estimated greenhouse gas emissions from Takoma Park's own population (vehicle population) in the analysis.[16]

[15] Incineration is considered CO_2 neutral but it is not without controversy. Many of those who live downstream from the Dickerson Plant stacks believe that they are being exposed to higher than normal levels of heavy metals as a result of the nearly continuous burning of MSW for the production of power. On the other hand, one of the main benefits of this facility is that it reduces the volume of MSW by over 90% (ash) while producing a significant amount of electricity.

[16] This dropped the transportation contribution to approximately one-third of the Department of Highway traffic count VMT figures.

List of Action Measures

Municipal Government Sector

- Takoma Park Municipal Electric Utility
- Street Lighting

Commercial/Residential Sector

- Shared Energy Savings For Apartments, Commercial And Institutional Buildings
- Solar Photovoltaics Schools Program
- Green Power Group Purchasing Program
- Public Information Dissemination
- Revolving Loan Fund Program
- Efficiency Upgrades at Building Sale Time of Transfer
- Group Purchasing Program

Natural Resources Sector

- Educate About Tree Selection, Planting, and Maintenance
- Educate About Trees and Parking Lot Heat Islands
- Plant Trees in Median Strips of New Hampshire Avenue and University Boulevard
- Build Bio-retention Areas and Plant Trees to Slow Storm Water
- Permeable Surfaces for Streets and Driveways in New Construction
- Larger Tree Boxes for New Plantings

Waste Sector

- Pay-As-You-Throw Trash Service
- Adopt and Enforce County Business Recycling Ordinance
- Expand Plastic Recycling Program

Transportation Sector

- Cleaner Municipal Fleet of Vehicles
- Vehicles Scrappage Program
- Promote Alternative Modes of Transportation
- Improve Transit Information

Bicycle and Pedestrian Facilities

Municipal Government Sector

The municipal government can affect energy consumption in all sectors through policy and governance and can reduce energy consumption directly by actions that cover publically-owned buildings and vehicles. The municipal government of Takoma Park can play a leadership role in reducing energy use across the city through high-profile example, through action and/or expenditure that encourage actions by the private sector through legislated mandates or incentives.

Current / Existing Actions That Affect Energy Consumption

Both through policy and through direct action, the municipal government of Takoma Park has already played a significant role in reducing greenhouse gas emissions. These actions include:

1. Energy efficiency upgrades in the Municipal Building and Library reduced energy use by 30 percent (1996).
2. Enactment of an aggressive recycling program that has reduced the city contribution to local landfills.
3. Enactment and enforcement of a strict urban tree ordinance regulating cutting of trees and aggressive action to purchase and preserve parcels of land for green and open space.
4. Use of a compressed natural gas fueling station for city vehicles on a pilot basis. Although this program has been discontinued, it did give the city a 'real world' test of the problems and promise of alternative fuels.
5. Initial use of solar photovoltaic electricity to light a park picnic shelter and a street/public pathway.

One of the most promising means for the municipal government to play a role in reducing energy consumption may be in the formation of a municipal (publically-owned) electric utility. This utility might service just the municipal electric loads of the city, or it may be expanded to bring energy services, in part or fully, to all sectors of the city.

The role of this municipal utility would be to deliver cleaner sources of electric power, either purchased from outside suppliers, and/or sited in the city on municipal property and/or on commercial and residential property. Clean power sources that may be developed within Takoma Park proper include low-emission natural gas fueled micro turbines or fuel cells, and zero emission photovoltaic systems, and eventually, hydrogen-fueled fuel cells. The Takoma Park municipal utility may also offer directly or broker

energy services such as energy-efficient retrofits or installation of renewable generation (solar), or energy service performance contracting for commercial consumers.

Christopher Cook, an attorney with electric utility experience and until recently a staff member of the Maryland Energy Administration, has authored a concept paper that explores this municipal utility option in greater detail.

Following Cook's report is the record from the analysis of Takoma Park street lighting by consultant Debra Sachs.

MUNICIPAL (CORPORATE) CONTRIBUTIONS AND POTENTIAL ACTIONS

Takoma Park Municipal Electric Utility

- DRAFT (November 24, 1999)

by

Christopher Cook, Esq., Consultant

The City of Takoma Park will investigate two areas in which it may provide its own electricity services, one supplying electrical loads defined as "municipal purposes", the second providing on-site distributed renewable and environmentally friendly generation systems and conservation services. Provision of both of these types of services will be done under the aegis of a Takoma Park Municipal Electric Utility to be named Takoma Park Power (TPP) for the purpose of significantly reducing greenhouse gas emissions associated with electricity consumption by and in the City.

Background/Feasibility

More than 2000 municipalities in this country offer full electric utility service providing supply, distribution, billing and maintenance in much the same manner as for-profit electric utilities. Interestingly, for residential customers, municipal electric service is on average 30 percent lower than for-profit utilities. The low cost of borrowing for municipalities is a primary reason for these lower rates, and this low cost bodes very well for high capital cost technologies like renewable energy, on-site generation and combined heat and power plants.

Typical investor owned electric utility cost of capital can be in the 10 to 11 percent range. Ordinary

commercial paper, loans or notes, may command interest rates of eight to ten percent. When one compares these rates against municipal bonds (in the five percent range), it is quite logical that if renewable generation (e.g., photovoltaics), as a very capital intensive generation technology, is to penetrate the market, municipal low-cost financing is key.

One obstacle to using municipal tax-free financing is that the capital can be used only for public purposes. In order to clear this hurdle Takoma Park, should establish itself as a non-wire service municipal electric utility. In Maryland, five municipalities already provide full electric service to their citizens, including all the traditional electric utility functions like distribution services (poles and wires), metering, meter reading, billing, generation and service restoration.

Maryland Public Service Commission law contemplates that additional municipalities could become municipal electric utilities. The Public Utility Companies Article, Section 7-210(b) states that, a municipal corporation (other than Baltimore City) may not build or operate a plant for supplying electricity for other than municipal purposes unless the municipality has a certificate of authority from the Commission (emphasis added). In other words, the Commission must approve the creation of the TPP, if it will supply electricity for non-municipal purposes but arguably no approval is needed if TPP will supply only those electrical loads deemed to be municipal purposes. As there is no case law defining municipal purpose, it is unclear whether the Public Service Commission would take a broad or narrow reading of this term. Under the most restrictive interpretation, municipal purposes would likely mean those owned and operated by the municipality. A broader reading may include electric service for all loads that have even a remote municipal purpose.

Under the likely interpretation of this section of the law, if Takoma Park wanted to provide service only to municipal loads, it should be able to do so without Commission authority. Commission authority would likely be needed to provide non-municipal loads with distributed renewable and environmentally friendly generation technologies. This authority may be easy to acquire as the existing electricity provider is not presently providing any service of this type, nor have they indicated any intention to provide this service in the future. Under this proviso, the Commission would not need to be concerned about displacing franchised electric service currently being offered in Takoma Park. The grant of authority, however, would not likely be an exclusive franchise, so TPP would be competing with other entities that may also wish to provide distributed generation services.

Creation

The steps to create this new municipal electric utility would include promulgating local legislation that authorizes the City to create a municipal electric utility or authority for the purposes of providing electricity service to serve municipal purposes, as well as providing customer sited renewable distributed generation; and conservation or "negawatt" services for all Takoma Park businesses and residences. After the municipal utility is authorized, it should be incorporated by filing with the State Assessments and Taxation division. It remains to be determined whether the laws pertaining to corporations providing electric service will apply to the new municipal electric utility. A board of directors will need to be appointed, either including or made up entirely from City officials.

Once established, the new municipal electric utility will legally be able to begin providing services for municipal purposes. To extend these services beyond just municipal electric loads, the new TPP should file an application with the Maryland Public Service Commission (PSC) to provide municipal electric service in the form of on-site distributed generation and conservation services, wholly within the municipal corporate borders. This filing should also notify the Commission that TPP will be serving municipal loads but it should be the position that Commission approval is not necessary pursuant to the Code (Public Utility Companies Article, Section 7-210).

As this is a case of first impression, the basis on which the PSC will make its decision and the procedure it will undertake to arrive at a decision are unknown. The PSC could have an expedited decision making process in which it approves the application at an administrative meeting, it could supplement that process with informal meetings or workshops, or it could require a full evidentiary hearing.

Serving Municipal Loads

The new TPP will be able to provide full electricity services for municipal purposes. These would include Heffner Park, the Public Works Facilities, the municipal building and library. Street lighting could also be included as a municipal purpose but the street lights would have to be physically interconnected with a distribution circuit, or a mutually acceptable arrangement would have to be negotiated with PEPCO. Municipal purposes might be extended to include schools, hospitals, colleges and even certain apartment buildings provided that Takoma Park was the landlord or owner either directly or through joint ventures.

TPP would be responsible for providing electricity generation services for all of these municipal loads. Unless the City decided to select a "green" electricity supplier (see discussion below), the most

environmentally friendly generation service is an on site generation source using a combined heat and power plant. These small electric production plants typically use natural gas as the primary fuel source with fuel oil as a backup fuel. Unlike large central station plants, however, these smaller plants, because they are sited near the load they serve, offset line losses which can account for up to ten percent of the power produced. In addition, instead of wasting the excess heat from electricity production, the heat can be turned into steam to provide district heating for buildings nearby. In the summer, the excess heat can be used to run a steam driven chiller which can provide district chilled water to offset building cooling needs. By providing all three end use energy needs (electricity, heat, chilled water) the combined heat and power plants can achieve efficiencies as high as 90 percent. In some cases this is 3 times the efficiency of central station plants providing a 1/3 or greater reduction in emissions per unit of electricity generated. The bulk of the non carbon-based emission savings results from the fuel source switch from coal to natural gas.

Even though purchasing 100 percent renewable electricity from the competitive electricity marketplace, when it opens in Maryland in July 2000, would effectively reduce Takoma Park 's electricity-based emissions to zero, the cost of purchasing this type of power may come at a significant premium. Conversely, the combined heat and power from an on-site generation source, may provide significant reductions in emissions but also reduce overall costs. Because the combined heat and power option is more efficient, it translates into reduced electricity and space conditioning costs.

In order to supply non-contiguous loads or load areas, the new TPP might have to physically interconnect each site with an electrical distribution system. If PEPCO (the distribution utility) is unwilling to lease or otherwise provide distribution services at a reasonable cost, the installation and maintenance cost of the mini-distribution system will need to be included in the total price for electricity.

Because a large part of the efficiencies of combined heat and power plants come from the use of the excess heat for heating or cooling needs, a combined heat and power plant at a single location would also have to employ a hot and chilled water distribution system. This system could be installed at the same time as the electrical distribution system providing mutual savings to both systems.

There is a good likelihood that the easiest and least costly approach to providing both the generation and distribution services will be to do so under a performance contract. This legal mechanism has been used successfully by a number of Maryland State Agencies and several local governments. Most recently, the

University of Maryland, College Park, entered into a large performance contract which will include the installation of generation equipment and electrical distribution services throughout the college campus. The performance contractor for the University will also upgrade and install new steam and hot water distribution services for the campus. There would be many similarities between the type of combined heat and power plant that Takoma Park might install with the type of system the University is preparing to install.

Estimated Costs/Technologies

If TPP serves only the municipal buildings and facilities that it presently owns, a small 200-kilowatt combustion turbine or fuel cell should provide sufficient capacity. A unit of this size, while reducing emissions from the electricity generation sources that currently supply the City, will likely provide only a portion of the heating and cooling needs of the municipal facilities. Since units of this size have a relatively small footprint (100-200 square feet) and can be operated with little noise, the optimal site for this size system would be at the municipal building itself. The cost to provide both a chilled-water, heat and electricity distribution system from this plant are probably too costly for the loads at other sites. An electrical distribution system by itself may make economic sense, particularly for municipal facilities that are paying electricity rates above 8 cents per kilowatt hour.

A fuel cell or micro turbine in this size range (200 kW) is estimated to be able to provide electricity in the 7 cents per kilowatt hour range provided the excess heat provided by either type unit is fully utilized. This represents approximately a 10% reduction in the cost of electricity for these Takoma Park facilities and would range from about $5700 per year to $20,000 assuming about one-third of street lights could be included in the service (excluding distribution investment amortization).

Because there are certain economies of scale to a larger on-site power plant, the costs to Takoma Park from a combined heat and power plant that would serve additional municipal electric loads acquired by the City, could be reduced to the 6 to 6.5 cents per kilowatt hour range. These costs are representative of a plant in the 10 to 20 Megawatt range and the costs would include an underground electrical distribution system to transmit the electricity from the production site to the loads within the City. While this is a more complex project and it is not clear that the City will be able to acquire an interest in all of the facilities it might like to serve from such a plant, the cost reduction to the City would be in the 15 to 25 percentage range or from $9000 to 30,000 per year. In order to be a viable option, this rate would have to represent a cost reduction to the other facilities the City would serve (apartment buildings, hospitals, etc.).

Serving a larger number of facilities from this larger plant would also extend the emissions savings to a broader base of loads than just the existing municipal facilities. The reductions in emissions from combined heat and power plants together with a lowered cost for electricity make this option quite attractive. The objective would be to identify the largest number of loads that could reasonably be served from a combined heat and power plant, then construct the plant at the site of the largest load. This would reduce the size of the distribution system needed to transmit the electricity to the location of the generator to the other electrical loads.

The other alternative would be to purchase the electricity for these facilities from a "green" electricity supplier. In the competitive market for generation services, open to Maryland retail customers starting July 1, 2000, Takoma Park should be able to purchase a 100% renewable generation option. However, the cost for this premium option will likely add one-half to two cents per kilowatt hour to the Takoma Park electric bill. This would represent an increase in the electricity expenditures for the City of about $ 9,000 to $30,000 per year depending on the green power premium.

Green or renewable energy electricity suppliers have offered varying levels of renewable energy mixes in the other jurisdictions where retail access electricity competition has been allowed. It is likely that the suppliers will offer similar gradations of renewable mixes in Maryland in July 2000. The higher percentages of renewable energy typically has the higher costs. Thus the premium for a 50 percent renewable mix might be in the 1 cent per kilowatt hour range.

Because of the cost premium for renewable energy generation that "Green" electricity suppliers may make available, it is doubtful that many commercial enterprises in Takoma Park will sign up for a large percentage of green electricity. Identifying a method by which to extend the service from a combined heat and power plant is likely the most economical approach to reducing their emissions.

Serving non-municipal loads

The complementary service to the direct supply of electricity through a combined heat and power plant is distributed generation and conservation for all residential and business customers within Takoma Park. Unless these services are deemed to be a "municipal purposes" (which is not likely) the TPP would need a certificate of authority from the PSC prior to offering these services.

Because no franchised electricity provider is providing these types of services, and because an offering

of these is not a direct infringement on the existing franchise, it is somewhat probable that the PSC would grant the City the certificate to provide these services. Assuming the City obtains this permission, it should offer the following services:

Renewable on site generation (primarily solar photovoltaics);
High efficiency, low emission distributed generation technologies (fuel cells and Micro-turbines);
Conservation/efficiency packages ("negawatt service");
Fuel switching (electric heat loads to solar thermal or natural gas).

Except for the solar photovoltaics, most of the other service offerings should be more economical for the customer over the life of the distributed generation equipment, than buying the comparable electricity from the grid. If photovoltaics are packaged with the energy efficiency technologies, the overall package could still provide a savings to the customer.

The first major benefit of providing these services through TPP is that the financing can be undertaken at tax free municipal rates. Since each of these technologies represents, for the customer, an up-front capital investment instead of a stream of monthly electricity purchases, the cost of capital is key to making the trade off cost effective.

The second major benefit, and, in a number of cases, this may be larger than the cost of capital, is the simplicity which TPP could bring to the overall process. If properly designed, a business or residential customer would need to place just a single phone call to have a complete package of measures installed in their home or business. The singular obligation of the customer would be to pay the monthly electric bill from TPP that would begin to arrive after the new efficiency and distributed generation technologies were installed.

In order for TPP to provide these services, it would need three things, all undertaken by contract. The first would be a financing fund. The financing will be secured by The TPP which shall provide distributed power generation and energy conservation programs for its customers. The return on this investment will be paid by a stream of revenues from the customers served, thus making it revenue backed financing. Many entities are willing to offer this type of tax free financing and it can be created without the need for a City bond issuance, although that is also a possible resource for the financing fund. In order to lower the monthly cost to the customer, the financing will need to be long-term (15 to 30 years).

The second need is for a performance contractor/installer. The City should select a contractor to undertake the analysis, installation, and to some degree monitoring and performance guarantees for the distributed generation and conservation measures. Since the facilities will technically be owned by TPP, and since it will likely be in the customer's best interest to have TPP maintain them, it is important that all facilities are of good quality with good installation. Thus TPP will need to ensure that it selects a good contractor and seeks performance guarantees from that contractor. Certainly one of the benefits of having the City undertake the process of contractor selection is that the residents and businesses will have a degree of trust in the installation of the equipment and measures. Many consumers have difficulty knowing whether a private contractor they might select on their own is properly evaluating and advertising the energy performance of equipment they install. The consumer buying from the open market is also not likely to receive any assurance the energy equipment will continue to perform as advertised through any period of duration. The municipal electric utility would provide assurance and comfort in both of these areas.

The third major need is a billing system. Since the TPP will be installing capital equipment on various customer sites, it will need to render a monthly (or quarterly) electric bill representing the revenue stream that will pay for the financing. Because of the costs of creating a new billing system, the bill for these new municipal utility services should be attached to an existing billing. This might be an existing utility bill issued by the City or a tax bill. Currently the only billing done by the city is for storm water and apartment rental licensing and these are sent out annually. All other tax bills are sent by the county. If the city were to take on this responsibility, it would have to review its data base to include all new TPP accounts that are current PEPCO electric power customers and switch to a monthly or quarterly billing cycle.

In the alternative, the TPP bill could appear on the billing for electricity from selected competitive electricity providers. Since each electricity supplier will need to have a billing system for their services, the TPP bill could become part of that electric bill. In return for providing the billing services, Takoma Park could recommend their constituents select that particular supplier for their non on-site generated electricity supply needs.

Once all three of these pieces were in place, TPP would be able to begin offering service to Takoma Park constituents/customers. An interested customer would call TPP (or a designated contractor) and select from several options for on-site generation (renewable or otherwise) and conservation packages. The designated contractor would visit the customer's site, conduct an energy analysis and recommend

measures that would save the customer energy and money. Once the identified measures were installed, the customer would start receiving an electric bill from TPP representing the revenues to pay the financing for the installed facilitates. TPP would own the facilities until the debt was satisfied, but could probably allow any customer to acquire ownership by paying an amount that would represent TPP's sunk cost in the facilities. The one contractual provision TPP would need is a guarantee that the customer would continue to pay the electric bill for the time needed to repay the financing. The revenues and billing could continue from one owner of the home or business to another or could be purchased at the time of sale of the home or business, as desired by seller and buyer.

The process should be kept simple for residents and businesses, allowing them to make a single phone call to initiate the process, and having them sign one simple agreement that binds them to pay the TPP electric bills for the period of time appropriate for the renewable generation and conservation measures installed.

The conservation and on-site renewable energy generation measures TPP delivers will reduce 100 percent of the emissions that were formerly created as part of the generation of electricity to supply the displaced electrical loads. Electrical loads that are switched to natural gas will reduce a significant percentage, but not 100 percent, of the emissions. The same holds true for on-site non-renewable electricity generation. For the likely technologies, fuel cells and micro turbines, the fuel source for both of these will probably be natural gas.

Green Power Providers

While the TPP may be able to reduce a significant percentage of the emissions from electricity production through the extension of conservation and distributed generation, Takoma Park citizens will continue to require central station generation services. The City should consider promoting one or more green power options for its citizens to further reduce the electricity-based emissions from this residual consumption. Takoma Park could negotiate with one or more green electricity suppliers to put together a special green power option or options that the City would assist in promoting. In return for this promotion, the green provider could be asked to offer a lower than retail rate to Takoma Park citizens and/or a reduction in the cost of a green power supply option to serve municipal facilities. The reductions may have a sliding scale to reflect the success of the promotion of the offering such as one rate if 10 percent of Takoma Park customers sign up but a lower rate if 25 percent were to sign up. This kind of agreement helps both the City by getting a lower cost green power option for itself (which saves taxes from the citizens) and for the citizens directly served, and the green power provider since they will likely have a greater interest in their

product because of the City's promotion thereof.

Municipal Utility for Electricity Supply Services

Another area for investigation would be an extension of the services offered by the contemplated TPP into electricity supply for all businesses and residences located within the City limits. Offering to purchase electricity supply for all Takoma Park citizens and businesses would require PSC approval because it would most likely be considered electricity service to non- municipal loads, which requires PSC approval under Section 7-210. If and when approved, however, the TPP would become responsible for purchasing electricity supply and delivering that supply to the distribution utility for distribution to all residences and businesses. TPP would be one step closer to a full municipal electric utility except that it would not be providing distribution services. Distribution services could continue to be provided by the existing distribution utility, PEPCO (which coincidently has stated it does not wish to continue to provide generation services).

If TPP provided these services as a municipal electric utility, it would become the standard offer generation provider and would have to supply any business or residence that could not otherwise find a competitive electricity supplier, or who did not select an electricity supplier. TPP would also have to address how and when it would cease to supply and effectively terminate service to customers who did not pay their electric bills or needed to close their accounts.

If TPP was authorized to become a municipal electric utility for all aspects of electric service save distribution (this may include billing and metering), it could, under the recently enacted electricity restructuring legislation, deny retail access to customers within the municipal borders. Instead, by exercising the provision in the restructuring legislation, that a municipal electric utility need not provide retail access, it could provide electricity supply (and other services) for each and every customer in Takoma Park . While legally this is an option, it is likely that the PSC would deny authority for TPP to provide electricity service if this was announced as the intention. Instead, the PSC's approval would likely be contingent on offering retail access to whichever customers so desire.

In this case, any customer that desired to select a competitive electricity supplier different than that selected by TPP, could do so. Other customers would be served by the supplier TPP chooses. The advantage of undertaking this approach is that TPP would likely be selecting a supplier for a much larger block of customers and could use that buying leverage to garner a lower price for a green electricity

product that might not otherwise be offered to consumers. In the alternative, and provided it was both economical and reduced emissions, TPP might build a much larger combined heat and power plant that would supply a large portion of the total electrical load in Takoma Park. In either case, TPP could include a requirement that the selected supplier or generator offer billing services (metering if possible) for the on-site distributed generation and conservation services that TPP would also offer as part of its municipal electric service (as discussed above).

TPP municipal power assumptions:

kWh/yr	Btu	est. gen capacity kW		cost $	kWh/yr	$/kWh	
9,376	32	2.14		911	9,376	0.097	Heffner Pk
656,021	2239	74.89		50,672	656,021	0.077	Muni bldg / library
62,408	213	7.12		5,360	62,408	0.086	PW
			sub total	56,943	727,805	0.078	
115,441	394	13.18		126,000	1,050,000	0.120	SL
		load fac	Total	182,943	1,777,805	0.103	<-avg
		50%					

Municipal Government Measure

Street Lighting

by

Debra Sachs
Lighting Consultant

Outdoor Lighting Action Measure:

Problem Statement and Approach

Like many U.S. communities, Mount Rainier and Takoma Park are striving to improve the quality and the energy efficiency of outdoor lighting in its public facilities, pedestrian areas, streets and roadways. The increased use of lighting, excessive illumination levels, glare and light trespass concern community leaders, decision-makers, and the public.

To help increase community awareness and to address the issues, the Mayors of Mount Rainier and Takoma Park hired a lighting expert to assist in facilitating a series of public forums, work sessions, night-time tours, and presentations in February, 1999. A group of enthusiastic citizens and municipal/state agency staff participated. The group explored opportunities to reduce energy consumption and identified ways to improve their communities via alternative lighting designs and use of innovative technologies.

Each community began by characterizing the specific outdoor lighting issues, and then explored the opportunities to achieve the community's objectives: 1) to increase energy efficiency and cost savings, and 2) to enhance community character, and to protect the night-time environment and night landscape.

Outdoor Lighting—How big is the Issue?

(a) Total city wide electricity demand in 1990 for Takoma Park is estimated at 2,400,000 kW. Electricity use for all lighting, typically represents 25 percent of the total, and of that amount 2.5 percent is used for outdoor lighting.

The International Dark Sky Association estimates that 30 percent of all outdoor lighting is wasted due to use on non-cut-off, unshielded and mis-directed fixtures. This translates into a large amount of wasted energy—and consequently, a negative impact on the night-time environment.

(b) Several lighting plans are well designed; however, many are not. Good lighting plans will

consider the tasks that need to be illuminated, will install quality fixtures, will design for the minimum light levels, and will utilize a variety of other energy efficiency measures (e.g., requiring lights to be extinguished following regular business hours, and using cut-off fixtures). Lighting can help to create warm and inviting outdoor spaces, but ill-designed sites can produce bright sources of glare along streets and roadways.

One mis-belief is that outdoor lighting will make it safer for pedestrians and property. Lighting alone will not make areas safer. It is the combination of factors including: well-designed spaces, use of appropriate light levels, and use of cut-off or non-glaring fixtures are the factors that attract people. Often the key is the presence of people, people that are drawn to vibrant, inviting centers. People and activities positively impact the incidence of crime to both people and property. More aesthetic and inviting places have the added economic benefit to business.

Part I: Characteristics of Outdoor Lighting

Competing needs makes the task of illuminating streets and sidewalks difficult. Research suggests that several factors play a role in the design of quality outdoor lighting applications. Good color full-spectrum light, appropriate illumination levels, absence of glare, and even light distributions all contribute to “visual acuity” and “good visual performance”. These are the characteristics of a quality outdoor lighting environment. Researchers indicate that “visual performance” is improved under a more full-spectrum light. Thus, one can see better under white light at lower levels than its poorer quality counterparts.

Takoma Park

Takoma Park is located on the northeast border of Washington, D.C. Takoma Park is a community with wonderful dense neighborhoods, narrow residential streets, sidewalks, and large street trees. Its juxtaposition with the District of Columbia and Prince Georges County makes the lighting of the City’s commercial areas very challenging. Takoma Park has two traditional village centers and City officials are working hard to link and promote the two centers with nearby neighborhoods and services. Commercial districts located on the boundaries of the City (south side of New Hampshire Avenue) and the resulting excessive illumination levels offer opportunities for improvement.

Several established neighborhoods in the City are adorned with historic street lamps of the “Admiral Cap” style. These fixtures are typically lamped with 186-watt incandescents. The City is well aware of the inefficiencies of incandescent lamps, but, the overall quality and color of the lighting must not be

compromised for efficiency sake. Though light levels are minimum, the existing system creates a warm and inviting neighborhood ambiance.

Crime rates in nearby District of Columbia and Prince George's County have elected officials, decision-makers and the public concerned. Recent incidents in Tacoma's neighborhoods however, are requesting action from the City to add more light. At issue is loss of character of these quiet neighborhoods. Elected officials are interested in exploring ways to address the neighborhood's concerns without compromising the character of these low lit neighborhoods. To date, the City has responded to the issues on a case-by-case basis.

Part II: Analysis of Lighting Opportunities

(a) Methodology: On-Site Visit & Follow-up

(i) All-hands presentation on lighting principles & general problems—On the afternoon of Saturday, February 6, 1999, Mayor Sissine and the U.S. Route 1 Round-about Task Force welcomed a group of more than 30 people interested in outdoor lighting from both Takoma Park and Mount Rainier to a kick-off discussion and presentation on outdoor lighting. Planning consultant and outdoor lighting expert, Debra Sachs presented the Vermont Outdoor Lighting Study and facilitated break-out discussion sessions. Participants articulated their concerns about the increased use of outdoor lighting and the relative impacts on the character of their communities.

(ii) Small group identification of local problems—Following the presentation, each community broke out into small groups to articulate the issues and the opportunities for each community.

(iii) Night-time tour—Advanced notice was given to meeting participants to join the night-time tour of the community. The pre-arranged tour included selected locations to visit to discuss a broad range of items including: How participants felt about the environment, the light levels, the quality of the light, and the presence or absence of glare. Each participant was provided color paint strips that would help participants evaluate the quality of the light and how well it rendered objects in the natural environment.

(iv) Photo tour—Following the night-time tour, the consultant and representatives of the community re-visited each site and took night-time photographs of each of the sites. The purpose was to develop a slide show for presentation to the City Council. This worked extremely well in conveying basic outdoor lighting principles and how the community measured up to these principles.

(v) Vendor tour/staff meetings—One of the more successful strategies of the kick-off presentation was the use of vendors. Representatives of a local outdoor lighting manufacturer set-up and

demonstrated various lamp technologies in their product line. Participants were able to experience first hand various lamp technologies and its color characteristics.

(vi) Council presentation—Both Takoma Park and Mount Rainier allocated time in their council meeting to increase their awareness about outdoor lighting and how installations compared in their community. Debra Sachs presented the results of the night-time tour at the Council meeting on local access television.

(vii) Staff Professional Development—Debra Sachs worked with City staff to discuss how to review and approve lighting plans and what questions are pertinent for developers, engineers and others. Design, safety, economic and environmental characteristics were addressed.

(v) Follow-up—Following the four day consultation and work with the two cities, the consultant conducted additional research of U.S. communities standardizing of induction lighting, a new technology to the U.S. Case-study summaries were prepared and distributed to staff and city officials for their use.

(b) Issues & Findings

Following the four days of accelerated work tasks on outdoor lighting, the City can be characterized as dealing with significant issues such as: excessive illumination levels on streets and commercial properties leading to wasted light, light pollution and resulting glare; lack of an inventory or plan for replacement of aging fixtures and antiquated technologies; and lack of a clear local outdoor lighting policy.

(i) Local technology choice: induction vs. metal halide (& others)

(ii) Barriers to induction technology

(informational, institutional, educational, physical, financial)

Part III: Conclusions for Action Plan

(a) Electric energy-saving potential: induction vs existing lights (mv, hps, incandescent)

(b) Life-cycle cost-saving potential

(c) Implications for forecast analysis

Suggested Actions for Takoma Park:

1) Develop a master plan and a clear policy that defines the lighting energy goals for the City.
2) Explore energy efficiency standards with an aim to reduce energy demand without compromising the night-time landscape and night-time environment.
3) Explore the use of new technologies for street lighting (e.g., induction lighting)
4) Work with PEPCO to re-invent programs that respond to customer needs.

5) Develop planning and zoning language to include performance-based standards for selected outdoor lighting applications.
6) Develop an education program to increase awareness among residents and commercial property-owners to explore various alternatives in lighting (e.g., satisfaction with less light).

Appendices:

(a) Records of 4-day visit (e.g. itinerary, agendas)
(b) Records of post-visit
(c) Spreadsheet

Note: Debra Sachs' final report to the Cities of Mount Rainier and Takoma Park, including all the details of her analysis can be found as Appendix D and E is a copy of the Study Guide - Nighttime outdoor Lighting Tour.

Commercial/Residential Sectors

Reducing energy consumption, with an accent on the reduction of the use of electric energy (or substitution of fossil-fueled electricity with renewably powered electricity) in the commercial and residential sectors, will require similar and overlapping local actions and strategies.

As discussed in the previous section, any action taken to form a full-service municipal utility will have a direct bearing on reducing and changing commercial and residential consumption patterns. A Takoma Park Power Municipal Utility would be able to deliver a package of energy efficient services to both residential and commercial consumers (it may be the logical entity to fill the role of the Energy Project Facilitator described in the following section by Caterina Hatcher). Takoma Park Power would be able to offer an affordable and attractive vendor of on-site renewable energy systems. And a TPP could aggregate city consumers to garner more attractive rates from a green power provider as Maryland opens its electricity market to choice in July 2000.

In the absence of a formally organized municipal electric utility that can service the commercial and residential sectors, there will be a strong need for public information on all of these energy choices to orient the public towards choices that reduce emissions while meeting energy needs in an affordable fashion. In addition, there should be a local oversight committee or association to organize, interface and provide the Energy Project Facilitator for the commercial sector, to recommend vendors for renewable on-site installations for both commercial and residential, and for other consumer help, such as aggregating the group purchase of energy efficient lighting systems, windows, etc.

There are other options to move the use of renewable energy forward with local action. An alternative to the city municipal utility is the formation of a green power cooperative, another option to aggregate green power purchases under utility deregulation in Maryland. A green power cooperative would not need to be limited to the borders of Takoma Park; in fact, a cooperative utility financing organization, the Cooperative Finance Corporation (CFC) of Herndon, Virginia, says that success of such a cooperative would require more consumer members than Takoma Park could yield. (CFC has financed new “paper” consumer electric cooperatives in California and New York City, and is negotiating with a green co-op forming in New England).

Potential CO2 Reduction Action Measures

for the

Commercial Sector

by

Caterina Hatcher
Energy Subcommittee
Committee on the Environment

Commercial Sector

Baseline year commercial building energy consumption in Takoma Park represents 25.8% of the City's greenhouse gas emissions. Burning fossil fuel to generate energy to run building systems causes the emission of greenhouse gases. Of the energy consumed by this sector, fossil-fuel generated electricity makes up 96.2% and directly supplied natural gas represent the remainder (3.8%). Fossil-fuel generated electricity in Maryland pollutes three times as much as directly supplied natural gas per Btu consumed.

Currently, commercial sector emissions are forecast to reach 125,381 tons (23.9%) in 2010. The combined sector reduction strategies need to reduce greenhouse gas emissions by 20% below 1990 levels (111,678.4 tons) by 2010.

Since this climate change action plan looks to 2010, the potential for cost-effective reduction measures in the commercial sector could vary with technology advancements, availability of cleaner burning fuels, and changes in governance. The ultimate reduction potential for each commercial building and the entire commercial sector could be as much as 100% or zero emissions.

To develop a viable commercial sector strategy, two parameters have to be employed: cost-effectiveness and feasibility. Building owner interests must be the "drivers" for this strategy to succeed. Most of the commercial buildings in Takoma Park are owned and occupied by small business. Typically, small business owners lack time and capital to invest in energy efficiency improvements. Therefore, implementation of this strategy will address these realities by reducing the administrative hassle and up-front financial burden.

With today's readily available technology, implementing whole-building energy efficiency upgrades can reduce energy use by 25% to 40% cost-effectively. The emissions reduction potential depends on emissions factors. It is well proven that investing in energy efficient lighting technology is profitable.

According to EPA's Energy Star Buildings program, investing in the rest of building systems, using a system-integrated approach, can yield twice the savings. Furthermore, eliminating wasted energy better prepares businesses for the rate uncertainty in a deregulated market.

Passed in 1999, Maryland utility restructuring legislation gives commercial consumers the ability to choose between power suppliers by July, 2000. Therefore, understanding and controlling energy needs is simply smart management . Businesses that reduce energy use through energy efficiency and strategically manage their energy needs can negotiate better rates by themselves or aggregating their loads with other businesses. For some businesses the savings may be significant enough that they can choose to use part of the savings to buy clean energy. The availability and affordability of clean power or green power is still uncertain. However, the greenhouse gas reduction potential of switching the energy supplied to Takoma Park to a cleaner burning fuel mix could allow the commercial sector to vastly exceed pollution reductions from simply increasing energy efficiency.

Commercial Sector Reduction Strategy

To maximize reduction potential cost-effectively, the commercial sector strategy has four parts. Actions to accomplish each part should take place concurrently versus sequentially.

- Business Network - create a network of business owners
- Benchmark and Plan - determine reduction potential and financing options
- Technical Reduction Approach- retrofit buildings cost-effectively while maximizing reduction potential
- Communicate Success - increase network members by sharing success stories

Business Network

In order to mobilize the Takoma Park business community to help meet 2010 reduction goals, we should create a network. Initiated by the City of Takoma Park, Committee on the Environment, or another non-profit organization, the businesses in the network need to understand the benefits of strategically managing energy use. Many of the benefits have already been documented by federal voluntary programs, such as Energy Star Buildings and Rebuild America. As a partner with both of these federal initiatives, Takoma Park can obtain materials to share the benefits with the business community.

There are many benefits. After initial conversations with the business community, some benefits may be more relevant than others. Some of the benefits are as follows:

- Reducing energy costs
- Improving work space comfort, leading to better attendance and greater productivity
- Being an environmental leader
- Reducing uncertainty in a restructured energy market

Once the businesses in the network recognize these benefits, an energy project facilitation "package" should be presented to the business owners that allows them to capitalize on the benefits by simply signing on the "dotted line." Included in the package would be a current statement of energy performance, recommended improvements, financial solutions, and a product and service provider to deliver the guaranteed savings. These elements are explained in greater detail throughout this strategy.

Benchmark and Plan

Strategically managing energy needs, by measuring and evaluating current energy use, is critical to maximizing potential energy-efficiency opportunities, preparing for deregulation, and achieving greater pollution reduction. EPA's ENERGY STAR Benchmarking Tool is a free web-based tool to help identify buildings with the greatest potential for energy-efficiency improvements. Expressed on a 0 to 100 scale, businesses can measure and compare their building's energy performance with that of buildings considered to be the top-performers nationwide. Effects such as location, weather, business activity, and site renewables are taken into account in the final score.

Buildings scoring a 75 or greater are recognized for excellent energy performance by receiving the ENERGY STAR Label, a bronze plaque, to place on the building. In addition, the building is registered along with other ENERGY STAR buildings on EPA's website with a brief case study.

A joint brand between EPA and DOE, ENERGY STAR is the mark of excellence in energy performance. Utilizing a nationally recognized brand, such as Energy Star, makes it easy for consumers and business owners to shop for energy efficient products and services.

Using the Energy Star Benchmarking Tool will help refine the potential energy and pollution reductions of Takoma Park's commercial sector. Whether performed by the business owner or another party accessing the businesses utility bill information, benchmarking will allow Takoma Park to rate buildings on the same scale. The rating can be used to determine potential reduction, prioritize projects, and bundle projects together. Provided in a printable Statement of Energy Performance, benchmarking results can become the foundation for planning upgrades.

Since small businesses lack the time to perform these functions and may be too small individually to attract performance contractors, Takoma Park or the Committee on the Environment may help businesses overcome this barrier by creating an unbiased non-profit organization to facilitate energy projects and attract bids. An Energy Project Facilitator (EPF) could aggregate or bundle performance information to increase the size of the projects. In addition, pooling projects may help the Energy Project Facilitator negotiate a reduced interest rate with lenders or energy rate with power suppliers. Some of the functions performed by the EPF could be as follows:

- Benchmark buildings
- Perform energy audits
- Aggregate or pool projects
- Write RFP and review bids
- Identify and secure financing
- Negotiate performance contract
- Report guaranteed savings information to Takoma Park to help track success

Funding for an EPF could come from many sources. Initially, seed money from the federal government, the State of Maryland, or Takoma Park may be necessary. It may be possible to initiate an EPF by agreeing with business owners to share a portion of the guaranteed savings.

Technical Reduction Approach

The technical approach to maximize emissions reduction is expressed below as an equation. It is as follows:

Part 1 + Part 2 = 100% reduction or zero emissions

Part 1 - Reduce or change DEMAND for energy:

Energy Efficiency + Fuel Switching[17] + Site Renewables = 25 to 40% Pollution reduction from Demand

Part 2 - Change SUPPLY to an acceptable clean-burning fuel mix:

Remaining kWh X Green Power Emissions Factor = 100% Pollution reduction from Supply

Part 1 - Technical Approach to Demand-Side Measures:

[17] Although direct natural gas is less polluting than fossil-fuel generated electricity, switching electricity loads to direct natural gas will result in less than 100% reduction potential. The 100% reduction potential is currently possible for an all electric load that switches supply to 100% green power or uses 100% site renewables.

Instead of recreating the wheel, Takoma Park can encourage the business network or EPF to use EPA's proven Energy Star Buildings 5-Stage approach to building upgrades. This approach is based on the interaction of building systems. Following the 5-stage approach will help Takoma Park businesses or an EPF choose where and when to invest in upgrades and how to select and size the most appropriate equipment for facilities. A change in one building system leads to savings opportunities in other systems - reducing lighting and other electrical loads can significantly change heating and cooling loads.

For example, increasing lighting and other equipment efficiencies connected to the electrical system, not only reduces the electrical load, it reduces heat gain as well. Significant reductions in waste heat changes the loads required of thermal comfort systems, which can change the size of the air handling, heating, and cooling equipment needed to satisfy the loads.

Stage 1 - Green Lights

Lighting alone accounts for 20 to 40 percent of all energy used in commercial buildings. High-efficiency lighting technologies can reduce the amount of energy consumed by 50 to 70 percent, while decreasing glare, reducing maintenance costs, and providing a better working environment. Too much light or inefficient light also generates more heat, thus raising cooling costs.

Stage 2 - Building tune-ups

This effort ensures that equipment is properly maintained and operates at design efficiency. Often, only simple adjustments are needed to make existing equipment more efficient, but the small adjustments made during Stage 2 will have a dramatic effect on the savings opportunities available in Stages 4 and 5.

Stage 3 - Other Load Reductions

Computers, printers, vending machines, and copiers use energy and generate heat, which increases the need for air conditioning in the summer. Using energy-efficient office equipment and building envelope technologies will reduce our building loads, thereby lowering our heating and cooling bills, while increasing occupant comfort.

After determining reductions in energy load and heat gain from Stages 1 through 3, equipment currently used for thermal comfort system's may be oversized. Re-measuring energy needs and evaluating opportunities from right-sizing equipment, during Stages 4 and 5, can lead to further substantial savings.

Stage 4 - Fan system upgrades

Many buildings have oversized fan systems, which under certain conditions circulate too much air. Buildings must, however, maintain the minimum recommended circulation of outside air to ensure good indoor air quality. Measuring how much fan power facilities need before upgrading the fan system is a low-cost, high-value investment. Many ENERGY STAR Buildings partners have found that their fan systems were using more energy than their chillers; therefore, right-sizing fans provide additional opportunities for significant savings.

Stage 5 - Heating & cooling system upgrades

Heating and cooling system components interact with each other extensively. The optimal size, design, and operation of these systems can translate into considerable savings. By implementing Stages 1 though 3 first and re-measuring our energy needs, the savings from rightsizing fan systems and heating and cooling systems will be substantially greater due to the reductions in loads and "waste heat". For every dollar spent on measuring needs, $10 to $100 will be saved on new equipment.

In addition, switching from electric heating to natural gas heating can further reduce pollution. Fossil-fuel (primarily coal fired) generated electricity in Maryland pollutes three times as much as directly supplied natural gas per Btu consumed. This may change as affordable green power becomes available or if combined heat an power systems are implemented.

This integrated approach reduces costs and increases performance, comfort, and efficiency. Ongoing maintenance and monitoring are imperative to ensuring that the efficiencies and savings continue. With today's readily available technology, implementing whole-building energy efficiency upgrades can reduce energy use by 25% to 40% cost-effectively. It is well proven that investing in energy efficient lighting technology is profitable. Investing in the rest of building systems, using a system-integrated approach, can yield twice the savings as lighting alone.

Part 2 - Supply-Side Measures:

Successful implementation of supply-side measures such as Green Power could increase pollution reduction potential to as much 100% or zero emissions. Unfortunately, the availability of green power is uncertain at this time. Over the next ten years, the Takoma Park - Committee on the Environment can continue to evaluate the potential as Maryland restructures its utility market.

Understanding energy needs and reducing energy loads through the other parts of this strategy will help determine the potential for green power in Takoma Park. This information can be used to attract green power marketers. Ultimately, the potential of green power hinges on the rate charged for the clean energy supply. If the rate is competitive with dirty energy, many of the businesses in Takoma Park would probably be persuaded to switch. Also, it could be part of the services provided by an EPF. Pooling demand through an EPF and negotiating a bulk rate may overcome many of these barriers.

Communicate Success

Communicating business network success demonstrates environmental leadership and sound financial management. Communicating the financial and environmental benefits of successful upgrade projects will also make it easier to convince more businesses to join the business network and ultimately increase pollution reduction.

Primary Measure: Calculate reduction from guaranteed savings agreements. See Action Measures "Shared Energy Savings Contracting for Apartments, Commercial, and Industrial Buildings".

Commercial/Residential Measure 1

Shared Energy Savings for Apartments, Commercial and Institutional Buildings

Description
Organize owners of high-rise apartments, commercial, and other institutional facilities for shared energy efficiency upgrades via an energy performance contractor. Contractors would evaluate and implement efficiency measures to save energy during a contract term (5-15 years). Hire energy technical coordinator (33% of time) to develop and implement program, and work with public relations coordinator on community outreach.

CO_2 Reduction (assumptions)

Total energy reduction 137,742 MMBtu

Total CO2 e reduction 15,672 tons

Target Sector
Residential (apartments) and commercial.

Sector Penetration (% Affected)
22.5%

Implementation Costs/Benefits
Coordinator salary range $25,000 - $50,000 (p/t vs f/t). Additional costs for meetings and information dissemination range from $500-$1,000 annually.

Savings ($/yr in 2010)
$3,994,527 annually over life of energy efficiency investments

Fiscal Impacts
Lower energy costs for homes and businesses. There is the potential for this program to be a net revenue generator with the program paying for itself in the second or third year.

Implementation Responsibilities
Primary: city staff
Support: volunteers

Funding Options

Federal or State Grants
Shared portion of guaranteed savings
Tax revenue

Implementation Schedule

Year:	Annual	Cumulative
2000	0%	0%
2001	0%	0%
2002	5%	5%
2003	10%	15%
2004	15%	30%
2005	15%	45%
2006	15%	60%
2007	10%	70%
2008	10%	80%
2009	10%	90%
2010	10%	100%

Implementation Steps

A. Create implementation strategy that minimizes city staff needed.

B. Create network of businesses.

C. Perform building screening to determine savings opportunities more precisely.

D. Link Individual technology opportunities to group bulk purchasing program.

Commercial/Residential Measure 2

Solar Photovoltaics Program for Takoma Intermediate Middle School

Description
Place photovoltaic power system as demonstration project on roof of Takoma Intermediate School. The project is a grid-tied 1.2 kW ac PV power system which would reduce the amount of power the school would need to purchase from utility company during sunny days.

CO_2 Reduction (assumptions)
Demonstration Project

Target Sector
Commercial/institutional.

Sector Penetration (% Affected)
Not applicable

Implementation Costs/Benefits
Cost of project is $10-12,000. This project would be jointly implemented by the Maryland Energy Administration, the school and BP Amoco. No cost to the city.

Savings ($/yr in 2010)
Demonstration Project

Fiscal Impacts
Minimal reduction in energy costs for school. However, could encourage new solar projects.

Implementation Responsibilities
Primary: Takoma Intermediate School
Support: MEA

Funding Options
BP Amoco - Solare for installation costs
MD Energy Administration- PV material costs
MCPS- Maintenance costs

Implementation Schedule
Currently in review process (2/00)
Completion target April 2000

Implementation Steps

A. Secure letter of commitment from MEA

B. Clear all MCPS permitting requirements

C. Secure contract with approved installation contractor

D. Install system and have commissioning ceremony

Commercial/Residential Measure 3

Green Power Group Purchasing Program

Description
Aggregate residential and commercial electric consumers for negotiating green power rates with electric power brokers.
Ideally this will be done via municipal aggregation opt-out plan pending state law changes.

CO_2 Reduction (assumptions)
Potential for eliminating all fossil power from the mix.

Target Sector
Residential, Commercial/institutional, Municipal Government

Sector Penetration (% Affected)
Ken Bosong Survey; PA Town: Green Mtn. Pwr. 3.5- 10% per year, increasing to potentially 35-100% by 2010

Implementation Costs/Benefits If the city can aggregate, cost of existing staff time. If other aggregation means needed such as a foundation, cost will be ???

Savings ($/yr in 2010)
Dependent on rate of future green power purchased

Fiscal Impacts
Minimal increase in energy costs for consumers.

Implementation Responsibilities
Municipal Government Primary
Support: MEA

Funding Options
Municipal purchase fund
Rebate for Opt In Program?
Operational

Implementation Schedule
State lobbying on going

Implementation Steps

A. Create long term strategy

B. Not to be implemented until legislation changes if to be done via municipal aggregation opt-out plan.

C. An alternate strategy would be to determine reasonable market rate and combine with energy efficiency services or group purchasing program.

Commercial/Residential Measure 4

Public Information Dissemination

Description
Hire global climate change information coordinator to educate residents and businesses about measures to reduce CO2 emissions. Coordinator would organize workshops, develop media strategies, initiate school education program and publicize energy efficiency information (including home measures, historic tax credit and energy efficiency contractors) via the Internet and other community communication vehicles.

CO_2 Reduction (assumptions)
Not directly quantifiable.
Captured in other Commercial/Residential measures

Target Sector
Residential and commercial

Sector Penetration (% Affected)

Implementation Costs/Benefits
Coordinator salary range $25,000 - $50,000 (p/t vs f/t). Additional costs for workshops and public information dissemination range from $500-$2,000 annually. Costs for school education program may be additional if school system does not absorb costs

Savings ($/yr in 2010)
Outreach is critical to the savings of over $4,000,000 annually in other measures.

Fiscal Impacts
Lower energy costs for homes and businesses.

Implementation Responsibilities
Primary: city staff
Support: volunteers

Funding Options
Federal or state grant
City tax revenues

Implementation Schedule
On-going - currently volunteer effort

Implementation Steps

A. Create outreach strategy that minimizes city staff needed.

B. Disseminate information to support other measures.

C. Promote successes to local, regional, and national media outlets .

Commercial/Residential Measure 5

Revolving Loan Fund Program

Description
Explore program existing Takoma Department of Housing low income home improvement loan fund program for expansion to cover homes energy efficiency upgrades.

Target Sector
Residential/commercial

Implementation Costs/Benefits
Same staff person(s) as other commercial/ residential measures

Fiscal Impacts
Provides capital for energy efficiency technologies and services

Funding Options
Federal and/or state grants to initially capitalize program

CO_2 Reduction (assumptions)
Captured under other measures

Sector Penetration (% Affected)

Savings ($/yr in 2010)
Captured under other measures

Implementation Responsibilities
Primary: Municipal Government

Implementation Schedule
To be determined

Implementation Steps

A. Create program strategy after evaluating other federal, state and local loan programs.

B. Secure necessary funds through grants.

C. Administer program - dispense funds.

Commercial/Residential Measure 6

Group Purchasing Program for Energy-Efficient Technologies

Description
Create a group purchasing program to make energy-efficient technologies available to residents and businesses at a discount. Some products to be included are home appliances, windows, office equipment, electronics equipment, on-site power generating equipment, and heating and cooling equipment.

Target Sector
Residential and commercial

Implementation Costs/Benefits
Coordinator salary range $25,000 - $50,000 (p/t vs f/t/t). Additional costs for workshops and public information dissemination range from $500-$2,000 annually.

Fiscal Impacts
Lower energy costs for homes and businesses.

Funding Options
Federal or state grants
Tax revenue

CO_2 Reduction (assumptions)
13,254 tons eCO2 - the electric power savings was estimated to account for 67% of the energy saved while natural gas counted for 33%.

Sector Penetration (% Affected)
The assumption is 30% energy reduction of 25% of total residential sector energy use.

Savings ($/yr in 2010)
$1,541,369

Implementation Responsibilities
Primary: city staff
Support: volunteers

Implementation Schedule
To be determined

Implementation Steps

A. Create implementation strategy that incorporates lessons learned from other group purchasing programs needed.

B. Negotiate contracts with suppliers.

C. Market group discounted buying opportunities to businesses and residences.

Commercial/Residential Measure 7

Efficiency Upgrades at Building Sale Transfer

Description
Issue city ordinance to require energy and water efficiency upgrades at building sales time of transfer for both residential and commercial buildings. Up to one percent of the selling price would be required to be invested in the property to achieve Home Energy Rating Service efficiency upgrade standards. Technical coordinator (33% of time) would work with city code officials to develop and implement program, and work with public relations coordinator on community outreach to Realtors etc.

Target Sector
Residential and commercial

Implementation Costs
One-third of Tech. Coordinator salary range $25,000 - $50,000 (p/t vs f/t/t). Additional costs for HERS standards information dissemination range from $1,000-$3,000 annually.

Economic Impacts/Benefits
Substantially lower energy costs for homes and businesses

Funding Options
Federal or state grants
Tax revenue

CO_2 Reduction (assumptions)
Already captured in other measures

Sector Penetration (% Affected)

Cost Savings ($/yr in 2010)
Already captured in other measures

Implementation Responsibilities
Primary: city staff (Takoma Park Housing Code dept.)
Support: Realtors

Implementation Schedule
Subject to program development and approval by council.

Implementation Steps

A. Create implementation strategy after evaluating other similar programs nationwide.

B. Seek council approval

C. Administer and measure success of program

Natural Resources Sector

Although the Washington Metropolitan area has a reputation as a green and forested area, this urban forest is seriously threatened. In the outer suburbs, forests and green space are steadily lost to sprawl development. In Washington and the older, inner suburbs like Takoma Park, in-fill development and neglect of an urban forest under increased stress has resulted in a sizeable decline in healthy tree cover in the past 25 years (documented by American Forests). While neighboring District of Columbia exacerbated the problem by suspending its replanting efforts for several years in the past decade, Takoma Park has worked to fight the decline through efforts that include a protective tree ordinance, a full-time arborist, and the annual tree-giveaway by the TPCoE. Takoma Park can lead the region by example, and improve the carbon sequestration offered by a healthy tree population, by promoting better care of and conditions for urban forest and street trees, and increasing awareness of the need to replace the mature trees that are now failing and falling.

Natural Resource Strategies
for the
Takoma Park Climate Change Action Plan
by Catherine Tunis
Co-chair, Committee on the Environment
Natural Resources Subcommittee

Current Energy Savings Actions - listing and description of actions already underway or completed by the City:

The City of Takoma Park has a strong tradition of natural resource appreciation and protection. The City was established in the 1880's and billed as “a healthful retreat from swampy, malarial Washington” and the location was chosen by developer Benjamin Franklin Gilbert largely because of its pure water.[18]

One of the strongest features that helps Takoma Park mitigate the effects of climate change is our trees. Trees can reduce the need for energy use by shading buildings, blocking wind, and acting as natural air conditioners, absorbing large quantities of solar energy in evapo-transpiration processes, and also serving as carbon sinks as they absorb carbon dioxide and convert it to carbon in the form of wood. Trees lower the ambient temperature, which reduces energy demands for air conditioning and also reduces the development of ground-level ozone. Trees clean the air and provide wildlife habitat. Trees also enhance the infiltration of rainwater, decreasing storm runoff and increasing groundwater infiltration, thereby reducing the severity of flooding and drought. An abundance of green space within the City and sylvan back yards also reduce the need for citizens to drive to other locations for recreation.

City of Takoma Park has received at least 14 annual designations as a "Tree City USA." Each year, the City has met the four National Arbor Day Foundation standards for the designation: 1) a tree board or department; 2) a city tree ordinance; 3) a community forestry program with an annual budget of at least $2 per capita; and 4) an Arbor Day observance and proclamation.

[18] *Takoma Park: Portrait of a Victorian Suburb*, by Ellen R. Marsh and Mary Anne O’Boyle, 1984, published by Historic Takoma, Inc., Takoma Park, Maryland.

Takoma Park Tree Ordinance

Takoma Park has a model tree protection law that was significantly strengthened in 1995. (See http://sligo.com/tpce/treelaw.htm.) The Takoma Park "Tree Ordinance" (Takoma Park Code, Chapter 12, Trees and Vegetation) protects all trees on City property and all trees planted by the City, with City funds, or because of City legal requirements, and all "urban forest trees" on private property that are greater than 7.5 inches in diameter (24 inches circumference) because of the significant public benefits these trees provide in terms of air, noise, and visual pollution control, control of water run-off and support to the biologic and hydrologic integrity of watersheds and ecosystems, and because trees have significant aesthetic value affecting property values and the quality of life in the City. The City government recognizes that the protection and proper care of the trees and vegetation within the City of Takoma Park enhances the level of public benefits they produce.

Anyone who wishes to remove an "urban forest tree" or take any action that may damage the health of a tree must apply for a permit. Takoma Park employees a full-time arborist who will examine and evaluate every tree for which a permit is sought. Permits are not issued unless there is good cause--either the requested activity will not harm the tree, proper steps are taken to mitigate damage to the tree, or, in the case of tree removal, there is no other option. The arborist will educate the individual about the value of and proper care of trees, and seek to find alternatives to tree removal. Permits will be denied where the property-owner's reason for wanting to remove the tree is unjustified. All permits issued must be posted for 15 days prior to cutting. Any citizen can protest a permit issuance (or permit denial) to a Tree Commission, a group of expert and interested citizens appointed by the City Council, and the Tree Commission will hold hearings and render a decision. Tree Commission decisions can be appealed to the Court, but this has never been necessary.

This process is extremely effective in raising the consciousness of citizens about the value of trees, engendering a strong sense of stewardship among citizens for their urban forest and each individual tree, and in protecting Takoma Park's trees from being cut. As a result, the City of Takoma Park has a much more extensive, mature, and healthy tree population than many other suburbs. The benefits of this urban forest in reducing the need for energy use and mitigating the effects of climate change are immense.

Another current activity regarding trees is our annual Arbor Day Adopt-a-Tree program. Each April since 1993, the Takoma Park Committee on the Environment (http://sligo.com/tpce/) and the Takoma Park Department of Public Works have sponsored Arbor Day events that often include tree planting and always include a tree seedling giveaway. We have given 400 to 600 tree seedlings away each year to Takoma Park residents. All the tree seedlings are species that are native to Maryland and are a mix of deciduous and evergreen. We encourage citizens to plant large overstory trees that will provide the most environmental benefits. We provide instructions to residents on how to plant and care for their trees. Many citizens return year after year and bring their neighbors.

Both the City Government and citizen volunteers work with County agencies and utilities to encourage reduced tree cutting, tree planting, and proper tree maintenance. In April, 1999, Takoma Park citizens cooperated with the County to plant trees along Sligo Creek. In 1998 and 1999, the City negotiated an agreement with the electric and telephone utilities to work with the City arborist on tree trimming around utility lines. Twice in 1998, the City administrator and mayor negotiated with the County to reduce tree cutting on County lands. And from 1997 through 1999, citizen volunteer tree experts worked with the local sewerage authority to plant and replace trees along the sites of recent sewer construction.

Both the City staff and the Committee on the Environment write educational articles for the City's Newsletter several times a year to provide information on the care of trees and other tree issues.

Takoma Park Public Works Department employees a full-time arborist and accepts citizen inquiries about tree issues daily. Public Works and a citizen volunteer monitor the Takoma Voice list-server and respond to citizen concerns about trees. Local newspapers interview Public Works employees and citizen volunteers for articles several times per year.

While implementing Takoma Park's Climate Change Action Plan, the City will continue to strongly enforce its Tree Ordinance, sponsor Arbor Day events, and educate the public about the value of trees.

CO2 REDUCTION PLAN ACTION MEASURES - individual descriptions and analysis of proposed action measures; divided by sector (residential, commercial/industrial, municipal, transportation, waste, natural resources):

Natural Resources Measure 1
Educate About Tree Selection, Planting, and Maintenance

Description
Prepare and publish articles and other materials to educate the citizens of Takoma Park and others about the value of trees, the provisions and procedures under the City's Tree Ordinance, identification of tree species, insects that may affect Takoma Park's trees, insect control, and proper maintenance of trees. Prepare and distribute brochures on the provisions and procedures under the City's Tree Ordinance and on identifying and selecting tree species. Hold seminars on tree care. Hold tree walks. Provide interviews to local newspapers and other media, and respond to inquiries and public discussion of tree issues on local list servers and when citizens call Public Works. Prepare and distribute brochures with instructions on how to plant trees each Spring. Encourage the planting of large and long-lived tree species that provide more ecosystem services. Encourage County agencies and utilities to plant and properly maintain trees.

Target Sector
Residential

Implementation Costs
Costs for these activities are minimal: Salary of City employees to write and edit materials, printing and distribution costs should be less than $5,000 per year.

Fiscal Impacts
Lower residential and municipal energy costs. Reduced illness and medical costs associated with ozone related illnesses. Reduced damage costs associated with projected air quality/global warming.

Funding Options
City taxes, grants, volunteer labor

CO2 Reduction
These education activities will enhance the care and maintenance of the trees we already have and encourage folks to plant new ones. We conservatively estimate preservation of the current tree stock but no additional carbon sequestration. Even the current tree stock provides energy savings in the form of reduced ambient temperatures and shading of buildings that reduces air conditioning needs.

Sector Penetration
100 % of the City's households receive the Takoma Park Newsletter, the Takoma Voice, and the Takoma Gazette in which articles would be published. Approximately 100 to 150 households participate in the Takoma Voice list server. The Takoma Park Public Works Department receives approximately 200 calls per year inquiring about tree care. Approximately 500 brochures on how to plant trees are picked up each year. The text of Takoma Park's Tree Ordinance and a brochure about the provisions of the Tree Ordinance have recently been added to the web site of the Takoma Park Committee on the Environment.

Savings ($/yr in 2010)
Our weather study will give us information to be able to calculate the energy savings from our current tree stock.

Implementation Responsibilities
Takoma Park Public Works Department and citizen volunteers.

Implementation Schedule
Already ongoing. The Department of Public Works and citizen volunteers produce at least four articles per year on tree care and other tree issues.

Implementation Steps
A. Write occasional new article on tree care, tree identification and selection, and the operation of

the Tree Ordinance. Publish in Takoma Park Newsletter.

B. Answer citizen questions as they appear on the Takoma Voice list server and as citizen calls are received at the Public Works Department.

C. Prepare and distribute brochures with instructions on how to plant trees each Spring in connection with annual Arbor Day event. Also provide verbal pointers to citizens.

D. Prepare copies of pervious articles on tree care and the Tree Ordinance and distribute at our annual Arbor Day event. Also distribute appropriate materials from other agencies.

E. Organize and hold tree care seminars. (The first one is scheduled for March 18, 2000.)

F. Organize and hold tree walks. (One was held in 1997. Another is scheduled for May 20, 2000.)

G. Provide interviews and other information to the media upon request.

Natural Resources Measure 2
Educate about Trees and Parking Lot Heat Islands

Description
The City will sponsor a study of the differences in microclimate between a treed area and a parking lot. Using two electronic weather stations, computers and specialized computer software, we will collect temperature data 24 hours per day over several Summer months. We will then analyze the data and report the findings locally, and perhaps in the academic press. We expect to calculate the differences in energy load for air conditioning for buildings located in the parking lot vs. heavily treed areas. This information will be used to show the importance of trees to reducing energy needs for buildings and the importance of shading parking lots to property owners so that they can see the benefits of installing trees in parking lots and surrounding landscaping.

Target Sector
Residential, commercial and industrial.

Implementation Costs
Approximately $1,500 for weather stations, computer hardware and software, citizen volunteer labor, publication in Takoma Park Newsletter and other press.

Economic Impacts
Lower energy bills for property owners. Better fuel economy for vehicles. (In addition to reducing temperatures, cars parked in the shade have reduced emissions due to reduced volatilization of fuel and other chemicals.) Reduced health care costs due to reduced ozone production.

Funding Options
City tax revenues, grants

CO2 Reduction
Uncertain. This will depend on the extent to which property owners actually implement tree planting strategies. We expect the reductions could be substantial because preliminary results are finding 12 to 15 degree F difference on a Summer afternoon between a treed backyard and a parking lot (with some grass and trees) 1 mile north. Even at night the parking lot was several degrees warmer.

Sector Penetration
Information will be disseminated widely. Study was already featured on September 8, 1999 Newsnight Maryland news show by Maryland Public Television, which was broadcast twice on that date throughout Maryland and surrounding states.

Savings ($/yr in 2010)
This will depend upon the extend to which tree preservation and planting recommendations are implemented.

Implementation Responsibilities
Citizen volunteers.

Implementation Schedule
Already ongoing. Preliminary study results expected within 6 months, final recommendations in approximately 1.5 years.

Implementation Steps

A. Research equipment and software needs. Purchase weather stations, computer hardware and software.

B. Install equipment. Collect temperature data at least hourly.

C. Research for information (energy costs per degree of increased temperature) to estimate benefits of trees.

D. Write articles that show the benefits that trees provide in terms of lowering ambient temperatures and energy costs. Publish and distribute.

Natural Resources Measure 3
Plant Trees in Median Strips of New Hampshire Avenue and University Boulevard

Description
Work with state and local government, citizen and business groups on landscaping aspects of revitalization plans for New Hampshire Avenue and University Boulevard to have trees that are of ling-lived, large-growing species planted in the median strips and along the roadsides.

Target Sector
Government, commercial.

Implementation Costs
$10, 000??

Economic Impacts
Reduced energy usage. Beautification will enhance local shopping environment.

Funding Options
State funds and commercial property owners.

CO2 Reduction
Exact benefits are uncertain. There are no trees in these areas now. Assume 60 oak trees installed on New Hampshire Avenue and 30 on University Boulevard. Assume trees installed very conservatively grow 2 cords of wood by 2010 (yield tables unavailable at time of preparation[2]) for 42 Million BTU equivalent of carbon sequestration.

Sector Penetration
Not applicable.

Savings ($/yr in 2010)
Uncertain.

Implementation Responsibilities
State and local government, commercial property owners, citizen volunteers.

Implementation Schedule
2 to 4 years.

Implementation Steps

A. Recommend inclusion of tree planting in these areas in the Takoma Park Master Plan. (Ongoing)

B. Coordinate with state and local government, citizen and business groups to design and plan installation of trees. Work especially to see that tree species used are ones that will grow large and be long-lived, as well as not be prone to having branches that will break or litter that can cause road hazards. (Willow Oak)

C. Install trees.

D. Consult with State and commercial property owners as needed during installation and maintenance of trees.

_____

2. Assume trees are 3 inch caliper and 18 feet high at planting and grow to 6 inch caliper and 30 feet height 10 years later. Calculate volume of bole, convert to cords. Assume one cord red oak yields 21.3 Million BTU equivalent carbon sequestration. Source of Cord/BTU data from "Heating with Wood," publication 016 of the National Center for Appropriate Technology and attributed to the U.S. Forest Products Laboratory, USDA Forest Service.

Natural Resources Measure 4
Build Bio-retention Areas and Plant Trees to Slow Storm Water

Description
Bioretention areas are small or large depressions in the landscaping that slow storm water runoff and allow portions of rainwater to soak slowly into the ground rather than immediately and quickly running off into storm drains or streams. Trees also slow storm water somewhat by slowing the rate at which rainwater hits the ground. Bioretention techniques help moderate climate by slowing the rush of storm water to streams, which helps to slow or stop erosion, and by enhancing groundwater recharge, which will mitigate the effects of droughts.

This measure will research the current state of the art on construction of bioretention areas and seek to increase the use of these techniques within Takoma Park and surrounding areas. This will take a number of forms: encourage the County to build bioretention areas and plant trees on County land, demonstrate the techniques on City land where appropriate, encourage the State to build bioretention areas and plant trees on State land and near State roads, encourage commercial and institutional property owners to build bioretention areas and plant trees on their land, and encourage residents to build small bioretention areas and plant trees on their land.

Target Sector
Government, commercial and industrial, residential

Implementation Costs
Constructing bioretention areas may be high or low cost depending upon the scale undertaken and what other work is being done. When built into landscaping that is already being done, and when done on a small scale, the costs are likely to be low. (For example, it is just as easy to build a small depression into tree plantings as to build in a small hill.) When land is purchased and large bioretention areas are built the costs will be higher. (Perhaps $50,000 or more)

Fiscal Impacts
Uncertain.

Funding Options
Grants, tax revenues, private funds.

CO2 Reduction
This will depend upon the extent to which the measure's recommendations are implemented. Perhaps calculate in terms of carbon sink effect of new trees.

Sector Penetration
We will seek to contact as many of responsible parties as possible in each of the sectors.

Savings ($/yr in 2010)
Uncertain.

Implementation Responsibilities
Government, citizen volunteers, private property owners.

Implementation Schedule
Uncertain. This will be researched and implemented slowly over a number of years.

Implementation Steps

A. Research construction of bioretention areas and associated costs.

B. Work with County to have recommendation to install bioretention areas in Takoma Park Master Plan. (Ongoing)

C. Prepare educational materials on how to construct bioretention areas and distribute to each sector.

D. Evaluate City properties where bioretention techniques can be demonstrated. Seek funding to

develop a demonstration and implement.

Natural Resources Measure 5

Permeable Surfaces for Streets and Driveways in New Construction

Description
Develop guidelines for streets and driveways in new construction to be of minimal surface area and be constructed using materials that allow some storm water to soak into the ground. This reduces the erosion caused by storm water and helps to increase groundwater recharge.

Target Sector
Government, all other sectors for new construction

Implementation Costs
This may be difficult to make mandatory.

Fiscal Impacts
The environmental effects of this measure may be mixed. While it may decrease storm water runoff, the extent to which current construction materials and techniques accomplish this goal are uncertain. Also, because vehicles sometimes spill toxic fluids, permeable surfaces may allow these chemicals to contaminate groundwater.

Funding Options
Taxes, grants

CO2 Reduction
Uncertain.

Sector Penetration
If required, penetration would depend on the extent to which new construction takes place.

Savings ($/yr in 2010)
Uncertain. This will depend upon the benefits that can accrue per area installed and the area installed.

Implementation Responsibilities
City, County, State, and private property owners.

Implementation Schedule
Research can start within two years. Success will depend on whether governments decide to make the use of permeable surfaces mandatory and the extent to which permeable surfaces are installed voluntarily.

Implementation Steps

A. Research permeable surface construction techniques and materials.

B. Prepare proposals for mandatory use of permeable surfaces in new construction of new streets and driveways. Work with appropriate government agencies to require the use of permeable surfacing for new streets and driveways.

C. Prepare guidance materials on how to construct streets and driveways using permeable surface materials and techniques.

D. Conduct outreach.

Natural Resources Measure 6

Larger Tree Boxes for New Plantings

Description
The average life of street trees in commercial areas is very low--about 10 (?) years. The main cause of these trees' early demise is the environment in which they live. Street trees in commercial areas are also subject to people using them to chain bicycles, post notices, and other abuses. These street trees often have small areas of soil in which to grow, the soil is often compacted by people walking on it, making it difficult for air and water to get to tree roots. These soil damages make trees seriously stressed and less able to withstand additional damage. Trees that are planted in large tree boxes and fitted with grates that keep the soil from becoming compacted have a much better environment in which to grow and a better chance of surviving and providing the ecological and aesthetic (attractive to patrons) benefits of a mature tree. This measure will seek to provide model tree boxes for the commercial areas of Takoma Park.

Target Sector
Government, commercial and industrial

Implementation Costs
This will depend on the number and style of tree boxes and grates provided.

Fiscal Impacts
Values will accrue due to increased survival of street trees in commercial areas. This will have the effect of making these areas more attractive for commerce as well as sequestering CO2 and lowering energy costs.

Funding Options
Tax revenues, grants.

CO2 Reduction
Uncertain. Perhaps we can project the carbon sink effects for extending the average life span of street trees.

Sector Penetration
Uncertain. Because this option would have a limited CO2 reduction effect, it is of a lower priority for implementation.

Savings ($/yr in 2010)
Uncertain.

Implementation Responsibilities
City, County and State Governments, local businesses

Implementation Schedule
Uncertain.

Implementation Steps

A. Research areas in Takoma Park where this measure will be applied. Candidate areas include Old Town Takoma, Takoma Junction, and commercial areas along New Hampshire Avenue, University Boulevard, and at Flower and Piney Branch Avenues.

B. Research types of tree boxes most suitable for the neighborhoods in which they will be installed. Research pricing.

C. Seek funding and implement measure as funding is received.

Waste Sector

At the June 5 citizen meeting in Takoma Park on Climate Change, there was a vigorous discussion of possible steps Takoma Park could take to reduce waste. One of the leading suggestions was the adoption of a Pay-As-You-Throw trash service, which achieves a common good that supports reduction of greenhouse gas emissions largely through the carrot of individual savings rather the stick of mandatory enforcement.

ICLEI and ILSR Draft Report on Waste Reduction Actions
for
Takoma Park's GHG Reduction Local Action Plan
by
Daryl Braithwaite, Solid Waste Team Manager
James Liljenwall, ICLEI Solid Waste Consultant
Kelly Lease, Institute for Local Self Reliance

Please note that all cost and waste diversion figures are estimates based on similar programs implemented in other jurisdictions and community specific data with input from Daryl Braithwaite, Solid Waste Team Manager, Department of Public Works, City of Takoma Park. Program costs can vary widely based on program design and local conditions including cost of living and disposal costs. Furthermore, tonnage estimates for each measure have been developed without consideration of other proposed measures and the results may not be additive.

Pay-As-You-Throw (PAYT) trash service

Currently, Takoma Park does not limit the amount of trash residents may set out on their collection day. Furthermore, the cost of trash collection and disposal is in the city's tax base. Residents receive no economic signals encouraging them to reduce trash disposal although research has indicated that PAYT trash fees serve as an incentive for residents to reduce disposal.

In order for Takoma Park to implement a traditional PAYT trash system, the city would first have to change its funding mechanism for trash services. Communities which have implemented PAYT have used a variety of funding schemes including:

- Charging a base fee (either in tax bills or utility bills) to cover the fixed costs of the trash system and charging for all trash on a per-bag or per-container basis;
- Charging a base fee (either in tax bills or utility bills) to cover the fixed costs of the trash system and the cost of a first trash container and charging for additional disposal amounts on a per-bag or per-container basis;
- Charging for trash on a per-bag or per-container basis; and
- Charging a trash subscription charge based on the number and volume of containers the resident sets out at the curb each week.

The city could chose to continue funding recycling and composting services through its tax base or set fees for the trash program to also cover these costs.

Implementation of PAYT in Takoma Park will most likely increase administration costs. In general, bag or tag programs require less accounting and billing than subscription services. An outreach program upon program introduction will be necessary and add to cost. These increased costs can be offset by reduced disposal costs, and potentially reduced collection costs if the city can rationalize trash collection routes and make fewer trips to the Transfer Station. Takoma Park could design a PAYT system to be revenue neutral.

As an interim measure before implementation of a PAYT system can be completed, Takoma Park could introduce the option of a small volume or "mini-can" trash service (e.g., 20 gallon). This option would limit the amount of trash residents could dispose each week in return for a tax rebate.

Establish a textile recycling program

Several communities have added collection of textiles and small reusable goods to their curbside collection programs. For example, Saint Paul, Minnesota, began offering citywide collection of these items in 1994. The program is a collaborative effort between the city's contractors and Goodwill Industries. Collection crews distribute tags for residents to use to identify bags of goods intended for donation. Crews place bags of donated materials in a cage mounted on top of the recycling trucks. (The city incurred no capital costs because collection trucks were already fitted with the cages for corrugated cardboard.) Crews transfer collected material to a trailer which Goodwill transfers, when full to its processing center.

Takoma Park could replicate a similar program to collect textiles or textiles and other small household items. The city may need to do a retrofit to its collection trucks in order to collect materials. Montgomery County accepts textiles at its transfer station and Takoma Park crews could deliver textiles to this facility at the same time they deliver commingled recyclables to the MRF. If the city collects small reusable goods, the city would need to identify a partner organization and develop a centralized location where collected goods were delivered before the recycling trucks drive to the Montgomery County MRF.

Alternatively, the city may want to collect textiles through a drop-off program. In general, a drop-off program will not collect as many materials as a weekly curbside collection. On the other hand, a program offered a few times a year may be easier to implement.

Mandate business recycling and enforce the requirements

Business often excluded from community recycling programs and planning because their waste is not handled by the municipality. This is the case in Takoma Park.

Montgomery County enacted Executive Regulation 109-92 on March 23, 1993, making business recycling mandatory. This regulation requires businesses to divert office paper, corrugated cardboard containers, newspaper, aluminum and steel/tin food and beverage cans (including bi-metal cans), glass and plastic food and beverage containers, and yard trimmings from their waste through recycling, composting, and/or waste reduction programs. Businesses with 100 or more on-site employees are also required to complete a business recycling and waste reduction plan, and submit an Annual Business Recycling and Waste Reduction Report. Small businesses with fewer than 100 on-site employees are required to, upon request from DSWS, submit a Plan or Annual Report. County staff will assist businesses with program implementation upon request.

The county has performed little enforcement of its mandatory recycling requirement in Takoma Park. The city could boost business recycling within its jurisdiction by passing and enforcing its own local ordinance. Ideally, Takoma Park should model its ordinance on Montgomery County's ordinance in

order to avoid establishing conflicting requirements and reduce administrative costs of compliance. In addition to enforcement, the city should consider developing a business waste audit and technical assistance program. At a minimum the city should develop a brochure or letter informing businesses of the county and/or local requirements and how to get into compliance.

Add all narrow-necked plastics to the curbside recycling program

The Montgomery County Materials Processing Facility (MPF), where Takoma Park delivers its commingled containers, began accepting all narrow-necked plastic containers in 1999. Before this change, Takoma Park only accepted #1 and #2 narrow-necked plastic containers in its curbside recycling program. The city has now (Nov.'99) has begun accepting these materials in its curbside program. This change requires an initial outreach program advertising the change. Furthermore the city needs to update its outreach materials and website to reflect the program change(s).

Summary Table of Takoma Park Cost and tonnage estimates

Measure	*Cost*	*Potential Annual Waste Diversion*	*Annual eCO2 reduction*
Phase 1: Interim small volume trash service option	Can be designed so revenue neutral. Estimated disposal cost reduction equals $17 per participating household per year.	100 tons	205 tons eCO2
Phase 2: PAYT trash system	Can be designed so revenue neutral.	250 tons	512 tons eCO2
Option 1: Curbside collection of textiles only	< $500 per year	12 tons	7 tons eCO2
Option 2: Curbside collection of textiles and small reusable items	< $1,000 per year	18 tons	84 tons eCO2
Adopt and enforce business recycling ordinance	Depends on program intensiveness: $10,000 - $30,000 per year.	500 tons	1,285 tons eCO2
Add all narrow-necked plastics to the curbside recycling program	< $500 first year	25 tons	41 tons eCO2

Waste Measure 1

Pay-As-You-Throw Trash Service

Description
Method for pricing refuse collection that encourages recycling and waste reduction by charging for collection based on the amount of refuse requiring collection for each household.

CO_2 Reduction
324 tons

Target Sector
Residential

Sector Penetration

Implementation Costs
The new program will require the creation of promotion and education programs. Establishing the rate and implementing the billing will add administrative costs.

Savings ($/yr in 2010)
expect program to be revenue neutral

Fiscal Impacts
The goal of the program is to be revenue neutral. The cost of the refuse collection program would no longer be carried in the general City budget.

Implementation Responsibilities
City government

Funding Options
Establish a per bag fee or require a tag per container. The bags or tags would have to be sold by the City or through agreements with area vendors.

An alternative would be to establish a subscription fee based on the number of trash containers requiring collection each week for each household

Implementation Schedule
Would require 6 to 12 months of preparation time once decision is made to move ahead with program

Implementation Steps

A. Council presentation and approval of concept
B. Public Hearings to solicit residents reaction to various fee methods (by tag, by bag or by containers, etc)
C. Design Program based on Council and resident input and preference.
D. Education/promotion program to begin 3 months prior to start-up through mailings, monthly newsletter articles and flyers delivered house to house.
E. Establish method for residents to purchase bags or tags or subscribe for service level depending on method selected.
F. Once program begins, establish monitoring system to determine whether fee sufficiently covers program costs. Review fee and adjust annually as necessary.

Waste Measure 2

Adopt and Enforce County Business Recycling Ordinance

Description
Montgomery County passed a business recycling ordinance (#109-92) in March, 1993 requiring all businesses to establish recycling programs. Those with more than 100 employees are required to submit annual reports. The County does not enforce this program for small businesses in Takoma Park. The City could boost recycling in area businesses adopting and enforcing a local ordinance.

Target Sector
Commercial businesses

Implementation Costs
Cost would be incurred by each business and would relate to quantity and frequency of collection. Hopefully refuse cost for each business could be reduced as a result of the recycling program. Additionally, cost to the City would come from establishing an enforcement process (most likely through Code Enforcement office) and providing assistance to businesses to set up programs (most likely through Solid Waste office).

Fiscal Impacts
Implementation and enforcement costs would be incurred by the City. Each business would fund their program.

Funding Options
Tax revenues for City expenses

CO_2 Reduction
1,620 tons

Sector Penetration
Would affect all commercial establishments, but impact on CO2 would be low

Savings ($/yr in 2010)
unknown

Implementation Responsibilities
The City's Solid Waste and Code Enforcement offices would be responsible for developing the program and informing affected businesses.

Implementation Schedule
This program would require Council action. Most likely the City would adopt the Montgomery County Business Recycling law. Once legislation was adopted the City would probably a phase in period of 12 months for businesses to investigate their options and establish programs.

Implementation Steps

A. Council adoption of Montgomery County Ordinance or similar legislation

B. Program Implementation - phase in period for business to learn of requirements and investigate options.

C. Establish business reporting requirements and determine enforcement responsibilities.

Waste Measure 3

Expand Plastic Recycling Program

Description
The City can now collect all narrow-necked plastic bottles in the curbside recycling program.

CO_2 Reduction
41 tons

Target Sector
Residential households

Sector Penetration
extremely minor

Implementation Costs
Very minor due to expansion of already existing program with infrastructure in place.

Savings ($/yr in 2010)
Minor reduction in solid waste disposal fees due to increased recycling of approximately $1,000 annually.

Fiscal Impacts
Very minor, slight increase in quantity of commingled materials collected and sent to processing facility. Processing facility charges a per ton fee, however plastic do not add much to weight of materials.

Implementation Responsibilities
City government, Solid Waste Division

Funding Options
Tax revenues

Implementation Schedule
To begin immediately.

Implementation Steps

A. Develop and implement public education program through City newsletter and other methods.

B. Update all program information currently available by hard copy and the City website to include the new plastic recycling program.

Transportation Sector

At the outset, the impact of transportation on the production of greenhouse gases is both significant and the most difficult to control with local action. That is because, one, many of the daily vehicle trips within the borders of Takoma Park do not originate (or end) here, and, two, Takoma Park does not have jurisdiction over the major transportation arteries nor control over any means of mass or public transit.

Transportation Overview and Options for Local Action
by
James Sebastian and Dean Menke
Transportation Subcommittee
Committee on the Environment

If flow-through commuter traffic is included in the count and analysis, the largest contributor to greenhouse gas emissions in Takoma Park is the transportation sector, representing 56.4% (3,862,379 MMBtu; 304,511 tons of CO2e). Even without commuter traffic, transportation still represents a third of the total — 34.3% (1,513,705 MMBtu; 119,341 tons of CO2e).

Takoma Park has some distinct advantages in its ability to limit transportation emissions. Its origin as a railroad suburb and the subsequent development of Metro and bus service make the city accessible by public transportation as well as by walking and bicycling. According to the 1990 census, less than half (48%) of the commuting trips are made by single occupancy vehicles (SOVs), well below the regional average. However, SOVs still comprise the dominant means of commuter travel.

For the purposes of the baseline emissions inventory, project volunteers estimated the city's vehicle miles traveled (VMT) using estimates for Montgomery County from the regional Household Travel Survey conducted by the Metropolitan Washington Council of Governments. The per capita VMT for Montgomery County was multiplied by the number of residents in the Takoma Park study area (the 20912 zip code). This resulted in a total annual VMT of 208 million.

Another method of determining VMT is to use actual traffic counts from roads in Takoma Park. There are two problems with using this approach in Takoma Park. First, counts are available only for state roads. Second, a significant portion of the vehicles on the state roads, especially at the peak periods, are vehicles from outside Takoma Park traveling through the city, commuting to and from work.

Similarly, Takoma Park's position as a small city in the middle of a region of 4 million people means it has fewer transportation control measures at its disposal than a larger or more self contained jurisdiction, such as Montgomery County. Takoma Park does not have its own transit system and does not really have any control over its major roads. Only 890 people employed in Takoma Park also live in Takoma Park; in comparison, 9,208 commute to work outside the Municipality. The Action Measures listed below attempt to change the behavior of individuals who either live or work in Takoma Park, as opposed to those who simply drive through.

Several of the action measures identified below build on regional efforts already

underway, such as the promotion of alternative transportation modes. Others, such as the bicycle and pedestrian facilities and municipal low emissions vehicles will be part of new city and county efforts. If implemented, they will reduce greenhouse gas emissions by 32 tons (423 MMBtu)per year by 2010.

Transportation Measure 1

Cleaner Municipal Fleet of Vehicles

Description
Purchase cleaner vehicles for municipal fleet such as hybrid gasoline/electric vehicle. Most police and public works vehicles would not be replaced.

Target Sector
Transportation; Municipal

Implementation Costs
5 vehicles @ $20,000/vehicle = $100,000

Assumptions:
* No difference in vehicle costs
* Normal turnover would replace 5 vehicles; Under this action measure, the city would replace 10 vehicles in the same amount of time

Economic Impacts/Benefits

Funding Options
State energy program will subsidize $2000 per vehicle for alternative fuel vehicles.

CO2 Reductions
By 2010, 119 ton/yr
Assumptions:
* 10 hybrid (gasoline-electric) vehicles will replace 10 gasoline-powered municipal vehicles.
* 400% improvement in fuel economy (i.e., 15 mpg to 60 mpg).

Sector Penetration
NA

Savings
By 2010, $12,000/yr

Implementation Responsibilities
City fleet manager

Implementation Schedule
Begin the evaluation process immediately, with implementation (i.e., purchase of vehicles) as soon as possible.

Implementation Steps

A. Continue to evaluate alternative technology and alternative fuel vehicles as they become available. Evaluate not only their applicability for particular municipal uses, but also their effectiveness at addressing the global warming and air quality issues. [For effectiveness, both city fleet managers and Environment Committee staff should work together.]
B. Propose a formalized commitment by the City to purchase alternative technology vehicles.
C. To promote awareness of cleaner vehicle alternatives in the community and to demonstrate their functionality, cleaner municipal vehicles should be clearly marked as such, possibly indicating the CO2 savings per year compared to conventional vehicles.
D. The cleaner vehicle fleet should be monitored to evaluate their performance, energy savings, and CO2 reductions.

Transportation Measure 2

Vehicles Scrappage Program

Description
Implement a scrappage program that removes older vehicles (pre-1980) from the road by offering monetary rebates.

Target Sector
Transportation - Public/Citizens of Takoma Park

Implementation Costs
$500/vehicle x 50 vehicles = $25,000

Funding Options
Implementation Schedule 2001-2006 with a goal of 10 vehicles per year

CO2 Reductions
By 2010, 26 tons/yr
Assumptions:
* 10 vehicles/year for 5 years
* 10,000 miles/yr/vehicle = 500,000 vmt over lifetime

Sector Penetration
1% of Takoma Park's private fleet by 2010.

Savings($/year in 2010)
By 2010, $2,667/yr
Economic Impacts/Benefits

Implementation Responsibilities
Environment Committee of Takoma Park

Implementation Steps

A. Identify sources of revenue to support the program.

B. Develop an evaluation mechanism that assesses the 'dirtiness' of the vehicle and its acceptability for the program.

C. Establish and publicize buy-back days on which residents can submit vehicles for evaluation and possible inclusion in the program.

D. Develop and strategically distribute (i.e., under the wiper of older cars) literature describing the program, the benefits to the environment, and the monetary rebate.

E. Maintain effective logs stating the vehicles scrapped. Include in this log information on the vehicle that may replace the scrapped vehicle, i.e., fuel economy improvement and other benefits.

Transportation Measure 3

Promote Alternative Modes of Transportation

Description
Promote alternative modes of transportation, such as ridesharing, transit, bicycling, walking, and telecommuting.

Target Sector
Transportation

Implementation Costs
$5000

Assumptions:
* Average of $1000 per mode, with 5 total shifts.
* Cost would be for literature development and distribution.

Funding Options

Implementation Schedule
Already underway (piggyback on efforts already underway by MWCOG).

CO2 Reductions
By 2010, 11 tons/yr

Trip reduction assumptions:
1. Car-pools - 1000 trips @ 10 miles/trip; 20 mpg; occupancy factor from 1 to 3
2. Bus - 500 trips @ 10 miles/trip
3. Train - 500 trips @ 10 miles/trip
4. Bike/Walk - 500 trips @ 2 miles/trip
5. Telecommute - 1000 trips @ 10 miles/trip

Sector Penetration
In aggregate, 10% of single occupancy vehicle travel.

Savings
By 2010 and in aggregate, $1,213/yr
Economic Impacts/Benefits

Implementation Responsibilities
Environment Committee of Takoma Park, in cooperation with the Commuter Connections program. (MWCOG).

Implementation Steps

A. Work with MWCOG and its Commuter Connection program to target Takoma Park residents and employers.

B. Provide information on alternative commuting at municipal building, civic events, public meetings, office buildings, etc.

C. Identify a city staffer as the alternative commute contact

Transportation Measure 4

Improve Transit Information

Description
Provide bus schedules and route maps at all bus shelters.

Target Sector
Transportation - Public Transportation Options

Implementation Costs
$1000, the cost to install maps and schedules at all bus shelters

Funding Options
Implementation Schedule
As soon as possible. 2000.

CO2 Reductions
By 2010, 4 tons/yr

Assumptions:
* Each map generates 2 new trips each day
* 20 shelters in Takoma Park
* 2 miles per trip

Sector Penetration
NA

Savings
By 2010, $578/year
Economic Impacts/Benefits
Implementation Responsibilities

Implementation Steps

A. Develop a clear description of the information resources requested.

B. Approach shelter owners and transit providers to determine feasibility.

C. Coordinate a meeting between transit providers and bus shelter owners/operators to establish protocol.

Transportation Measure 5

Bicycle and Pedestrian Facilities

Description
Improve the conditions for biking and walking in Takoma Park with the installation of bike racks, bike lanes/paths, and improved sidewalks.

Implementation Costs
$522,500

Assumptions:
* Racks - The city has already received 25 bike racks free of charge from the Maryland DOT. Installation will cost $100 per rack (or $2,500 total).
* Lanes - At an approximate cost of $1/ft. (or $20,000 total).
* Sidewalks/Trails: To install and improve sidewalks it costs $100,000/mile (or $500,000).

Economic Impacts/Benefits

Funding Options
Sidewalk retrofit program (state)
Transportation enhancements program (state/federal)

CO2 Reductions
By 2010, 37 tons/yr

Assumptions:
* 25 new racks adding 2 trips/day @ 2 miles/trip;
* 2 miles of bike lanes adding 50 new trips/day @ 2 miles/trip;
* 5 miles of new/improved sidewalks and trails, adding 10 trips/day @ 0.5 miles per trip.

Target Sector
Transportation

Cost Savings/Benefits
By 2010, $3750/yr

Sector Penetration
NA

Implementation Responsibility

Implementation Schedule
This would be an ongoing effort that is already underway by the city and county planning departments. Projects mentioned above will be complete by 2010.

Implementation Steps

A. Complete installation of the bike racks provided by the state highway administration

B. Work with city, county and state officials to install bike lanes and sidewalks.

C. Work with city, residents and business owners to site bicycle parking racks.

Chapter 6 -- CONCLUSION

This report is the draft of a plan that will be presented to the Takoma Park Mayor and Council for endorsement and adoption.

Upon adoption of some or all of these local actions to reduce greenhouse gas emissions, this Task Force recommends that:

1. If funding can be secured, energy use and emissions information should continue to be gathered from utilities, and ideally should be based on actual utility and/or municipal utility records at the zip code+4 level rather than the 5 digit zip data that was accessible under the terms of this study. While the 5 digit zip code data gives a useful general picture, a more exact record of municipal consumption and emissions would be preferred;

2. This data should become the foundation for a system that tracks and verifies changes in energy use and consumption as action measures are implemented.

To ICLEI, this Task Force urges that a serious effort be made to put the analytical and measurement information represented in this report into a complete software program (on CD) and widely disseminated. It is our belief that few municipalities of the size of Takoma Park would have the resources available for an undertaking of this magnitude and detailed nature without the benefit of a comprehensive template tool including a fully integrated action plan narrative complete with graphics and tables. This comprehensive CD would build on the work of Torrie Smith and Associates' ICLEI software that makes it easier to compile energy use information, ascertain the effect of consumption on emissions, and develop steps to change that consumption depending on local characteristics, would greatly improve the likelihood for the widespread adoption of local greenhouse gas emission reduction plans.

Even with such a tool available, there would still need to be a continuing outreach program that would introduce this program to City staff and other community leaders to stimulate sufficient desire to proceed with developing their own LAP. In other words there will still be a real need for the types of workshops that ICLEI has hosted with EPA sponsoring over the past four years. Even with a complete LAP cookbook there will need to be a certain amount of hand holding but in our opinion it MUST be done. Climate change is not going to go away. This is most likely the most significant challenge that contemporary man confronts.

For more detail, please see Methodology in Appendix C.

A CLOSING NOTE

from Albert Nunez, Consultant/Committee on the Environment, Energy Subcommittee

In 1999 the Maryland state legislature passed the Electric Utilities Deregulation Bill into law with no renewables/efficiency strategies recommenced by MaryPIRG or from the People's Council. Municipalities are banned from aggregating under Maryland's new Electric Utility Deregulation Law, and there are no renewable set-asides. But on the flip side, Maryland does have a relatively strong 'Net Metering' law on the books. A continuing lobbying effort is underway to improve this law to be more favorable to municipalities, energy efficiency and renewables.

There is a new paradigm unfolding, and it is anyone's guess what the future will hold. One thing is certain, mankind must learn to live in harmony with nature; that is, in a sustainable manner within the limits of our planet's resources while maintaining the ecosystem's delicate balance.

Maybe by 2010 there will be a solar-generated, hydrogen-powered Daimler-Chrysler--Ballard fuel-cells in every home? And in every car too? Or maybe they will both be one in the same? The technology exists, it's the political will that is lacking.

There are still great inequities in our "accounting" system that evaluates the "cost effectiveness" of renewables over fossil and nuclear. Society is bearing the costs for these failings in countless ways and eventually, as with the tobacco industry, the piper will be paid.

Industrialized societies must learn to live off of 'energy income' (renewables) and leave the 'energy savings' (fossils and nuclear) in the bank. Future generations will need this feedstock for higher end uses than keeping traffic flowing and buildings warmed in the winter, cooled in the summer and lit at night.

APPENDIX A -- MEASURING CO_2 AND ENERGY

Planning for CO_2 emission reductions and related energy efficiency improvements requires the measurement of CO_2 and various energy quantities. Because the primary audience for this plan is non-technical, the following conversions are provided:

- Global warming emissions are expressed in pounds or tons of carbon dioxide (CO_2) rather than carbon (C). The conversion is 44 pounds of CO_2 for 12 pounds of C, or 3.666667 pounds of CO_2 per one pound of C.

- In this plan, CO_2 is expressed as a function of fuel type by weight, in either pounds or tons (short tons of 2,000 lbs.). For example, 87 gallons of gasoline is equivalent to about one ton of CO_2.

- CO_2e = Carbon Dioxide Equivalent or Global Warming Potential - To make relative comparisons between carbon dioxide and methane and other greenhouse gasses possible, the Global Warming Potential for each has been calculated. For example, since methane is 21 times more potent as a greenhouse gas than carbon dioxide, the relative global warming potential of carbon dioxide = 1, and methane = 21. When methane and carbon dioxide emissions are summed, they are referred to as CO_2, indicating the methane has been converted to CO_2 equivalent (CO_2e).

- Energy use involves a variety of fuels that are measured in their own unique units. Electricity, for example, is normally expressed in kilowatt/hours while gasoline is measured in gallons. To simplify tabulations, all energy values are converted into British thermal units (Btu). One Btu is the amount of thermal energy required to raise the temperature of one pound (one pint) of water 1 $^{\circ}$F at sea level. Because a single Btu is a relatively small amount of energy, one million Btu (MMBTU) is used as a standard unit throughout the plan. **Table 1.3** presents conversions of various fuels into Btu equivalents according to energy and CO_2 content.

- C02 emissions are often expressed in pounds or tons per capita, which is the total amount of C02 from a given source divided by Takoma Park's total population. This latter expression is intended to give citizens better insight into how their personal actions contribute to the community's global warming emissions.

APPENDIX B -- EMISSIONS DATA SOURCES

Many challenges were encountered in assembling the data necessary to develop a credible 1990 Baseline Emissions Inventory which provided the basis for the 2010 Emissions Inventory and Emissions Reduction Goals. The core of the challenge was to obtain data which accurately reflected the municipality's use of electricity and natural gas as well as its transportation sector share of emissions.

Census Data

1990 U.S. decennial Census data provided information on population by age, number of households, number of singe-family and multi-family housing units and heating type, number of employees and place of work, means of transportation to work, car ownership, number of commuters and average travel time. **(Appendix ? 1990 U.S. Census Data)**

This essential 1990 U.S. Census data was available for both zip codes and municipalities. The borders of the Takoma Park municipality and the postal zip area were not perfect matches because the municipality border was and is smaller than the zip area. **(Exhibit A-1: Takoma Park and Zip Code 20712 Map)** This would not be an issue if all other data were available for the municipality. Unfortunately, this was not the case.

Data supplied by the gas and electric utilities was aggregated annual consumption data for the five-digit Zip Code Area 20712. Takoma Park very closely correlates between the zip and actual municipal boundaries. The 1990 Census indicates that there were 500 persons more in the zip code area than in the municipality or a +6.1% **difference** (Zip=8,442; City= 7,954), 122 (3.34%) more housing units (Zip=3,708; City=3,586) and 152 (4.35%) more households (Zip=3,645; City=3,493). However, it should be understood that as long as 5-digit zip code data is used, there will always be a discrepancy between the inventories and the actual Takoma Park numbers. For the purposes of this report, this percentage error did not affect the commercial sector and did not significantly affect the residential one.

Therefore, the decision was made that the Zip Code Area 20712 information, which more closely matched other available utility data, was meaningful and would be utilized to develop the Takoma Park inventories. The zip code area population and household counts would be used in establishing per capita and per household counts for the 1990 Baseline Inventory.

Natural Gas Consumption Data

Unfortunately,1990 utility data to establish the baseline inventory was no longer available; however, Washington Gas provided consumption information in therms for 1995, 1996 and 1997, which showed a gradual increase in use over the three-year period. The utility also prepared "weather-normalized" data to even out major weather fluctuations.**(Exhibit A-2: Takoma Park 1995, 1996 and 1997 Gas Consumption Data)** In addition, Washington Gas determined the number of residential/multi-family and commercial accounts and the total consumption in each category. **((Exhibit A-3: Takoma Park 1995, 1996 and 1997 Residential/ Multi-family Commercial Natural Gas Accounts) .** This data appeared credible and useful for converting into emissions data as well as backcasting and forecasting for the 1990 and 2010 inventories.

Electricity Consumption Data

Reliable PEPCO data was more difficult to acquire. At first request, PEPCO was reluctant to provide consumption data because it was not available as far back as 1990. Ultimately, it agreed to generate information for 1995, 1996 and 1997, providing residential and commercial totals in kilowatt hours (kwh) for the zip code for a $600 fee. This first run data, which was transmitted on April 17, 1998, had numerous holes, that is, zeros where there should have been quantities. When this was indicated to the utility, it agreed that this data should be discarded. **(Exhibit A-4: Takoma Park 1995, 1996 and 1997 Baseline Aggregate Electric Consumption Data)**

A second run was requested immediately, but it took a long time to prepare due to changes in the utility's internal organization and the regulatory climate. The Maryland Legislature had begun to work on electric utility deregulation which stalled the data acquisition process until the bill was passed into law. Apparently, PEPCO felt that this data might be used by the municipality to adversely affect the utility's competitive position. This new law actually forbids municipalities from forming independent power marketing groups, so PEPCO honored the data request once the law had passed. The second data set was transmitted on June 21, 1999. **(Exhibit A-5: Takoma Park 1996, 1997 and 1998 Baseline Aggregate Electric Consumption Data)**

There were problems with this second "cleaned" three-year data set, which now included 1996, 1997 and 1998. The 1998 zip-code consumption data indicated an almost 100% increase over the previous two years. At first, it was thought that this was possibly a result of a very hot summer that caused power consumption to skyrocket due to tremendous air-conditioning loads. The decision was made to request "weather-normalized" data as provided by Washington Gas. Unfortunately, since PEPCO either could not or would not produce this output for analysis, this left only one other option. That was to use the EPA weather normalization modeling program. In order to run this program, the provided aggregated annual electric data needed to be disaggregated by month. On July 27, 1999, PEPCO supplied disaggregated r regional suburban Maryland, not zip code, monthly data**. (Exhibit A-6: 1996, 1997 and 1998 Regional Suburban Maryland Monthly Electric Consumption Data)** Although it was doubtful that a perfect correlation between the total suburban Maryland monthly data and an individual zip code set existed, it was the best that was available. The suburban Maryland set likely included a different consumption pattern with many more electrically heated (including heat-pumps) buildings and large commercial and industrial power consumers than the localized zip set being evaluated.

Transportation Consumption Data

around the City of Takoma Park. **(Exhibit A-7: Maryland Department of Transportation Traffic Count Map)**

Descriptive paragraph **(Exhibit A-8: Land Use and VMT Summary by Jurisdiction Table)**

APPENDIX C -- METHODOLOGY

All of the emissions source data required some manipulations, assumptions, and conversions to carbon dioxide equivalents to make them applicable to the development of Takoma Park's 1990 Baseline Inventory. The following describes that process:

Census Data

The decision was made that the Zip Code Area 20912 U.S. Census data was meaningful **(Appendix A - Emissions Data Sources - Census Data)**; and therefore, it was utilized rather than the Takoma Park municipal boundary information to develop the inventories because it more closely matched other available data from the utilities. The zip code area population and household counts were used in establishing per capita and per household counts for the 1990 Baseline Inventory and carried forward to the 1995 interim study year and the 2010 projection. This strategy clears up most residential per capita/household discrepancies, but there are still small aggregate total discrepancies.

There are also still problems with commercial sector total square footage and estimated number of employees since the only data retrieved was at the municipality level not the Zip code is data set was reported as years 1993, 1994 for each municipality.

Natural Gas Consumption Data - Backcasting and Forecasting

As discussed in **Appendix A - Exhibits A-1 and 2,** Washington Gas no longer had consumption data for the 1990 baseline year nor did it have projections for 2010 at the municipality or zip code levels. Therefore, it was necessary to use the three-year data provided for 1995, 1996 and 1997 to project backward and forward. The weather-normalized data was used to do this analysis so that the anomalies of the weather fluctuations would not skew the results. This data was credible because it showed a gradual increase in usage over the three-year period; therefore, a trend could be established by averaging percent change which was a little over one percent per year. **Exhibit B-1** indicates the 1990 projected baseline, 1995 actual interim, and 2010 projected consumption data as well as the intervening years.

Electricity Consumption Data - Backcasting and Forecasting

As discussed in **Appendix A,** PEPCO no longer had consumption data for the 1990 baseline year nor did it have projections for 2010 at the municipality or zip code levels. Therefore, it was necessary to use the three-year data provided for 1996, 1997 and 1998 to project backward and forward.

As explained in **Appendix A,** PEPCO did not provide weather-normalized data for the zip code. So that the anomalies of weather fluctuations would not skew the results, PEPCO's regional suburban Maryland, not zip code, monthly data was used to run the EPA weather normalization modeling program. **(EPA Energy Star Building Benchmarking Tool <http://www.epa.gov/buildinglabel>)** Monthly energy consumption data had to be entered into the program for a building or a group of buildings along with other data such as site location, zip codes, number of employees, and square footage before the program could do the weather normalization. This software was designed to simulate commercial/office building use, but it was adapted for residential by inputting a 24-hour use period when residential sectors were weather-normalized. **(Exhibit B-2)**

This new 'clean' data was then analyzed, and it appeared that all of the 1998 figures were still over 100% increase above the previous years as described in **Appendix A**. This indicated faulty 1998 data sets. After consideration and consultations, it was decided that the most probable cause for the error was that on the last batch run (1998) the programmer failed to adjust the run start date to January 1, 1998 from January 1, 1997. With this assumption, 1997 aggregated annual data was subtracted from the 1998 data; and the whole weather normalization evaluation process was repeated for the 1998 revised data. This provided data which seemed more accurate and usable.

Because of the extreme variability

The next hurdle to be cleared dealt with the problem of projecting back and forward in time to estimate the 1990 and the 2010 consumption patterns for each of the Zips and sectors.

Unfortunately, city-wide 1990 utility data was not available so an emissions inventory was conducted for the years of 1995, '96, '97, '98 and then projected back to 1990. This inventory includes mostly carbon dioxide and other greenhouse gases (represented as a CO_2 equivalent, or CO_2e). The baseline year establishes the amount and sources of CO_2 that Takoma Park emitted for that year. The inventory does not cover a small subset of emissions that are not readily controlled by local government actions including large engine sources such as locomotive and aircraft and agricultural/landscaping sources like fertilizer.

There were numerous difficulties with reconciling the utility-provided data between the two dates. These are listed in detail below with suggested methodologies for resolution. These difficulties include residential vs commercial accounting on multi-family housing, weather normalization, reconciliation of zip vs municipality boundary, unification/ annexation.

Recommendations for Improving City-Wide, Utility-Supplied Energy Consumption Data:

1. Request aggregated utility data for zip code(s) that most closely matches municipal boundaries. If there are areas that are a poor fit at the 5 digit zip level, go to zip + 4 coding to increase geographic correlation. Takoma Park very closely correlates between the zip and actual municipal boundaries. The 1990 Census indicates a less than 500 person or a +6.1% **difference** (Zip=8,442; City= 7,954) and only 122 (3.34%) more housing units (Zip=3,708; City=3,586).

2. Zip + 4 coding can be determined with the assistance of local postmasters. The post office is obliged to provide the full zip + 4 coding to anyone who asks. Unfortunately, it will generally NOT be given for areas within municipal boundaries. The data is given for whole zip codes (5 digits) only. Once the data is in hand, both digitally (*.txt files) and a printed hard copy, it will need to be "cleaned" of all zip + 4 areas external to the municipality's borders. This can be done for the most part with accurate maps that show both the municipal and zip code borders, the names of all streets, roads, avenues, etc., preferably with numbering. Field verify all questionable deletions or additions to the final set. Once confident, provide this zip + 4 list to the utility(ies) to use for extracting the municipality's annual energy consumption data.

3. Multi-family residential master-metered account data is typically included in the commercial sector accounts. One way to quantify this deviation is to request the total number of accounts that the data represent. Do this for residential, commercial, industrial, and any other account breakdowns (i.e., electric vehicle

accounts) that may be available from the utility. In most cases, the utility should be able to provide this data. When this data is compared for the total number of dwelling units for that defined service area (municipality), it should give an indication of the total number of master- metered residential accounts that represent multiple dwelling units. From here an estimate can be made of the fraction of the total commercial that should really be considered in the residential sector.

4. Weather fluctuations can skew utility data dramatically, but fortunately it is possible to "back out" weather-caused demand fluctuations if the proper data sets are requested from the utility. The first approach is to ask the utility to provide "weather normalized" data as well as actual consumption for the years being analyzed . If the response is that it does not have that capability, then request the data be provided monthly rather than on an annual basis. Monthly data sets allow for weather normalization to be done by employing the US Environmental Protection Agency's Energy Star Buildings Benchmarking Program which is located on the Internet at <http//www.lbselbse.org/Tool/>. Once normalized data is derived for the "site" then it can be entered i n the ICLEI/ Torrie Smith Associates Software for further analysis. Note: If the EPA Benchmarking tool is used when entering the resulting normalized data into the ICLEI software, be certain that the proper units (kBtus) are entered and that the data selected from the report is the weather normalized set for the "Site" NOT the "Source". Individual state power plant source factors are included in the Torrie Smith Software algorithm.

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