City of Durham & Durham County

GREENHOUSE GAS AND CRITERIA AIR POLLUTANT EMISSIONS INVENTORY AND LOCAL ACTION PLAN FOR EMISSION REDUCTIONS

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List of Acronyms

BAU – business as usual: a scenario in which growth, energy use and waste production continue to follow existing patterns.

Btu – British Thermal Units; a standard unit of measure equivalent to the quantity of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit at the temperature at which water has its greatest density (approximately 39 degrees Fahrenheit).

CACP – Clean Air Climate Protection; the software used by ICLEI to calculate GHG emissions.

CAP – criteria air pollutant, a category of air pollutants including: nitrogen oxides (NOx) sulfur oxides (SOx), carbon monoxide (CO), particulate matter (PM), and volatile organic compounds (VOC), which have adverse effects on human health.

CCP – Cities for Climate Protection; a program developed by ICLEI – Local Governments for Sustainability to help local governments reduce greenhouse gas emissions from their operations and communities.

CIP – Capital Improvement Plan

DCHC MPO – Durham-Chapel Hill-Carrboro Metropolitan Planning Organization.

GHGs – greenhouse gases, primarily consisting of: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

GHG – equivalent CO_2 (eCO_2); used to describe all greenhouse gas emissions in an equivalent volume of carbon dioxide.

ICLEI – Local Governments of Sustainability (formerly the International Council for Local Environmental Initiatives).

kWh – kilowatt hours; a unit commonly used to measure electricity.

LAP – Local Action Plan

LRTP – Long Range Transportation Plan (a publication of the DCHC MPO).

t – tons (short ton); the unit of measure in which greenhouse gas emissions are usually calculated, equivalent to 2000 lbs. Not to be confused with a metric *tonne*.

MMBtu – Millions of British Thermal Units.

VMT – Vehicle miles traveled; a measure of the total distance traveled within a community. This is used to estimate fuel consumption and greenhouse gas emissions.

1 Background

1.1 *Introduction to Climate Change*

At its most basic level, climate change is a variation in the long-term average weather (temperature, precipitation, wind patterns) that a given region experiences. On a global scale, climate change refers to variations in the Earth's climate as a whole. The Earth's temperature is regulated by a natural system known as the greenhouse effect whereby a delicate balance of naturally-occurring gases trap some of the sun's radiation near the earth's surface. This radiation heats the atmosphere and creates the conditions which make life on earth possible. The most common, naturally occurring greenhouse gases (GHG) include: water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO), and ozone (O_3).

Human activities, such as fossil fuel utilization, deforestation and industrial activities have resulted in an increase in the concentration of greenhouse gases, thereby enhancing the capacity of the natural greenhouse effect to warm the atmosphere. The Earth's climate is now changing. While some variations in the climate have taken place over millions of years, the current atmospheric greenhouse gas concentrations are unprecedented and could potentially have a devastating impact on the climate and the globe. Due to the scale of change in atmospheric concentrations of GHG, climatic conditions can no longer be accurately gauged using historical rates of change and variability.

The temperature of the Earth is already approximately 0.8°C (1.44ºF) above 1750 levels, and the majority of this change has taken place during the 20th century, most rapidly since 1970.[1] Most experts agree that average global temperatures could rise a further 2.5 to 10.4 degrees Fahrenheit between 1990 and 2100 given current rates of increase.[2] Since the climate exists as a delicate balance and marginal warming has the potential to affect not only temperatures but also precipitation, wind patterns, water levels, and climate systems most generally, climate change, if continued unabated, has the potential to dramatically affect life on the planet as we know it. The time to act is now, there must be a reduction in greenhouse gas emissions or the world will suffer detrimental consequences in the years and decades to come.

1.2 *Climate Change Impacts*

Scientists have predicted that climate change will have significant effects in a variety of areas. One of the main concerns arising from climate change is the increase in climatic variability which could have significant environmental and human impacts including: flooding and erosion in coastal regions, increased risk to forests from pests and drought, decreases in agricultural yields, a decrease in the quality and quantity of drinking water as water sources are threatened by drought, more frequent and more severe weather conditions, and negative impacts on fisheries and wildlife.

Human health will also be affected. Higher ambient air temperatures could result in increased heat stress that can lead to illness or death, particularly in the very young, the ill, and the elderly. There are also some indirect health impacts. Respiratory disorders or allergies could worsen as a result of increased heat and humidity and declining air quality. The spread and risk of vector-borne infectious diseases (such as the West Nile Virus) could also increase due to a changing climate. Extreme weather events could result in increased deaths and injuries.

[1] 'Confronting Climate Change,' United Nations (February 2007).
[2] Intergovernmental Panel on Climate Change Working Group I, Third Assessment Report, 2002.

While no one can predict the consequences of climate change with absolute certainty; it is now evident that enough is known to comprehend the risks associated with it. Taking strong action against climate change at a local government level through emission reductions can be seen as an investment; a cost incurred presently that will aid in avoiding the future risks and costs of cataclysmic climate change.

1.3 *Why the City of Durham and Durham County Should Take Action*

Due to population density, urban and suburban areas will be more susceptible than rural areas to the negative impacts of climate change. This density, however, also provides cities with unique opportunities for efficiency and emission reductions, through shared infrastructure. Apart from Durham's responsibility to do its part to reduce its contribution to global climate change, there are numerous other benefits of reducing emissions in the region.

- **Improved Service Delivery**

Through the implementation of energy efficiency initiatives in facilities and operations and throughout the community, the County and City will be able to offer services more efficiently and economically.

- **Reduced Costs**

By reducing energy consumption, the County, City and local citizens will save money on energy bills. While energy efficiency initiatives may require an initial capital investment, paybacks of between four and seven years can be expected in many cases and savings will continue well beyond the payback period. Furthermore, by reducing energy consumption, the City and its citizens will be less vulnerable to fluctuations in the market price of energy.

- **Improved Air Quality and Public Health**

The combustion of fossil fuels used to produce electricity, heat buildings, and power vehicles, emits a variety of pollutants into the atmosphere that are known to have negative health impacts and reduce local air quality. Reduced energy consumption will result in a reduction in local air pollutants such as sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOC), particulate matter (PM10), and carbon monoxide (CO). Since climate change may lead to the increased spread of vector-borne and heat-related diseases, in the long term, taking steps to reduce greenhouse gas emissions reduces the likelihood of climate-related health problems.

- **Asset Management**

Asset management involves developing a plan to systematically review the state of facility operations and implementing a logical repair or upgrade schedule that focuses on a proactive approach to facility improvements. Preventative maintenance improves the value of the City's assets by reducing facilities' operating costs, modernizing equipment, and decreasing deferred maintenance. Furthermore, increasing the efficiency of facilities and operations leads to better-run operations, greater client satisfaction, along with increased energy efficiency and the resulting cost savings emission reductions.

- **Community Leadership**

By taking concrete steps to address climate change and reducing the emissions of greenhouse gases from their own facilities and operations, Durham County and the City of Durham will be able to provide a solid example to the community to follow.

- **Quality of Life for Citizens/ Healthy Cities**

By reducing expenditures on energy and fuel, the County and City can apply the savings towards improving community services, such as reducing crime, community beautification and youth programming. Some programs that reduce emissions, such as an increase in number of bike paths, improved public transit and greener public areas, also contribute to an increased quality of life in the community by improving air quality, promoting active lifestyles and creating a more beautiful community. Together, these types of measures can help build healthier, more sustainable communities.

- **Job Creation**

The transition to a low emissions society will require a certain degree of innovation and effort. This transition is likely to result in the creation of new jobs, as homes will need to be retrofitted, educational programs will need to be developed and new technologies will need to be installed as they come on the market. These new jobs are likely to be particularly concentrated in the construction and engineering sectors. This job creation will, in turn, stimulate the local economy. A strong local economy is an essential aspect of a healthy and sustainable community.

1.4 *Durham: Amongst International Leaders*

In 1996, the City of Durham passed a resolution to join the Cities for Climate Protection (CCP), an international campaign of local governments who are committed to achieving quantifiable reductions in local greenhouse gas emissions, improved air quality, and enhanced urban livability and sustainability. Over 770 municipalities in 29 countries worldwide participate in the Cities for Climate Protection program. In the United States, over 160 municipalities have joined the CCP. Together, these communities are home to 55 million Americans - 20% of the total US population. Collectively, American CCP participants are reducing greenhouse gases by 23 million tons per year, equivalent to the emissions produced annually by four million passenger vehicles, or 1.8 million households. These communities are also reducing local air pollutants by more than 43,000 tons per year and saving over $535 million in energy and fuel costs.

The City of Durham has committed to follow the five milestone framework of the CCP program. In 1999, the City of Durham completed a greenhouse gas inventory and action plan as part of the CCP. This

Milestone 1. Conduct a baseline emissions inventory and forecast. Based on energy consumption and waste generation, the local government calculates greenhouse gas emissions for a base year (e.g., 2005) and for a forecast year (e.g., 2030). The inventory and forecast provide a benchmark against which the local government can measure progress.

Milestone 2. Adopt an emissions reduction target. The local government establishes an emission reduction target. The target fosters political will and creates a framework to guide the planning and implementation of measures.

Milestone 3. Develop a Local Action Plan. Through a multi-stakeholder process, the local government develops a Local Action Plan that describes the policies and measures that the local government will take to reduce greenhouse gas emissions and achieve its emissions reduction target. Most plans include a timeline, a description of financing mechanisms, and an assignment of responsibility to departments and staff. In addition to direct greenhouse gas reduction measures, most plans also incorporate public awareness and education efforts.

Milestone 4. Implement policies and measures. The local government implements the policies and measures contained in their Local Action Plan. Typical policies and measures implemented by CCP participants include energy efficiency improvements to municipal buildings and water treatment facilities, streetlight retrofits, public transit improvements, installation of renewable power applications, and methane recovery from waste management.

Milestone 5. Monitor and verify results. Monitoring and verifying progress on the implementation of measures to reduce or avoid greenhouse gas emissions is an ongoing process. Monitoring begins once measures are implemented and continues for the life of the measures, providing important feedback that can be used to improve the measures over time.

inventory is a follow up to that document.[3] By joining the City in the development of this most recent inventory and local action plan, Durham County has indicated its desire to take a leadership role in climate change mitigation and air quality improvement within the community.

1.5 *Municipal and State Activities*

In 2006, the North Carolina Department of Environment and Natural Resources (DENR) convened the first meeting of the Climate Action Plan Advisory Group (CAPAG). The purpose of the CAPAG will be to develop public recommendations to DENR and the Division of Air Quality for a state level climate action plan, focusing in particular on economic opportunities and co-benefits associated with potential climate mitigation actions. The goal of the CAPAG is to seek consensus on a comprehensive series of individual proposed actions to reduce GHG's in North Carolina. With so many of the sources of GHG emissions being under their direct or indirect control, local governments will undoubtedly play a key role in enabling North Carolina to achieve any emission reduction target it establishes. Because the City of Durham, Durham County, and the State of North Carolina are planning for climate change action concurrently, they are poised to aid one another in achieving their mutual goals of climate change mitigation and social and economic vitality.

Orange County, Carrboro, and Chapel Hill are jointly developing a greenhouse gas emissions inventory and local action plan. Given the proximity of the two counties, their shared interest in climate change mitigation, and a history of cooperation, it makes sense that the two counties work together to identify potential emission reduction measures that could be implemented cooperatively in Durham and Orange County this would also allow the governments to maximize their available resources.

1.6 *Background on Report Content and Structure*

In 2005, ICLEI Energy Services (the consulting division of ICLEI – Local Governments for Sustainability) was retained by the City and County of Durham to help develop a GHG and CAP inventory and action plan for the community and local governments of Durham. Using the CCP framework and Protocol, ICLEI worked in collaboration with City and County staff and a community advisory committee to develop the inventory and action plan. These teams consisted of stakeholders whom would be essential sources of information for the inventory and a fundamental driving force behind the implementation of a plan. Appendix A contains a list of all of the members of these teams. This document is the outcome of this collaboration and helps Durham to fulfill Milestones 1 through 3 of the CCP framework: the creation of an emission baseline and forecast, the adoption of emission reduction targets and the development of a local action plan.

This report is divided into six chapters. The first chapter of the report provides background information on climate change, the Cities for Climate Protection (CCP) program and rationale for participation in the program. The second chapter of the report outlines the methodology used to gather information and calculate emissions. The third chapter contains the baseline greenhouse gas inventories for both the municipal and community sectors. The fourth chapter contains the forecast of emissions to the target year under the BAU and planned measures scenarios. The fifth chapter outlines the historic and planned emission mitigation measures in the community and their impact on total emissions. The sixth and final chapter contains the local action plan and potential emission reduction targets in three different scenarios, which reflect varying levels of commitment on the part of the local governments.

[3] The differences between the 1999 inventory and the current one are discussed in Appendix G.

2 Introduction to Emissions Analysis

The purpose of a GHG inventory is to provide a baseline against which Durham can measure progress towards the reduction of greenhouse gases. The baseline inventory expresses greenhouse gas production as the number of tons of carbon dioxide equivalent ($eCO^{2/}$GHG) produced by energy use and waste generation in the community. The reduction target that Durham chooses is expressed as a percentage reduction from this baseline emission. For example, if a community is producing 100,000 tons of greenhouse gases in its baseline year and they commit to a 20% reduction in emissions by its target year, it is committing to produce only 80,000 tons of greenhouse gases by its target year.

The forecast section of the report helps a community to take into account any growth that it will experience between the baseline year and the forecast year. If a community continues to grow and continues to consume energy at current rates, emissions will grow beyond current levels. For example, a community with a baseline inventory of 100,000 tons of greenhouse gas emissions may grow in size and produce 120,000 tons of greenhouse gases by the forecast year if current energy consumption patterns continue (this is a called a business-as-usual scenario). In order for this community to reach its target of 80,000 tons, or a 20% decrease from baseline year emissions, the community must really offset 40,000 tons of emissions, rather than 20,000 tons. In this way, the forecast is an essential and useful tool for ensuring that targets are met in spite of growth.

Durham's inventory and forecast capture emissions from all areas of local government operations (i.e. municipal and county owned and/or operated buildings, streetlights, transit systems, vehicle fleets, wastewater treatment facilities and waste generated by government operations) and from energy and waste related community activities (i.e. residential and commercial buildings, motor vehicles, waste streams, industry). The inventory excludes emissions from certain other sources such as agriculture, cement production, paving, air and marine traffic in accordance with the CCP protocol. This is because these sources are typically out of a local government's control and they are accounted for in state-level and national inventories.

The inventory and forecast provide a benchmark against which the towns and county can measure progress towards reducing emissions. In combination with an analysis of the impacts of existing climate mitigation activities in the community, the inventory will also enable Durham to identify those areas in which the local governments and the community at large have successfully reduced emissions and those areas that are auspicious for new mitigation activities. In this sense, the inventory and forecast are policy development tools.

2.1 *Methodology*

ICLEI used the Clean Air and Climate Protection (CACP) software to develop a greenhouse gas emission inventory, forecast, target and local action plan. ICLEI also used the software to undertake an analysis of criteria air pollutants produced within the County. The CACP software applies fuel and sector-specific GHG and CAP emission factors to inputs of energy consumption in order to determine the emissions generated by the energy use.[4]

[4] Duke University recently completed a GHG inventory using the Clean Air Cool Planet software. This software is designed to help universities calculate GHG emissions. There are several emissions sources included in the Clean Air Cool Planet program that are not included in the Cities for Climate Protection program. These include: agriculture, air travel, refrigerants, other chemicals and carbon offsets.

2.1.1 Electricity Emissions

GHG emissions from energy consumption are calculated by using emissions coefficients which specify the amount of GHG produced per unit of energy used. The coefficients are standard for different fuel types, but vary for electricity consumption depending on the mix of fuel types used to generate electricity in the region in which the municipality is located in any given year. The software uses the regions that are defined by the North American Electric Reliability Council (NERC) to determine regional variations in electricity emissions. These regions correspond to the grid-connected electricity-producing regions of the country. Durham County is located within NERC region 09 - Southeastern Electric Reliability Council/Excluding Florida. CAP emissions are calculated using activity levels with emission factors. The CAP emission factors used are provided in the CACP software.

The net emission of a pollutant from a given source in tons per year is expressed as the product of the emission factor by the source's activity rate:

$$E = Ef \times A$$

The emission factor *Ef* is process specific and has a unit of mass per quantity (mass or volume) of raw material processed at source, e.g., the emission factor from natural gas combustion has a unit of pounds per millions of Btu of natural gas burned. The activity rate *A* is the quantity (mass or volume) processed at the source per unit time.

The CACP software is programmed to use a calendar year for emissions estimates; accordingly, the average of the 2004 and 2005 emission factors for all fuel types was used to estimate emissions for the fiscal year 2005. A discussion of the process undertaken to collect inputs for the software is described in the following section.

2.1.2 Fuel Emissions

The CACP software uses a set of criteria air pollutant emission factors for each of the Residential, Commercial and Industrial sectors that are based on average technologies found in these sectors. These emissions factors represent the typical emissions of air pollutants associated with the burning of the fuels listed. In some cases, the emission factors vary by sector (e.g. emissions for fuel oil are different in the industrial than the residential sector). These average emission factors can be used as defaults throughout the residential, commercial and industrial sectors for both inventory and measures analysis, and they are recommended for use in the analysis modules.

The software uses a separate common set of carbon dioxide emission factors for all sectors (municipal, residential, commercial, industrial and transportation), since carbon dioxide emissions vary only with the type and amount of fuel consumption and do not have significant technology dependence.

Carbon dioxide emissions from biomass fuels are excluded from the inventory. The rationale for this is that, the burning of fossil fuels releases carbon into the atmosphere that is not part of the natural carbon cycle, whereas the burning of biologically derived fuels emits carbon dioxide that would have eventually been released in natural processes when the wood or biomass died and decomposed. This carbon is therefore considered to be part of the natural carbon cycle. The burning of bio-fuels is not considered to have a long-term impact on climate change (i.e. its global warming potential is zero).

Biologically derived fuels that are not included in the analysis include: wood and other wood derived fuels, landfill methane, sewage gas, methanol, ethanol and biodiesel. When blended fuels (i.e. B20 – 20%

biodiesel and 80% petroleum diesel) are used, the fossil fraction of the fuel does contribute to the jurisdictions emissions. It is assumed that all of these fuels are fully combusted when they are utilized. The CCP adopts the convention that burning of wood or biomass is not a source of GHG in the emissions inventory. This assumes that the source of the biofuel is allowed to regrow. For example, if the wood burned comes from an old growth forest that has been clear cut and converted into a parking lot, there would be a net increase of GHGs in the atmosphere. As most biofuels come from on-going agricultural processes and not onetime land conversions, this is not usually an issue. Excluding biomass fuel emissions follows international (IPCC) conventions.

2.1.3 Transportation Emissions

The CACP software uses a simple equation for describing the impact of a particular measure or strategy for the transportation and vehicle fleet sectors.[5] The following equation separates the vehicle miles traveled (VMT) component (number of trips, length of trips, number of people per vehicle) from the vehicle fuel efficiency (miles per US gallon) and fuel (emissions/unit of fuel) components. For both greenhouse gases and air pollutants:

Emissions = VMT X Emissions per VMT

The two terms in this equation can be broken down further:

VMT = (Person-Trips/Persons per Vehicle) X Trip Length (miles)

The term in brackets represents vehicle-trips. The difference between the number of individual person-trips and the number of vehicle-trips depends on how many people there are in the vehicle. The vehicle occupancy factor (persons per vehicle) is the reason why transit and car-pooling are such effective ways of reducing emissions per passenger mile of travel.

Emissions per VMT = Fuel Efficiency (i.e. MPG) X Emissions per Unit of Fuel (emission coefficient)

Combining these factors leads to the five-factor formula for transportation emissions:

CO2 Emissions = (A/B) X C X D X E

A *is the number of person trips made using the vehicle type*
B *is the number of people per vehicle (occupancy factor)*
C *is the trip length*
D *is the fuel consumption (in Gal/100miles)*
E *is the emissions per unit of fuel (i.e. the fuel type factor)*

Each one of these factors is dependant on a number of other factors (technological, behavioral, structural, etc.), and are interrelated. For example, a switch from an automobile to a diesel transit bus would change the value of *A* for cars and buses. While fuel consumption and emissions per unit (*D* and *E*) of fuel would increase due to the change in vehicle choice, the number of people per vehicle (on the transit bus) would increase substantially offsetting the increase of *D* and *E*.

[5] CAP emissions in this report were produced using the CACP software. The Division of Air Quality, as part of the transportation conformity process, also produces NOx and VOC emission estimates from the transportation sector using the EPA's Mobile6 model. Due to differences in the CACP software and Mobile6 models, the emissions do not match. This report uses emissions produced by the CACP software in order to ensure consistency with the emissions from other sectors and to ensure that the emissions inventory can be easily reproduced and updated by the local governments.

Carbon dioxide emissions vary directly with the amount of fuel consumed; however, criteria air pollutant (CAP) emissions are not as directly related to the quantity of fuel consumed. Two vehicles with very different fuel efficiencies could have similar air pollution emissions per mile traveled and conversely, two vehicles with similar pollution emission profiles could have quite different fuel efficiencies. In the CACP software, average transportation emissions of greenhouse gases and air pollutants are based on actual *average* emissions of the entire on-road fleet of each vehicle type. However, GHG emissions are calculated using fuel efficiency and CAP are calculated using vehicle miles traveled.

2.1.4 Solid Waste Emissions

Greenhouse gas emissions from waste and waste related measures depend on the type of waste and on the disposal method. The CACP software can only calculate GHG emissions generated by solid waste (not CAP emissions). This is because there is insufficient information on waste related CAP emissions to enable the development of accurate coefficients for the software.

The combinations of waste types and disposal methods used in the CACP software are shown below. For each waste type and disposal method combination represented in the software, there is a set of five emission factors (*A, B, C, D, E*) which specify tons of GHG emissions per ton of waste:

Table 1. Waste-Related GHG Emission Factors

Emission Factor	Description
A	GHG emissions of methane per ton of waste at the disposal site
B	GHG sequestered at the disposal site, in tons per ton of waste
C	GHG sequestered in the forest as the result of waste reduction and recycling measures
D	Upstream emissions from manufacturing energy use saved as the result of waste reduction or recycling, in tons of GHG per ton of waste
E	Non-energy related upstream emissions from manufacturing saved as the result of waste reduction or recycling, in tons of GHG per ton of waste

In the GHG inventory, only emissions at the disposal site (factors *A* and *B*) are calculated. The following equation is used:

$$GHG = W_t * [(1-R)\,A+B]$$

W_t *is the quantity of waste type 't", and*
R *is the methane recovery factor which is only applied in the case of landfilled waste.*

In the measures modules, the impact of any particular measure on emissions will depend on the difference between the emissions that would have happened in the absence of the measure and the emissions that occur after the measure.

$$GHG = W_t * \quad [(1-R)\,A_{Afte}r + B_{After} + C_{After} + D_{After} + E_{After}] - [(1-R)\,A_{Before} + B_{Before} + C_{Before} + D_{Before} + E_{Before}]$$

A complete list of the emission coefficients is provided in the CACP software.

2.2 Community Inventory & Forecast Data Collection

2.2.1 Electricity

According to staff at the North Carolina Utilities Commission, four electric utilities provide service within Durham County. These companies are Duke Energy, Piedmont EMC, Wake EMC and Progress Energy. The DCHC MPO requested data on electricity consumption by residential, commercial and industrial customers within the 2005 from each of these utilities. Duke Energy provided electricity consumption figures for each sector. Piedmont EMC provided an estimate of the total number of commercial and residential customers that they service within the County, along with an estimate of the average annual electricity consumption by their residential and commercial customers. Wake EMC provided an estimate of electricity use by their customers (which include one state park and several households). ICLEI contacted Progress Energy for their data and they stated that they do not supply any energy to Durham County. As a result, no energy distributed by Progress Energy was included in the inventory.

2.2.2 Natural Gas

PSNC is the only natural gas provider within Durham County. PSNC provided ICLEI with natural gas consumption data for each of the residential, commercial and industrial sectors. These categories are based on PSNC's rates classes which are based on the volume of gas consumed rather than the type of the customer's business. However, communications with PSNC staff suggested that the rate class divisions would largely follow the Standard Industrial Classification (SIC) system, which classifies commercial and industrial enterprises. In other words, those consumers included in PSNC's "industrial" rate class would most likely be engaged in an industrial goods-producing industry as defined the SIC.

2.2.3 Other fuels

In addition to electricity and natural gas, other fuels including: propane, kerosene, light and heavy fuel oils, stationary diesel and coal are used to power homes, businesses and institutions within Durham County. ICLEI contacted each of the fuel providers within Durham County to request data on fuel use by their customers within the fiscal year 2005. ICLEI discovered that the vast majority of these fuel providers do not track fuel sales by County or sector and were therefore unable to provide data. The same conclusion was drawn from conversations with staff at state fuel associations within North Carolina (e.g. North Carolina Propane Gas Association).

Accordingly, ICLEI collected state-level fuel sales data from the U.S. Energy Information Administration (EIA). Sales of distillate fuel oil and kerosene by end-use in North Carolina were available for years up to and including 2004. With this information, ICLEI used state-level indicators, to determine approximate volumes of fuel used per household and per commercial and industrial employee in North Carolina in 2004. These factors were then multiplied by the number of households and employees in Durham County to create an estimate of the total fuel use in the county. The EIA does not publish data on propane or coal sales by end-use at the state level. EIA does publish national coal consumption by end-use. This distribution was applied to coal-use in North Carolina to estimate consumption per sector. A study completed for the National Propane Gas Association provided estimates of propane consumption by end-use in North Carolina (Vida et al, 2004).

2.2.4 Transportation

DCHC MPO provided average daily vehicle miles traveled for the eight vehicle classes defined by the EPA's MOBILE6 on-road emission modeling software. All of these classes correspond with the vehicle classes used within the CACP software, except for the MOBILE6 classes Light Duty Gas Vehicle (LDGV) and Light Duty Diesel Vehicles (LDDV). In MOBILE6 a LDDV or LDGV is defined as a

passenger car with [gasoline or diesel] engines up to 6000 lbs gross vehicle weight. The CACP software further divides light duty gasoline-fueled vehicles into the classes Auto-Full-Size, Auto Mid-Size and Auto – Sub-Compact/Compact and assigns specific fuel efficiencies and emission factors to each of these classes. The CACP software divides LDDV into Auto Full-Size and Auto-Sub-Compact/Compact. ICLEI used the size characteristics of the US on road automobile fleet to apportion the LDGV VMT to each of the CACP gasoline automobile classes.

Using a weighted average of automobile sales by size-class in the US for 1975 to 2005, ICLEI estimated that the following distribution of automobiles by size in the US: 54% sub-compact/compact autos, 31% mid-size autos and 15% large autos. This distribution was confirmed in the table "Vehicle Stock and New Sales in the United States, 2002 Calendar Year" from the Transportation Energy Data Book: Edition 24, published by the Center for Transportation Analysis. This distribution was applied to the LDGV VMT estimates provided by the DCHC MPO. ICLEI could not find information to determine or estimate how Durham County's LDDV fleet is distributed by automobile size. Accordingly, ICLEI assumed that LDDV VMTs in Durham County would be by sub-compact or compact automobiles. It would be helpful if the County gathered and tracked this data for inclusion in future inventories.

2.2.5 Solid Waste

Durham's material waste stream distribution was not available from either the City of Durham or the North Carolina Division of Pollution Prevention and Environmental Assistance. Accordingly, ICLEI used an average distribution of municipal solid waste (MSW) published by the EPA to estimate Durham's waste stream distribution. Orange County has completed several audits of construction and demolition (C&D) waste generated within its borders; ICLEI applied the results of these audits to Durham's C&D waste to estimate the amount of each type of waste. See Appendix B for the material waste stream distribution applied to both the MSW and C&D waste.

2.2.6 Off-Road Engines

The Cities for Climate Protection Protocol (CCP) does not include emissions produced by off-road engines (i.e. lawnmowers, golf carts and etc.) because of the difficulties in accurately tracking the use of these types of equipment and in accurately calculating the associated CAP emissions. At the request of the advisory committee, ICLEI used the EPA's NONROAD emissions modeling tool to estimate the GHG emissions associated with off-road engine use within Durham County in 2005. ICLEI obtained model inputs (i.e. fuel characteristics) from the North Carolina Division of Air Quality. Appendix C contains a summary of the inputs ICLEI used in the model and Appendix D contains the emissions analysis results.

2.2.7 Growth Indicators

Staff within the Durham City-County Planning Department provided ICLEI with growth indicators for the residential, commercial and industrial sectors. This data included population, number of households, commercial and industrial employees and property data for the baseline year 2005 and the forecast year 2030.

Staff within the DCHC MPO provided the research team with estimates of total vehicle miles traveled within Durham on a typical day in 2005 and 2030. VMT was broken down by time of day, road type and MOBILE6 vehicle class.

2.3 *Local Government Operations Inventory & Forecast Data Collection*

Members of the technical team provided energy consumption and cost data for local government operations to ICLEI Energy Services. The advisory committee and technical team decided that they wanted school board operations, including buildings and fleets, to be included in the Local Government Operations Inventory. This information was collected from school board staff, and is included as a sixth sector within the local government inventory. A complete list of data sources is provided in Appendix E.

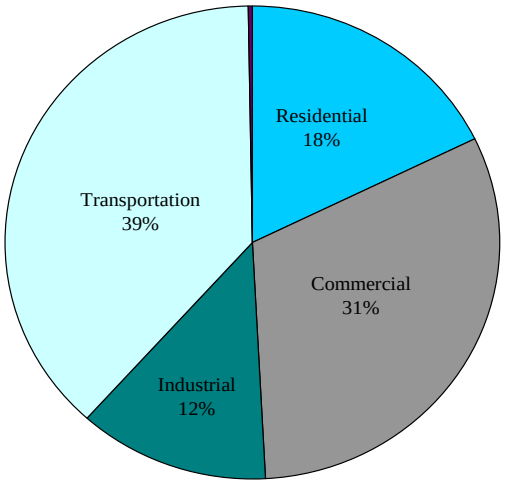
Where data was missing or unavailable, estimates of total energy use and/or cost were made. These cases are described in detail throughout the report.

Where possible, technical team members also provided details of proposed new energy-consuming infrastructure that will be acquired by the City and/or County between 2005 and 2030. Team members were also asked to provide estimates of the potential annual energy consumption of this infrastructure. Where these estimates were unavailable, ICLEI developed estimates based upon annual energy use by similar existing infrastructure within the City and the County. ICLEI also reviewed the Capital Improvement Plans published by both the City and the County to identify and characterize new infrastructure projects.

3 Inventory

3.1 *Community Inventory*

Figure 1. Community GHG Emissions in 2005



The Community inventory provides an estimate of all of the greenhouse gas and criteria air pollutant emissions produced within Durham County, both by residents in their homes and by local businesses and agencies as they carry out their operations in the baseline year, the 2005 fiscal year. Five key sectors are included in the community inventory: Residential, Commercial, Industrial, Transportation, and Solid Waste. This breakdown of emissions into five sectors follows CCP protocol. Emissions from off-road engines have not been included in the overall inventory, since these emissions are difficult to account for with any accuracy and are therefore not typically included in the CCP program. At the request of the advisory committee, ICLEI has estimated community off-road emissions using the EPA's NONROAD software. The findings are summarized in Appendix D.

During the 2005 fiscal year, Durham produced approximately 6,837,430 tons of GHGs.
Table 2 provides a summary of energy use, CAP and GHG emissions produced by each sector. Based on the CCP breakdown of emissions, transportation accounts for the largest portion of emissions (39%), however, it should be noted that when the impact of the residential (18%) and commercial (31%) sectors are combined, 'buildings' contribute more to the overall emissions than transportation.
provides an illustration of the contribution of emissions from each sector.

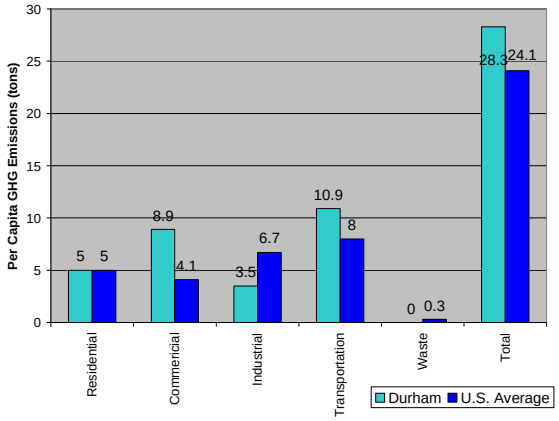
Table 2. Base Year 2005 Community Energy Use, CAP and GHG Emissions (tons)[6]

Sector	Total Energy (MMbtu)	NOx	SOx	CO	VOC	PM10	GHGs
Residential	8,539,650	2,038	5,432	209	32	126	1,221,610
Commercial	13,209,220	3,688	10,731	353	48	249	2,161,090
Industrial	7,034,560	1,778	4,042	315	40	141	845,900
Transportation	30,663,780	8,792	455	60,851	6,353	260	2,624,880
Solid Waste	0	NA	NA	NA	NA	NA	(16,050)
Total	**59,447,210**	**16,295**	**20,661**	**61,729**	**6,473**	**776**	**6,837,430**

It is difficult and sometimes misleading to compare per capita emissions in different communities. Factors such as the fuel used to generate electricity, the availability of alternative fuels in the community and the type and pace of business development in the region can make comparison difficult. That said, it is useful to understand Durham's per capita emissions in regards to broader state and national per capita emissions. Reduction efforts at the state and federal levels should affect Durham's emissions. Likewise Durham's efforts to reduce its emissions will influence state and national emission outputs.

[6] Due to rounding, numbers in tables may not add up exactly.

Figure 2. Per Capita GHG Emissions in Durham and US



In 2005, Durham generated approximately 28.3 tons of GHGs per capita. In 2004, per capita GHG emissions in the U.S. were approximately 24.1 tons; therefore, emissions in Durham are considerably higher than the national average.[7] It should also be noted that total U.S. emissions include some sources which are not included in a CCP inventory (e.g. agricultural soil management, air transportation and industrial emissions not related to energy use). If these sources had been included in this inventory, the per capita emissions in Durham would have been even higher. By end-use sector, 21% of the national energy related emissions are residential, 17% are commercial, 28% are industrial and 33% are transportation related.[8] By distribution, the transportation and commercial sectors in Durham are considerably higher than the national average. Figure 2 illustrates the national emission averages by sector relative to Durham's emissions profile. The following sections of the report provide a sector by sector analysis of energy use and GHG production.

3.1.1 Residential

In 2005, there were approximately 97,840 households in Durham County. On average, each of these households produced 12.5 tons of GHGs and consumed 87 MMBtu of energy, accounting for 18% of Durham's total emissions. The national average is 12.5 tons of GHG per household or 21% of total fossil-fuel derived emissions.[9] Therefore, on a per capita basis, the residential sector in Durham is on par with the national average household GHG emissions. Within the residential sector, energy is consumed for such end-uses as space and water heating, appliances, lighting and space cooling.

Table 3 provides a summary of energy consumption and emissions produced within the residential sector in 2005.

Table 3. Residential Sector: Base Year 2005 Energy Use, CAP & GHG Emissions (tons)

Fuel	Total Energy (MMBtu)	NO_x	SO_x	CO	VOC	PM_{10}	GHGs
Electricity	4,402,240	1,651	5,245	120	14	106	948,290
Natural Gas	3,094,240	272	10	67	14	8	191,170
Coal	8,510	5	25	2	0	2	920
Kerosene	325,680	43	135	9	1	5	27,480
Light Fuel Oil[10]	236,670	31	17	6	1	4	19,560
Propane	472,310	36	0	5	1	1	34,190
Total	**8,539,650**	**2,038**	**5,432**	**209**	**32**	**126**	**1,221,610**

[7] Source: Based on 2004 populations estimates published by US Census Bureau and total GHG emissions produced in US in 2004 as published by US EPA.
[8] Source: EPA National GHG Inventory.
[9] Source: Calculated using the national per capita GHG emission average of 24.1 tons and the end-use residential sector emissions (21%) included in the US EPA GHG Inventory, and the average people/household (2.47)
[10] The EIA only reports total No. 2 Distillate Sales to residential customers in NC, it does not break the No. 2 distillate out into fuel oil and diesel fuel. Accordingly, some of the fuel contained in the EIA data may be fuel oil, while other fuel may be #2 diesel (likely used for off-road vehicles). To determine only the amount of light fuel used in the residential sector, ICLEI assumed that 4.3% of Durham's homes are heated with light fuel oil. According to the PMA, the average oil-heated NC home uses 400 gal/year, which would mean that 1,690,641 gal/year total.

The greatest source of household GHG emissions in Durham County was electricity consumption (78% of total GHGs), followed by natural gas consumption (16%), propane (3%), kerosene (2%), light fuel oil (2%) and coal (less than 1%). The Energy Information Administration (EIA) did not report any sales of heavy fuel oil to the residential sector within North Carolina in 2004.

3.1.2 Commercial

The commercial sector consists of office buildings, retail outlets, institutions (hospitals, schools, universities, etc.) and government facilities. Approximately 135,020 people were employed in the commercial sector in Durham County in 2005. Commercial operations occupied over 30 million square feet of facility space during the same period[11]. The commercial sector in Durham produced 2,161,090 tons of GHG in 2004-2005 or 31% of Durham's total emissions. The commercial sector produces 17% of the total national fossil fuel derived emissions or 4.1 tons per capita.[12] The average commercial business in Durham produced 16 tons of greenhouse gas emissions per employee, 0.07 tons per square foot of facility space or 8.9 tons per capita, which is considerably higher than the national average.

A summary of energy use and associated emissions is provided in Table 4. The largest source of greenhouse gas emissions was electricity consumption (86%), followed by natural gas consumption (11%).

Table 4. Commercial Sector: Base 2005 Energy Use, CAP & GHG Emissions by Fuel Type (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_x	CO	VOC	PM_{10}	GHGs
Electricity	8,667,960	3,251	10,326	237	27	208	1,867,160
Natural Gas	3,844,330	323	13	83	18	10	237,510
Coal	101,180	56	300	23	1	26	10,980
Kerosene	45,350	6	19	1	0	1	3,830
Light Fuel Oil[13]	169,490	22	70	5	1	3	14,010
Propane	379,840	29	0	4	1	1	27,490
Heavy Fuel Oil[14]	1,070	1	2	0	0	0	110
Total	**13,209,220**	**3,688**	**10,730**	**353**	**48**	**249**	**2,161,090**

3.1.3 Industrial

In 2005, Durham County's industrial sector employed approximately 52,420 people and occupied approximately 20,036,150 square feet of space, including industrial warehousing. The industrial sector in Durham produced approximately 845,900 tons of GHG in 2004-2005, or approximately 12% of Durham's total emissions. On the national level, approximately 28% of all U.S. fossil fuel derived emissions can be attributed to the industrial sector or 6.7 tons of emissions per capita.[15] In Durham approximately 16 tons of GHGs were generated for each industrial employee, 0.04 tons of emissions were generated per square foot of industrial space and 3.5 tons of emissions were generated per capita. This is significantly lower than the national average. The average annual energy use per square foot was 0.35 MMBtu. Table 5 provides a summary of energy use and associated emissions produced within Durham's industrial sector in 2005.

[11] Based on total area of occupied space for OFC and Commercial Land Uses, as provided by Durham City/County Planning. In 2005, the total area of occupied square feet of OFC space was 11,172,517 sq. ft.; 18,950,762 sq. ft. of commercial space was occupied during the same period.
[12] Source: EPA National GHG Inventory.
[13] Based on estimates of No. 2 fuel oil and No. 1 distillate sales to commercial and industrial sectors in NC
[14] Based on estimates of No. 4 distillate and residual oil sales to the commercial and industrial sectors in NC
[15] Source: US EPA National GHG Inventory

Table 5. Industrial Sector: 2005 Energy Use, CAP & GHG Emissions by Fuel Type (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_x	CO	VOC	PM_{10}	GHGs
Electricity	2,105,950	790	2,509	58	6	51	453,640
Natural Gas	2,701,920	397	190	113	20	14	166,930
Coal	1,737,660	541	1310	109	7	74	188,590
Kerosene	13,860	2	6	0	0	0	1,170
Light Fuel Oil[4]	107,070	8	17	27	6	1	8,830
Propane	363,140	38	0	6	1	1	26,280
Heavy Fuel Oil[5]	4,970	2	11	1	0	1	460
Total	**7,034,560**	**1,778**	**4,043**	**314**	**40**	**142**	**845,900**

3.1.4 Transportation

The transportation sector was responsible for 39% of all GHG emissions in Durham in 2005. This sector includes privately and publicly owned passenger vehicles, transport trucks, public transit vehicles, and all other on-road vehicles associated with personal, commercial, industrial and government activities. This sector excludes emissions produced by off-road engines. For more information about off-road vehicle emissions, see Appendix D**.** This sector also excludes air, marine and rail travel in compliance with the CCP Protocol.

In 2005, motor vehicles traveled approximately 3,246,654,000 miles within Durham County, or approximately 13,450 miles per resident.[16] These vehicles emitted approximately 2,624,820 tons of GHG, equivalent to approximately 10.9 tons per resident. Nationally, the transportation sector is responsible for 33% of total end-use fossil fuel emissions or 8 tons of GHG per capita.[17] At 10.9 per capita, Durham's transportation sector emissions are much higher than the national average, especially since Durham's inventory excludes air, marine and rail travel, all of which are included in the national inventory.[18] Table 6 summarizes the fuel used by Durham's transportation sector and the resulting emissions. Gasoline-fueled vehicles traveled 92% of the total vehicle miles traveled (VMT) and accordingly produced the majority of GHG (81%) and CAP emissions.

Table 6. Transportation Sector: 2005 Fuel Use, CAP and GHG Emissions by Fuel Type (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_x	CO	VOC	PM_{10}	GHGs (Tons)
Gasoline	24,936,610	5,224	317	58,158	6,004	113	2,127,080
Diesel	5,727,180	3,567	138	2,693	349	147	496,810
Total	**30,663,780**	**8,791**	**455**	**60,851**	**6,353**	**260**	**2,624,820**

3.1.5 Solid Waste

In 2005 approximately 36,210 tons of construction and demolition (C&D) waste and 271,890 tons of municipal solid waste (MSW) were produced within Durham County. GHG and CAP emissions resulting from the transportation of solid waste from residences and businesses to disposal are not included in this sector, they fall under the transportation sector of the community inventory. Waste produced within Durham County is sent to nine different landfills. Most (approximately 162,750 tons) of Durham's waste is sent to the Brunswick landfill in Virginia, which flares methane. Methane is generated in landfills as waste decomposes under anaerobic (without oxygen) conditions. Since methane is 23[19] times more potent

[16] This includes all traffic on Durham highways including non-resident through-traffic.
[17] Calculated using the national average emissions per capita of 24.1 tons, and transportation end source emissions of 33%. Source: EPA National GHG Inventory.
[18] Source: EPA National GHG Inventory
[19] Intergovernmental Panel on Climate Change, Third Assessment Report, 2002.

than CO2 as a greenhouse gas, combusting it reduces its global warming potential by 23 times.[20] Methane flaring significantly reduces GHG production associated with solid waste generation.[21] Furthermore, since a fraction of the carbon found in solid waste is never released, but remains sequestered in the landfill, landfills can act as carbon sinks. The negative values found in Table 7 are the result of carbon sequestration in the landfill, combined with the impact of methane flaring.

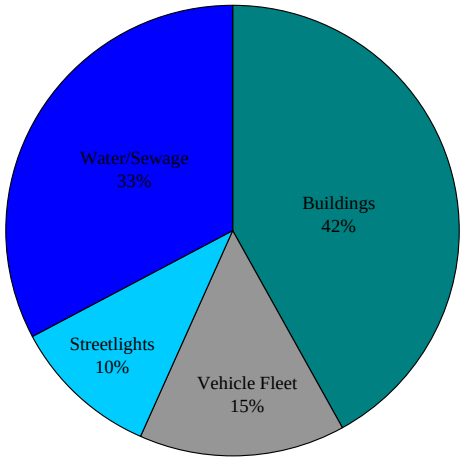
In Table 7, certain waste streams including plant debris, wood and textiles have negative GHG emissions and other waste streams including paper products and food waste have positive emissions. This is because paper products and food waste decompose more readily than the other waste streams. The 'other' waste stream represents inorganic waste and therefore does not decompose and cause emissions.

Table 7. Solid Waste: 2005 Material Distribution and GHG Emissions

Waste Type	Materials	Material Percent of Total Waste Stream	GHGs (tons)
Municipal Solid Waste	Paper Products	26%	2,420
	Food Waste	16%	20,180
	Plant Debris	8%	(11,720)
	Wood/Textiles	13%	(20,320)
	All Other Waste	37%	0
Construction & Demolition	Paper Products	3%	40
	Wood/Textiles	32%	(6,660)
	All Other Waste	65%	0
Total			(16,050)

3.2 *Municipal Operations Inventory*

Figure 3. Municipal GHG Emissions (w/o schools)



Local government operations of the City of Durham and Durham County resulted in the production of approximately 158,710 tons of greenhouse gases in the fiscal year 2005. This accounts for approximately 2.5% of the community's total emissions. Within the PCP framework, the local government module quantifies emissions from: buildings, vehicle fleets, streetlights & traffic signals, water & wastewater treatment facilities and waste produced through municipal operations. Durham has requested that this module also include emissions from school board buildings and fleets. These emissions have been included as a sixth sector within the module. It should be understood that the local government inventory is a subset of the community inventory.

The local government module is reported in more detail than the community module. This is due to local governments having direct control over their own operations and it is therefore the area in which they are most likely to be able to directly effect major emissions reductions. Local government can use their emission reductions and resulting cost savings to set an example for the rest of the community to follow. With more detailed information, local governments can better determine where the greatest opportunities for improvement lie.

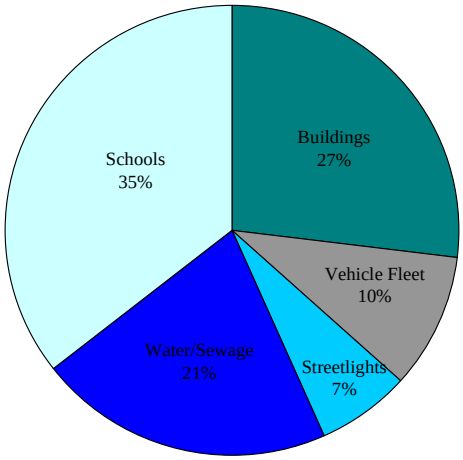
[20] Combustion of one molecule of methane results in one molecule of carbon dioxide ($CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$).
[21] Durham has a methane recovery factor (MRF) of 55%, which reflects the efficiency of flaring at local facilities.

Table 8 provides a summary of energy use, energy costs, CAP and GHG emissions by area of local government operations.

Table 8. Local Government Operations Emissions in Fiscal Year 2005 (tons)

Operations	Total Energy (MMbtu)	Cost ($)	NOx	SOx	CO	VOC	PM10	GHGs
Buildings	305,450	3,421,420	71	186	8	1	4	42,740
Vehicle Fleet	178,920	2,055,100	60	3	316	33	2	15,310
Streetlights	49,240	1,778,130	18	59	1	0	1	10,610
Water/Sewage	163,670	2,381,080	58	182	4	1	4	33,560
Waste	0	3,310	N/A	N/A	N/A	N/A	N/A	-5
Schools	395,460	6,607,480	132	244	76	8	7	56,510
Total	**1,092,740**	**$16,246,510**	**339**	**673**	**405**	**43**	**18**	**158,710**

Figure 4. Municipal GHG Emissions (with Schools)



An illustration of the contribution of each area of operations to total GHG emissions is provided in (excluding schools) and **Error! Reference source not found.** (including schools). In 2005, energy use within City and County buildings was the largest source of greenhouse gas emissions within local government operations, followed by emissions produced as a result of energy consumption for water and wastewater treatment.

3.2.1 Buildings

The City of Durham manages approximately 1,928,000 square feet of facility space.[22] Durham County operates 37 buildings with a total area of 1,212,000 square feet. Collectively, energy use within these facilities resulted in the production of approximately 42,739 tons of greenhouse gas emissions in 2005. Energy use within these facilities costs the City and County approximately $3,421,420. Table 9 provides a summary of energy use, cost and emissions generated by the City and County's facilities. A complete list of City and County facilities is provided in Appendix F along with the energy use and costs for each facility.

To maximize the effectiveness of any investments that the City or County may wish to make to reduce greenhouse gas emissions that result from energy use in their facilities, the City and County may want to target those facilities that produce the greatest amount of emissions and are the most energy intensive (i.e. energy use/square foot).

[22] City of Durham Property Schedule, July 1, 2002.

Table **10** and
Table **11** contain the top five large emissions-intensive facilities operated by the County and City.

Table 9. Local Government Buildings: 2005 Energy Use, Energy Costs and Emissions (tons)

Jurisdiction	Fuel Type	Total Energy (MMBtu)	Energy Costs	NOx	SOx	CO	VOC	PM10	GHGs
City	Electricity	69,640	$1,263,040	26	83	2	0	2	15,000
County	Electricity	85,740	$1,294,460	32	102	2	0	2	18,470
City	Natural gas	40,740	$459,220	3	0	1	0	0	2,520
County	Natural gas	109,340	$405,640	10	0	2	1	0	6,760
Total		**305,460**	**$3,421,420**	**71**	**185**	**7**	**1**	**4**	**42,740**

Table 10. Durham County: Top Five Large Emission-Intensive Facilities

Building	Total GHGs	GHG Intensity (GHGs/1000 Sq. Ft)	Total Energy Use (MMBtu)	Energy Intensity (MMBtu/ 1000 Sq. ft)	Total Energy Costs	Total Area (Sq. Ft)
Detention Facility	10,139	34.9	100,065	344.0	$511,338	290,919
Judicial Building (and 3 parking lots)	2,951	20.8	16,448	116.2	$184,469	141,462
Health Department	1,875	25.7	8,721	119.5	$125,056	73,000
Main Library	1,442	22.2	7,663	117.9	$92,072	63,000
Judicial Bldg Annex	733	28.5	3401	132.4	$59,792	25,692

Table 11. City of Durham: Top Five Large Emission-Intensive Facilities

Building	Total GHGs	GHG Intensity (GHGs/1000 Sq. Ft)	Total Energy Use (MMBtu)	Energy Intensity (MMBtu/ 1000 Sq. ft)	Total Energy Costs	Total Area (Sq. Ft)
City Hall	4,338	34.3	20,139	159.2	$282,850	126,510
Police Headquarters	1,730	22.9	10,300	136.2	$139,423	75,630
Durham Bulls Athletic Park	1,574	39.3	7,305	182.6	$151,624	40,000
Edison Johnson Community Centre	788	35.0	5,947	263.7	$85,286	22,550
Fleet Maint. Building	768	20.4	5,930	157.3	$82,762	37,700

ICLEI was able to acquire the square footage for less than twenty-five percent of the City's owned and operated facilities. Therefore, this list contains only those buildings with known square footage which have high energy intensities. It is likely that there are other buildings that should be included in this list. It is highly recommended the City of Durham determine the square footage of all of its facilities in order to assess which buildings are the most in need of efficiency retrofitting.

3.2.2 Vehicle Fleet

Vehicles fleets operated by the County and City include but are not limited to: public works, fire department, police department, solid waste transportation, mail and public health department. In 2005, the City operated approximately 1,195 fleet vehicles (excluding off-road vehicles). During the same period, the County operated a fleet of approximately 360 vehicles. The City's vehicles consumed approximately 771,210 gallons of gasoline and 407,230 gallons of diesel fuel. The County's vehicles consumed approximately 235,240 gallons of gasoline and 23,140 gallons of diesel. These fuel consumption figures exclude fuel used in off-road engines. Fuel purchased with a fuel key is included in Table 12, although the exact end-use of this fuel is unknown[23]. A summary of the GHG and CAP emissions produced as a result of fuel use within these vehicles is provided in Table 12.

Table 12. Local Government Vehicle Fleets: 2005 Energy Consumption, Costs and Emissions (tons)

Jurisdiction	Energy (MMbtu)	Cost ($)	Emissions (tons)					
			NOx	SOx	CO	VOC	PM10	GHGs
City of Durham	146,560	1,687,880	52	2	242	25	2	12,540
Durham County	32,370	367,220	8	0	74	8	0	2,770
Total	**178,930**	**2,055,100**	**60**	**2**	**316**	**33**	**2**	**15,310**

3.2.3 Streetlights, Traffic Signals & Other Outdoor Lights

This sector includes road lighting, park lighting, specialty or accent lighting (e.g. lights used in downtown shopping areas), traffic signals, and other lights operated by the city and county governments that are not associated with any particular facility.

The City of Durham operates all of the traffic signals located within Durham County. The City of Durham leases streetlights from Duke Energy and Piedmont EMC to illuminate roads within the City's boundaries. Streetlights located outside of city boundaries are managed by the North Carolina Department of Transportation (NC DOT). These lights were not included in ICLEI's analysis of local government operations because these lights are not under the direct control of either the City or the County.

During the fiscal year 2005, the City operated approximately 350 intersections with traffic signals. Approximately 2,395 of the City's 10,739 traffic signal bulbs are LEDs. An LED traffic signal uses almost 90% less energy than an incandescent bulb. In the same period, the City leased approximately 14,870 streetlights from Duke Energy.
Using information provided by city staff, ICLEI estimated that the city's traffic signals consumed 3,493,370 kWh of electricity in 2005[24]. Using data provided by Duke Energy staff, ICLEI estimated that the streetlights consumed approximately 10,912,830 kWh of electricity.

[23] ICLEI assumed that fuel purchased with a fuel key would be used in a Passenger Vehicle (in the CACP software, passenger vehicles are a weighted mix of all size classes of automobile as well as Sport Utility Vehicles and Pickup Trucks. Both fuel economy (expressed in miles per gallon) and emission factors are weighted based on the following vehicle mix: (i) Auto – full-size / SUVs / Pick-ups = 36.4% (ii) Auto – Midsize = 18.8% (iii) Auto – Compact / Sub-compact = 44.8%

[24] Duke Energy provided ICLEI with a list of all street lights that had been installed in the City of Durham as of June 23, 2006. This inventory included the monthly consumption of the light, its installation date and the type of light. Using this data, ICLEI estimated the total energy use in the 2005 by adding the total monthly kWh used by lights installed before 2005 and multiplying by 12 months. For lights installed in the 2005, ICLEI multiplied the number of lights installed in the month by the number of remaining months in the fiscal year. For example, in July 2004, new lights with a total monthly kWh of 564 were installed; this consumption was multiplied by 11 to determine the energy used by these lights in the 11 remaining months in the fiscal year. Accordingly, lights installed in the last month of the 2005 are not included the 2005 data.

According to staff in the General Services Department of Durham County, the County has some parking lot lights that are not metered or that may be connected to the meters of nearby County buildings. The County does not have an inventory of these lights and accordingly, energy use by these lights is not captured in this section. Energy used by those lights that are connected to County buildings, would be included in the Buildings section of this report. Accordingly, the County's independently metered or not metered parking lot lights are not included in this inventory.

Table 13. Streetlights, Traffic Signals & Other Outdoor Lights: 2005 Energy Use, Costs and Emissions (tons)

Lighting Type	Total Energy (MMBtu)	Energy Costs ($)	Emissions (tons)					
			NO_x	SO_x	CO	VOC	PM_{10}	GHGs
Traffic Signals	11,920	267,140	4	14	0	0	0	2,570
Streetlights & other Outdoor Lights	37,320	1,510,980	14	44	1	0	1	8,040
Total	**49,240**	**1,778,120**	**18**	**59**	**1**	**0**	**1**	**10,610**

3.2.4 Water & Wastewater Treatment

The City of Durham operates two water treatment plants: Williams Water Treatment Plant and Brown Treatment Plant, as well as two wastewater reclamation facilities: North Durham Wastewater Reclamation Facility (WRF) and South Durham WRF. The City's water treatment facilities have a combined capacity of 52 million gallons per day (MGD) and the wastewater reclamation facilities have a combined permitted capacity of 40 MGD. The County operates the Triangle Wastewater Treatment Plant with a capacity of 12 million gallons per day.

In the fiscal year 2005 the average treatment output at the City's water treatment facilities was 26.44 MGD. During the same period the average treatment output at the wastewater reclamation facilities was 19.8 MGD. Approximately 1.2 tons of greenhouse gas emissions were generated per MGD water treated and 2.4 tons for each MGD of wastewater that the City treated.

Table 14 summarizes the total energy use, energy costs and emissions generated by the City and County's water and wastewater treatment operations, including pumping stations[25].

Table 14. Local Government Water & Wastewater Treatment: 2005 Energy Use, Energy Costs and Related GHG & CAP Emissions (tons)

Jurisdiction	Area of Operations	Total Energy (MMBtu)	Energy Costs	NO_x	SO_x	CO	VOC	PM_{10}	GHGs
City	Water & Wastewater Treatment	141,870	1,992,510	50	156	3	1	3	28,860
County	Wastewater Treatment	21,800	388,560	8	26	1	0	1	4,700
Total		**163,670**	**2,381,080**	**58**	**182**	**4**	**1**	**4**	**33,560**

[25] Nancy Newell, City of Durham, provided data for each of the pumping stations that she could find information for. There were a few stations that were not listed in the account list that was available to Nancy which were therefore not included.

3.2.5 Solid Waste Produced by Local Government Operations

The Local Government Waste Sector includes emissions from solid waste generated through government operations. This includes all employee generated waste and waste generated at municipal government facilities, such as parks and recreation buildings. The City of Durham does not track the volume of waste generated within its local government operations: this is not uncommon. In cases where solid waste is tracked, it typically amounts to less than 3% of the community's total solid waste.

The County tracks the amount of waste produced within its operations each year. In the fiscal year 2005, County operations produced 120 tons of solid waste. In the landfill, the decomposition of this waste resulted in the production of approximately 54 tons of GHGs. Since this methane was flared, this was reduced to -4 tons of greenhouse gases.

3.2.6 Durham Public Schools Operations

The CCP Protocol allows communities to tailor their emission inventories to specific situations, or the particular wishes of a community by allowing a sixth "other" sector to be included in an inventory. The Durham Advisory committee expressed a strong desire to include public school emissions within the local government sector of the report since the City and County of Durham have a significant degree of influence over the Durham Public Schools (DPS). Since public school buildings and fleets are responsible for considerable emissions, ICLEI has decided to include these emissions under the "other sector," rather than including them in municipal buildings and fleets, so as to avoid overwhelming these other sectors.

Durham Public Schools operates fifty-one buildings including 46 schools, operations and administrative facilities. In total, these buildings amount to approximately 5,092,960 square feet of facility space. These buildings consumed a total of 312,850 MMBtu of energy that resulted in the production of 50,510 tons of GHG and cost $5.5 million dollars to operate in 2005. Table 15 summarizes the energy use, greenhouse gas and criteria area pollutant emission by fuel type for public school facilities.

Table 15. Durham Public Schools Buildings: FY2004-2005 Energy Consumption, Cost and Emissions by Source

Source	Total Energy (MMBtu)	Energy Costs ($)	Emissions (tons)					
			NO_x	SO_x	CO	VOC	PM_{10}	GHGs
Electricity	202,980	4,285,340	76	242	6	1	5	43,720
Natural Gas	109,870	1,250,450	9	0	2	1	0	6,790
Total	**312,850**	**5,525,790**	**84**	**242**	**8**	**1**	**5**	**50,510**

Durham Public Schools has been recognized as a national clean bus leader as a result of using of B20 biodiesel in its entire school bus fleet. DPS operates a fleet of vehicles including 332 school buses, 37 large trucks and 176 vans, small trucks and cars. The fleet used approximately 125,000 gallons of unleaded gasoline (in its non-school bus vehicles) and 552,830 gallons of biodiesel (B20) in its buses in the 2005 school year. Table 16 summarizes energy use, cost and emissions by fuel type for these vehicles.

Table 16. Durham Public Schools Fleet: FY2004-2005 Energy Consumption, Cost and Emissions by Source

Source	Total Energy (MMBtu)	Energy Costs ($)	Emissions (tons)					
			NO_x	SOx	CO	VOC	PM_{10}	GHGs
B20	66,900	909,180	43	1	28	3	2	4,650
Gasoline	15,700	172,500[26]	4	0	40	4	0	1,340
Total	**82,600**	**1,081,680**	**47**	**2**	**68**	**7**	**2**	**5,990**

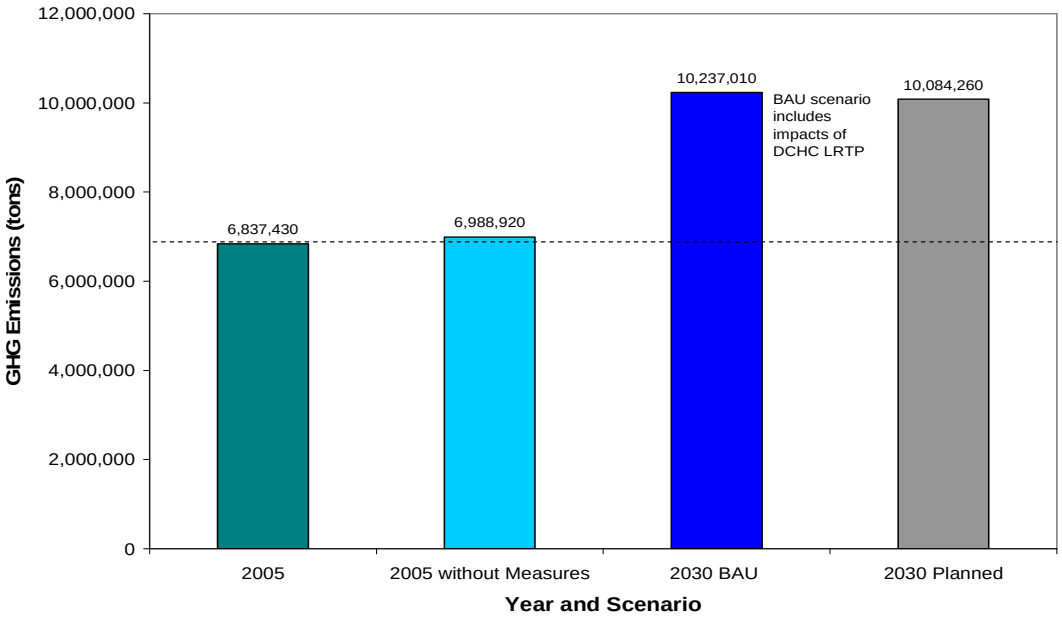
[26] This cost is estimated based on the average cost of gasoline purchased by the DPSB in 04-05 ($1.38 per gallon).

4 Forecasts to 2030

4.1 *Community Forecast*

Durham County has selected 2030 as the year by which the community will achieve a GHG emissions reduction target. In order to determine the level of emission reductions that could be achievable given socio-economic growth in the region, emissions were forecast to 2030 using a set of growth factors. Two possible future scenarios were developed: a business-as-usual (BAU) forecast and a forecast that includes new emission reduction projects which are currently planned. Figure 5 illustrates these scenarios. The first column, "2005," is the baseline year emissions as described in the preceding chapter. The second column takes into account all emissions reduction programs implemented before 2005, to demonstrate what Durham emissions profile would have been like in the absence of these programs. The column entitled "2030 BAU" assumes that new growth will occur in absence of any new emission reduction initiatives beyond the baseline year, except the impacts of the DCHC 2030 LRTP, which are included in the BAU forecast. The "2030 Planned" column includes growth projections for the community (BAU), but also accounts for future planned emission reduction programs. The methodology used to develop each of these scenarios is explained in detail below.

Figure 5. Community GHG Emission Scenarios 2005 though 2030



4.1.1 2030 Business-As-Usual Scenario

The business-as-usual (BAU) emissions scenario provides a projection of potential emissions in 2030 if no new emission reduction measures are implemented in Durham County before 2030. Residential, commercial and industrial GHG and CAP emissions were forecast to 2030 using socio-economic growth indicators provided by Durham City/County Planning. Transportation emissions were forecast using projections of vehicles mile traveled (VMT) in 2030 that were developed by the DCHC MPO, based on the implementation of the transportation improvement projects contained within the DCHC MPO Long Range Transportation Plan. Due to the complexity of the transportation modeling process, the DCHC MPO was unable to provide an estimate of the 2030 VMT that would occur with no GHG emission

reduction measures (i.e. transit and non-motorized transportation improvements). Solid Waste emissions were forecast by applying 2005 per capita waste generation rates to 2030 population projections. The values provided for each of the growth indicators used in the BAU forecast are provided in Table 17.

The BAU scenario forecast does not model for economic, technological or demographic changes. This is because the BAU scenario is meant to act as a control group, against which the impact of the community's actions outlined in the Local Action Plan can be measured. In the BAU scenario, GHG emissions would increase by approximately 50% from 2005 levels to 10,237,010 tons or 31.2 tons per capita, up from 6,837,430 tons or 28.3 tons per capita in the baseline year. This growth would correspond with local economic and population growth.

Table 17. Community Forecast Growth Indicators

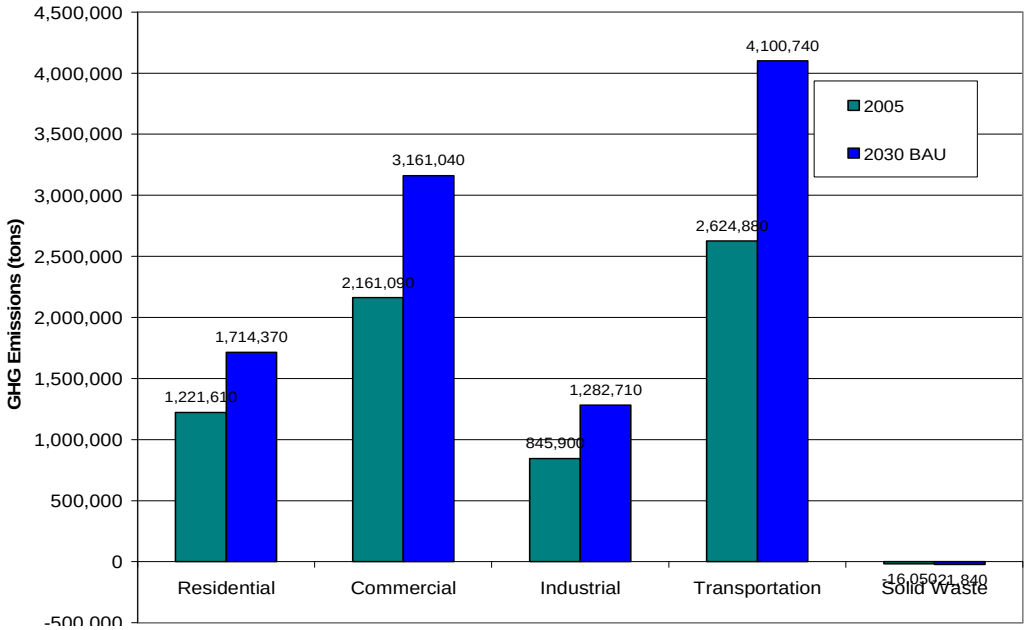
Indicator	2005 Value	2030 Projected Value	Growth (%)
Households	97,838	146,378	50%
Commercial Employees	135,023	211,946	57%
Industrial Employees	52,420	83,000	58%
Population	241,472	328,573	36%
Annual VMT	3,246,653,998	5,288,671,522	63%

4.1.2 2030 Planned Emission Reduction Scenario

The planned emission reduction scenario assumes that all of the planned new measures outlined in the section entitled "Future Community Measures" are fully implemented, including the DCHC MPO LRTP. This scenario presents a more realistic outlook of emissions in Durham County by applying the impacts of planned emission reduction measures to the BAU growth scenario. In the planned scenario, GHG emissions would increase by approximately 48% from 2005 levels by 2030 to 10,084,260 tons, or 30.7 tons per capita. Approximately 152,750 tons of GHGs would be avoided as a result of the implementation of these new measures.

Figure 6. Community GHG Emissions by Sector, 2005 and 2030 BAU
provides a comparison of the GHG emissions from each sector between 2005 and the 2030 planned emission reduction scenario.

Figure 6. Community GHG Emissions by Sector, 2005 and 2030 BAU



4.1.3 Community Emissions Forecast Summary

Table 18 provides a summary of forecasted CAP and GHG emissions within Durham County. The measures completed to date have not resulted in significant greenhouse gas emission reductions. Measures implemented before 2005 resulted in a reduction of 143,410 tons of GHG or a decline of about two percent from 2005 levels had no measures been in place. Current planned measures to be in place by 2030 will result in a slight decrease in greenhouse gas production (approximately three percent) from the business-as-usual scenario in 2030; however, they will be insufficient to offset a 47% overall increase in emissions from 2005 levels.

Table 18. Community CAP & GHG Emission Forecast Summary (tons)

	Emissions (tons)					
Year & Scenario	NOx	SOx	CO	VOC	PM10	GHGs
2005	16,295	20,661	61,729	6,473	776	6,837,430
2005 without Measures	16,477	21,015	62,589	6,563	785	6,988,920
2030 BAU	20,024	24,819	93,989	9,137	909	10,237,010
2030 Planned	19,867	24,370	93,974	9,135	899	

4.2 *Local Government Operations Forecast*

Emissions from the City and County's local government operations were projected to 2030 following a similar methodology used to develop the community forecasts. **Error! Reference source not found.** illustrates the differences in potential emissions between the 2005 and 2030 scenarios. The left-most column illustrates estimated GHG emissions in 2005. The second column, labeled "2005 w/o Measures", illustrates emissions that would have occurred in 2005 if the City and County had not made any efforts to reduce their energy use or related greenhouse gas emissions up to that point. A third column provides a projection of emissions if the City and County were to continue to grow in a business-as-usual (BAU) fashion without implementing any new or additional emission reduction efforts. Finally, the last column on the far right of the chart illustrates the emissions that will occur in 2030 as a result of growth (BAU) and the new measures that the City and County plan to implement between now and then. A detailed

description of each of the 2030 scenarios is provided below and a summary of forecasted CAP emissions is provided in Table 19.

Figure 7. Local Government Operations GHG Emissions Scenarios Forecasts 2005 – 2030

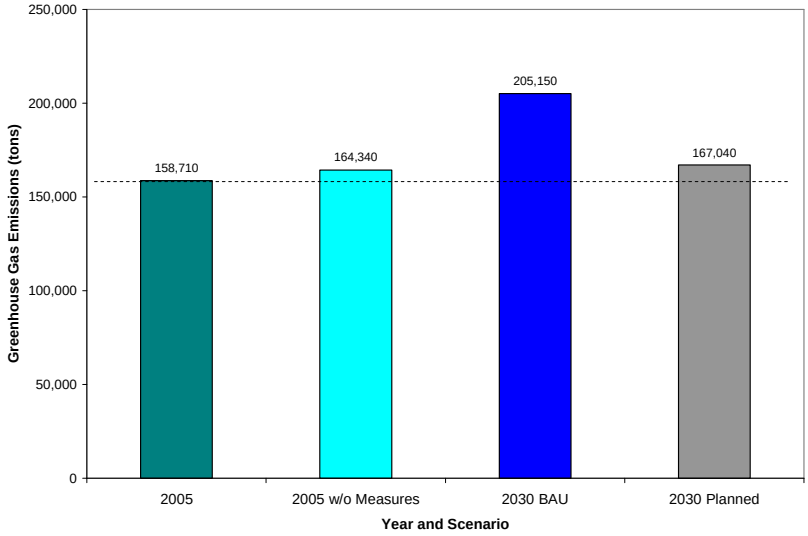


Table 19. Local Government Operations: 2005 & 2030 Emission Scenarios (Emissions in Tons)

Year and Scenario	NOx	SOx	CO	VOC	PM_{10}	GHGs
2005	339	673	405	43	18	158,710
2005 without Measures	213	446	338	36	11	164,340
2030 Business-As-Usual	389	781	496	49	21	205,150
2030 with Planned Measures	334	666	486	48	19	167,920

4.2.1 2030 Business-As-Usual Scenario

Under a BAU scenario, emissions produced by City and County operations would increase approximately 29% above 2005 levels. To construct the business-as-usual (BAU) forecast of energy use within local government operations in 2030, ICLEI worked with City and County staff to identify and estimate the impacts of new local government infrastructure, which would be developed between the baseline year and the forecast year. These projections are as follows:

Buildings

City and County staff based their estimates of new building area on projects identified within the Capital Improvement Plans (CIP) of each government. It should be noted that neither CIP extends to 2030; the City's CIP includes projects that will be implemented by 2012, while the County's CIP extends to 2015. According to the City's CIP, the City will construct at least 220,900 square feet of new facilities before 2030. City staff estimated that these facilities could consume approximately 7,276,800 of natural gas and 2,847,700 of electricity. The construction of at least 640,303 square feet of new facilities is scheduled in the County's CIP. Using the energy intensity reported in existing facilities, ICLEI estimated the additional annual energy consumption of the County's new facilities. The Carmichael Building, Health Department, and Social Services Buildings were removed from the 2030 forecast as these buildings are scheduled to close. The County's CIP stated that these buildings will not be needed upon completion of the new Human Services Complex. A complete list of projected changes in building tenure is included in Appendix G.

Vehicle Fleet
The City of Durham is in the midst of improving its vehicle management system. This process includes the review of vehicle utilization rates and reallocation and disposal of underused vehicles. Accordingly, City staff does not foresee any growth in the vehicle fleet. Based on new vehicle acquisitions in 2003/2004 and 2005, ICLEI assumes that County will add six new vehicles to its fleet each year for a total of 150 new vehicles by 2030. The software does not attempt to model for future changes to automobile demographics since this is a business as usual scenario.

Streetlights, Traffic Lights and Other Outdoor Lighting
City staff estimates that approximately 900 new streetlights are installed in the City each year. Transportation staff project ten new signalized intersections will be installed in the City each year over the next ten years and five per year thereafter. An average intersection contains 28 vehicle indicators and two pedestrian indicators.

Water and Wastewater
To estimate water and wastewater treatment energy use in 2030, ICLEI applied the per capita energy used for water and wastewater treatment in 2005 to projections of 2030 population.

Waste
Based on 2005 per capita waste generation rates in local government operations, the County will produce approximately 163 tons in 2030.

Schools
Projections for this sector are based on 2005 per capita consumption rates for school board operations and population projections for 2030.

4.2.2 2030 Planned Emission Reduction Scenario

This scenario assumes that each of the emissions reductions described in the section entitled "future reduction measures for local government operations" is implemented. New emission reductions of approximately 32,230 tons per year would be realized under this scenario. Under the planned scenario, 2030 emissions increase approximately 6% above 2005 levels.

5 Emission Reduction Measures

This section summarizes the estimated impacts of activities or decisions that have resulted in the reduction of CAP and GHG emissions within Durham County. These measures are divided into existing and planned measures. Existing measures were implemented prior to the 2005 baseline year. According to the CCP Protocol, the impacts of these measures cannot be counted towards an emission reduction target. New measures are those initiatives that will be implemented after the 2005 base year, which can be counted towards the emission reduction target. It should also be noted that where an existing measure will have new or expanded impacts after the baseline year, these new impacts can be counted towards the emission reduction target.

5.1 *Existing Community Measures*

Businesses, institutions and individuals within Durham County have already undertaken initiatives to reduce their GHG and CAP emissions. A summary of these measures is provided in Table 20 along with an estimate of the annual impacts of these measures. Some of these measures are education and awareness campaigns, which are very important, however, the results of which are difficult to quantify. For some other measures, insufficient information was provided to estimate the impacts of the measure. Some measures are grouped and the impacts presented as one emission reduction estimate. Each of the preceding conditions is noted in the table. In total, these initiatives will result in at least 152,280 tons of GHG emission reductions annually.

Table 20. Existing Community Emission Reduction Measures and Their Potential Annual Impacts

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHGs (t)
Residential							
Solar Hot Water Heater installations	Private Sector	850	2,210	90	10	50	250
NC Green Power Purchases	NC GreenPower	3,520	11,170	260	30	230	1,010
Heat Pump Loans - Piedmont EMC	Piedmont EMC	60	180	0	0	0	20
Energy Audits - Piedmont EMC	Piedmont EMC	760	1,950	80	10	40	230
NC Healthy Built Homes	NC Solar	160	450	20	0	10	50
Soltera - Environmentally Friendly Co-housing	Private Sector	570	1,660	70	10	40	200
Eno Commons	Private Sector	410	1,180	50	10	30	140
Affordable Housing Program	Advanced Energy	100	300	10	0	10	30
Energy Conservation Loans	Duke Energy	Not implemented in Durham					
Equipment Loan	Duke Energy	Not implemented in Durham					
Heating & Cooling Equipment Loans	Duke Energy	Not implemented in Durham					
Off Peak Water Heating	Duke Energy	Not implemented in Durham					
Public Information	Duke Energy	Not implemented in Durham					
Public Information - PSNC	PSNC	Not implemented in Durham					
Commercial							
Social Security Income Rate	Duke Energy	Not implemented in Durham					
Customer Resource Center	Duke Energy	Not implemented in Durham					

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHGs (t)
Equipment Loan	Duke Energy	Not implemented in Durham					
Off Peak Water Heating	Duke Energy	Not implemented in Durham					
Public Information	Duke Energy	Not implemented in Durham					
Public Information - PSNC	PSNC	Not implemented in Durham					
Institutional							
Steam System Upgrade or Replacement	NCCU	Need more info					
Low-level Waste Generator	NCCU	Need more info					
Utilities Savings Initiative	NCCU	Need more info					
State Building Initiatives	State of NC	No Impact					
Energy Efficiency Program for Nonprofits	State of NC	No Impact					
Geothermal Heating & Cooling	State of NC	No Impact					
Clean Cities Coalition	Clean Cities Coalition	Not quantifiable					
Energy Management Program	Duke University	26,540	84,290	1,940	220	1,700	7,620
LEED Buildings	Duke University	18,120	48,890	2,300	320	1,160	6,330
Green Building Program	Triangle J COG	Not quantifiable					
US EPA RTP (Main Building)	US Government	172,710	510,970	14,820	1,980	10,680	50,560
EPA National Computer Centre - LEED Certified	US Government	12,050	35,640	1,030	140	750	3,530
Equipment Loan	Duke Energy	Not implemented in Durham					
Off Peak Water Heating	Duke Energy	Not implemented in Durham					
Equipment Loan	Duke Energy	Not implemented in Durham					
Off Peak Water Heating	Duke Energy	Not implemented in Durham					
Industrial							
Customer Resource Center	Duke Energy	Not implemented in Durham					
Equipment Loan	Duke Energy	Not implemented in Durham					
Off Peak Water Heating	Duke Energy	Not implemented in Durham					
Public Information	Duke Energy	Not implemented in Durham					
Public Information - PSNC	PSNC	Not implemented in Durham					
Transportation							
Compressed Natural Gas Vehicles	Duke University & TJCOG	390	30	3,770	490	10	30
Ethanol 85 Fuel Use in Durham	TJ COG	3,540	340	84,510	8,630	200	1,350
Biodiesel Use in Durham County	TJCOG	-2,360	940	11,790	2,870	560	1,960
Biodiesel Program - public fuel station	Private Sector/ State of NC	Included above					
Duke University Alternative Fuels - Biodiesel	Duke University	Included above					
Alternative Fuel Use	DATA	Included above					
Durham County Commute Trip Reduction Ordinance	Triangle Transit Authority	118,600	7,760	1,522,580	156,680	2,280	24,310
Commute A Little Easier	City/County of Durham	Included above					
Smart Commute	RTP	Included above					
Best Workplaces for Commuters	TJCOG	Included above					
RAVE	Durham County	Included above					

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHGs (t)
Car/Vanpool	Duke University	210	10	2,360	240	10	40
Electric Vehicles	Duke University	200	-340	3,400	350	0	10
Prius Hybrid Vehicles	Duke University	0	0	0	0	0	10
Carpool Parking Permits	Duke University	6,290	390	71,200	7,340	140	1,190
Land Use Planning - Transit Friendly Communities	City/County of Durham	Not quantifiable					
Fannie Mae Smart Commute™ Mortgage Program	Greater Triangle Research Council	Not quantifiable					
Anti-idling Program	DATA	Not quantifiable					
DAQ Mobile Source Emission Grants	DAQ	Not quantifiable					
Solid Waste							
Yard Waste Recycling	City of Durham						-4,760
Tidewater Fibre Corporation (TFC) Recycling	City of Durham						41,340
Commercial Corrugated Cardboard	City of Durham						15,950
White Goods	City of Durham						0
Recycling Bins Provided at Community Events	City of Durham	Included above					
Keep Durham Beautiful	City of Durham	Not quantifiable					
Compost Demonstration Centre	City of Durham	Not quantifiable					
Multi-departmental Code Enforcement Nuisance Abatement Team (CENAT)	City of Durham	Not quantifiable					
Swap Shop at Waste Disposal and Recycling Center	City of Durham	Not quantifiable					
Stickers Listing Banned Recyclables on Garbage Carts	City of Durham	Not quantifiable					
Compost Bins	City of Durham						100
Other							
NC GreenPower - Large Volume product $2.50 per month	NC GreenPower	2,770	8,780	200	20	180	790
Total		**365,450**	**716,810**	**1,720,470**	**179,350**	**18,050**	**152,280**

5.2 *Future Community Measures*

Businesses, institutions, and individuals are planning to implement many new measures that will reduce their GHG and CAP emissions. Many of these measures and their estimated impacts are summarized in Table 21. Together, these initiatives will help Durham avoid approximately 152,780 of GHG emissions.

Table 21. New Community Emission Reduction Measures Implemented After Base Year 2005: Estimated Annual Emission Reductions

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHGs (t)
Residential							
Energy Audits	Piedmont EMC	15,250	36,340	2,140	330	910	5,300
Durham Campaign for Solar Hot Water Heaters	Private Sector (possible expansion to County/Clean Energy Durham)	26,420	63,570	3,670	560	1,590	9,180
Manufactured Home Heat Pump Program	TJCOG	430	1,330	50	10	30	150
Heat Pump Loans	Piedmont EMC	1,080	3,360	120	10	80	380
Affordable Housing Program	Advanced Energy	1,910	5,910	210	20	130	660
West Village Expansion Project		38,270	103,270	4,870	670	2,450	13,360
Green Building Standard	Durham OC Chatham Home Builders Assoc.	Not quantifiable					
Operation Breakthrough	Operation Breakthrough	670	1,930	80	10	40	230
Commercial							
Energy Audits for Commercial Buildings	Triangle J Council of Governments	Not quantifiable					
Imperial Point L.L.C. Page RD LEED Certified Restaurant	Chapel Hill Restaurant Group	460	1,230	60	10	30	160
LEED Building - 3054 Cornwallis Rd, RTP	Syngenta Biotechnology Inc.	370	1,000	50	20	20	130
Institutional							
Facility Energy Efficiency	NC School of Science & Math	1,100	2,670	180	20	60	340
Power Plan (low-sulfur coal)	Duke University	No impact on GHGs					
Green Purchasing Policy - Energy Star for New Appliances	Duke University	2,560	8,120	190	20	160	730
New First Environments Early Learning Center,EPA, RTP	US Government	170	490	20	0	10	60
LEED Building - H, 12 Davis Drive, RTP	Research Triangle Foundation	810	2,200	100	10	50	280
Industrial							
None							
Transportation							
Smart Commute Challenge	TTA	1,960	130	26,370	2,710	40	420
Hybrid Electric Buses	DATA	1,340	60	1,270	160	20	120
Petroleum Displacement Plan	NCCU	Can estimate with baseline fuel use, need more info					
Petroleum Displacement Plan	NC School of Science & Math	-10	10	20	10	10	20
Park and Ride Lots	DCHC MPO	Not quantifiable					
Parking Fare Increases	DCHC MPO	Not quantifiable					
DCHC (LRTP) - Transportation Improvement Projects	DCHC MPO, City/County of Durham	Impacts of measures on VMT included in BAU forecast					

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHGs (t)
TTA Rail - Phase 1	TTA	Impacts of measures on VMT included in BAU forecast					
TTA Phase II	TTA	Impacts of measures on VMT included in BAU					
I-40 High Occupancy Vehicle (HOV) Lanes	DCHC MPO	Impacts of measures on VMT included in BAU forecast					
NC 147 (Durham Freeway) High Occupancy Vehicle (HOV) Lanes	DCHC MPO	Impacts of measures on VMT included in BAU forecast					
High Capacity Transit	DCHC MPO	Impacts of measures on VMT included in BAU					
Pedestrian Transportation Plan	City/County of Durham	Impacts of measures on VMT included in BAU forecast					
Bike Lanes	DCHC MPO	Impacts of measures on VMT included in BAU					
Bicycle Transportation Plan	City/County of Durham	Impacts of measures on VMT included in BAU					
Solid Waste							
Ordinance Amendments in 06/07 provide for Civil Enforcement	City of Durham	not quantifiable					
SWM Code Enforcement Officer (Proposal for Funding)	City of Durham	not quantifiable					
Household Hazardous Waste - long term plan	City of Durham	not quantifiable					
Compost Bins	City of Durham						2,650
Waste Management Plan	City of Durham						118,580
Bar & Restaurant Recycling	State-lead Initiative	included above					
New Development Requirement - Cardboard Dumpsters and Recycling Bins with each garbage dumpster	City of Durham	included above					
Recycling – Mixed Paper	City of Durham	included above					
Total		**92,770**	**231,620**	**39,370**	**4,560**	**5,650**	**152,780**

5.3 *Existing Reduction Measures for Local Government Operations*

The City and County have initiated many activities within their operations that have enabled them to reduce energy use, save money and reduce greenhouse gas and criteria air pollutant emissions.
Table **22** provides a summary of the estimated annual emission and cost savings that each of these measures has had. To date, the City and County's efforts have resulted in GHG emission reductions of approximately 5,630 tons and avoided costs of approximately $510,380.

Table 22. Existing Local Government Emission Reduction Measures

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Buildings								
Energy Efficiency: Administrative Complex	Durham County	80	240	10	0	10	30	1,960
Energy Efficiency: Carmichael Building	Durham County	670	1,740	90	10	40	240	21,800

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Energy Efficiency: Community Shelter	Durham County	120	280	20	0	10	40	2,730
Energy Efficiency: Social Service Building	Durham County	190	320	30	10	10	70	6,220
Energy Efficiency: Cooperative Extension	Durham County	70	190	10	0	10	30	2,900
Energy Efficiency: Detention Facility	Durham County	3,060	5,210	540	100	160	1,090	57,530
Energy Efficiency: Health Department	Durham County	320	1000	40	0	20	110	18,760
Energy Efficiency: Judicial Building (including 3 prk lots)	Durham County	3,700	13,460	300	20	290	1,270	69,730
Energy Efficiency: Main Library (Before Expansion)	Durham County	330	3,820	-100	-40	60	100	-14,530
Durham Bulls Athletic Park Resource Conservation Program	Awaiting information							
Energy Efficiency: Durham Solid Waste Operations Facility	City of Durham	60	200	10	0	0	20	2,070
Vehicle Fleet								
Hybrid Vehicles	City of Durham	30	0	310	30	0	10	750
Ethanol 85 Fuel Use	City of Durham	90	5	1000	120	0	20	none
Compressed Natural Gas Vehicle	City of Durham	80	0	620	80	0	0	none
Bike Police Fleet	City of Durham	960	50	14,370	1,320	30	210	6,030
LED on Police/Fire Trucks	City of Durham	No Impact on emissions						
Biodiesel Vehicle	Durham County	0	0	0	0		0	NA
Ethanol-fueled vehicle	Durham County	20	0	440	0	0	10	NA
Hybrid Vehicle	Durham County	20	0	300	30	0	0	NA
Lights								
LED Traffic Signals - replacements/installations	City of Durham	2,240	7,110	160	40	140	640	66,860
Water & Sewage								
Showerhead Exchanges	City of Durham	230	740	20	0	20	70	6,980
Water Conservation Team	City of Durham	Not quantifiable						
Biogas Capture and Flaring	City of Durham	Cannot be counted towards target						
Water Conservation Program	City of Durham	No impact on inventory						
Water Use Assessments	City of Durham	No impact on inventory						
Solid Waste								
Waste Reduction Policy	City of Durham	Not quantifiable						
Recycling Program	City of Durham						140	NA
Recycling Program	Durham County						360	NA
Schools								
Public School Energy Efficiency Initiatives	Durham Public Schools	0	0	0	0	0		97,000

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Public School Energy Efficiency Initiatives	Durham Public Schools	0	0	0	0	0		40,000
Biodiesel Use in Fleet	Durham Public Schools	-486	342	1,761	1,122	82	1,210	123,590
Total		**11,745**	**34,684**	**19,171**	**2,794**	**873**	**5,630**	**510,380**

5.4 *Future Reduction Measures for Local Government Operations*

Both the City and the County have plans for several new emission reduction measures. The total impact of these planned measures will be 37,230 tons of GHG reductions and approximately $3,566,300 in savings. The potential emission impacts of each of these measures are summarized in Table 23 below.

Table 23. Local Government Operations: Planned New or Expanded Emission Reduction Measures

Name of Measure	Implementing Authority	Nox (lbs)	Sox (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Buildings								
LEED for New Buildings Contained within CIP	Durham County	10,590	31,340	910	120	660	3,100	310,260
Animal Control NEW CONSTRUCTION	Durham County	Included above						
East Durham Branch Library NEW CONSTRUCTION	Durham County	Included above						
EMS Old Fayetteville St (Station 2) NEW CONSTRUCTION	Durham County	Included above						
Health and Human Services Complex NEW CONSTRUCTION	Durham County	Included above						
Justice Center NEW CONSTRUCTION	Durham County	Included above						
North Durham Branch Library NEW CONSTRUCTION	Durham County	Included above						
Senior Center NEW CONSTRUCTION	Durham County	Included above						
South Durham Branch Library NEW CONSTRUCTION	Durham County	Included above						
Sheriff/Police Training Center NEW CONSTRUCTION	Durham County	Included above						
Administrative Complex - Direct Digital Control	Durham County	480	1,480	50	10	30	170	12,230
Detention Facility t - Solar Energy	Durham County	110	420	40	0	30	40	3,530
General Services Complex	Durham County	80	260	10	0	10	20	2,590
Jail Annex - Roof Insulation	Durham County	20	40	0	0	0	10	540
Main Library EXISTING SPACE	Durham County	1,160	3,430	100	10	70	340	38,640
Main Library AFTER EXPANSION PROJECT	Durham County	not quantifiable						
Stanford L. Warren Library - Energy Efficient Upgrades	Durham County	90	280	10	0	10	30	2,580

Name of Measure	Implementing Authority	Nox (lbs)	Sox (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Youth Home – Roof insulation	Durham County	10	30	0	0	0	0	330
LEED Water Treatment Bldg.	Durham County	need more info						
City HVAC Upgrade Program	City of Durham	330	970	40	10	20	120	13,640
City Hall Elevator & Energy Efficiency Upgrade	City of Durham	need more info						
Fleets								
Underutilized Vehicle Study	City of Durham	30	0	290	30	0	10	420,780
Vehicle Replacement Plan - improved fuel efficiency of police fleet	City of Durham	210	10	3,080	280	10	40	2,930
Idle Reduction Policy	Durham County	Awaiting information						
Lights								
New LED Traffic Signals – Replacements after 2005	City	7,730	24,560	560	60	500	2,220	230,950
LED Traffic Signals - new lights installed after 2005	City	280	880	20	0	20	80	148,900
Water								
Landfill Gas Utilization	City	20,160	800	5,210	1,110	-630	7,410	1,258,380
Water Reclamation Project	County	need more info						
Solid Waste								
none								
Schools								
Public School Energy Efficiency Initiatives	Durham Public Schools	20190	36410	3460	610	1070	7170	704,760
LEED for New Schools	Durham Public Schools	38450	104350	4860	660	2470	13420	245,520
Durham Public School Temperature Controls	Durham Public Schools	8720	26033.140	990	120	590	3030	166,070
No Idle Policy	Durham Public Schools	340	10	260	30	10	30	3,690
Total		**108,960**	**231,300**	**19,880**	**3,060**	**4,860**	**37,230**	**3,566,310**

6 Local Action Plan

6.1 *Introduction*

6.1.1 Reduction Targets

A CCP reduction target is the annual quantity of GHGs that a jurisdiction commits to reducing from their community and local government operations by a given year. It is expressed as a percentage reduction in emissions in the target year, relative to the baseline year's emissions. In Durham's case, it is a percentage reduction from 2005 emission levels by the year 2030. Different targets can be established for the both the community and local government sectors. A more aggressive target is often selected for the local government sector, as these emissions are under the direct control of the local government and, as a result, are easier to control. Establishing a reduction target helps local governments to quantify their commitment to reducing GHG emissions, and sets a concrete, measurable goal for the government and community to strive towards. By establishing an emission reduction target, and officially adopting this target through a council resolution, a local government fulfills Milestone 2 of the Cities for Climate Protection (CCP) Five Milestone Framework.

Within the CCP program, reduction targets and the timelines for achieving them are completely voluntary. When the program began in 1993, it was standard for cities to commit to a 20% reduction from 1990 emission levels by 2010. This target was adopted by the City of Toronto in 1990 and was the first GHG reduction target officially adopted by any government body. The year 1990 was a logical baseline year because it corresponded with Kyoto Protocol targets. However, more recently it has become difficult for cities to inventory the year 1990 due to the lack of data availability, therefore, baseline years are now entirely up to the discretion of individual cities. Nonetheless, ICLEI still recommends a 20% target for local government operations and 6% target for the community within 10 years of joining the program. ICLEI maintains that these targets are low enough to be achievable, but also high enough to present the local government and community with a collective challenge.

When choosing a reduction target, a local government should be aware that targets should be seen as an interim policy development tool which can and should be refined and increased over time. Ultimately a larger reduction in GHG emissions is needed to avert the worst impacts of climate change. The target that Durham chooses to adopt following this report should be seen as the first step in that direction.

Table 24 contains some examples of targets set by other local governments throughout the CCP program. Additionally, over 400 U.S. mayors, representing over 57 million Americans, have pledged to meet Kyoto commitments in their cities by reducing overall emissions to 7% below 1990 levels by 2012 through the US Mayor's Climate Protection Agreement.

Table 24. Emission Reduction Targets Adopted by Other Local Governments

Local Government	Baseline	Target Year	Reduction Goal
Arlington County, VA	2000	2012	10% (for local government operations)
Alachua County, FL	1990	2010	20% (for local government operations)
City of Santa Monica, CA	1990	2015	30% (local government) 15% (community)
City of Austin, TX		2020	Carbon Neutral (for local government operations)
City of New York, NY	2006	2020	10% (community)
City of Portland, OR	1990	2010	20% (local government) 10% (community)
City of San Francisco, CA	1990	2012	20% (community)
London, England	1990	2025	60% (community)
Melbourne, Australia	FY 1996	2010	50% (community)

6.1.2 Target Scenarios

ICLEI has developed three different scenarios for Durham to consider when adopting their reduction target. These scenarios demonstrate different levels of emission reductions (low, medium and high) that are achievable through different levels of commitment, investment and ingenuity on the part of the City and County of Durham. The low target is achievable through taking advantage of 'low hanging fruit.' That is, easy and quick methods of reducing energy consumption and emissions. The medium scenario involves some ingenuity and longer term strategizing. The high scenario involves aggressive emission reduction efforts and will involve significant ingenuity and initial investment. These three different scenarios can help Durham to determine which target is achievable, given its commitment to saving energy, improving local air quality and helping to avert global climate change. The different scenarios can also be seen as stages in an emission reduction strategy. Durham may choose to begin with a lower target, and as progress is made towards this target, the target may be modified to follow a more aggressive emission reduction strategy.

Targets are measured as a reduction in emissions from the baseline year 2005, however, forecasted emissions must be considered when developing emission reduction scenarios and plans. The following emission reduction scenarios were developed by using the "Planned Emissions Forecast" for 2030, which takes into account community and local government growth, plus any currently planned measures to reduce emissions. Further achievable emission reductions under the different scenarios are subtracted from this forecast to develop the three scenarios. These scenarios are then measured relative to the baseline year's emissions.

The following sections of the report outline steps that can be taken within each sector on the part of the local governments to achieve their chosen target. These sections analyze measures implemented and planned to date in each sector, identify further options for emission reductions, provide case studies of programs developed in other cities and recommend steps that the city and county should take to reduce emissions in each sector.

6.2 *Proposed Community Measures*

6.2.1 Residential

The residential sector was responsible for 1,221,610 tons of GHG or 17.9% of the community's total emissions for the baseline year. Measures to reduce emissions implemented before 2005 resulted in approximately 1,930 tons of GHG reductions. Most of these savings are from the use of renewable energy sources (wind, solar, etc) and from energy efficient design and retrofitting. The measures that will be implemented after the baseline year will result in approximately 29,260 tons of GHG reductions. A large portion of this reduction is a result of emissions that will be averted through the use of sustainable design features in the West Village expansion project. All of the historic and planned measures in the residential sector have come from the private sector. Neither the City nor County of Durham has been directly involved with any reductions in this sector. Emission reductions in the residential sector are largely dependant on the voluntary participation of homeowners and developers. The City and County of Durham, in conjunction with the private sector and community groups, can play a major role in coordinating this effort to bring about energy-use and emission reductions in the residential sector.

There are many cost effective methods to reduce emissions in the residential sector.

- The most important role that local governments can play is to coordinate the dissemination of information to citizens through coordinated education campaigns, about private, local and state level initiatives they can participate in, and how to easily conserve energy and water in the home.

- Home energy retrofit programs are an effective way to improve the efficiency of homes and reduce residential emissions. Professional energy audits can identify the most energy and cost effective solutions for individual houses.
- Policies and incentives can be developed within the community to encourage developers to meet higher energy efficiency standards for new construction (such as LEED or the DOCC Homebuilders Association Green Building Standard). The city can also apply to the State Building Council for a waiver to set higher building standards, however, such applications have often been historically denied. Such an application might be more successful if Durham partnered with surrounding communities to apply for a waiver.
- Homeowners can be encouraged to look into alternatives such as green energy tags or renewable energy generation through education and incentives. There has been much debate about the value of purchasing green energy tags and carbon offsets. These should be seen as complementary to rather than a replacement for efficiency measures in an emission reduction strategy.
- As a community with a high proportion of rental properties, the City of Durham could implement a program to encourage property owners to retrofit their rental properties.

Case Study: Allegheny, PA

The Allegheny College project was designed to make energy efficiency visible to the renter/consumer. Beginning in 1998, the Commonwealth Community Energy Project developed a Home Energy Ratings System. One of the primary goals of the program was to evaluate the energy usage of the community's many rental properties. Data on houses' insulation levels, air leakage, heating system efficiency and other property features was collected and then used to determine a rating. Energy audits leading to an efficiency rating allow the prospective renter to shop for a rental with the best total cost—rent *and* utilities. Landlords were given suggestions on how they could increase efficiency in their properties and were provided with low-interest loans to making the improvements. Educational materials were designed to teach renters what the ratings mean and simple ways to save energy. The program estimated that changes to the 50 properties rated over the past four years have resulted in an annual savings of $30,000.

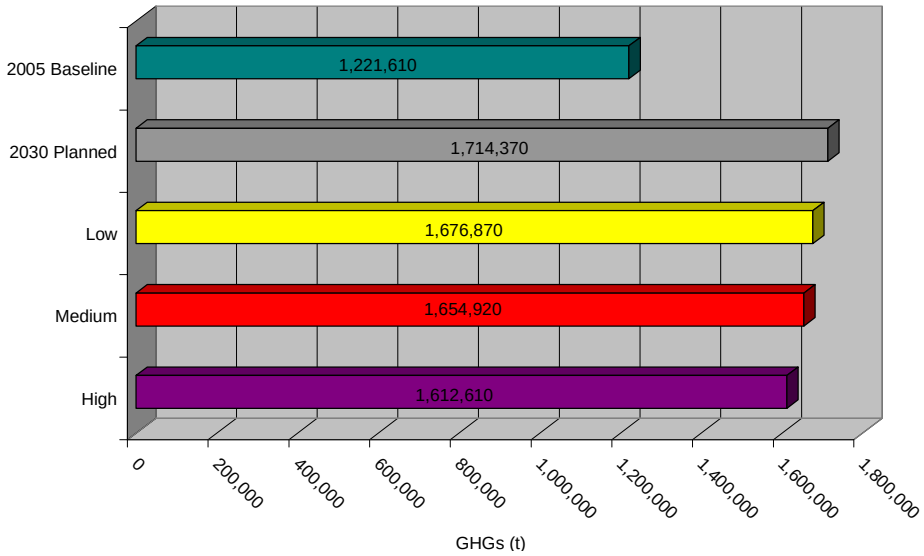
Estimates of the emissions reductions that would be possible through conservation and supply side management in the residential section have been estimated below. Specific examples of the types of actions that could be taken to achieve these reductions are included in Appendix K.

Table 25. Residential Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Expand conservation measures	Measures implemented to date have resulted in less than 1% emissions reduction. If they were improved upon and other measures were considered, such as implementing the Duke Energy Projects that were done in other regions, a rough estimate would aim for an conservative scenario of 2%, typical scenario of 3% and aggressive scenario of 5%	34,290	51,430	85,720
Expand alternative energy measures	Alternative energy measures implemented to date are minor (1,600t); including solar water heater installations, passive heating and cooling, geothermal as well as limited green power purchases. By supporting and building upon these initiatives, much greater impact can be achieved. A conservative estimate is double the initial impact, moderate is 5 times, and aggressive is 10 times.	3,210	8,020	16,040
	Total	**37,500**	**59,450**	**101,760**

Error! Reference source not found. illustrates the impact that the proposed measures could have on the emission profile of the residential sector. Due to the planned growth in this sector, even an aggressive implementation of measures will not be enough to overcome growth and reduce emissions below baseline levels.

Figure 8. Residential Emission Reduction Scenarios



General Recommendations

The North Carolina State Energy Office offers many programs and incentives that could be accessed by residents and promoted by the City and County governments of Durham. These include an Energy Efficient Mortgage program that allows prospective homeowners to finance energy efficient systems through the home mortgage and an "Upgrade and Save" program whereby grants are provided to replace inefficient electric furnaces with more energy efficient furnaces. Solar thermal heating is particularly viable in Durham, given North Carolina's mild climate and is also more financially viable than solar voltaic energy. ICLEI recommends that Durham initiate a public education campaign that promotes the benefits of home energy efficiency and how it can be achieved through home design and retrofitting, the use of renewable energy, and financing assistance programs, such as those described above. ICLEI also recommends that Durham foster partnerships with community groups such as the Durham Orange County Chatham Home Builders Association, Clean Energy Durham and private developers to promote home energy efficiency. Finally, due to the high proportion of rental properties in Durham, ICLEI strongly recommends that Durham consider implementing an energy efficiency program for rental properties, such as the Allegheny program described above. The City should also work with Duke Energy to expand on the energy conservation programming they have developed but have not delivered in Durham.

6.2.2 Commercial

The commercial sector is a considerable energy user and therefore is responsible for significant GHG and CAP emissions. In the baseline year, the commercial sector (including the institutional sector) emitted approximately 2,161,090 tons of GHGs, which accounted for approximately 32% of the community's total emissions. Prior to 2005, there were no programs implemented in Durham to reduce commercial sector emissions. The institutional sector (a sub-sector of the commercial sector) has been more active and implementing programs before the baseline year have resulted in approximately 68,040 tons of GHG reductions. The most successful of these projects was the construction of a new energy efficient building owned by the EPA, which resulted in approximately 50,000 tons of GHG savings. There are also very few planned measures for this sector. Commercial planned measures will only result in approximately 290 tons of GHG reductions. Institutional planned measures will result in approximately 1410 tons of GHG reductions.

There is a lot of room for improvement in this sector. Since very little has been done to reduce emissions from Durham's commercial sector, there are many opportunities to further reduce GHG emissions. The City and County of Durham can play an important role in encouraging and coordinating the efforts of various partners and assist them in running programs to further reduce GHG emissions.

- Cities can encourage developers to achieve high energy efficiency in new buildings through incentive programs, even if no regulations are in place. Many incentives require little investment for the city. For example, cities can offer: priority permit processing for builders/developers who propose low-carbon projects, reduced permit fees for such projects, and advertising or recognition for developers who use green/energy efficient design.
- Cities can encourage or provide energy audits for businesses to identify opportunities to increase efficiency through improvements to the building envelope, lighting, HVAC, appliances and electronics.
- Conservation programs can be developed to encourage employees to save electricity and water in the workplace.
- Business owners can be encouraged to look into alternatives such as green energy tags or renewable energy generation.
- A rental property evaluation and retrofit program, such as the one described in the residential section of this chapter, could be applied to commercial rental properties.
- The City can require that businesses fill out a form along with their application to renew business licenses that outlines their sustainability plans. They could also choose to attach existing sustainability plans or check a box refusing to submit this information. This information could be shared online with the public, which would make businesses accountable to residents and would act as an incentive for businesses to become more sustainable.

Case Study: NC State Energy Office
The Energy Improvement Loan Program (EILP) is sponsored by the State Energy Office, N.C. Department of Administration. The program provides low interest loans, secured by bank letter of credit, for eligible energy conservation measures for industry, commercial businesses, local government units, community colleges, K-12 school systems, and nonprofit organizations. Loans with a one percent interest rate are available for some renewable energy projects. A three percent rate is available for projects that demonstrate energy efficiency, energy cost-savings or reduced energy demand. The loan can be repaid from the energy savings these improvements generate. Applicants must negotiate with their lending institution any fees charged over and above these rates. Loans up to $500,000 per recipient are available. Loans requested for new construction will be made only for the incremental costs between state code and above-code improvements.

Case Study - Cool Shops Program – Ontario, Canada
Cool Shops is a market transformation program targeting street-facing retailers in neighborhoods across Ontario. The purpose of the program is to identify and implement in-store energy management measures that encourage the small-business commercial sector to save on utility costs and reduce energy consumption. Through strategic partnerships the Cool Shops program is well positioned to provide significant greenhouse gas emissions reductions. As of October 2006, Cool Shops has visited over 14,500 stores and has resulted in:

- Over 7,422 Palm Pilot energy audits conducted,
- Over 12,000 CFLs installed,
- 1,506 tonnes of GHG emissions reduced,
- Over $500,000 in savings to small businesses per year.

Participating stores not only reap the energy savings and a reduction on their utility bills but also get well deserved recognition within the community and contribute to a reduction in GHG emissions.

Table 26 shows the estimated emissions reduction potential from energy conservation and demand side management in the commercial sector. The estimated impacts of this type of programming in the commercial sector is higher than predicted in the residential sector since the commercial sector tends to contain larger energy users, which once approached, can achieve more significant savings. Specific examples of the types of actions that could be taken to achieve these emissions reductions are included in Appendix K.

Table 26. Commercial Emission Reduction Scenarios

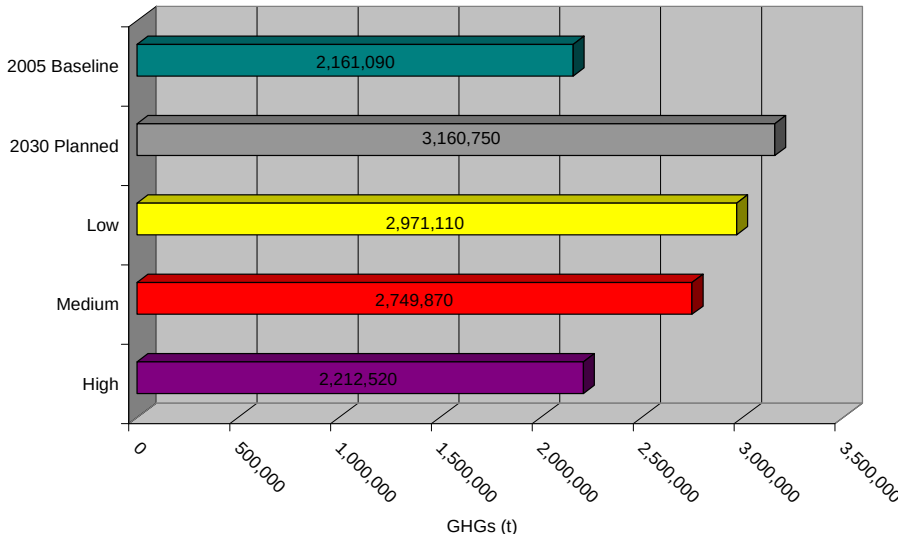
Suggested Measure	Description	Low	Medium	High
Energy conservation programming	Conservation and efficiency programming should be targeted to existing building stock as none has been done to date. GHGs could be reduced by 5%, 10% and 25% respectively for each of the 3 scenarios.	108,050	216,110	540,270
New construction energy efficiency	Growth in the commercial sector is expected to increase GHGs by 1 million tons by 2030. By focusing on initiatives to increase efficiency, emissions could be reduced by 5%, 10% and 25% respectively.	50,000	99,990	249,990
Alternative energy purchases	Promote the use of alternative fuels and green power purchasing. 1%, 3%, and 5% uptake into the 3 scenarios.	31,610	94,820	158,040
	Total	**189,660**	**410,920**	**948,300**

Figure 10 illustrates the impact of the proposed measures on the commercial sector emissions profile. Commercial emissions are expected to rise nearly 50% between 2005 and 2030, requiring a considerable effort be made in order to reduce emissions below the baseline year levels.

General Recommendations

The City and County of Durham should play a larger role in encouraging energy conservation in the commercial sector. ICLEI recommends that Durham consider developing an energy and water conservation program for the commercial sector that highlights energy saving opportunities and resources, such as energy retrofitting and solar thermal heating.

Figure 10. Commercial Emission Reduction Scenarios



Lighting retrofits are one of the easiest ways for businesses to decrease their energy consumption and have a definite lifetime payback. Lighting retrofits and more comprehensive retrofits (HVAC systems) should be widely encouraged. The City and County can use their own experiences with retrofitting to serve as an example of the potential energy and cost savings that can be incurred through efficiency. The City could develop a registry of sustainability plans of all businesses located in the city and could use this information to build and expand on other sustainability programming in the commercial sector.

There are many resources at the state and national level that businesses can take advantage of. The U.S. EPA's ENERGY STAR program works with local partners to help businesses implement lighting retrofits and other energy savings programs. The North Carolina State Energy Office has many energy efficiency

programs for businesses. These programs should be promoted. Duke Energy has developed several energy savings programs; however these programs have not been implemented in Durham. The City and County should work with the utility to implement these programs locally. The local governments should also consider developing a program to work with owners and tenants of rental commercial properties to encourage them to retrofit these properties. Finally, ICLEI recommends that Durham consider providing incentives for developers to build new construction to higher efficiency standards.

6.2.3 Industrial

The industrial sector emitted approximately 845,900 tons of GHG in the baseline year (12.4% of the total community emissions). There are no historic or planned measures for emission reductions in this sector. There is a lot to be done within this sector to reduce its impact on GHG emissions,. It would be particularly useful to identify which industries in Durham emit the highest levels of GHGs through their operations. Addressing these emissions is a critical means of managing emissions throughout the community now and in the future.

Strategies for addressing industrial emissions are similar to those for addressing commercial emissions. The most important role that local government can play in this process is coordinating encouraging industry to get involved in the local GHG reduction strategy and providing them with resources to enable them to do so. Ways to reduce emissions from the industrial sector include:

- Encouraging local industry to switch their main sources of fuel to cleaner sources, such as natural gas, cogeneration, biodiesel, ethanol or renewable energy.
- Encouraging local industries to improve the efficiency of existing buildings and industrial processes and set higher standards for new buildings and operations.
- Promoting employee energy and water conservation in the workplace.
- The City could develop a registry of sustainability plans for the industrial sector, as described under commercial measures.

Case Study – NCSU Industrial Assessment Center

The North Carolina State University Industrial Assessment Center (IAC) program, administered by Rutgers University has been funded by the North Carolina State Energy Office to reduce emissions from the industrial sector. The two main goals of the program are to provide energy conservation and cost reduction assessments to small and medium sized manufacturers and to educate the next generation of energy managers in conservation. Advanced undergraduate and graduate students from the Mechanical & Aerospace Engineering Department at NCSU conduct a one-day assessment of a facility with an experience faculty member. Data on plant operations and energy costs are collected and analyzed to determine potential conservation measures. These measures are compiled into a technical report detailing the recommended actions, the potential savings, the estimated cost of implementation and simple payback period. This program has benefits for local industry, students and community emissions.

Table 27 demonstrates the emissions reduction potential from basic supply and demand side management measures in the industrial sector. Industrial processes tend to be very specialized and dependent on the product being produced; therefore the specific activities must be addressed on a case-by-case basis. Specific examples of the degree of action that would be required to achieve these emissions reduction levels are included in Appendix K.

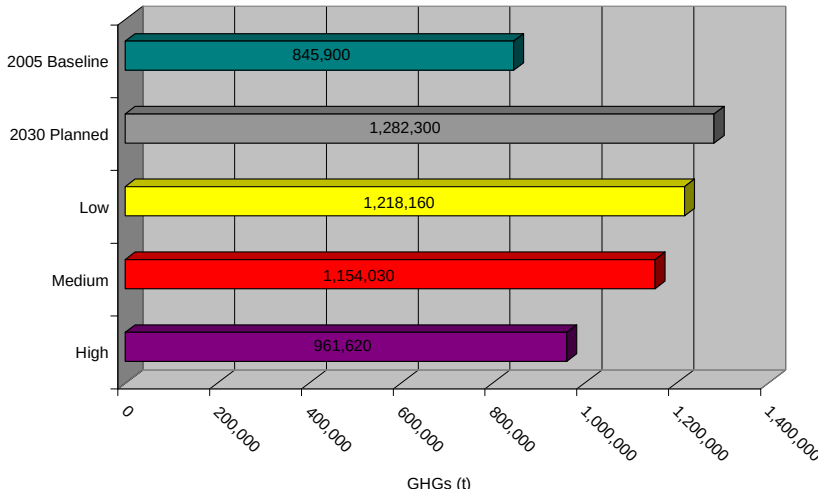
Table 27. Industrial Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Demand and supply side management	No tangible attempts to reduce emissions, improve energy efficiency or use alternatives have been made in the Industrial sector. GHGs could be reduced by 5%, 10% and 25% respectively in 3 scenarios.	64,060	128,130	320,320

Total	**64,060**	**128,130**	**320,320**

Similar to the residential and commercial sectors, there is considerable growth expected in the industrial sector. Emission reduction strategies would need to be extremely aggressive to even stabilize emissions at baseline levels, as illustrated in Figure 11.

Figure 11. Industrial Emission Reduction Scenarios



General Recommendations

The industrial sector has the ability to be incredibly innovative and aggressive to achieve emission reductions, since there have been no emission reduction programs implemented in this sector so far. It is difficult to categorize efficiency measures in the industrial sector since industrial processes are so varied and specific. However, emissions in the industrial sector can be controlled by local governments without regulations through the creation of incentives, voluntary reduction programs and business networks to encourage local industries to reduce their energy consumption and emissions. ICLEI encourages Durham to consider establishing a program to engage industry in emission reduction process, such as sustainability plan registry, as described above. There are also many state-led initiatives that Durham could participate in through the NC State Energy Office.

6.2.4 Transportation

The transportation sector is one of the largest sources of GHG emissions, producing approximately 2,624,880 tons of GHGs in the baseline year, which accounts for 38% of the community's total GHG emissions in the baseline year. Historic measures resulted in a decrease in GHG emissions of approximately 28,900 tons, the majority of these reductions were achieved through the Durham County Commute Trip Reduction Ordinance, implemented by the Triangle Transit Authority. Future reduction measures will result in a further 549 tons of GHG emission reductions (not including measures in the LRTP). As this sector plays a major role in the community's total emissions, it is important to work aggressively to reduce community transportation emissions.

It is important that Durham reduce the number of single occupancy vehicle (SOV) trips in the community in order to reduce the amount of GHG emissions resulting from the transportation sector. There are many ways in which this behavioral change can be brought about.

- Integrate non-motorized transportation into all transportation and land-use planning activities. Educate city planners in non-motorized transportation planning principles.
- Strengthen and uphold policies that control urban sprawl. This not only reduces the number and distance of motorized vehicle trips, but also helps to conserve forests, which help to deter climate change by acting as carbon sinks.
- Promote the use of non-motorized transportation, carpooling and transit to citizens and employees. For example, the Town of Chapel Hill, the TTA and UNC Chapel Hill provide maps of housing that is accessible by transit. This tool enables students to plan to use transit when looking for apartments.

- Use planning practices and design standards that accommodate the widest range of potential users (incorporating all transport modes), including people with mobility and visual impairments and other special needs. Plan for Durham to become a more walkable community.

Case Study: UNC Commuter Alternatives Program

In an effort to reduce traffic congestion and the number of vehicles parked on campus, the Commuter Alternatives Program is designed to reward UNC faculty, staff and students who do not drive a Single Occupancy Vehicle (SOV) to commute to campus. The program is free and only requires that the CAP registrants commute to school or work and not hold an SOV permit. The Commuter Alternatives Program encourages all forms of alternative transportation including, bicycling, walking, transit, park and ride, carpool and vanpool. Staff, faculty and commuter students who use transit to get to work or school and do not have a parking permit can join CAP and receive the full menu of benefits, discounts and eligibility for prizes. In addition, UNC offers a car-sharing program, to both CAP and non-CAP members.

Case Study: City of Bellingham, WA

Managing the size and number of parking lots in the city can reduce pavement space and vehicle use. A variety of techniques exist for cities to incorporate GHG reduction into parking management systems. For example, charging storm water management fees based on the amount of pavement on a lot can act as an incentive for property owners to reduce parking supply and implement transportation management programs for their employees. In addition to reducing car travel, such programs can help to reduce the burden on local storm sewers and watersheds, and can raise revenue for other environmental programs in the community. One example of this type of program is in the City of Bellingham, Washington. Bellingham charges storm water runoff fees of $3 a month for houses with a building footprint between 300 to 1,000 square feet, $5 for houses with a building footprint up to 3,000 square feet and $5 per 3,000 square feet for larger commercial buildings, of which this measurement includes the total land parcel's impervious area. Property owners can qualify for a discount if they have their own on-site storm water management facilities or if they use partially pervious surfaces such as gravel for large paved areas.

- Implement school and campus transportation management programs to encourage parents, students and staff to use alternative transportation when traveling to school, college and universities.
- Traffic Flow Management Software Programs can be used to synchronize traffic signals to maximize traffic flow and reduce vehicle idling times.
- Durham can work with the State to implement tougher emission standards (i.e. as the State of California has done) on all vehicles. Start with an enforceable anti-idling by-law within the community, and a strict emissions testing procedure.
- Residents and local businesses can be encouraged to use higher fuel efficiency vehicles, especially hybrids, or use alternative fuel such as biodiesel and ethanol.
- Parking can be discouraged directly, through higher parking fees, or indirectly, through storm water runoff fees charged to property owners.
- Although not included in the CCP inventory, emissions from off-road engines should be stabilized through programs such as encouraging community members to use rakes and shovels, rather than leaf and snow blowers.

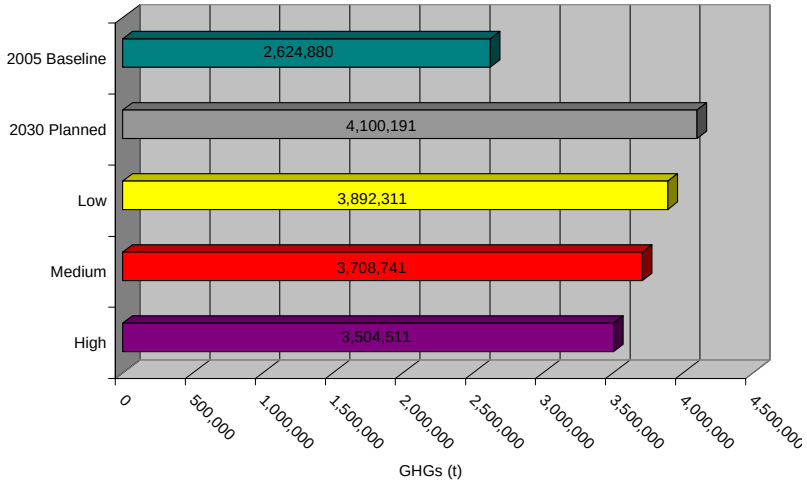
Table 28 presents emission reduction estimates from measures that can be used to reduce emissions in the transportation sector. Specific examples of the types of actions that could be taken to achieve these emissions reduction levels are included in Appendix K. The most successful program to date in terms of emission reductions has been the Durham County Commute Trip Reduction Ordinance, which ICLEI suggests be expanded beyond 2010 to 2030. Given the target year 2030 is considerably far in the future, land use planning can also play a large role in reducing emissions from transportation. ICLEI recommends that alternative fuel use be expanded throughout the Durham community.

Table 28. Transportation Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Land Use Planning	It is commonly acknowledged that land use planning has a great influence over GHG emissions related to transportation; however it is also very difficult to quantify this impact. It can be assumed that by 2030, plans could be in place to reduce the growth in emission via planning activities by 10, 20 and 30% respectively.[27]	147,590	295,170	442,760
Alternative Fuels & vehicles	Current alternative fuel & vehicle initiatives in the community include Duke and the Triangle Council's CNG vehicles, the promotion of E85 and biodiesel, amounting to approx 3,370t of GHG reduction. At a minimum, with limited effort these initiatives could be increased by10x by 2030 in a conservative scenario, 20x in a mid scenario, and 30x in aggressive scenario.	34,820	69,640	104,460
Expanded Durham County Commute Trip Reduction Ordinance	Durham County has a goal of 15% reduction in VMT by 2010. With a target year of 2030, this goal could be doubled to 30% in an aggressive scenario, 25% in a moderate, and 20% in a conservative.	25,530	26,750	48,630
	Total	**207,940**	**391,560**	**595,850**

Figure 12 illustrates that emissions in the transportation sector are projected to grow significantly between 2005 and 2030, causing even aggressive reduction activities to pale against the baseline year profile.

Figure 12. Transportation Emission Reduction Scenarios



General Recommendations

As the transportation sector is one of the largest sources of emissions in the community, Durham should thoroughly examine the sector for further emission reduction opportunities. The most successful long-term, sustainable approach to reducing transportation emission is through denser, multi-use urban planning. Such densification, coupled with strong legislation to control urban sprawl, can have a significant impact on the carbon footprint of a community. As Durham's target year is not until 2030, there is a significant amount of time to achieve tangible results through land-use planning decisions. ICLEI strongly recommends that Durham reexamine its planning strategies to determine if current plans will help to build a sustainable future for Durham. ICLEI also

[27] Durham's land use plan goes to 2030 and includes many smart growth measures. Plan website: http://www.durhamnc.gov/departments/planning/comp_plan/

recommends that Durham City and County partner with community groups and local businesses to promote the use of alternative modes of transportation and fuels within the community.

6.2.5 Solid Waste

The solid waste sector in Durham has resulted in negative 16,050 tons of GHG emissions in the baseline year (2005). This negative amount is due to a combination of factors: when waste is put into a landfill, some of the carbon contained within the materials is sequestered and the flaring of methane reduces its global warming potential. Since landfill gas is about 50% methane and methane has a global warming potential of 23 times that of CO2, it appears to be slightly beneficial to landfill waste rather than reduce it. However, the environmental impacts and cost of landfilling organic waste - which accounts for approximately 16% of Durham's waste stream (based on the EPA's "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2003") makes organics the logical next step in waste diversion for the City/County of Durham.

Case Study: San Francisco Organic Collections Program

The City of San Francisco instituted residential curbside collection of organic material as part of its "Fantastic Three" program. The program provides each household with a green cart for organic waste, a blue cart for various recyclables, and a black cart for all remaining trash. Residents and businesses are encouraged to place all food scraps and yard trimmings into the green cart, which is collected for composting at a regional facility. The composting program diverts more then 300 tons per day of organics. Many times the resultant compost can be sold at local green houses, landscapers, golf courses, and back to the community and result in revenue being generated for the municipality. By instituting a curbside organics collection, San Francisco became the first large city in the nation to collect food scraps citywide. The "Fantastic Three" program enabled the city to reach a reported overall 67 percent garbage diversion rate in 2004. Through outreach and other methods, the City plans to expand the Fantastic Three program and increase both the amount of organics and recyclables collected. The program's expansion is projected to achieve annual GHG reductions of 70,000 tons.

While landfills can sequester carbon such as yard waste (wood, food, leaves, etc) these types of products can sit for years and be unproductive in distributing various nutrients back into the soil. Additionally, as landfills become more strained with the amount of waste in them, diversion of materials becomes more attractive and sustainable. A composting program could divert up to 16% of waste away from landfills, and in the process, create a non-toxic, nutrient rich alternative to harmful fertilizers.

- As a consumer society, it is important to consider the "Rs" related to waste reduction. There are the usual 3 Rs that are very familiar to everyone – reduce, reuse and recycle. In that order, recycling should be the last step in reducing the amount of waste sent to the landfills each year. There are also two more Rs that are important, and they should come before the familiar 3 Rs. They are Rethink (before purchasing – make greener choices) and Refuse (products that have extra packaging, products were not made/grown locally etc), these two options should be introduced into all facets of the community through an intensive education campaign.
- Landfill gas can be captured and used to produce heat or electricity for adjacent buildings. This can offset some of the electricity and natural gas used in the community.

General Recommendations

The waste sector is unique in Durham's case since it contributes negatively to GHG emissions. As a result, further efforts to reduce emission will not lower the quantified emissions from this sector. This does not mean however, that in the long run, the diversion and reduction in the amount of waste being sent to landfills is unnecessary. Reducing waste production and landfilling will have benefits for water and soil quality and will help to make Durham a more sustainable community. ICLEI recommends that Durham examine the possibility of implementing a curbside organics program to further reduce the

amount of waste heading to the landfill. ICLEI also encourages Durham to develop a public education campaign to encourage the 5 Rs within the community.

6.3 *Proposed Local Government Measures*

6.3.1 Buildings

The local government building sector (not including school buildings) was responsible for approximately 42,740 tons of GHG or 27% of total local government emissions in 2005. Energy saving measures implemented before 2005 resulted in a savings of approximately 3,000 tons of GHG. The majority of these savings were as a result of HVAC and lighting retrofitting in existing County owned facilities. Measures implemented after the baseline year will result in a savings of approximately 3,800 tons of GHG. The majority of these savings will result from additional retrofitting of County owned facilities, and the adoption of LEED standards for all new County buildings. The City of Durham has done very little so far to reduce emissions from their buildings. Local governments are often able to achieve major emissions reductions in the building sector. Therefore, plans for improvement within this sector should feature prominently in Durham's emission reduction plan.

There are several ways in which emissions reductions can be achieved within the local government buildings sector:

- Existing buildings can be retrofitted so that they are more energy efficient. This can be done through changes in lighting and HVAC technology, replacing old appliances with Energy Star approved appliances and improvements to the building envelope including sealing leaks, replacing windows and adding insulation. It is often easy to achieve at least a 10% reduction in a building's energy consumption through basic retrofitting.
- By making energy efficiency a priority in the early stages of the design process, much higher energy efficiencies are achievable in new construction and major renovations. A city can resolve to meet a certain standard for energy efficiency in all new buildings. The U.S. Conference of Mayors has resolved that all new buildings be 60% more efficient by 2010 with the ultimate aim of reaching carbon neutrality by 2030.
- Emissions can also be reduced through the development of energy and water conservation programs and policies for buildings. Examples of such programs include: turning off all lights and computers at night, installing low-flow toilets and faucets, increasing the temperature of the air conditioning in the summer and lowering the temperature of the heat in the winter, encouraging employees to turn off lights when not in a room, and countless others.
- Emissions from local government buildings can also be offset through the purchase of renewable energy tags.

Case Study: New Haven, CT

The City of New Haven, CT began an Energy Conservation Program in 1994 to reduce energy consumption and cut costs. It was determined that the most economical way of achieving this was through energy efficiency measures. These measures included an energy saving performance contract (ESPC) between the board of education and a private contractor, whereby the contractor evaluated the potential energy savings and completed the retrofit at no cost to the board of education. The contractor then recovers their costs and makes a profit by receiving a percentage of the energy costs savings over a period of time. The program also includes a centralized Energy Management System, whereby all of the city's energy use is monitored and controlled by central facility. The system limits consumption during peak demand periods, when the price is the highest and the electricity generated is often the most polluting. Since the program began, New Haven has saved over $24 million in energy costs, cutting costs by over $5 million per year and has reduced GHG emissions by thousands of tons.

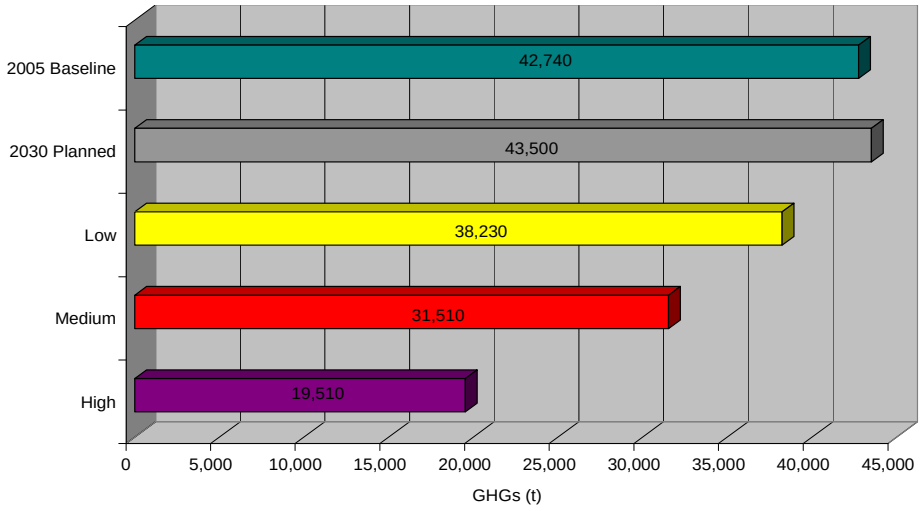
Table 29 describes the potential impact of expanding the City and County's demand side management activities and considers the emissions reduction potential of using alternative energy sources. Specific examples of the action that would be required to achieve these emissions reduction levels are included in Appendix K.

Table 29. Local Government Buildings Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Energy efficiency upgrades/expansion of existing programs	Some energy efficiency initiatives are already planned. More could be done with the remaining building stock. 35% reduction in overall energy would be considered aggressive (ie HVAC & lighting), while lesser percentages would be more appropriate for the conservative and typical approaches (ie 10 & 20%).	4,800	9,600	16,800
Energy supply management	Alternative energy sources could be pursued or subsidized via green tags etc. Reductions are based on 1%, 5%, and 15% offset from alternative energy sources.	480	2,400	7,200
Total		**5,280**	**12,000**	**24,000**

Table 29 shows how even low or conservative amounts of emissions reduction efforts can bring emissions below baseline levels. Moderate or aggressive action in the building sector can lead to even more significant reductions.

Figure 13. Local Government Buildings Emission Reduction Scenarios



General Recommendations

The City of Durham was unable to provide ICLEI with the square footage of more than 25% of its facilities. The City should collect this data for the remaining buildings and enter it into the CACP software to determine the energy intensity of these facilities. Buildings with high energy intensities (emissions/square foot), that are also large, are generally considered 'low hanging fruit' in an emission and energy reduction strategy. That is to say, major emission reductions can likely be achieved through a basic energy retrofit of these facilities. Of the City's buildings with known square footages, the ones with the highest energy intensities (that are also large) include: City Hall, Police Headquarters, Durham Bulls Athletic Park, the Edison Johnson Community Center and the Fleet Maintenance Building. The County facilities with the highest energy intensities include: the Detention Facility, the Judicial Building and Annex, the Health Department and the Main Library.

The County of Durham has begun to take some major strides towards improving the energy efficiency of their buildings; however, there is still room for improvement. There are several energy efficiency technologies that have not been included in previous retrofits and there are some County owned buildings that have not been retrofitted at all. ICLEI recommends that the County thoroughly examine the options for all of its facilities, particularly focusing on the low hanging fruit highlighted above. ICLEI also recommends that the County aim for highest energy efficiency possible in their new LEED certified facilities. This will not only reduce emissions from these buildings, but will save on energy costs in the long run.

The City of Durham has as of yet, done little to reduce emissions from their facilities. ICLEI recommends that Durham examine retrofit options for all of its facilities, particularly the facilities with high emissions intensities highlighted above. ICLEI also recommends that Durham adopt a standard such as LEED or the US Conference of Mayor's efficiency standard for all new local government construction and major renovations to existing buildings. Finally, both the City and County should consider using solar thermal technology for hot water heating in their facilities.

6.3.2 Fleets

The local government fleet sector (not including school fleets) was responsible for approximately 15,310 tons of GHG or 10% of total local government emissions in 2005. Fuel saving measures implemented before 2005 resulted in a savings of approximately 243 tons of GHG. These savings were achieved through the use biodiesel, ethanol and CNG in a few fleet vehicles owned by both the City and County and the use of bicycles for certain police patrols. Measures implemented after the baseline year will result in an approximate savings of 50 tons of GHG. These reductions are mainly the result of a plan by the City to purchase police vehicles with higher fuel efficiencies and to dispose of underutilized vehicles. The measures currently implemented and planned by the City and County of Durham to reduce fleet emissions has very little impact on total emissions. Therefore, there is ample room for improvement in this sector.

Case Study: Durham Public Schools
The Environmental and Energy Study Institute (EESI) have recognized Durham Public Schools as a national leader because of its use of biodiesel in all school buses. This program began in 2004, and the marginal additional cost of fuel was funded by the Triangle J. Council of Governments through a grant from the NCDOT Congestion Mitigation and Air Quality Improvement Program (CMAQ) and the North Carolina State Energy Office (NC SEO). This program has been continued annually since 2004 and has been successful in reducing school bus GHG emissions by approximately 1,200 tons annually, equal to about 20% of total school bus emissions in Durham.

There are many strategies for reducing fleet emissions that Durham may wish to consider. Typical emissions reduction strategies for local government fleets include:

- The replacement of typical fleets with alternative fleets, such as foot, bicycle and Segway patrols for police officers and parks and recreation staff. In addition to being better for the environment, and the health of employees, this would bring city staff in closer contact with residents, and would set a positive example for active transportation in the community.
- The reduction in the number of fleet vehicles. A study can be conducted to determine if any of the fleet vehicles are unnecessary and these vehicles can be disposed of.
- The use of alternative fuels such as biodiesel and ethanol blends in fleet vehicles can significantly decrease emissions of both GHG and criteria air pollutants. Biodiesel (B20) produces 20% less GHG than regular diesel and ethanol (E85) produces 85% less GHG than regular gasoline. B20 can generally be used in unmodified diesel engines. E85 is used in flex-fuel vehicles that are now available for purchase from most major automobile manufacturers.
- The transition of fleets to more efficient vehicles can also decrease emissions significantly. A study can be conducted to determine if smaller or more efficient vehicles could be used in the

place of current fleet vehicles. Hybrid-electric vehicles should also be considered, as they can have up to twice the mileage of a regular vehicle. It is also particularly positive marketing if the mayor is proudly transported in a hybrid vehicle.

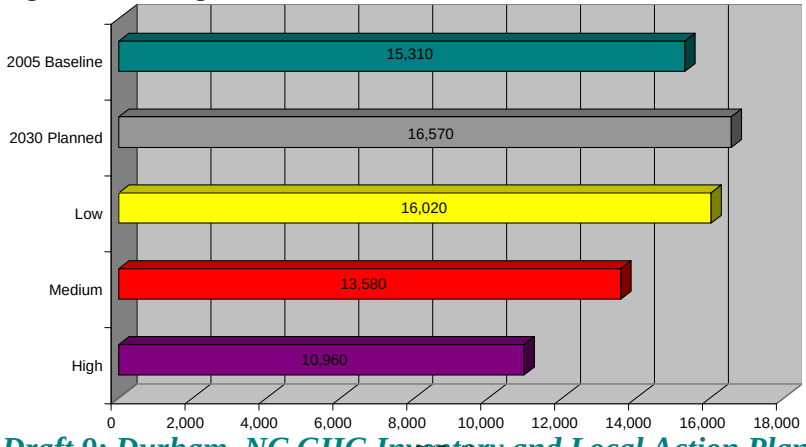
- Emissions can also be significantly reduced through driver behavior training. Practices such as reduced idling, driving at the speed limit and other practices can reduce emissions in existing vehicles by approximately 5%.

Table 30 demonstrates the impact that expanding the current fleet measures will have on the fleet sector emissions profile. Measures include expanding active transportation, alternative fuels and vehicles as well as improving the general efficiency of the fleet. Specific examples of the types of actions that could be taken to achieve these emissions reductions are included in Appendix K.

Table 30. Local government Fleets Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Active Transportation	Initiate active transportation in County as was done in City Police. County's fleet is aprox 1/3 that of the City's, therefore 1/3 of the savings are expected in the conservative scenario, 1/2 in the moderate scenario and equal parts in the aggressive scenario.	60	100	210
Fleet Efficiency	The vehicle replacement plan should be expanded beyond the police vehicles in the City as well as to the entire Durham Fleet. An underutilized vehicle study should also be done in the County.	180	260	350
Hybrid Vehicles	Conservative is to double hybrid fleet in City from 2 to 4 and for County to match fleet with 4 of its own. Moderate scenario is 4 times the conservative (16 cars in City and County) and Aggressive is double the moderate (32 cars in City and County)	30	120	240
Biodiesel	Conservative includes 20% use of biodiesel in fleet, moderate includes 50% and aggressive includes 80%. Fleet expected to increase by 9% (150 vehicles) by target year, therefore diesel projected to increase from 430,370gal to 469,103 gal.	190	470	740
Ethanol (E85)	Conservative scenario includes doubling E85 use in City and matching it in the County. Moderate assumes 20% of fleet is converted, Aggressive assumes 40% of fleet is converted.	90	2,040	4,070
Total		**550**	**2,990**	**5,610**

Figure 14. Local government Fleets Emission Reduction Scenarios



In
, the impacts of the three emissions reduction scenarios can be seen relative to the baseline and forecasted emissions. Engaging in the conservative or low scenario would bring emissions back down nearly to baseline levels. Activities beyond the low scenario would bring emissions down to well below baseline levels.

General Recommendations

The City of Durham is conducting an ongoing under-utilized vehicle study and ICLEI recommends that the County do the same. It is also recommended that both the City and County consider downsizing the fleet or transitioning to smaller or more efficient vehicles. This will not only decrease fuel use and emissions, but will also save on costs in the long run. The police fleet is currently planning to move from Crown Victorias to Impalas because they have slightly higher fuel efficiency. However, the analysis estimates that this measure will only result in 44 tons of GHG savings. ICLEI would recommend the City consider purchasing police vehicles with even higher fuel efficiencies, flex-fuel vehicles (if they decide to use E85 in these vehicles)[28] or even consider purchasing hybrid-electric vehicles for all non-pursuit vehicles. ICLEI also recommends that the City and County consider switching to biodiesel in all diesel-fuelled fleet vehicles. This can result in major emission reductions and can usually be done without any changes to vehicle technology and with only a marginal increase in costs. ICLEI recommends that the City and County consider developing a driver training program, which will increase the fuel efficiency of all fleet vehicles and will save on fuel costs and reduce emissions significantly in the long run. Finally, ICLEI recommends that the City and County consider adopting a tangible fuel reduction target. For example, Raleigh and the State of North Carolina have pledged to reduce fuel use in fleets by 20% by 2010. This would provide fleet managers and drivers with a tangible target to strive towards.

6.3.3 Streetlights, Traffic Signals and Other Outdoor Lighting

In 2005, streetlights, traffic signal and other outdoor lighting were responsible for approximately 10,610 tons of GHG emissions, equivalent to approximately 7% of total local government emissions for that year. The City of Durham operates all outdoor lighting in the county. The replacement of incandescent traffic signals with light emitting diodes (LED) traffic signals before the baseline year resulted in approximately 640 tons of GHG reductions. LED traffic lights use 90% less energy than incandescent bulbs and last at least ten times as long. In the baseline year, less than 25% of all of the traffic signals in the city were LEDs, however, the city plans to replace all of the remaining incandescent traffic signals with LEDs in the next five years. This will result in approximately 2,300 tons of additional GHG savings.

So far, no measures have been planned or implemented to reduce emissions from streetlights or other outdoor lights. Streetlights and other outdoor lights are responsible for the majority of emissions in this sector. All of the streetlights and other outdoor lights in Durham are high pressure sodium (HPS) lights leased by the City from Duke Energy.

There are various ways in which Durham can save electricity in the lighting sector. These include:

- The use of more energy efficient streetlights, such as low pressure sodium or induction lighting. LED street lighting technology is currently being refined but is expected to be on the market in the next few years and is expected to

Case Study: San Diego, CA

The City of San Diego has replaced 179 high pressure sodium (HPS) light fixtures with induction lighting in the Gaslamp Quarter, a busy pedestrian area with many restaurants and shops. The City decided that induction lighting would enhance the ambience and safety of this popular destination for both residents and tourists. Induction lighting is a new technology that is brighter than a HPS lamp of the same wattage. This technology has been highly praised for the whiteness, clarity and fullness of the light it produces. Since induction lighting produces a brighter and whiter light, a lower wattage lamp can be used, which saves energy in the long run. Induction lamps are also four times longer lasting than HPS lighting. Through this retrofitting program, the city has saved approximately $12,700 annually in maintenance and energy costs.

[28] The efficiency of FFV is often lower than regular vehicles if regular gasoline is used.

be 60% more efficient than HPS lighting.

- Changes to the orientation and design of light fixtures can save energy by focusing light in the direction it is most needed and thus decreasing the number and wattage of lights needed. This can be done through changes to the lamp's height, the distance between poles and the fixture's cutoff angle.
- New remote streetlight control technology called Lumen IQ™ allows a municipality to centrally program streetlights to dim or turn off depending on traffic volume. This technology can decrease energy consumption by as much as 25-40%.
- The energy consumption of streetlights can also be decreased through an overall reduction in the hours of use for streetlights and the total number of streetlights.
- Solar panels can be installed on LED traffic signals to power them without producing any emissions.
- Emissions from lighting can be offset through the purchase of renewable energy tags.

Table 31 showcases the impacts of potential new measures in the lighting sector. Specific examples of the types of actions that could lead to these emissions reduction levels are included in Appendix K.

Table 31. Lighting Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Alternative energy sources	Alternative energy sources could be pursued or offset using green tags. Reductions are based on 10%, 25%, and 50% offset.	1,830	4,580	9,160
Additional energy efficiency measures - operational	Additional energy efficiency measures include decreasing the number of streetlights, decreasing the hours of operation, and improving the efficiency of streetlights. A combination of decreasing the number of streetlights and decreasing the hours of operation could reduce energy use and emissions by 2% in a conservative scenario, 5% in a mid scenario, and 10% in an aggressive scenario.	370	920	1,830
Additional energy efficiency measures - technological	It is expected that LED technology will be available for streetlight lamps in the next few years. This technology is 60% more efficient than high pressure sodium. A conservative scenario assumed 10% of the streetlights could be retrofitted, a mid scenario assumed 20% and an aggressive scenario assumed 30%.	1,100	2,200	3,300
	Total	**3,300**	**7,690**	**14,290**

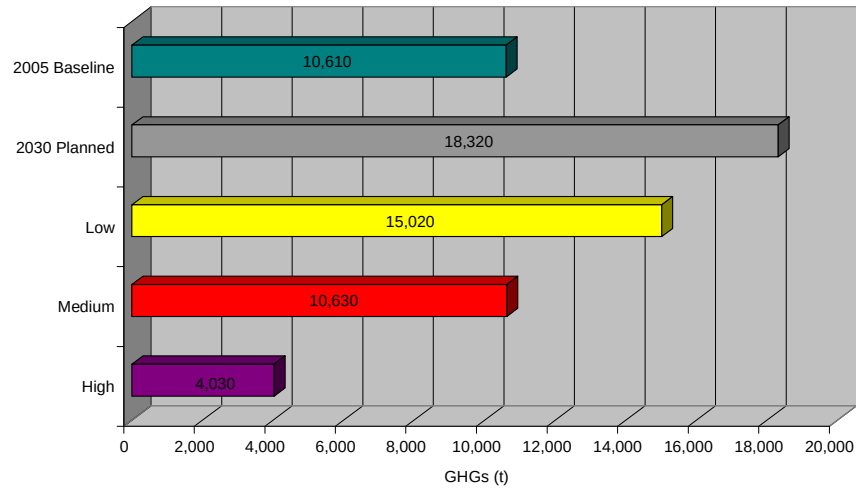
Figure 15 illustrates the impact of the low, medium and high target scenarios on the lighting sector. There is considerable growth anticipated in the lighting sectors (directly related to the anticipated growth in the residential sector) and moderate target scenario measures must be engaged in order to reduce emissions to baseline levels. Since much of the anticipated infrastructure growth has yet to occur, it is good timing to put policies and technologies in place to offset this growth.

General Recommendations

Replacing incandescent traffic signals with LED traffic signals and mercury vapor street lighting with HPS street lighting are generally considered low hanging fruit in a city's energy reduction strategy. Durham has made some excellent strides towards energy efficiency in the lighting sector, as the transition

to LED lighting is already underway and all of the streetlights in the city are HPS. Durham will therefore need to be innovative in order to further reduce emissions in this sector. HPS lighting is fairly energy efficient; however, low pressure sodium lighting, induction lighting and LED lighting are even more efficient and should be considered as alternatives. ICLEI recommends that the City of Durham, in collaboration with Duke Energy, conduct a full audit of all streetlights in the city to determine if there are any opportunities for increased lighting efficiency through the use of lower wattage bulbs, alternative lighting technologies, changes in orientation or design of fixtures or the removal of unnecessary lights. ICLEI also recommends that the City consider the purchase of a remote streetlight control program to centrally manage streetlights.

Figure 15. Lighting Emission Reduction Scenarios



6.3.4 Water and Sewage

In 2005, water and wastewater treatment was responsible for approximately 33,560 tons of GHG emissions, equivalent to 21% of total local government emissions. Measures implemented before the baseline year resulted in approximately 70 tons of GHG reductions. Measures included showerhead exchanges and water conservation programs. Planned measures implemented after the baseline year will result in approximately 7410 tons of GHG reductions. This significant reduction in emissions is the result of a plan to capture the biogas produced at the City's wastewater treatment facility and use it to produce heat, or electricity to power the facility. Although there have not been any retrofits to city's water and sewage treatment facilities in the last few years, efficiency has been a priority since the 1920s. Nonetheless, it is very likely that many opportunities still remain for emission reduction in the water sector through both supply-side and demand-side management.

Emissions from the water and wastewater sector can be reduced through supply-side management, by improving the efficiency of water treatment operations. Savings can also be achieved through demand-side management programs, which decrease the amount of water that is consumed.

- Water treatment operations can be made more efficient through the installation of more efficient pumps, motors and valves, repairs to existing pumps and pipes, or other operational improvements, such as employee training.
- Water treatment can be shifted to off-peak electricity rate

Case Study: The City of Columbus, GA

The City of Columbus wanted to reduce water and sewage treatment costs and decided that the best way to do this would be to retrofit its existing municipally-owned water and waste water treatment facility. As a result of this retrofitting, the city has saved over $1 million in energy costs over the past five years. Changes included: the water and wastewater treatment operations were reengineered to be fully automated, all old motors were replaced with more energy efficient ones and automated motor operators were retrofitted on the system's compressed air blowers. These improvements reduced energy costs by 25% and had a payback period of less than a year. Consultants and staff conduct ongoing evaluations of the system's efficiency. Finally, managers and team leaders are required to attend regular training sessions on energy efficiency.

periods to save on electricity costs.

- Water and sewage treatment plants can be retrofitted to improve facility energy efficiency (see buildings sector above).
- Water conservation programs implemented through the community including educational campaigns and strategic pricing can reduce the demand for treated water, thereby saving energy for water treatment.
- Green energy tags can be purchased to offset emissions from water and sewage treatment operations.

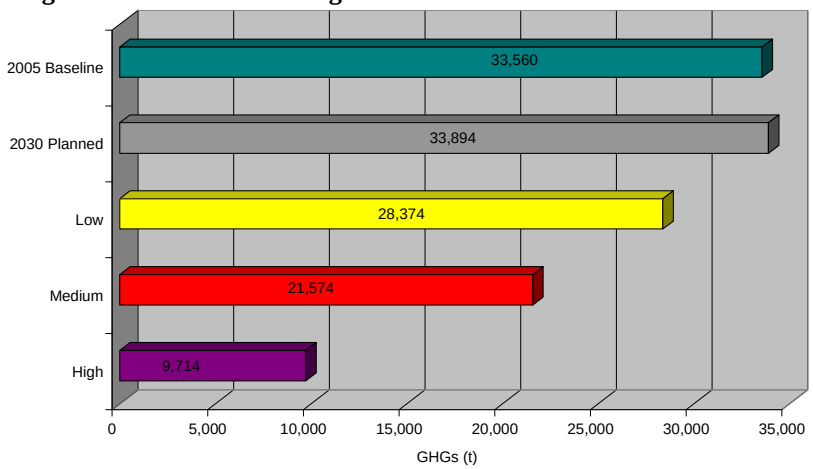
Table 32 demonstrates the impact of an expanded water conservation program, efficiency improvement to water and sewage processes and the use of alternative energy. Specific examples of actions that could be taken to achieve these emissions reduction levels are included in Appendix K.

Table 32. Water and Sewage Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Water Conservation - Expanded Program	Brown's and William's water treatment facilities are expected to produce 8880t of GHGs in 2030. A conservative scenario would be to reduce that by 10%, 20% for a moderate scenario, and 35% for an aggressive scenario.	890	1,780	3,110
Efficiency improvements	Neither the City nor the County reported any initiatives to improve the efficiency of the treatment processes, pumps, motors etc. It's reasonable to assume that there is significant room for improvement in this area. Conservative = 10%, moderate = 20%, Aggressive = 35%.	4,210	8,430	14,750
Energy supply management	Alternative energy sources could be pursued or subsidized via green tags etc. Reductions are based on 1%, 5%, and 15% offset from alternative energy sources.	420	2,110	6,320
	Total	**5,520**	**12,320**	**24,180**

Figure 16 illustrates the impact that the three target scenarios could have on the water and sewage sector emissions profile. Measures between the low to medium target scenario should be pursued to reduce emissions below the baseline year.

Figure 16. Water and Sewage Emission Reduction Scenarios



General Recommendations

There are many areas in which Durham could make improvements in their water and sewage treatment operations. ICLEI recommends that both the City and County conduct audits of their facilities to determine where opportunities for improvements in efficiency lie. ICLEI also recommends that the County consider biogas capture and use in its sewage treatment facility. Finally the City and County should continue to increase existing and consider new water conservation

public outreach campaigns.

6.3.5 Local Government Waste

Due to methane flaring and carbon sequestration, emissions from government waste resulted in approximately -4 tons of GHG emissions in the baseline year (not including the City of Durham's waste). The City of Durham has successfully implemented a waste reduction policy to promote the purchase of recycled products. Neither the City nor the County have plans for any new measures to reduce government waste for implementation after the baseline year.

Waste from local government operations entering the landfill can be reduced in the following ways:

- Waste reduction programs can be implemented within government buildings. Examples of such programs include: encouraging printing on both sides of a page, supplying mugs and glasses instead of disposable coffee cups and recycling or donating old electronic equipment.
- Diversion of waste from the landfill through a recycling program and supplying recycling bins in all government facilities.
- An organics waste collection program can also be developed for the community and government facilities can be supplied with disposal containers.

Case Study: Government of Ontario Green Workplace Program (GWP)
In 1991, the Government of Ontario, created the Green Workplace Program (GWP). The GWP facilitates waste reduction, resource conservation, and environmentally responsible purchasing in provincial facilities. An integral part of the GWP's waste reduction programs, composting diverted approximately 1,500 metric tons (1,650 U.S. tons) of food discards from landfills in FY96. From all its composting programs combined (in-vessel, on-site, and off-site), the Government of Ontario avoided C$150,000 in trash disposal costs in FY96.

General Recommendations

ICLEI recommends that the County of Durham implement a green purchasing policy and both the City and County examine opportunities to reduce waste production in their facilities. Both the City and County should also ensure that recycling programs are being fully implemented and followed in all facilities by making sure that there are enough recycling bins in all facilities and these bins are clearly labeled.

6.3.6 Schools

Case Study: Peterborough, Ontario
Energy Savers is an energy conservation program delivered by Peterborough Green-Up, in partnership with the local School Board, a local engineering firm and Home Depot. The goal of the Energy Savers program is to provide students, staff and the school board with the knowledge and tools to conserve energy both within the schools and to transfer that knowledge to home energy conservation. There are three main components to the Energy Savers program; the first two are in-school workshops linked to Ontario's curriculum for grade 5 and 6 students focusing on energy conservation in schools and at home. The final part of the program is a professional energy audit and report to school administration with recommendations for energy savings. While there is no obligation to implement the energy conservation recommendations, the suggestions will are often adopted.

Durham Public Schools operations, including buildings and fleets, resulted in approximately 56,510 tons of GHG in the baseline year. This sector is equivalent to roughly 35% of all local government emissions. Measures implemented before the baseline year resulted in approximately 1,210 tons of GHG reductions. These reductions were largely the result of the school bus biodiesel initiative. Measures planned to be implemented in school operations after the baseline year will result in at least 23,600 tons of GHG reductions. These reductions will largely be the result of an energy saving performance contract to retrofit all school buildings, a plan to build all new schools to LEED standards, improved temperature controls in all facilities and a no idling policy for school buses.

Potential reduction measures include:

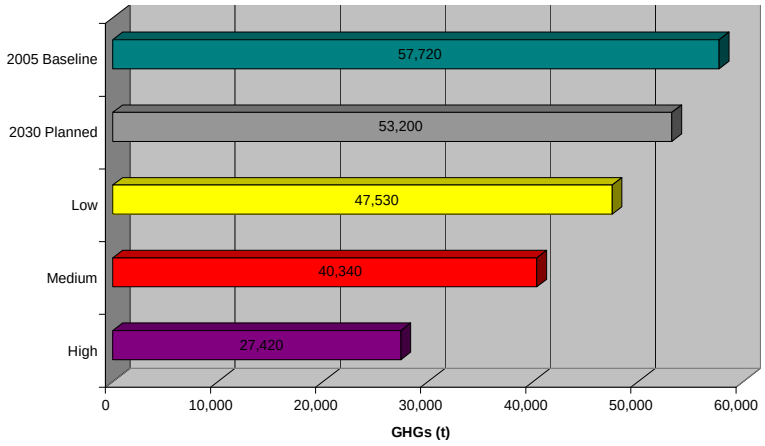
- Building Efficiency (see buildings sector recommendations)
- Fleet Efficiency (see fleet sector recommendations)
- Encourage water and energy conservation both in school an at home through education programs.

Table 33 illustrates the potential impact of various types of measures on the emissions of the school sector. Specific examples of the types of actions that would be required to achieve these emissions reduction levels are included in Appendix K. Figure 17 illustrates the impact of reduction scenarios on the school sector emission profile.

Table 33. Schools Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Building -energy efficiency upgrades	A conservative scenario suggest a 10% reduction in energy and emissions while a typical scenario suggests 20% and an agressive scenario suggestion 35% (same assumptions as in buildings sector)	5,050	10,100	17730
Building - energy supply management	Reductions are based on 1%, 5%, and 15% offset from alternative energy sources. (Same assumptions as in buildings sector)	505	2526	7,577
Fleet - Alternative fuels	Biodiesel is already being used. E85 of 10, 20 and 40% is estimated.	120	240	475
	Total	**5,675**	**12,860**	**25,780**

Figure 17. School Emission Reduction Scenarios



General Recommendations

The schools have made some excellent progress towards reducing their emissions and planning to reduce emissions further. There are however, a few areas in which there is room for improvement. The school board operates approximately 200 vehicles not including school buses. Options to decrease the emissions of these fleets should be examined. The schools should also aim for highest energy efficiency possible when doing retrofits of existing buildings and planning the construction of new buildings. This will result in significant energy and cost savings in the long run. Finally, the school should examine options for the implementation of energy and conservation education programs in all of its schools.

6.4 *Target Recommendations*

6.4.1 Community Target

ICLEI usually recommends that CCP participants adopt a 6% community emissions reduction target; meaning emissions would be reduced by 6% below the baseline year within 10 years, however, given the anticipated growth in emissions between Durham's chosen baseline and target years, this would be extremely difficult and far too unrealistic of a target to set at this point. The three target scenarios that

were developed in this inventory and local action planning process predicted that 2030 emissions could be reduced from forecasted levels to 41% above the baseline (low scenario), 33% above the baseline (medium scenario) and 19% above the baseline (high scenario). Given that the BAU scenario would result in a 50% growth in GHG emissions, and the planned scenario would result in 48% growth in emissions, these scenarios would respectively involve a 7%, 15% or 29% reduction from planned emission levels by 2030.

Figure 18. Community Emission Reduction Scenarios

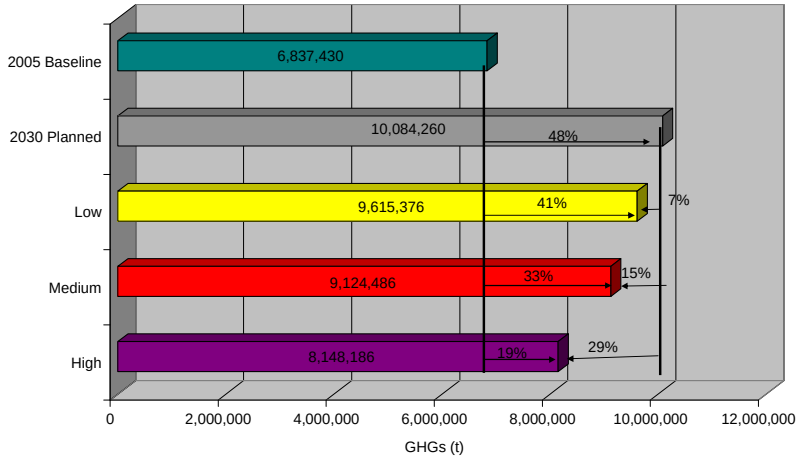


Figure **18** illustrates the three emission reduction scenarios by overall emission reductions.

Although emissions must be reported to the CCP in overall levels, they can also be expressed on a per capita basis. This can be particularly useful for communities such as Durham that will experience rapid overall growth. On a per capita basis, the reduction scenarios would involve a reduction from 28.3 tons per person in the baseline year (31.2 tons per capita in BAU and 30.7 tons per capita in the planned scenario), to 29.2 tons per capita in the low scenario (actually an increase from the baseline), 27.8 tons per capita in the medium scenario and 24.8 tons per capita in the high scenario.

Figure 19. Community GHG Emissions Per Capita

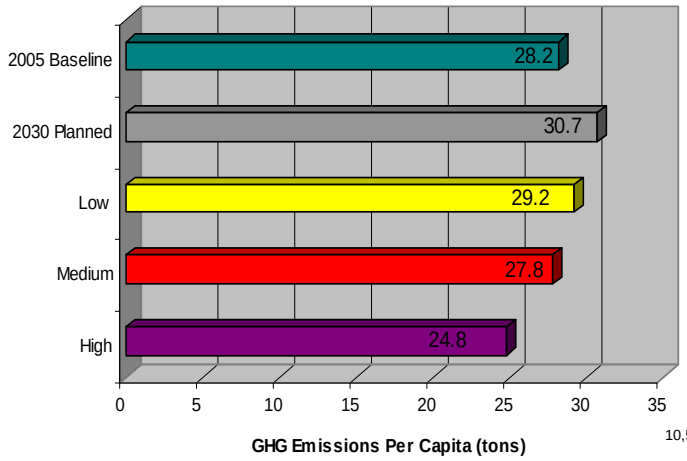
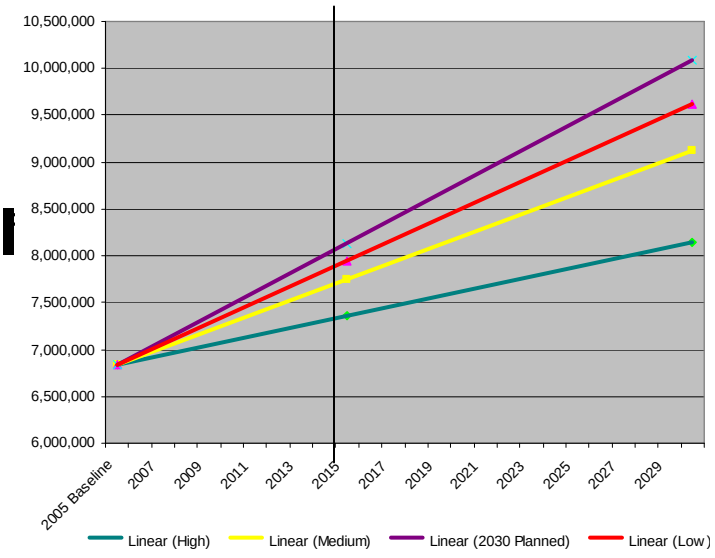


Figure 19 illustrates GHG emissions per capita under the different emission reduction scenarios.

Figure 20. Emissions Growth Scenarios: 2005-2030



ICLEI recommends that the City and County of Durham adopt the medium target scenario, for now, building upon previous successes in GHG reductions in order to meet this target. This target can be reevaluated as progress is achieved in the implementation phase of this program. Since Durham's 2030 target year is so far in the future and there are many unforeseeable factors that may impact the community emission levels, ICLEI recommends that Durham adopt an interim target for the year 2015, to ensure that progress is being made towards the overall target. Figure 20 illustrates the linear growth

patterns for the high, medium, low and planned emission scenarios.

Table 34 contains estimates of where emissions should be by 2015 if Durham is on track to achieving its selected target. In the planned scenario, emissions will increase from 6,837,430 tons in the baseline to approximately 8,136,170 tons of GHG by 2015 (a 19% increase from the baseline). Under the high scenarios, emissions will increase to 7,361,730 tons (a 7.7% increase from the baseline). Under the medium scenario, emissions will increase to approximately 7,752,254 tons by 2015 (a 13.3% increase from the baseline). Under the low scenario, emissions will increase to 7,948,610 tons (a 16.3% increase from the baseline). ICLEI recommends that Durham work towards meeting or exceeding one of these targets by 2015 and then re-evaluating the 2030 target at that point.

Table 34. Growth in Emissions by 2015 under Different Reduction Scenarios

Scenario	2015 Emissions (tons)	Growth from Baseline
Planned	8,136,165	19%
Low	7,948,610	16.3%
Medium	7,752,254	13.3%
High	7,361,734	7.7%

The assessment of historic and existing measures demonstrated that there is a lot of potential for the City and County to engage with the community as there has not been a lot of community-wide coordination of emission reduction efforts to this point. ICLEI has presented many different potential emission reduction measures, however we recommend those sectors and measures with the most potential to reduce emissions be prioritized to help build momentum for the City's local action plan and ensure that the areas with the greatest opportunity for improvement are targeted as soon as possible.

There should be a major focus on retrofitting old buildings and designing new buildings to higher standards, as buildings are the largest source of emissions in Durham. As the largest single sector in the community there should also be a considerable focus on transportation. ICLEI recommends that the City and County address the following three measures first.

- Expand energy conservation measures in the commercial, residential and industrial sectors in both existing and new construction.
- Consider land use planning strategies to avoid transportation emissions related to new development.
- Promote the use of alternative vehicles and fuels in the transportation sector.

6.4.2 Community Speculative Forecast

The community targets included above reflect the emissions reductions that are achievable directly and through the exclusive actions of the local governments in Durham, given current technologies, fuels, energy generation mix, legislation and levels of community engagement. These targets exclude as many factors as possible beyond the control of the local governments and focus on what is achievable exclusively through their actions. This is done so that achievements made through local government programs can be benchmarked, and also so that the selected community target is realistic and achievable. If a target depends upon external factors, it can become impossible to reach. For example, Miami-Dade developed an inventory using 1990 as the baseline year and their reduction target included assumptions about increased vehicle standards. However, since these standards were not met, Miami-Dade did not come close to meeting its reduction target because of the reliance on this one measure beyond the control of the local government. This purpose of the CCP and this report is to determine what is achievable through the commitment and actions of the local government. Therefore, ICLEI's forecasts attempt to isolate all other variable in this equation. Obviously, higher levels of emissions reductions are desirable, and ultimately necessary to avert the more catastrophic impacts of climate change. These higher levels of

reductions can only be achieved if citizens, businesses, utilities, industry and all three levels of government make a concerted effort to reduce our collective carbon footprint.

To attempt to reflect what the cumulative impact of collective action can be on Durham's emissions profile, ICLEI has developed a speculative projection that takes into account current planned emissions reductions on the state and federal level. This projection is extremely speculative, as it depends on projections and commitments made by external stakeholders, however, it can serve as an example to illustrate the level of emissions reductions which could be achieved, given the right combination of factors. This projection is dependant on the full implementation of currently planned programs at the state and federal level. The impact of these programs could be much higher or lower than anticipated, or could be cancelled. New programs could also be developed between now and 2030. This projection also excludes several other factors which could have a contributing effect on Durham's emission profile. As stated above, we have excluded these external factors from our main scenarios in section 6.4.1 since they are so highly variable and are well beyond the control of the local governments.

On the state level, North Carolina's Climate Action Plan Advisory Group (CAPAG) is currently in the process of developing a climate change action plan and has recommended 53 actions that should be taken to reduce greenhouse gas emissions in the state. ICLEI used the estimates of the impact of all of these programs (excluding agricultural and forestry programs since they are not included in Durham's inventory) and used census population data for the State and County to determine approximately what share of these reductions could be applied to Durham. If all the recommendations in CAPAG are implemented, this will reduce Durham's emissions in 2030 by approximately 2,913,520 tons of GHG. A complete list of the 53 recommendations made by CAPAG and the methodology used to calculate its impact in Durham is included in Appendix J.

In February 2002, President Bush committed the United States to a comprehensive strategy to reduce the greenhouse gas intensity of the American economy by 18 percent by 2012 through several programs including research, innovation, regulation and networking. A complete list of the programs in this strategy is included in Appendix J. If this National Goal to Reduce Emission Growth is met, it will prevent the release of approximately 500 million metric tons GHG emissions. For the speculative forecast, ICLEI assumed that this reduction is achieved and sustained until 2030 and applied a per capita share of this to Durham based on census population data. If this reduction in emissions is achieved, this will translate into approximately 484,880 tons of GHG reductions in Durham.

Table 35 illustrates the cumulative impact that local government, state and federal actions can have on Durham's emissions profile under a high, medium and low scenario, or if no action is taken on the part of the local governments. **Error! Reference source not found.** and Figure 22 graphically illustrate the emissions levels if the local governments chose to adopt a medium emission target.

Table 35. Estimated Cumulative Impact of Local Government, State and Federal Actions on Community Emissions Level (tons)

Scenario	Durham (t)	Change from 2005	Durham + NC (t)	Change From 2005	Durham +NC + US (t)	Change from 2005
High	8,148,184	+19%	5,234,662	-23%	4,749,782	-31%
Medium	9,124,484	+33%	6,210,962	-9%	5,726,082	-16%
Low	9,615,374	+41%	6,701,852	-2%	6,216,972	-9%
2030 Planned	10,084,262	+48%	7,170,739	+5%	6,685,859	-2%

Figure 21. Estimated Cumulative Impact of Local Government, State and Federal Actions in Medium Emissions Reduction Scenario

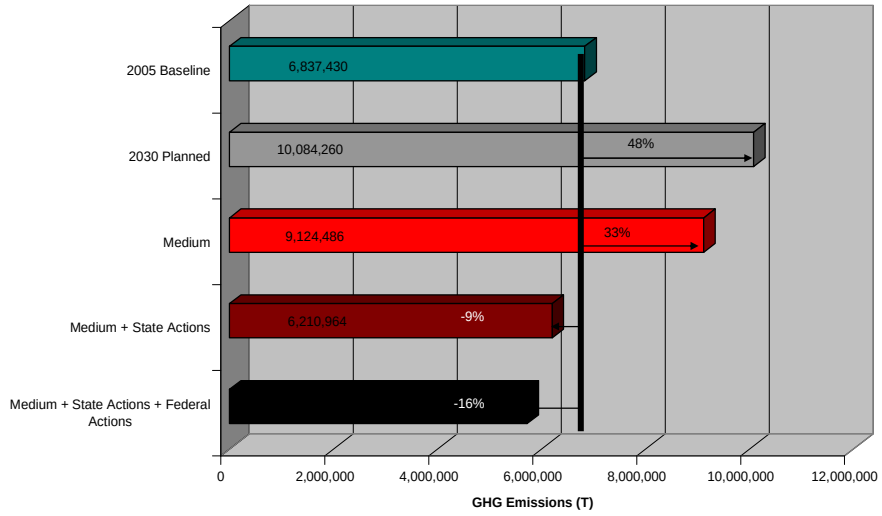
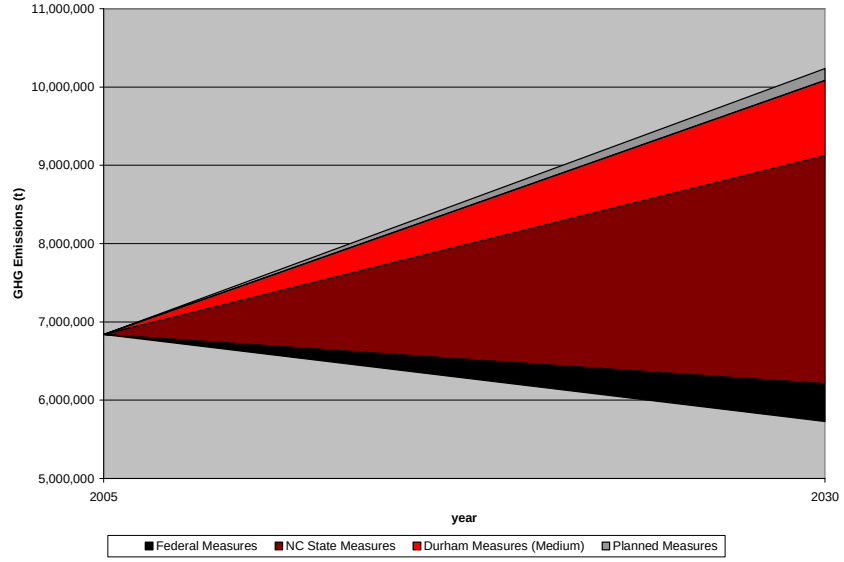


Figure 22. Estimated Cumulative Impact of Local Government (medium scenario), State and Federal Actions

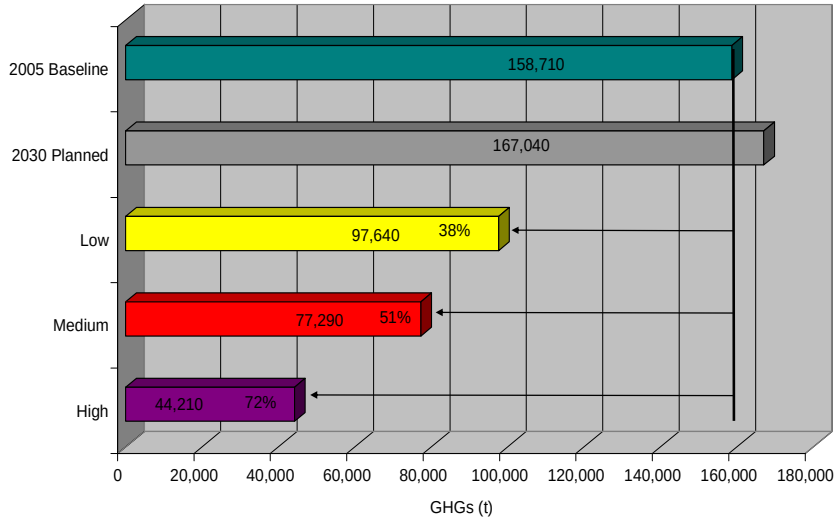


6.4.3 Local Government Target

The emissions profile and forecasts from the City and County operations present a much different picture than the community sector. Although emissions are still expected to grow between 2005 and 2030, the City and County have a lot more potential to manage these emissions. ICLEI typically recommends that CCP members aim for a 20% emissions reduction target within 10 years of joining the program. Since the City and County have opted for a target year further into the future, they are able to set a target that is even more aggressive. The three target scenarios that were developed in this exercise demonstrate that emission could be reduced by 38% in the low scenario, 51% in the medium scenario, and 72% in the high scenario.

Since 2030 is 25 years in the future, it is difficult to predict with much certainty all of the changes that may have implications for emissions between now and then. The City and County operations may change more than anticipated, and new technologies may become available. With this uncertainty, ICLEI recommends that the City and County adopt the low target scenario of 38% below 2005 levels by 2030, but also agree to revisit this commitment periodically in the future to make sure the targets are on track towards meeting the set goals and consider whether or not the emission reductions are achievable.

Figure 23. Local Government Emission Reduction Scenarios



ICLEI recommends that the City and County should immediately target the sectors within local government operations that are the largest sources of emissions, but also have the greatest potential to reduce emissions. The top three emission reduction activities based on our analysis include:

- Expanded energy efficiency improvements in the buildings of both the City and the County.
- New efficiency improvements in both the City and County's water and sewage operations including treatment processes, pumps, motors etc.
- Consider offsetting emissions from buildings, streetlights and water & sewage operations by purchasing green electricity or green tags.

6.5 *Implementation*

The development of a local action plan is a major step toward Durham achieving greenhouse gas emissions mitigation; however, unless the plan is followed by an implementation plan that addresses how the local action plan will be instigated, it will not be successful. The CCP Campaign divides these two steps into Milestones 3 and 4. Milestone 4 involves the implementation of the action plan, as well as the development of a plan for how to go about this implementation. While scope of this study was to address Milestones 1 through 3, the process has led us to some recommendations addressing how the City and County should proceed with implementing their plan.

6.5.1 Departmental Roles & Responsibilities

As separate political entities, the City and County governments have different structures, budgets and responsibilities. However, as they have decided to develop and deliver this program jointly, there needs to be clear delineation of both the City and County's roles and responsibilities in implementing the climate change action plan. Implementing and overseeing the local action plan is going to require staff time from both the City and the County, as it addresses issues that cross the mandates of many City and County departments. The City and County departments that participated in the creation of the plan should continue to play an active role in the monitoring and implementation of the plan. Tracking and reporting of relevant data will be necessary to produce annual reports and plan updates. In addition, the

departments will need to identify opportunities to implement the plan and include this in their annual work programs and budgets. The implementation plan should contain estimates of how staff time will be divided within departments and between the two governments.

In order for the action plan to be successful, programs and efforts need to be coordinated across departments and between the two local governments. The City and County should jointly fund a sustainability coordinator staff position to fulfill this role and ensure that progress is being made overall. The sustainability coordinator would organize the work of City and County departments, monitor progress, update the inventory and provide regular plan updates to the City Council and County Commissioners. This person will ensure that the experiences, successes and failures of both governments are shared with one another. The sustainability coordinator would also pursue grants and funding to implement the plan. In addition, the new position would coordinate community outreach and educational programs and work with citizens in identifying and pursuing new incentive programs, regulations, and policies to implement the plan.

The vision statement of the city of Durham states that: "Durham will be North Carolina's leading City in providing an excellent and sustainable quality of life." Through the implementation of this action plan, this commitment to sustainability should become integrated into the everyday decision-making process of the City and County departments and councils. Each department should be required to set sustainability and energy efficiency goals on an annual basis (for example, as part of their annual work plan). This will save money and resources in the long run and should be seen as efficiency in government. Energy efficiency and other sustainability measures should become evaluative criteria in work plans, budget requests, tenders, construction contracts and other contracts and proposals. A green purchasing policy should be developed to guide these purchasing decisions.

6.5.2 Leadership & Partnerships

The City and County have a very important leadership role to play within the community. The City has voluntarily signed-on to a program (CCP) that is geared towards reducing emissions not only within local government operations, but in the community-at-large. Durham County should also join the CCP in order to receive support from ICLEI. The City and County are well positioned to reduce their own emissions, but their sphere of influence is much less when it comes to community emissions. This is where their leadership role becomes very important. As the level of government closest to their citizens, the City and County have the ability to influence the community the way no other government bodies can.

Partnerships will become a very important component of the community implementation strategy. Through the development of this inventory and action plan, the City and County of Durham have already formed a partnership that should be maintained through the implementation of the action plan. Through this partnership, the City and County can learn from one another and can reach a broader public audience by creating a unified message and shared outreach programs. Partnerships with state and national governments will enable access to programs and funding arrangements and can help the local governments influence policy at a state and national level. Partnerships with major institutions and business groups will improve the efficiency with which the commercial sector is approached. Partnerships with local environmental groups and community groups will help the City and County to connect with engaged citizens. Partnerships will ensure that the broader Durham community builds a sense of ownership over the local action plan and start to champion it in their own right.

6.5.3 Timelines

Timelines should be developed to guide the implementation of the local action plan over the next 25 years. Certain recommendations contained within the local action plan could be implemented in a fairly short period of time, for example, water and sewage treatment operations could be retrofitted within a

year. Other recommendations however, will need to be spaced out over time, such as land-use planning strategies, comprehensive building upgrades and public education programs. The implementation plan should contain specific timelines for the implementation of the various measures that will be adopted in the short-term and long-term to ensure that there is enough time to complete them before the target year is reached. The timeline should also take into account updates to the inventory and interim reduction targets to measure progress towards reaching the target year.

6.5.4 Monitoring & Verification

Monitoring and verification is the Fifth Milestone of the CCP Campaign. We recommend the City and County also begin to consider how they will monitor their local action plan at this early stage.

- Now that the method for completing an inventory has been applied once, it should be fairly easy to complete another inventory at a later stage. ICLEI recommends that new inventories be completed every five years. This enables the City and County to assess if their growth projections were correct and if emission reductions are being achieved as planned. With this new knowledge, the emissions targets can be reassessed and updated as needed.
- Information about the measures that are implemented should be documented for future reference and reporting. Not only is this simply good management practice, but it can also be very helpful in reporting successes back to funders or in applying for new funds. For instance, what was the cost of the measure, when was it implemented, who was involved, were there tangible indicates of success such as number of participants, number of units services, kWh of electricity reduction. This type of information was collected for the historical and existing measures analysis which will be given to the City and County.
- Council should be updated on the progress of the local action plan at regular intervals. It is important that they are aware the climate mitigation activity, as they can often be the biggest advocates in the community and their support is fundamental to the success of the plan.

6.5.5 Financing

Cities have various financing options available for emission reduction projects. Some of the most popular and successful financing mechanisms include: grants, revolving funds and performance contracts because none of these options rely on capital funding. The City and County will also need to dig into their own resources to a certain degree if they wish to accomplish all of the recommendations contained in the local action plan, however, the options described below can help to lighten the burden.

Grants:

There are various grants available to cities for environmental projects at the federal and state level. The best and most up-to-date sources of information for current grant opportunities are granting agency websites. Some examples of these grants and grant sources are summarized below.

EPA Grants

- Many of the EPA's current grants can be found on the federal government site: www.grants.gov.
- The EPA also awards ongoing Environmental Education Grants (mostly under $15,000): www.epa.gov/enviroed/grants.html.
- The EPA also has a list of their water quality related grants on their website: www.epa.gov/water/funding.html. Although these grants are not explicitly for climate change or air quality programs, water quality projects often have these co-benefits.

U.S. Department of Energy

- The DOE offers several grants and incentives for the use of renewable energy and energy efficient technologies through their office of Energy Efficiency and Renewable Energy: www1.eere.energy.gov/financing/.

U.S. Department of Transportation

- The DOT offers several financing options for transportation infrastructure projects such as the Congestion Mitigation and Air Quality Improvement Program (CMAQ): www.fhwa.dot.gov/environment/cmaqpgs/.
- More information on their other programs can be found on their website at: www.dot.gov/Government_Services.htm.

NCDOT/DCHC MPO

- The NC DOT has various programs to promote alternative modes of transportation. Information can be found at: www.ncdot.org/programs/.
- Communities can bid for funding for bicycle, pedestrian or environmental programs under the STP-DA and Transportation Enhancement Program: www.ncdot.org/financial/fiscal/Enhancement/ProgramInformation/Eligibility/#QUALIFYING.
- The DCHC MPO works with NCDOT to construct bicycle, pedestrian, and transit facilities on many projects. The City and County should continue to work with DCHC MPO and NCDOT on the programming of these facilities.

NCDAQ

- The NC Department of Environment and Natural Resources, Division of Air Quality provides grants for programs that will reduce emissions through their Mobile Source Emissions Reduction Grants. Information can be found at: daq.state.nc.us/motor/ms_grants/

U.S. Conference of Mayors

- On January 25th, 2007, the US Conference of Mayor called on the federal government to grant $4 billion to cities for energy and environmental programs to help combat climate change. Although this grant has not yet been awarded, this story is worth following. Information can be found at: usmayors.org/75thWinterMeeting/eebg_012507.pdf

Revolving Funds:

A city can establish a permanent revolving fund to finance energy efficiency and greening programs. A revolving fund operates by financing new projects with the savings achieved through older programs. In this way, energy efficiency savings can finance other environmental programs. For example, revenues from increased parking fees can be reinvested in other green initiatives such as bicycle infrastructure or revenues from energy efficient lighting retrofitting, can be reinvested into a community outreach program on lighting efficiency. By establishing a revolving fund for environmental programs, a city can keep the costs and savings from environmental programs independent of the capital budget.

Performance Contracts:

Local governments can avoid the upfront costs of energy retrofitting and reap the benefits in the long run by entering into an energy saving performance contracts with an energy service company. Through this contract, the contractor conducts an energy audit of` government facilities and identifies opportunities for energy savings, estimating the cost and savings of the retrofits. The contractor then conducts the retrofit, at no cost to the local government and then recovers its costs by receiving a percentage of the energy cost savings over a specified period of time. Due to the tremendous amount of cost-savings potential in most buildings, payback periods for are usually between two and ten years. Upon completion of the contract, the city owns a more efficient building that costs much less to operate and has a much higher value.

More information on these, and other financing mechanisms can be found in the EPA document entitled

"A State and Local Government Guide to Environmental Program Funding Alternatives" http://www.epa.gov/owow/nps/MMGI/funding.htm.

Deep Retrofit Approach:

A question that municipalities are often faced with is how to prioritize which retrofits to undertake first. It is often tempting to pick the 'low-hanging fruit' with quick payback periods first, however, this approach is considered by some to be 'cream skimming' and can make it more difficult to perform comprehensive retrofits in the future. Often the measures that produce the greatest energy savings are those measures with longer payback periods. If these measures are left until the end, their long payback period often acts as a major obstacle to implementation. Therefore, it is more beneficial in the long run to take a more comprehensive 'deep retrofit' approach through packaging fast payback retrofits with longer payback ones so that the overall payback of the retrofits is medium-term and greater energy and cost savings overall are achieved.

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8 Appendix A: Technical Team and Advisory Committee Members

9 Appendix B: Material Waste Stream Distributions

Table 36. US Environmental Protection Agency Municipal Solid Waste Material Distribution

Material	Weight Generated	Weight Recovered	Recovery (% of Generation)	Total Discards	Discarded Materials (% of Total Discards)
Paper and paperboard	83.1	40.0	48.1%	43.1	26.3%
Glass	12.5	2.35	18.8%	10.2	6.2%
Metals					
Steel	14.0	5.09	36.4%	8.9	5.4%
Aluminum	3.23	0.69	21.4%	2.5	1.5%
Other nonferrous metals*	1.59	1.06	66.7%	0.5	0.3%
Total metals	**18.8**	**6.84**	**36.3%**	**12.0**	**7.3%**
Plastics	26.7	1.39	5.2%	25.3	15.4%
Rubber and leather	6.82	1.10	16.1%	5.7	3.5%
Textiles	10.6	1.52	14.4%	9.1	5.5%
Wood	13.6	1.28	9.4%	12.3	7.5%
Other materials	4.32	0.98	22.7%	3.3	2.0%
Total Materials in Products	**176.4**	**55.4**	**31.4%**	**121.0**	**73.8%**
Other wastes					
Food, other**	27.6	0.75	2.7%	26.9	16.4%
Yard trimmings	28.6	16.1	56.3%	12.5	7.6%
Miscellaneous Inorganic wastes	3.62	Neg.	Neg.	3.62	2.2%
Total Other Wastes	**59.8**	**16.9**	**28.2%**	**42.9**	**26.2%**
Total Municipal Solid Waste	236.2	72.3	30.6%	163.9	100.0%

Table 37. Orange County Construction & Demolition Waste: Material Waste Stream Distribution (based on audits completed in 1995, 2000 and 2005)

Material	Percent of Total Waste Stream
Clean Lumber	14%
Plywood	8%
Painted, Treated Wood	5%
Pallets	3%
Dirt, Rocks & Stumps	20%
Brick, Concrete & Block	20%
Drywall	8%
Asphalt Shingles	7%
Scrap Metal	4%
Paper & Textiles	3%
Furniture & Cabinetry	2%
Plastics	1%
Other	5%

10 Appendix C: Inputs Used in EPA's NONROAD Model

Average Temperature in Durham County

Data contained within the table below was obtained from the State Climate Office of North Carolina's Climate Retrieval and Observations Network of the Southeast Database (CRONOS). Temperatures are based on observations at the Durham Station, ID 312515.

Table 38. Average Temperature in Durham County

Season	Minimum Temperature (F)	Maximum Temperature (F)	Average Temperature (F)
Winter: Jan/Feb/Dec	29.2	51.8	40.5
Spring: Mar/Apr/May	46.1	70.7	58.4
Summer: Jun/Jul/Aug	67.8	86.8	77.3
Autumn: Sep/Oct/Nov	48.1	71.5	59.8

Staff within the North Carolina Department of Environment and Natural Resources (NC DENR) Division of Air Quality provided fuel characteristics for 2002 and 2017. NC DENR used the characteristics provided in the table below to estimate emissions produced by off-road engines in Durham County. In their model run, NC DENR used the default values for engine populations, size and etc., contained within the model. NC DENR also applied the default value of 0.0 for Stage II control. ICLEI applied the 2002 fuel characteristics to the 2005 emission period and the 2017 fuel characteristics to the 2030 emission period. ICLEI assumed marine diesel sulfur content of 0.0015 in 2030 and applied the spring, autumn and winter 2002 fuel RVP values to the correlating 2030 seasons.

Table 39. Fuel Characteristics for Durham County

	Fuel RVP	Oxygen Weight (%)	Gas Sulfur (%)	Diesel Sulfur (%)	Marine Diesel Sulfur (%)	CNG/LPG Sulfur (%)
2002						
Spring	12.27	0	0.003	0.0348	0.0408	0.003
Summer	7.8	0	0.003	0.0348	0.0408	0.003
Autumn	12.27	0	0.003	0.0348	0.0408	0.003
Winter	14.5	0	0.003	0.0348	0.0408	0.003
2017						
Summer	7.8	0	0.003	0.0015	NA	0.003

11 Appendix D: Off-Road Emissions Analysis

ICLEI used the EPA's NONROAD model to estimate emissions produced by fuel burned in off-road engines within Durham County. Appendix D provides an estimate of the air pollutants and greenhouse gas emissions generated by off-road engines in Durham County. It should be noted that the Cities for Climate Protection (CCP) does not require communities to include emissions produced by off-road engines in their emission reduction efforts because of the challenges associated with collecting accurate data on the use of these engines.

Table 40. Off-Road Engine 2005: CAP & GHG Emissions Estimated Using EPA NONROAD Model

	Total Energy (MMBtu)	NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Off-Road Engines		2,093	31	19,332	1,378	161	199,008

12 Appendix E: Data Providers and Sources

Table 41. Sources of Data for Community Greenhouse Inventory

Sector	Source (Contact/ Title/Department)	Organization	Data provided
Transportation	Ellen Beckmann, Transportation Planner	DCHC MPO	Average daily VMT 2005 and 2030
RCI	Laura Dale Woods, Senior Planner, Planning Department	City of Durham	Population, Household, Employment for 2005/2030
RCI	Davis Montgomery, Customer Relations	Duke Energy	Electricity consumption
RCI	Robin Blanton, Manager of Engineering	Piedmont EMC	Electricity consumption
RCI		Wake EMC	Electricity consumption
RCI	Jerry O'Keeffe, Manager - Large Accounts, Raleigh & Durham Regions	PSNC Energy	Natural Gas Consumption
Solid Waste	Julia Mullen, Program Analyst, Department of SW Management	City of Durham	SW Generation, Diversion Initiatives, Forecast data
Solid Waste	Jim Hickman, Local Government Assistance Team Leader	NC Division Of Pollution Prevention and Environmental Assistance	Solid Waste Generation
Off-road Engines	Matthew Mahler, Environmental Engineer	NC DENR Division of Air Quality	Fuel sulfur content and RVP for 2002 and 2017 for NONROAD model

Table 42. Sources of Data Compiled for Local Government Operations Inventory & Forecast

Area of Operations	Source (Contact/ Title/Department)	Organization	Data Provided
Buildings	Michael Turner	Durham County	Energy consumption and cost for County buildings
Buildings	Youssef Hammad	City of Durham	Access to City's gas bills
Buildings	Glen Whistler	Durham County	New buildings
Buildings	Ken Kernodle, Customer Relations	Duke Energy	Electricity consumption and costs in City-owned facilities
Vehicle Fleet	Jacqueline Boyce, Purchasing Division Manager	Durham County	Fuel use and costs per vehicle
Vehicle Fleet	Tina Carden	City of Durham	Fuel use and costs per vehicle; gross vehicle weight
Street, Traffic and Other Outdoor Lights	Philip Loziuk	City of Durham	Estimate of number and wattage of lights and annual new lights
Street, Traffic and Other Outdoor Lights	Terry Thompson	City of Durham	Electricity costs for streetlights operated by City; number and type of lights in place in 2005; estimate of annual new light installations
Water & Sewage	Nancy Newell	City of Durham	Energy consumption & costs for water and wastewater treatment, indicators, energy cost and consumption in admin. buildings
Water & Sewage	Glen Whisler	Durham County	Energy consumption and costs for TWWTP, vehicle fleet info and measures
Local Government Solid Waste	Michael Turner	Durham County	Tons of solid waste produced by County's operations

13 Appendix F: 2004/05 Energy Use & Costs by Individual Buildings

Table 43. City of Durham Buildings: 2005 Energy Consumption, Costs and Building Size

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf)
000 G T JONES DURHAM	79	0	268.80	0.00	
100 CORCORAN ST	18	0	23.51	0.00	
1911 E CLUB BLVD	1,743	0	300.07	0.00	
2 Third Fork Rd	0	5,602	0.00	6,548.47	
200 N MANGUM	26	0	133.05	0.00	
2007 HILLOCK PLACE	83,904	0	6,547.70	0.00	
2100 W CLUB BLVD	6	0	131.14	0.00	
2117 CAMDEN AV	58,960	0	6,059.58	0.00	
2309 HAVENTREE RD	6,528	0	765.42	0.00	
3 Third Fork Rd	0	1,889	0.00	2,292.80	
300 W CLUB DURHAM	2	0	65.47	0.00	
3510 SANDY CREEK RD	57	0	136.10	0.00	
3617 WESTOVER RD #6	8,126	0	920.81	0.00	
3727 FAYETTEVILLE ST	10,998	0	3,562.64	0.00	290
400 COMMONWEALTH	8,765	0	967.52	0.00	
400 US 70	14	0	131.92	0.00	
4600 FAYETTEVILLE ST	1,045	0	232.20	0.00	
5 Third Fork Rd,	0	6,973	0.00	8,034.46	
502 FOSTER ST	320	0	984.00	0.00	
7615 CASSEM RD BTNER	29,296	0	2,959.75	0.00	
8 SUMNER CIR	28,966	0	2,923.84	0.00	
8400 NC 751	148,224	0	11,095.87	0.00	
917 E NC 54	82,380	0	6,068.43	0.00	
ALSTON AV & GILBERT	46,243	0	4,002.54	0.00	
ALSTON AV DURHAM	38,245	0	3,478.30	0.00	
ARMORY	208,560	7,640	14,689.60	8,856.98	
BEECHWOOD CTERY	4,338	0	552.43	0.00	
BELLEVUE AV DURHAM	1,277	0	243.87	0.00	
BRITT ST DURHAM	21,420	0	2,675.04	0.00	
BURTON PARK	667	110	97.51	171.71	
CAMPUS HILLS	725,376	27,557	37,523.00	31,484.86	
CASSEM RD BUTNER	21,559	0	2,222.92	0.00	
CITY HALL	5,900,700	0	282,850.15	0.00	126.5
COMM BLDG #1 & #2	156,480	0	10,302.86	0.00	0.3
CORNER PARRISH & MANGUM	0	0	130.56	0.00	
DUKE PARK	11,928	2,138	1,690.36	2,760.00	
DURHAM ARTS COUNCIL	79,104	0	7,710.30	0.00	
ATHLETIC PARK	2,572	127	2,794.00	139.00	

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf)
BULLS ATHLETIC PARK	2,140,416	47,014	151,624.24	51,409.64	40
E.D. MICKLE COMM CTR	19,807	0	2,056.80	0.00	3.7
E DURHAM COMM CTR	25,130	1,753	2,500.13	2,186.57	3.65
EAST END PARK	29,710	1,775	2,948.66	2,209.21	
EDISON JOHNSON COMMUNITY CENTER	803,060	32,062	49,674.85	35,611.19	22.555
ELMIRA PARK	26,700	0	3,020.41	0.00	
ENGINEERING OPS CTR	15,936	0	2,433.15	0.00	1.568
FARRINGTON RR6B138 CHAPEL HILL	154	0	145.55	0.00	
FIRE ADMIN & TRAINING	272,276	13,416	19,499.14	15,788.52	11.4
FIRE STATION #1	0	6,013	0.00	6,948.20	18
FIRE STATION #2	125,840	7,083	7,064.55	8,157.79	10.762
FIRE STATION #3	63,120	3,639	5,051.61	4,301.13	6.5
FIRE STATION #4	70,520	2,506	4,276.16	3,028.26	6.5
FIRE STATION #5	74,360	2,320	4,731.36	2,801.10	5.35
FIRE STATION #6	69,496	3,884	4,470.72	4,590.45	5.626
FIRE STATION #7	71,030	3,282	4,565.48	3,911.90	4.43
FIRE STATION #9	46,405	2,116	3,606.60	2,587.44	2.4
FIRE STATION #10	55,360	2,538	4,642.25	3,078.57	2.555
FIRE STATION #11	69,240	0	4,387.97	0.00	5.328
FIRE STATION #12	58,240	3,180	3,883.92	3,801.08	5.328
FIRE STATION #13	65,120	2,859	5,157.19	3,431.75	6.5
FIRE STATION #14	65,800	2,651	5,193.08	3,194.93	6.5
FLEET MAINT. BUILDING	766,500	33,135	46,071.88	36,690.14	37.7
FOREST HILLS CLUBHOUSE & OFFICES	44,218	5,503	4,335.69	6,410.00	4.3
GENERAL SERVICES	737,520	15,404	45,629.81	17,477.46	53
GUESS RD DURHAM	11,469	0	1,376.49	0.00	
HILLANDALE & I85 S	102	0	42.56	0.00	
HILLSIDE PARK	36,276	0	2,742.85	0.00	
I85 & ROXBORO	118	0	142.05	0.00	
INTERIM TRAIN STATION	36,440	0	3,468.29	0.00	0.95
LEIGH FARM RD RENTAL	11,300	0	1,229.49	0.00	
LONG MEADOW PARK	36,987	0	4,426.25	0.00	
LYON PARK	724,389	749	47,354.00	1,020.35	3.603
MANGUM & MORGAN ST	13,622	0	1,393.15	0.00	
MAPLEWOOD CTRY OFF	26,808	0	3,023.82	0.00	1.156
MORREENE RD PARK	42,660	1,209	4,228.00	1,560.92	2.9
N ALSTON AVE DURHAM	0	0	130.56	0.00	
OLD FIRE STATION #3	51,856	2,601	3,831.30	3,133.49	5.6
OLD OXFORD HWY	34,432	0	3,609.63	0.00	
OREGON ST DURHAM	30,528	0	3,467.74	0.00	
PARKS & REC OFFICE	364,480	6,869	20,672.83	7,710.16	16.796
PINEYWOOD PARK	40,896	0	5,965.76	0.00	

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf)
PLANNING	0	56,727	0.00	61,264.77	
POLICE CRIME LAB	174,946	1,774	11,305.19	2,201.26	14.4
POLICE HQ	2,085,000	31,844	104,003.95	35,419.12	75.629
POLICE SATELITE FCTY	64,410	1,395	5,119.71	1,779.13	
POLICE SELECT ENFORCEMENT	15,560	219	1,643.77	383.37	14.375
POLICE SUBSTATION	214,040	0	13,732.86	0.00	
PUBLIC WRKS FACILITY	0	252	0.00	433.27	
RECREATION CENTER	107,000	0	8,793.18	0.00	10.443
RENTAL HOUSE	22,469	0	2,315.68	0.00	
ROCK QUARRY PARK	35,018	0	5,819.47	0.00	
ROXBORO RD DURHAM	0	0	196.80	0.00	
S ALSTON & SHERMAN	8,240	0	1,164.70	0.00	
SHERWOOD PARK	500	0	451.38	0.00	
SIGNAL SIGN SHOP	80,534	3,472	5,970.96	4,145.25	
SOLID WASTE OPR/MGMT BLDG	821,832	29,317	51,833.87	30,804.63	36.5
SOLID WASTE OPS CTR	0	9,837	0.00	11,157.82	
S BOUNDARIES PARK	113,980	0	9,899.95	0.00	
ST MARKS RD #19	16,188	0	1,704.83	0.00	
STALLINGS RD DURHAM	21,760	0	1,871.65	0.00	
STALLINGS RD L#4	461,440	0	33,081.55	0.00	
TRAFFIC SIGNAL SHOP	9,396	1,056	1,044.00	1,369.91	
VALLEY SPRINGS PARK	61,010	0	9,229.59	0.00	
W.D. HILL REC CENTER	312,800	6,442	18,714.00	7,462.67	17.76
W.I. PATTERSON	31,280	1,661	3,013.24	2,050.85	
WALLTOWN	12,537	1,072	1,349.78	1,391.00	2.6
WATER & SEWER MAINTENANCE OFFICE	50	0	135.44	0.00	
WEAVER ST. CENTER	0	6,839	0.00	7,889.26	
W POINT ON ENO PARK	67,939	0	6,999.38	0.00	
WEYBURN AVE DURHAM	5,723	0	687.12	0.00	
WRIGHT'S PROPERTY	10,212	0	1,123.68	0.00	8.8
Total	**19,624,693**	**407,504**	**1,211,317.48**	**459,080.84**	

Table 44. Durham County Buildings: 2005 Energy Consumption, Costs and Building Size

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf)
Administrative Complex	2,445,640	0	122,282.00	0.00	109.136
Adult Probation	334,150	0	20,049.00	0.00	11.05
Animal Control	34,081	0	3,374.00	0.00	3
Animal Shelter	269,772	53,369	15,377.00	35,117.00	22.968
Bahama Container Site	15,350	0	2,149.00	0.00	
Bragtown Branch Library	52,450	0	3,147.00	0.00	1

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf)
Carmichael Building	1,734,450	41,453	104,067.00	28,437.00	114.226
Community Shelter	277,617	17,299	16,657.00	11,383.00	17.816
Cooperative Extension	185,213	8,915	11,298.00	6,285.00	16.772
Criminal Justice Res Ctr	104,317	0	6,259.00	0.00	10.531
Detention Facility	7,545,870	743,113	347,110.00	164,228.00	290,919
Eastern Satellite Station	36,701	1,406	3,193.00	1,292.00	3.038
Eligibility Building	13,299	0	1,024.00	0.00	28.358
EMS Holloway (Station 4)	37,736	2,415	3,283.00	1,995.00	1.856
EMS Lebanon (Station 6)	75,738	3,716	7,801.00	2,813.00	7.805
EMS Stadium Dr. (Base)	205,817	0	12,349.00	0.00	10.37
Fire Marshal's Office	74,197	3,020	5,268.00	2,434.00	2.915
General Services Cplx	205,527	7,591	11,304.00	5,625.00	10.387
Health Department	2,549,306	199	124,916.00	140.00	73
Hwy 55 Container Site	32,867	0	1,972.00	0.00	
Jail Annex	300,242	14,691	18,615.00	10,137.00	38.385
Judicial Building (+prkn)	3,689,380	38,563	184,469.00	25,606.00	141.562
Judicial Building Annex	996,533	0	59,792.00	0.00	25.692
Law Building	90,400	0	5,424.00	0.00	12.364
Main Library	1,847,511	13,578	83,138.00	8,934.00	65
Memorial Stadium	148,887	1,859	7,891.00	1,223.00	
N Durham Branch Library	138,817	0	8,329.00	0.00	9.764
North Satellite Station	30,683	0	1,841.00	0.00	2.946
Parkwood Branch Library	126,541	3,455	9,364.00	3,973.00	9.871
Redwood Container Site	7,732	0	1,214.00	0.00	
Rougemont Cont. Site	14,857	0	1,144.00	0.00	
Sheriff's Firing Range	5,280	0	1,130.00	0.00	1.5
Social Service Building	796,052	78,340	46,171.00	50,294.00	43.776
Southwest Branch Library	127,750	1,978	8,176.00	1,598.00	10.448
Stanford L. Warren Libry	131,033	2,276	7,862.00	1,627.00	7.245
Whitted School	234,333	47,129	16,169.00	35,818.00	98.379
Youth Home	204,660	9,080	10,847.00	6,683.00	10.325
Total	**12,034,144**	**225,473**	**$635,186.00**	**$156,905.00**	**581.73**

Table 45. School Board Buildings: FY2004-2005 Energy Consumption, Cost and Building Size

Building	Energy Use		Energy Cost		
	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf.)
Bacon Street	867,128	14,574	65,460.83	16,265.94	85.75
Bethesda	1,019,400	13,235	65,804.23	15,110.95	71.36
Brogden	579,907	9,589	46,477.26	11,155.39	45.09
Burton	510,600	9,484	32,863.83	10,505.66	80.14
C.C. Spaulding	887,904	13,691	61,640.91	15,240.02	71.17
Carrington	1,016,400	15,060	67,720.33	17,136.47	78
Chewning	810,799	26,714	61,436.47	30,005.50	88.55
Club Blvd	529,555	34,186	40,953.74	37,785.50	53.49
Creekside	1,049,536	12,708	74,093.69	14,456.53	85.89

	Energy Use		Energy Cost		
Building	Electricity (kWh)	Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s sf.)
DSA	1,039,213	16,359	74,400.67	16,358.88	80.3
E.K. Powe	735,255	13,032	52,074.41	14,997.82	66.9
Easley	1,098,816	12,476	75,083.49	14,152.99	85.89
Eastway	1,262,976	18,377	83,551.35	22,798.92	98,208
Eno Valley	771,300	10,698	59,568.21	12,166.28	79.23
Fayetteville St.	610,736	15,580	42,898.06	17,405.51	61.53
Forest View	1,168,685	16,307	84,271.04	18,410.10	83.62
Fuller Bldg	416,711	0	39,410.96	0.00	47.1
George Watts	1,050,586	18,702	74,444.18	21,310.74	103.08
Githens	282,787	21,668	23,364.42	28,357.13	33.52
Glenn	1,505,008	14,640	99,427.86	19,053.02	96.38
Hamlin W/house	1,283,016	18,489	94,080.72	21,129.53	80.34
Hillandale	733,858	21,869	50,766.52	25,062.71	54.06
Hillside	1,276,246	20,358	89,971.14	23,017.37	100.79
Holt	879,554	15,816	64,850.23	18,240.27	99.38
Hope Valley	685,615	2,577	49,695.89	2,986.11	46.31
Jordan	1,165,858	7,241	81,519.86	8,346.81	91.17
Lakeview	600,754	10,620	43,337.66	12,619.55	47.54
Lakewood	925,875	9,442	61,311.11	10,803.08	65.84
Little River	1,360,312	40,558	96,705.17	44,712.33	176.86
Lowe's Grove	2,040,454	52,358	145,167.11	57,057.29	163.07
Maintenance	1,863,024	29,107	138,419.52	32,325.22	125
Mangum	2,208,210	32,562	138,614.66	36,441.55	133
Merrick-Moore	1,600,267	29,834	120,369.70	33,815.35	125
Morehead	1,128,354	45,225	79,110.38	50,046.68	130
Morris Street	1,311,783	21,319	95,792.21	24,398.15	122.55
Neal	322,353	19,995	29,666.11	22,681.73	73.86
Northern	300,134	9,638	23,399.23	10,989.81	
Oak Grove	2,539,781	77,986	177,539.37	87,369.95	310.44
Parkwood	4,159,360	37,763	265,618.30	40,551.03	290
Pearsontown	3,041,359	37,616	214,049.71	45,602.44	262
Proctor House	3,142,073	71,358	230,717.54	77,866.23	256.99
R.N. Harris	2,969,481	50,716	321,926.86	55,379.11	277.75
Riverside	3,507,781	53,735	230,441.45	58,850.45	284
Rogers-Herr	910,566	15,188	51,757.31	17,192.96	94.78
Shepard	735,067	3,687	48,432.13	4,669.81	54.67
Southern	363,372	11,122	24,926.56	16,399.68	43
Southwest	312,337	13,594	24,106.89	15,563.78	19.46
Staff Devel Ctr	224,187	6,806	15,881.31	8,160.96	14.41
Transportation	36,558		2,697.63		3.2
W.G. Pearson	255,918	8,012	19,201.59	14,190.87	35.44
Y.E. Smith	376,824	17,039	30,316.90	21,310.10	16.88
Total	**59,473,633**	**1,098,710**	**4,285,336.71**	**1,250,454.26**	**5,092.96**

14 Appendix G: Changes to Building Tenure (Fiscal Year 2005 through 2030)

Table 46. Changes to Building Tenure in Durham 2005-2030

Building Name/ Address	Change to Size/ Tenure	Area (sf)	Estimated Electricity (kWh)	Estimated Natural Gas (therms)	Jurisdiction
Campus Hills Park & Recreation Centre	Addition of weight room	1,300 (weight room) 100 (office/ storage)	22,000	51,000	City of Durham
Environmental Education Center	Construct an Environmental Education Center with classroom and meeting space. Initial site selection is West Point on the Eno Park, but Sandy Creek Park is also possible.	Not funded or designed at this time	NA	NA	City of Durham
Leigh Farm Historic Site Renovation, Phase II	Historically-accurate restoration of the National Register Property Leigh Farm, including the 1832 house and buildings as a Rural Life Educational Center and creating a small visitor center.	No new facilities. Current energy costs to be assumed by City.	NA	NA	City of Durham
NECD Recreation Center	This project includes the purchase and renovation of the Holton Middle School site as a full-service recreation center with gym. This is a City, County & DPS partnership; DPS will manage it.	30,000 sq ft DPS space, 35,000 shared space. No decisions yet on cost sharing.	1,007,500	1,911,000	City of Durham, Durham County and Durham Public Schools
New Park - SE Durham	Request is for acquisition of a parcel adequate for a community park (min 20 acres) in SE Durham to be developed with amenities and athletic fields.	Funding for land acquisition only at this time	NA	NA	City of Durham
Northern Athletic Park	This project designs and develops an eight-field athletic complex north of Snow Hill Road, with utilities and parking to be shared with proposed adjacent middle school.	Not funded nor designed at this time	NA	NA	City of Durham
Southwest Durham Recreation Center	Design and construction of a full-service rec center (pool and gym) to serve SW Durham.	Not funded or designed at this time	NA	NA	City of Durham
Durham Performing Arts Center	Design and construction of a new 2,800 seat theatre for major concerts, plays and the American Dance Festival.	100,000	970,000	3,579,000	City of Durham

Building Name/ Address	Change to Size/ Tenure	Area (sf)	Estimated Electricity (kWh)	Estimated Natural Gas (therms)	Jurisdiction
City Hall Annex Major Renovation	This project corrects deferred maintenance conditions in the 56,877 square foot City Hall Annex/ Planning Building and includes a 5,000 sf. addition	5,000	77,500	147,000	City of Durham
Camden Ave. Radio Building	Construct a masonry building to replace the two modular buildings currently in use and improve lightning protection and grounding.	Unknown	NA	NA	City of Durham
Fire Station #15	Fire station to serve the far N area of the City. Will be a two-bay, 6500 sf station with accommo-dations for firefighters. The project proposes new positions to staff an Engine and Ladder company.	6,500	100,000	23,600	City of Durham
Fire Station #16	Fire station to serve the SW area of the City. The fire station will be a two-bay, 6500 sf station with separate accommodations for firefighters. This project is funded and is scheduled for completion in Aug 2006.	6,500	100,000	236,600	City of Durham
Fire Station #8	This fire station will serve the SW area of the City. The fire station will be a two-bay, 6500 sf station with separate accommodations for firefighters. This project is funded and is scheduled for completion in Aug 2006.	6,500	100,000	236,600	City of Durham
Joint 911/E.O.C Building	A joint funded project to be constructed on county-owned property near Lowes Grove.	30,000	470,700	1,092,000	City of Durham
Durham Station	Construction of a multi-modal transportation center in central Durham that will provide bus, rail, regional transit and taxi services. Part of the NC Transportation Improvement Plan.	Unknown	NA	NA	City of Durham
Animal Control	New construction	3,340			Durham County
East Durham Branch Library	New construction	26,649			Durham County
EMS Old Fayetteville	New construction	6,016			Durham County

Building Name/ Address	Change to Size/ Tenure	Area (sf)	Estimated Electricity (kWh)	Estimated Natural Gas (therms)	Jurisdiction
St (Station 2)					
Health and Human Services Complex	New construction	244,000			Durham County
Justice Center	New construction	255,000			Durham County
Main Library	Expansion	Unknown			Durham County
North Durham Branch Library	New construction	26,649			Durham County
Senior Center	New construction	35,000			Durham County
South Durham Branch Library	New construction	26,649			Durham County
Sheriff/Policy Training Center	New construction	17,000			Durham County
Carmichael Building	The Carmichael Building, Health Department, and DSS Buildings are not needed upon completion of the Human Services Complex. (Source: 2006-2015 CIP)	114,226	1,734,450	41,453 (therms)	Durham County
Health Department		73,000	2,549,306	199	Durham County
Social Service Building		43,776	796,052	78,340	Durham County

15 Appendix H: Discrepancies between 1999 and 2006 Inventories

Table 47. Differences in Community Baseline Emissions Between the 1999 and 2006 Inventories

Sector	Energy Consumption (MMbtu)		GHG Emissions	
	1999 Inventory	2006 Inventory	1999 Inventory	2006 Inventory
Residential	7,678,000	8,539,650	491,000	1,221,610
Commercial	5,277,000	13,209,220	573,000	2,161,090
Industrial	5,120,000	7,034,560	476,000	845,900
Transportation	Not included	30,663,780	864,000	2,624,880
TOTAL		**59,447,210**	**2,612,000**	**6,837,430**

The major increase in emissions between the 1999 and 2006 inventories can be partially accounted for by the methods used for calculating electricity emissions. According to the CCP Protocol, if there is only one electricity provider in the community, coefficients should reflect the energy generation of that particular provider, however, if there is more than one provider, coefficients should reflect the average for the grid to which the community is connected. In the 1999 report, Duke Power was the only energy provider accounted for. Since approximately 47% of energy produced by Duke was generated by coal and the rest from nuclear, hydro and other low emission sources, the total emissions from electricity were calculated as the equivalent of 47% of the emissions of coal (0.778 lbs/kWh*0.47=0.366 lbs/kWh). This methodology results in a much lower coefficient than was used in the current report. In the 2006 report, coefficients were calculated based on the regional electricity emission factors defined by the North American Electric Reliability Council (NERC) since multiple electricity providers were taken into account. These coefficients correspond to regional electricity grids to which cities are connected, and reflect the emissions of electricity sources in the region. Based on the most current set of coefficients, greenhouse gas emissions from electricity generation were higher in 2005 than they were in 1998 (1.425 lbs/kWh in 1998 to 1.463 lbs/kWh in 2005) and therefore, emissions have, in fact, increased at a higher rate than energy consumption.

It is useful to compare the energy consumption by sector between 1998 and 2005 to ensure that increases in consumption are consistent with population growth. Both the residential and industrial sector showed a reasonable amount of growth in energy consumption, however, the commercial sector's consumption appears to have more than doubled in seven years. It is unlikely that this sector has grown at this rate and is more likely that the discrepancy can be accounted for by the fact that new inventory is more comprehensive than the last.

It may also be helpful to note that, although GHG emissions seem to have grown drastically, which can be discouraging, it is likely that the previous inventory was not as comprehensive in including emissions sources. As a result, it is likely that the 1999 inventory greatly underestimated emissions.

Table 48. Differences in Government Operations Baseline Emissions Between the 1999 and 2006 Inventories

Operations	Energy Consumption (MMbtu)		GHG Emissions	
	1998	2005	1998	2005
Buildings	Not included	305,450	10,000	42,740
Fleet	Not included	178,920	10,000	15,310
Lights	55,000	49,240	11,000	10,610
Water/Sewage	136,000	163,670	23,000	33,560
TOTAL		**697,280**	**54,000**	**102,210**

The buildings sector in the 1998 inventory only included city owned facilities. The inclusion of county owned facilities in the 2005 inventory, combined with the change in energy coefficients, can account for the increase in emissions. Differences in emissions of individual facilities, such as City Hall Plaza (2,000 tons in 1998 to 4,340 tons in 2005), can be accounted for by the change in energy coefficients combined with possible increases in consumption.

Vehicle Miles Traveled

The 2005 VMT estimates are based on the most current model available for calculating VMT and were provided to ICLEI by the DCHC MPO. The discrepancy between the VMT numbers in the old and new reports reflects both a growth in transportation in the past 7 years and the increased accuracy of VMT modeling methodologies. The major increase in transportation emissions between 1998 and 2005 can be accounted for by this change in VMT estimates.

Baseline Vehicle Miles Traveled (VMT)	1.5 million (1998 inventory)	3.2 million (2005 inventory)
Projected Target Year VMT	2.4 million (2025 – 1998 forecast)	5.2 million (2030 – 2005 forecast)

Population

The change in baseline population is consistent with the population growth rate used to project population in 2030. In 1998, it was predicted that the population would grow by an average rate of 1.6 percent per annum until 2025. In fact, it grew at 2 percent per annum until 2005 and is projected to grow at an average rate of 1.2 per annum until 2030. Nonetheless, the growth from 1998 to 2030 is projected to be 1.5 percent per annum which is consistent with 1999 projections. This reflects a projected deceleration in population growth over the time period. Therefore, there is no major discrepancy between population estimates in the 1999 and 2006 reports.

Baseline Population	211,700 (1998 inventory)	41,470 (2005 inventory)
Projected Population	300,600 (2025 – 1998 forecast)	311,370 (2030 – 1998 forecast)

16 Appendix I: Additional Online Resources

North Carolina - Division of Pollution Prevention and Environmental Assistance
To protect the environment and conserve natural resources by providing technical assistance on the elimination, reduction, reuse and recycling of wastes and pollutants. This website serves as a tool to find information within North Carolina for support to various projects, and includes funding available to communities within the State. http://www.p2pays.org/ (general info)
http://www.p2pays.org/compost/ (for waste/composting info)

Duke Energy – Energy Efficiency and Conservation Initiatives - Duke Energy offers a variety of energy efficiency and conservation programs to its customers. The programs also help customers save money on their energy bills by making their homes and businesses more energy efficient. This website offers information for residential, business and large business.
http://www.duke-energy.com/environment/energy_efficiency/initiatives/

North Carolina State Energy Office – This office is the lead agency for energy programs and services and serves as the official source for energy information and assistance for consumers, businesses, government agencies, community colleges and schools and the residential, commercial and industrial sectors. The Office's main areas of focus are alternative fuels; energy information and education; energy efficiency for industry and state agencies, universities, community colleges and local government; and renewable energy. http://www.energync.net/

Natural Capitalism Solutions Climate Protection Manual - This Climate Protection Manual for Cities is designed to provide local governments with the expertise they need to curb their city's greenhouse gas emissions. http://www.natcapsolutions.org/ClimateProtectionManual.htm

The GHG Action Guide - Created by the BC Climate Exchange, this is a great web tool for municipalities that may have limited resources and provides adaptations to current municipal actions that are cost effective and already viable in many other municipalities. The website has various actions that can be taken related to transportation, waste, buildings and land use (and many more) to help reduce GHG emissions. http://www.ghgactionguide.ca/about/

SustainLane Government Best Practices Database - This is a free online database of best practices searchable by category. The database is designed for state and local government professionals and their preferred contractors. http://sustainlane.us/home.jsp

EPA – Green Power Partnership - The Green Power Partnership encourages organizations to purchase green power as a way to reduce the environmental impacts associated with conventional electricity use. This website provides a large amount of information and tools for governments and businesses http://www.epa.gov/greenpower/index.htm

Cool Mayors Website - Mayors in the United States who have committed their cities to reducing greenhouse gas emissions. This website contains a successes page as well as a taking action section and various tools available to Mayors and local governments.
http://www.coolmayors.org/common/11061/?clientID=11061

ICLEI International Progress Report - Cities for Climate Protection – This report is available for download via the ICLEI US website it details on how 546 local governments in 27 countries are collectively reducing greenhouse gas emissions by 70 million tons a year.
http://www.iclei.org/index.php?id=391

ICLEI USA's Cities in Action Report – This report is available for download through the ICLEI US website and it offers budget saving tips for local governments reducing greenhouse gas emissions, twelve US case studies are included, and it contains four easy steps that will guide the development of a Local Action Plan. http://www.iclei.org/index.php?id=391

17 Appendix J: Speculative Forecast Data and Methodology

Table 49. North Carolina Climate Action Plan Advisory Group (CAPAG) Recommendations

	Actions	2020 GHG Reductions (MMtCO2e)
RCI MEASURES		
RCI-1	Demand Side Management Programs for the RCI Sectors	3.9 (mid EE investment) 18.3 (high EE investment)
RCI -2	Expand Energy Efficiency Funds	8.2
RCI -3	Energy Efficiency Requirements for Government Buildings	1.7
RCI -4	Market Transformation and Technology Development Programs	2.1
RCI -5	Improved Appliance and Equipment Efficiency Standards	1
RCI -6	Building Energy Codes	4.4
RCI -7	Beyond Code' Building Design Incentives and Targets, Incorporating Local Building Materials and Advanced Construction	2.9
RCI -8	Education (Consumer, Primary/Secondary, Post-Secondary/Specialist, College and University Programs	not quantifiable
RCI -9	Green Power Purchasing (required for state facilities) and Bulk Purchasing for Energy Efficiency or Other Equipment	0.4
RCI -10	Distributed Renewable and Clean Fossil Fuel Power Generation	3.9
RCI -11	RCI Energy and Emissions Technical Assistance and Recommended Measure Implementation	2.8
Sector Total After Adjusting for Overlap	*31.3 (mid EE investment) 35.0 (high EE investment)*	
ENERGY SUPPLY MEASURES		
ES-1	Renewable Energy Incentives	0
ES-2	Environmental Portfolio Standard	37.7
ES-3	Removing Barriers to CHP and Clean DG	1.6
ES-4	CO2 Tax and/or Cap and Trade	TBD
ES-5	Legislative Changes to Address Environmental and Other Factors	TBD
ES-6	Incentives for Advanced Coal	8.3
ES-7	Public Benefit Charge	4.5
ES-8	Waste to Energy	0.01
ES-9	Incentives for CHP and Clean DG	included in ES-3
ES-10	NC Green Power Renewable Resources Program	0
Sector Total After Adjusting for Overlap (combined with RCI)		*53.3*
TRANSPORTATION AND LAND USE		
TLU-1b	Land Development Planning	1

TLU-1a	Multi-Modal Transportation and Promotion	3
TLU-3a	Feebates to Raise Revenue	included in TLU-1b
TLU-3b	Feebates to Change Fleet Mix	0.5
TLU-4	Truck-Stop Electrification	included in TLU-8
TLU-5	Tailpipe GHG Standards	8.08
TLU-6	Biofuel Bundle	3.25
TLU-7	Procure Efficient Fleets	Includes in TLU-6
TLU-8	Anti-Idling	0.2
TLU-9	Diesel Retrofits	TBD
TLU-10a	Fuel Tax Incentives (50 cents/gallon)	13.9
TLU-10b	Fuel Tax Incentives (10 cents/gallon)	2.8
TLU-11	Pay as You Drive Insurance	5.3
TLU-12	Incentives for Advanced Tech Vehicles	n/a
TLU-13	Buses Clean Fuels	included in TLU-6
Sector Total After Adjusting for Overlap		*42.84*
AGRICULTURE, FORESTRY AND WASTE		
AFW-1	Manure Digesters and Energy Utilization	0.9
AFW-2	Biodiesel Production-Incentives for feedstocks and production plants	0.8
AFW-3	Soil Carbon Management (including organic farming incentives)	0.4
AFW-4	Preserve Agricultural Land	0.3
AFW-5	Agricultural Biomass Feedstocks for Electricity or Steam Production	0.01
AFW-6	Policies to Promote Ethanol Production	6.9
AFW-7	Forest Protection - Reduced Clearing and Conservation to Non-Forest Cover	4.3
AFW-8	Aforestation and/or Restoration of Non-Forested Lands	2.4
AFW-9 & 10	Expanded Use of Forest Biomass and Better Forest Management	3.6
AFW-11	Landfill Methane and Biogas Energy Programs	1.9
AFW-12	Increased Recycling Infrastructure and Collection	0.5
AFW-13	Urban Forestry Measures	TBD
Sector Total After Adjusting for Overlap		*21.89*
CROSS CUTTING ISSUES		
CC-1	GHG Inventories and Forcasts	not quantifiable
CC-2	GHG Reporting	not quantifiable
CC-3	GHG Registry	not quantifiable
CC-4	Public Education and Outreach	not quantifiable
CC-5	Adaptation	not quantifiable
CC-6	Options for Goals or Targets (for CAPAG in support of COMMISSION)	not quantifiable

All of the CAPAG recommendations, excluding agriculture, forestry and waste measures were added together and then converted from metric tonnes into tons.

96.14 MMtCO2e = 105,949,280 tons of GHG

Using US Census population projection data, it was estimated that approximately 2.75% of the population of North Carolina will reside in Durham in 2030. This fraction of state level emission reductions was then attributed to Durham.

*105,949,280 * 0.0275 = 2,913,523 tons of GHG reductions in Durham*

Table 50. Proposed Federal Actions on Climate Change

Cabinet Committee on Climate Change Science and Technology Integration
Increased Budget for Climate Change Activities
Tax Incentives to Reduce Greenhouse Gas Emissions
Climate Change Technology Program (Hydrogen, Low Emission Coal Generation, Fusion)
Climate Change Science Program (CCSP): research, earth observation
Near-Term Greenhouse Gas Reduction Initiatives: Climate Vision Parternships, Climate Leaders, Voluntary Reporting Program, Targeted Incentives for Sequestration, SmartWay Transport Partnership, Increased fuel efficiency standards for light trucks
International Cooperation: Methane to Markets Partnership, International Partnership for a Hydrogen Economy, Carbon Sequestration Leadership Forum, Generation IV International Forum, Renewable Energy and Energy Efficiency Partnership, Regional and Bilateral Cooperation, Global Environmental Facility, Tropical Forest Conservation Act (TFCA), President's Initiative Against Illegal Logging

For more information on these programs, please visit: http://www.state.gov/g/oes/rls/fs/2004/38641.htm

It was assumed that national emissions would be reduced by 500,000,000 metric tons. This is equivalent to approximately 484,880 tons of GHG that could be attributable to Durham based on population forecasts for 2030.

18 Appendix K: Sample Measures for Achieving Emissions Reduction Scenarios

Table 51. Residential Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Expand conservation measures	Measures implemented to date result in less than 1% emissions reduction. If they were ramped-up and other measures were considered, such as implementing the Duke Energy Measures that were done in other regions, a rough estimate would aim for an conservative scenario of 2%, typical scenario of 3% and aggressive scenario of 5%	*34,290* 8% of households (7,829) improve efficiency by 35% or 19% of households (18,239) improve efficiency by 15%	*51,430* 12% of households (11,740) improve efficiency by 35% or 30% of households (27,356) improve efficiency by 15%	*85,720* 20% of households (19,571) improve efficiency by 35% or 47% of households (45,596) improve efficiency by 15%
Expand alternative energy measures	Alternative energy measures implemented to date are minor (1,600t); including solar water heater installations, passive heating and cooling, geothermal as well as limited green power purchases. By supporting and building upon these initiatives, much greater impact can be achieved. A conservative estimate is double the initial impact, moderate is 5 times, and aggressive is 10 times.	*3,210* 0.002% of households (257) use 100% green power or 3% of households (2,568) use 10% green power	*8,020* 0.007% of households (642) use 100% green power or 7% of households (6,416) use 10% green power	*16,040* 1% of households (1,283) use 100% green power or 13% of households (12,832) use 10% green power
	Total	***37,500***	***59,450***	***101,760***

Table 52. Commercial Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Energy conservation programming	Conservation and efficiency programming should be targeted to existing building stock as none has been done to date. GHGs could be reduced by 5%, 10% and 25% respectively for each of the 3 scenarios.	*108,050* 15,436 1,000 sqft businesses reduce emissions by 10% or 1,544 10,000 sqft businesses reduce emissions by 10% or 4,410 1,000 sqft businesses	*216,110* 30,873 1,000 sqft businesses reduce emissions by 10% or 3,087 10,000 sqft businesses reduce emissions by 10% or 8,821 1,000 sqft businesses	*540,270* 77,181 1,000 sqft businesses reduce emissions by 10% or 1,544 10,000 sqft businesses reduce emissions by 10% or 22.052 1,000 sqft busnesses

		reduce emissions by 35% or 441 10,000 sqft businesses reduce emissions by 35%	reduce emissions by 35% or 882 10,000 sqft businesses reduce emissions by 35%	reduce emissions by 35% or 2,205 10,000 sqft businesses reduce emissions by 35%
New construction energy efficiency	Growth in the commercial sector is expected to increase GHGs by 1 million tons by 2030. By focusing on initiatives to increase efficiency, emissions could be reduced by 5%, 10% and 25% respectively.	*50,000* 7,143 new 1,000 sqft businesses avoid 10% of emissions or 714 new 10,000 sqft businesses avoid 10% of emissions or 2,041 new 1,000 sqft businesses avoid 35% of emissions or 204 new 10,000 sqft businesses avoid 35% of emissions	*99,990* 14,284 new 1,000 sqft businesses avoid 10% of emissions or 1,428 new 10,000 sqft businesses avoid 10% of emissions or 4,081 new 1,000 sqft businesses avoid 35% of emissions or 408 new 10,000 sqft businesses avoid 35% of emissions	*249,990* 35,713 new 1,000 sqft businesses avoid 10% of emissions or 3,571 new 10,000 sqft businesses avoid 10% of emissions or 10,204 new 1,000 sqft businesses avoid 35% of emissions or 1,020 new 10,000 sqft businesses avoid 35% of emissions
Alternative energy purchases	Promote the use of alternative fuels and green power purchasing. 1%, 3%, and 5% uptake building into the 3 scenarios.	*31,610* 4,516 1,000 sqft businesses purchase 10% green power or 452 10,000 sqft businesses purchase 100% green power or 452 1,000 sqft businesses purchase 10% green power or 45 10,000 sqft business purchase 100% green power	*94,820* 13,546 1,000 sqft businesses purchase 10% green power or 1,355 10,000 sqft businesses purchase 100% green power or 1,355 1,000 sqft businesses purchase 10% green power or 135 10,000 sqft business purchase 100% green power	*158,040* 22,577 1,000 sqft businesses purchase 10% green power or 2,258 10,000 sqft businesses purchase 100% green power or 2,258 1,000 sqft businesses purchase 10% green power or 226 10,000 sqft business purchase 100% green power
	Total	***189,660***	***410,920***	***948,300***

Table 53. Industrial Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Demand and supply side management	No tangible attempts to reduce emissions or improve energy efficiency or use alternatives have been made in the Industrial sector. GHGs could be reduced	*64,060* 1,602 10,000 sqft facilities improve efficiency by 10%	*128,130* 3,203 10,000 sqft facilities improve efficiency by 10%	*320,320* 8,008 10,000 sqft facilities improve efficiency by 10%

	by 5%, 10% and 25% respectively in 3 scenarios.	or 458 10,000 facilities improve efficiency by 35% or 1,602 10,000 sqft facilities purchase 10% green power or 160 10,000 sqft facilities purchase 100% green power	or 915 10,000 facilities improve efficiency by 35% or 3,203 10,000 sqft facilities purchase 10% green power or 320 10,000 sqft facilities purchase 100% green power	or 2,288 10,000 facilities improve efficiency by 35% or 8,008 10,000 sqft facilities purchase 10% green power or 801 10,000 sqft facilities purchase 100% green power
	Total	***64,060***	***128,130***	***320,320***

Table 54. Transportation Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Land Use Planning	It is commonly acknowledged that land use planning have a great influence over GHG emissions related to transportation, however it is also very difficult to quantify this impact. Without knowing specifics regarding Durham's land use plans out to 2030, it is difficult to assess the GHG impact with any certainty. However, we assume that by 2030, plans could be in place to reduce the growth in emission via planning activities by 10, 20 and 30% respectively.[29]	*147,590* 20,913 mid-sized cars avoided or 41,825 mid-sized cars avoid 50% of trips	*295,170* 41,824 mid-sized cars avoided or 83,647 mid-sized cars avoid 50% of trips	*442,760* 62,736 mid-sized cars avoided or 125,472 mid-sized cars avoid 50% of trips
Alternative Fuels & vehicles	Current alternative fuel & vehicle initiatives in the community include Duke and the Triangle Council's CNG vehicles, the promotion of E85 and biodiesel, amounting to aprox 3,370t of GHG reduction. At a minimum, with limited effort these initiatives could be increased by10x by 2030 in a conservative, 20x in a mid, and 30x in aggressive scenario.	*34,820* 5,527 mid-sized cars replaced with hybrids or 5,790 mid-sized cars switch from gas to E85	*69,640* 11,054 mid-sized cars replaced with hybrids or 11,580 mid-sized cars switch from gas to E85	*104,460* 16,581 mid-sized cars replaced with hybrids or 17,370 mid-sized cars switch from gas to E85

Expanded Durham County Commute Trip Reduction Ordinance	Durham County has a goal of 15% reduction in VMT by 2010. With a target year of 2030, this goal could be doubled to 30% in an aggressive scenario, 25% in a moderate, and 20% in a conservative.	*25,530* 4,019 mid-sized cars reduce trips by 10% or 7,235 mid-sized cars reduce trips by 50%	*26,750* 4,211 mid-sized cars reduce trips by 10% or 7,581 mid-sized cars reduce trips by 50%	*48,630* 7,656 mid-sized cars reduce trips by 10% or 13,781 mid-sized cars reduce trips by 50%
	Total	***207,940***	***391,560***	***595,850***

Table 55. Local Government Buildings Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Energy efficiency upgrades /expansion of existing programs	Some efficiency initiatives are already planned. More could be done with the remaining building stock. A 35% reduction in overall energy would be considered aggressive, while lesser percentages would be more appropriate for the conservative and typical approaches (ie 10 & 20%).	*4,800* City and County's top 5 energy intensive facilities improve efficiency by 18% or Total City and County building stock improves efficiency by 11%	*9,600* City and County's top 5 energy intensive facilities improve efficiency by 36% or Total City and County building stock improves efficiency by 22%	*16,800* Total City and County building stock improves efficiency by 39%
Energy supply management	Alternative energy sources could be pursued or subsidized via green tags etc. Reductions are based on 1%, 5%, and 15% offset from alternative energy sources.	*480* City and County's top 5 energy intensive facilities use 2% green power or Total City and County building stock use 1% green power.	*2,400* City and County's top 5 energy intensive facilities use 9% green power or Total City and County building stock use 6% green power.	*7,200* City and County's top 5 energy intensive facilities use 27% green power or Total City and County building stock use 17% green power
	Total	***5,280***	***12,000***	***24,000***

Table 56. Local Government Fleets Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Active Transportation	Initiate active transportation in County as was done in City Police. County's fleet is aprox 1/3 that of the City's, therefore 1/3 of the savings are expected in the conservative scenario,	*60* remove 6 vehicles from fleet or reduce the usage of 20 vehicles by 30%	*100* remove 10 vehicles from fleet or reduce the usage of 34 vehicles by 30%	*210* Remove 21 vehicles from fleet or reduce the usage of 71

	1/2 in the moderate scenario and equal parts in the aggressive scenario.			vehicles by 30%
Fleet Efficiency	The vehicle replacement plan should be expanded beyond the police vehicles in the City as well as to the entire Durham Fleet. An underutilized vehicle study should also be done in the County.	*180* 77 full-sized vehicles downsized to compact	*260* 111 full-sized vehicles downsized to compact	*350* 150 full-sized vehicles downsized to compact
Hybrid Vehicles	Conservative is to double hybrid fleet in City from 2 to 4 and for County to match fleet with 4 of its own. Moderate scenario is 4 times the conservative (16 cars in City and County) and Aggressive is double the moderate (32 cars in City and County)	*30* replace 5 mid-sized vehicles with hybrids	*120* replace 19 mid-sized vehicles with hybrids	*240* replace 39 mid-sized vehicles with hybrids
Biodiesel	Conservative includes 20% use of biodiesel in fleet, moderate includes 50% and aggressive includes 80%. Fleet expected to increase by 9% (150 vehicles) by target year, therefore diesel projected to increase from 430,370gal to 469,103 gal.	*190* 14,356 gallons of regular diesel replaced with B20 or 3,586 gallons of regular diesel replaced with B80	*470* 35,487 gallons of regular diesel replaced with B20 or 8,872 gallons of regular diesel replaced with B80	*740* 55,873 gallons of regular diesel replaced with B20 or 13,968 gallons of regular diesel replaced with B80
Ethanol (E85)	Conservative scenario includes doubling E85 use in City and matching it in the County. Moderate assumes 20% of fleet is converted, Aggressive assumes 40% of fleet is converted.	*90* 9,424 gallons of regular gas replaced with E85	*2,040* 213,613 gallons of regular gas replaced with E85	*4,070* 426,178 gallons of regular gas replaced with E85
	Total	***550***	***2,990***	***5,610***

Table 57. Lighting Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Alternative energy sources	Alternative energy sources could be pursued or offset using green tags. Reductions are based on 10%, 25%, and 50% offset.	*1,830* purchase 17% green power	*4,580* purchase 43% green power	*9,160* purchase 86% green power
Additional energy efficiency measures -	Additional energy efficiency measures include decreasing the number of streetlights, decreasing the hours of operation, and improving the efficiency of	*370* 6,843 streetlights with 10% improved efficiency	*920* 17,015 streetlights with 10% improved efficiency	*1,830* 33,846 streetlights with 10% improved efficiency

operational	streetlights. A combination of decreasing the number of streetlights and decreasing the hours of operation could reduce energy use and emissions by 2% in a conservative, 5% in a mid and 10% in an aggressive scenario.	or 1,955 streetlights with 35% improved efficiency	or 4,862 streetlights with 35% improved efficiency	or 9,670streetlights with 35% improved efficiency
Additional energy efficiency measures - technological	It is expected that LED technology will be available for streetlight lamps in the next few years. This technology is 60% more efficient than high pressure sodium. A conservative scenario assumed 10% of the streetlights could be retrofitted, a mid scenario assumed 20% and an aggressive scenario assumed 30%.	*1,100*	*2,200*	*3,300*
	Total	***3,300***	***7,690***	***14,290***

Table 58. Water and Sewage Emission Reduction Scenarios

Suggested Measure	Description	Low	Medium	High
Water Conservation - Expanded Program	Brown's and William's water treatment facilities are expected to produce 8880t of GHGs in 2030. A conservative scenario would be to reduce that by 10%, 20% for a moderate scenario, and 35% for an aggressive scenario.	*890* 256 million gallons to be conserved	*1,780* 512 million gallons to be conserved	*3,110* 894 million gallons to be conserved
Efficiency improvements	Neither the City nor the County reported any initiatives to improve the efficiency of the treatment processes, pumps, motors etc. It's reasonable to assume that there is significant room for improvement in this area.	*4,210* All facilities improve efficiency by 13%	*8,430* All facilities improve efficiency by 25%	*14,750* All facilities improve efficiency by 44%
Energy supply management	Alternative energy sources could be pursued or subsidized via green tags etc. Reductions are based on 1%, 5%, and 15% offset from alternative energy.	*420* purchase 1% green power	*2,110* purchase 5% green power	*6,320* purchase 15% green power
	Total	***5,520***	***12,320***	***24,180***