City of Durham & Durham County

GREENHOUSE GAS EMISSIONS INVENTORY AND LOCAL ACTION PLAN FOR EMISSION REDUCTIONS

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BAU – business as usual; a scenario in which growth and activities continue to follow existing patterns.

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

CAP – criteria air pollutant, air pollutants including nitrogen oxides (NOx) sulfur oxides (SOx), carbon monoxide (CO), particulate matter (PM), and volatile organic compounds (VOC)

CCP – Cities for Climate Protection; an international campaign of over 700 local governments in 29 countries who are committed to reducing greenhouse gas emissions.

DCHC LRTP – Durham-Chapel Hill-Carrboro Metropolitan Planning Organization 2030 Long Range Transportation Plan

GHG – greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)

GHGs – equivalent CO_2 (used to describe greenhouse gas emissions in equivalent volume of carbon dioxide).

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

kWh – kilowatt hours

LAP – Local Action Plan

CCP – Cities for Climate Protection

t – tons; typically the unit of measure in which emissions are calculated

VMT – Vehicle miles traveled (measure of miles traveled within community that can be used to estimate fuel consumption and subsequent greenhouse gas emissions)

1 Background

1.1 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. By joining the City in the development of this inventory and local action plan, Durham County has indicated its desire to take a leadership role in climate change mitigation and air quality improvement.

US CCP Participants are saving over $535 million each year in energy and fuel costs

Over 770 municipalities in 29 countries worldwide participate in the Cities for Climate Protection. 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.

1.2 Timing is Everything

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 therefore 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 currently developing a greenhouse emission 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 to identify potential emission reduction measures that could

be implemented cooperatively in Durham and Orange County, allowing the governments to maximize their available resources.

1.3 Cities for Climate Protection: Five Milestones to Sustainability

The City of Durham has committed to follow the five milestone framework of the Cities for Climate Protection. The five milestones are:

Milestone 1. Conduct a baseline emissions inventory and forecast. Based on energy consumption and waste generation, the city 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 city can measure progress.

Milestone 2. Adopt an emissions reduction target for the forecast year. The local government establishes an emission reduction target for the local government. The target both 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 aware-ness 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.

2 Introduction – Emissions Analysis

Durham's inventory and forecast capture emissions from all areas of local government operations (e.g., City and County owned and/or operated buildings, streetlights, transit systems, wastewater treatment facilities) and from all community-related activities (e.g., residential and commercial buildings, motor vehicles, waste streams, industry). The inventory and forecast provide a benchmark against which the City and County can measure progress. In combination with an analysis of the impacts of existing climate mitigation activities in the County, the inventory will also enable the City of Durham and Durham County 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 (GHG) emission inventory, forecast, target and local action plan. ICLEI also used the software to undertake an analysis of criteria air pollutants (CAP) produced within the County. The CACP software applies fuel and sector-specific greenhouse gas and criteria air pollutant emission factors to inputs of energy consumption in order to determine the emissions generated by the energy use.

2.1.1 Electricity Emissions

GHG emissions from energy consumption are calculated based on emissions coefficients which specify the amount of GHGs per unit of energy. The coefficients are standard for different fuel types, but vary for electricity consumption depending on the annual average mix of fuel types used to produce the electricity and the area of the country in which the municipality is located. The software defines regional variations in electricity emission factors using the regions of the country that are defined by the North American Electric Reliability Council (NERC) and correspond to 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:

$E = E_f \times A$

The emission factor E_f 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). As carbon dioxide emissions vary only with the type and amount of fuel consumption and do not have significant technology dependence, they are kept here separately.

2.1.3 Transportation Emissions

It is important to note that the CAP emissions produced in this report were produced using the CACP software. NOx and VOC emission estimates from the transportation sector are also produced by the Division of Air Quality as part of the transportation conformity process 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.

The quantification framework for the transportation sectors in the CACP software (Transportation sector in the community modules, Vehicle Fleet and Employee Commute sectors in the Government modules) is based on a simple equation for describing the impact of a particular measure or strategy. 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 = Vehicle Miles Traveled X Emissions per Vehicle Mile

The two terms in this equation -- VMT and Emissions/VMT -- break down further. First, there is the VMT term, which tracks the three determinants of VMT for any particular mode:

Vehicle Miles Traveled = (Person-Trips/Persons per vehicle) X Trip Length (km)

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 critical and is the main reason why transit and car-pooling are such effective ways of reducing emissions per passenger mile of travel.

The second factor – Emissions/VMT -- also breaks down to separate factors describing the fuel efficiency of the vehicle and the emissions intensity of the fuel being used:

Emissions per VMT = Fuel Efficiency (i.e. miles per US gallon)
X Emissions per Unit of Fuel (the fuel type factor)

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

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

Where
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 L/100km)
E is the emissions per unit of fuel (i.e. the fuel type factor)

Each one of these factors is determined by a number of other factors (technological, behavioral, structural, etc.), and even these simple factors are not independent. A switch from automobile to diesel transit bus that changes the values of A for cars and buses, for example, usually means D and E go up (bad) but B goes up even more (good). People are more likely to walk or bicycle for short trips (C affects A). For cars, we know that fuel consumption per vehicle mile is higher for short trips (cold start effect) so that when C for cars goes down (good), D goes up (bad).

In addition, while carbon dioxide emissions vary quite directly with the amount of fuel consumed and can therefore be specified in terms of emissions per unit of fuel burned, criteria pollutant emissions are not so directly tied for the quantity of fuel consumption. Air pollution emissions and emission standards for vehicles are more often expressed in emissions per vehicle-mile, without reference to the fuel efficiency of the vehicle. 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 this 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, when it comes to emissions associated with particular vehicle standards, greenhouse gas emissions are computed based on fuel efficiency and criteria pollutants are computed based on vehicle miles of travel.

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. Details of the methods used to calculate emissions produced by the decomposition of solid waste area provided in Appendix A. The CACP software does not calculate CAP emissions generated by solid waste. Insufficient information is available on CAP emissions produced by solid waste to enable the development of accurate coefficients for the 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 FY 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 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 did not receive a response. As a result, any energy distributed by Progress Energy within Durham County was left out of 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 directly on the volume of gas consumed and not necessarily the type of business of the customer. 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. At the onset of the project, ICLEI contacted each of the fuel providers within Durham County to request data on fuel use by their customers within the fiscal year 2004/2005. 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 commercial and industrial employees in North Carolina.

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 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 lb 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.

2.2.5 Solid Waste

A characterization of 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, to characterize the material waste stream of municipal solid waste (MSW) generated within Durham County, ICLEI used an average distribution published by the EPA. 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. 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. lawnmower, golf carts and etc.) because of the difficulties faced by communities in accurately tracking populations and use of these types of equipment and in accurately calculating the associated CAP emissions. However, ICLEI used the EPA's NONROAD emissions modeling tool to estimate the potential emissions associated with off-road engine use within Durham County. 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 F contains the emissions analysis results.

2.2.7 Growth Indicators

Staff within the Durham City-County Planning Department provided the research team with growth indicators for the residential, commercial and industrial sectors. This data included population, number of households, commercial and industrial employees and land-use 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 their area of local government operations. A complete list of data sources is provided in **Appendix D**. In the absence of data, estimates of total energy use and/or cost were made; these cases are described in detail in those specific sections of 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 prior to 2030. Team members were 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 Community Inventory

3.1 Overview

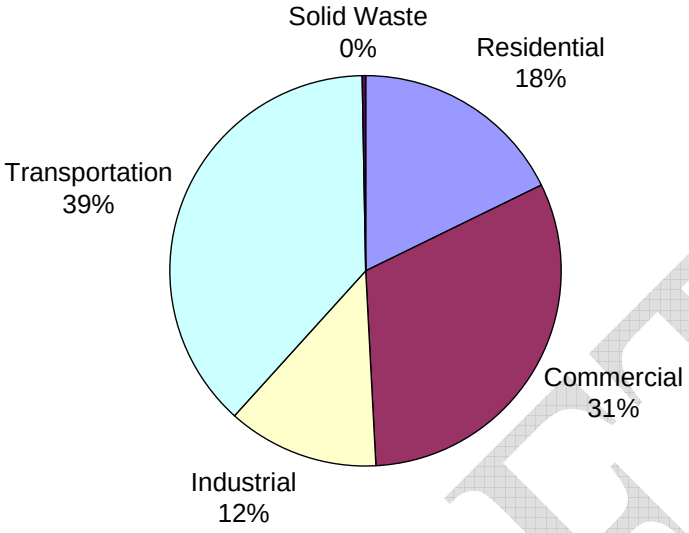
The Community inventory provides an estimate of all of the greenhouse gas and criteria air pollutant emissions produced within Durham County, whether by residents in their homes or by local businesses as they carry out their operations. Five key sectors are included in the community inventory: residential, commercial, industrial, transportation, and solid waste. Other emissions from off-road engines are summarized in Appendix F – **Changes to Building Tenure (Fiscal Year 2005 through 2030)**.

During the fiscal year 2004/2005, the community produced approximately 6,837,434 tons of GHGs. Table 1 provides a summary of energy use, CAP and GHG emission production for each sector. The transportation sector was responsible for 39% of the greenhouse gas emissions produced in the County and was the largest single source of emissions, followed by the commercial sector (31%), the residential sector (18%) and the industrial sector (12%) and solid waste methane gas flaring reduced greenhouse gases production by 16,052 tons. Figure 1 provides an illustration of the contribution of emissions from each sector.

Table 1. Base Year 2004/2005 Community Energy Use, CAP and GHG Emissions (tons)

Sector	Total Energy (MMbtu)	NOx	SOx	CO	VOC	PM10	GHGs
Residential	8,539,653	2,038	5,432	209	32	126	1,221,609
Commercial	13,209,215	3,688	10,731	353	48	249	2,161,090
Industrial	7,034,559	1,778	4,042	315	40	141	845,904
Transportation	30,663,784	8,792	455	60,851	6,353	260	2,624,882
Solid Waste	0	NA	NA	NA	NA	NA	(16,052)
Total	**59,447,211**	**16,295**	**20,661**	**61,729**	**6,473**	**776**	**6,837,434**

Figure 1. Community Greenhouse Gas Emissions by Sector in FY 2005



It is difficult and sometimes even unfair, to compare per capita emissions in different communities. Factors such as the fuel used to generate electricity, the availability of alternative fuel 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 as reduction efforts wrought at these levels should benefit Durham's emissions and like wise Durham's efforts to reduce its emissions will influence state and national emission outputs. In 2005, Durham generated approximately 29.14 tons of GHGs per capita. In 2004, per capita GHG emissions in the US were approximately 24.09 tons.[1]

In the following section of this report, energy consumption and resulting emissions produced within each of the community sectors will be discussed in detail.

[1] 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. Note total US emissions include some sources not included in CCP inventory (e.g. agricultural soil management, air transportation and others.)

3.2 Residential

In 2005, there were approximately 97,838 households in Durham County. On average, each of these households produced 12.5 tons of GHGs and consumed 87 MMBtu of energy. Table 2 provides a summary of energy consumption by and subsequent emissions produced within the residential sector. Within the residential sector, energy is consumed for such end-uses as space and water heating, appliances, lighting and space cooling.

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 within North Carolina in 2004.

Table 2. Residential Sector: Base Year 2004/2005 Energy Use, CAP & GHG Emissions (tons)

Fuel	Total Energy (MMBtu)	NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Electricity	4,402,240	1,652	5,245	120	14	106	948,285
Natural Gas	3,094,243	272	10	67	14	8	191,169
Coal	8,512	5	25	2	0	2	924
Kerosene	325,681	43	135	9	1	5	27,481
Light Fuel Oil[2]	236,668	31	17	6	1	4	19,564
Propane	472,309	36	0	5	1	1	34,186
Total	8,539,653	2,039	5,432	209	31	126	1,221,609

3.3 Commercial

Approximately 135,023 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[3]. The average commercial business produced 16 tons of greenhouse gas emissions per employee or 0.07 tons per square foot of facility space.

[2] The EIA only reports total No. 2 Distillate Sales/Deliveries 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 be #2 diesel (likely used for off-road vehicles). In order to determine only the amount of light fuel used in the residential sector in Durham, ICLEI used information provided by the NC Petroleum Marketers Association, who assumes that approximately 4.3% of Durham's homes are heated with light fuel oil. According to the PMA, the average oil-heated NC home uses 400 gallons of fuel oil per year, which would mean that approximately 1,690,641 gallons of oil are used in Durham each year.

[3] 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.

A summary of energy use and associated emissions is provided in Table 3. The largest source of greenhouse gas emissions was electricity consumption (86%), followed by natural gas consumption (11%).

Table 3. Commercial Sector: Base Year 2004/2005 Energy Use, CAP & GHG Emissions (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Electricity	8,667,959	3,251	10,326	237	27	208	1,867,162
Natural Gas	3,844,328	323	13	83	18	10	237,511
Coal	101,179	56	300	23	1	26	10,981
Kerosene	45,346	6	19	1	0	1	3,826
Light Fuel Oil[4]	169,488	22	70	5	1	3	14,011
Propane	379,844	29	0	4	1	1	27,493
Heavy Fuel Oil[5]	1,071	1	2	0	0	0	106
Total	13,209,215	3,688	10,730	353	48	249	2,161,090

3.4 Industrial

In 2005, Durham County's industrial sector employed approximately 52,420 people and occupied over 20 million square feet of facility space[6]. Approximately 16 tons of GHGs were generated for each employee and 0.04 tons of emissions per square foot of industrial space. The average annual energy use per square foot was 0.35 MMBtu.

Table 4 provides a summary of energy use and associated emissions produced within Durham's industrial sector in 2004/2005.

Table 4. Industrial Sector: Base Year 2004/2005 Energy Use, CAP & GHG Emissions (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Electricity	2,105,945	790	2,509	58	6	51	453,641
Natural Gas	2,701,916	397	190	113	20	14	166,930
Coal	1,737,659	541	1310	109	7	74	188,593
Kerosene	13,856	2	6	0	0	0	1,169
Light Fuel Oil[4]	107,067	8	17	27	6	1	8,830
Propane	363,142	38	0	6	1	1	26,284
Heavy Fuel Oil[5]	4,974	2	11	1	0	1	457
Total	7,034,559	1,778	4,043	314	40	142	845,904

[4] Based on estimates of No. 2 fuel oil and No. 1 distillate sales to commercial and industrial sectors in NC
[5] Based on estimates of No. 4 distillate and residual oil sales to the commercial and industrial sectors in NC
[6] Approximately 20,036,153 square feet of space was occupied by industry, including industrial warehousing.

3.5 Transportation

As discussed earlier in this report, the transportation sector is the single largest source of GHG emissions within the County. In the year 2004/2005, motor vehicles traveled approximately 3,246,653,998 miles within Durham County, or approximately 13,445 miles per year per resident. Table 5 summarizes the amount of fuel used by these vehicles and the emissions they produced. Gasoline-fueled vehicles traveled 92% of the total vehicle miles traveled (VMT) and accordingly produced the majority of GHG and CAP emissions.

It is important to note that the CAP emissions in Table 5 were produced using the CACP software. NOx and VOC emission estimates from the transportation sector are also produced by the Division of Air Quality as part of the transportation conformity process 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.

Table 5. Transportation Base Year 2004/2005 Fuel Use, CAP and GHG Emissions (tons)

Fuel Type	Total Energy (MMBtu)	NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Gasoline	24,936,608	5,224	317	58,158	6,004	113	2,127,077
Diesel	5,727,177	3,567	138	2,693	349	147	496,806
Total	30,663,784	8,791	455	60,851	6,353	260	2,624,822

3.6 Solid Waste

In 2004/2005 approximately 36,205 tons of construction and demolition (C&D) waste and 271,892 tons of municipal solid waste (MSW) was produced within Durham County. As a result of effective handling, the waste resulted in a reduction of greenhouse gases of 16,052 tons of GHGs (see Table 6 for a breakdown of emissions by waste and material type).

Waste produced within Durham County is sent to nine different landfills. Most (approximately 195,910 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[7] times more potent than CO2 as a greenhouse gas, combusting it reduces its potential global warming potential. Methane flaring significantly reduces GHG production associated with solid

[7] International Panel on Climate Change's Third Assessment Report

waste generation. Furthermore, since a fraction of the carbon found in solid waste is never released, but remains sequestered indefinitely in the landfill, landfills can act as carbon sinks. The negative values found in Table 6 are the result of carbon sequestration in the landfill, combined with the impact of methane flaring.

Table 6. Solid Waste Base Year 2004/2005 Material Distribution and GHG Emissions

Waste Type	Materials	Material Percent of Total Waste Stream	GHGs (tons)
Municipal Solid Waste	Paper Products	26%	2,424
	Food Waste	16%	20,184
	Plant Debris	8%	(11,715)
	Wood/Textiles	13%	(20,321)
	All Other Waste	37%	0
Construction & Demolition	Paper Products	3%	37
	Wood/Textiles	32%	(6,661)
	All Other Waste	65%	0
Total			(16,052)

4 Local Government Operations Inventory

4.1 Overview

Local government operations of the City of Durham and Durham County resulted in the production of approximately 102,206 tons of greenhouse gases in the fiscal year 2004/2005. Table 7 provides a summary of energy use, energy costs, criteria air pollutant and greenhouse gas emissions by area of local government operations[8].

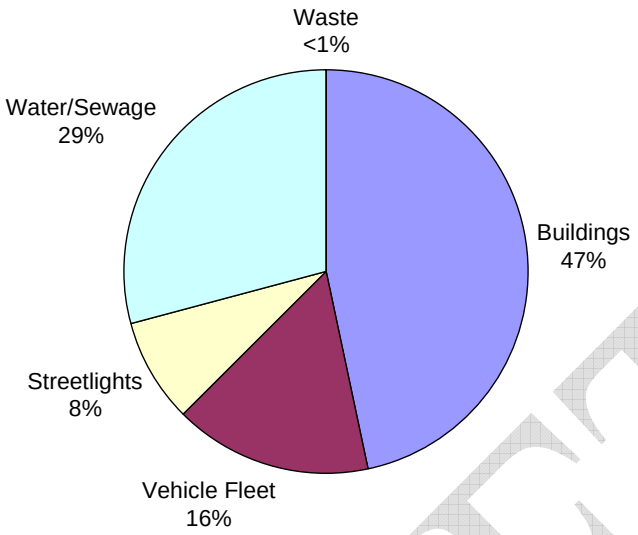
Table 7. Local Government Operations Emissions in Fiscal Year 2004/2005 (tons)

Operations	Total Energy (MMbtu)	Cost ($)[9]	NOx	SOx	CO	VOC	PM10	GHGs
Buildings	305,455	3,422,357	71	186	8	1	4	42,741
Vehicle Fleet	178,924	2,055,099	60	3	316	33	2	15,306
Streetlights	49,239	1,778,128	18	59	1	0	1	10,607
Water/Sewage	163,668	2,381,078	58	182	4	1	4	33,556
Waste	0	3,307	0	0	0	0	0	-4
Total	**697,286**	**$9,639,969**	**207**	**429**	**329**	**35**	**11**	**102,206**

An illustration of the contribution of each area of operations to total greenhouse gas emissions is provided in Figure 2. In the fiscal year 2004/2005, 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.

[8] Numbers in tables may not add due to rounding.
[9] Costs do not include traffic lighting costs; ICLEI is awaiting confirmation of these costs.

Figure 2. Base Year Distribution of GHG Emissions from Local Government Operations



4.2 Buildings

The City of Durham manages approximately 1,928,000 square feet of facility space[10]. 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 42,741 tons of greenhouse gas emissions in 2004/2005. Energy use within these facilities costs the City and County approximately $3,422,357. Table 8 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 E along with the energy use and emissions generated by each facility.

Table 8. Local Government Buildings: Base Year Energy Use, Energy Costs and Emissions (tons)

Jurisdiction	Fuel Type	Total Energy (MMBtu)	Energy Costs	NOx	SOx	CO	VOC	PM10	GHGs
City	Electricity	69,637	$1,263,040	26	83	2	0	2	15,000
County	Electricity	85,737	$1,294,455	32	102	2	0	2	18,468
City	Natural gas	40,738	$459,220	3	0	1	0	0	2,517
County	Natural gas	109,344	$405,642	10	0	2	1	0	6,756
Total		**305,456**	**$3,422,357**	**71**	**185**	**7**	**1**	**4**	**42,741**

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

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).

Table 9. 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 (Including 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 Building Annex	733	28.5	3401	132.4	$59,792	25,692

Note: ICLEI has acquired square footage for less than twenty-five percent of the City owned and operated facilities, therefore, we have been unable to accurately assess which buildings are the most energy intensive. We are looking into the possibility of determining the square footage of more of the buildings. We are also examining the possibility of including school board owned/operated facilities to the municipal inventory. For now, we have provided a list of energy intensive facilities from the buildings with known square footage.

Table 10. 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)
101 City Hall Plaza	4,338	34.3	20,139	159.2	$282,850	126,510
505 W Chapel Hill	1,730	22.9	10,300	136.2	$139,423	75,630
409 Blackwell	1,574	39.3	7,305	182.6	$151,624	40,000
600 Murray	788	35.0	5,947	263.7	$85,286	22,550
1900 Camden	768	20.4	5,930	157.3	$82,762	37,700

4.3 Vehicle Fleet

In fiscal year 2004/2005, 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 771,214 gallons of gasoline and 407,233 gallons of diesel fuel. The County's vehicles consumed approximately 235,238 gallons of gasoline and 23,136 gallons of diesel. These fuel consumption figures exclude fuel used in off-road engines which the Cities for Climate Protection Protocol does not require participants to include in their inventories. Fuel purchased with a fuel key is included in the summary in Table 11, although the exact end-use of this fuel is unknown[11]. A summary of the GHG and CAP emissions produced as a result of fuel use within these vehicles is provided in Table 11.

Table 11. Local Government Vehicle Fleets: Base Year 2004/2005 Energy Consumption, Costs and Emissions

Jurisdiction	Energy (MMbtu)	Cost ($)	Emissions (tons)					
			NOx	SOx	CO	VOC	PM10	GHGs
City of Durham	146,555	1,687,883	52	2	242	25	2	12,541
Durham County	32,369	367,216	8	0	74	8	0	2,766
Total	**178,924**	**2,055,099**	**60**	**2**	**316**	**33**	**2**	**15,307**

4.4 Street, Traffic & Other Outdoor Lights

The City of Durham operates all of the traffic signals located within Durham County. The City of Durham leases street lights from Duke Energy and Piedmont EMC to illuminate roads within the City's boundaries. Street lights 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 (i.e. neither the City, nor the County owns, operates, maintains or finances these lights).

During the fiscal year 2004/2005, the City operated approximately 350 signalized traffic intersections. Approximately 2,395 of the City's 10,739 traffic indicators are LEDs. An LED traffic light uses almost 90% less energy than an incandescent bulb.
In the same period, the City leased approximately 14,870 lights from Duke Energy. A summary of the estimated energy used by these lights is provided in Table 12. Using information provided by City staff, ICLEI estimated that the City's traffic signals

[11] 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%

consumed 3,493,369 kWh of electricity in 2004/2005[12]. Using data provided by Duke Energy staff, ICLEI estimated that the street lights consumed approximately 10,912,826 kWh of electricity.

Table 12. Local Government Street, Traffic & Other Outdoor Lights: Base Year 2004/2005 Energy Use, Energy Costs and Emissions (tons)

Lighting Type	Total Energy (MMBtu)	Energy Costs ($)	Emissions (tons)					
			NO_x	SO_2	CO	VOC	PM_{10}	GHGs
Traffic signals	11,923	267,144	4	14	0	0	0	2,568
Street & other outdoor lights	37,316	1,510,984	14	44	1	0	1	8,038
Total	**49,239**	**1,778,128**	**18**	**59**	**1**	**0**	**1**	**10,607**

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 unmetred or independently metered parking lot lights are not included in this inventory.

4.5 Water & Wastewater Treatment

The City of Durham operates two water treatment plants – Williams Water Treatment Plant and Brown Treatment Plant – and 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.

In the fiscal year 2004/2005 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.

[12] 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 FY 2004/2005 by adding the total monthly kWh used by lights installed before FY 2004/2005 and multiplying by 12 months. For lights installed in the FY 2004/2005, 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 FY 2004/2005 are not included the 2004/2005 data.

Table 13 summarizes the total energy use, energy costs and emissions generated by the City and County's water and wastewater treatment operations, including pumping stations[13].

Table 13. Local Government Water & Wastewater Treatment: Base Year 2004/2005 Energy Use, Energy Costs and Related GHG & CAP Emissions

Jurisdiction	Area of Operations	Total Energy (MMBtu)	Energy Costs	NO_x	SO_x	CO	VOC	PM_{10}	GHGs
City	Water & Wastewater treatment	141,868	1,992,514	50	156	3	1	3	28,860
County	Wastewater treatment	21,800	388,564	8	26	1	0	1	4,696
Total		**163,668**	**2,381,078**	**58**	**182**	**4**	**1**	**4**	**33,556**

4.6 Solid Waste Produced by Local Government Operations

The City of Durham does not track the volume of waste generated within its local government operations. However, the City has implemented a recycling program within its operations (this program is discussed in a separate section). The County tracks the amount of waste produced within its operations each year. In the fiscal year 2004/2005, 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. Methane flaring caused this to be reduced to negative four tons of greenhouse gases.

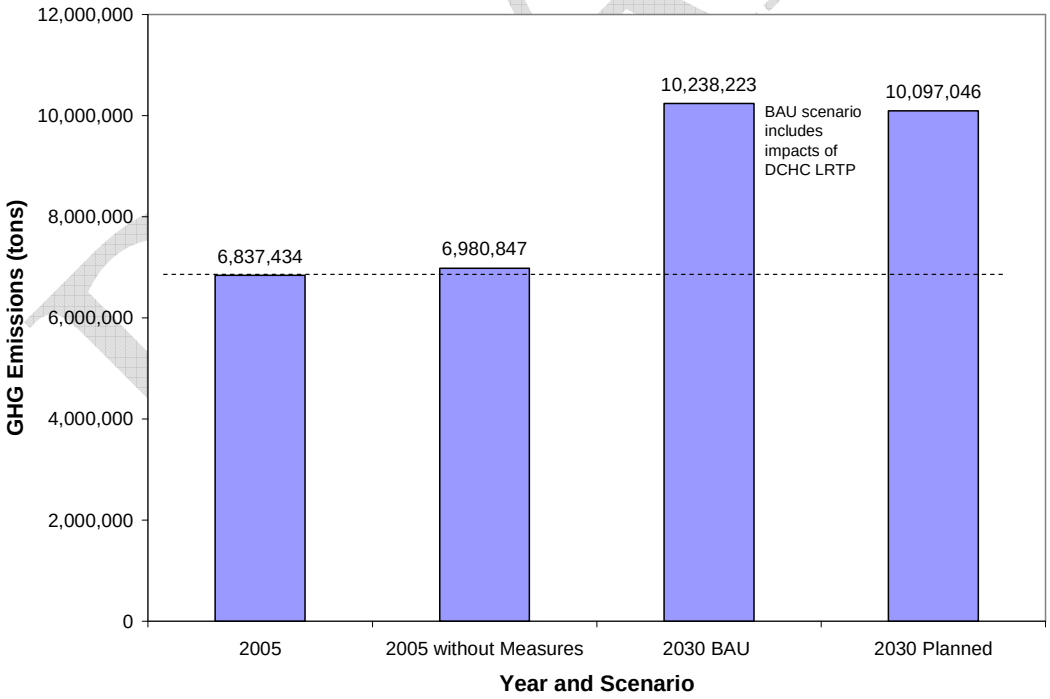
It is not uncommon for a local government to lack access to solid waste production numbers from its operations. In cases where solid waste is tracked, it typically amounts to less than 3% of the community-wide solid waste sector emissions.

[13] 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.

5 Community Forecast

Durham County has selected 2030 as a date by which the community will achieve a voluntary GHG emissions reduction target. In order to determine the potential level of emission reductions that could result from socio-economic growth in the region, emissions were forecast to 2030 using a set of growth factors described in Table 14. Two possible future scenarios were developed: a business-as-usual (BAU) forecast and a forecast that includes several new emission reduction efforts that will be implemented within the County. Figure 3 illustrates the potential GHG impacts of these scenarios. The column entitled "2030 BAU" assumes that new growth in the County will occur in absence of any new emission reduction initiatives, except the impacts of the DCHC 2030 LRTP, which are included in the BAU forecast. A second scenario is presented in the "2030 Planned" column, which includes growth projections for the community, but also accounts for emission reductions that will be achieved because of new emission reduction efforts that members of the community are planning to implement, in addition to the DCHC 2030 LRTP. The methodology used to develop each of these scenarios is explained in detail below.

Figure 3. Community GHG Emission Scenarios 2004/2005 though 2030



5.1 2030 Business-As-Usual Scenario

The business-as-usual (BAU) emissions reduction scenario provides a projection of potential emissions in 2030 if no new emission reduction measures were implemented within Durham County. 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 is 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 14.

Table 14. Community Forecast Growth Indicators

Indicator	2004/2005 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	311,374	29%
Annual VMT	3,246,653,998	5,288,671,522	63%

In the BAU scenario, GHG emissions would increase by approximately 50% from 2005 levels. This growth would correspond with local economic and population growth.

5.2 2030 Planned Emission Reduction Scenario

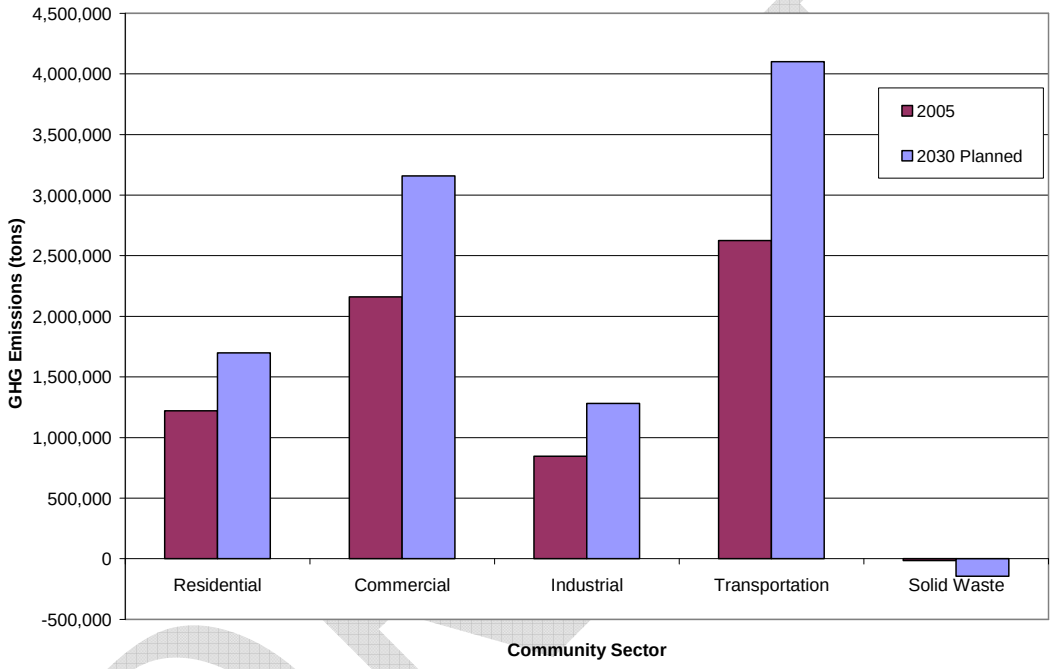
This scenario assumes that all of the planned new measures outlined in the section entitled “Future Community Measures” are implemented, including the DCHC MPO LRTP. This scenario presents a more realistic outlook of emissions in Durham County by applying the impacts of planned emission reduction measures to the BAU growth scenario.

In the planned scenario, GHG emissions would increase by approximately 48% from 2004/2005 levels by 2030. Approximately 124,796 tons of GHGs would be avoided as a result of the implementation of new measures.

Figure 4 provides a comparison of GHG emissions from each sector for 2005 and the 2030 planned emission reduction scenario.

The contribution of each sector to total community emissions will remain almost unchanged between 2005 and 2030 despite the implementation of the new, planned reduction measures (i.e. in 2005, the residential sector produced 17% of total GHG emissions, and under the 2030 planned scenario, the residential sector will produce 16% of total community GHG emissions).

Figure 4. Community GHG emissions: Comparison of 2005 and 2030 Planned Emissions



5.3 Community Emissions Forecast Summary

Table 15 provides a summary of forecasted CAP and GHG emissions within Durham County. The measures completed to date have not had a significant impact on greenhouse gas emission reductions. Measures implemented in 2005 resulted in a reduction of 143,413 tons of greenhouse gases 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 one percent) from the business-as-usual scenario in 2030; however, they will be insufficient to offset a thirty-two percent overall increase in emissions from 2005 levels.

Table 15. Community CAP & GHG Emission Forecast Summary

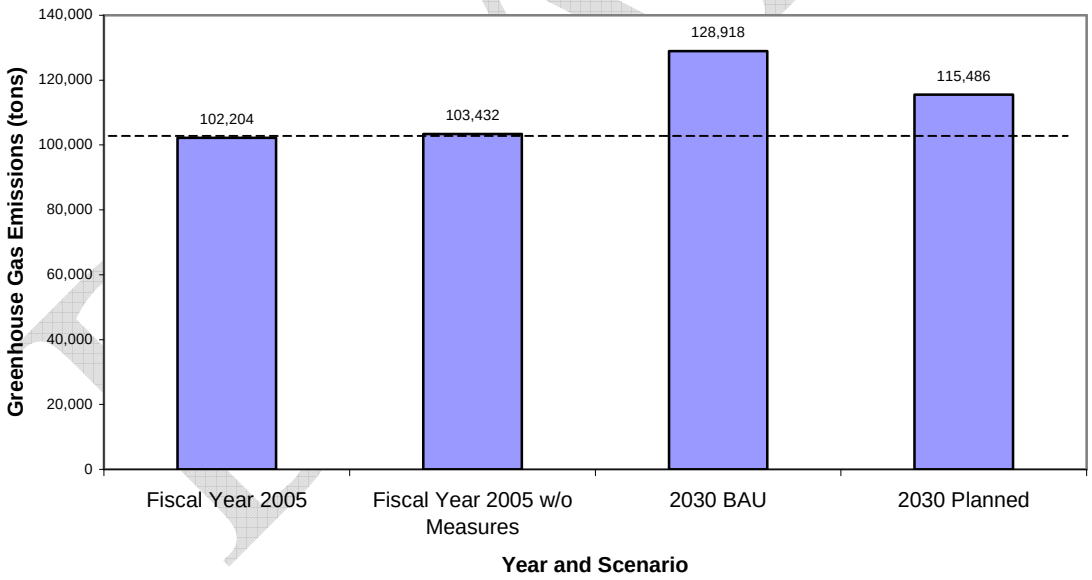
	Emissions (tons)					
Year & Scenario	NOx	SOx	CO	VOC	PM10	GHGs
2005	16,295	20,661	61,729	6,473	776	6,837,434
2005 without Measures	16,465	20,989	62,546	6,558	784	6,980,847
2030 BAU	20,024	24,819	93,989	9,137	909	10,238,223
2030 Planned	19,995	24,746	93,972	9,135	907	10,097,046

[*Draft note: emission reductions in this section d/n include impacts of "Other" reduction measures, i.e. grid-wide measures – figures will be adjusted.*]

6 Local Government Operations Forecast

Potential emissions attributable to the City and County's local government operations were projected for the emission reduction target year of 2030. Forecasted emissions will vary according to the projected level of rigor with which emission reductions are pursued and achieved in each area of the City and County's operations. Figure 5 illustrates the differences in potential emissions between 2004/2005 and 2030. The left-most column illustrates estimated GHG emissions in 2004/2005. A second column, labeled "Fiscal Year 2005 w/o Measures", illustrates potential emissions that could have occurred in 2005 if the City and County had not made any efforts to reduce their energy use or related greenhouse gas emissions. A third column provides a projection of emissions if the City and County were to continue to grow in a business-as-usual (BAU) scenario without implementation of any new or additional emission reduction efforts. Finally, the last column on the far right of the chart illustrates the potential emissions that will occur in 2030 as a result of growth and the new measures that the City and County plan to implement. A detailed description of each of the 2030 scenarios is provided below and a summary of forecasted CAP emissions is provided in Table 16.

Figure 5. Local Government Operations GHG Emissions Scenarios Forecasts 2005 – 2030



6.1 2030 Business-As-Usual Scenario

To construct a 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 base year and the forecast year.

Projections of these changes in infrastructure were provided by members of the project team and are as follows:

6.1.1 Buildings:

City and County staff based their estimates of new building area on projected identified within the capital improvement plans (CIP) developed by each government. It should be noted that neither CIP plans as far into the future as 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 Capital Improvement Plan, the City will construct at least 220,900 square feet of new facilities before 2030. City staff have 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 Capital Improvement Plan. Using the energy intensity reported in existing facilities, ICLEI estimated the potential annual energy consumption of the County's new facilities. The Carmichael Building, Health Department, and Social Services Buildings were removed from the 2030 forecast. 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 F.

6.1.2 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 do not foresee any growth in the vehicle fleet at the time of writing. Based on new vehicle acquisitions in 2003/2004 and 2004/2005, ICLEI assumes that County will add six new vehicles to its fleet each year for a total of 150 new vehicles by 2030.

6.1.3 Street lights:

City staff suggested that approximately 900 new street lights 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.

6.1.4 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.

6.1.5 Waste:

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

Under a BAU scenario, emissions produced by City and County operations would increase approximately 22% above 2004/2005 levels.

6.2 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 13,442 tons per year would be realized under this scenario.

Under the planned scenario, 2030 emissions increase approximately 9% above 2004/2005 levels.

6.3 Summary of GHG and CAP Emission Scenarios

A summary of the forecasted CAP emissions for 2030 in a business-as-usual scenario and with implementation of new emission reduction efforts planned by the City and County is provided in Table 16.

Table 16. Local Government Operations: 2005 & 2030 Emission Scenarios (Emissions in Tons)

Year and Scenario	NOx	SOx	CO	VOC	PM_{10}	GHGs
2005	207	429	329	35	11	102,204
2005 without Measures	209	433	330	35	11	103,432
2030 Business-As-Usual	212	452	392	39	12	128,918
2030 with Planned Measures	191	420	387	38	11	115,486

7 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 new measures. Existing measures were implemented prior to the 2004/2005 base 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 2004/2005 base year, which therefore can be counted towards the voluntary emission reduction target that will be implemented within the City & County's operations and the community-at-large. It should also be noted that where an existing measure will have new additional or expanded impacts after the base year, these new impacts may be counted towards the emission reduction target.

7.1 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 17 along with an estimate of the annual impacts of these measures. Some of these measures are important education and awareness campaigns, the results of which are difficult to quantify; for other measures, insufficient information was made available 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 144,179 tons of GHG emission reductions annually. A description of each of these measures is provided in **Appendix G** along with details of the assumptions made to estimate the potential emission impacts of the measure.

Table 17. Existing Community Emission Reduction Measures and Their Potential Annual Impacts

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Residential Sector							
Solar Hot Water Heater installations	Private Sector	849	2,205	89	14	49	254
NC Green Power	NC GreenPower	3,518	11,174	257	29	226	1,010
Energy Conservation Loans	Duke Energy	More information required					
Equipment Loan	Duke Energy	More information required					
Heating & Cooling Equipment Loans	Duke Energy	More information required					
Off Peak Water Heating	Duke Energy	More information required					
Public Information - Duke Power	Duke Energy	Education & awareness program					
Public Information - PSNC	PSNC	Education & awareness program					
Heat Pump Loans - Piedmont EMC	Piedmont EMC	57	180	4	0	4	16
Energy Audits - Piedmont EMC	Piedmont EMC	754	1,947	80	13	43	226
NC Healthy Built Homes	NC Solar	0	0	0	0	0	0
Soltera - Environmentally Friendly Co-housing Community	Private Sector	More information required					
Eno Commons	Private Sector	More information required					
Social Security Income Rate	Duke Energy	More information required					

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Commercial/Institutional Sector							
Customer Resource Center	Duke Energy	Education and awareness program					
Equipment Loan	Duke Energy	More information required					
Off Peak Water Heating	Duke Energy	More information required					
Public Information - Duke Power	Duke Energy	More information required					
Public Information - PSNC	PSNC	Education and awareness program					
Steam System Upgrade or Replacement (to be confirmed)	NCCU	Information to be provided in September					
Low-level Waste Generator	NCCU	Information to be provided in September					
Utilities Savings Initiative	NCCU	Information to be provided in September					
Duke University Energy Management Program	Duke University	26,536	84,293	1,935	218	1,702	7,620
Duke University LEED Buildings	Duke University	More information required					
Green Building Program	Triangle J COG	Education and awareness program					
LED Traffic Signals	NC DOT	More information required					
High Pressure Sodium	NC DOT	More information required					
Equipment Loan	Duke Energy	More information required					
Off Peak Water Heating	Duke Energy	More information required					
Equipment Loan	Duke Energy	More information required					
Off Peak Water Heating	Duke Energy	More information required					
US EPA RTP (Main Building) 109 T.W. Alexander Dr.	US Government	172,705	510,969	14,819	1,980	10,675	50,562
EPA National Computer Centre - LEED Certified	US Government	12,046	35,639	1,034	138	745	3,527

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Industrial Sector							
Customer Resource Center	Duke Energy	Education and awareness program					
Equipment Loan	Duke Energy	More information required					
Off Peak Water Heating	Duke Energy	More information required					
Public Information - Duke Power	Duke Energy	More information required					
Public Information - PSNC	PSNC	More information required					
Transportation Sector							
Compressed Natural Gas Vehicles	Duke University & Triangle J Council of Governments	389	30	3,773	494	6	34
Ethanol 85 Fuel Use in Durham	Triangle J Council of Governments	More information required					
Biodiesel Use in Durham County	Triangle J Council of Governments; Durham Public Schools; Duke University & Private Sector (via a public fuel station)	-2,362	935	11,789	2,870	561	1,964

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Transportation sector continued…							
Alternative Fuel Use in DATA vehicles	DATA	Analysis forthcoming					
Durham County Commute Trip Reduction Ordinance	Coordinated by Triangle Transit Authority, implemented by every employer in Durham with 100 or more employees)	118,598	7,764	1,522,580	156,675	2,275	24,314
Duke University Car/Vanpool	Duke University	214	12	2,360	243	5	35
Duke University Alternative Vehicles - Electric	Duke University	205	-339	3,398	348	0	9
Duke University Alternative Vehicles - Prius Hybrid Vehicles	Duke University	0	0	0	0	0	8
Carpool Parking Permits	Duke University	6,293	392	71,195	7,342	137	1,189
Land Use Planning - Transit Friendly Communities	City of Durham/Durham County	analysis forthcoming					
Fannie Mae Smart Commute™ Mortgage Program	Greater Triangle Research Council	No information provided					
Anti-idling Program for Vehicles	DATA	More information required					

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Solid Waste							
Yard Waste Recycling	City of Durham	NA	NA	NA	NA	NA	-4,764[14]
Tidewater Fibre Corporation (TFC) Recycling	City of Durham	NA	NA	NA	NA	NA	41,335
Commercial Corrugated Cardboard	City of Durham	NA	NA	NA	NA	NA	15,949
White Goods	City of Durham	NA	NA	NA	NA	NA	0
Recycling Bins Provided to Community Events	City of Durham	Impacts included in other recycling measures					
Keep Durham Beautiful	City of Durham	Education and awareness program					
Compost Demonstration Centre	City of Durham	Education and awareness program					
Multi-departmental Code Enforcement Nuisance Abatement Team (CENAT)	City of Durham	Enforcement and compliance program					
Swap Shop at Waste Disposal and Recycling Center	City of Durham	More information required					
Stickers Listing Banned Recyclables Placed on Garbage Carts	City of Durham	Education and awareness program					
Compost Bins	City of Durham						97

[14] A negative number indicates that the diversion method will result in greater generation of GHGs than if the waste had been sent to landfill.

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs)					GHG Emission Reduction (t)
		NOx	SOx	CO	VOC	PM10	
Other							
Load Control - Winter (Piedmont EMC)	Piedmont EMC	Estimate to be provided					
Load Control - Summer (Piedmont EMC)	Piedmont EMC	Estimate to be provided					
NC GreenPower - Large Volume product $2.50 per month	NC Green Power	2,765	8,783	202	23	177	794
Total		**342,567**	**663,984**	**1,633,515**	**170,387**	**16,605**	**144,179**

7.2 Future Community Measures

Businesses, institutions, and individuals are already planning to implement many new measures that will reduce their GHG and CAP emissions. Many of these measures and their estimated potential impacts, are summarized in Table 18. Details of the assumptions underlying the emission estimates are provided in **Appendix G**. Together, these initiatives will help Durham County avoid over 124,000 tons of GHG emissions.

Table 18. New Community Emission Reduction Measures Implemented After Base Year 2004/2005: Estimated Annual Emission Reductions

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs)					GHG Emission Reduction (t)
		NOx	SOx	CO	VOC	PM10	
Residential Sector							
Durham Campaign for Solar Hot Water Heaters	Private Sector (possible expansion by County/Clean Energy Durham)	3,274	8,516	343	54	189	979
Manufactured Home Heat Pump Program	TJCOG	85	271	6	1	5	25
Heat Pump Loans - Piedmont EMC	Piedmont EMC	57	180	4	0	4	16
Energy Audits - Piedmont EMC	Piedmont EMC	754	1,947	80	13	43	226
Commercial/Institutional Sector							
Energy Audits for Commercial Buildings	Triangle J Council of Governments						
Imperial Point L.L.C. Page RD LEED Certified Restaurant	Chapel Hill Restaurant Group	Design in progress: Information forthcoming					
North Carolina School of Science & Math - Facility energy efficiency	North Carolina School of Science & Math (NCSSM)	Estimate forthcoming					
Duke University Power Plan (low-sulfur coal)	Duke University	More information required					
Duke University Green Purchasing Policy - Energy Star for New Appliances	Duke University	2,556	8,120	186	21	164	734
Public School Energy Efficiency Initiatives	Durham Public Schools	Information not yet available					
LEED for New Schools	Durham Public Schools	More information required					
Public School Temperature Controls	Durham Public Schools	12,583	37,360	1,072	142	779	3,681
New First Environments Early Learning Center (FEELC), EPA, RTP	US Government	More information required					
LEED Building - Research Triangle Foundation H, 12 Davis Drive, RTP	Research Triangle Foundation	Design in progress: Information not yet available					
LEED Building - 3054 Cornwallis Rd, RTP	Syngenta Biotechnology Inc.	More information required					

Industrial Sector
No new measures identified

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Transportation Sector							
Smart Commute Challenge	Triangle Transit Authority	1,959	132	26,366	2,711	36	418
No Idle Policy	Durham Public Schools	345	13	260	33	14	24
Hybrid Electric Buses - DATA	DATA	More information required					
North Carolina Central University Petroleum Displacement Plan	NCCU	Information will be provided in September					
North Carolina School Science & Math Petroleum Displacement Plan	North Carolina School of Science & Math	-13	7	19	13	7	15
DCHC Long Range Transportation Plan (LRTP) - Transportation Improvement Projects[15]	DCHC MPO, City of Durham, Durham County and Triangle Transit Authority	The LRTP will have a very significant impact on GHG and CAP emissions within Durham County, however the impacts of this project are included in the business as usual scenario and would be double-counted if provided here. (Includes measures such as Park and Ride Lots, and Parking Fare Increases)					

Name of Measure	Implementing Authority	CAP Emission Reduction (lbs) NOx	SOx	CO	VOC	PM10	GHG Emission Reduction (t)
Solid Waste							
Ordinance Amendments in 06/07 provide for Civil Enforcement	City of Durham	Enforcement and compliance program					
SWM Code Enforcement Officer (Proposal for Funding)	City of Durham	Enforcement and compliance program					
Household Hazardous Waste - long term plan	City of Durham	Enforcement and compliance program					

[15] Emission reductions include combined impacts of the following LRTP projects: 1)TTA Rail - Phase 1; 2) TTA Phase II; 3) I-40 High Occupancy Vehicle (HOV) Lanes; 4) NC 147 (Durham Freeway) High Occupancy Vehicle (HOV) Lanes; 5) High Capacity Transit; 6) Pedestrian Transportation Plan; 7) Bike Lanes and 8) Bicycle Transportation Plan

Compost Bins	City of Durham	CAPs not calculated for waste management measures				97
Waste Management Plan	City of Durham					
Bar & Restaurant Recycling in NC	NC State-lead initiative					
New Development Requirement - Cardboard Dumpsters and Recycling Bins with each garbage dumpster	City of Durham					
Recycling - Mixed Paper	City of Durham	CAPs not calculated for waste management measures				118,581
Total		**21,600**	**56,546**	**28,337**	**2,988**	**1,241**	**124,796**

7.3 Existing Reduction Measures for Local Government Operations

The City and County have already initiated many activities within their operations that have enabled them to reduce energy use, save money or avoid expenditures and reduce greenhouse gas and criteria air pollutant emissions. Table 19**Error! Reference source not found.** provides a summary of the estimated annual emission and financial impacts that each of these measures has produced. To date, the City and County's efforts have resulted in GHG emission reductions of approximately 2,359 tons and avoided costs of approximately ***[to be determined]***. A brief description of each measure follows Table 19 and specific information about how the GHG reduction impact was calculated is provided in an accompanying spreadsheet in **Appendix** .

Table 19. 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	County							
Energy Efficiency: Carmichael Building	County							
Energy Efficiency: Community Shelter	County							
Energy Efficiency: Cooperative Extension	County							
Energy Efficiency: Detention Facility	County							
Energy Efficiency: Health Department	County							
Energy Efficiency: Judicial Building (including 3 prk lots)	County	2,987	12,350	48	-18	222	784	
Energy Efficiency: Main Library (Before Expansion)	County	1,208	3,837	88	10	77	347	
Energy Efficiency: Social Service Building	County							
Energy Efficiency: Durham Solid Waste Operations Facility	City	More information required						

Table 19 continued…

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM10 (lbs)	GHG (t)	Avoided Costs ($)
Vehicle Fleet								
Hybrid Vehicles	City	27	2	305	32	1	6	
Ethanol 85 Fuel Use	City	90	5	995	120	0	15	
Compressed Natural Gas Vehicle	City	76	4	623	77	1	2	
LED Traffic Signals - replacements/installations	City	2,238	7,110	163	18	144	643	
Water & Sewage								
Showerhead Exchanges	City	232	738	17	2	15	67	
Water Conservation Team	City	0	0	0	0	0	0	
Biogas Capture and Flaring	City	More information required						
Water Use Assessments	City	Cost saving measure w/o emission impacts						
Solid Waste								
Waste Reduction Policy	City	More information required						
Recycling Program	City						136	
Recycling Program	County						359	
Total		**6,858**	**24,046**	**2,239**	**241**	**460**	**2,359**	

[Draft Note: estimated cost savings to be added]

[Draft Note: Descriptions of Each Measure to be added]

7.4 Future Reduction Measures for Local Government Operations

Both the City and the County have already committed to implementing several new emission reduction measures. The potential emission impacts of these measures are summarized in Table 20 below. An additional description of each measure is provided in the text that follows this table and details of the assumptions made to estimate the potential impacts of these measures are provided in **Appendix** .

Table 20. Local Government Operations: Planned New or Expanded Emission Reduction Measures

Name of Measure	Implementing Authority	NOx (lbs)	SOx (lbs)	CO (lbs)	VOC (lbs)	PM_{10} (lbs)	GHG (t)	Avoided Costs ($)
Buildings								
LEED for New Buildings Contained within Capital Improvement Plan	County	10,590	31,336	908	121	655	3,100	
Administrative Complex 200 E. Main Street - Direct Digital Control	County	626	1,989	46	5	40	180	
Detention Facility 217 S. Mangum Street - Solar Energy	County							
General Services Complex 310 S. Dillard Street	County	82	261	6	1	5	24	
Jail Annex 326 E. Main Street - Roof Insulation	County							
Main Library EXISTING SPACE	County	1,158	3,426	99	13	72	339	
Main Library AFTER EXPANSION PROJECT	County							

Table 21 continued…

Name of Measure	Implementing Authority	NO_x (lbs)	SO_x (lbs)	CO (lbs)	VOC (lbs)	PM_{10} (lbs)	GHG (t)	Avoided Costs ($)
Buildings								
Stanford L. Warren Library - Energy Efficient Upgrades	County	87	276	6	1	6	25	
Youth Home 2432 Broad Street	County							
City Hall Elevator & Energy Efficiency Upgrade	City							
Vehicle Fleet								
Underutilized Vehicle Study	City	25	2	294	31	1	6	
Vehicle Replacement Plan - improved technology	City	May be business-as-usual; need to discuss further						
Vehicle Replacement Plan - improved fuel efficiency of police fleet	City	310	16	3,285	338	7	54	
Alternative Fuel Vehicles - Biodiesel	County	Information required to estimate impacts						
Ethanol-fuelled vehicles and infrastructure	County	Information required to estimate impacts						
Biodiesel/Ethanol	County	Information required to estimate impacts						
Hybrid Vehicles	County	Information required to estimate impacts						
Idle Reduction Policy	County	Information required to estimate impacts						

Name of Measure	Implementing Authority	NO_x (lbs)	SO_x (lbs)	CO (lbs)	VOC (lbs)	PM_{10} (lbs)	GHG (t)	Avoided Costs ($)
Street, Traffic & Other Outdoor Lighting								
LED Traffic Signals - replacements made after FY 2005	City	7,732	24,560	564	63	496	2,220	
LED Traffic Signals - new lights installed after FY 2005	City	277	880	20	2	18	80	
Water & Sewage								
Landfill Gas Utilization	City	20,161	803	5,206	1,110	-634	7,414	
Water Reclamation Project	County	Information required to estimate impacts						
Triangle Wastewater Treatment Plant - LEED certified	County	Information required to estimate impacts						
Total		**41,048**	**63,549**	**10,434**	**1,685**	**666**	**13,442**	

[Draft note: descriptions of each measure to be added]

8 Local Action Plan Implementation Plan

8.1 Departmental Roles & Responsibilities

8.2 Monitoring & Follow-up

8.3 Funding

Works Cited

Energy Information Administration. *Adjusted Distillate Fuel Oil and Kerosene Sales by End Use 1984-2004. Data Tables. Accessed online: http://www.eia.doe.gov/*

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Vida, H., Henning, B., and B Hugman. *Study of the Propane Industry's Impact on U.S. and State Economics November 2004.* Prepared for the National Propane Gas Association and the Propane Education & Research Council.

Capital Improvement Plan, Durham County, North Carolina. 2006-2015. Available online: http://www.co.durham.nc.us/departments/bdmg/PDF/2006-2015CIP.pdf

[Draft note: additional sources to be added]

Appendix A – Solid Waste Emission Calculation Methodology

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

Table A. Waste-Related GHG Emission Factors

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 inventory, only emissions at the disposal site are calculated using the following equation:

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

where W_t is the quantify of waste type ‘t", and

R is the methane recovery factor and is only applied in the case of landfilled waste. It is assumed that there is no methane recovery for the disposal types (open burning, open dumps, etc.)

In the Community Measures and Government Measures modules, the impact on emissions of any particular measure will depend on the difference between the emissions that happened or would have happened in the absence of the measure (the "before" or "from" disposal type) and the emissions that occur after the measure (the "after" or "to" disposal type).

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

where the “after" and "before" subscripts indicate the emission factors associated with this waste type for the "after" or "to" disposal type and the "before" or "from" disposal type.

A complete list of the emission Analysis Module Default Waste Coefficients (tons GHG /ton) and Measures Module Default Waste Coefficients (tons GHG /ton) is provided in the CACP software.

Appendix B – Material Waste Stream Distributions

Table A. 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 B. 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%

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.

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.

	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

Appendix D – Data Providers and Sources

Sources of Data Compiled for Community Greenhouse Inventory

Sector	Source (Contact/Title/Department)	Organization	Data provided
Transportation	Ellen Beckmann, Transportation Planner	DCHC MPO	Vehicle Miles traveled on average day in 2005 and 2030
Residential/Commercial/Industrial	Laura Dale Woods, Senior Planner, Planning Department	City of Durham	Population, Household, Employment by sector for 2005 & 2030
Residential/Commercial/Industrial	Davis Montgomery, Customer Relations	Duke Energy	Electricity consumption
Residential/Commercial/Industrial	Robin Blanton, Manager of Engineering	Piedmont EMC	Electricity consumption
Residential/Commercial/Industrial		Wake EMC	Electricity consumption
Residential/Commercial/Industrial	Jerry O'Keeffe, Manager - Large Accounts, Raleigh & Durham Regions	PSNC Energy	Natural Gas Consumption
Solid Waste	Julia Mullen, Program Analyst, Department of Solid Waste Management	City of Durham	Solid Waste 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 I	NC DENR Division of Air Quality	Fuel sulfur content and RVP for 2002 and 2017 for NONROAD model

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 information for County buildings
Buildings	Youssef Hammad	City of Durham	Internet access to City's natural gas bills
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 total number and wattage of lights; estimate of annual new light installations
Street, Traffic and Other Outdoor Lights	Terry Thompson	City of Durham	Total electricity costs for street lights operated by City of Durham; number and type of lights in place at the end of FY 2005; estimate of annual new light installations
Water & Sewage	Nancy Newell,	City of Durham	Energy consumption & costs for water and waste water treatment facilities, indicators, energy cost and consumption in admin. buildings
Water & Sewage	Glenn Whisler	Durham County	
Solid Waste (generated by local government operations)	Michael Turner	Durham County	Tons of solid waste produced by County's operations

Appendix E – Local Government Inventory: 2004/2005 Energy Use & Costs by Individual Buildings

City of Durham Buildings: 2004/2005 Energy Consumption, Costs and Building Size

Service Address	Energy Use Electricity (kWh)	Natural Gas (therms)	Energy Cost Electricity ($)	Natural Gas ($)	Floor Area ('000s Square Feet)
000 G T JONES DURHAM	79	0	268.8	0	0
1 Third Fork Rd, Durham, NC 2770	0	252	0	433.27	0
100 CORCORAN ST DURHAM	18	0	23.51	0	0
1001 NINTH ST DURHAM	125,840	7,083	7064.55	8157.79	11
101 CITY HALL PLAZA DURHAM	5,900,700	0	282850.2	0	127
101 S DRIVER ST DURHAM	51,856	2,601	3831.3	3133.49	0
104 MORRIS ST #A DURHAM	10212	0	1123.68	0	0
109 E Chapel Hill St, Durham, NC 27701	0	0	0	0	0
1100 Gilbert St, Durham, NC 27701	0	1,056	0	1369.91	0
1100 MARTIN LUTHER KING JR PKY DURHAM	50	0	135.44	0	0
1100 MORREENE RD DURHAM	35,560	1,209	3317.48	1560.92	0
1100 N ALSTON AVE DURHAM	80,534	3,472	5970.96	4145.25	0
1101 GILBERT ST DURHAM	9,396	0	1044.33	0	0
1200 N ALSTON AV DURHAM	19,807	0	2056.8	0	0
1204 ALSTON AV DURHAM	29,710	1,775	2948.66	2209.21	0
1230 CARPENTER FLETC DURHAM	58,240	3,180	3883.92	3801.08	5
1300 S ROXBORO ST DURHAM	36,276	0	2742.85	0	0
1300 W CLUB BLV DURHAM	12,537	0	1349.78	0	0
1301 W Club Blvd, Durham, NC 27705	0	1,072	0	1391.17	0
1308 FAYETTEVILLE ST DURHAM	16,360	0	1625.47	0	18
131 HALLEY ST DURHAM	707,700	0	45392.76	0	0
1327 UMSTEAD RD DURHAM	65,800	2,651	5193.08	3194.93	7
139 E Morgan St, Durham, NC 27701	0	6,013	0	6948.2	0
1400 FAYETTEVILLE ST DURHAM	296,440	6,442	17088.88	7462.67	0
1530 ACADIA ST DURHAM	11,808	1,102	1387.69	1417.04	0
1531 S ROXBORO ST DURHAM	4,582	0	794.52	0	0
1608 Acadia St, Durham, NC 27701	0	1,036	0	1342.8	0

Service Address	Energy Use Electricity (kWh)	Energy Cost Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s Square Feet)
1630 UNIVERSITY DR DURHAM	44,218	0	4335.69	0	0
1639 University Dr, Durham, NC 27707	0	5,503	0	6409.86	0
1805 COLE MILL RD DURHAM	55,360	2,538	4642.25	3078.57	3
1809 Camden Ave, Durham, NC 27704	0	9,837	0	11157.82	0
1811 CAMDEN AV DURHAM	156,480	0	10302.86	0	0
1818 RIDDLE RD DURHAM	70,520	2,506	4276.16	3028.26	7
1833 CAMDEN AVE DURHAM	821,832	29,317	51833.87	30804.63	0
1900 CAMDEN AV DURHAM	766,500	33,135	46071.88	36690.14	38
1911 E CLUB BLVD DURHAM	1,743	0	300.07	0	0
2 Third Fork Rd, Durham, NC 27707	0	5,602	0	6548.47	0
200 N MANGUM DURHAM	26	0	133.05	0	0
2002 S Alston Ave, Durham, NC 27707	0	27,557	0	31484.86	0
2007 HILLOCK PLACE DURHAM	83,904	0	6547.7	0	0
2008 E CLUB BLV DURHAM	272,276	13,416	19499.14	15788.52	0
2010 S ALSTON AV DURHAM	725,376	0	37522.97	0	0
2011 FAY ST DURHAM	737,520	15,404	45629.81	17477.46	0
2012 E CLUB BLVD DURHAM	45,400	2,116	3476.22	2587.44	2
2100 W CLUB BLVD DURHAM	6	0	131.14	0	0
2117 CAMDEN AV DURHAM	58,960	0	6059.58	0	0
213 BROADWAY ST DURHAM	174,946	1,774	11305.19	2201.26	14
2212 CHAPEL HILL RD DURHAM	74,360	2,320	4731.36	2801.1	0
222 Foster St, Durham, NC 27701	0	7,640	0	8856.98	0
2309 HAVENTREE RD DURHAM	6,528	0	765.42	0	0
2614 CREST ST DURHAM	31,280	1,661	3013.24	2050.85	0
2615 HARVARD AVE DURHAM	25,130	1,753	2500.13	2186.57	0
2800 W CORNWALLIS DURHAM	69,240	0	4387.97	0	5
2901 MIAMI BLV DURHAM	65,120	2,859	5157.19	3431.75	7
2920 WEAVER ST DURHAM	107,000	0	8793.18	0	10
3 Third Fork Rd, Durham, NC 27707	0	1,889	0	2292.8	0

Service Address	Energy Use Electricity (kWh)	Energy Cost Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s Square Feet)
3022 FAYETTEVILLE ST SEC#B DURHAM	64,410	1,395	5119.71	1779.13	0
314 N Mangum St, Durham, NC 27701	0	56,727	0	61264.77	0
318 Liggett St, Durham, NC 27701	0	0	0	0	0
3223 E Geer St, Durham, NC 27704	0	0	0	0	0
3300 FAYETTEVILLE ST DURHAM	4,338	0	552.43	0	0
3400 THIRD FORK CREEK RD DURHAM	113,980	0	9899.95	0	0
3510 SANDY CREEK RD DURHAM	57	0	136.1	0	0
3617 WESTOVER RD #6 DURHAM	8,126	0	920.81	0	0
3700 SWARTHMORE RD DURHAM	69,496	3,884	4470.72	4590.45	6
3727 FAYETTEVILLE ST DURHAM	10,998	0	3562.64	0	0
3919 N DUKE ST DURHAM	71,030	3,282	4565.48	3911.9	4
400 CLEVELAND ST DURHAM	364,480	6,869	20672.83	7710.16	17
400 COMMONWEALTH ST DURHAM	8,765	0	967.52	0	0
400 MORRIS ST DURHAM	432	0	984	0	0
400 US 70 DURHAM	14	0	131.92	0	0
400 W CHAPEL HILL ST DURHAM	36,440	0	3468.29	0	1
401 E LAKEWOOD AV DURHAM	214,040	0	13732.86	0	0
404 W Lavender Ave, Durham, NC 27704	0	0	0	0	0
409 BLACKWELL ST DURHAM	2,140,416	0	151624.2	0	4
411 Blackwell St, Durham, NC 27701	0	47,014	0	51409.65	0
428 MORRIS ST DURHAM	2,140	0	1810.1	278.64	0
4600 FAYETTEVILLE ST DURHAM	1,045	0	232.2	0	0
5 Third Fork Rd, Durham, NC 27707	0	6,973	0	8034.46	0
502 FOSTER ST DURHAM	320	0	984	0	0
505 W CHAPEL HILL ST DURHAM	2,085,000	31,844	104004	35419.12	76
5101 N ROXBORO RD DURHAM	67,939	0	6999.38	0	0
514 E WOODCROFT PKWY DURHAM	40,896	0	5965.76	0	0
516 RIGSBEE AV DURHAM	15,560	219	1643.77	383.37	14
531 LAKELAND ST DURHAM	667	110	97.51	171.71	0

Service Address	Energy Use Electricity (kWh)	Energy Cost Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s Square Feet)
600 GARRETT RD RR7 DURHAM	22,469	0	2315.68	0	0
600 MURRAY AV DURHAM	803,060	32,062	49674.85	35611.19	23
7615 CASSEM RD BUTNER	29,296	0	2959.75	0	0
8 SUMNER CIR DURHAM	28,966	0	2923.84	0	0
822 N MIAMI BV DURHAM Fire Station 3	63,120	3,639	5051.61	4301.13	7
8400 NC 751 DURHAM	148,224	0	11095.87	0	0
900 LIBERTY ST DURHAM	12,041	0	2355.38	0	0
917 E NC 54 DURHAM	82,380	0	6068.43	0	0
917 LIBERTY ST DURHAM	24,946	0	2070.87	0	0
ACADIA ST DURHAM	120	0	302.36	0	0
ALSTON AV & GILBERT DURHAM	46,243	0	4002.54	0	0
ALSTON AV DURHAM	38,245	0	3478.3	0	0
BELLEVUE AV DURHAM	1,277	0	243.87	0	0
BRITT ST DURHAM	21,420	0	2675.04	0	0
CASSEM RD BUTNER	21,559	0	2222.92	0	0
CHEEK @ SHERWOOD PK DURHAM	500	0	451.38	0	0
CORNER PARRISH & MANGUM DURHAM	0	0	130.56	0	0
E CLUB BLVD DURHAM	1,005	0	130.38	0	2
FARRINGTON RR6B138 CHAPEL HILL	154	0	145.55	0	0
FOSTER ST DURHAM	208,560	0	14689.6	0	0
GUESS RD DURHAM	11,469	0	1376.49	0	0
HALLEY ST DURHAM	16,689	0	1960.71	0	0
HILLANDALE & I85 SOUTH DURHAM	102	0	42.56	0	0
I85 & ROXBORO DURHAM	118	0	142.05	0	0
LEIGH FARM RD DURHAM	11,300	0	1229.49	0	0
MANGUM & MORGAN ST DURHAM	13,622	0	1393.15	0	0
MORREENE RD PARK DURHAM	7,100	0	911	0	0
MORRIS ST DURHAM	79,104	0	7710.3	0	0
N ALSTON AVE DURHAM	0	0	130.56	0	0

Service Address	Energy Use Electricity (kWh)	Energy Cost Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s Square Feet)
OREGON ST DURHAM	30,528	0	3467.74	0	0
ROXBORO RD DURHAM	0	0	196.8	0	0
S ALSTON & SHERMAN DURHAM	8,240	0	1164.7	0	0
ST MARKS RD #19 DURHAM	16,188	0	1704.83	0	0
STADIUM DR DURHAM	35,018	0	5819.47	0	0
STALLINGS RD DURHAM	21,760	0	1871.65	0	0
STALLINGS RD L#4 DURHAM	461,440	0	33081.55	0	0
THIRD FORK CREEK RD DURHAM	15,936	0	2433.15	0	2
VALLEY SPRINGS PARK DURHAM	61,010	0	9229.59	0	0
WEYBURN AVE DURHAM	5,723	0	687.12	0	0
Total	**19,227,000**	**399,789**	**$1,172,565**	**$450,311**	

Durham County Buildings: 2004/2005 Energy Consumption, Costs and Building Size

Building	Energy Use Electricity (kWh)	Natural Gas (therms)	Energy Cost Electricity ($)	Natural Gas ($)	Floor Area ('000s square feet)
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
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 Resource Center	104,317	0	6,259.00	0.00	10.531

Building	Energy Use Electricity (kWh)	Energy Cost Natural Gas (therms)	Electricity ($)	Natural Gas ($)	Floor Area ('000s square feet)
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. (EMS 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 Complex	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 (including 3 prk lots)	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	
North 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 Container 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 Library	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**

Appendix F – Changes to Building Tenure (Fiscal Year 2005 through 2030)

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
Campus Hills Park & Recreation Centre Renovation	Addition of weight room	1,300 (weight room) 100 (office/storage)	22,000	51,000	City of Durham	
Environmental Education Center	This project will design and construct an Environmental Education Center with classroom space and meeting space. Initial site selection is West Point on the Eno Park, but Sandy Creek Park is also possible--public meetings are underway to determine site.	Not funded or designed at this time	NA	NA	City of Durham	
Leigh Farm Historic Site Renovation, Phase II	This project funds the historically-accurate restoration of the National Register property Leigh Farm, including refurbishing the 1832 house and buildings as a Rural Life Educational Center and creating a	No new facilities. Current building energy costs will be assumed by City when tenants leave	NA	NA	City of Durham	

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
	small visitor center.					
NECD Recreation Center	This project includes the purchase and renovation of the former 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 DPR space, 35,000 shared space with DPS. No decisions yet on how operations cost will be shared.	1,007,500	1,911,000	City of Durham, Durham County and Durham Public Schools	
New Park - SE Durham	SE Durham is the most rapidly growing area of the City, but its park facilities are very limited. This funding request is for acquisition of a parcel adequate for a community park (min 20 acres) 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	Not funded nor designed at this time	NA	NA	City of Durham	

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
	complex north of Snow Hill Road, with utilities and parking to be shared with proposed adjacent middle school.					
Southwest Durham Recreation Center	This project will design and construct a full-service recreation center (pool and gym) to serve the rapidly growing section of southwest Durham.	Not funded nor designed at this time	NA	NA	City of Durham	
Durham Performing Arts Center	This project designs and constructs a new 2,800 seat theatre venue for major concerts, performances, plays and the American Dance Festival. It will serve as a catalyst for tourism in Durham and provide sufficient space for existing performances.	100,000	970,000	3,579,000	City of Durham	
City Hall Annex Major	This project corrects	5,000	77,500	147,000	City of	

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
Renovation	deferred maintenance conditions in the 56,877 square foot City Hall Annex/Planning Building and includes a 5,000 sq. ft. addition to the Annex.				Durham	
Camden Ave. Radio Building	Construct a masonry building to replace the two modular buildings currently in use and improve lightning protection and grounding of tower.	Unknown	NA	NA	City of Durham	
Fire Station #15	This fire station will serve the far northern area of the City. The fire station will be a two-bay, 6500 square foot station with separate accommodations for firefighters. The project proposes new positions to staff an Engine and Ladder company.	6,500	100,000	23,600	City of Durham	

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
Fire Station #16	This fire station will serve the southwestern area of the City. The fire station will be a two-bay, 6500 square foot station with separate accommodations for firefighters. This project is funded and is scheduled for completion in August 2006.	6,500	100,000	236,600	City of Durham	
Fire Station #8	This fire station will serve the southwestern area of the City. The fire station will be a two-bay, 6500 square foot station with separate accommodations for firefighters. his project is funded and is scheduled for completion in August 2006.	6,500	100,000	236,600	City of Durham	
Joint 911/E.O.C Building	A joint funded project with the county will be constructed on county-owned	30,000	470,700	1,092,000	City of Durham	City of Durham & Durham

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
	property near Lowes Grove. The proposed 30,000 sq. ft. facility will provide needed space.					County
Durham Station	This project constructs a multi-modal transportation center in central Durham that will provide bus, rail, regional transit and taxi services. The project is 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 St (Station 2)	New construction	6,016			Durham County	
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	New construction	26,649			Durham	

Building Name/Address	Change to Size/Tenure	Area (square feet)	Electricity Consumption (estimated)	Natural Gas Consumption (estimated)	Jurisdiction	Year
Library					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	

Appendix G – Details of Community Emission Reduction Measures

Appendix H – 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. Table 21 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 21. Off-Road Engine Base Year 2004/2005: CAP & GHG Emissions Estimated Using EPA NONROAD Model

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

Note: A more detailed breakdown of this analysis will be provided in subsequent drafts.

Appendix I – Details of Local Government Emission Reduction Efforts