Carrboro, Chapel Hill Hillsborough, & Orange County

GREENHOUSE GAS EMISSIONS INVENTORY AND FORECAST

Final Report

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

Btu - British Thermal Units; 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). A standard unit of measure.

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

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

CRed – Community Carbon Reduction Program; a greenhouse gas mitigation program developed by the University of East Anglia, UK.

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

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

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

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

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

LAP – Local Action Plan.

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

MMBtu – Millions of British Thermal Units.

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

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

UNC – University of North Carolina at Chapel Hill.

FOREWORD

The following report is a working document and should be considered to be a work-in-progress. This report contains the baseline inventory (2005), and a forecast of emissions to the target year 2030. The communities involved will need to select collective emissions reduction targets for both the community and for local government operations to achieve by the target year. The forecasts will help to determine how much growth in emission between 2005 and 2030 will need to be offset, before a further reduction in emissions below baseline levels can be achieved.

This report also contains an inventory of emissions reduction measures already in place, or planned within Orange County, Hillsborough, Carrboro and Chapel Hill. The measures section is intended to illustrate what types of programs are already in place in Orange County, as well as which of these programs have been the most successful at reducing greenhouse gas emissions. This information will be helpful when the communities begin to implement more reduction activities.

The Emissions Reduction Plan contains recommendations for the types of programs that could be implemented by the local governments of Orange County to reduce emissions in their communities and in their own operations by 2030. Using measures recommended by staff and committee members, as well as their own recommendations, ICLEI has developed scenarios that illustrate the levels of emissions reductions that are achievable based on different levels/ of commitment on the part of the local governments (low, medium and high). Staff and the Climate Change Committee are responsible for selecting targets (for the local governments sector and the community sector) and recommending them to town councils and the county board of commissioners for formal adoption.

This report is divided into six sections. Section 1 provides background information on climate change and the community of Orange County, as well as an introduction to the Cities for Climate Protection (CCP) campaign, and rationale for participation in the program. Section 2 lays out the methodology of the project, and emission calculations, as well as data sources used for completing the inventory. Section 3 of the report contains the 2005 baseline greenhouse gas inventory for both the municipal sector and the community sector in Orange County. Section 4 contains the forecast of emissions to the target year 2030, given current levels of growth. Section 5 contains details of the GHG reduction measures currently in place, or planned in Orange County that ICLEI has been able to collect and quantify. Section 6 contains the body of the Local Action Plan, including: recommended measures (by sector), illustrative case studies, general recommendations, and estimated reductions under the conservative, moderate and aggressive scenarios.

1 Background

1.1 What is Climate Change?

At its most basic level, climate change is a change in the long-term average weather (temperature, precipitation, wind patterns) that a given region experiences. On a global scale, climate change refers to changes in the Earth's climate as a whole. The Earth's temperature is regulated by a natural system known as the "greenhouse effect" whereby a delicate balance of naturally-occurring gases traps some of the sun's radiation near the earth's surface. This radiation heats the atmosphere and creates the conditions which make life on earth possible. The most common naturally occurring greenhouse gases (GHG) include: carbon dioxide, water vapor, methane, nitrous oxide, and ozone.

Over time, human activities and lifestyles have resulted in increased concentration of greenhouse gases, intensifying the natural greenhouse effect thus warming the atmosphere more rapidly. The current atmospheric concentrations of greenhouse gases are unprecedented and could potentially have devastating consequences. International scientific consensus is that that our world is getting warmer faster. Climate data gathered during the past 150 years has shown that while the earth has gone through a series of warm periods and cool periods, the rate of increase in average global temperatures has exceeded that of any historical period. This is cause for concern. At the current rate of increase, most experts agree that average global temperatures could rise by 2.5 to 10.4 degrees Fahrenheit over the period from 1990 to 2100.[1] Climate systems exist as a delicate balance and marginal warming has the potential to affect not only temperatures but also precipitation, wind patterns, water levels and other aspects of planet's regulatory system. Climate change, if allowed to continue unabated, has the potential to dramatically alter the planet and life as we know it.

1.2 Climate Change Impacts

Scientists have predicted that climate change may have significant effects in a variety of areas. Environmental impacts could include flooding and erosion in coastal regions, increased risk to forests from pests and drought, changes in agriculture yields. More frequent and severe weather conditions, such as drought, could threaten water sources, causing a decline in water quality and quantity which negatively impacts, humans fish and wildlife.

Climate change will also affect human health directly and indirectly. Higher air temperatures could result in increased heat-related illness or death, particularly in the very young, the ill, and the elderly. Respiratory disorders or allergies could worsen as a result of increased heat, humidity and declining air quality, as could the spread of vector-borne infectious diseases (such as the West Nile Virus). Extreme weather events, such as tornadoes, hurricanes and heat waves could result in increased deaths and injuries.

[1] Intergovernmental Panel on Climate Change Working Group I, Third Assessment Report, 2002.

1.3 The Community of Orange County, NC

Orange County, North Carolina is a growing, dynamic community comprised of both beautiful, rolling farmland and the towns of Chapel Hill, Carrboro and Hillsborough. Orange County is adjacent to Durham County and the City of Durham and nearby Raleigh is located in Wake County. Chapel Hill, Durham, and Raleigh, and surrounding areas in Orange, Durham and Wake Counties, respectively, are referred to as the Research Triangle Region, due to their numerous prominent universities and medical and technological research industries. These sectors attract skilled and educated workers to high paying jobs and the average standard of living in the region is excellent. As a result of the booming local economy and mild climate, the Triangle Region continues to be rated as one of the best places to live in America. As a result, the region continues to attract new businesses and workers and is experiences a rapid rate of growth, which is expected to continue into the coming decades.

In Orange County, over 95% of the workforce is employed in the commercial/institutional sector, major components of which include retail, office work, service provision, medical centers and universities. The remaining 5% of the workforce is employed in the industrial sector.[2] In 2005, the total population of Orange County was 121,991. Table 1 displays the populations of the Towns of Chapel Hill, Carrboro and Hillsborough and the county as a whole in 2005.

Table 1. Population of Orange County and Towns in 2005

Community	2005 Population
Chapel Hill	50,262
Carrboro	17,797
Hillsborough	6,162
Rural Orange County	45,964
Orange County Total	**121,991**[3]

1.4 Why Should Orange County Take Action?

Because of their population density, urban and suburban areas will be more susceptible than rural areas to the negative impacts of climate change. Apart from Orange County's responsibility to do its part to reduce its total contribution to the global climate change problem, there are numerous associated benefits of reducing GHG emissions in the region.

- **Improved Service Delivery**

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

[2] Data source: DCHC MPO

[3] Data source: NC State Demographer's Office. Note: In NC and many other states, cities limits can cross county borders. The city limits of Mebane and Durham both extend somewhat into Orange County and Chapel Hill's city limits extent somewhat into Durham county.

- **Reduced Costs**

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

- **Improved Air Quality and Public Health**

The combustion of fossil fuels used to produce electricity, heat buildings, and power vehicles emits a variety of pollutants into the atmosphere known to have negative health impacts and reduce local air quality. Reduced energy consumption will result in a reduction in local air pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter (PM_{10}), and carbon monoxide (CO). Fighting climate change will also help to offset some its adverse health impacts such as the increased spread of vector borne disease, respiratory ailments and death or injury caused by extreme weather events mentioned above.

- **Asset Management**

Proper asset management involves developing a plan to systematically review the state of facility operations and equipment and implementing a logical repair or upgrade schedule that focuses on a proactive approach to facility improvements. It reduces emissions and also makes good business sense. Preventative maintenance improves the value of local governments' assets by reducing facilities' operating costs, upgrading equipment, and decreasing deferred maintenance. Increasing the efficiency of facilities and operations leads to more efficient, effective and reliable operations, which in turn leads to greater client satisfaction, and the cost savings incurred from improved energy efficiency.

- **Leadership**

By taking concrete steps to address climate change and reduce the emission of greenhouse gases from facilities and operations, Chapel Hill, Carrboro, Hillsborough and Orange County will be able to lead by and provide a solid example to the community. The county and towns have already made commitments to reduce greenhouse gas emissions through participation in the Cities for Climate Protection (CCP) program and as members of ICLEI – Local Governments for Sustainability.

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

By reducing expenditures on energy and fuel, the county and towns can apply the savings towards improving various community services. These may include increasing the number of bike paths, improved public transit and more green space. Measures that make Orange County residents less dependent on automobiles can reduce traffic congestion, clean the air, and contribute to more efficient homes and offices and more sustainable land use patterns. Together, these types of measures can help build healthier, more sustainable communities.

1.5 Local, Regional, National and Global Action on Climate Change

US CCP Participants are saving over $535 million each year in energy and fuel costs and are reducing GHG emission by 23 million tons per year

In 2001, Chapel Hill and Carrboro became members of ICLEI - Local Governments for Sustainability, an international membership association of over 1000 local governments worldwide committed to a sustainable future. In 2003 Orange County also joined ICLEI. The three local governments have also all committed to take part in ICLEI's Cities for Climate Protection (CCP) campaign, joining over 800 municipalities in 31 countries worldwide that participate in the CCP campaign. In the United States alone, over 400 municipalities have joined the CCP. Collectively, American CCP participants, representing approximately 55 million Americans or twenty percent of the total US population, 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 annually in energy and fuel costs. Through this project and report, Chapel Hill, Carrboro and Orange County, in conjunction with the Town of Hillsborough, are working towards completing Milestones One, Two and Three of the CCP campaign.

This inventory and plan coincides with other actions currently being undertaken at the local, regional and national level. As an example of two institutions working together to combat climate change, UNC - Chapel Hill and the Town of Chapel Hill are concurrently working on establishing and piloting Community Carbon Reduction (CRed) programs. The CRed was developed by the University of East Anglia in the UK to help reach the target of 60% reduction in greenhouse gas emissions by 2025 set by the British government. This program seeks to engage the public and local business and organizations in personal carbon reduction efforts. In 2004, UNC Chapel Hill students partnered with University of Cambridge students to implement a pilot CRed program in the City of Cambridge. Upon returning from Cambridge, students challenged Chapel Hill to be the first CRed community in the US, and Chapel Hill Mayor Kevin Foy accepted this challenge. UNC's Carolina Environmental Program (CEP) is taking the lead on these projects and has completed CRed inventories for both the university and in the community. The students and faculty in the CEP have worked with the university to establish economically viable timelines for the implementation of a CRed plan for the university and the university has submitted its intermediate target reductions to the CRed program.

On the national level the United States Department of Energy (DOE) in April 2006, issued new guidelines for the voluntary reporting of greenhouse gas emissions known as "1605 (b)." These new guidelines encourage broader reporting of emissions and sequestration by industry, utilities, small businesses and institutions. The goal of this registry is to comply with the current administration's goal of reducing greenhouse gas emission intensity. Emissions intensity refers to the quantity of emissions resulting from each unit of production rather than reducing overall emissions. Under the program, participating companies will submit an annual report of emissions and reduction efforts. This registry will enable emitters to be credited with reductions they have made. The intent of the new guidelines is to improve accuracy, reliability and verifiability of reported emissions.

At the state level, in 2006, the North Carolina Department of Environment and Natural Resources (DENR) has convened the Climate Action Plan Advisory Group (CAPAG), a group of interested citizens and local climate and energy experts. The purpose of the CAPAG is to develop 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 locally 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 plan established by the CAPAG. Because Carrboro, Hillsborough and Chapel Hill, Orange County and the State of North Carolina are all planning for climate change action concurrently, they are poised to aid one another in achieving their mutual goals of climate change mitigation and social and economic vitality.

The City of Durham and Durham County are also currently developing a greenhouse emission inventory and local action plan. Given the proximity of the Orange County and Durham County, their shared interest in climate change mitigation, and a history of cooperation, it makes sense that the local governments work together to identify potential emission reduction measures that could be implemented cooperatively, which would allow the governments to maximize their available resources. The Durham Chapel Hill Carrboro Metropolitan Planning Organization (DCHC MPO) has been involved with the development of both the Durham and Orange County inventories and local action plans. These plans will complement the DCHC MPO's Long Range Transportation Plan (DCHC LRTP), which uses 2005 as a base year and plans for sustainable growth in transportation infrastructure to 2030.

Given current action at the local, state and national level to regulate greenhouse gas emissions, the time is right for Orange County and the towns of Chapel Hill, Carrboro and Hillsborough to act as leaders on climate change mitigation for the social, environmental and economic sustainability of the region.

1.6 Cities for Climate Protection: Five Milestones to Sustainability

Orange County and the towns of Chapel Hill and Carrboro have formally committed to follow the five milestone framework of the Cities for Climate Protection. The five milestones of the program 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 forecasts emissions for a future year (e.g., 2030) based on current trends. The inventory and forecast provide a benchmark against which the local government can measure progress towards reducing emissions.

Milestone 2. Adopt an emissions reduction target for the forecast year. The local government establishes an emission reduction target as a percentage decrease from baseline year emissions, for both the local government and community as a whole. 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 awareness and education efforts.

Milestone 4. Implement policies and measures. The local government implements the policies and measures contained in its 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

2.1 Emissions Analysis

The purpose of a GHG inventory is to provide a baseline against which the community can measure progress towards the reduction of GHGs. The baseline inventory expresses GHG production as the number of tons of carbon dioxide equivalent (eCO_2/GHG) produced by energy use and waste production in the community. Carbon dioxide equivalent (eCO_2) is a commonly used measure that expresses all GHGs as an equivalent amount of carbon dioxide. For example, nitrous oxide (N_2O) is 310 times as potent as carbon dioxide in causing the greenhouse effect. Therefore, one ton of N_2O is equivalent to 310 tons of CO_2 and equals 310 tons of eCO_2. The reduction target that the community chooses is expressed as a percentage reduction from this baseline emission. For example, if a community is producing 100,000 tons of GHGs in its baseline year and they commit to a 20% reduction in emissions by its target year, it is committing to produce only 80,000 tons of GHGs by its target year.

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

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

The inventory and forecast provide a benchmark against which the towns and county can measure progress towards reducing emissions. In combination with an analysis of the impacts of existing climate mitigation activities in the community, the inventory will also enable Orange County and the towns of Chapel Hill, Carrboro and Hillsborough 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.

2.2 Methodology

At the onset of this project, Orange County and the participating towns established a joint advisory committee of local politicians and community members and a technical team of town and county staff to guide and assist with the creation of the inventory and the development of the local action plan. The teams consisted of people who would be both essential sources of information for the inventory and fundamental driving forces behind the implementation of a plan.

One of the first tasks that these teams were responsible for was to determine an appropriate base year and target year for the inventory. To coincide with Kyoto targets, ICLEI recommends a baseline year of 1990. However, this is often not possible to gather data from 1990, given the amount of time that has lapsed, and the lack of data available to local governments. If a baseline year of 1990 is not possible, ICLEI recommends using the furthest back year for which data is available. The years 2002 and 2005 were both considered for Orange County's inventory baseline year. Ultimately, the year 2005 was selected because it was the year for which the most comprehensive data was available. The one drawback of selecting such a recent baseline year, however, is that reductions measures undertaken up to that year cannot be counted towards the overall reduction target. The year 2030 was selected as the target year, partially so that this action plan would coincide with the DCHC MPO's *Long Range Transportation Plan*.

ICLEI used the Clean Air and Climate Protection (CACP) software to develop a GHG emission inventory, forecast, target and local action plan. The CACP software applies fuel and sector-specific GHG emission factors to inputs of energy consumption in order to determine the emissions generated by the energy use.

A discussion of the process undertaken to collect inputs for the software is described in section 2.3. The remaining sections under 2.3 explain how emissions were calculated from energy consumption data.

2.2.1 Electricity Emissions

GHG emissions from energy consumption are calculated using emissions coefficients which specify the amount of GHGs per unit of energy used. 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 in the region in which the municipality is located. The software uses the regions of the country defined by the North American Electric Reliability Council (NERC) to determine regional energy emissions. These regions correspond to grid-connected electricity-producing regions of the country. Orange County is located within NERC region 09 - Southeastern Electric Reliability Council/Excluding Florida.

The net GHG emission 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 2005 emission factors were used to calculate GHG emissions in this report. A further discussion of how emission factors were derived is included in Appendix H.

2.2.2 Fuel Emissions

The CACP software uses a set of carbon dioxide emission factors for all sectors (local government, residential, commercial/institutional, industrial, and transportation) for each fuel type. Carbon dioxide emissions vary only with the type and amount of fuel consumption and do not have significant technology dependence.

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

Examples of biologically derived fuels that are not included in the analysis are: wood and other wood derived fuels, landfill methane, sewage gas, methanol, ethanol and biodiesel. It should be noted that when blended fuels (i.e. B20 – 20% biodiesel + 80% traditional diesel) are in use, the fossil fraction of the fuel does contribute to the net-GHG emissions.
It is assumed that all of these fuels are fully combusted when they are utilized. The CCP adopts the convention that burning of wood or biomass is not a source of GHG in the emissions inventory. This assumes that the source of the biofuel is allowed to regrow. For example, if the wood burned comes from an old growth forest that has been clear cut and converted into a parking lot, there would be a net increase of GHGs in the atmosphere. As most biofuels come from on-going agricultural processes and not onetime land conversions, this is not usually an issue. Excluding the GHG emissions from the emissions analysis follows international (IPCC) conventions.

2.2.3 Transportation Emissions

The CACP software uses a simple equation for describing the impact of a particular measure or strategy for the transportation and vehicle fleet sectors. 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 GHGs:

$$\textit{Emissions} = \textit{VMT} \; X \; \textit{Emissions per VMT}$$

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

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

The term in brackets represents vehicle-trips. The difference between the number of person-trips and the number of vehicle-trips depends on how many people there are in the vehicle. The vehicle occupancy factor (persons per vehicle) is the 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

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

2.2.4 Solid Waste Emissions

GHG emissions from waste and waste related measures depend on the type of waste and on the disposal method. The combinations of waste types and disposal methods used in the CACP software are shown below in Table 2. For each waste type and disposal method combination represented in the software, there is a set of five emission factors (A, B, C, D, E) which specify tons of GHG emissions per ton of waste:

Table 2. 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 GHG inventory, only emissions at the disposal site (factors A and B) are calculated using the following equation:

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

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

2.3 Community Inventory & Forecast Data Collection

This section contains a discussion of the sources of information that were used for calculating emissions. A complete list of data sources is included in Appendix D.

2.3.1 Electricity

According to staff at the North Carolina Utilities Commission, two electric utilities provide service within Orange County. These companies are Duke Energy and Piedmont Electric Membership Corporation (PEMC). Duke Energy staff was able to provide us with the total amount of electricity sold within Orange County in 2005, broken down by rate class (residential, commercial/institutional and industrial). Piedmont EMC provided an estimate of the total number of commercial/institutional and residential customers they serviced within the County in 2005 along with an estimate of the average annual electricity consumption by their residential and commercial/institutional customers. Piedmont does not service any industrial customers.

UNC at Chapel Hill also produces energy and steam at its co-generation plant. This plant runs mostly on coal but also uses some natural gas and fuel oil. This plant operates at over 90% efficiency, which is much higher than a typical power plant, in which much of the energy is lost as heat. However, the plant still produces GHG relative to the amount of coal consumed.

2.3.2 Natural Gas

PSNC is the only natural gas provider within Orange County. PSNC provided ICLEI with the total natural gas consumed by its customers within Orange County for 2005, broken out by three rate classes: residential, commercial/institutional and industrial. PSNC's rates classes 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/institutional 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 by the SIC. UNC Chapel Hill is classified as industrial by PSNC, however, it is classified as commercial by Duke Energy. In order to be consistent, we have subtracted UNC Chapel Hill's natural gas use from the industrial total, and have added it to the commercial/institutional total.

2.3.3 Other fuels

In addition to electricity and natural gas, other fuels such as propane, kerosene, light and heavy fuel oils, stationary diesel and coal are used to power homes, businesses and institutions within Orange County. At the onset of the project, ICLEI contacted each of the fuel providers within Orange County to request data on fuel use by their customers in 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/institutional and industrial employees in North Carolina. These factors were then multiplied by the number of households and employees in Orange 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).

ICLEI acknowledges that this methodology may not represent actual fuel use in Orange County entirely accurately; however it was the best data available at the time this report was published. Orange County may want to consider collecting more accurate data for this sector so that issues arising from the use of alternative fuels that vary by demographics can be addressed.

2.3.4 Transportation

Transportation emissions were estimated using vehicle miles traveled (VMT) in the community as provided by the DCHC MPO. A new model for calculating VMT was developed at the same time as this inventory. Accordingly, the transportation data in the inventory was calculated using the new model. At the time of writing, the model was not yet ready to forecast VMT, and accordingly, the data calculated using the old model was used for the 2030 forecast. It should be noted that the community transportation emissions in the Durham inventory were calculated using the old VMT model, and as a result, may not be directly comparable to Orange County's transportation emissions.[4] Vehicle registration was not taken into account to calculate transportation emissions.

Staff from the 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 pound 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. The DCHC MPO was unable to provide a further breakdown of vehicle types; therefore, ICLEI used the size characteristics of the U.S. on-road automobile fleet to apportion the LDGV VMT to each of the CACP gasoline automobile classes for Orange County. Using a weighted average of automobile

[4] The new model resulted in an 8% increase in the total VMT for Orange County in 2005.

sales by size-class in the U.S. for 1975 to 2005, ICLEI estimated the following distribution of automobiles by size: 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 LDDV in Orange County are distributed by automobile size. Accordingly, ICLEI assumed that LDDV VMTs in Orange County would be by sub-compact or compact automobiles.

2.3.5 Solid Waste

Orange County operates a landfill on Eubanks Road, between North Carolina Highway 86 and Old NC 86 in the Chapel Hill Township. At that location, Orange County maintains a lined landfill for disposal of municipal solid waste and an unlined landfill for disposal of construction and demolition wastes and other dry wastes. Staff from the Orange County Solid Waste Management Department provided ICLEI with the total tons of municipal solid waste (MSW), construction and demolition (C&D) waste, land clearing debris and stumps that were buried in the landfill in 2002 and 2005. Staff also provided data for the tons of mobile home materials that were sent to the landfill in 2002 and 2005. Parts of mobile homes are diverted from the landfill; however staff could not provide an estimate of the proportion of the total mass that was diverted versus the portion that was buried. ICLEI assumed that approximately 50% of the mobile home materials were recycled and 50% were buried in the landfill. Staff from the North Carolina Division of Pollution Prevention provided ICLEI with estimates of the mass of waste that was generated within Orange County, but sent to landfills outside of the County. They could only provide data for the fiscal year 2004-2005 so ICLEI included this data, rather than 2005 calendar year data, in the community inventory.

2.3.6 Growth Indicators

Staff from the DCHC MPO provided the research team with growth indicators for the residential, commercial/institutional and industrial sectors. This data included population, number of households, commercial/institutional and industrial employees and land-use for the inventory years 2002 and 2005 and the forecast year 2030. The county's population for 2005 was received from the North Carolina State Demographer's Office.

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

2.4 Municipal Operations Inventory & Forecast

Members of the technical team provided energy consumption and cost data for their area of municipal 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 towns or the 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 of energy use for new infrastructure based upon annual energy use by similar existing infrastructure owned by the towns and the county.

3 2005 GHG INVENTORY

The inventory section of the report provides estimates of the GHG emissions within the communities as a whole and emissions produced by local government operations in the baseline year 2005. In the sections below, emissions from each module (community and local government) are broken down into five different sectors to provide a detailed analysis of each module. This model of categorizing emissions into modules and sectors follows the Cities for Climate Protection (CCP) protocol which has been developed to facilitate and standardize emissions inventories that take part in the CCP program. It is important to note that the local government operations module is a subset of the community module and to add them together would be double-counting emissions.

3.1 Community Inventory

3.1.1 Overview

The community inventory provides an estimate of all of the GHG emissions produced within Orange County both by residents in their homes and by local businesses and agencies as they carry out their operations. Five key sectors are included in the community inventory: residential, commercial/institutional, industrial, transportation, and solid waste.

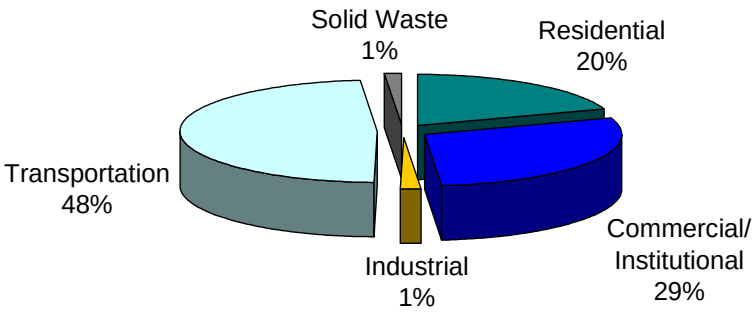
During 2005, Orange County (including Carrboro, Hillsborough and Chapel Hill) produced approximately 2,777,281 tons of GHGs. Table 3 provides a summary of the energy used and GHG emissions produced by each of the sectors. Figure 1 provides an illustration of the contribution to emissions from each sector. The transportation sector was the largest contributor to total emissions, responsible for 48% of the GHG emissions produced within the county. This was followed by the commercial/institutional sector (29%) and the residential sector (20%). The industrial sector (2%) and solid waste sector (1%) contributed a relatively small amount to total emissions.

Table 3. Base Year (2005) Community Energy Use and GHG Emissions by Sector (tons)

Sector	Energy (MMbtu)	GHGs (tons)	GHGs (%)
Residential	4,018,260	552,188	20%
Commercial/Institutional	5,641,828	819,969	29%
Industrial	243,009	40,542	2%
Transportation	15,850,531	1,356,984	48%
Solid Waste		38,816	1%
Total	**25,753,627**	**2,802,500**	**100%**[5]

[5] Numbers may not add correctly because of rounding.

Figure 1. 2005 Community GHG Emissions by Sector



It is difficult and sometimes misleading to compare per capita emissions in different communities because of the multiplicity of factors that contribute to a community's emissions. 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 Orange County's per capita emissions in regards to broader state and national per capita emissions as reduction efforts wrought at these levels should benefit Orange County's emissions and likewise, Orange County's efforts to reduce its emissions will influence state and national emission outputs.

In 2005 Orange County generated approximately 22.8 tons of GHGs per capita, only slightly less than the U.S. average of approximately 24.09 tons per capita.[6] However, it is important to consider that total US emissions include some sources not included in a CCP inventory (e.g. agriculture, soil management, air transportation and others) and given Orange County's relative lack of industry, this emission profile is high. Furthermore, given the serious nature of the global problem of GHG emissions, it is our hope that Orange County can serve as local, regional, and national leader through coordinated efforts to lower emissions.

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

[6] 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.

3.1.2 Residential

In 2005, there were approximately 51,700 households in Orange County. Within the residential sector, energy is consumed for such end-uses as space and water heating and cooling, appliances and lighting. On average, each household produced 10.6 tons of GHGs and consumed 77 MMBtu of energy. Table 4 provides a summary of energy consumption and emissions produced within the residential sector in Orange County in 2005, broken down by fuel type.

The residential sector was responsible for 20% of all emissions within Orange County. The greatest contributor to household GHG emissions in Orange County in 2005 was electricity consumption, which resulted in 73% of total residential emissions. This was followed by natural gas consumption, which resulted in 17% of total emissions in the residential sector. Information on other fuel sales was not available and therefore estimates were made (as explained in 2.2.2). It was estimated that the contribution of propane (3%), kerosene (3%) and light fuel oil (4%) resulted in less than 10% of total residential emissions. The Energy Information Administration (EIA) did not report any sales of heavy fuel oil within North Carolina to the residential sector in 2004.

Table 4. Residential Sector: Base Year Energy Use and GHG Emissions

Fuel	Energy (MMbtu)	GHGs (tons)	GHGs (%)
Electricity	1,912,421	410,780	73%
Natural Gas	1,455,551	89,927	17%
Kerosene	172,287	14,538	3%
Light Fuel Oil[7]	228,130	18,858	4%
Propane	249,870	18,086	3%
Total	**4,018,260**	**552,188**	**100%**

3.1.3 Commercial/Institutional

The commercial/institutional sector consists of offices, retail outlets, institutions (hospitals, schools, universities, etc.) and government facilities. This sector caused 2,802,500 tons of GHG emissions, or around 29% of the community's total emissions. Approximately 61,047 people were employed in the commercial and institutional sectors in Orange County in 2005. The average commercial/institutional business produced 13.3 tons of GHG emissions per employee. The largest source of GHG emissions was electricity consumption (62%), followed by coal consumption (29%) and natural gas consumption (6%). The vast majority of coal consumed by this sector was used to power UNC's cogeneration plant, which is discussed in more detail below. A summary of the commercial/institutional sector's energy use and associated emissions by fuel type is provided in Table 5.

[7] 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 #2 diesel (likely used for off-road vehicles). In order to determine only the amount of light fuel used in the residential sector in Orange County, ICLEI used information provided by the NC Petroleum Marketers Association, which assumes that approximately 4.3% of Orange County'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.

Table 5. Commercial/Institutional Sector: Base Year 2005 Energy Use & GHG Emissions

Fuel	Energy (MMbtu)	GHGs (tons)	GHGs (%)
Electricity	2,344,868	503,667	62%
Natural Gas	830,925	51,336	6%
Kerosene	20,434	1,724	0%
Light Fuel Oil	76,557	6,329	1%
Propane	171,681	12,426	2%
Coal	2,197,364	238,486	29%
Total	**5,641,828**	**813,969**	**100%**

The University of North Carolina at Chapel Hill is the largest employer in Orange County, employing approximately 11,000 staff and faculty. It has a student body of over 26,000 full time and part-time students. UNC's buildings total almost 8.9 million square feet of facility space. As a result, the university and its associated hospital are responsible for over half (58%) of the commercial/institutional sector emissions in Orange County. The university has been actively engaged in reducing their emissions and has produced their own GHG inventory. University staffs have also played a role in the development of this report. As a result of their impact on emission in the community and willingness to participate in this project, their emissions in both the commercial/institutional sector and transportation sector have been specifically laid out in this report.

UNC buys power from Duke Energy and also produces its own power and heat in an onsite co-generation plant. The plant is fuelled primarily by coal but the coal is supplemented by some natural gas. The university also buys natural gas for stationary purposes. The hospital does not purchase any natural gas.

Table 6. UNC Energy Consumption and GHG Emissions FY2004-2005

Fuel	Energy (MMbtu)	GHGs (tons)
Electricity	1,049,208	225,365
Co-generation	2,253,063 (365,362)[8]	240,131
Natural Gas	77,092	4,763
Total	**3,379,363**	**470,259**

Table 6 shows the energy consumption and associated emissions for UNC. ICLEI used the energy consumption figures in the inventory titled: "An Application of the Carbon Reduction Project (CRED) Methodology to the UNC-Chapel Hill Campus"[9] for the fiscal year 2004-2005 and applied the CCP methodology for emissions calculations to these figures. It should be noted that the figures in the above table are a subset of the total energy use in the commercial/institutional

[8] 2,253,063 MMbtu of coal and natural gas were consumed by the cogeneration plant. 365,362 MMbtu of electricity and 1,850,885 mLB (thousand pounds) of steam were produced by the plant.
[9] UNC Inventory by Doug Crawford-Brown and Tyler Felgenhauer.

sector and therefore should not be added to the numbers above. The fuel consumption and emissions from UNC's fleet and transportation are discussed under the community transportation sector.

3.1.4 Industrial

The industrial sector contributed 40,542 tons of GHGs in 2005, equivalent to only about 2% of Orange County's total emissions. The contribution of industry to total emissions is unusually small relative to other communities. This is as a result of strict regulations and a relative lack of industry in the county compared to other counties. The industrial sector in Orange County is expected to grow marginally between 2005 and 2030.

In 2005, Orange County's industrial sector employed approximately 2,685 people. Approximately 15 tons of GHGs were generated for each employee. The largest source of GHG emissions within the industrial sector was electricity consumption (74%), followed by coal consumption (21%). Table 7 provides a summary of energy use and associated GHG emissions produced within Orange County's industrial sector in 2005 broken down by fuel types.

Table 7. Industrial Sector: Base Year 2005 Energy Use & GHG Emissions

Fuel	Energy (MMbtu)	GHGs (tons)	GHGs (%)
Electricity	141,230	30,336	74%
Natural Gas	199	12	0%
Kerosene	700	59	0%
Light Fuel Oil	5,458	450	1%
Propane	18,568	1,344	4%
Coal	76,854	8,341	21%
Total	**243,009**	**40,542**	**100%**

3.1.5 Transportation

As discussed earlier in this report, the transportation sector is the single largest source of GHG emissions within Orange County, responsible for 48% of all emissions. This sector includes privately-owned and government operated passenger vehicles, transport trucks, buses, and all other on-road vehicles associated with private, commercial, institutional, industrial and government activities. This sector excludes emissions produced by off-road engines. Transportation emissions are estimated based on vehicle miles traveled (VMT) estimate provided by DCHC MPO.[10] In 2005, motor vehicles traveled an estimated 1,568,196,614 miles within Orange County, or 11,694 miles per year per resident. It is important to note that two major highways intersect within Orange County's borders, and a portion of the VMT on these highways result from through-traffic of non-Orange County residents. As a result, a portion of VMT and emissions estimates should be attributed to through-traffic.

Table 8 summarizes the amount of fuel used by these vehicles and the emissions they produced. The majority of VMT (89%) were traveled by gasoline-fuelled vehicles and accordingly, these vehicles produced the majority (77%) of GHG emissions.

Table 8. Transportation Base Year 2005 Fuel Use and GHG Emissions

Fuel Type	Vehicle Type	Annual VMT	Total Energy (MMBtu)	GHGs (Tons)
Gasoline	Auto-Full-Size	85,194,716	575,003	49,021
	Auto-Mid-Size	176,069,080	1,107,675	94,659
	Auto-Subcompact/ Compact	306,700,978	1,501,851	129,637
	Heavy Truck	80,192,382	2,079,891	175,204
	Light Truck/ SUV/Pickup	736,402,859	6,743,141	575,232
	Motorcycle	8,344,310	41,613	3,492
Diesel	Auto-Subcompact/ Compact	3,136,852	10,023	880
	Heavy Truck	169,018,584	3,767,967	326,816
	Light Truck/ SUV/Pickup	3,136,852	23,371	2,044
Total		**1,568,196,614**	**15,850,351**	**1,356,984**

UNC has a fleet of 628 on-road vehicles and leases 249 additional vehicles from the state's Motor Fleet Management Division (MFMD). The hospital also operates 49 fleet vehicles for a total of

[10] The DCHC MPO breaks down VMT by vehicle type and fuel type. The fuel type categories are gasoline and diesel. Other fuels are grouped into these two categories: biodiesel and kerosene under diesel and ethanol under gasoline. As a result, the emissions these low emission fuels might not be accounted for and the transportation sector's emissions might be slightly over-estimated.

926 vehicles managed by UNC. Approximately 17% (159) of the UNC fleet runs of E85 fuel (85% ethanol, 15% gasoline by volume). In total, the UNC fleet produced 3,567 tons of emissions, equivalent to an average of 3.8 tons per vehicle.

Table 9. UNC Fleet Fuel Consumption FY2004-2005

Fuel Type	Total Energy (MMBtu)	GHGs (Tons)
Gasoline	37,136	3,189
E85	4,975	72[11]
Diesel	3,506	306
Total	**45,616**	**3,567**

3.1.6 Solid Waste

In 2005, an estimated 27,116 tons of construction and demolition (C&D) waste and 57,374 tons of municipal solid waste (MSW) were produced within Orange County. The waste resulted in the production of 38,862 tons of GHGs (see Table 10 for a breakdown of emissions by waste and material type).[12]

Some of Orange County's waste is kept in landfills within its borders and some is sent to landfills outside of Orange County. Since a fraction of the carbon found in solid waste is never released but remains sequestered indefinitely, landfills can act as carbon sinks. The negative emission values found in Table 10 are representative of carbon sequestration in landfills.

Table 10. Material Waste Streams and Associated GHG Emissions

Waste Type	Material	Material Percent of Total Waste Stream	GHGs (tons)
Municipal Solid Waste	Paper Products	33%	25,355
	Food Waste	23%	16,494
	Plant Debris	2%	-205
	Wood/Textiles	7%	-1,076
	All Other Waste	35%	0
Construction & Demolition	Paper Products	2%	493
	Wood/Textiles	34%	-2,199
	All Other Waste	65%	0
Total			**38,862**

[11] UNC provided a total for gallons of gasoline and E85 used but was unable to provide a breakdown of these gallons by fuel type. ICLEI therefore estimated these amounts based on the percentage of fuel and gasoline powered vehicles that were E85 fuelled (19%) and used this ratio to estimate fuel distribution.

[12] GHG emissions resulting from the transportation of solid waste from residences and businesses to disposal sites fall into the transportation sector of the community inventory.

3.2 Municipal Operations Inventory

3.2.1 Overview

The local government module quantifies emissions from buildings, vehicle fleets, streetlights & traffic signals, water & wastewater treatment facilities, and waste produced by municipal and county operations. The local government module is reported in more detail than the community module. This is because local governments have direct control over their own operations and it is therefore the area in which they are most likely to be able to directly effect major emissions reductions, and can act as a leader within their own community. With more detailed information, local governments can better determine where the greatest opportunities for improvement lie. Local government operations for Chapel Hill, Carrboro and Hillsborough and Orange County produced approximately 42,840 tons of GHGs in 2005. This accounts for approximately 2% of the emissions produced by the community as a whole. Table 11 provides a summary of energy use, energy costs and GHG emissions by area of local government operations[13].

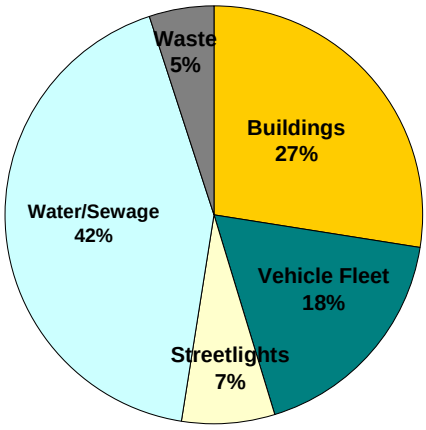
Table 11. Local Government Operations Emissions in 2005 (tons)

Sector	Energy (MMbtu)	Cost ($)	GHGs (tons)	GHGs (%)
Buildings	80,075	1,531,813	11,658	27%
Vehicle Fleet	92,477	1,455,710	7,530	18%
Streetlights	14,181	426,292	3,046	7%
Water/Sewage	92,916	1,381,492	18,034	42%
Waste	0	0	2,112	5%
Other (off-road)	317	7,400	416	1%
Total	**279,967**	**4,802,707**	**42,840**	**100%**

An illustration of the contribution of each area of operations to total GHG emissions is provided in Figure 2. In 2005, energy use for water and wastewater treatment was the largest source of municipal GHG emissions (42%), followed by city and county buildings, which accounted for 27%.

[13] Numbers in tables may not add due to rounding.

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



3.2.2 Buildings

The Town of Chapel Hill manages approximately 421,929 square feet of facility space. The Town of Carrboro manages approximately 64,133 square feet of facility space. The Town of Hillsborough manages approximately 36,094 square feet of facility space. Orange County operates 37 buildings with a total area of approximately 1,212,000 square feet. Collectively, energy use within these facilities resulted in the production of an estimated 11,658 tons of GHG emissions in 2005 or 27% of all emissions from local government operations. Energy use within these facilities cost the towns and county an estimated $1,531,813.

Table 12 provides a summary of energy use, cost and emissions generated by the local government facilities. A complete list of towns and county facilities is provided in Appendix F, along with the energy use and cost of energy used by each facility.

Table 12. Local Government Buildings: Base Year 2005 Energy Use, Energy Costs and Emissions

Jurisdiction	Energy (MMbtu)	Cost ($)	GHGs (Tons)
Orange County	47,461	755,689	6,444
Town of Chapel Hill	25,385	624,423	4,016
Town of Carrboro	5,114	104,375	834
Town of Hillsborough	2,115	47,327	364
Total	**80,075**	**1,531,813**	**11,658**

To maximize the effectiveness of any investments that the towns and county decide to make to reduce GHG emissions and energy use in their facilities, the governments may want to target those facilities that are the most energy and emission intensive (i.e. energy use and emissions per square foot). Table 13 shows Hillsborough's top three emission-intensive facilities and Table 14 lists Orange County's top five emission-intensive facilities in 2005.

Town of Hillsborough

Table 13. Town of Hillsborough: Top Three 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 ($)	Cost Intensity ($/1000 Sq. Ft.)	Total Area (Sq. Ft)
101 E. Orange st. (Ruffin-Roulhac)	64	20.3	376	118.5	7,649	2,424.5	3,168
127 N. Churton	102	18.8	474	87.4	11,231	2,072.1	542
137 N. Churton	46	14.3	341	106.0	6,819	2,118.3	3,219

Orange County

Table 14. Orange 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	Cost Intensity ($/1000 Sq. Ft.)	Total Area (Sq. Ft)
Animal Shelter	282	39.1	1,916	266.1	30,196	4,193.8	7,200
EMS-911 New Hope	150	24.4	727	118.4	15,871	2,584.9	6,140
Government Services Annex	141	22.7	956	153.6	23,976	3851.6	6225
Jail	784	21.1	5,495	148.3	73,996	1,997	37,053
RWHS Complex	1,240	17.4	8,210	115.1	134,561	1,886.1	71,344

The Town of Chapel Hill has only been able to provide ICLEI with a combined total square footage and total emissions for all of their buildings. Therefore, ICLEI can only calculate the average GHG intensity, energy intensity and cost intensity for Chapel Hill's buildings. The average GHG intensity of Chapel Hill's combined municipal buildings is 9.5 GHG tons/1000 square feet. The average energy intensity for the grouped Chapel Hill's municipal buildings is 60.2 MMBtu/1000 square feet. The average cost intensity of energy for Chapel Hill's municipal buildings is $1480 per 1000 square feet of facility space.

The Town of Carrboro has provided ICLEI with the energy consumption and costs of their individual buildings; as well as a few of their square footage values. The highest emission intensive building in Carrboro is the Fire Department (Station) with 16.22 GHG tons/1000 square feet. The energy intensity for fire station building is 45.11 MMBtu/1000 square feet and the it's

cost intensity is $1627 per 1000 square feet of facility space. The other buildings within Carrboro had significantly smaller GHG intensity levels, including the Town Hall which only had a value of 5.3 GHG tons/1000 square feet.

3.2.3 Vehicle Fleet

Uses for vehicles operated by the county and towns include but are not limited to: public works, fire department, police department and solid waste transportation. Public transit vehicles are excluded from corporate fleets because they serve the community's transportation needs. Vehicle fleets are responsible for 7,530 tons of GHG, or 18% of all of local government emissions in Orange County and participating towns. In 2005, the Town of Chapel Hill operated approximately 286 fleet vehicles (excluding off-road vehicles and transit vehicles), the Town of Carrboro operated approximately 123 fleet vehicles and the Town of Hillsborough operated approximately 60 fleet vehicles. During the same period, the government of Orange County operated a fleet of approximately 303 vehicles. Chapel Hill, Carrboro, OWASA and the solid waste department use B20 fuel (20% biodiesel blended with 80% diesel) in some of their fleet vehicles. These fuel consumption figures exclude fuel used in off-road engines which has been included under the 'Other' sector. A summary of the GHG emissions produced as a result of fuel use within fleet vehicles is provided in Table 15. Table 16 provides a summary of GHG emissions broken down by fuel type.

Table 15. Local Government Vehicle Fleets: Base Year 2005 Energy Consumption, Costs and Emissions

Jurisdiction	Energy (MMbtu)	Cost ($)	GHGs (Tons)
Orange County	50,761	750,943	4,167
Town of Chapel Hill	26,040	485,798	2,068
Town of Carrboro	8,755	124,391	701
Town of Hillsborough	6,921	94,578	594
Total	**92,477**	**1,455,710**	**7,530**

Table 16. Local Government Fleet Emissions (2005) by Fuel Type

Fuel Type	Energy (MMbtu)	Cost ($)	GHGs (Tons)	GHG (%)
Gasoline	60,730	603,695	5,184	69%
Diesel	18,123	128,431	693	9%
B20	7,384	120,711	1,652	22%

3.2.4 Street, Traffic & Other Outdoor Lighting

This sector includes road lighting, park lighting, specialty or accent lighting (e.g. lights used in downtown shopping areas), traffic signals, and other lights operated by the town and county governments. Overall, outdoor lighting operated by the towns and county used 14,181 MMBtu and produced 3,046 tons of GHGs. Lighting was responsible for 7% of the total emissions from municipal operations.

Hillsborough staff provided 2005 total street lighting costs from the town's Finance Department Records. Hillsborough purchases some of the electricity it uses for lighting from Duke Energy and

some from Piedmont EMC. Town staff provided ICLEI with 2005 electricity bills for the street lighting, from which ICLEI was able to determine the amount of electricity purchased from Duke Energy. However, the billing data provided to town staff by Piedmont EMC was incomplete. Accordingly, ICLEI spoke with Piedmont EMC staff[14] who stated that the Town of Hillsborough is currently billed for 22,440 kWh per year for their street lights.

Carrboro operates some street lights and other outdoor lights, and was able to provide ICLEI with data on these lights. Chapel Hill provided aggregated data for total costs and electricity consumption, including all traffic signals owned and operated by the Town of Chapel Hill and those lights owned by the NC Department of Transportation, but managed on behalf of the State by the Town of Chapel Hill. Orange County operates some outdoor lighting. The Town of Chapel Hill operates a few traffic signals within the jurisdictions of Carrboro and Orange County. The energy use and emissions from these signals are included under Chapel Hill's total.

Table 17. Local Government Street Lights, Traffic Signals & Other Outdoor Lights: 2005 Energy Use, Energy Costs and GHG Emissions

Jurisdiction	Energy (MMbtu)	Cost ($)	GHGs (Tons)
Orange County	651	29,122	140
Town of Chapel Hill	11,434	330,000	2,456
Town of Carrboro	160	11,317	34
Town of Hillsborough	1,936	55,853	416
Total	**14,181**	**426,292**	**3,046**

3.2.5 Water & Wastewater Treatment

Water and sewage treatment was responsible for 42% of emissions produced by local government operations in Orange County in 2005. The water and wastewater treatment sector includes all water treatment and wastewater treatment facilities, and all pumping stations and lift stations that serve the community. It does not include administrative facilities for water and wastewater treatment operations. Water and wastewater is included in the local government module of the inventory because water and wastewater treatment facilities often fall under the direct control of the local government; therefore local governments have control over the efficiency of these facilities. Hillsborough has its own water and wastewater treatment facilities. The Orange Water and Sewer Authority (OWASA) serves Carrboro, Chapel Hill, the University of North Carolina and surrounding areas. The cities of Mebane and Durham provide water and wastewater services to a very limited number of customers in areas of these cities that fall within Orange County borders. We have not included these customers because they fall within the jurisdiction of Mebane and Durham. Orange-Alamance Water System provides water to only 3,300 customers within the Orange and Alamance Counties.

[14] The Piedmont accounts in question were: #2960916, #2965116, and #3342000. The first account is for lighting the Grandview subdivision. According to Piedmont staff, there are 12 lights in the subdivision; each uses a maximum of 40kWh/month. The second account is for a security light at Lakeshore Dr 650 pump; this light uses a maximum of 70 kWh/month. The last account is for lighting in Becketts Rdg; there are 33 lights there that each use a maximum of 40 kWh/month.

The Hillsborough water treatment facility takes water from the Eno River, cleans and disinfects it, and then pumps it to residents. The water treatment plant is located at 711 Dimmocks Mill Road. The Town of Hillsborough owns and operates a wastewater treatment plant located at 355 Elizabeth Brady Road. The plant is able to process 3 million gallons of wastewater per day. The average flow through the plant is 0.753 million gallons per day and is discharging at about 25% of its capacity. Hillsborough water and wastewater treatment cost $195,852 in 2005 and resulted in the production of approximately 2,456 tons of GHGs.

OWASA serves Carrboro, Chapel Hill and the University of North Carolina. It is responsible for water and wastewater treatment and pumping for these areas. The OWASA water treatment plant is located at 400 Jones Ferry Road and is able to process up to 20 million gallons of water per day. Water treatment and pumping cost $477,297 and resulted in the production of 5,902 tons of GHGs in 2005. OWASA also operates Mason Farm Wastewater Treatment Plant, located at 100 Old Mason Farm Road, which can treat up to 12 million gallons of wastewater per day. Wastewater treatment and pumping cost $708,343 and resulted in the production of 9,676 tons of GHGs in 2005. In 2005, OWASA output of treated water was on average 9 million gallons per day and wastewater treated was 7.65 million gallons per day. Table 18 summarizes the total energy use, energy costs and emissions generated by the community's water and wastewater treatment operations, including pumping stations.

Table 18. Local Government Water & Wastewater Treatment: Base Year 2005 Energy Use, Energy Costs and Related GHG Emissions

Jurisdiction	Energy (MMbtu)	Cost ($)	GHGs (Tons)
Town of Hillsborough	11,461	195,852	2,456
OWASA	81,455	1,185,450	15,578
Total	**92,916**	**1,381,302**	**18,034**

3.2.6 Solid Waste Produced by Municipal Operations

The Local Government Waste Sector includes emissions from solid waste generated through government operations. This includes all employee generated waste and waste generated at municipal government facilities such as parks and recreation buildings. Neither Orange County, nor any of the participating towns specifically track this waste. This is not uncommon. Estimates of municipally produced solid waste have been made using average office waste density and composition estimates.

Local Government Solid Waste: Base Year 2005 Related GHG Emissions

Jurisdiction	Waste (Tons)	GHGs (Tons)
Orange County	2,247	1,499
Town of Chapel Hill	705	470
Town of Carrboro	137	91
Town of Hillsborough	77	51
Total	**3,166**	**2,111**

4 FORECAST

The forecast section of the report provides an estimate where emissions *might be* by the target year *if* growth continues at current rates and nothing more is done to check GHG emissions. Both a business-as-usual (BAU) forecast and planned measures forecast were developed. The BAU forecast provides an estimate of GHG emissions in the target year if no new measures are implemented between the baseline year and the target year. The "2030 Currently Planned" emissions reduction scenario provides an estimate of GHG emissions in the target year if currently planned measures are implemented between the baseline year and the target year. The through the local action planning process, further emission mitigation options will be considered and more aggressive emissions reductions scenarios will be developed.

4.1 Community Forecast

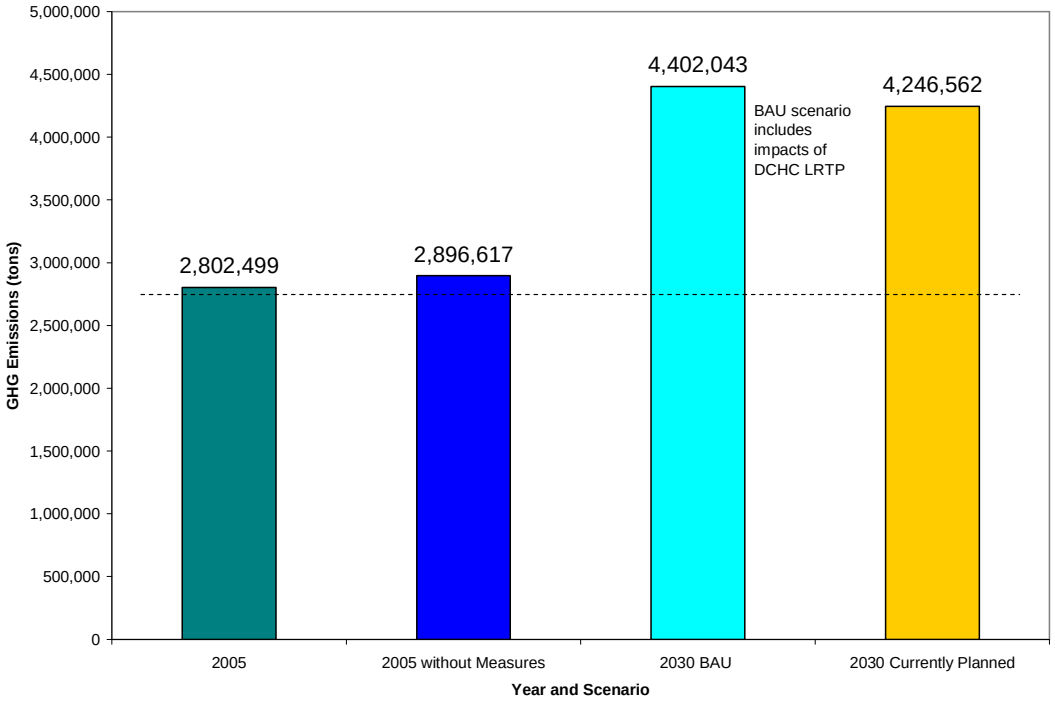
Orange County, and the Towns of Chapel Hill, Hillsborough and Carrboro have selected 2030 as the year by which the communities will achieve a voluntary GHG emissions reduction target. In order to determine the level of emission reductions that could be achieved given socio-economic growth in the region, emissions were forecast to 2030 using a set of growth factors described in Table 19. The methodology used is described in more detail in section 4.1.1.

Table 19. Community Forecast Growth Indicators

Indicator	2005 Value	2030 Projected Value	Growth (%)
Households	51,756	70,535	36%
Commercial/Institutional Employees	61,047	102,357	67%
Industrial Employees	2,685	6,129	128%
Population	134,100	180,129	34%
Annual VMT	1,568,196,614	2,431,899,213	68%

Figure 3 summarizes the potential growth in GHG emissions in the 2030 BAU and 2030 currently planned measures scenarios, relative to the baseline year emissions. The first column, '2005,' represents community emissions in the baseline year as described in the previous chapter. The second column, '2005 without measures,' takes into account all emissions reduction programs implemented before 2005 to demonstrate what Orange County's emissions profile would have been like in the absence of these programs. The column entitled "2030 BAU" assumes that new growth will occur in the absence of any new emission reduction initiatives beyond the, except the impacts of the DCHC 2030 LRTP, which are built into the BAU forecast. A second forecast scenario is presented in the "2030 Currently Planned" column, which includes growth projections for the community (BAU), but also accounts for currently planned future emission reductions programs. The methodology used to develop each of these scenarios is explained in detail below.

Figure 3. Community GHG Emissions Scenarios 2005 and 2030



4.1.1 2030 Business-as-Usual Scenario

The business-as-usual (BAU) emissions scenario provides a projection of potential emissions in 2030 if no new emission reduction measures are implemented in Orange County. Residential, commercial/institutional and industrial GHG emissions were forecast to 2030 using socio-economic growth indicators provided by the Durham Chapel Hill Carrboro Metropolitan Planning Organization (DCHC MPO). For example, for the residential section of the forecast, per household emissions in 2005 were applied to the anticipated growth in the number of households in the community to forecast BAU residential emissions for 2030. The same was done for the commercial/institutional and industrial sectors, using emissions per employee as the critical indicator.

Transportation emissions were forecast using projections of VMT in 2030 that were developed by the DCHC MPO based on the implementation of the transportation improvement projects contained within the DCHC MPO Long Range Transportation Plan. Due to the complexity of the transportation modeling process, the DCHC MPO was unable to provide an estimate of the 2030 VMT that would occur with no GHG emission reduction measures (i.e. transit and non-motorized transportation improvements).

Solid Waste emissions were forecast by applying 2005 per capita waste generation rates to 2030 population projections. In the BAU scenario, GHG emissions would increase to approximately 4,402,043 tons by 2030, which would be an increase of approximately 59% from 2005 levels. This growth would correspond with projected local economic and population growth.

4.1.2 2030 Currently Planned Emission Reduction Scenario

The 2030 Currently Planned emission reduction scenario assumes that all of the planned new measures outlined in the section entitled "Planned Future Community Measures" are implemented, including the DCHC MPO LRTP. This scenario presents a more realistic outlook of emissions in Orange County by applying the impacts of currently planned emission reduction measures to the BAU growth scenario. In the currently planned scenario, GHG emissions would increase by approximately 53% from 2005 levels by 2030. Approximately 155,481 tons of GHGs would be avoided as a result of the implementation of new measures.

4.1.3 Community Emissions Forecast Summary

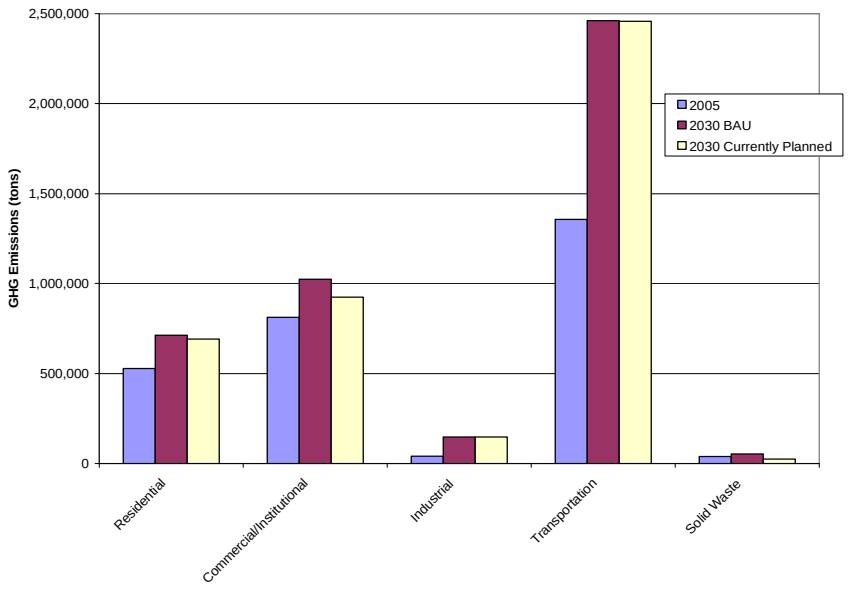
Table 20 provides a summary of forecasted GHG emissions within Orange County. Measures implemented before 2005 resulted in a reduction of 94,118 tons of GHGs or a decline of about three percent from 2005 levels had no measures been in place. Currently planned measures to be in place by 2030 will result in a slight decrease in GHG production (approximately six percent) from the BAU scenario in 2030; however, they will be insufficient to offset a 53% percent overall increase in emissions from 2005 levels.

Figure **4** represents the difference between 2005 emissions, and 2030 BAU and 2030 Currently Planned Measures scenarios by sector. 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.

Table 20. Community GHG Emission Forecast Summary

Year & Scenario	GHGs (Tons)	Difference from Baseline
2005	2,496,505	-
2005 Without Measures	2,871,399	3%
2030: BAU	4,402,043	59%
2030: Currently Planned Measures	4,246,562	53%

Figure 4. 2005 Community GHG Emissions, 2030 BAU and 2030 Planned Emission



4.2 Municipal Operations Forecast

Emissions from the Towns' and County's local government operations were projected for the target year of 2030 under BAU and "Currently Planned" emissions reduction scenarios. Figure 5 illustrates the differences in emissions between 2005, 2030 BAU and 2030 with currently planned measures. The left-most column illustrates estimated GHG emissions in 2005. A second column, labeled "2005 w/o Measures," illustrates potential emissions that could have occurred in 2005 if the Towns and County had not made any efforts to reduce their energy use or related GHG emissions. A third column provides a projection of emissions if the Towns 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 in light of the new measures for which the Towns and County currently have plans to implement. A detailed description of each of the 2030 scenarios is provided below and a summary of forecasted GHG emissions is provided in Table 21.

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

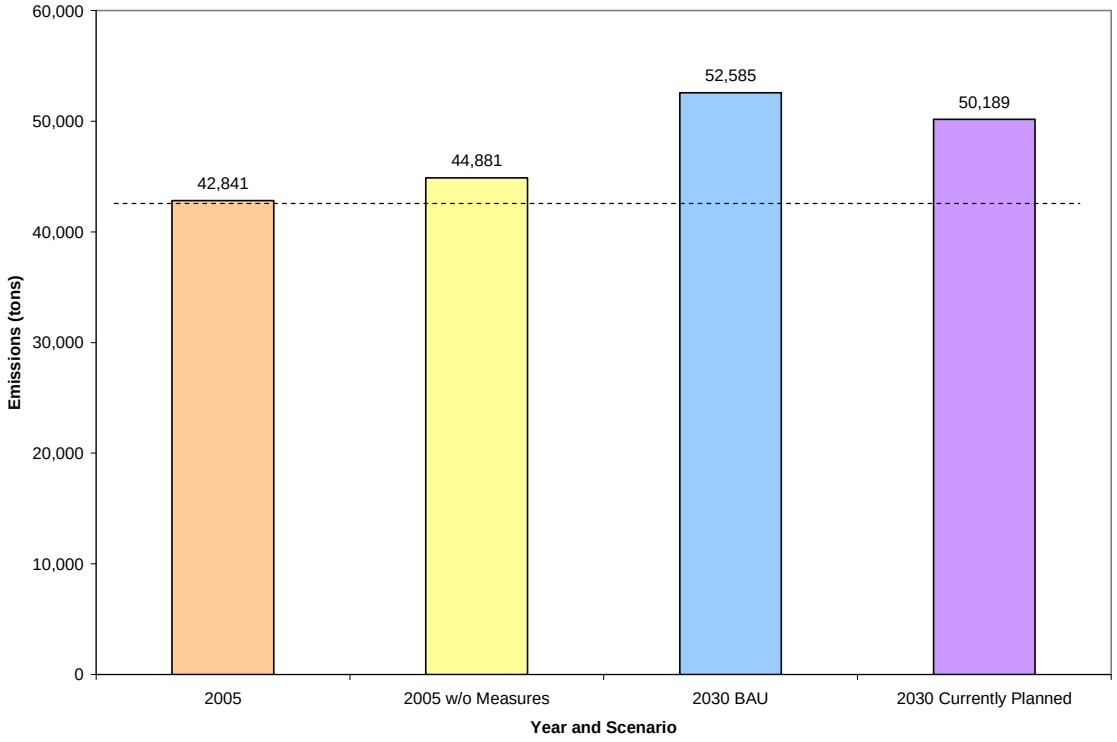


Table 21. Local Government Operations: 2005 & 2030 Emission Scenarios (Emissions in Tons)

Year & Scenario	GHGs (Tons)	Difference from Baseline
2005	42,841	
2005 Without Measures	44,881	5%
2030: BAU	52,585	23%
2030 Currently Planned Measures	50,189	17%

4.2.1 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 Town and County staff to identify and estimate the anticipated growth in local government infrastructure 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:

Buildings

Alan Dorman provided ICLEI with an estimate of the area of new facilities that will be constructed by Orange County between 2005 and 2030. Alan's estimates were based in part on the 2001 Orange County Space Needs Study and his knowledge of County infrastructure development plans. Chapel Hill and Carrboro staff also provided ICLEI with details of anticipated changes to building tenure between the baseline and forecast years. The details of these changes are included in Appendix E. Hillsborough did not indicate and anticipated change to building tenure between 2005 and 2030.

Vehicle Fleet

Alan Dorman recommended that ICLEI estimate Orange County's fleet increases based on County population increases, as the County's service level is dependant on population. ICLEI uses 2005 per capita fleet fuel use, and 2030 population projections to estimate additional fuel use. The Town of Carrboro plans to purchase an additional one-ton dump truck in the 2007-2008 Fiscal Year. This additional vehicle was included in the BAU forecast. Chapel Hill estimated that four new vehicles are added to their fleet each year; including retirement and replacement of old vehicles (four added to the total number). Based on the change in Hillsborough's fleet between 2002 and 2005, ICLEI assumed that the town added one additional vehicle every 3 years. Approximately 1 in 8 of Hillsborough's current fleet vehicles are diesel powered, so it was assumed that between 2005 and 2030, Hillsborough would add 1 diesel vehicle and 7 gas vehicles.

Street, Traffic & Other Outdoor Lights

According to Woody Meadows, Traffic Program Supervisor, Town of Chapel Hill, the Town adds fewer than 100-100 Watt HPS bulbs to its stock each year and at least two intersections per year with eight – 15 watt LED indicators each. It was assumed that Chapel Hill will add 2 new intersections and 50 new streetlights each year.

The Town of Hillsborough staff based their estimate of new street lights on future development plans in place as of June 2006. The Town will add 87 lights to its stock of street lighting to illuminate the Waterstone Phase I development. These lights will use approximately 108,576 kWh per year[15].

The County operates very few outdoor lights. It was assumed that there would be no net increase in outdoor lights operated before 2030.

Water & Sewage Treatment

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. The population of Hillsborough was used to estimate the increase for the Hillsborough water and sewage treatment operations and the populations of Chapel Hill and Carrboro were used to estimate OWASA's increased energy use.

Waste

ICLEI applied the anticipated population growth in each area to the relative per capita local government waste generation rate.

4.2.2 2030 Planned Emission Reduction Scenario

This scenario assumes that all of the currently planned future measures for local government operations are implemented. New emission reductions of approximately 2,396 tons per year

[15] Data provided by Town of Hillsborough Assistant Town Manager Demetric Potts. Data provided included number of new lights (87), wattage (250 per bulb) and kWh (104 per month).

would be realized under this scenario. Under the currently planned scenario, 2030 emissions increase approximately 17% above 2005 levels.

5 Emission Reduction Measures

This section of the report summarizes the estimated impacts of activities or decisions that have resulted or will result in the reduction GHG emissions within Orange County, Chapel Hill, Carrboro and Hillsborough. These measures are divided into existing and currently planned measures. Existing measures were implemented prior to the 2005 base year; according to the CCP Protocol, the impacts of these measures cannot be counted towards an emission reduction target. Currently planned measures are those initiatives that are already planned to be implemented after 2005, which can be counted towards the voluntary emission reduction target. 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. The local action plan will suggest the expansion of some of these measures, as well as the implementation of several new measures, in order to meet aggressive community and local government targets.

5.1 Existing Community Measures

Businesses, institutions and individuals within Orange County had already undertaken initiatives to reduce their GHG emissions prior to 2005. A summary of these measures is provided in Table 22 along with an estimate of the annual impacts of these measures.

Some of the measures are education and awareness campaigns, which although important, are difficult to quantify in terms of emissions reductions. For some other measures, insufficient information was made available to estimate the impacts of the measure, and although they have no GHG savings associated with them, the knowledge of the programs is also very important. Some measures are grouped and the impacts presented as one emission reduction estimate. In total, the quantifiable initiatives have resulted in at least 94,118 tons of GHG emission reductions annually.

Table 22. Existing Community Emission Reduction Measures and Their Potential Annual Impacts

Name of Measure	Implementing Authority	Brief Description of Measure	Annual GHG Savings (t)
Residential			
Solar Hot Water Heating Systems (as estimated by Million Solar Roofs Initiative)	Chapel Hill	It was estimated that there were 110 solar hot water heaters installed in Orange County by 2001	952
Meadowmont Energy Efficient Homes	Meadowmont Development	626 energy efficient new homes 40-50% better energy performance than an average home.	465
Energy Conservation Loans	Duke Energy	Matches energy improvement contractors and lender with consumers	not implemented
Equipment Loan	Duke Energy	Finances energy efficient heat pumps, central AC and electric water heaters	not implemented
Heating & Cooling Equipment Loans	Duke Energy	Matches heating and cooling contractors and lenders with consumers	not implemented
Off Peak Water Heating	Duke Energy	Peak load management	not implemented
Public Information - Duke Power	Duke Energy	Information services include online energy audit, seasonal energy tips, etc.	not implemented

Name of Measure	Implementing Authority	Brief Description of Measure	Annual GHG Savings (t)
Public Information - PSNC	PSNC	Energy efficiency and conservation information	not implemented
Commercial			
Social Security Income Rate	Duke Energy	Lowers payments for Social Security recipients	Not implemented
Customer Resource Center	Duke Energy	Showcases energy technologies	Not implemented
Equipment Loan	Duke Energy	Finances energy efficient heat pumps, central AC and electric water heaters	Not implemented
Off Peak Water Heating	Duke Energy	Peak load management	Not implemented
Public Information - Duke Power	Duke Energy	Case studies in efficiency, productivity; consulting services	Not implemented
Commercial Gas Equipment Financing	PSNC	New natural gas equipment financing assistance	Not implemented
Propane Equipment Conversion Financing	PSNC	Propane to natural gas conversion equipment financing	Not implemented
Technical Assistance	PSNC	Professional consulting services (e.g. Walk Through Energy Audits, Boiler Combustion Analysis)	Not implemented
Public Information - PSNC	PSNC	Energy efficiency and conservation information	Not implemented
Institutional			
R.D. & Euzelle P. Smith Middle School	Chapel Hill-Carrboro City Schools	125,360 sqft. Project includes: daylighting, solar HW heating, motion sensor classroom lighting, sixteen 120W integrated photovoltaic panels.	406
UNC Thermal Energy Storage Tank and Chiller Plant	UNC	Five million gallon thermal energy storage system completed. Water cooling is moved to off-peak period	Does not impact avg. energy use.
UNC Energy Savings - 2002/2003 - 2004/2005	UNC	UNC has implemented many projects to reduce energy use on campus which resulted in a decrease in total energy use between 2002/2003 and 2004/2005 of 63,552 MMbtu (an energy reduction of 5.04%).	41500
UNC RetroCX Projects	UNC	3 Retro-commissioning Projects	included above
UNC Motor Replacements	UNC		included above
Classroom lighting setbacks	UNC		included above
Nighttime HVAC setbacks (100%) on 17 buildings	UNC		included above
UNC Boiler replacement at Cogeneration Plant	UNC		included above
UNC building retrofits - energy efficient lighting	UNC	A dozen energy conservation lighting projects were completed between '01-'05	included above
UNC Energy Management Program - UNC RB House Library, Van Hecke-Wettech Hall, UNC Hamilton Hall & UNC Public Safety	UNC	State Energy Office program to assist ICI and governmental organizations in reducing their energy and maintenance costs. This program consists of workshop training and on-site surveys by	included above

Name of Measure	Implementing Authority	Brief Description of Measure	Annual GHG Savings (t)
		experienced specialists	
Energy Recovery Systems (e.g. Genetic Medicine Building, Hooker Research Center)	UNC		included above
Green Building Program	TJCOG		no measurable impact
Energy Efficiency Program for Nonprofits	State of North Carolina	Will assist nonprofits to reduce energy costs, thereby expanding funds available for services & programs	No measurable impact
Geothermal Heating & Cooling	State of North Carolina	Compares an advanced geothermal heat pump with a conventional one. Installed in an adjacent mobile classroom unit.	no impact.
State Energy Plan	State of North Carolina		no impact.
State Energy Office's Utility Savings Initiative	State of North Carolina		no impact.
Down 20 Program - Chapel Hill-Carrboro City Schools	Chapel Hill-Carrboro City Schools	A program to reduce energy use by lighting and computers in schools.	2156
Equipment Loan	Duke Energy	Targeted at colleges; finances energy efficient heat pumps, central AC and electric water heaters	not implemented
Off Peak Water Heating	Duke Energy	Targeted at colleges; Peak load management	not implemented
Equipment Loan	Duke Energy	Targeted at K-12 schools; finances energy efficient heat pumps, central AC and electric water heaters	not implemented
Off Peak Water Heating	Duke Energy	Targeted at K-12 schools; Peak load management	not implemented
Industrial			
Customer Resource Center	Duke Energy	Showcases energy technologies	not implemented
Equipment Loan	Duke Energy	Finances energy efficient heat pumps, central AC and electric water heaters	not implemented
Off Peak Water Heating	Duke Energy	Peak load management	not implemented
Public Information - Duke Power	Duke Energy	Case studies in efficiency, productivity; consulting services	not implemented
Public Information - PSNC	PSNC	Energy efficiency and conservation	not implemented
Transportation			
Best Workplaces for Commuters	Triangle J Council of Governments		not quantifiable
UNC Hybrid Vehicle	UNC - Chapel Hill	UNC has one hybrid vehicle	2
UNC Vehicle Monitoring Program	UNC	Monitor mileage and dispose of vehicles that are under used	not quantifiable
Southern Village Transit-Friendly Community	Town of Chapel Hill	Designed to reduce sprawl's negative impacts, discouraging a medium-density	not quantifiable

Name of Measure	Implementing Authority	Brief Description of Measure	Annual GHG Savings (t)
		sprawl pattern that results in longer commute times and high VMT	
Economic Development District design standards	Orange County	Promotes mixed-use development to minimize trips, prohibits commercial drive-through windows	not quantifiable
Land Use/Zoning to encourage transit-friendly land use patterns	Chapel Hill	Land Use Plans, Zoning Map, and Development approvals encourage development along transit corridors	not quantifiable
Urban Services Boundary	Chapel Hill		not quantifiable
Travel Demand Management	Chapel Hill	Require Transportation Management Plans as conditions of approval for new development, to include a Rideshare Coordinator, bike racks, showers in buildings and/or other measures	not quantifiable
Chapel Hill Fare-Free Transit	Chapel Hill Transit	Fare Free transit for university students as of January 2002. Resulted in a 66% increase in ridership.	2275
Bicycle Facilities	Carrboro	Provide bike lanes on most of the arterial and collector road network, bike racks are provided on buses, and bike racks are available at most schools, libraries, office buildings, and retail centers	not quantifiable
Fannie Mae Smart Commute™ Mortgage Program	Greater Triangle Research Council	Promote homeownership near public transportation to reduce fuel consumption, car emissions and demand for new roads	not quantifiable
20% Biodiesel - UNC Chapel Hill	UNC Chapel Hill	UNC began using B20 in its fleet in 2003.	58
Community Biodiesel Use (B99)	Various Organizations in Chapel Hill	Includes fuel provided to Carolina Biodiesel, 1000 gallons to Chatham schools, 400 to North Carolina Zoo, and 2000 gallons at Piedmont Biofuels.	94
DAQ Mobile Source Emission Grants	DAQ	The program targets reductions in mobile source emissions but does not require verification. Grants provided on a reimbursement basis for known and proven technologies.	not quantifiable
Solid Waste			
Wood - Regulated Recyclable Material Ordinance (RRMO)	Orange County	In October 2002, Orange County adopted an ordinance that banned the landfilling of 'clean' unpainted, untreated wood	2160
Scrap Metal - Regulated Recyclable Material Ordinance (RRMO)	Orange County	In October 2002, Orange County adopted an ordinance that banned the landfilling of scrap metal	2219
Corrugated Cardboard - Regulated Recyclable Material Ordinance (RRMO)	Orange County	In October 2002, Orange County adopted an ordinance that banned the landfilling of corrugated cardboard.	3434
Newspaper, Phonebooks & Gloss magazine recycling	Orange County		15596
Mixed paper recycling	Orange County		2376

Name of Measure	Implementing Authority	Brief Description of Measure	Annual GHG Savings (t)
Glass bottles & Jars recycling	Orange County		845
Plastic Bottles recycling	Orange County		975
Metal Cans (aluminum & steel recycling)	Orange County		6018
Food waste & animal bedding	Orange County		-387
Urban Leaf Collection			-4281
Orange County & Chapel Hill Public Schools	Orange County & Chapel Hill Public Schools		259
UNC Chapel Hill Recycling (d/n include coal ash)	UNC		11564
Other private recycling			4878
Electronics Recycling	Orange County	County collects and recycles used electronics	553
Total			**94,118**

5.2 Planned Future Community Measures

Businesses, institutions, and individuals are already planning to implement several new measures that will reduce GHG emissions. Many of these measures and their estimated potential impacts are summarized in Table 23. Together, these initiatives will help Orange County avoid over 155,481 tons of GHG emissions. The local action plan can build upon these early achievements, and assist the communities in developing innovative measures that will be suitable to their communities capacity and will assist in reducing emissions even further.

Table 23. New Community Emission Reduction Measures Implemented After Base Year 2005: Estimated Annual Emission Reductions

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
Residential			
Million Solar Roofs Initiative	Chapel Hill	Using 2001 as a baseline, the MSRI established a target of 500 new solar hot water heating system by 2010.	822
Green Power	NC GreenPower	Customers pay premium to purchase 100 kWh blocks of green power. As of May 2006, approximately 663 customers in OC had signed up.	837
Manufactured Home Heat Pump Program	TJCOG	Program will fit new homes with ground source heat pumps (100 homes over 7 yrs)	149
Landmark Solar Homes	Landmark Solar Homes (Private Sector)	Energy efficient homes built using passive solar as the primary design platform. Solar panels, dual zone HVAC systems, CF lights, 2 x 6	5

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
		exterior framing systems, radiant barrier sheathing. Approximately 50% more efficient than code.	
M-Squared Energy Efficient Homes	M-Squared Builders & Designers	Approximately 2 homes per year that are 40% more efficient.	199
Advanced Energy Affordable Energy Efficient Homes	Advanced Energy	Program concentrates on energy efficiency, health, safety, durability and comfort of the home. As of July 2006, AE has built 79 homes in OC.	592
Heat Pump Loans - Piedmont EMC	Piedmont EMC	To finance the purchase of an energy efficient electric heat pump.	36
Energy Audits - Piedmont EMC	Piedmont EMC	When requested, Piedmont provides energy audits and provides advice on opportunities for energy savings.	19,123
Commercial			
Energy Audits for Commercial Buildings	Triangle J Council of Governments	Triangle J will work with retired Engineers to provide audits to commercial facilities in Triangle Area	not yet quantifiable
Institutional			
Lighting Program	Chapel Hill-Carrboro City Schools	In the summer 2006, CCHCS converted T-12s to T-8s in one of its facilities.	1,339
Biodiesel Fuel Processor	Chapel Hill-Carrboro City Schools	Biodiesel Fuel Processor was built in 2006 (estimates captured in transpt.)	0
LEED-certified High School	Chapel Hill-Carrboro City Schools	Planned LEED Certified high school.	Not enough info to yet estimate
UNC Chapel Hill Strategic Energy & Water Plan	UNC at Chapel Hill	Goal is to reduce energy use in existing facilities by 4%/year '02-'07.	44,815
UNC Lighting Conversion T-12 with Magnetic Ballasts to T-8 with electronic ballasts	UNC at Chapel Hill	Sustainability Office identified $237,000 of work that could be completed, with projected return of 32% per year.	Included above
UNC - Carrington Nursing School Addition - LEED	UNC at Chapel Hill	69,000 sq ft addition, completed in 2005, LEED certification. Plumbing uses 41% less water and 56% of waste was diverted. Includes green roof and glycol loop to recover energy used for heating and cooling	Included above
UNC - Environment Health & Safety Building	UNC at Chapel Hill	Completed 2006. Includes controlled day lighting, which will reduce electricity use and need for cooling. Project will also include district cooling system. 22,592 sq. ft.	Included above
UNC - Morrison Residence Hall	UNC at Chapel Hill	New heating system, energy-efficient windows, solar hot water, real-time monitoring systems to provide feedback & awareness to students living in residence. Morrision will be added to the chilled water loop.	Included above
North Carolina Botanical Garden Visitor Education	UNC at Chapel Hill	Designed to be LEED Platinum. Building will employ geothermal	Included above

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
Center		energy system, photovoltaics, day-lighting and other green features	
UNC LEED Silver Target for New Facilities	UNC at Chapel Hill	UNC is aiming for at least LEED Silver standard on all new facilities. Plans for net growth of 4.1M sqft.	53,813
UNC - Expanded cogeneration facility	UNC at Chapel Hill	UNC plans to rebuild the current 28-megawatt generator and add another one.	Does not affect consumption
Model Solar Fuel Cell Cars Program	NC Solar Center	A program for middle school students to build a model fuel cell car with solar panel to compete in a statewide competition and learn about today's transportation issues.	not quantifiable
Industrial			
None			
Transportation			
Long Range Transportation Plan Transportation Improvement Projects	Durham-Chapel Hill-Carrboro MPO	The 2030 LRTP guides major transportation investments in OC to 2030.	Included in BAU forecast
I-40 High Occupancy Vehicle Lanes	Durham-Chapel Hill-Carrboro MPO	HOV along regional corridor b/w Durham/Chapel Hill & Raleigh	Included in BAU forecast
TTA Phase 2	Triangle Transit Authority	Fixed guide way between Durham and Chapel Hill	Included in BAU forecast
High Capacity Transit (I-40 to Carrboro Plaza via US 15-501)	Durham-Chapel Hill-Carrboro MPO	Provision of high level transit service in congested corridor that runs from western Carrboro to Franklin St	Included in BAU forecast
High Capacity Transit (Eubanks Road to Southern Village)	Durham-Chapel Hill-Carrboro MPO	Provision of high level of transit to Southern Village in Chapel Hill	Included in BAU forecast
New Bike Lanes	Chapel Hill/Carrboro	Addition of 56 miles of bike lanes	Included in BAU forecast
New Bike Lanes	Orange County/Hillsborough	Addition of 182 miles of bike lanes	Included in BAU forecast
New Bike Lanes	Carrboro	Addition of 18 miles of bike lanes	Included in BAU forecast
UNC Petroleum Reduction Plan	UNC	To achieve a 20% reduction in petroleum use by Jan. 1, 2010	631
UNC/Chapel Hill Parking Restrictions	University of North Carolina at Chapel Hill (UNC)	Reduction in parking supply for commuters. To be replaced with alternative transportation	3382
Hybrid Buses	Chapel Hill	3 40' Hybrid Buses	81
Solid Waste			
Expansion of Existing Curbside Recycling Program	Orange County	County adds several hundred homes to program each year	271
Landfill Gas Capture and Utilization	Orange County	Orange County currently passively vents its landfill gas, however, in the future, the County may use the landfill gas to power a facility.	29386
Total			**155,481**

5.3 Existing Reduction Measures for Local Government Operations

The Towns and County initiated many activities prior to 2005 within their own operations that have enabled them to reduce energy use, save money and reduce GHG emissions. Table 24 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 2,040 tons.

Table 24. Existing Local Government Emission Reduction Measures

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
Buildings			
Building Retrofits	Orange County	Older buildings	need more info
Energy Conservation Ordinance for Buildings Constructed with Town Funds	Town of Chapel Hill	Any buildings built with Town funds shall be designed to achieve a goal of using at least 30 per cent less energy than required by code.	105
Energy Efficient Lighting in Town Hall	Hillsborough	CF light bulbs in Town Hall	8
Retrofit of Fire Station #1	Town of Chapel Hill	BVM Engineering developed a draft energy bank concept, conducted an energy audit of Fire Station #1 and recommended energy projects for the station including: installation of a solar system, efficient windows and doors, and upgrades to HVAC units.	16
OWASA Operations Centre - best practices in energy use and design	OWASA	New Construction: Water-saving amenities, daylight, insulated glass, glass block walls, white roof, high-efficiency boiler	192
OWASA Administration Building	OWASA	Renovation: Energy efficient lighting, higher efficiency heating and cooling units, reflective roof.	included above
Fleets			
Compressed Natural Gas - Chapel Hill	Chapel Hill	Chapel Hill had seven CNG vehicles in 2001and Town added 3 in 2003.	232
Electric/Hybrid vehicles - Chapel Hill	Chapel Hill	Town leased two electric vehicles for pilot program but retired them in '04	-1
Ethanol 85	OWASA	Three light-duty trucks equipped to run on E85	21
E-85 Flex-fuel vehicles	Orange County	he County owned eight ethanol (flex-fuel) vehicles	48
E-85 Flex-fuel vehicles	Chapel Hill	Town owned nine ethanol (flex-fuel) vehicles, one vehicle retired in 2005	25
B20 - Carrboro	Carrboro	Biodiesel use B20.	57
B20 - Chapel Hill	Chapel Hill	Since 2003, used biodiesel in its municipal fleet vehicles.	166
B20 - Orange County	Orange County	In 2005 Orange County began using B20 in its vehicles.	115
B20 - Carrboro	Carrboro	Carrboro has been using B20 since at least 2002..	40

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
B20 - OWASA	OWASA	OWASA began using B20 in 2004.	64
Bicycles for use by Town employees	Carrboro	Bikes are available for use by police and fire fighters during special events	not quantifiable
Hybrid Vehicle	OWASA	In February 2005, OWASA purchased one Honda Civic Hybrid	2
Lights			
Mercury Vapor street lights replaced with High Pressure Sodium	Town of Chapel Hill	HPS is approximately 2.5 times more efficient than MV.	47
L.E.D. Retrofits - retrofits that have already taken place (as of 2006)	Town of Chapel Hill		319
Water & Sewage			
Water Reclamation Project	OWASA	OWASA recycles highly treated process water back to the head of the Water Treatment Plant (WTP) for treatment, reducing raw water withdrawal and energy needed for pumping.	183
Government Waste			
Solid Waste Recycling and awareness	OWASA	In 2004, OWASA partnered with Orange County Solid Waste Management Department to implement a more cost-effective recycling program (1-2 tons/year).	6
Office Paper (Government facilities recycling program)	Orange County		395
Total			**2,040**

5.4 Planned Future Reduction Measures for Local Government Operations

Both the Towns and the County have already committed to implementing several new emission reduction measures beyond the baseline year 2005. These measures will collectively result in approximately 2,396 tons of emissions savings. The potential emission impacts of these measures are summarized in Table 25. The local government's local action plan(s) will aspire to build upon and expand the successes of these programs. Due to jurisdictional restrictions each community will have to implement their own measures for almost all of the sectors, however, coordinating and sharing best practices will be very beneficial and increase success for all of the communities involved.

Table 25. Local Government Operations: Planned New or Expanded Emission Reduction Measures

Name of Measure	Implementing Authority	Brief Description of Measure	GHGs (t)
Buildings			
IFC Boiler Replacement	Town of Chapel Hill	2 old boilers replaced with new ones	114
LEED Certification - Northern Transition Area Fire Station	Town of Carrboro	Town staff expressed a desire to build a facility that would be LEED certified. The gross building area of the facility will be 7,900 square feet.	29
Triangle J High Performance Certification - Public Works Facility Administration Building	Town of Carrboro	Gross building area: 4,200 square feet	16
Triangle J High Performance Certification - Public Works Facility Service Building	Town of Carrboro	Gross building area: 21,450 square feet	80
Fleets			
Hybrd Vehicle - Truck	Hillsborough	Town is considering the purchase of a Hybrid Truck	not quantifiable
Vehicle Right-Sizing	Hillsborough	Town staff have discussed the need to consider the purchase of smaller vehicles	not quantifiable
Hillsborough - Alternative fuels for municipal vehicles	Hillsborough	Hillsborough would like to use fuel	not quantifiable
Hybrid Vehicle	Carrboro	3 hybrid vehicles in the fleet (1 added 2006, and 2 added 2007)	Need more information
Lights			
Mercury Vapor street lights replaced with High Pressure Sodium	Town of Chapel Hill	HPS is approximately 2.5 times more efficent than MV.	586
L.E.D. Traffic Signals - Retrofit all Existing Remaining Incandescents with LEDs	Town of Chapel Hill	Chapel Hill maintains about 115 intersections with over half of them still operating with incandescent bulbs. The rest are being replacesd with LEDs	442
L.E.D. traffic signals - new intersections	Town of Chapel Hill	Chapel Hill constructs approximately two new LED intersections within the town each year.	359
Solar Panels/L.E.D.s for New Flashers	Town of Chapel Hill	New flashers are to be installed with solar panels with LEDs.	need more info
Fibre Optic Connected Traffic and Camera Systems	Town of Chapel Hill	Long term goals are to use fiber optic interconnected Traffic and Camera Systems.	no quantifiable net energy savings
L.E.D. Warning Lights	Town of Chapel Hill	As a safety measure using warning lights made with L.E.D.'s for the Traffic division.	no quantifiable net energy savings
Water & Sewage			
Energy Audits	OWASA	OWASA is currently considering a proposal from NCSU Industrial	not yet quantifiable.

		Extension to conduct energy audits of their facilities.	
Methane gas capture and reuse	OWASA	The installation of a storage system to enable use of methane gas from the solids digesters to power air blower and boilers at the plant.	770
Government Waste			
None			
Total			**2,396**

6 LOCAL ACTION PLAN

6.1 Introduction

6.1.1 Reduction Targets

A CCP reduction target is the annual quantity of GHG emissions that a jurisdiction commits to reducing from their community and local government operations by a given year. It is expressed as a percentage reduction in emissions in the target year from the baseline year's emission level. In Orange County's case, it is a percentage reduction from 2005 emission levels by the year 2030. Different targets can be established for the both the community and local government sectors. A more aggressive target is often selected for the local government sector, since these emissions are under the direct control of the local government. Establishing a reduction target helps local governments to quantify their commitment to reducing GHG emissions and sets a concrete, measurable goal for the government and community to strive towards. By establishing emission reduction targets, and officially adopting these targets through council resolutions, the Board of County Commissioners (Orange County), Town Bard (Hillsborough), Town Council (Chapel Hill) and board of Aldermen (Carrboro) will fulfill Milestone 2 of the Cities for Climate Protection (CCP) Five Milestone Framework.

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

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

Table 26 contains some examples of targets set by other local governments throughout the CCP program. Additionally, over 400 U.S. mayors, representing over 57 million Americans, have pledged to meet Kyoto commitments in their cities by reducing overall emissions to 7% below 1990 levels by 2012 through the US Mayor's Climate Protection Agreement.

Table 26. Emission Reduction Targets Adopted by Other Local Governments

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

6.1.2 Target Scenarios

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

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

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

6.2 Proposed Community Measures

In the following section proposed community measures are outlined, as well as various target scenarios, the tables within the main body of the recommended action plan outline various levels of engagement that can be taken by the local governments. Within Appendix J there are more specific samples of measures that quantify in more tangible terms how these reductions can be achieved. For example if the target is to reduce 5,000 tons, the sample measures will indicate how many cars that would equal being taken off the road.

6.2.1 Residential

The residential sector included the municipal residents of Chapel Hill, Carrboro, Hillsborough and Orange County combined generated approximately 19% of all of Orange County's community emissions. Several projects have taken place in Orange County that has already helped to reduce GHG emissions throughout this sector. Some of these projects include the implementation of solar hot water heating systems that since their inception within the community prior to 2001. Over 500 hundred units are slated to be installed by 2010 in Orange County.

Since 1984 Piedmont EMC has been providing home energy audits to local residents upon request and they provide home owners with advice on opportunities for energy savings. This measure has resulted in a large amount of GHG reductions thus far (approximately 19,123 tons of eCO_2 /year). This program allows many residents to reduce their energy consumption by as much as 25%.

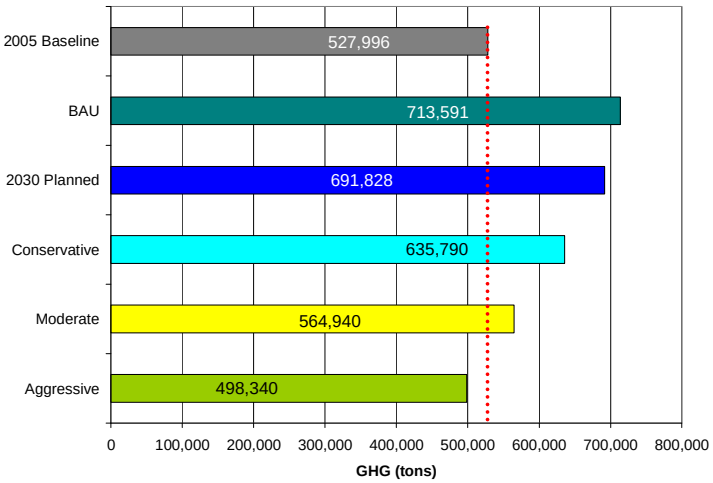
To help further reduce emissions throughout the residential sector there are many steps that could be taken some of these include but are not limited to the following suggestions. Table 25 outlines some of the general measures that could be taken and how at each level of action they can effect the emissions within the residential sector. Achieving any of the emission reduction scenarios outlined in this report will require a broad range of measures with varying costs and paybacks to be implemented.

Table 27 Residential Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Expand Conservation Measures	Measures in conservation so far have resulted in approximately x% of emissions reduced. If other programs were ramped up such as Audits from Piedmont EMC, and other measures were considered such as those historically done by Duke Energy (although not implemented in Orange County). A conservative estimate would aim for 2x the effort into currently planned measures, a moderate scenario of 3x, and an aggressive scenario of 5x.	40,200	100,490	140,690
Expand Alternative Energy Measures	Orange County has approximately 79 residents that purchase NC Green Power. Expanding further Alternative Energy measures such as this and the Landmark Solar Homes and Millions Solar Roofs initiative would assist in lowering emissions from the residential sector. A conservative scenario would be approximately 2% increase, a moderate scenario of 3%, and an aggressive scenario of 5%	15,840	26,400	52,800
	Total	**56,040**	**126,890**	**193,490**

Participation in Duke Energy and Piedmont Energy projects that have been delivered in other municipalities in North Carolina would be beneficial. A partnership between the various communities and the local utilities would be beneficial for all participating communities. Furthermore, the city can inform the public through coordinated education campaigns about how to conserve energy and water in the home and the local, state and federal programs and resources could be made available to homeowners to facilitate energy conservation. The various communities can provide or subsidize home energy audits for residents.

Figure 6. Residential Emission Reduction Scenarios



Professional energy audits can identify the most energy and cost effective solutions for individual houses and if the recommended retrofits are implemented, can result in significant energy savings and emissions reductions. Policies and incentives can be implemented within the communities which encourage developers to meet higher energy efficiency standards (such as LEED) for new construction and major renovations. Homeowners can be encouraged to consider purchasing

green energy through education and incentives. A Case Study can be found in Appendix I that demonstrates a project that was successful within the residential sector in decreasing emissions by another community.

Figure 6 illustrates the impact that the proposed measures could have on the emission profile of the residential sector. Due to the anticipated growth within the residential sector aggressive action would have to be taken to take emissions below the 2005 baseline year emissions. The conservative and moderate scenarios will not be enough to overcome growth and reduce emissions below baseline levels.

ICLEI would recommend that Hillsborough, Carrboro, Chapel Hill and Orange County work together diligently to reduce emissions as much as possible within the residential sector, sharing successes and best practices between the communities. Partnerships with outside organizations will also lead to successful emission reduction measures; some of these organizations would include the Home Builders Association of Durham Orange and Chatham Counties, and private developers to promote home energy efficiency. Also, Duke Energy has many initiatives that have not been implemented within the various communities, these initiatives should be explored to increase energy conservation programming within this sector. On a federal level the North Carolina State Energy Office offers many programs and incentives that could be accessed by residents and promoted by the Orange County governments participating in this local action planning process. These include an Energy Efficient Mortgage program that allows prospective homeowners to finance energy efficient systems through the home mortgage and an "Upgrade and Save" program whereby grants are provided to replace inefficient electric furnaces with more energy efficient furnaces. Solar thermal heating is particularly viable given North Carolina's mild climate and is also more financially viable than solar voltaic energy. Finally, ICLEI recommends that all of the communities implement public awareness campaigns to educate their residents on the benefits of energy efficiency and conservation.

6.2.2 Commercial/Institutional

In the baseline year, the commercial sector emitted approximately 29% of the communities' emissions, this included emission from the local institutional sector as well. No measures had been implemented in the commercial sector. Many emission reductions were seen within the Institutional portion of this sector.

Between the years 2002 and 2005, combined measures from UNC at Chapel Hill were able to reduce 41,500 tonnes of GHG emissions through their Strategic Energy and Water Plan. Some of the initiatives that were involved with the Strategic Plan at UNC were: building retrofits, boiler replacement at the cogeneration plant and HVAC retrofits in 17 buildings. Having similar projects implemented within the other communities and throughout the commercial sector could result in further successful emission reductions throughout this sector.

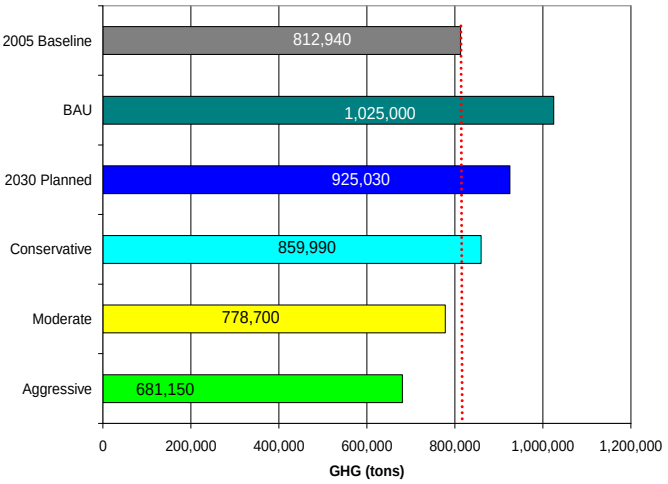
Table 28 Commercial/Institutional Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Energy Conservation Programming	Conservation and efficiency programming should be targeted to existing building stock as none has been done to date. GHGs could easily be reduced by 2%, 5% and 10% respectively for each of the 3 scenarios.	16,260	40,650	81,290
New Construction Energy Efficiency	Growth in this sector is expected to grow approximately 8% by 2030. By focusing on initiatives to increase efficiency, emissions could be reduced by 5%, 10% and 15% respectively on new buildings	40,650	81,290	121,940
Alternative Energy Purchases/Utilization	No alternative energy sources have been purchased by either the commercial or institutional sides of this sector. Therefore a conservative scenario would be 1%, moderate 3% and aggressive would be 5%	8,130	24,390	40,650
	Total	**65,040**	**146,330**	**243,880**

Orange County, Chapel Hill, Carrboro and Hillsborough can play an important role in encouraging and coordinating design. Within the commercial/institutional sector economic benefits or financial incentives are usually the most effective in propagating change for this sector. There are several initiatives throughout the State of North Carolina that can assist with businesses, for example the North Carolina Department of Environment and Natural Resources has a Small Business Assistance Program that assists small businesses with air quality and other regulatory requirements, encouraging environmental compliance and stewardship. Various other programs can be developed to assist within the commercial/institutional sector, educational campaigns geared towards employees to encourage them to reduce water and energy consumption. Also, business owners can be encouraged to look into alternatives such as green energy tags or renewable energy generation. Some suggested ideas that the communities could implement include; having the communities encourage builders and developers to achieve high energy efficiency in new buildings as well as when upgrading older buildings. This can be done in several ways; incentive programs, implementing policies and providing recognition to successful companies who successfully implement green efforts.

Table 28 is an overview of the measures that could be taken, and shows the estimated emissions reduction potential from energy conservation and demand side management in the commercial sector. Figure 7 illustrates the impact of the proposed measures on the commercial and institutional sector emissions profile. Commercial and institutional emissions are expected to rise by approximately 752,575 tons between 2005 and 2030, requiring a considerable effort be made in order to reduce emissions below the baseline year levels.

Figure 7. Commercial/Institutional Emission Reduction Scenarios



A case study examines North Carolina's Energy Improvement Loan program that can assist businesses and institutions within this sector emissions within this sector in Appendix I.2.

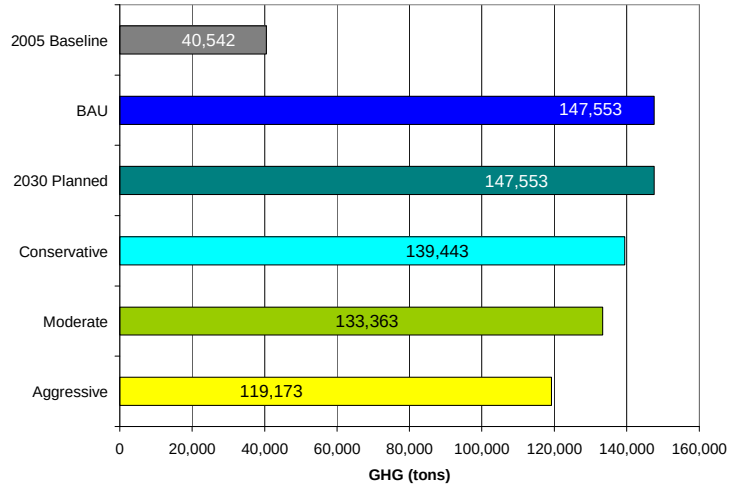
Figure 7 illustrates the impact of the proposed measures on the commercial and institutional sector emissions profile, utilizing the forecast scenarios. Commercial emissions are expected to rise within the planned scenario, taking action within the moderate and aggressive scenarios would see reductions below the baseline year levels.

6.2.3 Industrial

The industrial sector emissions totaled only 2% or 40,542 tons of GHGs of the communities' GHG inventory. Approximately only 2% of the population worked within the industrial sector in 2005, within the Orange County region. This sector is estimated to increase in employees by more than two and a half times by the year 2030 and GHG emissions will increase by approximately 107,000 tons of GHGs. While there is not a strong need currently to reduce emissions in this sector, knowing that there is projected growth within this sector should encourage proactive measures that will assist with decreasing emissions despite growth in the future.

Duke Energy appears to have many programs that could be successfully utilized by the communities to assist in reducing emissions, developing a partnership with Duke Energy throughout the communities would be beneficial for a sector which emissions are projected to grow by almost 30% by 2030.

Figure 8. Industrial Emission Reduction Scenarios



There are other measures that can be taken; Table 27 takes a look at the target scenarios that could be implemented within all of the communities. There are currently no measures planned for the future within the industrial sector, as this is an estimated expanding sector in Orange County it is important to be proactive early with measures.

Strategies for addressing industrial emissions are similar to those for addressing commercial emissions. The most important role that local governments can play in this process is encouraging industry to get involved in the local GHG reduction strategy and providing industrial partners with the resources to enable them to do reduce emissions. Ways to reduce GHG emissions from the industrial sector for the Towns and Orange County should include: Encouraging local industry to switch their main sources of fuel to cleaner sources, such as natural gas, cogeneration, biodiesel, ethanol biomass or renewable energy. Encouraging local industries to improve the efficiency of existing buildings and industrial processes and set higher standards for new buildings and operations. Promoting employee energy and water conservation in the workplace is also beneficial to reducing the impact of emissions from this sector. Figure 8 demonstrates the target scenarios with a conservative, moderate and aggressive approach to emission reductions within the industrial sector.

Table 29 Industrial Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Upgrade efficiency of buildings	No Measures have been captured by any of the communities' Industrial sector. As emissions in the BAU and 2030 Planned forecast are assuming to grow substantially, increasing efficiency of all buildings will help to reduce GHG emissions. GHGs could be reduced by 5%,10% and 15% respectively in 3 scenarios	2027	4054	6081
Utilization of alternative fuel sources	A switch to biologically derived fuels could work for industries in the area. GHGs could be reduced by 5%, 10% and 20% respectively in 3 scenarios	2027	4054	8108
Demand and supply side management	No tangible attempts to reduce emissions or improve energy efficiency or use alternative energy sources have been made in the Industrial sector. GHGs could be reduced by a conservative scenario would see a reduction of 5%, moderate 10% and aggressive 25% for the 3 scenarios.	2027	4054	10135
	Total	**6080**	**12160**	**24330**

Since there have been almost no emission reduction programs implemented within this sector by any of the municipalities, ICLEI recommends that all of the communities take innovative and aggressive actions to reduce the emissions profile projected for this sector. It is difficult to categorize efficiency measures within the industrial sector since industrial processes are so varied and specific. However, emissions in this sector can be controlled by local governments without regulations through the creation of incentives, voluntary reduction programs and business networks to encourage local industries to reduce their energy consumption and emissions. At the state level, the North Carolina State Energy Office offers many business and industry programs that assist North Carolina companies with energy and cost savings through education and training, surveys and technical assistance and loan programs.

6.2.4 Transportation

Combined between the communities the transportation sector contributed 49% to the total emissions profile. This sector is the highest contributor to the four community's emissions and therefore requires the most action be taken, as illustrated in Figure 9 even aggressive actions will not reduce emissions below the baseline year, due to the projected growth (almost doubling by 2030) within the transportation sector.

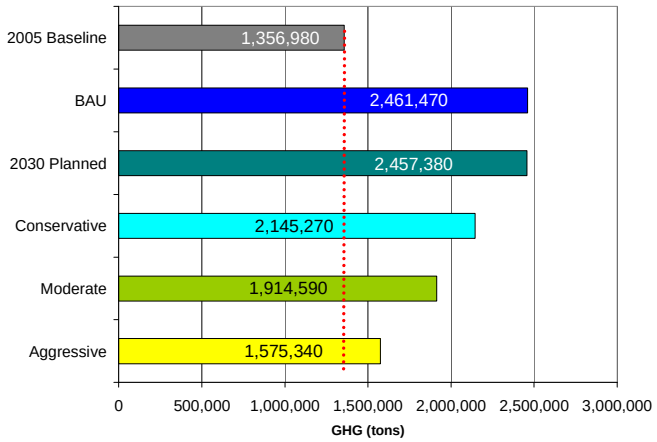
There are many measures planned within this sector as part of the Transportation Improvement Plan (included in the Business as Usual scenario) including UNC Chapel Hill implementing parking restrictions, which will reduce vehicle miles traveled by 5,800,000. UNC is also planning on reducing its fuel consumption and hopes to achieve a 20% reduction in petroleum use by Jan. 1, 2010 through various methods. One of the benefits of people living in this area already is the fact that there is a fare-free transit system in place, a continued push and education on the benefits of transit would be beneficial to the community. Table 30 demonstrates the emissions reduction potential from implementing land-use planning techniques, utilizing alternative fuels and transportation demand management measures in the transportation sector. Whether it be conservative which assumes completing low hanging fruit measures first, or an aggressive scenario which sees a marked decrease from the baseline year yet requires a lot of planning and resources to complete. It is recommended that the communities assess which of the scenarios best suited for them for this sector, however, since the transportation sector is such a large contributor to the total emissions profile for the community, moderate or aggressive actions may need to be taken.

It is important that Orange County, Carrboro, Hillsborough and Chapel Hill reduce the number of single occupancy vehicle (SOV) trips in the communities in order to reduce transportation related GHG emissions. There are many ways in which this behavioral change can be brought about by utilizing Transportation Demand Management strategies. Integrating non-motorized transportation into all transportation and land-use planning activities will encourage citizens to utilize other modes of transportation. Educate city planners in non-motorized transportation planning principles will benefit the community and will encourage non-motorized transportation choices.

Table 30 Transportation Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Land-use planning	It is commonly acknowledged that land use planning have a great influence over GHG emissions related to transportation, however it is also very difficult to quantify this impact. Joint planning/rural buffer designations, water and sewer boundary agreements, water conservation etc. It is assumed that by 2030, plans could be in place to reduce the growth in emissions via planning activities by 10, 20 and 30% respectively.	135,700	271,400	407,100
Alternate Fuel Buses	Following UNC Chapel Hill's utilization of a B20 blended fuel other fleets could start utilizing biodiesel fuels. For a conservative scenario a reduction of 3%, moderate 5% and aggressive 10%.	40,710	67,850	135,700
Initiate Transportation Demand Management (TDM)	Initiate programs within the communities that would reduce single vehicle occupancy trips. By encouraging alternative modes of travel - carpooling, telecommuting, and other strategies - to reduce peak travel, by 2030, an aggressive scenario would be 25%, a moderate would be 15% and a conservative scenario would see VMTs reduced by 10% by 2030.	135,700	203,550	339,250
	Total	**312,110**	**542,790**	**882,040**

Figure 9. Transportation Emission Reduction Scenarios



The local government can strengthen and uphold policies that control urban sprawl. This not only reduces the number and distance of motorized vehicle trips, but also helps to conserve forests, which help to deter climate change by acting as carbon sinks.

The local communities could expand programs that promote the use of non-motorized transportation, active transportation, carpooling and transit to citizens and employees such as the BEST workplace for commuters program. Using planning practices and design standards that accommodate the widest range of potential users (incorporating all transport modes), including people with mobility and visual impairments and other special needs. Another beneficial way of reducing emissions is by implementing school and campus transportation management programs to encourage parents, students and staff to use alternative transportation when traveling to school, college and universities. Traffic Flow Management Software Programs can be used to synchronize traffic signals to maximize traffic flow and reduce vehicle idling times. For local residents and local businesses they can be encouraged to use higher fuel efficiency vehicles,

especially hybrids, or use alternative fuels through subsidy programs or perhaps reduced loans. Finally, although they are not included in the CCP inventory, emissions from off-road engines should be stabilized through programs such as encouraging community members to use rakes and shovels, rather than leaf and snow blowers.

There is a significant amount of time to achieve tangible results through land-use planning decisions within this sector before the target year 2030. As this sector is one of the highest contributors to the community's emission profile and projected to grow substantially as seen in Figure 9, aggressive action should be taken to reduce the emissions. ICLEI recommends that the most successful long-term, sustainable approach to reducing transportation emission is through denser, mixed-use urban planning. Such densification, coupled with strong legislation and local policies to control urban sprawl, can have a significant impact on the carbon footprint of the local communities

6.2.5 Solid Waste

The community's emissions from this sector contributed to approximately 1% of the total emissions profile. Many strides have been made already within Orange County to reduce emissions within this sector. Historically measures (those measures that took place before the baseline) have reduced 26,702 tons of waste going to land fills, and reduced emissions by 46,209 $eC0_2$. A planned measure for Orange County includes landfill gas capture and utilization, Orange County currently passively vents its landfill gas. The US EPA did a study 6-7 yrs ago to look at cost/benefit analysis of using the gas to produce electricity. In the future, the County may use the landfill gas to power a facility that will house the County Board of Commissioners Building or an Animal Shelter.

Forecasting was not completed for the Solid Waste sector as the emission profile was low, and almost all efforts of dealing with landfills were dealt with in the planned scenario. However, following through with planned measures such as methane capture and flaring will be an important part of making sure that the landfills do not exceed their capacity and emissions are further reduced within this sector.

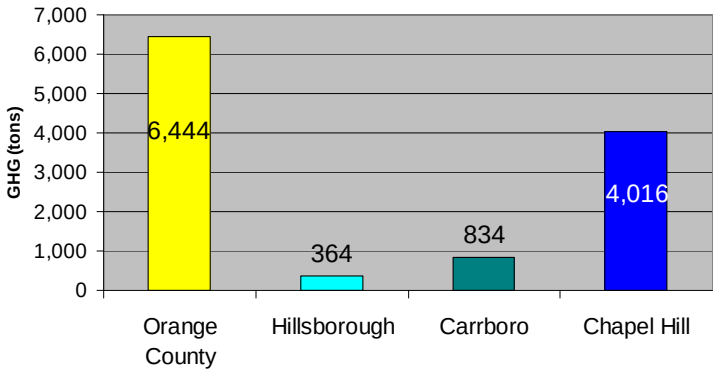
6.3 Proposed Local Government Measures

In the following section a break down of the recommended local government measures will be outlined, a breakdown of the emissions, energy use and costs for government operations by community can be found in Appendix H. As well, in this section proposed local government measures are outlined, as well as various target scenarios, the tables within the main body of the recommended action plan outline various levels of engagement that can be taken by the local governments. Within Appendix J there are more specific samples of measures that quantify in more tangible terms how these reductions can be achieved.

6.3.1 Buildings

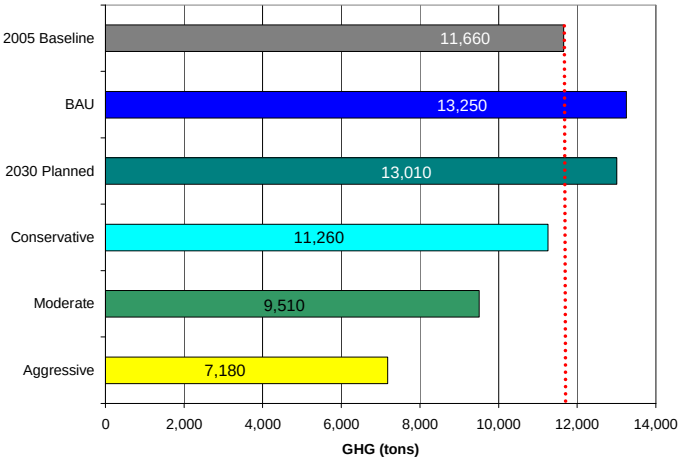
In the baseline year, municipal buildings emitted approximately 27% of the communities' total eCO2 emissions for the communities of Orange County Carrboro, Hillsborough and Chapel Hill. Each community provided information to ICLEI regarding energy consumption in its buildings Figure 10 illustrates each community's contribution to this sectors emission profile.

Figure 10. Building Emissions by Municipality



There are not a lot of measures planned for any of the communities' municipal buildings for the future, and historical measure completed before the baseline year only account for approximately 322 tons. There are many efforts that all of the communities will need to take to reduce their GHG emissions, Orange County and Chapel Hill will have to make the most effort, as their emissions in this sector are significantly higher than those of Hillsborough and Carrboro. A case study in Appendix I outlines the efforts made by another municipality to reduce emissions from their buildings. There are many measures that can be implemented or expanded upon that will reduce the buildings sectors impact on the emissions profile. Table 31 describes the potential impact of expanding the Communities' demand side management activities and considers the emission reduction potential of using alternative energy sources. Other activities that would reduce emissions within the building sector include; Existing buildings can be retrofitted so that they are more energy efficient. This can be done through changes in lighting and HVAC technology, replacing old appliances with EnergyGuide approved appliances and improvements to the building envelope including sealing leaks, replacing windows and adding insulation. It is often easy to achieve at least a 10% reduction in a building's energy consumption through basic retrofitting. Orange County, Hillsborough, Carrboro and Chapel Hill can commit to doing a comprehensive audit of all of its facilities to identify opportunities for improvement.

Figure 11. Buildings Emission Reduction Scenarios



By making energy efficiency a priority in the early stages of the design process, much higher energy efficiencies are achievable in new construction and major renovations. A municipality can resolve to meet a certain standard for energy efficiency in all new buildings. The American Institute of Architects has resolved that all new buildings be 60% more efficient by 2010 with the ultimate aim of reaching carbon neutrality by 2030. Emissions can also be reduced through the

development of energy and water conservation programs and policies for buildings. Examples of such programs include: turning off all lights and computers at night, installing low-flow toilets and faucets, increasing the temperature of the air conditioning in the summer and lowering the temperature of the heat in the winter, encouraging employees to turn off lights when not in a room, and countless others. Emissions from local government buildings can also be offset through the purchase of renewable energy tags.

Figure 11 illustrates various levels of actions that could be taken through various measures; emissions are expected to increase within this sector before 2030, however, with conservative or moderate actions communities could easily reduce emissions below the baseline year.

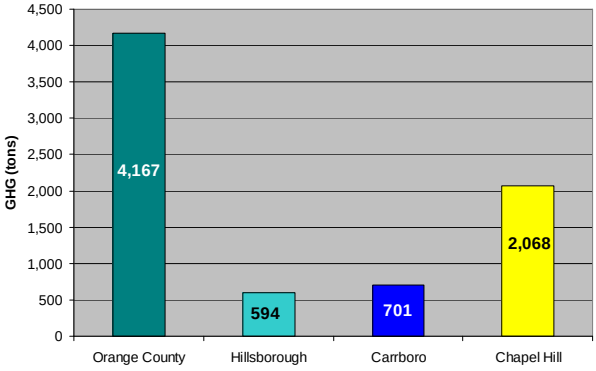
Table 31 Buildings Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Energy efficiency upgrades/expansion of existing programs	Some energy efficiency initiatives are already planned with in Chapel Hill and Carrboro. More could be done with the remaining building stock within the other communities. A 35% reduction in overall energy would be considered aggressive (ie HVAC & lighting), while lesser percentages would be more appropriate for the conservative and moderate scenarios (i.e. 10 & 20%).	1,170	2,330	4,080
Renewable and Alternative Energy Sources	Alternative energy measures have not yet occurred within any of the municipalities; Some examples include solar water heater installations, passive heating and cooling, geothermal as well as green power purchases. By supporting and implementing these types of initiatives, an impact on emissions can be achieved. A conservative estimate is 5%, moderate 10% and aggressive is 15%	580	1,170	1,750
	Total	**1,750**	**3,500**	**5,830**

6.3.2 Fleets

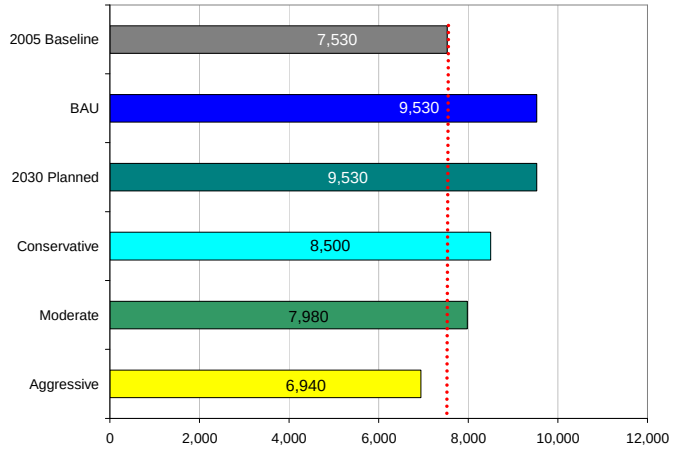
The combined four local government's fleets sector emitted 8, 299 tons or 18% of the community's emissions for the 2005 baseline year. Figure 12 illustrates the break down between Orange County, Hillsborough, Carrboro and Chapel Hill's contributions to the fleet sectors emission profile. Orange County and Chapel Hill have the highest contributions to the

Figure 12. Fleets Emissions by Municipality



emissions within the fleet sector. Other communities have also taken action by implementing measures a case study can be found in Appendix I.6. There are not many measures planned for the future, Hillsborough has indicated that there are measures planned including purchasing of smaller vehicles, hybrid vehicles and utilizing alternative fuels. There are many other strategies for reducing fleet emissions that Orange County, Carrboro and Chapel Hill may wish to consider. Typical emissions reduction strategies for local government fleets include; altering the municipalities' policies on fleet vehicle purchasing, this could also include replacement of typical fleets with alternative fleet options, including foot and bicycle patrols, parks and recreational departments. In addition to being better for the environment, and the health of the employees this would bring the staff closer to the citizens, and would set a positive example of active transportation throughout the communities. Reducing the size of the fleets where possible by conducting a study of the fleets sizes can be conducted. The use of alternative fuels such as biodiesel and ethanol fleet wide can reduce GHG emissions.

Figure 13. Fleet Emission Reduction Scenarios



Hybrid vehicles, like those being considered by Hillsborough have up to twice the mileage of regular vehicles. Conservative, Moderate and Aggressive scenarios have been developed with hoping to expand and implement various measures. Table 32 demonstrates through increasing the utilization of alternative fuels and the municipalities increasing and improving upon the fleet efficiency.

The impacts of the three emissions reduction scenarios can be seen in Figure 13 relative to the baseline and forecasted emissions. Engaging in the moderate scenario would bring emissions back down nearly to baseline levels, however aggressive actions would result in below baseline levels. ICLEI recommends that continued and increased use of biodiesel fuel continue, within all of the community's fleets. Downsizing or 'right-sizing' the fleets will also be an improvement, it would be beneficial to look into the City of Durham, as it's municipality is conducting an ongoing under-utilized vehicle study, which would be beneficial to all municipalities looking to reduce municipal fleets emissions.

Table 32 Corporate Fleet Emission Reduction Scenarios

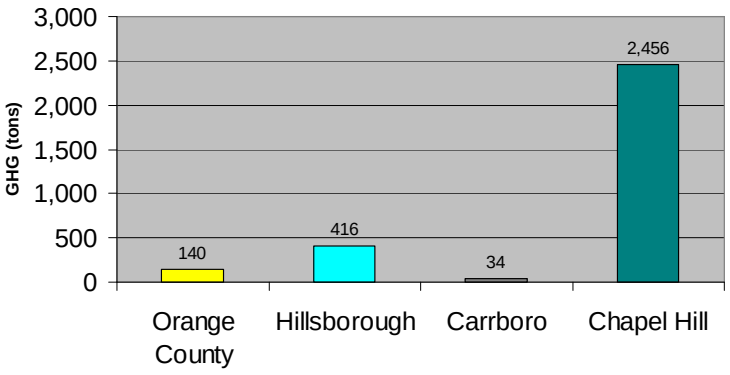
Suggested Measure	Description	Conservative	Moderate	Aggressive
Increasing the utilization of Alternative Fuels	Using vehicles that run on fuels such as compressed gas, ethanol, methanol, biodiesel, hydrogen and electricity can improve urban air quality and reduce GHG emissions. Many of these communities are already using B20 Blend, and an E85 blended fuel. A conservative estimate would be 2x increase, moderate 3x and aggressive 5x increase in alternative fuel use.	880	1,330	2,210
Increasing Fleet Efficiency	Aim to improve the efficiency of the fleet by further implementing successful programs such as Fleet Smart. Conservative 2%, Moderate 3%, and Aggressive 5% reductions of steps already taken.	150	230	380
	Total	**1,030**	**1,550**	**2,590**

6.3.3 Streetlights, Traffic Lights and Other Outdoor Lighting

In the baseline year (2005) streetlights, traffic signals and other outdoor lighting contributed to 7% of the local governments GHG emissions. The town of Chapel Hill has made many strides in reducing their GHG emissions from this sector, which is important as can be seen through Figure 14 where Chapel Hill has the highest GHG emissions for this sector (data only shows that was provided to ICLEI). However, in Hillsborough's case, the town pays a flat rate for its street lights as they are not metered, which means there is no exact record of the electricity used by those lights.

The utility companies assign a maximum monthly consumption value to each light depending on its wattage. The town is charged for this level of consumption whether or not the bulb actually consumes that amount of electricity.

Figure 14. Streetlights Emissions by Municipality



There are various ways in which Orange County, Chapel Hill, Hillsborough and Carrboro can save electricity in the lighting sector. These include, but are not limited to; using energy efficient streetlights, such as low pressure sodium or induction lighting more widely. LED street lighting technology is beginning to come on the market and is approximately 60% more efficient than HPS lighting.

Changes to the orientation and design of light fixtures can save energy by focusing light in the direction it is most needed and thus decreasing the number and wattage of lights needed. This can be done through changes to the lamp's height, the distance between poles and the fixture's cutoff angle. New remote streetlight control technology called Lumen IQ™ allows a municipality to centrally program streetlights to dim or turn off depending on traffic volume. Figure 15 illustrates that by tackling the low hanging fruit (the conservative scenario) emissions within this sector can be reduced well below the 2005 baseline year.

Figure 15. Streetlight Emission Reduction Scenarios

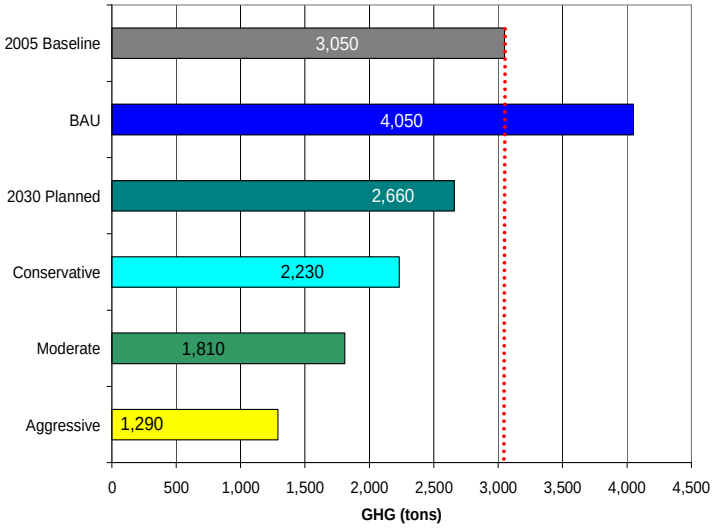


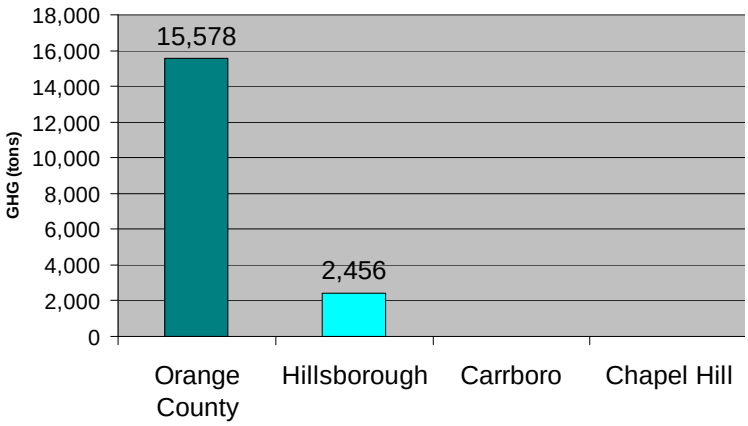
Table 33 showcases the impacts of potential new measures in the lighting sector. This technology can decrease energy consumption by as much as 25-40%. The energy consumption of streetlights can also be decreased through an overall reduction in the hours of use for streetlights and the total number of streetlights. As Chapel Hill plans on doing, solar panels can be installed on LED traffic signals or flashers to power them without producing any emissions. Emissions from lighting can also be offset through the purchase of renewable energy tags.

Table 33 Streetlight Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Alternative energy sources	Alternative energy sources could be pursued or emissions could be offset by using green tags. Reductions are based on 2%, 3%, and 5% offset.	60	90	150
Additional energy efficiency measures - operational	Additional energy efficiency measures include decreasing the number of streetlights, decreasing the hours of operation, and improving the efficiency of streetlights. A combination of decreasing the number of streetlights and decreasing the hours of operation could reduce energy use and emissions by 2% in a conservative scenario, 5% in a moderate scenario, and 10% in an aggressive scenario.	60	150	300
Additional energy efficiency measures - technological	It is expected that LED technology will be available for streetlight lamps in the next few years. This technology is 60% more efficient than high pressure sodium. A conservative scenario assumed 10% of the streetlights could be retrofitted; a mid scenario assumed 20% and an aggressive scenario assumed 30%.	300	610	910
	Total	**430**	**850**	**1,370**

6.3.4 Water and Sewage Treatment

Figure 16. Water & Sewage Emissions by Municipality



In 2005, water and wastewater treatment were responsible for approximately 43 % or 18,450 tons of eCO_2 of total local government emissions. Figure 16 breaks down the emissions by community, Orange County and Hillsborough have the highest contribution to the emissions profile within this sector. This profile includes figures from OWASA Water and Wastewater treatment facilities. OWASA has started to look at measures which could reduce their GHG emissions including energy audits of their facilities. As well part of the larger $50 Million Capital Improvements Project underway at the Mason Farm Wastewater Treatment Plant (WWTP) to further improve the facility's environmental performance and provide expanded capacity to meet future needs. This includes the installation of a storage system to enable use of methane gas from

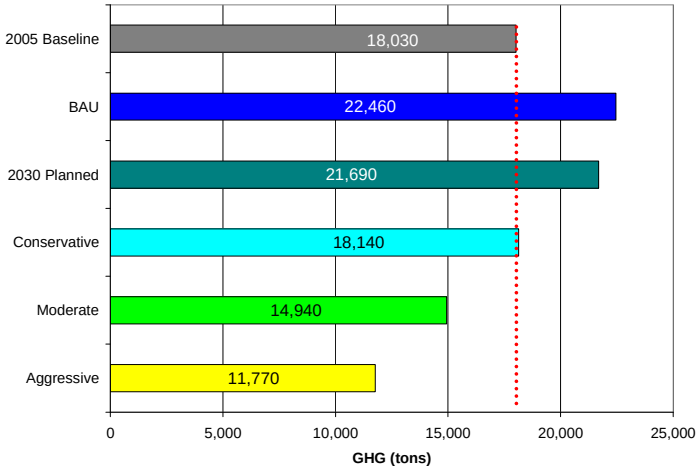
the solids digesters to power air blower and boilers at the plant. Once completed and operational, energy cost savings are estimated to be $50,000.00 per year.

Table 34 demonstrates the impact of an expanded water conservation programming, efficiency improvement to water and sewage processes and the use of alternative energy. Illustrated in Figure 17 are the impacts that the three target scenarios could have on the water and sewage sector emissions profile. Measures between the moderate and aggressive target scenario should be pursued to reduce emissions below the baseline year. ICLEI recommends that OWASA complete an audit of all of its facilities to determine where opportunities for improvements in efficiency lie.

Table 34 Water & Sewage Emission Reduction Scenarios

Suggested Measure	Description	Conservative	Moderate	Aggressive
Water Conservation Program Expansion	A conservative scenario would be to reduce by 5%, 10% for a moderate scenario, and 20% for an aggressive scenario.	1,120	2,250	3,610
Retrofits of plants	OWASA has reported minimal initiatives that have been implemented to improve the efficiency of the treatment processes, pumps, motors etc. It's reasonable to assume that there is significant room for improvement in this area. Conservative = 10%, moderate = 20%, Aggressive = 25%.	2,250	3,610	4,510
Alternative Energy	Alternative energy sources could be pursued or subsidized via green tags etc. Reductions are based on 1%, 5%, and 10% offset from alternative energy sources.	180	900	1,800
	Total	**3,550**	**6,750**	**9,920**

Figure 17. Water & Sewage Emission Reduction Scenarios



6.3.5 Local Government Waste

For the municipalities of Chapel Hill, Orange County, Hillsborough and Carrboro only 5% of their total GHG emissions come from the local government waste sector. Historically (prior to 2005 baseline year) there were a few measures implemented including; OWASA partnering with Orange County Solid Waste Management Department to implement a more cost-effective recycling program at OWASA facilities, as well government facilities implemented office paper recycling.

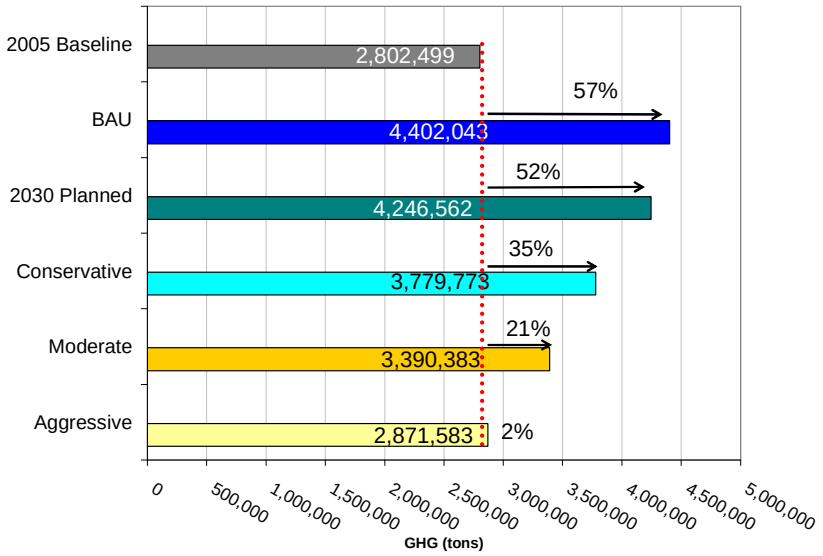
Waste from local government operations entering the landfill can be reduced in the following ways: Waste reduction programs can be implemented within government buildings. Examples of such programs include: encouraging printing on both sides of a page, supplying mugs and glasses instead of disposable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

6.4 Target Recommendations

6.4.1 Community Target

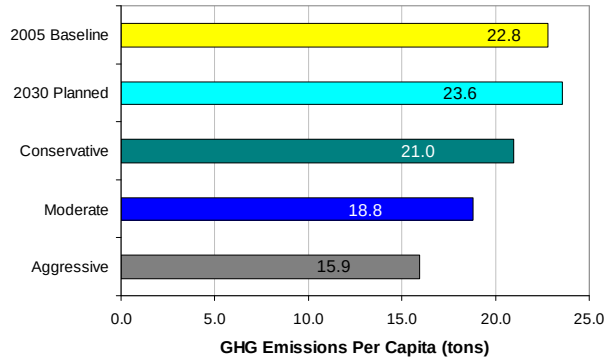
ICLEI usually recommends that CCP participants adopt a 6% community emissions reduction target; meaning emissions would be reduced by 6% below the baseline year within 10 years, however as can be seen from Figure 18 projected growth within these communities from the 2005 baseline year and the 2030 target year, 6% would be an unrealistic target to set. The three target scenarios that were developed in this inventory and local action planning process predicted that 2030 emissions could be reduced from forecasted levels to 35% above the baseline (conservative scenario), 21% above the baseline (moderate scenario) and 2% above the baseline (aggressive scenario). Given that the BAU scenario would result in a 57% growth in GHG emissions, and the planned scenario would result in 52% growth in emissions, these scenarios would respectively involve a 17%, 31% and 50% reduction from planned emission levels by 2030.

Figure 18. Community Emission Reduction Scenarios



Another way to report emission reductions to the CCP is through per capita emissions, with the expected growth of so many sectors, and various governments, this may be a more useful way of tracking emissions.

Figure 19 GHG Emissions Per Capita Scenarios



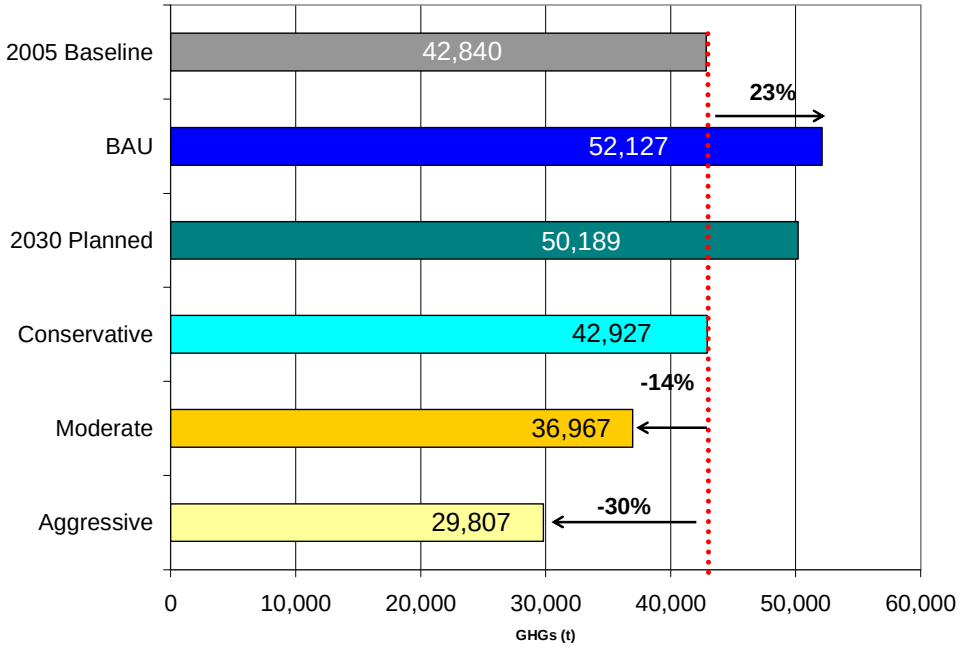
ICLEI would recommend conservative to moderate action be taken within the Community sector. The participating local governments with the support of their councils can set their own targets, based on the recommendations within this plan.

The assessment of historic and existing measures demonstrated that there is a lot of potential for Hillsborough, Chapel Hill, Carrboro and Orange County to engage with the community, as there has not been a lot of community-wide coordination of emission reduction efforts to this point. ICLEI has presented many different potential emission reduction measures, however we recommend those sectors and measures with the most potential to reduce emissions be prioritized to help build momentum for the municipalities' local action plans and ensure that the areas with the greatest opportunity for improvement are targeted as soon as possible. The four communities should work in tandem to achieve the emission reduction targets, through sharing resources, best practices and developing partnerships whenever possible.

6.4.2 Local Governments Target

The emissions profile and forecasts from Orange County, Chapel Hill, Hillsborough and Carrboro municipal operations present a much different picture than the community sector. Although emissions are still expected to grow between 2005 and 2030, the communities' have a lot more potential to manage these emissions. ICLEI typically recommends that CCP members aim for a 20% emissions reduction target within 10 years of joining the program. Since the four communities have opted for a target year further into the future, they are able to set a target that is even more aggressive, if they choose to do so. It is recommended since a lot of the information has been combined for this report for all four communities to select the same target. The three target scenarios seen in Figure 20 that were developed in this exercise demonstrate that emissions could be reduced by just below the baseline within the conservative scenario, 14% in the moderate scenario, and 30% in the aggressive scenario. ICLEI would recommend that the four communities take moderate to aggressive actions within the corporate sector to reduce its emissions. Since, municipalities have such a high ability to control their own operations, these four communities should easily be able to achieve moderate emission reductions by 2030, and with creativity and ingenuity a 30% reduction of emissions could be achieved.

Figure 20 Corporate Emission Reduction Scenarios



6.5 Implementation

The development of a local action plan is a major step toward Orange County, and the Towns of Chapel Hill, Hillsborough and Carrboro achieving GHG emissions mitigation; however, unless the plan is followed by an implementation strategy that addresses how the local action plan will be instigated, it will not be successful. The CCP Campaign divides these two steps into Milestones 3 and 4. Milestone 4 involves the implementation of the action plan, as well as the development of a plan for how to go about this implementation. While scope of this study was to address Milestones 1 through 3, the process has led us to some recommendations addressing how the Towns and County should proceed with implementing their plans. Again these can be separate from each other, and due to jurisdictional restrictions ICLEI recommends that implementation be done by each individual community, with maximum coordination and communication between the communities. Communities within the CCP are eligible to set their own targets, and then combine them to be measured against the joint baseline year total. Additionally, it is important to note that Chapel Hill can work in conjunction with the pledge of a 60% reduction of GHGs through CRed (and vice versa) to outline a plan, and utilize those emission reductions to measure against the baseline of this inventory.

6.5.1 Departmental Roles and Responsibilities

ICLEI strongly recommends that a full-time coordinator be hired on by all the participating communities, to act as a liaison, not only for communication purposes, but also for the purpose of data collection and the monitoring of successes by all communities. Communication should continue through committee work and partnerships to help achieve complete success of emission

reductions and reaching targets. A more specific outline of the roles and responsibilities will need to be developed as each community approves their targets.

6.5.2 Leadership and Partnerships

A continued partnership between the communities is essential for this Local Action Plan and Emission Reductions to be successful. Further partnership with Duke Energy would also be beneficial to all of the communities. Continued cohesion between Chapel Hill and the CRed will also be beneficial in achieving targets for both programs.

6.5.3 Timelines

Timelines should be developed to guide the implementation (Milestone Four) of the local action plan over the next 25 years. Certain recommendations contained within the local action plan could be implemented in a fairly short period of time, for example, water and sewage treatment operations could be retrofitted within a year. Other recommendations however, will need to be spaced out over time, such as land-use planning strategies, comprehensive building upgrades and public education programs. The implementation plan should contain specific timelines for the implementation of the various measures that will be adopted in the short-term and long-term to ensure that there is enough time to complete them before the target year is reached. The timeline should also take into account updates to the inventory and interim reduction targets to measure progress towards reaching the target year.

6.5.4 Monitoring and Verification

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

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

6.5.5 Financing

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

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

EPA Grants

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

U.S. Department of Energy

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

U.S. Department of Transportation

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

NCDOT/DCHC MPO

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

NCDAQ

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

U.S. Conference of Mayors

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

Revolving Funds:

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

Performance Contracts:

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

More information on these, and other financing mechanisms can be found in the EPA document entitled “A State and Local Government Guide to Environmental Program Funding Alternatives” http://www.epa.gov/owow/nps/MMGI/funding.htm.

Deep Retrofit Approach:

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

approach through packaging fast payback retrofits with longer payback ones so that the overall payback of the retrofits is medium-term and greater energy and cost savings overall are achieved.

6.5.6 Works Cited

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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.

6.5.7 Additional Online Resources

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

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

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

7 Appendix A - Material Waste Stream Distribution

Orange County regularly conducts waste composition studies.

ICLEI contacted each of the landfills receiving waste generated within Orange County to determine if the landfill flares or captures landfill gas (the practice of flaring or capturing landfill gas destroys a large portion of the methane that is released by the decay of organic materials). **Error! Reference source not found.** below contains the findings of these communications and the mass of waste that is sent to each landfill.

Table 35 County Waste Disposal Report, Orange County Fiscal Year 2004/2005 with Status of Gas Flaring at Landfill

Facility Type	Facility Name	ID #	Permit #	Tons	Landfill Gas Capture or Flaring In Place
CDLF	BFI-HOLLY SPRINGS DISPOSAL INC	P0467	9214	18	No
CDLF	COBLE'S C&D LANDFILL	P0879	0105	189	No
CDLF	ORANGE COUNTY C&D UNIT	P0569	6801	16,084	No
CDLF	RED ROCK DISPOSAL, LLC	P1031	9228	89	No
MSWLF	ORANGE COUNTY LANDFILL	P0112	6801	56,308	No
MSWLF	UPPER PIEDMONT REG LANDFILL	P0759	7304	4,234	No
MWP	D.H. GRIFFIN RECLAMATION CENTER	P0968	9224	6,640	Unknown
MWP	PCM CONSTRUCTION SERVICES-APEX TRANSF	P1036	9229	11,205	No (NA)
TRANSFE	CITY OF DURHAM TRANSFER STATION	P0926	3212-T	336	No (NA)
TRANSFE	STONE PARK COURT TRANSFER STATION	P0971	3214-T	1,383	C&D waste sent to Red Rock MSW goes to Sampson
TRANSFE	WASTE MANAGEMENT OF RAL-DUR	P0499	9215-T	545	Waste sent to Sampson County

Source: Jim Hickman, Local Government Assistance Team Leader NC Division of Pollution, Prevention and Environmental Assistance also available online at: http://wastenot.enr.state.nc.us/SWHOME/CtyWstdisp0405.pdf

8 Appendix B – Inputs Used in EPA's NONROAD Model

Average Temperature in Orange 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 State Climate Office of North Carolina Station: 311677 - Chapel Hill 2 W (COOP).

Table 36. Average Seasonal Temperatures in Orange County

Season	Minimum Temperature (F)	Maximum Temperature (F)	Average Temperature (F)
Winter: Jan/Feb/Dec	29.0	51.8	40.4
Spring: Mar/Apr/May	45.1	70.2	57.7
Summer: Jun/Jul/Aug	64.2	87.1	75.7
Autumn: Sep/Oct/Nov	46.8	71.6	59.2

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 Orange County. In their model run, NC DENR used the default values for engine populations, size and etc., contained within the model. NC DENR also applied the default value of 0.0 for Stage II control. ICLEI applied the 2002 fuel characteristics to the 2005 emission period and the 2017 fuel characteristics to the 2030 emission period. ICLEI assumed marine diesel sulfur content of 0.0015 in 2030 and applied the spring, autumn and winter 2002 fuel RVP values to the correlating 2030 seasons.

Table 37 Fuel Characteristics for 2002 and 2017 in North Carolina

	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

9 Appendix C – Off-Road Emissions Analysis

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

10 Appendix D – Data Providers

Table 38 Community Data Providers

Sector	Source (Contact/ Title/ Department)	Organization	Data provided
Transportation	Ellen Beckmann, Transportation Planner	DCHC MPO	Vehicle Miles traveled on average day in 2002, 2005 and 2030
Residential, Commercial & Industrial	Ellen Beckmann, Transportation Planner	DCHC MPO	Population, Household, Employment by sector for 2002, 2005 & 2030
Residential, Commercial & Industrial	Doug Crawford-Brown, Professor of Environmental Sciences and Public Policy	University of North Carolina Chapel Hill	Total electricity consumption by Duke Energy's Orange County customers in 2005
Residential, Commercial & Industrial	Robin Blanton, Manager of Engineering	Piedmont EMC	Number of residential and commercial customers and average energy consumption in 2005
Residential, Commercial & Industrial		Progress Energy	
Residential, Commercial & Industrial		PSNC Energy	Natural Gas Consumption
Solid Waste			Solid Waste Generation, Diversion Initiatives, Forecast data
Solid Waste		NC Division Of Pollution Prevention and Environmental Assistance	Solid Waste Generation

Table 39 Local Government Operations Data Sources

Area of Operations	Source (Contact/Title/Department)	Organization	Data Provided
Buildings	Alan Dorman	Orange County	Energy consumption and cost information for County buildings
Buildings	Doug Crawford-Brown	Chapel Hill	Internet access to City's natural gas bills
Buildings	Antonio Baxter	Carrboro	Electricity consumption and costs in City-owned facilities
Buildings	Greg Siler & Carolyn Glasgow	Hillsborough	
Vehicle Fleet	Alan Dorman	Orange County	Fuel use and costs per vehicle
Vehicle Fleet	Doug Crawford-Brown	Chapel Hill	Fuel use and costs per vehicle; gross vehicle weight
Vehicle Fleet	Antonio Baxter	Carrboro	
Vehicle Fleet	Greg Siler & Carolyn Glasgow	Hillsborough	
Street, Traffic and Other Outdoor Lights			
Street, Traffic and Other Outdoor Lights			
Water & Sewage			
Water & Sewage			
Solid Waste (generated by local government operations)			

11 Appendix E - Energy Consumption Estimates for Proposed Changes to Building Tenure 2005-2030

Energy consumption estimates were made using energy intensity at existing facilities in municipality with similar uses (e.g. Orange County's Southern Senior Center energy estimates were estimated using energy intensity at existing Meadowlands Senior Center). Where no existing facilities with similar uses were identified, the total average 2005 energy intensity for all of the local government's facilities was used to estimate the energy use of the new building.

Table 40 Changes to Municipal Building Tenure Between 2002 and 2030

Building	Owner	Completion Year	Area (square feet)	Estimated Annual Energy Consumption	
				Electricity (kWh)	Natural gas (therms)
Meadowlands Annex - Office	Orange County	FY 2006/2007	11,000	181,945	4,901
Meadowlands Annex - Warehouse	Orange County	FY 2006/2007	11,000	181,945	4,901
Southern Senior Center	Orange County	FY 2007/2008	25,000	217,896	3,692
Government Service Center Expansion	Orange County	Not planned	46,000 - 52,000 sq. ft. expansion	767,404	14,226
Central Senior Center	Orange County	FY 2007/2008	Unknown	NA	NA
Northern Transition Area Fire Station	Carrboro	2007 Construction Start Date	7,900	129,445	2,442
Public Works Facility – Administration Building	Carrboro	2011 Construction Start Date	4,200	68,819	1,298
Public Works Facility – Service Building	Carrboro	2011 Construction Start Date	21,450	351,469	6,630
Town Operations Center	Chapel Hill		128,025	1,792,350	25,605
Sale of Public Works Facility	Chapel Hill		- 54,953	-769,342	-10,991

12 Appendix F – Local Government Inventory: 2005 Energy Use and Cost by Individual Building

Table 41 Orange County Buildings, 2005 Energy Consumption, Cost and Building Size

	Energy Use			Energy Cost			
Name	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Propane (US Gal)	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Propane (US Gal)	Floor Area ('000 Sq. Ft.)
501 WEST FRANKLIN	118854.00	0	0	11863	0	0	5.819
ANIMAL CONTROL	25351.00	696	0	2589.72	1047.02	0	1.31
ANIMAL SHELTER	301960.00	8491	0	19026	10358.18	0	7.2
BLACKWOOD FARM PROPERTY	0.00	0	0	96.8	0	0	0
BRADSHAW QUARRY ROAD	4314.00	0	0	548	0	0	0.144
COURT STREET ANNEX	112869.00	3681	0	8316	5019.76	0	8.32
EFLAND COMMUNITY CENTER	25678	0	1131	3009	0	2220.14	2.755
EFLAND RESCUE	8076	0	1211	913.01	0	2335.18	1.2
EFLAND SEWER STATION	17840	0	40	2117.64	0	93.17	0
EMS - ENO MOUNTAIN TOWER	23310	0	0	2712.87	0	0	0.252
EMS-911 NEW HOPE	199490	0	492	15119.72	0	751.53	6.14
EUBANKS ROAD	6886	0	0	785	0	0	0.144
FERGUSON ROAD	4308	0	0	548	0	0	0.144
GOVERNMENT SERVICES ANNEX	114400	4183	0	8216	5652.27	0	6.225
GOVERNMENT SERVICES CENTER	433600	8038	0	28336.78	10406.06	0	25.991
GRAHAM BUILDING	8373	1574	0	945.5	2214.3	0	0.75
HIGH ROCK ROAD	4147	0	0	2125.11	0	0	0.144
HIGHWAY 49 STORAGE	0	0	0	372.38	0	0	0
HIGHWAY 57	4517	0	0	555	0	0	0.144
HILLSBOROUGH SAVINGS & LOAN	40720	0	0	3249.24	0	0	3.5
HOMESTEAD COMMUNITY CENTER	14600	0	2379	1544	0	3699.78	3.198
JAIL	850480.00	25926	0	40600.8	33394.81	0	37.053
MEADOWLANDS SENIOR CENTER	52295.00	886	0	5444.34	1444.82	0	6
MOODY BUILDING	131680.00	0	0	8689.82	0	0	4.8
MOTOR POOL FACILITY	99080.00	5904	0	7944.95	7242	0	10.8
MOTOR POOL FACILITY (OLD)	21360.00	6967	0	2194.51	8651.28	0	4.663
NEW COURTHOUSE	352800.00	13228	0	24877.39	17053.15	0	28.75

NORTHERN HUMAN SERVICES	123690.00	0	0	10275	0	0	34.55
NORTHSIDE	165680	16043	0	12099	20643	0	15.639
OLD COURTHOUSE	118880	4386	0	7009.74	6049.22	0	7.128
OPT MODULAR OFFICE	48809	0	0	4230.01	0	0	2.52
OWASA Administration and Operations (400 Jones Ferry Rd.)	559008	54949	0	30325	64603	0	58.3
PLANNING & AGRICULTURE BLDG	252374.00	4488	0	17155	6165.35	0	20.172
PUBLIC WORKS ADMIN BLDG	25520.00	531	0	2594	794.87	0	2.4
PUBLIC WORKS FUEL STATION	11483.00	0	0	1238.96	0	0	0.1
PUBLIC WORKS STORAGE	38.00	0	0	134	0	0	0
PURCHASING BUILDING	121423.00	0	0	8068.8	0	0	7.06
RWHS COMPLEX	1390390	34198	0	90357	42943.45	0	71.344
SAWYER BUILDING	37173.00	0	0	3523.65	0	0	3.311
SHERIFF DEPARTMENT BUILDING	167800.00	4538	0	9290.24	6169.62	0	7.359
SKILLS DEVELOPMENT CENTER	144960.00	1543	0	10131.48	2189.8	0	13.232
SOUTHERN HUMAN SERVICES	486838.00	23583	0	31625	28432.83	0	28.612
WALNUT GROVE CHURCH ROAD	6297.00	0	0	725	0	0	0.144

Table 42 Town of Carrboro Buildings, 2005 Energy Consumption, Cost and Building Size

	Energy Use		Energy Cost		
Name	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Floor Area ('000 Sq. Ft.)
301 W. Main St.	0	0	0	139.32	0
301 W. Main St. Unit B	0	2125	0	2824.17	0
Anderson Park	60920	0	19584.83	0	0
Anderson Park - Pond Fountain	15433	0	2181.05	0	0
Building and Trades Shop at Town Hall	13950	0	1490.76	0	0
Carrboro Fire Department	231600	0	13636.8	0	0
Carrboro Public Works	87911	2507	6392.94	4428.68	0
Centure Center Statue Fountain	488	0	181.53	0	0
Century Center	365360	12458	20528.27	15756.88	0
Farmer's Market	3396	0	589.56	0	0
Meter on house and site of future MLK Park	110	0	132.14	0	0
Town Hall	162040	187	10768	376	0

Town Hall 911 Back-up System	3094	0	431.51	0	0
Wilson Park	48000	0	4932.11	0	0

Table 43 Town of Chapel Hill Buildings, Energy Consumption, Cost and Building Size

	Energy Use		Energy Cost		
Name	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Floor Area ('000s Sq. Ft.)
Chapel Hill Municipal Buildings	4686087	93912	510268	114155	0

Table 44 Town of Hillsborough Buildings, Energy Consumption, Cost and Building Size

	Energy Use		Energy Cost		
Name	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Electricity (Grid Average) (kWh)	Natural Gas (therms)	Floor Area ('000s Sq. Ft.)
101 E. Orange St - Barn	17848	0	1990.86	0	2.26
101 E. Orange St. - Yard	4992	0	565.21	0	1.598
127 N. Churton St	138848	0	11230.6	0	5.42
137 N Churton Street	47752	1783.152	4289.53	2529.17	3.219
206 S Churton St (Fire Dept.)	73587	2203.438	5942.25	3093.39	7.155
355 Elizabeth Brady	2621	0	386.76	0	7000
501 Rainey Ave (Fairview Comm)	32288	844.6511	3263.26	1357.93	2.709
719 Dimmocks Ml Rd (Garage)	37540	0	3609.89	0	3.645
Cemetary Fountain Corbin Street	2311	0	368.36	0	0
Elizabeth Brady Duke Energy Account #173065	1830	0	171.54	0	0
Elizabeth Brady Duke Energy Account #2556409	104480	0	7832.96	0	0
Elizabeth Brady Duke Energy Account #2556410	8541	0	879.44	0	0

13 Appendix G – Forty Largest Employers in Orange County

Appendix G contains a list of the forty largest employers in Orange County as of 2003 according to the Orange County Economic Development Commission. Several of these businesses have participated in the development of this plan. If each of these businesses could be convinced of the benefits of GHG mitigation (e.g. reduced fuel and electricity costs) and committed to reducing their emissions, the County would be well on its way to achieving its emission reduction.

Table 45 Forty (40) Largest Employers in Orange County

Employer	# of Employees	Sector
1. University of North Carolina	16,600	Institutional
2. UNC Hospitals	6,819	Institutional
3. Chapel Hill-Carrboro City Schools	2,618	Institutional
4. Blue Cross/Blue Shield of NC	1,373	Commercial
5. Orange County Schools	1,253	Institutional
6. Town of Chapel Hill	769	Institutional
7. Orange County Government	740	Institutional
8. General Electric Corp.	525	Commercial
9. Harris Teeter	522	Commercial
10. Sports Endeavors, Inc.	434	Commercial
11. Wal-Mart Stores, Inc.	426	Commercial
12. Orange-Person-Chatham Mental Health	400	Institutional
13. Aramark Services.	380	Commercial
14. PHE, Inc.	369	Commercial
15. A Southern Season	341	Commercial
16. Magnolia Gardens	300	Institutional
17. Whole Foods Market	270	Commercial
18. US Postal Service	250	Commercial
19. Kenan Transport Company	240	Commercial
20. Mebane Packaging Corp	237	Commercial
21. Carol Woods	227	Institutional
22. Lowes Food Stores, Inc.	205	Commercial
23. Weaver Street Market, Inc.	195	Commercial
24. Rho, Inc.	190	Commercial
25. Performance Chevrolet	175	Commercial
26. AKG of America, Inc.	165	Industrial

27. UPS	164	Commercial
28. Orange Water & Sewer Authority	150	Institutional
29. Lowe's of Chapel Hill, NC	150	Commercial
30. Town of Carrboro	147	Institutional
31. Orange Enterprises, Inc.	139	Commercial
32. FGI	130	Commercial
33. Britthaven of Chapel Hill	128	Institutional
34. Sheraton-Chapel Hill	126	Commercial
35. Chapel Hill-Carrboro YMCA, Inc.	120	Commercial
36. Kerr Drug	111	Commercial
37. Child Care Services Association.	111	Commercial
38. IPAS, Inc.	110	Commercial
39. The Siena Hotel	108	Commercial
40. Residential Services, Inc.	108	Commercial

Source: OC EDC Survey 2003, www.co.orange.nc.us/ecodev/stats/emplwage.htm.

14 Appendix H – Emission Coefficients

Electricity Coefficients

Specific emission factors for each grid region, as defined by the North American Electricity Reliability Council (NERC), were developed for the CACP software. Electricity emission factors specify the emissions per kilowatt-hour of the annual average kilowatt-hour produced in the electricity region specified. Default values were calculated 1990 through 2020. Essentially, these average kilowatt-hour factors were derived by dividing emissions in each NERC region by end use electricity. Regional average emission factors for carbon dioxide, methane and nitrous oxide were determined as follows:

CO2

1. Total emissions (in short tons) of carbon dioxide, sulfur dioxide, and nitrogen oxides associated with electricity generation were obtained directly from regional outputs of the AEO2001 reference case NEMS model run.
2. Total electric sales of electricity (in MWh) were obtained directly from regional outputs of the AEO2001 reference case NEMS model run.
3. Final emission factors for each NERC region were determined by dividing total annual emissions by total annual electric sales.

CH4 and N2O

1. Since emission inventory levels for these pollutants are not tracked in the U.S. EPA's National Air Quality and Emissions Trends Report (U.S. EPA, 2000), we used "Tier 1" fuel-specific emission factors, as recommended by the Intergovernmental Panel on Climate Change (IPCC, 1996).
2. Total annual average emissions for the years 2000-2020 were determined by multiplying the fuel-based emission factors from Step #1 above by primary consumption of these fuels in each of the 13 NERC regions, as projected by the AEO2001 reference case NEMS model run.
3. Final annual emission factors for each NERC region were determined by dividing total annual emissions in Step #2 above by total annual electric sales, as projected by the AEO2001 reference case NEMS model run.

Table 46 Region 09-Southeastern Electricity Reliability Council/Excluding Florida

Year	CO2 (t/GWh)	CH4 (t/GWh)	N20 (t/GWh)
2005	729.3	0.009	0.012

Fuel Coefficients

The main source for carbon dioxide (CO2) emission coefficients was the 1605 Voluntary GHG Emissions Reporting Guidelines produced by the DOE. For fuels for which U.S. values were not readily available, the primary source was the IPCC default emission factors supplied in the 1996 Revised Reporting Guidelines on GHG Emissions.

Table 47 Fuel Coefficients by Source

Fuel	Coefficient	Unit
Heavy Fuel Oil	27.584	lbs/gal
Kerosene	23.490	lbs/gal
Light Fuel Oil	23.010	lbs/gal
Natural Gas	0.126	lbs/cubic feet
Propane	144.642	lbs/MMBtu
Stationary Diesel	171.850	lbs/MMBtu
Stationary Gasoline	164.873	lbs/MMBtu
Coal	215.568	lbs/MMBtu
Biodiesel (B20)	16.572	lbs/gal
CNG	143.248	lbs/MMBtu
Diesel	20.968	lbs/gal
Ethanol (E-10)	148.386	lbs/MMBtu
Ethanol (E-85)	24.731	lbs/MMBtu
Gasoline	20.709	lbs/gal
Hydrogen	147.200	lbs/MMBtu
LPG	144.642	lbs/MMBtu
Methanol (M-85)	139.991	lbs/MMBtu

- Landfill gas, wood, sewage gas, solar, wind, hydroelectricity, biodiesel (B100), Ethanol (E100), biomethane and charcoal have zero net emissions.

15 Appendix I – Case Studies

I.1 Residential Sector Case Study: ***Portland, OR***

The city of Portland offers a loan program through the Portland Development Commission (PDC) for home improvements including energy efficiency upgrades. The loans are up to $20,000 with low-interest and deferred-payment and are available for income-qualified homeowners. The Community Action Program (CAP) is a county-level program for lower-income weatherization assistance. Each county administers a CAP to offer free weatherization services to low-income households. Both single-family homes and multi-unit complexes may be eligible. Priority is given to households with young children, senior citizens and people with disabilities.

The Portland Office of Sustainable Development also provides free assistance to property owners (of multifamily units) to achieve energy efficiency and financial savings through weatherization. Their customer service specialists educate the multifamily community about energy efficiency and help property owners and managers apply for valuable incentives from the Energy Trust of Oregon, Inc. and the Oregon Department of Energy. Through innovative public-private collaboration, the Office of Sustainable Development Multifamily Energy Assistance Program promotes and administers the Multifamily Home Energy Savings program for Energy Trust of Oregon. The Multifamily Home Energy Savings program provides property owners with cash incentives for purchasing and installing energy efficient weatherization measures, such as new energy efficient windows; ceiling, floor and wall insulation, low-flow showerheads and more. They also assist property owners in applying for Business Energy Tax Credits from the Oregon Department of Energy.

I.2 Commercial/Institutional Case Study: ***NC State Energy Office***

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

I.3 Industrial Case Study**: *NCSU Industrial Assessment Center***

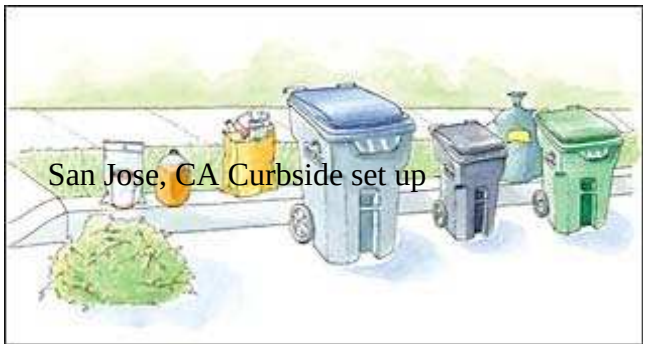
The North Carolina State University Industrial Assessment Center (IAC) program, administered by Rutgers University has been funded by the North Carolina State Energy Office to reduce emissions from the industrial sector. The two main goals of the program are to provide energy conservation and cost reduction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

I.4 Transportation Case Study**: *Ferndale, MI***

Since May 2006, drivers of fuel- efficient vehicles in a suburb outside of the Motor City are saving money on more than fuel. The city of Ferndale recently passed a local ordinance, the first of its kind in Michigan, that enables drivers of cars that get 30-milesa-gallon or better, to park for free at the city's parking meters.78 In order to pay for the administrative costs of the program, car owners must register their vehicle and pay $8 to get a permit for the free meter parking. Craig Covey, the Ferndale council member who proposed the ordinance, explained the city's decision, "We're all hurting with the high gas prices and this is a small, symbolic step to send a message: We care about progress."

I.5 Waste Case Study**: *San Jose, CA***

San Jose has been one of the leaders in creating incentives for reducing waste by implementing "pay as you throw"27 policies. Citizens are charged to dispose of garbage and the rate pay is based on the size of garbage carts. Alternatively, recycling is unlimited at no additional charge. As San Jose website states "By recycling as much as you can, you will be able to use the smaller garbage cart sizes, which cost less." San Jose is one of the few cities that recycles' more than 64% of their solid waste.


San Jose, CA Curbside set up

Since the curbside recycling started the city has recycled:

- 372,000 tons of newspaper
- 277,000 tons of mixed paper
- 132,000 tons of glass
- 135,000 tons of mixed recyclables
- 1,900,000 tons of yard trimmings

I.6 Buildings Case Study**: *Fort Worth, TX***

Between 2001 and 2003, the city of Fort Worth, Texas, reduced its electricity consumption by 16%. This was in part due to the passage of Senate Bill 5 (SB5) also known as the Texas Emissions Reduction Plan, by the Texas Legislature in 2001. The new law required all city and county governments in the state to implement all cost effective energy efficiency measures. The law also requires the governments to establish a goal of 5% reductions annually in electricity use for government facilities and operations between 2002 and 2006. The city of Fort Worth achieved and surpassed the state's efficiency benchmarks. They did so by implementing cost-effective strategies in coordination with a private company that specializes in energy efficiency retrofit projects known as an Energy Savings Company (ESCO). Many states have ESPS legislation, including Florida and Wisconsin. There are many other resources that might be useful to a municipality exploring the use of ESCOs, including the National Association of Energy Service Companies and Model Performance Contracting Legislation.

I.7 Fleet Case Study**: *Charlotte, North Carolina and Calgary Alberta***

Charlotte:

When Charlotte's fleet managers found that hybrid gas-electric vehicles are less expensive to operate than conventional cars, Mayor Pat McCrory and Council members Susan Burgess and John Tabor took action. Working with city staff and with the cooperation of Mecklenburg
County, the City Council supported a plan to bring the total number of hybrids in the fleet to over two dozen by the end of 2006—more than tripling the city/county's current number of hybrids.
Although they typically cost more initially than standard gasoline-fueled cars, gas-sipping hybrids save on gasoline, have lower maintenance costs, and retain a higher resale value at the end of their useful life, according to Charlotte's Fleet Environmental Analyst David Friday.
Mr. Friday estimates that switching from a gas-only Ford Taurus to a hybrid Toyota Prius or Honda Civic would save city taxpayers approximately $800-$1200 annually per vehicle, including over $400 in annual fuel costs. "This results in a payback of the extra purchase cost within 2.5 to 5.5 years, depending on the model chosen and miles driven," said Friday. [Source: "Ford Taurus to Honda Civic Hybrid and Toyota Prius Comparative Analysis," David Friday, Charlotte Fleet Environmental Analyst, May 2005]

Calgary:

In September 2001 the City of Calgary announced its decision to use commercial wind energy as the primary source of the C-train's electricity. The program is called *Ride the Wind!*™ because people using the C-Train would actually be traveling with the help of energy captured from the wind. Before the switch to wind power, the C-Train's energy supply accounted for about 20,000 tonnes of GHGs and other air pollution every year, less than 1/10 of the pollution that would have resulted if all C-Train passengers had driven in their own cars. Under the *Ride the Wind!* ™ program, these emissions are reduced to practically zero. The reduction in GHG emissions resulting from this change is like

taking another 4,000 cars off the road for a year. This makes the C-train one of the most environmentally friendly forms of transportation you can use.

I.8 Streetlights/Traffic Lights Case Study**: *Chicago, IL***

The city of Chicago has an estimated 2,800 intersections. Through a joint venture between the Chicago Department of Transportation (CDOT) and the City's Bureau of Electricity, old traffic lights at 350 intersections have been replaced with LED traffic signals. According to Matt Smith, Director of Communications at CDOT, the new LED traffic signals have demonstrated their efficiency through significantly reduced energy costs. The city estimates that it will save $2.5 million annually by retrofitting all of its intersections. The program has already reduced the city's annual CO2 emissions by 7,250 tons. An added benefit of switching to LEDs is the ability to use backup power supply for traffic signals during power outages. In conjunction with the LED retrofit program, the city of Chicago has installed PowerBack ITS Systems at approximately 800 new and existing traffic intersections. The PowerBack ITS System is a complete battery backup system for traffic signal intersections that keeps traffic signals on when the power goes out. The PowerBack ITS Series will operate traffic signals after a power outage in either normal or "flash" mode for up to 24 hours. Although such backup power supplies can be used in traditional incandescent traffic signal systems, they provide a much longer range of emergency coverage with more energy efficient LEDs. CDOT has also begun implementing the use of activated or actuated traffic signals that can detect when a vehicle is in the intersection. This network of vehicle detectors automatically detects traffic movement and patterns and allows automated adjustments of the traffic signal operation to streamline the flow of traffic. Stop-and-go traffic wastes energy since gasoline-powered cars use almost as much energy idling as driving.

Timing traffic lights, particularly during commuting hours in the commuting direction, will alleviate congestion and excessive stop-and-go traffic. The results of CDOT's integrated traffic management program are a better understanding of traffic patterns, better coordinated traffic signals at any particular intersection, increased efficiency of traffic flow, and fewer accidents.

Mayor Daley's Traffic Management Task Force meets regularly to review major construction projects and special events that are likely to have significant impact on the city's traffic. Members of CDOT, the Mayor's Office, and other key city departments and agencies work with media outlets to design solutions and inform the public on road closures, alternate routes and traffic advisories.

I.9 Water and Sewage Treatment Case Study**: *FairField, OH***

Fairfield Wastewater Treatment Facility in Ohio provides services to 45,000 people. Since 1986, the utility has been working to increase the energy efficiency of its operations through an automated system and continuous technology upgrades.

In 1999 the Wastewater Division implemented a real-time rate-pricing program. This program uses data from previous years to calculate an energy usage baseline. When electricity prices peak, the facility can use its automated system to shut down temporarily and save money. This automated operations system has shifted 35–40% of peak loads to cheaper, off-peak periods, resulting in energy bill reductions of up to 17%. Continuous monitoring of the system's operations and energy use allow the utility to maintain optimal performance.

Fairfield's utility management uses a general set of guidelines to facilitate investment decisions in energy efficiency upgrades. The Fairfield Wastewater policy states that efficiency upgrades that cost less than $15,000 and have a payback of less than five years receive automatic authorization. This process gives project managers much more flexibility in including such upgrades in their annual budgets.

There is a 21-member team composed of operations staff members that meets regularly to discuss new technology and energy efficiency ideas. Fairfield Wastewater also encourages feedback and input from staff at weekly operations meetings.

I.10 Local Government Waste Case Study**: *San Clemente, California***

The City of San Clemente has adopted a resolution and a policy prohibiting the use of food service items comprised of expandable polystyrene (PS) containers within city facilities and at city-sponsored events. The California Integrated Waste Management Board (CIWMB) estimates that Californians landfill approximately 300,000 tons of PS each year at a cost of approximately $30 million, not including the added

cost of collection and disposal of litter. In fact, Californians use more than 165,000 tons of PS each year for packaging and food service purposes alone.

It was decided that the City of San Clemente shall not purchase or acquire food service products which are produced with expandable polystyrene. Prohibited products include, but are not limited to, expandable polystyrene food containers, bowls, straws, plates, trays, cartons and cups which are not intended for reuse, on or in which any food or beverage are placed or packaged. Alternative products have been made more readily available in California including paperboard or aluminum containers, coated paper or polylactic acid cups and utensils made from potatoes.

A copy of the report can be found at the following URL: http://www.projectsurf.org/pdf/04-20-04-Agenda%20Report.pdf

16 Appendix J – Sample Measure Cases by Sector

Below are a breakdown of some of the sectors where significant indicator data was available to give examples of qualitative measures within the sector. These examples can give the local government a more tangible idea of what is required for each scenario. Low is a conservative effort (low-hanging fruit), medium is a conservative effort, requiring more effort and capital, and high is an aggressive scenario that requires more initiative, cost investment and is usually considered long term planning.

COMMUNITY MEASURE SAMPLES

Residential Sector:

Suggested Measure	Low	Medium	High
Expand conservation measures	**40,197**	**100,495**	**140,691**
# households improve efficiency by 35%	8	20	27
# house holds improve efficiency by 15%	18	46	64
New Construction Energy Efficiency	**40,647**	**81,294**	**121,941**
# of new houses improve by 20%	14	28	42
# of new houses improve by 35%	8	16	24
Expand alternative energy measures	**15,840**	**26,400**	**52,800**
100% green power	1	2	4
10% green power	11	18	36

Commercial Sector:

Suggested Measure	Low	Medium	High
Energy conservation programming	**16,260**	**40,650**	**81,290**
# of businesses to reduce annual emissions by 1000 tons (equiv of 1400,000kwH or 4,778 MMBTu or 160 homes)	16	40	81

Transportation Sector:

Suggested Measure	Low	Medium	High
Land Use Planning	**135,700**	**271,400**	**407,100**
# miles avoided by midsized cars	252,406,788	504,813,576	757,220,364
Alternative Fuels & vehicles	**40,710**	**67,850**	**135,700**
# midsized cars replaced by hybrids	6,462	10,770	21,540
# midsized cars switching from gasoline to E85	6,770	11,283	22,565
Initiate Transportation Demand Management (TDM)	**135,700**	**203,550**	**339,250**
# miles avoided by midsided cars	252,406,788	378,610,182	631,016,970

LOCAL GOVERNMENT MEASURE SAMPLES

Buildings Sector:

Suggested Measure	Low	Medium	High
Energy efficiency upgrades/expansion of existing programs	**1,170**	**2,330**	**4,080**
Towns and County building stock improve efficiency by	3%	5%	10%
Renewable and Alternative Energy Sources	**580**	**1,170**	**1,750**
Towns and County's buildings use 100% percent green power	2%	4%	7%

Fleet Sector:

Suggested Measure	Low	Medium	High
Alternative energy sources	**61**	**92**	**153**
% of green power to be purchased	0.57%	0.87%	1.44%
Additional energy efficiency measures - operational	**61**	**153**	**305**
# of streetlights to improve efficiency by 10%	1,220	3,060	6,100
# of streetlights to improve efficiency by 35%	349	874	1,743
Additional energy efficiency measures - technological	**305**	**610**	**915**
# of streetlights to improve efficiency by 35%	1,743	3,486	5,229
# of streetlights to improve efficiency by 60%	1,017	2,033	3,050

Streetlight Sector:

Suggested Measure	Low	Medium	High
Alternative energy sources	**61**	**92**	**153**
% of green power to be purchased	0.57%	0.87%	1.44%
Additional energy efficiency measures - operational	**61**	**153**	**305**
# of streetlights to improve efficiency by 10%	1,220	3,060	6,100
# of streetlights to improve efficiency by 35%	349	874	1,743
Additional energy efficiency measures - technological	**305**	**610**	**915**
# of streetlights to improve efficiency by 35%	1,743	3,486	5,229
# of streetlights to improve efficiency by 60%	1,017	2,033	3,050

Water/Waste Water Sector:

Suggested Measure	Low	Medium	High
Water Conservation - Expanded Program	**1123**	**2,246**	**3,606**
million gallons to be conserved	28,092	56,183	90,204
Retrofits of Plants	**2,246**	**3,606**	**4,508**
all water and sewage facilities to improve efficiency by	7%	11%	13%
Alternative Energy	**180**	**901**	**1,803**
% of greenpower to be purchased	1%	3%	5%

17 Appendix H - Summary of Local Government GHG Emissions in 2005

Orange County	eC02 (tons)	eCO2 (%)	Energy (MMBtu)	Cost ($)
Buildings	6,444	15	47,461	755,689
Fleet	4,167	9.7	50,761	750,943
Streetlights	140	0.3	651	29,122
Water/Sewage	15,578	36.4	81,455	1,185,640
Waste	1,499	3.5		
Other	461	1.1		
Subtotal	**28,289**	**66**	**180,328**	**2,721,393**

Town of Carrboro	eC02 (tons)	eCO2 (%)	Energy (MMBtu)	Cost ($)
Buildings	834	1.9	5,114	104,374
Fleet	701	1.6	8,755	124,317
Streetlights	34	0.1	160	11,317
Water/Sewage				
Waste	91	0.2		
Subtotal	**1,660**	**3.9**	**14,029**	**240,082**

Town of Chapel Hill	eC02 (tons)	eCO2 (%)	Energy (MMBtu)	Cost ($)
Buildings	4,016	9.4	25,385	624,423
Fleet	2,068	4.8	26,040	485,789
Streetlights	2,456	5.7	11,434	330,000
Water/Sewage				
Waste	470	1.1		
Subtotal	**9,010**	**21**	**62,859**	**1,440,221**

Town of Hillsborough	eC02 (tons)	eCO2 (%)	Energy (MMBtu)	Cost ($)
Buildings	364	0.8	2,115	47,327
Fleet	594	1.4	6,921	94,578
Streetlights	416	1	1,936	55,852
Water/Sewage	2,456	5.7	11,461	195,852
Waste	51	0.1		
Subtotal	**3,881**	**9.1**	**22,433**	**393,610**

TOTAL	**42,840**	**100**	**279,649**	**4,795,306**