



TOWN OF CARRBORO  
NORTH CAROLINA

**TRANSMITTAL PLANNING DEPARTMENT**

**DELIVERED VIA:**  *HAND*  *MAIL*  *FAX*  *EMAIL*

**To:** David Andrews, Town Manager  
Board of Aldermen

**From:** Chris Lazinski, Delta Fellow  
Randy Dodd, Environmental Planner

**Date:** March 29, 2012

**Subject:** Town of Carrboro Greenhouse Gas Inventory and Reduction Planning

**Background and Summary**

Pursuant to the Town of Carrboro’s membership in ICLEI – Local Governments for Sustainability, the Cities for Climate Protection (CCP) initiative, and the passage of a resolution in 2009 committing the Town to reduce its greenhouse gas (GHG) emissions, information has been pulled together to establish a baseline GHG emissions inventory for the Town’s municipal operations. Membership in the CCP program involves members agreeing to follow a five-milestone process for reducing their emissions (Table 1). This information contained in this memo will allow the Town to improve upon previous efforts pursued for Milestone 1, which is to conduct a baseline emissions inventory and forecast, and set the Town up to complete Milestone 2, which is to adopt an emissions reduction target for a chosen forecast year. This memo includes an analysis of all carbon dioxide emissions resulting from all Town electricity, natural gas, and vehicle fuel use since January 2007, as well as projected trends in emissions and policy options for reducing them through the year 2035.

**Table 1: Cities for Climate Protection Five Milestone Process**

<b>Milestone</b>	<b>Description</b>	<b>Notes</b>
1	Conduct a baseline emissions inventory and forecast.	The Orange County inventory and forecast ( <a href="http://www.co.orange.nc.us/ercd/greenhousegas.asp">http://www.co.orange.nc.us/ercd/greenhousegas.asp</a> ), was completed in 2008. Carrboro pursued an updated inventory in partnership with a UNC Capstone Team in 2011. The effort described herein represents further refinements.
2	Adopt an emissions reduction target for the forecast year.	The Orange County effort included several target scenarios. Carrboro adopted a climate protection resolution in 2009; this memo suggests an approach for further articulation as a

		measurable emissions reduction target for Carrboro municipal emissions.
3	Develop a Local Action Plan	Carrboro has not adopted a Local Action Plan. Carrboro has pursued components of a plan, for example, through the WISE program, and through various local planning efforts.
4	Implement policies and measures	Carrboro has adopted the climate protection resolution, and has pursued various measures, such as establishment of the WISE program, transportation and land use planning and management, the WISE program, support of alternative fuels
5	Monitor and verify results	The effort described in this memo provides the foundation for ongoing monitoring and verification of municipal emissions.

**Information**  
**Data Collection**

In putting together this GHG emissions baseline report, an emphasis was placed on clarity of scope, accessibility and transparency of both energy consumption and GHG emissions data, and repeatability of the methodology. While there have been two prior GHG inventories that have accounted for Carrboro in their analysis, these inventories were lacking in one or more of these areas. Focusing on these three qualities in this report provides the greatest chance that the Town will be able to continue to accurately track its GHG emissions with the smallest possible staff impact.

*Scope*

As per standard GHG inventory reporting protocols, this report focuses only on the Scope 1 and Scope 2 GHG emissions attributable to Town operations. Scope 1 emissions are direct emissions resulting from the combustion of fuel on-site. Examples of Scope 1 emissions include vehicular tailpipe emissions from Town vehicles and emissions from burning natural gas to heat Town facilities. Scope 2 emissions are indirect emissions associated with the consumption of purchased or acquired energy. Scope 2 emissions primarily result from the Town’s electricity consumption. As a general rule, emissions are attributable to the Town if they are emitted by an entity that the Town has full operational control over. By this definition, the scope of this inventory includes all electricity use billed to the Town for its facilities, street lighting, and public lighting, as well as the fuel usage of the Town’s vehicle fleet and natural gas use in its facilities. This scope excludes any emissions from operations of the Orange Water and Sewer Authority (OWASA), Orange County Solid Waste (OCSW), and Chapel Hill Transit (CHT), electricity usage attributable to traffic signals within Town limits, and other non-municipal activities. While the services of water treatment and delivery, waste processing, public transit, and traffic management are in the public sector and occur within Town limits, the emissions attributable to these services cannot be directly controlled by only the Town and are therefore outside the scope of this inventory. It is worth noting that the total community footprint for Carrboro was estimated at 115k MTCDE (2009 values), while municipal operations were estimated at less than 2k MTCDE (<2%). Therefore, the Town’s effort in cooperating with other private and public entities is paramount to appreciable local reductions. In order to obtain a more complete understanding of the comprehensive local carbon footprint, it is recommended that the Town continue to work with other public service providers and the private sector in coordinating future GHG inventories.

### *Data Accessibility*

The data required for this inventory can be broken down into three main sectors of electricity, natural gas, and vehicle fuel. Before this inventory, no process existed for the Town to access its electricity and natural gas bills digitally. To address this, Town online billing accounts were created with Duke Energy for electricity and PSNC for natural gas, and an email notification process was set up with Piedmont EMC. Through these channels, monthly electricity usage data was obtained for each Town Duke Energy account dating back to February 2003 and each Piedmont EMC account back to January 2007. Monthly natural gas usage totals were obtained for Town PSNC accounts back to January 2009, with annual usage totals available to 2007. The creation of these online accounts greatly streamlined the data collection process for future inventories and allows all interested Town staff to see how much electricity and natural gas the Town is using and at what cost. As for vehicle fuel usage data, Public Works already compiles and releases quarterly fuel usage reports, which can be found on the Town’s network dating back to July 2006. Taken together, these records paint a complete picture of the Town’s energy usage from January 2007 to December 2011. It is recommended all supporting documentation and analysis used in this report be maintained and made accessible on staff file servers for sharing across departments.

### *GHG Accounting Methodology*

While electricity, natural gas, and vehicle fuel are all different forms of energy, they all produce GHG emissions from their consumption. In order to combine different sources of energy into one emissions profile, all usage figures must be converted into one “common denominator” unit, which in this case is metric tons of carbon dioxide equivalent, or MTCDE. Conversion factors used in converting kilowatt-hours (kWh) to GHGs were obtained from the EPA. Many of the conversion factors convert the base unit of energy into lbs. CO<sub>2</sub>, so to get the units into MTCDE, a factor of 2204.62 lbs. per metric ton was applied. A table of obtained and derived conversion factors is presented below.

<b>Energy Type</b>	<b>Unit</b>	<b>Lbs. CO<sub>2</sub></b>	<b>MTCDE</b>
<b>Electricity</b>	1 Kilowatt-hour	1.11841	0.0005073
<b>Natural Gas</b>	1 Therm	11.0231	0.00500
<b>Gasoline</b>	1 Gallon	19.54	0.00886
<b>B20 Bio-diesel</b>	1 Gallon	17.89	0.00811

### Results

The conversion factors in the table above were applied to all Town electricity, natural gas, and vehicle fuel use as defined by the project scope from January 2007 to December 2011. Figure 1 shows the Town’s overall annual emissions from 2007 to 2011, and Figure 2 breaks those emissions down by sector during that time frame. Figure 3 shows the monthly breakdown of emissions from 2009 to 2011 by sector. Because vehicle fuel use is reported quarterly, those figures were averaged over the quarter to obtain the monthly usage approximations in Figure 3.

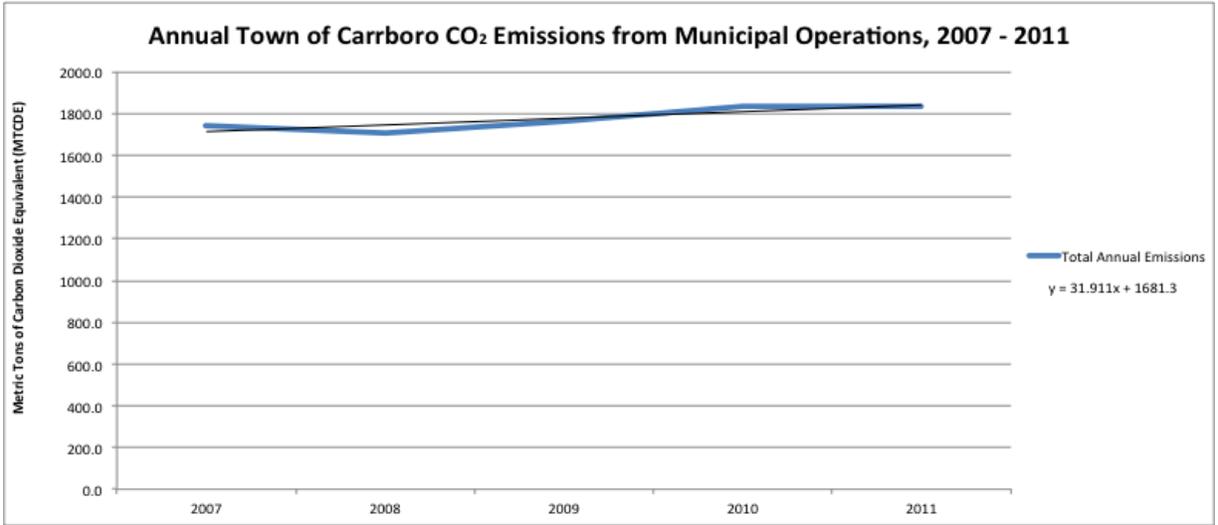


Figure 1.

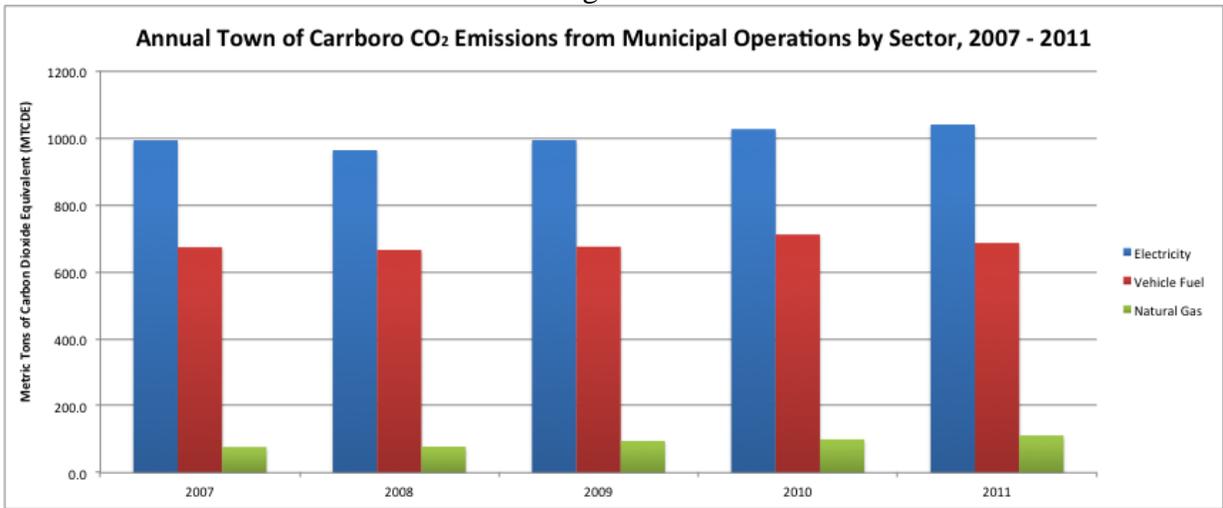


Figure 2.

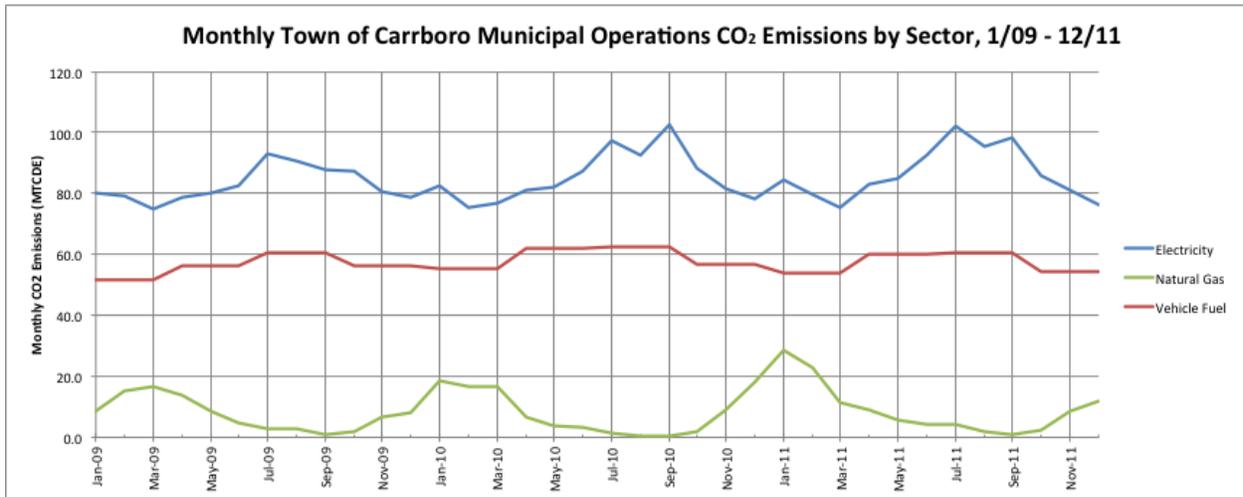


Figure 3.

A trend line applied to the data in Figure 1 reveals that the total emissions attributable to Town operations have been growing at an average rate of 31.9 MTCDE per year between 2007 and 2011, or 1.8% of 2007 emissions per year. Below, Figure 3 was constructed in order to determine how the opening of Fire Station #2 in August 2010 contributed to this growth in emissions. The blue line shows the emissions totals depicted in Figure 1, and the red line shows the Town's emissions without counting those from Fire Station #2. The change in scale of the y-axis allows for easier visualization of the trends. This plot reveals Town's emissions excluding the new fire station were growing at a rate of 18.0 MTCDE per year between 2007 and 2011, or 1.0% of 2007 emissions per year.

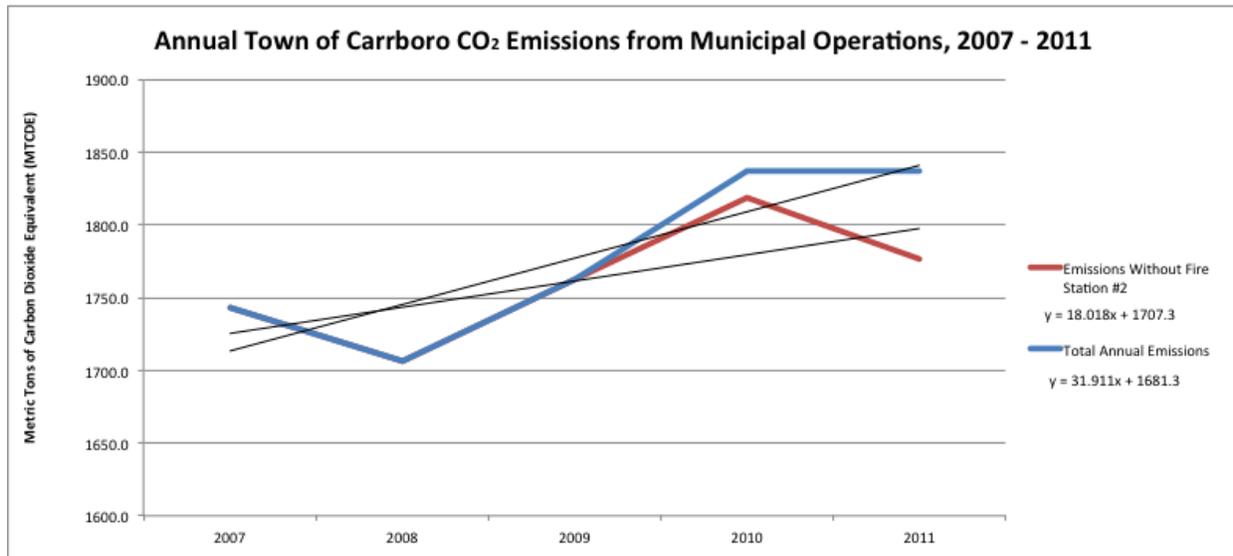


Figure 4.

While Town emissions are not increasing at a particularly high rate, they did increase during this 5-year window, which is contrary to the direction desired based on participation in Cities for Climate Protection and the Town's 2009 pledge to reduce its emissions. Based on this new data, should the Town's commitment to emissions reductions continue, it is clear that action is needed to prevent future emissions growth and begin to reduce overall emissions.

In order to begin the conversation of where the Town's efforts should be focused in carbon emission reduction, Figure 5 was constructed to show the percentage contribution to the Town's emissions from all sources during the calendar year 2011. All vehicle fuel usage combined accounts for 38% of emissions, while all facilities combined contribute 36% of emissions, with the remaining 26% attributable to streetlights and public lighting. The single largest source of emissions is street lighting at 22% of the total, but it is worth noting that the Town does not own its street lighting infrastructure and instead has a lease arrangement with electric utility providers. Emissions from streetlights were followed by Carrboro Police and Public Works fuel usage, at 17% and 16%, respectively. The Century Center is the largest emitter among facilities operated by the Town, accounting for 15% of total emissions.

With the completion of this project, a protocol has been developed that will allow for efficient and effective tracking of Town GHG emissions in the future. In order to continue the CCP

process, Milestone 2 must now be discussed, which is to set an emissions reduction target for a chosen forecast year. In this matter, Carrboro can look to its 2009 climate change resolution and model policies in other cities for guidance.

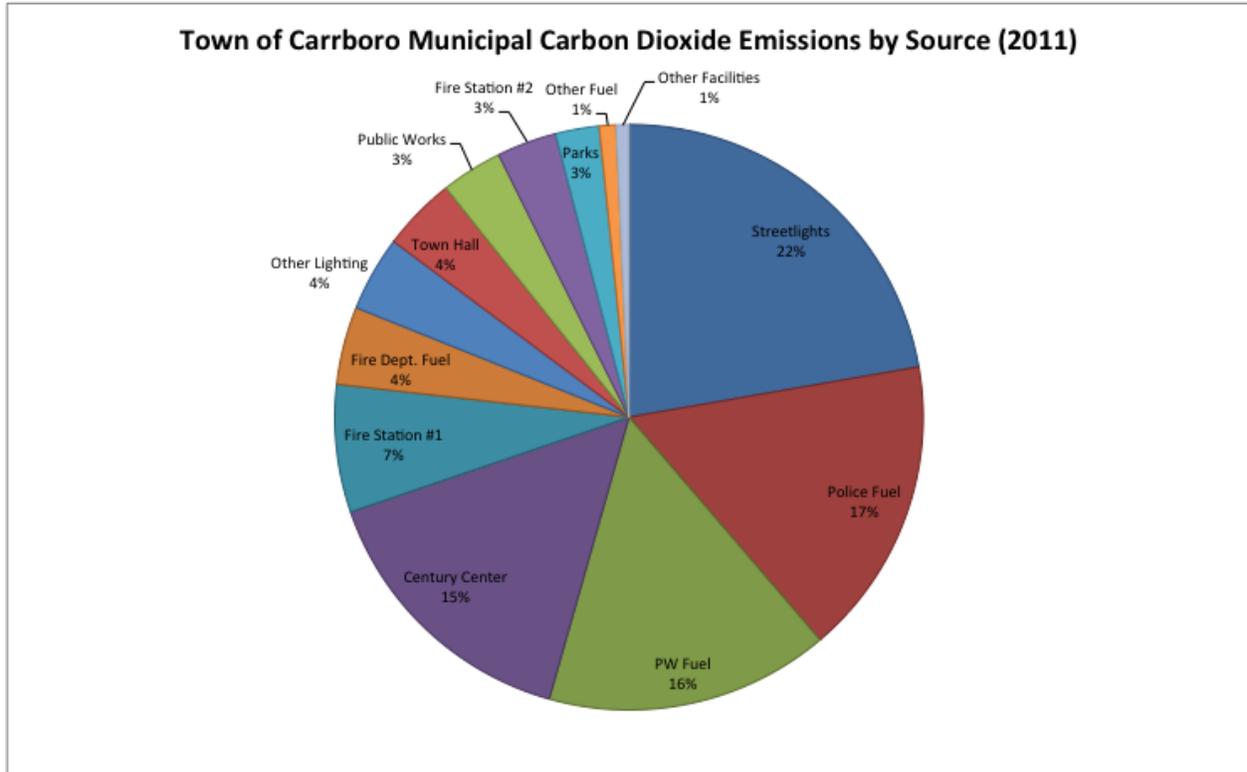


Figure 5.

### Emissions Reduction

According to a 2009 resolution passed by the Board, the Town’s goal is to “cut CO<sub>2</sub> emissions by [the Town’s] proportion of the amount which is required to stabilize the climate back to less than 350ppm of CO<sub>2</sub> in the atmosphere in time for a 90% probability for success” in averting the worst impacts of climate change. While this resolution applies to the emissions of the whole community, the most easily quantifiable and manageable emissions of the community from a government perspective are those attributable the Town’s municipal operations, which make sense as the starting point for any emissions reduction initiative. In an effort to understand what the corresponding emissions reductions must be to bring the emissions from the Town’s municipal operations in line with the 350ppm goal, a “back-cast” was performed using current emissions trends. While there is considerable difficulty in quantifying an emissions reduction target in line with the Town’s 2009 resolution for reasons of atmospheric physics and scientific uncertainty, the current trends were projected linearly back to 1988, which is the year where global annual average atmospheric CO<sub>2</sub> crossed the 350ppm threshold.

Due to the short nature of the time series over which data is available, it is difficult to determine the true rate at which the Town's emissions attributable to municipal operations have grown between 1988 and present. The assumption implicit in this analysis is that the data gathered from 2007 to 2011 can be used to accurately represent trends prior to 2007. It should be noted that certain events, such as the incorporation of the Century Center into Town facilities in 2001, likely mean that a linear representation of the growth in emissions based on current trends overestimates Town emissions in 1988, and should be the subject of further study. For the purposes of this analysis, in order to approximate the Town's possible historical and future emissions from 1988 to 2035, the two trend lines from Figure 4 were extended to determine upper and lower bounds for emissions growth. The trend line incorporating the contribution of Fire Station #2 represents a "high emissions growth" scenario, and the trend line excluding the contribution of Fire Station #2 represents a "low growth" scenario. In Figure 6 on the next page, these two trends are projected back to 1988 and forward to 2035 to determine possible GHG emission rates over that time series. The 1988 baseline is selected from the "high emissions growth" scenario because that scenario results in the lowest baseline, giving the Town a lower emissions level to work toward.

In recognition of the facts that good data is not readily attainable before 2007, a baseline of 1988 has substantial uncertainty in quantifying those emissions, and a local atmospheric equivalent to 350ppm of CO<sub>2</sub> is very difficult to evaluate with measurable and tractable protocol, it is recommended that the Town investigate the feasibility of pursuing a more easily quantifiable GHG emissions reduction policy. Two cities that are recommended as exemplars for Carrboro in designing a potential policy are Asheville and Chapel Hill. In 2007, Asheville committed to reducing its municipal operations carbon footprint by an amount equal to 2% of its 2007 emissions every year with the goal of reducing emissions 80% by the year 2050. In pursuit of their goal, the City has managed to outperform their goal with GHG emissions reductions totaling 8.42% over 3 years while reducing energy spending by 5.91%. The scale of their effort is much greater than Carrboro's, however, as their total reductions achieved to date under their reduction mandate are greater than all of the emissions of the municipal operations of Carrboro combined. The Town of Chapel Hill adopted a goal of a 35% reduction by 2025 of emissions attributable to Town operations on their way to a goal of a 60% reduction by 2050. Their 2025 target works out to be reducing emissions by 1.8% of baseline emissions per year, assuming that 2006 is their baseline year. Given the policies in place in these two model cities, it is recommended that Carrboro explore the feasibility and fiscal impact of implementing a GHG reduction policy that sets an annual reduction goal of 2% of 2007 levels per year.

Figure 6 below depicts past and present emissions according to current trends as well as future emissions forecasts under different policy scenarios for Carrboro. If implemented in 2012, a 2% annual reduction policy would result in emission levels that are 42.6% lower than the 2007 baseline by 2035 and a return to possible 1988 levels by 2033. A 4% annual reduction policy would reduce emissions to 90.6% lower than the baseline by 2035 and a return to possible 1988 levels by 2022.

To put a 2% annual emissions reduction goal into more concrete terms, 2% of 2007 emissions levels is 34.9 MTCDE. In 2011, Fire Station #2 contributed 60.3 MTCDE of emissions to the Town total through its electricity and natural gas use. If a 2% annual reduction target were

implemented, the target would be met by reducing emissions equivalent to just over half of Fire Station #2's 2011 emissions contribution every year until 2025. Put another way, according to a solar site assessment performed by Strata Solar on the proposed solar photovoltaic project at the Farmers' Market, a 4.84kW installation there would produce 7,066kWh annually. That electricity production, if used entirely by the Town, would offset the emission of 3.6 MTCDE. If the ratio of system capacity to system output holds true, the Town could meet an annual 2% reduction goal by installing between 45 and 50kW of solar PV capacity every year and using all of that electricity in Town facilities. Assuming that the panels used are 220W panels of typical dimensions (5.4ft. x 3.3ft.), the size of the necessary array would cover between 3,645 and 4,050 ft.<sup>2</sup>, or just less than one-tenth of an acre. Of course, such a strategy would be much less cost-effective than pursuing energy efficiency and other means, which the Town has already studied in part.

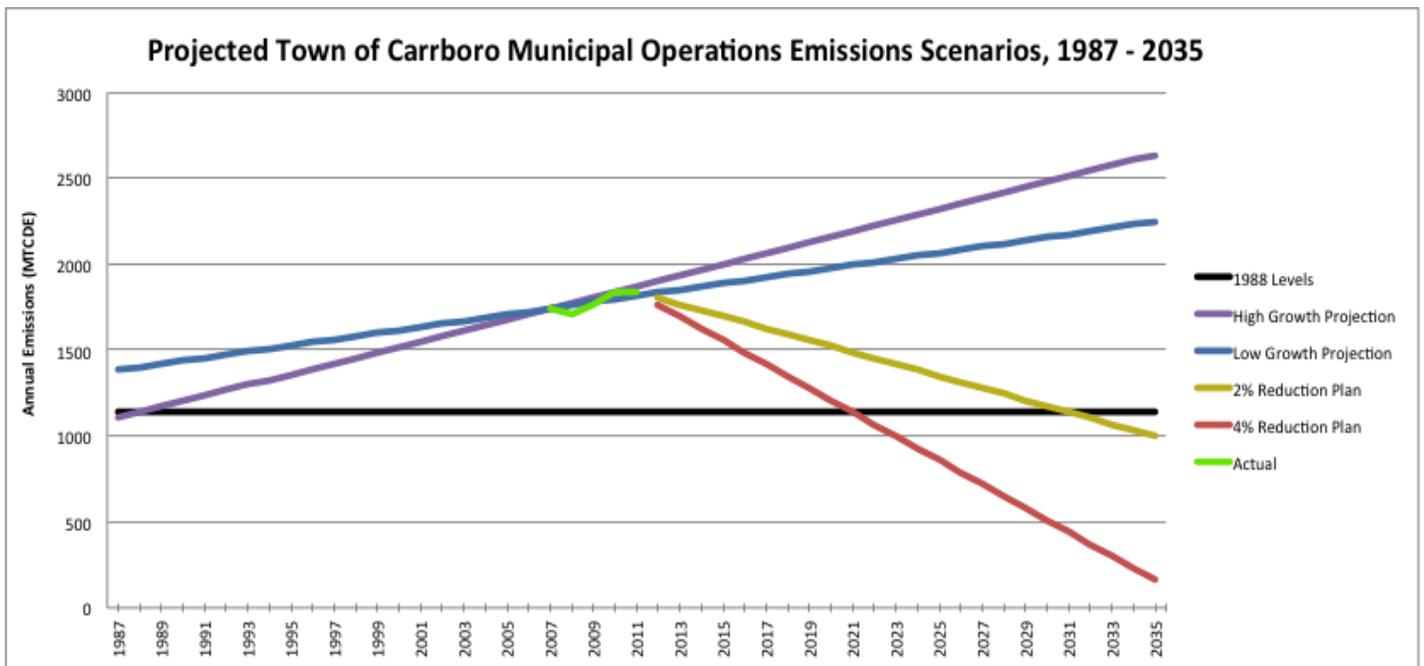


Figure 6.

An annual percent reduction strategy is recommended because it provides a measurable goal for the Town to pursue. Implicit in future efforts would be exploration of the best financing mechanisms for pursuing efforts, whether it is through performance contracting, an internal revolving fund or “energy bank”, or other ways to finance projects through energy savings, as well as possibly through debt servicing such as Qualified Energy Conservation Bonds.

In order to help achieve any proposed emission reduction goal, a number of energy efficiency projects in Town facilities have already been preliminarily investigated as part of a study by Waste Reduction Partners in 2008 and the Town's applications to obtain Energy Efficiency Conservation Block Grant (EECBG) money in 2010.

According to the figures provided in the EECBG applications, if the proposed projects for the Century Center, Town Hall, Public Works, and Fire Station #1 were all completed at a total cost

of \$75,980, the total emissions reduction would be 57.2 MTCDE, or 3.28% of the 2007 baseline. Across all buildings, these projects produce an average cost per 1% emissions reduction of \$23,132. In the Waste Reduction Partners study, only the savings potential of proposed projects was analyzed without listing the costs. According to the projections for kWh savings, if all proposed projects were implemented, it would result in a reduction of 84 MTCDE, or 4.82% of the 2007 baseline. In both the EECBG applications and the Waste Reduction Partners study, many of the proposed projects are low-cost and have a short payback, such as adjusting building heating and cooling controls or removing lights from over-lit areas, while others are much more substantial and expensive, like upgrading the HVAC system of a facility. For both studies, the projects were identified based upon the criteria available for those efforts and may no longer be the best options for reducing energy usage in Town facilities, which means that further study is necessary in order for the Town to determine the best way to move forward with planning for and financing emissions reductions across all sectors, not just in facilities. Studies comparable to the Waste Reduction Partners and EECBG studies for municipal buildings have not been completed for energy and emissions reductions for other energy uses such as lighting and the Town fleet.

### **Recommendation**

Based on the information contained in this memo, it is recommended that the Town investigate the fiscal implications and alternative strategies for implementing a GHG reduction policy across all Town operations with a goal of reducing emissions by at least 2% of 2007 levels annually through at least 2025. This approach will allow the Town to determine the best fit for Carrboro to implement the policy in order to further the Town's goals of environmental stewardship, economic sustainability, and "leading by example".