

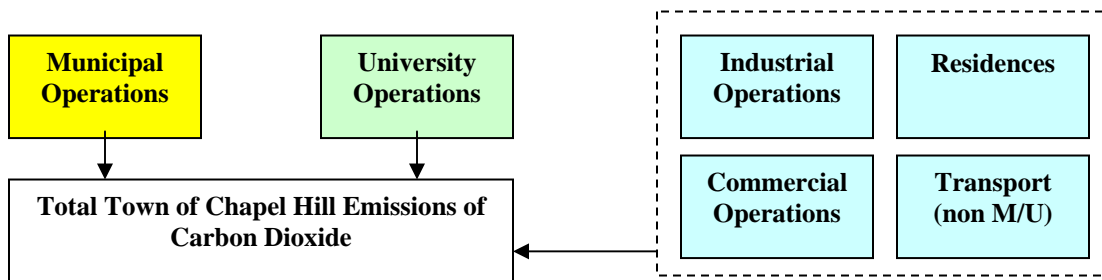
## Moving forward on the Community Carbon Reduction (CRed) pledge in Chapel Hill

Doug Crawford-Brown, June 12, 2006

*\*Revised June 17, 2006*

### What is our goal?

The goal of CRed in Chapel Hill is to bring about a 60% reduction in carbon dioxide emissions from all sources within the geographic boundaries of Chapel Hill by 2050 at the latest, and preferably by 2025 (to set an example other communities can follow by 2050). We can imagine the town as emitting carbon dioxide from several sectors shown in Figure 1.



**Figure 1.** The 6 sectors of activities resulting in carbon dioxide emissions within the boundaries of Chapel Hill.

The yellow box represents emissions from operations under the direct control of the Town of Chapel Hill. The green box represents emissions under the direct control of the University of North Carolina at Chapel Hill. The blue boxes, bundled together here, are under the control of other entities (individuals, companies, etc). Ultimately, the CRed-Chapel Hill project seeks to reduce all emissions (the white box) by 60%.

### The Pledge and First Steps

In Fall 2005, the Town Council voted unanimously to be the first component of Figure 1 to join the CRed-Chapel Hill project. The idea was to act first as an example to the other components of Figure 1 by developing plans to reduce emissions associated with the Municipal Operations box by 60% (again, as of somewhere between 2025 and 2050). Once the example was set, the Town Council would have the standing needed to request similar reductions in the other sources in Figure 1, and could even consider how Town policies might be used to help stimulate those reductions (e.g. the planning and permitting process). So, the initial pledge of the Town Council was to (i) identify areas of municipal operations that might most effectively reduce carbon dioxide emissions; (ii) develop goals for reduction focused on these operations; (iii) develop strategies to reach

those goals; (iv) implement those strategies over the coming decades; and (v) periodically assess the success of those strategies.

The pledge from the Carolina Environmental Program was two-fold: to assist the Town in any way needed to perform the five steps mentioned above, and to work with individuals and institutions in the other five sectors of Figure 1- including the University of North Carolina at Chapel Hill- to move them similarly into the CRed program.

This short report focuses on the first component of this pledge. The students in the Environmental Science and Studies program, working with Town of Chapel Hill staff (special thanks here to David Bonk and Frost Rollins) have now completed two steps needed to identify a formal CRed pledge for municipal operations (the same two steps have been completed for the University, but that is not the subject of this report):

**Step 1.** The Town of Chapel Hill is signed up through the CRed website ([www.cred-uk.org](http://www.cred-uk.org)). There is no specific pledge yet entered- only the name of the Town of Chapel Hill. I (Crawford-Brown) currently am listed as the point of contact, but the Town will want to assign someone there, unless you want me to keep serving as the contact point. I am happy to do so, but you probably should take ownership of this yourselves at some point. The Town of Chapel Hill is registrant number 8502 in the CRed computers, with a password of chapelhill. To see the page on Chapel Hill (which really has nothing entered at present), go to [www.cred-uk.org](http://www.cred-uk.org), then select Enter CRed near the bottom of the page, then go to Existing Users Login and type 8502 for the User ID and chapelhill for the Password.

I and the rest of the CRed team are in the process of creating a mirror website here in Chapel Hill so people won't need to go to the British site. We should have that up and going at the end of summer, 2006. But this has no implications for Town of Chapel Hill activities or entries into the CRed database. The idea is that this site will be used for all organizations and individuals in Chapel Hill (not just the Municipal Operations) who want to make similar pledges to CRed. They (or you) could do the same thing through the British site, but we want to mirror that site here in Chapel Hill so the rest of North Carolina and America can begin to think of Chapel Hill as the locus of the most significant actions leading to carbon dioxide reduction.

**Step 2.** A preliminary Carbon Dioxide Inventory has been created for the Municipal Operations (and also for the University, but that is not the subject of this report). This is being coordinated with the ICLEI team so we can be sure the two teams (CRed and ICLEI) are using the same numbers in assessing emissions and locating effective strategies. I show these preliminary results in Figure 2.

***An important caveat:** As with all carbon dioxide inventories for institutions, there is some uncertainty as to the total amount of electricity consumption to be attributed to Municipal Operations. This arises in part because the Municipality is in some cases a "pass through" for consumption associated with structures such as streetlights that might ultimately be the responsibility for other institutions such as UNC-Chapel Hill (a similar issue arises with respect to the bus system). There also are two values one could*

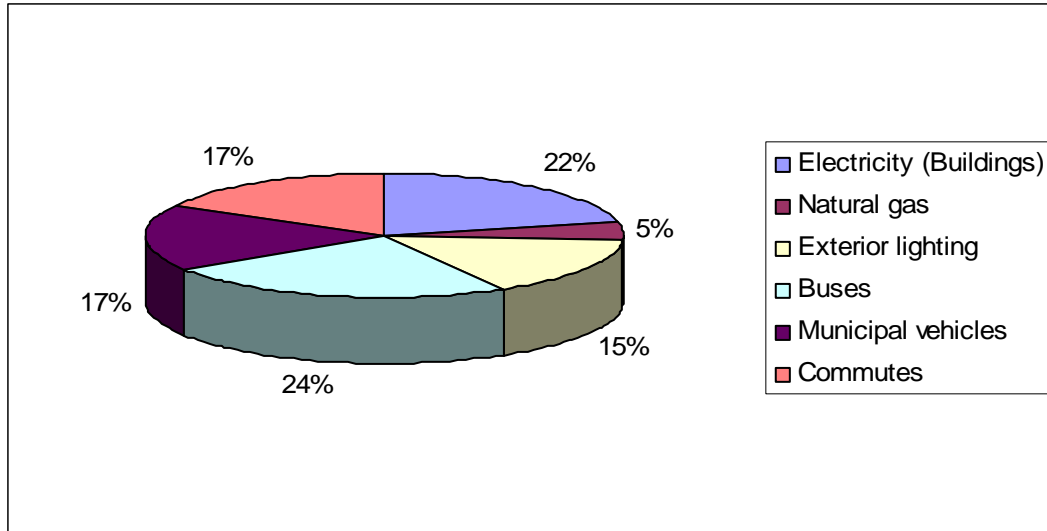
*use for the emissions factors from electricity production by Duke Energy. The value specific to Duke Energy could be used, or a regional average could be used based on all electricity providers in the Southeast. The CRed project uses the former, while ICLEI uses the latter. Results using both values are reported here. In the following analysis, we reflect this uncertainty by giving lower and upper bounds on the emissions due to electricity consumption. Finally, the amounts shown here include electricity and natural gas consumption in public housing, based on the argument that these buildings are owned by the Town. The policies that must be implemented to reduce emissions at these facilities, however, are only partly under the control of the Town (i.e. building insulation, efficiency of boilers, etc).*

There remains a question as to baseline year to be selected for the analysis (2000, 2002, 2005?). Our CRed team has been collecting data for all 3 years where these are available, but by far the most complete data are for 2005, and the CRed program looks for reductions from the emissions levels AS OF THE MOMENT OF MAKING THE PLEDGE. So for CRed, we will want to use the figures you see on the next page, which are for 2005. ***However, the strategies for reducing emissions will be the same through the CRed and ICLEI processes.***

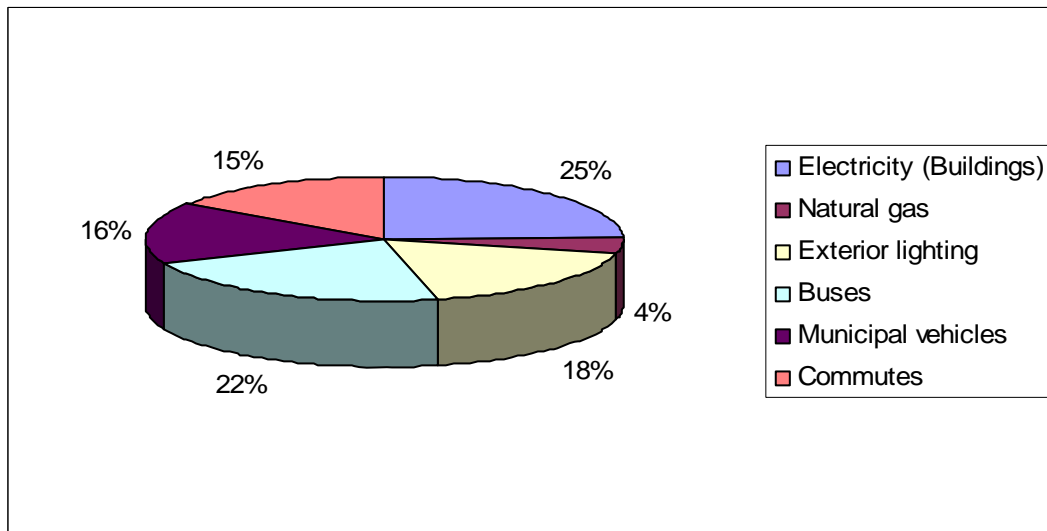
You will note from this information that Town of Chapel Hill Municipal Operations emit about 11537 (lower bound using the Duke Power emissions factor for electricity) or 12597 (upper bound, using the regional average emissions factor for electricity) metric tons of carbon dioxide per year (a metric ton is 2200 pounds or 1000 kilograms). The methodology behind these numbers is described in the Appendix. The emissions are broken down as follows:

- 2492 (lower bound) or 3110 (upper bound) metric tons per year from electricity consumption in Public Works and Public Housing buildings;
- 526 metric tons per year from natural gas consumption in all buildings combined;
- 1782 (lower bound) or 2223 (upper bound) metric tons per year from exterior lighting (streetlights plus other exterior lights);
- 2798 metric tons per year from buses (the total is 5596 metric tons of carbon dioxide per year, but approximately half of this is assigned to UNC-Chapel Hill);
- 1991 metric tons per year from Municipal vehicles (non-bus);
- 1949 metric tons per year from employee commuting.

Note that these 6 items sum to approximately 11537 (lower bound) or 12597 (upper bound) metric tons of carbon dioxide per year (small differences are due to rounding of individual components).



**Figure 2a.** The carbon dioxide emissions inventory for Town of Chapel Hill Municipal Operations using the CRed emissions factor for electricity production by Duke Energy. MT refers to metric tons; one MT is 1000 kilograms or 2200 pounds. The percentages are the percentage of the total 11537 MT/year.



**Figure 2b.** The carbon dioxide emissions inventory for Town of Chapel Hill Municipal Operations using the ICLEI emissions factor for regional electricity production. MT refers to metric tons; one MT is 1000 kilograms or 2200 pounds. The percentages are the percentage of the total 12597 MT/year.

Is a carbon dioxide emission rate of between 11537 and 12597 metric tons per year large or small? It doesn't make sense to focus on the total and try to compare it against other towns, because the magnitude of emissions depends on the size of the population. But we can calculate *per capita* emissions (emissions per person). As a baseline, the average in

the United States at the moment is slightly over 21 metric tons of carbon dioxide per person per year, taking into account all forms of energy consumption and spreading it equally over the entire US population. There is a good table showing this on the EPA web site at

[yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html](http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2006.html).

The per capita values for Town of Chapel Hill Municipal Operations can be calculated in one of three ways:

1. We could divide the 11537 (lower bound) or 12597 (upper bound) metric tons of carbon dioxide per year by the number of Municipal employees. If we take that to be about 670 employees, that would be  $11537/670$  (lower bound) or  $12597/670$  (upper bound) = ***17.2 (lower bound) or 18.8 (upper bound) metric tons of carbon dioxide per person per year associated with running all operations of the Town.***
2. But that isn't completely fair, since the bus use and streetlight use is not limited to employees. So, we can subtract out the buses and streetlights (but not "other" lights) and again divide by about 670 employees, which gives approximately  $7850/670$  (lower bound) or  $8690/670$  (upper bound) = ***11.7 (lower bound) or 13.0 (upper bound) metric tons of carbon dioxide per person per year associated with running the offices of the Town.***
3. Or, we could take the total emissions and divide by the total population of Chapel Hill, arguing that we ALL own the Municipal Operations and are responsible for them as part of our role as citizens. If we assume there are 48715 people in Chapel Hill, this yields  $11537/48715$  (lower bound) or  $12597/48715$  (upper bound) = ***0.24 (lower bound) or 0.26 (upper bound) metric tons of carbon dioxide per person per year from the part of all of our lives associated with municipal operations.***

In the end, it doesn't matter which of these per capita values we use, since the task at hand is to reduce ANY and ALL of these three values by 60% by 2050. Just so you know, the Municipal Operations in the City of Cambridge, England, is about 6000 tons of carbon dioxide per year (compared to 12155 in Chapel Hill) for a city with about the same number of Municipal employees and a population of about 120,000. This mirrors the general differences between the US and England, and in fact all of Europe, since the US emits more than twice the carbon dioxide per person per year as Europe. This also suggests an important point here. The CRed program does not require (contrary to popular opinion) that we all move back into caves. It simply requires that we create a style of living that mimics Cambridge. Figure 3 shows Cambridge, from which it should be clear that the quality of life there at least rivals that of Chapel Hill.

As to specific policies the Town might adopt, these should be left for the ICLEI team to propose, as their team will give much more detailed recommendations. I wouldn't want there to be two sets of recommendations out there, and so you can consider the ICLEI

recommendations in the Fall to be vetted by both ICLEI and CRed team members (we are working with ICLEI to ensure this).

### A Note on Population Growth

Although we are considering Chapel Hill here, the larger goal of the CRed program is to reduce carbon dioxide emissions by 60% worldwide. The emission rate from any geographic area within the world (e.g. Chapel Hill) depends on two factors: population size and emissions per person. If either or both of these increases, so do the emissions from that geographic area.

What are the implications for Chapel Hill and its policies? Clearly, so long as the population of Chapel Hill remains constant, a 60% reduction in emissions requires a 60% reduction in *per capita* emissions. Each of the existing citizens would need to reduce their personal emissions by 60%. If families were to have children at a rate above the replacement rate (a little over 2 children per family), the *per capita* emissions would need to go down proportionately just to stay at our current rate of emissions. So, such “internal” population growth- called “internal” because it does not involve immigration or emigration- requires that the reduction in per capita emissions would need to be more than 60%.

What about people who move into the town from outside? At first blush, this would seem to suggest that the emissions from Chapel Hill will be increased, and that is correct. But they must have moved here from somewhere. The question is whether the *per capita* emissions they will produce in their lives in Chapel Hill will be higher or lower than was the case at the place where they lived originally. If the *per capita* emissions rate in Chapel Hill is lower, the world emissions rate will go down when they move to Chapel Hill. Conversely, if the *per capita* emissions rate in Chapel Hill is higher, the world emissions rate will go up due to immigration into Chapel Hill.



**Figure 3.** The City of Cambridge, the first municipality in England to do what Chapel Hill is doing in CRed.

The point here is that population growth in Chapel Hill should not be taken automatically to mean that we have failed to meet our CRed pledge. To the extent we focus only on the

existing population, our goal certainly is to reduce total emissions from that population by 60%. But to the extent we focus on population growth, our CRed pledge is to ensure that we create Chapel Hill in a way that reduces *per capita* emissions associated with these people as they move to Chapel Hill from wherever they come. It may seem counterintuitive, but if Chapel Hill were to become a model town, with a design that facilitates very low *per capita* carbon dioxide emissions, we would be meeting our CRed pledge most dramatically as our population grows- so long as that population growth is not “internal”.

### **A Note on Data Capture**

This project was made significantly more difficult by the fact that data needed to create the emissions inventory were not readily available. This is not unusual, as most municipalities, institutions and individuals have not found it necessary to create such inventories in the past, and so have not stored needed data, or at least have not stored them in a form that makes the task of creating the inventory simple. To facilitate updating the inventory annually, we recommend that a system of data capture be created for the municipal operations, with automatic data entry into a central database, which would allow creation of charts such as Figure 2 annually. Specifically, this database would include:

- Monthly electricity use in buildings, with both consumption (kilowatt-hours) and cost of electricity, broken down if at all possible by municipal building.
- Monthly natural gas use, with both consumption (dekatherms or cubic feet) and cost of gas, broken down if at all possible by municipal building.
- Monthly electricity use for street lights, with both consumption (kilowatt-hours) and cost of electricity.
- Monthly fuel use by buses, broken down by fuel category (diesel, biodiesel, gasoline, etc).
- Monthly fuel use by municipal vehicles, broken down by fuel category (diesel, biodiesel, gasoline, etc).
- Employee commute data, updated every few years where significant changes are expected.

All of these data would be entered into a central database and conversion factors used (those recommended by this report and/or the ICLEI report) to develop estimates of the emissions rate for carbon dioxide by each of the six categories above. It also is recommended that a more formal energy survey of municipal buildings be conducted to determine the fraction of the first two items going for specific uses (space heating, space cooling, lights, etc). The Carolina Environmental Program would be pleased to develop such an energy survey at no cost to the Town.

## The Next Step

The project team recommends that the Town Council now take the next step, which is the filing of a formal pledge on the CRed website. There is no need at this time to specify any strategies precisely. In fact, you will want to wait for the ICLEI recommendations in the Fall to develop such explicit strategies, in part to be sure yours mesh with those of other governments (Carrboro, Orange County, etc) which also will be presented strategies. But we believe there is enough information on hand to make the following initial pledge on the CRed site so the world can begin to see what is going on in Chapel Hill, and so the combined UK-US CRed team can begin to advertise this movement in Chapel Hill.

**Draft Pledge:** *The Town of Chapel Hill has produced a carbon dioxide inventory for all emissions sources owned and operated by the municipal government. That inventory indicates that municipal operations result in the production of between 11,000 and 13,000 metric tons of carbon dioxide per year (the range reflects the uncertainty in this value). This is divided roughly as follows (depending on whether upper bound or lower bound estimates are used: 22 to 25% from electricity consumption in Public Works and Public Housing buildings; 4 to 5% from natural gas consumption in all buildings combined; 15 to 18% from power for exterior lights (including streetlights); 22 to 24% from operation of buses; 16 to 17% from operation of municipal service vehicles; and 15 to 17% from employee commuting.*

*Our goal is to reduce these total carbon dioxide emissions from municipal operations by at least 60% by 2050, with a timetable as follows (consistent with the repair and replacement cycle of the town): A% reduction by 2010; B% reduction by 2015; C% reduction by 2020; D% reduction by 2030; 60% reduction by 2050. The specific strategies to bring about these reductions will be specified in a further submission to CRed in Fall, 2006, but at least initially include making bus service free to riders (to stimulate ridership), improving the entry and exit doors on municipal buildings to raise heating and cooling efficiency, and migrating town buses and service vehicles to biodiesel or other biomass options.*

*Working with the Carolina Environmental Program (CEP) of the University of North Carolina at Chapel Hill, we will implement a system to ensure accurate data capture for emissions in future years so the success in movement towards these goals can be assessed annually. This will include participating with the CEP in an innovative education program using the Town of Chapel Hill as a study site for undergraduate and graduate students at the University of North Carolina at Chapel Hill, focused on issues of sustainability, energy, community design and economic development.*

*We further pledge to develop policies to encourage similar reductions of carbon dioxide emissions in the other sectors of the Town of Chapel Hill (the University of North Carolina at Chapel Hill and the non-municipal and non-university residential, commercial, industrial and transportation sectors), and to work with those sectors in implementing those policies. Finally, we pledge to further this movement towards carbon*



*dioxide reduction, and integrate it with other issues of sustainability, by participating in the International Council for Local Environmental Initiatives (ICLEI) program.*

### **Appendix: Methods Used**

For the six emissions sources on Page 3, the methods used were as follows:

- For emissions from electricity consumption, the available data were on kW-hrs consumed by Public Works buildings and Public housing (separate accounts). The conversion factor from kilowatt-hours to carbon dioxide emissions was 1.17 pounds of carbon dioxide per kilowatt-hour (for Duke Energy and adjusted for transmission loss), or 1.46 pounds of carbon dioxide per kilowatt-hour (for regional providers).
- For emissions from natural gas consumption, the available data were on billed costs per year (\$114,155 in 2005). These were converted to cubic feet consumed through use of an average rate of \$1.24 per 100 cubic feet. The conversion factor from cubic feet to carbon dioxide emissions was 12.57 pounds of carbon dioxide per 100 cubic feet (obtained from ICLEI).
- For emissions from energy use in exterior lights (including streetlights), the available data were on electricity consumption. The conversion factor from kilowatt-hours to carbon dioxide emissions was 1.17 pounds of carbon dioxide per kilowatt-hour (for Duke Energy and adjusted for transmission loss), or 1.46 pounds of carbon dioxide per kilowatt-hour (for regional providers).
- For emissions from buses, the available data were on kerosene consumed per year (524111 gallons of kerosene in 2005). This was converted to carbon dioxide emissions through the conversion factor of 23.49 pounds of carbon dioxide per gallon of kerosene (obtained from ICLEI).
- For emissions from municipal service vehicles (non-bus), the available data were on gasoline consumed (127360 gallons in 2005) and diesel consumed (83053 gallons in 2005). These were converted to carbon dioxide emissions through the conversion factors of 20.71 pounds of carbon dioxide per gallon of gasoline and 20.97 pounds of carbon dioxide per gallon of diesel (obtained from ICLEI).
- For emissions from employee commuting, we used the results of the 2005 employee commute survey. Surveys were sent by the Town to all employees; as of this date, 300 responded (almost half). For each respondent, the total miles commuted to work was determined. If that commute was by foot, bike or public transit, that individual was assigned zero carbon dioxide emissions. If that commute was in a personal vehicle, the distance traveled (the mid point of the 4 distance categories: < 5 miles; 5-10 miles; 10-20 miles; > 20 miles) was converted to gasoline or diesel use by the following conversion factors for miles per gallon:

CO2 emissions calculations for TOCH 2005. **These INCLUDE electricity and natural gas consumed at Public Housing**  
 These figures use the Duke Power values for emissions from electricity **All other emissions factors are from ICLEI (2005 CAPS)**

From actual Town consumption records

Public Works Electricity:		4686087 kW-hr	5482721.79 pounds	2492.146 MT
Natural Gas	114155 \$\$\$	92060.484 100 cubic feet	1157200.28 pounds	526.0001 MT
Lights*	330000 \$\$\$	3350270 kW-hr	3919815.9 pounds	1781.735 MT
Buses		524111 gallons kerosene	12311367.4 pounds	5596.076 MT
Municipal Vehicles			TOCH half:	2798.038 MT
Gasoline		127360 gallons gasoline	2637625.6 pounds	1198.921 MT
Diesel		83053 gallons diesel	1741621.41 pounds	791.6461 MT
			4379247.01 total	1990.567
Commuting	309 gallons gasoline per employee	207030 gallons gasoline	4287591.3 pounds	1948.905 MT

Employee size: 670

Grand total 11537.39 MT

\*includes streetlights and other lot lights  
 Streetlights alone are 2539607 kW-h  
 or: 1350.609 MT/year

per capita 17.4809 MT/person-year for employees

Subtract out bus use and streetlights

Grand total 7388.744 MT

per capita 11.19507 MT/person-year for employees

Total town population 48715

per capita 0.236834 MT/person-year for total population

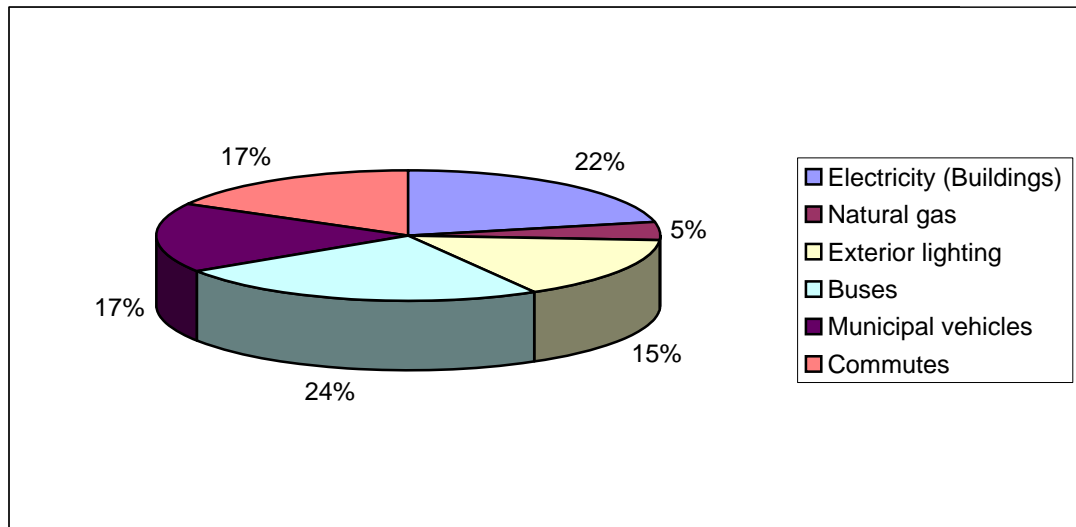
CO2 emissions calculations for TOCH 2005. **These INCLUDE electricity and natural gas consumed at Public Housing**

These figures use the Duke Power values for emissions from electricity

**All other emissions factors are from ICLEI (2005 CAPS)**

Pie charts:

Electricity (Buildings)	2492.15
Natural gas	526.00
Exterior lighting	1781.73
Buses	2798.04
Municipal vehicles	1990.57
Commutes	1948.905



CO2 emissions calculations for TOCH 2005. **These INCLUDE electricity and natural gas consumed at Public Housing**  
 These figures use the **ICLEI** values for emissions from electricity **All other emissions factors are from ICLEI (2005 CAPS)**

			From actual Town consumption records	
Public Works Electricity:		4686087 kW-hr	6841687.02 pounds	3109.858 MT
Natural Gas	114155 \$\$\$	92060.484 100 cubic feet	1157200.28 pounds	526.0001 MT
Lights*	330000 \$\$\$	3350270 kW-hr	4891394.2 pounds	2223.361 MT
Buses		524111 gallons kerosene	12311367.4 pounds	5596.076 MT
			TOCH half:	2798.038 MT
Municipal Vehicles				
Gasoline		127360 gallons gasoline	2637625.6 pounds	1198.921 MT
Diesel		83053 gallons diesel	1741621.41 pounds	791.6461 MT
			4379247.01 total	1990.567
Commuting	309 gallons gasoline per employee	207030 gallons gasoline	4287591.3 pounds	1948.905 MT
	Employee size:	670		
			Grand total	12596.73 MT
			per capita	19.08595 MT/person-year for employees
*includes streetlights and other lot lights				
Streetlights alone are 2539607 kW-h				
or: 1350.609 MT/year		Subtract out bus use and streetlights	Grand total	8448.082 MT
			per capita	12.80012 MT/person-year for employees
Total town population	48715		per capita	0.25858 MT/person-year for total population

CO2 emissions calculations for TOCH 2005. **These INCLUDE electricity and natural gas consumed at Public Housing**

These figures use the **ICLEI** values for emissions from electricity

**All other emissions factors are from ICLEI (2005 CAPS)**

Pie charts:

Electricity (Buildings)	3109.86
Natural gas	526.00
Exterior lighting	2223.36
Buses	2798.04
Municipal vehicles	1990.57
Commutes	1948.905

