ATTACHMENT 1

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

Doug Crawford-Brown, June 12, 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.

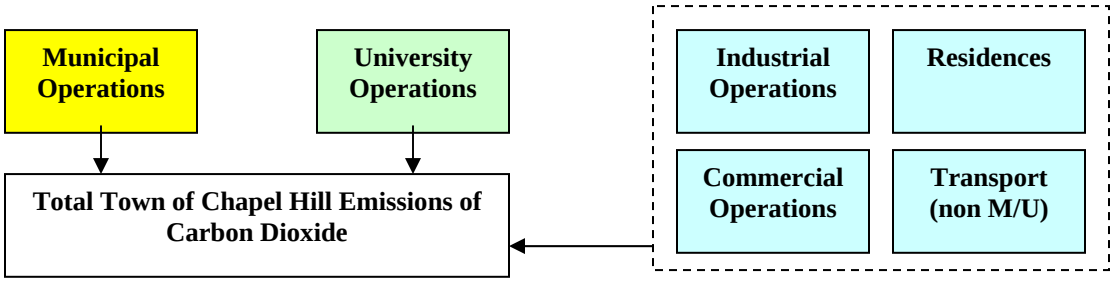


Figure 1. The 6 sectors of activities resulting in carbon dioxide emissions within the boundaries of Chapel Hill.

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). 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, 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 2005 values for consumption have been approximated using payment figures rather than values on kilowatt hours consumed (the latter was available only for 2004) and 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). In the following analysis, we reflect this uncertainty by giving lower and upper bounds on the emissions due to electricity consumption. The final value selected to represent this part of the carbon dioxide inventory may change slightly as the CRed and ICLEI*

team compare notes, and as this issue is resolved, but it will fall between these lower and upper bounds and won't affect actions taken now.

There remains a question as to baseline year to be selected for the ICLEI 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 11597 (upper bound) or 10,905 (lower bound) 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:

- 3392 (upper bound) metric tons per year from electricity consumption; the lower bound estimate is approximately 2700 metric tons per year;
- 506 metric tons per year from natural gas consumption;
- 1315 metric tons per year from streetlights (which you might consider DOT responsibility);
- 2566 metric tons per year from buses (the total is 5132 metric tons of carbon dioxide per year, but approximately half of this is assigned to UNC-Chapel Hill);
- 1977 metric tons per year from Municipal vehicles (non-bus);
- 1841 metric tons per year from employee commuting

Note that these 6 items sum to 11597 (upper bound) or 10,905 (lower bound) metric tons of carbon dioxide per year.

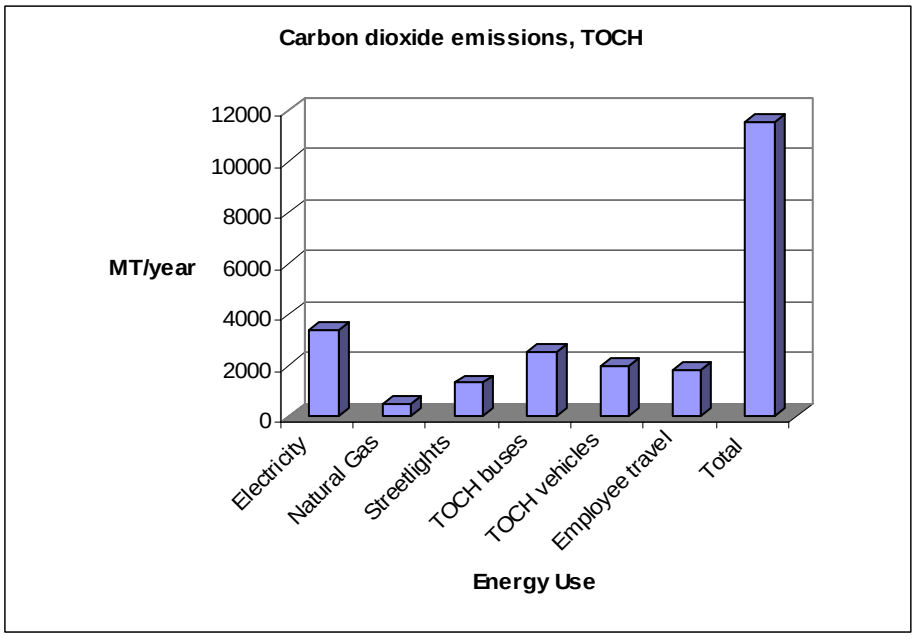


Figure 2. The carbon dioxide emissions inventory for Town of Chapel Hill Municipal Operations (the uncertainty mentioned previously is hidden with the resolution possible for this figure). MT refers to metric tons; one MT is 1000 kilograms or 2200 pounds.

It is clear from this that Electricity consumption dominates, and all other categories except Natural Gas are smaller but still significant contributors.

Is a carbon dioxide emission rate of between 10905 and 11597 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.

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

1. We could divide the 11597 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 11597/670 = ***17.3 metric tons of carbon dioxide per person per year (lower bound of 16.3) 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 and again divide by about 670 employees, which gives 7716/670 = ***11.5 metric tons of carbon dioxide per person per year (lower bound of 10.8) associated with running the offices of the Town***.

3. Or, we could take the total emissions (11597 metric tons per year) 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 11597/48715 = ***0.24 metric tons of carbon dioxide per person per year (lower bound of 0.23) 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. Personally, I believe Option 2 above is the more relevant. 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 10,000 and 13,000 metric tons of carbon dioxide per year (the range reflects the uncertainty in this value). This is divided as follows: 38% from electricity consumption in buildings; 3% from natural gas consumption in buildings; 15% from power for streetlights; 18% from operation of buses; 14% from operation of municipal service vehicles; and 12% 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): 10% reduction by 2010; 20% reduction by 2015; 30% reduction by 2020; 45% reduction by 2025; 60% reduction by 2030. 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 billed costs per year ($840268 in 2005; subtracting out $330,000 from streetlights leaves $510,268). These were converted to kilowatt-hours consumed through use of an average rate of $0.08 per kilowatt hour (which was the average for the 2004 year, where both billing charge and kW-hr data are available). The conversion factor from kilowatt-hours to carbon dioxide emissions was 1.17 pounds of carbon dioxide per kilowatt-hour (obtained from Duke Power and adjusted for transmission loss).

- 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 12.1 pounds of carbon dioxide per 100 cubic feet (obtained from the Energy Information Administration: www.eia.doe.gov/oiaf/1605/coefficients.html).

- For emissions from energy use in streetlights, the available data were on electricity consumption (2472196 kWh in 2005). The conversion factor from kilowatt-hours to carbon dioxide emissions was 1.17 pounds of carbon dioxide per kilowatt-hour (obtained from Duke Power and adjusted for transmission loss).

- 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 21.54 pounds of carbon dioxide per gallon of kerosene (obtained from the Energy Information Administration: www.eia.doe.gov/oiaf/1605/coefficients.html).

- 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 19.56 pounds of carbon dioxide per gallon of gasoline and 22.38 pounds of carbon dioxide per gallon of diesel (obtained from the Energy Information Administration: www.eia.doe.gov/oiaf/1605/coefficients.html).

- 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:

Motorcycle	40
Minivan	25
Sedan	30
Pickup	20
SUV	15

For gasoline, the conversion factor from gallons to carbon dioxide emissions was 19.56 pounds of carbon dioxide per gallon burned (obtained from the Energy Information Administration: www.eia.doe.gov/oiaf/1605/coefficients.html). For diesel, the conversion factor was 22.38 pounds of carbon dioxide per gallon burned (obtained from the Energy Information Administration: www.eia.doe.gov/oiaf/1605/coefficients.html).

All of the calculations above are summarized in the attached EXCEL file (TOCHemissions calculations.xls), and provided in even more detail in the other attached EXCEL file (TOCHemissions detail.xls).

CO2 Calculator

= user input

Fuel	Amount	Unit		Lbs CO2	Lbs C
Gasoline	5.00	gallons	=	97.8	26.7
Diesel	5.00	gallons	=	111.9	30.5
Biodiesel	5.00	gallons	=	93.9	25.6
Natural Gas	5000.00	cubic feet	=	605.0	165.0
Electricity	500.00	kwH	=	585.0	159.5
Heating Oil	5.00	gallons	=	42.4	11.6

% Biocomponents in Biodiesel 20

Carbon Inventory

	Electricity ($)	Carbon (lbs)	Natural Gas ($	Carbon (lbs)	Year	MDF
All buildings	510268	7462670	114155	1113932	2005	11
	366443	5359228	69506	678248	2002	11
	300611	4396436	66269	646657	2000	11
Streetlights	330000	4826250			2005	12
	278158	4068061			2002	12
	249649	3651117			2000	12

	Gasoline (gals)	Diesel (gals)	Kerosene (gals	Vehicle Miles	MPG	Carbon (lbs)	Year	MDF
TOCH Buses			524111	2009733	4	11289351	2005	13
		75490				1476584	2000	13
Town vehicles	127360	83053		1651098		4349888	2005	14
	121201	82258				4211626	2002	14
	123206	75490				4099376	2000	14

	employees	gallons/employee	total gallons	Vehicle Miles	MPG	Carbon (lbs)	Year	MDF
Employee Transport	670	309	207030	4643709	22	4049507	2005	15

Meta Data File

Item	Source	Contact Information	
1	Department of Energy	http://www.eia.doe.gov/oiaf/1605/coefficients.html	
2	Department of Energy	http://www.eia.doe.gov/oiaf/1605/coefficients.html	
3	Department of Energy	http://www.eia.doe.gov/oiaf/1605/coefficients.html	
4	Department of Energy	http://www.eia.doe.gov/oiaf/1605/coefficients.html	
5	Campus Report		
6	Department of Energy	http://www.eia.doe.gov/oiaf/1605/coefficients.html	
7			
8	Town of Chapel Hill	Finance Department - Vanessa Weymouth	919-968-2824
9	Town of Chapel Hill	Finance Department - Vanessa Weymouth	919-968-2824
10			
11	Town of Chapel Hill	Finance Department - Vanessa Weymouth	919-968-2824
12	Town of Chapel Hill	Kumar Neppalli - traffic engineer	kneppalli@townofchapelhill.org
13	Town of Chapel Hill	Kurt Neufang - Director - Chapel Hill transit	kneufang@townofchapelhill.org
14	Town of Chapel Hill	Brady Moore - Public Works Dept	bmoore@townofchapelhill.org
15	Town of Chapel Hill	Survey	

Notes

1 Therm= 100 cubic feet

Duke Power provided the team with a rate of 0.97lbs CO2/kwh with a 108.5% increase in this rate to include transmission and distribution losses, which would make the rate 1.05lbs CO2/kwh. However, team was told to make the rates consistent with the Carbon Inventory of the University of North Carolina-Chapel Hill, therefore 1.17lbs CO2/kwh is being used. The rate of 1.17lbs CO2/kwh can be changed in the Conversion Values page.

Vanessa Weymouth produced a rate range of $0.04-$0.35 per kwh; however this range was too great, therefore $0.08/kwh was used because that is the standard rate that the entire town of Chapel Hill gets. The rate $0.08/kwh can be changed in the Conversion Values page.

Vanessa Weymouth produced a rate range of $1.18-$1.30 per Therm. The rate $1.24/kwh was used because the range was small enough for the team to use the mean value. The rate $1.24/Therm can be changed in the Conversion Values page.

Only data from 2005 was available about VMT and total gallons of fuel consumed.

Only data from 2005 available about VMT because for 2000 and 2002 they used a different data collection system at Town Hall, but total fuel consumed available for all years.

For employees, about 150 surveys missing from our results.

Graphs

Units of metric tons

	Elec	NG	total	
All buildings	1998	294	2292	2000
	2436	308	2744	2002
	3392	506	3898	2005

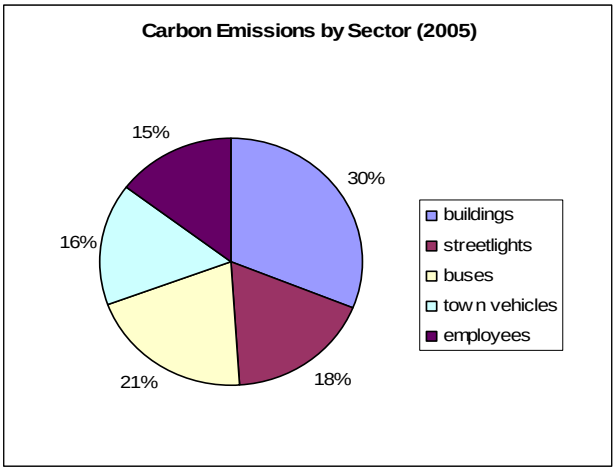
Streetlights	1660	2000
	1849	2002
	2194	2005

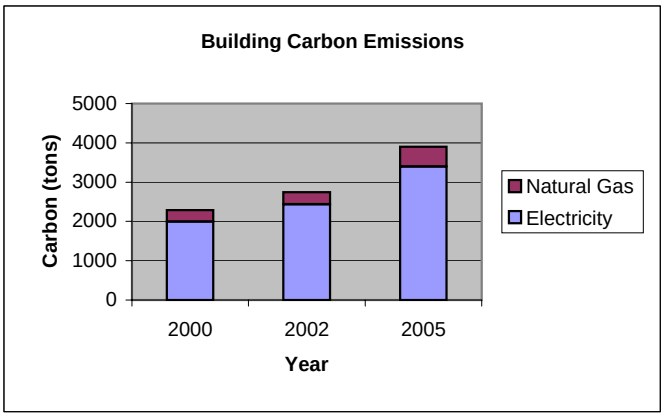
	Carbon (lbs)	Year	
TOCH Buses	2566	2005	only 50% assigned to TOCH, 50% to UNC-CH
	336	2000	

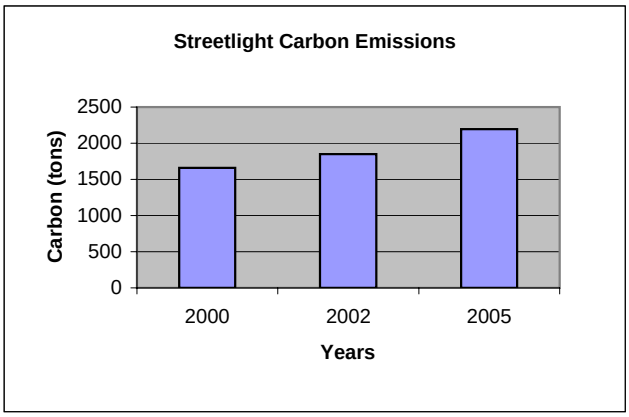
Town vehicles	1863	2000
	1914	2002
	1977	2005

	Carbon (lbs)	Year
Employee commuting	1841	2005

	2005	
	0	buildings
Elec		streetlights
	0	buses
Carbon (lbs)		town vehicles
	0	employees
	0	total







Electricity:	510268	$$$	6378350	kW-hr	7462670	pounds	3392.1225	MT
Natural Gas	114155	$$$	92060.48	100 cubic feet	1113932	pounds	506.3326613	MT
Streetlights	330000	$$$	4125000	kW-hr	4826250	pounds	2193.75	MT
Buses			524111	gallons kerosene	11289351	pounds	5131.523155	MT
						TOCH half:	2565.761577	MT
Municipal Vehicles								
Gasoline			127360	gallons gasoline	2491162	pounds	1132.346182	MT
Diesel			83053	gallons diesel	1858726	pounds	844.8755182	MT
				(20% biodiesel)	4349888	total	1977.2217	
Commuting	309	gallons gasoline per employee	207030	gallons gasoline	4049507	pounds	1840.684909	MT
Employee size:			670					
						Grand total	12475.87335	MT
						per capita	18.90283841	MT/person-year for employees
				Subtract out bus use and streetlights		Grand total	7716.36177	MT
						per capita	11.69145723	MT/person-year for employees
Total town population			48715			per capita	0.256099217	MT/person-year for total population