# Tulane University

# Greenhouse Gas Inventory

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# Tulane University Greenhouse Gas Inventory

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**Why a Greenhouse Gas Inventory?**

A greenhouse gas inventory estimates the amount of global-warming causing gases emitted into the atmosphere as a result of an institution's activities. It is a good initial environmental management system for universities and businesses. Also known on some campuses as a "climate footprint," it is fairly simple to complete, mainly requiring the collection of various kinds of energy bills and using coefficients to determine the greenhouse gases released by each energy use. It outlines our relationship to one of our most pressing international and local environmental issues. A greenhouse gas inventory can help identify wasteful energy use and be a first step towards reducing energy costs.

When we began working on a Tulane greenhouse gas inventory in the fall of 2000, a number of corporations, international agencies, and environmental organizations were enthusiastically working together to develop an inventory "protocol"—an established, common method of measuring an institution's emissions of gases that contribute to global climate change. A number of corporations saw that inventories would be the basic tool of almost any global climate change policy, from required reductions to emissions trading schemes. They wanted to establish the rules of conducting an inventory—what emissions would be measured and how—so that actions to reduce emissions now would receive credit later.[1]

With the election of George W. Bush and his withdrawal from the Kyoto Protocol negotiations, the political context of has changed dramatically. However, these corporate and environmental climate change partnerships still seem to be moving forward. For example, in May 2001, our local utility, Entergy, announced a commitment to hold greenhouse gas emissions at 2000 levels through 2005 and to join the Partnership for Climate Action, an international consortium of business and environmental organizations

In the meantime, a greenhouse gas inventory remains a tool that can help us make concrete steps towards slowing global climate change. Forward thinking universities, cities, and businesses can make a significant dent in national greenhouse gas emissions, and save money in the near and long-term by implementing energy efficiency measures. For example, the 400 cities that have joined the Cities for Climate Protection (CCP) campaign together represent 8% of global greenhouse gas emissions. Each of these cities has pledged to reduce emissions by conducting a greenhouse gas inventory and then developing and implementing a local action plan for reducing emissions. By following a similar process, large institutions such as local governments, universities, businesses and corporations can make a significant difference, even in the absence of U.S. participation in the Kyoto treaty.

Perhaps even more importantly for universities, conducting our own greenhouse gas inventory can help us better understand the policy options proposed for slowing global climate change, as well as the possible effects these policies would have on our economy and way of life. What exactly would it take, as the Kyoto Protocol would require us, to reduce GHG emissions to 7% below 1990 levels by 2008? Some climate change experts are saying it will take reductions of 70% to ultimately stabilize the climate. What would we have to do to reduce to those levels? Conducting an inventory at Tulane, setting reductions targets and then working towards them, will give faculty and students across disciplines hands-on familiarity with the policies and technologies emerging to address global warming. Perhaps the person who will lead the international, collaborative effort to ultimately stabilize the world's climate will get her start working on Tulane's campus inventory.

Using a greenhouse gas inventory to connect climate change to campus life will also help Tulane students develop informed energy habits that they may carry with them into their adult lives and various careers. Finally, as residents of South Louisiana, which a recent Time Magazine article placed alongside Bangladesh, Egypt, and the Carolinas as a "coast in peril," we have a special responsibility to act. New Orleans is a seminal city in American culture, perhaps the most artistically alive city in the United States today. The wetlands that surround us serve the same function for the U.S. environment. As the temperatures rise, New Orleans will face greater health hazards, more dangerous weather,

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[1] For more discussion of greenhouse gas inventory methods and issues, see the reports by the United Nations Environment Programme, the Pew Center for Global Climate Change, and the World Business Council for Sustainable Development and World Resources Institute.

loss of our surrounding wetlands, and ultimately, inundation. In these circumstances, a greenhouse gas inventory is a first step in a massive effort to preserve our city.

**Methods**

A number of tools for conducting greenhouse gas (GHG) inventories are available, and most are available on the internet. University inventories have been done by Tufts University and the CU Environmental Center at the University of Colorado-Boulder. The United Nations Environment Programme (UNEP) has published comprehensive guidelines for institutional inventories, including sample spreadsheets and emissions factors. An excellent report by the Pew Center on Global Climate Change reviews the policy questions raised by inventories and provides links to a range of inventory initiatives. (See the bibliography for links.)

Tulane's inventory was done using a software called *e-Mission* from Torrie Smith Associates. The software is designed specifically to calculate greenhouse gas emissions due to activities done by businesses. The software is fairly expensive, but has a number of advantages over tools such as the UNEP spreadsheets. Torrie Smith software is used by the Cities for Climate Protection program, including the City of New Orleans, so using the software makes it easier for us to coordinate with the New Orleans Mayor's Office of Environmental Affairs. The software is very user-friendly, allowing any interested student (or staff person) to use it, regardless of their experience. It has a "Measures" feature that allows you to estimate the energy, cost and GHG emissions savings of different actions. A demonstration version of the software can be uploaded from www.torriesmith.com.

Data, such as kilowatt hours of electricity and thousands of cubic feet of natural gas used, were gathered from various offices around campus. They were then entered into their respective places within the software, and, after making calculations, the software output the amount of carbon dioxide released in metric tonnes.

**Sources of Greenhouse Gases**

There are six main types of gases that trap heat in the earth's atmosphere: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. (Chlorofluorocarbons also have a greenhouse effect, but they are already regulated by the Montreal Protocol, the international treaty that protects the ozone in the upper atmosphere.) All greenhouse gas inventories measure carbon dioxide emissions, but beyond carbon dioxide different inventories include different greenhouse gasses (GHGs). Because different greenhouse gases absorb and re-radiate different wavelengths of infrared light, and because they last different lengths of life in the atmosphere, each type of greenhouse gas traps a different amount of heat. Thus in an inventory, emissions of GHGs are converted to a "carbon dioxide equivalent." This initial Tulane inventory includes only the greenhouse gases emitted as a result of burning fossil fuels—carbon dioxide and nitrous oxide.

For now, the inventory focuses only on the uptown campus. (It does not include the Tulane Health Sciences Center in downtown New Orleans, the Tulane Primate Center in Covington, or the Belle Chasse Research facility.) Approximately 3100 students live and attend class on the uptown campus. Another 9980 people come to campus during the day to work and take classes. In 1990, 12,819 people lived, worked, and attended class on the uptown campus.

The scope of the inventory can also refer to the kinds of activities included. A greenhouse gas emissions inventory can measure, most narrowly, the emissions released directly on our campus: the emissions released by burning natural gas or diesel in our co-generation plant and the burning of gasoline and diesel by motor vehicles. Most broadly, a GHG inventory can try to account for all of the releases that are necessary to our activities, including the energy used to produce the things we use on campus and energy used by outsource service providers. This inventory falls somewhere in between. It measures emissions from electricity imported to campus from Entergy and generated on campus, as well as the work-related and commuting vehicle emissions of Tulane staff, faculty and students. This inventory examines the greenhouse gas emissions of activities on Tulane University's uptown campus.

*Building Energy Use*

Tulane installed a 5 megawatt cogeneration plant on the uptown campus at the end of 1999. The plant burns natural gas (and sometimes diesel) to produce steam for heating and cooling, and at the same time produces electricity for the buildings. In addition to its co-generated electricity, Tulane uses power off the Entergy grid. Entergy has relatively low greenhouse gas emissions for an electric utility. Its plants are 45% natural gas and 35% nuclear, which have relatively low GHG emissions, and 16% coal and 4% oil, which have high GHG emissions. Entergy provided us with coefficients for its fuel mix (see below).

In 1990, all of the campus's electricity was purchased from Entergy, and on-campus boilers burned natural gas to generate steam for heating and hot water. The new cogeneration plant now produces about half of the uptown campus's electricity. This may ultimately decrease our GHG emissions, as it improves the overall efficiency of our campus energy system by using the gas turbine to generate electricity and simultaneously use the hot exhaust to produce steam which heats our buildings and hot water. A new absorption chiller, which uses steam instead of electricity to cool water for air conditioning, will add to the savings. Emergency use of less expensive diesel during times of high natural gas prices, on the other hand, will increase overall GHG emissions.

Data on campus building energy use were obtained from the Utilities Department. The Reily Center and Aron Residences are metered separately, and Department of Campus Recreation and Housing and Residence Life, respectively, provided us with electricity consumption data for these buildings.

*Vehicle Fleet*

Tulane has its own fleet of cars and trucks, and buys gasoline and diesel fuel for them from Retif Oil. These include facilities services trucks, the tractors used by Grounds, public safety vehicles, research vehicles, and TEMS ambulances. Our figures also include the vans owned by the Associated Student Body and used by student organizations. They do not include Athletic Department rentals. Data on fuel purchased by Tulane for its vehicle fleet were provided by Retif Oil and the Logistics Department.

They do not include fuel purchased off campus with Fuel Credit Cards or purchases by individuals who are reimbursed by the university.

*Employee and Student Commute*

Commuter data were gathered for the 2000 inventory in a transportation survey done by the fall 2000 Urban Sociology class. Of the 9,990 people on campus, a little more than 300 were surveyed. From this sample group miles driven to campus were extrapolated for all students, staff, and faculty. For example, of the 300 surveyed, 30 were faculty members who drive cars a total of 154 miles to campus. When that 52% of people surveyed is projected to all 1014 faculty members, it turns out that faculty drive cars about 2,700 miles per day. (When calculating emissions, on-campus students were removed because they do not commute to and from campus. Some other survey data were also removed because they lacked the particular information that was needed.)

Once the useful transportation data had been extrapolated, a spreadsheet determined the number of kilometers traveled in a twelve-month period by each group of people and type of vehicle. These data were categorized by the person's vehicle type and what group of people they belong to. It is assumed that students drive to campus 180 days per year, faculty 200, and staff 240. These estimates were based on the number of months they attend class or work, respectively, and five-day workweeks. (A five-day week is supported by the survey itself) In the example above, faculty drive cars 1,735,000 kilometers per year(1,075,700 miles). The final kilometers per year were entered into *e-Mission*.

**What's Missing?**

- The Torrie Smith software also has categories for tracking emissions from Manufacturing and Business Travel, which we did not complete.
- Methane emissions from landfilling organics.
- Compressed natural gas used in laboratories.
- Actual use of GHG gases, such as nitrous oxide.
- We looked into estimating campus carbon sequestration (also known as carbon sinks or carbon offsets)—the amount of carbon taken out of the atmosphere by Tulane

activities. The estimate methods are problematic, and works against the overall goal of reducing emissions. Most inventories do not include carbon sequestration.

**Electricity Coefficients**

Every electric utility uses a different mix of power sources, and therefore releases different amounts of greenhouse gases for every kilowatt hour (or Megawatt hour) of electricity it generates. Utilities that burn coal release the highest amounts of greenhouse gases per kilowatt hour produced, those that burn natural gas release less, and those that use nuclear, hydroelectric, wind and solar release the least. We replaced the average Louisiana coefficients in Torrie Smith's e-Mission software with figures obtained from our Utility, Entergy. Entergy 1999 numbers were used in the year 2000 inventory.

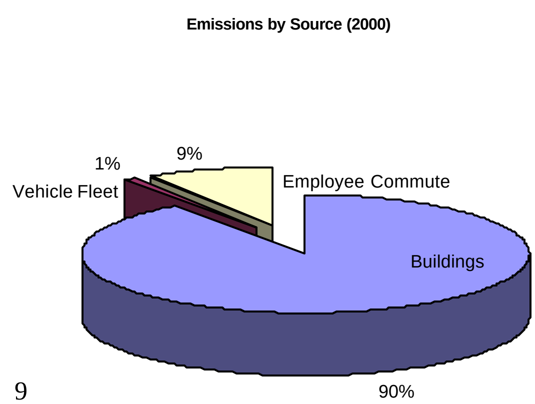
| | $CO_2$ (lbs/MWh) | NOX (lbs/MWh) | $SO_2$ (lbs/MWh) |
|---|---|---|---|
| 1990 | 728.82 | 2.11 | .18 |
| 2000 | 898.01 | 2.52 | .38 |

Source: Linda Baynham, email, 20 February 2001.

Because of its reliance on natural gas and nuclear, Entergy's emissions of $CO_2$, NOX, and SOX are below-average for U.S. electric generators. Though not publicly announced, Entergy has plans to cut these emission coefficients in half by 2010.

**Results**

In the year 2000, the activities of the uptown campus resulted in the emission of approximately 52,981.2 metric tonnes of carbon dioxide or carbon dioxide equivalent. Building energy use—electricity use, lighting, heating and cooling—was by far the largest source of emissions, about 90%. Given the size and number of building on the uptown campus,



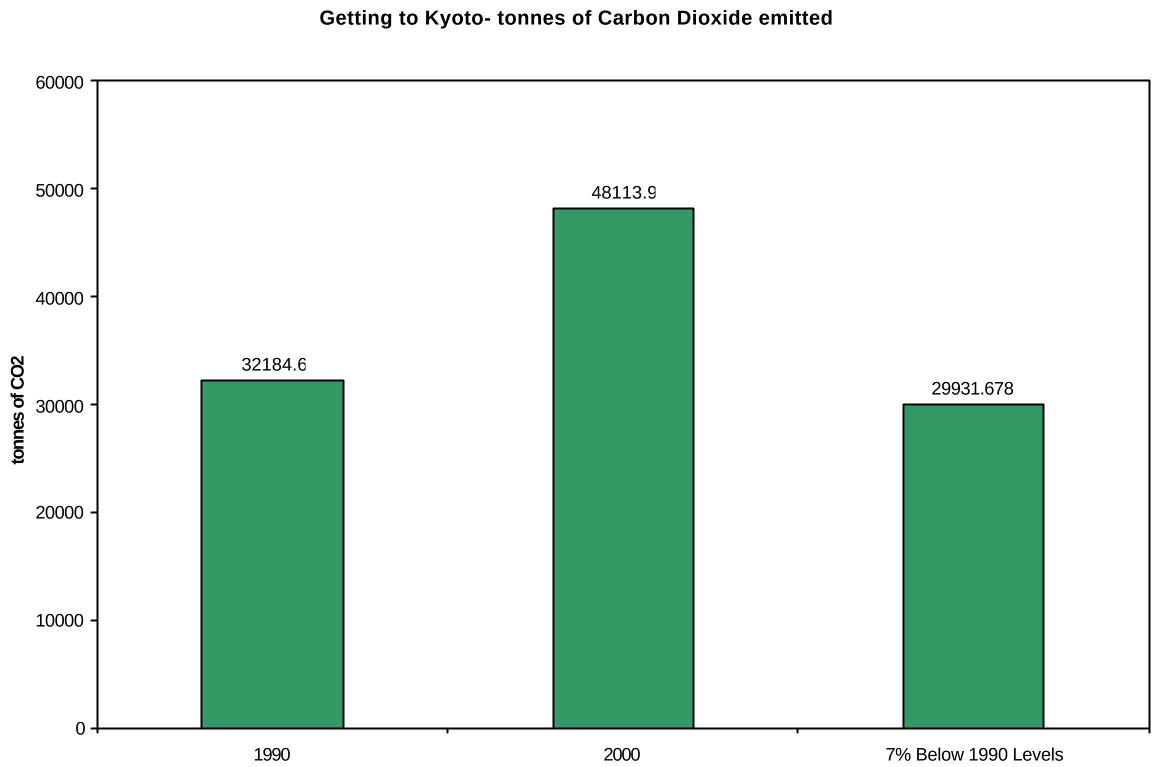
the intensity of energy use in Tulane buildings, and the number of people who live on campus, it is not surprising that building energy use makes up so large a share of our global warming impact. The other 10% was mostly from commuting. Staff commuting alone contributes 4% of our greenhouse gas emissions. We should note the much higher quality of the data we used to estimate emissions from our building energy use, which are based on actual utility bills. Commuting data are based on extrapolations from survey data.

## Getting to Kyoto

Data from 1990 and 2000 were compared, in order to give a sense of what meeting the Kyoto Protocol, the international treaty on climate change, might mean for an institution like Tulane. It is important to note that Kyoto specifies a national reduction of greenhouse gas emissions to 7% below 1990 levels, not institutional, corporate or local level reductions. But using Tulane as a microcosm helps us better understand the magnitude and implications of the proposed reductions—what these policies might mean for us at the local level.

We compared 1990 and 2000 by looking only at emissions produced directly on campus (from cogeneration and campus vehicles) and indirect emissions from our purchased electricity. For the purpose of this comparison, we didn't include emissions from employee commute, mainly because we don't have 1990 data.

In 1990, the activities of the Uptown campus released 32,184.6 metric tonnes equivalent CO2, while in 2000 the campus emissions had increased to 48,113.9 metric tonnes. To meet the reductions outlined in the Kyoto Protocol, we would need to reduce our emissions 37.79% from current levels, to 29,931.7 tonnes. This reduction needs to be achieved even as the university's infrastructure steadily increases. There have already been investments in efficiency, and our utility, Entergy, has plans to reduce their emissions significantly.




Data from 1990 were more available than we expected. However, comparison of 1990 and 2000 data suggest the changing configuration of activities within Tulane may make it tricky to compare emissions over time. Mainly, in the early 1990s (1992) Tulane had a high use of gasoline and diesel compared to the amounts used in the last six years. The drastic drop in gasoline and diesel use may be due to outsourcing an activity—switching fuel for vehicles on university business from an in-house pump to a fuel card used at outside stations, or switching from university owned to leased vehicles—rather than a shift to a cleaner or more efficient technology. In other words, it may be a change in how things are counted, rather than how things are done.

## Conclusion

The university has a daunting task ahead of it. Reducing emissions by almost 38% will require the cooperation of every department on campus. It will require an initial investment in technology and education, but the payback will be far greater. Members of the Tulane community will be able to feel confident that they are a part of an organization that is trying to diminish its contribution to global climate change.

The next step for the Office of Environmental Affairs is to write a climate action plan. A climate action plan is a summary of measures that the school can take to reduce its greenhouse gas emissions. It will analyze the current measures being implemented and possible new strategies for their cost effectiveness and their impact on emissions.

**Note**

If you have read an earlier version of this report you may be surprised at the drastic changes. We recently discovered that we were using an outdated version of the e-mission software. We purchased it in its infancy, and missed a major update to the default fuel coefficients. The natural gas data was off by a factor of 10 in our favor. All this means is that we have a little more work to do to reduce our emissions, but we are up to the challenge.

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*Conversion Factors Used*

| When you know | Multiply by | To find |
|---|---|---|
| sq feet | .09 | square meters |
| kilometers | .62 | miles |

# Greenhouse Gas Emissions in 2000
## Detailed Report

| | | Equiv CO2 (tonnes) | Equiv CO2 (%) | Energy (GJ) | Cost ($) |
|---|---|---|---|---|---|
| **Buildings** | | | | | |
| Aron Residences | | | | | |
| | Electricity | 1,079 | 2 | 9,543 | 426,781 |
| | ***Subtotal Aron Residences*** | 1,079 | 2 | 9,543 | 426,781 |
| Reily Center | | | | | |
| | Electricity | 1,697 | 3 | 15,012 | 228,770 |
| | ***Subtotal Reily Center*** | 1,697 | 3 | 15,012 | 228,770 |
| Uptown Campus | | | | | |
| | Electricity | 20,576 | 39 | 182,000 | 3,528,041 |
| | Natural Gas | 24,350 | 46 | 458,724 | 3,273,017 |
| | ***Subtotal Uptown Campus*** | 44,927 | 85 | 640,724 | 6,801,058 |
| ***Subtotal Buildings*** | | 47,703 | 90 | 665,279 | 7,456,609 |
| **Vehicle Fleet** | | | | | |
| ASB Van Fleet | | | | | |
| | Gasoline/Petrol | 56 | 0 | 757 | 6,850 |
| | ***Subtotal ASB Van Fleet*** | 56 | 0 | 757 | 6,850 |
| Uptown Motor Pool | | | | | |
| | Gasoline/Petrol | 250 | 1 | 3,354 | 0 |
| | Diesel | 104 | 0 | 1,393 | 0 |
| | ***Subtotal Uptown Motor Po*** | 355 | 1 | 4,747 | 0 |
| ***Subtotal Vehicle Fleet*** | | 411 | 1 | 5,503 | 6,850 |
| **Employee Commute** | | | | | |
| Faculty Commute | | | | | |
| | Gasoline/Petrol | 311 | 1 | 4,172 | |
| | Diesel | 23 | 0 | 311 | |
| | Electricity | 16 | 0 | 138 | |
| | ***Subtotal Faculty Commute*** | 350 | 1 | 4,621 | |
| Staff Commute | | | | | |
| | Gasoline/Petrol | 2,082 | 4 | 27,900 | |
| | Diesel | 45 | 0 | 598 | |
| | ***Subtotal Staff Commute*** | 2,127 | 4 | 28,497 | |
| Student Commute | | | | | |
| | Gasoline/Petrol | 2,206 | 4 | 29,560 | |
| | Diesel | 159 | 0 | 2,116 | |
| | Electricity | 25 | 0 | 219 | |
| | ***Subtotal Student Commut*** | 2,390 | 5 | 31,895 | |
| ***Subtotal Employee Commute*** | | 4,867 | 9 | 65,013 | |
| **Total** | | 52,981 | 100 | 735,796 | 7,463,459 |

This report has been generated for Tulane University, New Orleans, LA 70118
with software created by Torrie Smith Associates

## Greenhouse Gas Emissions in 1990
## Base Year Detailed Report

| | | Equiv CO2 (tonnes) | Equiv CO2 (%) | Energy (GJ) | Cost ($) |
|---|---|---|---|---|---|
| **Buildings** | | | | | |
| Aron Residences | | | | | |
| | Electricity | 579 | 2 | 6,302 | 140,538 |
| | ***Subtotal Aron Residences*** | 579 | 2 | 6,302 | 140,538 |
| Reily Center | | | | | |
| | Electricity | 1,232 | 4 | 13,396 | 215,150 |
| | ***Subtotal Reily Center*** | 1,232 | 4 | 13,396 | 215,150 |
| Uptown Campus | | | | | |
| | Electricity | 17,284 | 54 | 187,984 | 3,138,115 |
| | Natural Gas | 10,262 | 32 | 193,317 | 872,693 |
| | ***Subtotal Uptown Campus*** | 27,546 | 86 | 381,301 | 4,010,808 |
| ***Subtotal Buildings*** | | 29,357 | 91 | 400,999 | 4,366,496 |
| **Vehicle Fleet** | | | | | |
| ASB Van Fleet | | | | | |
| | Gasoline/Petrol | 48 | 0 | 642 | 0 |
| | ***Subtotal ASB Van Fleet*** | 48 | 0 | 642 | 0 |
| Uptown Motor Pool | | | | | |
| | Gasoline/Petrol | 1,776 | 6 | 23,796 | 0 |
| | Diesel | 1,004 | 3 | 13,382 | 0 |
| | ***Subtotal Uptown Motor Po*** | 2,780 | 9 | 37,178 | 0 |
| ***Subtotal Vehicle Fleet*** | | 2,828 | 9 | 37,820 | 0 |
| **Total** | | 32,185 | 100 | 438,819 | 4,366,496 |

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