

# A Summary of Energy Consumption and Greenhouse Gas Emissions at Middlebury College

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In 1995 the Middlebury College Trustees adopted the following environmental mission statement in support of President McCardell identifying environmental stewardship as one of the college's five peaks of excellence.

Middlebury College as a liberal arts institution is committed to environmental mindfulness and stewardship in all its activities. This commitment arises from a sense of concerned citizenship and moral duty and from a desire to teach and lead by example. The College gives a high priority to integrating environmental awareness and responsibility into the daily life of the institution. Respect and care for the environment, sustainable living, and intergenerational responsibility are among the fundamental values that guide planning, decision making, and procedures. All individuals in this academic community have personal responsibility for the way their actions affect the local and global environment.

The Environmental Council, a standing committee of the college reporting directly to the president, in the true spirit of the college's environmental mission statement decided to address the college emission of greenhouse gases (GHG) in hopes of identifying reduction targets. The Environmental Council supported the development of a comprehensive emissions inventory of college activities for the decade of the 1990s and including the year 2000. This document summarize the results of the emissions inventory and the consumption of energy at Middlebury College.

Energy consumption and GHG emissions are, unfortunately, in today's society directly linked. It is important at the outset to develop a working definition for energy because all too often the words energy and electricity are used interchangeably. While electricity is one source of energy, energy covers a much broader spectrum. For the purposes of this summary energy will be understood to include; purchased electricity, propane, #2 and #6 oil, diesel fuel, gasoline, and coal, consumed by the college. Middlebury College energy consumption is extremely reliant on fossil fuels. Purchased electricity, primarily from Central Vermont Power Supply (CVPS) is not dominated by fossil fuels (Table 1). The college consumption of fossil fuels are used in heating and cooling institutional buildings, buildings and grounds equipment, and the college

fleet of vehicles. The central heating and cooling plant burns fossil fuels to heat water in order to make steam, over 200 million pounds last year. The steam is then distributed to buildings for heating and cooling purposes. In an effort to be as efficient as possible the college utilizes co-generation to produce electricity.

There is a significant pressure difference between the pressure of steam produced in the boilers and the pressure at which it is

used by buildings on campus. This pressure differential drives three turbines which generate between ten and fifteen percent of the Colleges yearly electricity needs. The boilers in the central heating and cooling plant burn #6 oil and until 1993 they burned coal as well. #2 oil (home heating oil) is used in the furnaces of small college buildings and small residential houses. Both gasoline and diesel are consumed by the college vehicle fleet and buildings and grounds equipment. Propane is used to heat some small house and is primarily used by gas stoves and ovens in the dining halls. Table 2 shows the amount of each fossil fuel consumed by the college each year.

Fossil fuel consumption (Table 2) is one input source in inventorying the GHG emissions from Middlebury College over the past decade. There are three additional input source of importance in conducting a comprehensive inventory, electricity consumption, solid waste, and

**TABLE 1: CVPS Sources of Electricity**

<b>Year</b>	<b>Nuclear</b>	<b>Hydro</b>	<b>Coal</b>	<b>Oil</b>	<b>Wood</b>
<b>1990</b>	46.9 %	35.4 %	9.1 %	3.9 %	4.7 %
<b>1991</b>	45 %	30.2 %	8.6 %	11.7 %	4.5 %
<b>1992</b>	41.4 %	29.9 %	8.3 %	16.8 %	3.6 %
<b>1993</b>	37.7 %	33.3 %	9.2 %	14.4 %	5.4 %
<b>1994</b>	47.4 %	26 %	7.1 %	12.9 %	6.6 %
<b>1995</b>	35.7 %	38.9 %	7.7 %	3.7 %	14 %
<b>1996</b>	37.8 %	38 %	7.8 %	1.5 %	14.9 %
<b>1997</b>	36 %	38.2 %	9.4 %	1.8 %	14.6 %
<b>1998</b>	38.5 %	38.5 %	2.1 %	3.7 %	17.2 %
<b>1999</b>	37.3 %	40.9 %	0 %	1.4 %	20.4 %
<b>2000</b>	41.1 %	34.4 %	0 %	2.7 %	21.8 %

Source: CVPS 2001. Percent contribution by source to the overall production of Electricity sold by CVPS during the years 1990-2000. Because the majority of electricity sold by CVPS comes from nuclear and hydroelectric there is relatively little emission of GHGs from the consumption of this electricity.

**TABLE 2: Yearly Fossil Fuel Consumption**

<b>YEAR</b>	<b>Coal (Ton)</b>	<b>Gasoline (gal)</b>	<b>Diesel (gal)</b>	<b>#2 Oil (gal)</b>	<b>#6 Oil (gal)</b>	<b>Propane (gal)</b>
<b>1990</b>	630	21,934	21,387	73,171	949,651	No Data
<b>1991</b>	945	48,657	43,841	233,385	899,169	No Data
<b>1992</b>	0	48,136	35,428	254,949	1,242,467	No Data
<b>1993</b>	507	47,840	50,876	326,360	1,371,846	30,551
<b>1994</b>	0	51,549	29,019	306,803	1,274,363	27,879
<b>1995</b>	0	55,520	47,625	316,161	1,269,161	34,617
<b>1996</b>	0	55,618	36,120	368,439	1,419,290	32,033
<b>1997</b>	0	55,534	45,972	343,478	1,253,018	39,632
<b>1998</b>	0	61,136	38,184	322,191	1,295,487	38,440
<b>1999</b>	0	64,660	44,006	403,199	1,481,972	39,745
<b>2000</b>	0	70,221	71,520	390,599	1,694,233	40,759

transportation. Electricity use at the college has doubled in the last decade (Table 3). Electricity is not currently a significant source of GHGs because the majority of power comes from

**TABLE 3: Electricity Consumption in KWh**

<b>Year</b>	<b>Electricity Purchased</b>	<b>Electricity Generated</b>	<b>Total Electricity</b>
<b>1984</b>	6,078,000	586,000	6,664,000
<b>1985</b>	6,817,200	452,320	7,269,520
<b>1986</b>	6,945,600	940,200	7,885,800
<b>1987</b>	7,570,800	581,520	8,152,320
<b>1988</b>	7,890,000	964,480	8,854,480
<b>1989</b>	8,041,800	978,082	9,019,882
<b>1990</b>	10,450,846	902,242	11,353,088
<b>1991</b>	10,220,532	968,000	11,188,532
<b>1992</b>	10,579,351	1,365,040	11,944,391
<b>1993</b>	10,678,290	1,432,864	12,111,154
<b>1994</b>	11,071,336	1,286,230	12,357,566
<b>1995</b>	11,269,461	1,628,995	12,898,456
<b>1996</b>	11,869,513	1,928,288	13,797,801
<b>1997</b>	12,952,076	2,000,840	14,952,916
<b>1998</b>	14,974,903	1,695,350	16,670,253
<b>1999</b>	18,201,997	2,106,325	20,308,322
<b>2000</b>	19,915,255	2,702,965	22,618,220

Only the purchased electricity was used in calculated emissions. The electricity generated on campus is a by product of Steam production and the fuel used to produce the steam is used directly as an impute source.

hydroelectric and nuclear power which have little to no associated production of GHGs (Table 1). However, the regional nuclear power plant is scheduled to be decommissioned in ten years and it has been proposed that a coal plant be built to supply the electricity that will go off line when the nuclear plant is decommissioned. If this happens the GHGs associated with the college use of electricity would skyrocket. Solid waste as an input source includes waste that is sent to a land fill, waste that is composted on site, and waste

that is

recycled (Table 4). The last impute source, transportation, is perhaps one of the most challenging to quantify.

Transportation poses a unique challenge for two primary reasons. First transportation

records are not as well kept as are the records of other impute sources so it is harder to collect data on transportation from the past, especially ten years in the past. The second challenge is what to include and what not to include. This is a decision that the researchers have to make based on the best available knowledge. In the case of the Middlebury College emissions inventory the limitations on the availability of data were so great that the only transportation input included

<b>Year</b>	<b>FACULTY &amp; STAFF</b>	<b>STUDENTS</b>
<b>1990</b>	4,771,393	3,110,532
<b>1991</b>	4,959,868	3,025,911
<b>1992</b>	5,183,062	2,941,291
<b>1993</b>	4,771,393	2,923,783
<b>1994</b>	4,577,958	2,977,765
<b>1995</b>	4,880,510	3,133,875
<b>1996</b>	4,806,112	3,174,726
<b>1997</b>	4,840,831	3,326,460
<b>1998</b>	5,217,781	3,304,575
<b>1999</b>	5,733,608	3,323,542
<b>2000</b>	6,016,320	3,365,852

The emissions inventory output categories are

<b>Year</b>	<b>Total</b>	<b>Composted</b>	<b>Recycled</b>	<b>Shipped Off Site</b>
<b>1993</b>	1,835,771	335,420	435,311	1,065,040
<b>1994</b>	1,845,049	475,520	581,849	787,680
<b>1995</b>	2,053,620	506,200	769,660	777,760
<b>1996</b>	2,272,924	576,940	877,489	818,495
<b>1997</b>	2,406,921	559,218	971,903	875,800
<b>1998</b>	2,666,420	578,586	1,034,594	1,053,240
<b>1999</b>	3,085,897	559,120	1,352,437	1,174,340
<b>2000</b>	2,903,595	560,712	1,091,323	1,251,560

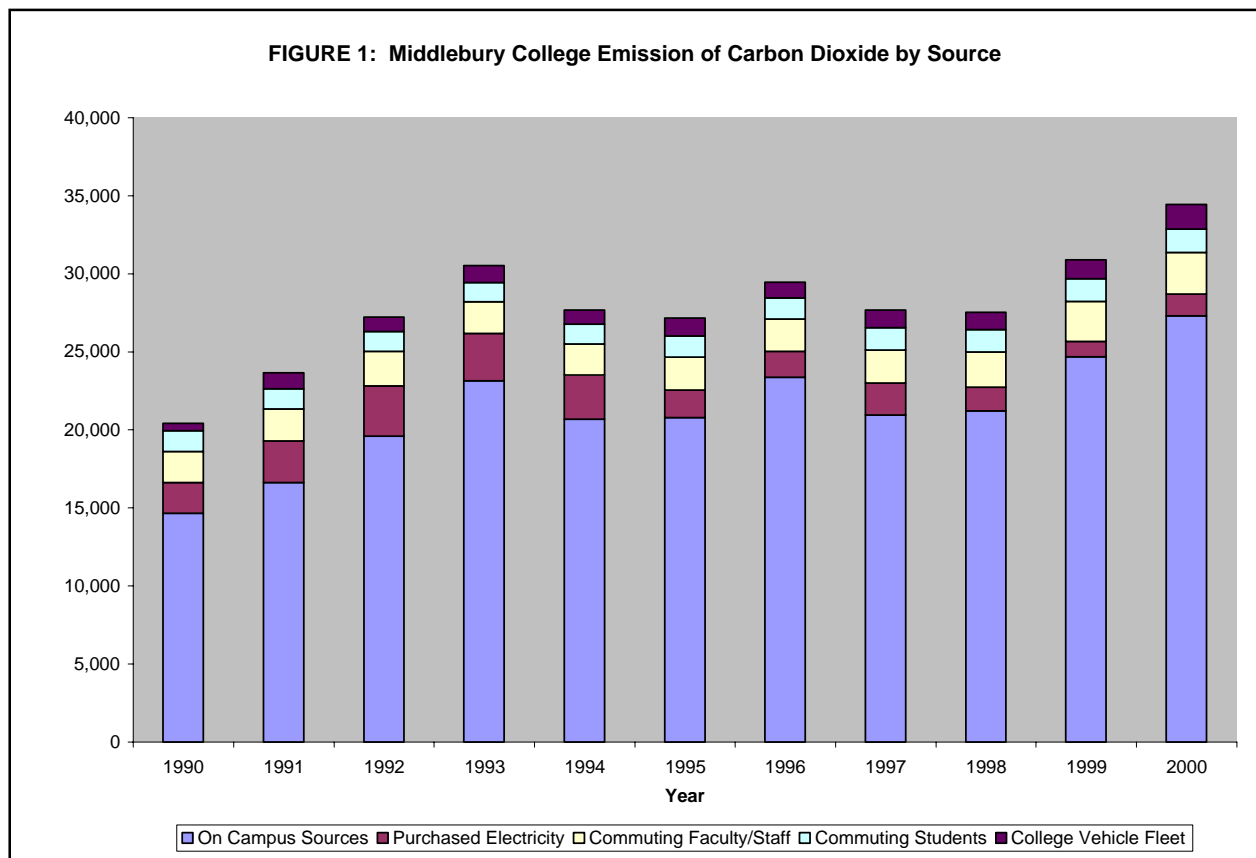
There has been a decrease in the percent of total waste that gets recycled each year since the early nineties.

was commuting by students, faculty, and staff (Table 5).

All of the input sources are converted to emissions by a series of emissions factor calculations. Then the emissions from each input category are grouped together into six output categories. Emissions are reported as metric tonnes of carbon dioxide equivalence (MTCDE).

- On Campus Sources which includes all activities on campus that contribute to the production of GHG. Primarily this category is all the fossil fuel used on campus but it also includes solid waste. This is the most significant output category.
- Purchased Electricity contains the emissions due to electricity consumption.
- Commuting Faculty and Staff contains the emissions form the miles commuted by faculty and staff each year
- Commuting Students contains the emissions form the miles commuted by students ever year.
- College Vehicle Fleet Includes the emissions produced by the college’s fleet of vehicles on a yearly basis.

The college vehicle fleet output category grew by over 200 % from 1990 to 2000 and was by far the category that experienced the most growth. The total growth in MTCDE for Middlebury College was 70 % between 1990 and 2000. Figure 1 is a graph displaying the yearly production of GHGs by source for Middlebury College.



The growth in GHG emissions is about what has been experienced nationally and the per capita production of CDE is also similar to what has been experienced nationally. The United States has lagged behind the rest of the world in dealing with GHG emissions and since the US opted out of the Kyoto Agreement it has not suggested any new strategy for addressing emissions. Fortunately on important place where Middlebury College is not in line with the nation is in addressing GHG emissions. Middlebury College is using the GHG inventory to make reduction targets and lessen its contributions to global warming.