



# GREENHOUSE GAS EMISSIONS INVENTORY REPORT

## **Tompkins County, New York**

---

Prepared by Gwenaël Fay  
In cooperation with  
The International Council for Local Environmental Initiatives  
and the Tompkins County Planning Department  
September 2001



# Table of Contents

---

Acknowledgements	
Executive Summary.....	4
Introduction.....	6
Global Climate Change.....	6
Climate Change in New York State and Tompkins County.....	6
International Council for Local Environmental Initiatives.....	7
Benefits to Tompkins County.....	8
Overall Inventory and Forecast Methodology.....	10
General Overview.....	10
Baseline and Forecast Years.....	11
CCP Greenhouse Gas Emissions Software.....	12
Community Inventory and Forecast Methodology.....	13
Government Operations Inventory and Forecast Methodology.....	18
Community Emissions Inventory Results.....	21
Government Operations Inventory Results.....	32
Conclusion.....	38
Glossary of Terms.....	40
Appendix A: General Inventory Contacts.....	43
Appendix B: Community Inventory Data Sources and Contacts.....	44
Appendix C: Government Inventory Data Sources and Contacts.....	46
Appendix D: Residential Sector Data and Computations.....	47
Appendix E: Commercial Sector Data and Computations.....	48
Appendix F: Industrial Sector Data and Computations.....	49

## Acknowledgements

---

The author would like to express her sincere appreciation to all those who made this inventory possible. Foremost, the author would like to thank the International Council for Local Environmental Initiatives (ICLEI) and the Cities for Climate Protection Campaign (CCP) for funding this project and providing direction regarding environmental science and technical matters. Much gratitude is extended to the Tompkins County Board of Representatives for taking initiative on this project and to Peter Penniman for serving as the elected liaison. Mikel Shakarjian deserves particular recognition for her role as the staff liaison, providing daily supervision and guidance. Lastly, the author would like to thank the numerous County departments and individual staff members, for supplying data pertinent to the completion of this inventory.

## Executive Summary

---

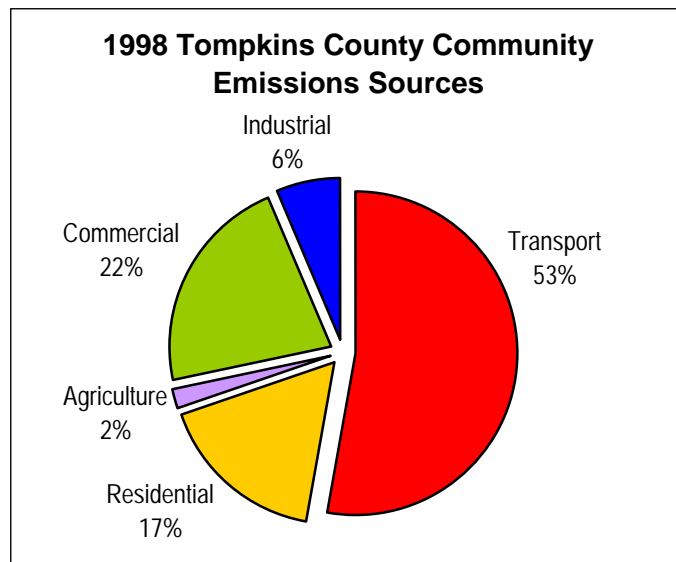
In April 2001, Tompkins County joined the Cities for Climate Protection (CCP) Campaign, a project of the International Council on Local Environmental Initiatives. This action recognizes the need to address the global warming problem swiftly and effectively, and the County's unique position to play a role. Local governments influence important decisions affecting global warming such as building and home energy use, transportation, street lighting, and waste disposal; the major sources of greenhouse gas emissions. Efforts to reduce greenhouse gas emissions not only helps to slow global warming, it can save taxpayer dollars, improve local air quality, and increase the quality of life in the community. Over 75 local governments in the U.S., and over 400 around the world, have joined the Cities for Climate Protection Campaign to reduce their contribution to the global warming problem and are finding the opportunities and benefits to be real and substantive.

The Greenhouse Gas Emissions Inventory is the first milestone in the CCP Campaign. It is meant to serve as a tool for other milestones: choosing an emissions reductions target and developing and implementing a Local Action Plan. Inventory results will give Tompkins County a clear picture of the quantities and sources of greenhouse gas emissions. This will help the County choose an adequate emissions reduction target, prioritize emissions concerns, and develop effective initiatives.

An inventory was taken of greenhouse gas emissions from both the Tompkins County community, and emissions as a result of County government operations. In addition, projections of emissions for 2020 from vehicles, waste, and all sources of energy use (electricity, natural gas, heating oil, and propane) in Tompkins County were made based on expected population growth and trends in energy use.

### ***Community Inventory Results***

In 1998, the Tompkins County community produced a total of 1,223,432 tons eCO<sub>2</sub>. The inventory shows that emissions from transportation (more specifically, the combustion of gasoline and diesel) produced the majority of community emissions at 53%. Commercial energy use (from electricity, natural gas, heating oil, and propane) is the second biggest source of emissions, comprising 22% of community emissions.

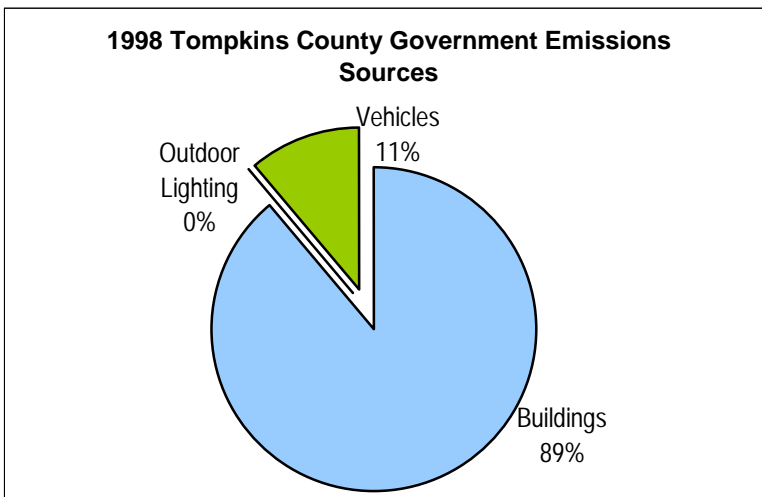


Of the 106,555 tons of solid waste generated in Tompkins County in 1998, 42%, or 45,007 tons, was recovered and recycled. The remaining 58%, or 61,548 tons, was brought to a landfill with high amounts of methane recovery. Due to complex chemical process, methane recovery reduced emissions to -8,751 tons eCO<sub>2</sub>. This result must be interpreted with caution and should not be used as evidence that emissions can be “banked” in order to be made up with other emission-producing activities in other sectors.

In 2020, community emissions are forecasted to rise to 1,264,120 tons eCO<sub>2</sub>, an increase of 3.3% from 1998. This projected increase comes exclusively from a 7.7% increase in emissions as a result of automobile use.

### ***Government Operations Inventory Results***

Municipal activities play an important role in the public sector’s contribution to global climate change. The County ultimately has greater control over its own emission-producing actions, such as building heating and cooling, in contrast to those resulting from private activities.



The County spent approximately \$1.14 million on electricity, natural gas, gasoline and diesel, all energy sources that emit greenhouse gases during their production prior to consumption.

The vast majority of emissions, 89%, came from building energy use, which powers things such as electronics, lighting,

heating, and air conditioning systems. The County buildings that produced the most emissions include the Airport Terminal, Human Services Building, Biggs A, and the three buildings that comprise the Courthouse Complex. The County vehicle fleet, through the combustion of gasoline and diesel fuels, accounts for another 11% of total emissions from government operations.

Government emissions are expected to increase 1.9% by the year 2020.

# Introduction

---

## *Global Climate Change*

The *greenhouse effect*<sup>1</sup> refers to the natural mechanisms that keep the earth at a suitable temperature for living creatures. Biological and chemical processes release certain gases into the atmosphere that capture the sun's energy on earth. This blanket of gases acts the same as the glass roof of a greenhouse in that it allows the sun's energy to pass through it to reach the earth, but prevents some of the energy from escaping back into space. A delicate balance of carbon dioxide, methane, nitrous oxide, and other gases is achieved, perfect to sustain life on earth.

This balance, however, has been disturbed by human actions such as industrial processes, fuel combustion, and changes in land use. These activities produce large amounts of select greenhouse gases. The increase in greenhouse gas concentration, primarily *carbon dioxide* (CO<sub>2</sub>) and *methane*, is trapping heat on the earth, thus warming it beyond its

Even the slightest warming of the earth's surface may be accompanied by events such as storms and droughts, losses of ecosystems and species, and alterations in regional agricultural productivity.

normal temperature. Human industrial activity has contributed to a 30% increase in the global CO<sub>2</sub> level through the combustion of fossil fuels for energy. Other anthropogenic contributions of greenhouse gases include methane production from the decomposition of waste, the burning of gasoline and diesel fuels in vehicle operation, and the manufacturing of

*chlorofluorocarbons*. The term "global climate change" refers to the potential alternations in the planet's physical conditions. Even the slightest warming of the earth's surface may be accompanied by an increase in severe weather events such as storms and droughts, loss of ecosystems and species, reduced polar ice caps, and alterations in regional agricultural productivity.

## *Climate Change in New York State and Tompkins County*

Although climate change is a global issue and is often presented in the media as a problem addressed solely by international treaties, the effects of rapidly rising temperatures will be felt in every local community. Temperatures in New York State are projected to increase between 4°F and 9°F by 2100, with the largest increases in the coastal regions. This warming suggests possible increases in rain events over frozen ground or rapid snow melting events that can increase flooding. Moreover, climate change has great

Temperatures in New York State are projected to increase between 4° and 9° by 2100, with the largest increases in the coastal regions.

---

<sup>1</sup> All italicized terms are further explained in the glossary section beginning on page 40.

potential to add to existing stresses. Major potential consequences of climate change particular to this area include increased heat-related illness and death due to temperature extremes, and the impact of changing rates of precipitation and evaporation. The latter could be especially problematic on relatively inflexible water supply systems.

New York State and Tompkins County can expect changes in the local economy and cultural traditions as recreational patterns shift due to increased temperatures. The ability

**Rises in temperature may lead to elevated populations of disease-carrying insects carrying infectious maladies such as encephalitis and malaria will put stresses on human health.**

of ski areas to maintain snow pack will become limited, the fall foliage colors muted, and the sugar maple will likely migrate northward into Canada as the climate warms, sharply reducing maple syrup production, a longtime practice in this area. Elevated populations of disease-carrying insects such as mosquitoes and ticks carrying a growing range of infectious diseases usually found in tropical areas, such as encephalitis and malaria, will put stresses on human health. Ground level *ozone* levels are expected to rise, thus reducing air quality in the area and leading to

greater respiratory problems such as asthma, especially for the young, ill, and elderly in the local population. High levels of low-lying ozone will also damage crops and vegetation.

As such dramatic local and regional effects approach reality, it becomes increasingly clear that climate change, though a global problem, is one that must be addressed by local governments. On April 3, 2001, the Tompkins County Board of Representatives passed Resolution No. 69 on recommendation of the Environmental Management Council, joining the network of 350 cities and counties actively involved in the Cities for Climate Protection Campaign, a division of the International Council for Local Environmental Initiatives.

### ***International Council for Local Environmental Initiatives***

Since 1993, the *International Council for Local Environmental Initiatives* (ICLEI) has been assisting cities and counties around the United States and the world to reduce emissions of the gases and air pollutants that cause global warming with their *Cities for Climate Protection Campaign* (CCP). Currently 350 city, town, and county governments are members of ICLEI worldwide and 75 municipalities are participating in the CCP Campaign within the United States. It is estimated that the CCP communities combined represent 8% of greenhouse gas emissions released from the United States.

The CCP Campaign methodology follows a set of milestones designed to assist Tompkins County in reducing its contribution to global warming:

- ⇒ Milestone 1 — Conduct a greenhouse gas emissions analysis and inventory. The inventory results from community activities and County operations contained in this report complete Milestone 1.
- ⇒ Milestone 2 — Set a reduction target. The reduction target is the specific greenhouse gas emissions reduction goal that Tompkins County aims to achieve by a designated year. It is usually expressed as a percentage reduction below the quantity of emissions released in the year for which the emissions inventory was conducted.
- ⇒ Milestone 3 — Develop a Local Action Plan. The Local Action Plan is a description of the policies, programs, and measures Tompkins County will take to meet its reduction target.
- ⇒ Milestone 4 — Implement the Local Action Plan. Implementing the actions is an on-going process that will probably last through the target date.
- ⇒ Milestone 5 — Monitor progress and report results. With ICLEI's help, the impact and status of the Local Action Plan policies will be measured and evaluated.

The process of completing the milestones is not necessarily linear. The milestones can be undertaken concurrently or in any order. The specific target and contents of the Local Action Plan is the responsibility of Tompkins County to determine. The amount of time needed to complete the milestones depends largely on the size and complexity of a jurisdiction, as well as the political environment and availability of data. CCP is designed as a program to assist local governments, recognizing that each locality is influenced by factors particular to that area.

With the Milestone Process as a guide, ICLEI provides hands-on technical assistance to CCP participants. With ICLEI's experience in other CCP communities, a system of information exchange and feedback is continually available to active partners in Tompkins County. ICLEI training workshops provide an opportunity for officials, staff, and community partners to pursue effective actions in their effort to reduce greenhouse gas emissions and promote more efficient and clean energy throughout Tompkins County.

### ***Benefits to Tompkins County***

Acting to reduce greenhouse gas emissions and protect the climate has numerous benefits to Tompkins County government and the community:

- ⇒ Saves taxpayer money. Actions that reduce greenhouse gas emissions cut electricity and fuel use, reducing energy costs for citizens, businesses, and institutions, creating savings for municipalities.
- ⇒ Improves air quality and public health. In the short-term, less fossil fuel use in all sectors means less air pollution and fewer air quality-related public health



- impacts, such as asthma and other respiratory ailments. In the long-term, acting to reduce greenhouse gases reduces the likelihood of climate-related public health problems, such as the spread of heat dependent diseases.
- ⇒ Improves livability of the community. Cutting greenhouse gas emissions with measures that make Tompkins County less auto dependent can reduce traffic congestion, clean the air, and contribute to more efficient homes, offices, and land use patterns. In combination, these types of measures can help build a more livable community.
  - ⇒ Boosts local economy. Decreased energy costs, coupled with expansion into new services and technologies (e.g. energy efficiency and renewable energy) give local firms a competitive edge. The demand for energy efficient products and services and for new or alternative energy technologies expands local business, creates local jobs, and boosts the local economy.

There are five municipalities in addition to Tompkins County in New York State that have joined the CCP campaign and completed Milestone 1 by the end of Summer 2001. They are the cities of Buffalo, New Rochelle, Saratoga Springs, and the counties of Westchester and Suffolk.

This report summarizes greenhouse gas emissions from Tompkins County as a whole, with a specific subsection highlighting emissions from Tompkins County government operations. Tompkins county-wide emissions data has been collected for energy consumption, waste formation, transportation, and agriculture. Government emissions data has been collected for energy use by County-owned buildings, waste from County offices, vehicle fleets, and streetlights.

### ***Data Sources***

Detailed information regarding all organizations and contacts mentioned in this section can be found in the Appendix A of this report.

# Overall Inventory and Forecast Methodology

---

## *General Overview*

The greenhouse gas emissions inventory in Tompkins County for 1998 and forecasts to 2020 in was conducted on two levels:

- **Community sources:** All emission-causing actions within the geographic area of Tompkins County.
- **County government operations:** All emission-causing actions as a result of County procedures. It is important to note that the government operations inventory is a subset of the community inventory. Emissions from County proceedings are already embedded in the community inventory.

The Community Inventory is a catalogue of all energy consumption and waste producing activities that occur within the borders of Tompkins County that produce greenhouse gases. The community inventory and forecast involved collection of data on consumption of several fuel types from the following sectors:

- **Residential:** Electricity, natural gas, heating oil, and propane use from all households within Tompkins County.
- **Commercial:** Electricity, natural gas, and heating oil use from all properties classified as commercial enterprises in the County. This sector includes publicly-owned buildings, large residential units (e.g. apartment buildings), and educational facilities.
- **Industrial:** Electricity, natural gas, heating oil, and propane use from all establishments in the County classified as industrial.
- **Transportation:** Gasoline and diesel fuel use from personal and commercial vehicles, and passenger buses operating within the County borders.
- **Waste:** Amount and types of waste sent to landfill from all establishments in Tompkins County. Global warming pollution from waste comes from methane, which is formed from the decomposition of waste.
- **Other:** This sector is left to include emissions sources that may be particular to a given jurisdiction. For this inventory, methane from livestock methane was included and is labeled as the agriculture sector in the results.

Forecasting for the community inventory accounts for changes in Tompkins County population, trends in fuel use and transportation patterns, and shifts in waste and recycling methods.

The County Government Inventory is a separate inventory conducted in order to trace emissions resulting from Tompkins County government operations. This portion was singled out because the County ultimately has greater control over its own emission-producing actions, such as building heating and cooling, rather than those resulting from private activities. Local governments can use their influence, their decision-making and their purchasing powers in ways that increase energy efficiency and reduce greenhouse gas emissions. By identifying specific activities within County operations that produce

higher than necessary emissions, appropriate recommendations can be made to not only reduce emissions, but also reduce money spent on energy. Operational costs, including amounts spent on utilities from Tompkins County buildings and costs of fuel for County vehicles, are outlined in the inventory reports of the government inventory.

The government inventory is divided into sectors similar to those found in the community inventory. Government operations that are not directly controlled by County government as well as energy and fuel used by private entities contracted by the County are not included in this inventory, unless otherwise noted. It is important to note that the County government emissions inventory is included in the community inventory. The government inventory is simply a sub sector of the community results.

The County government inventory and forecast consisted of the following sectors:

- **Buildings:** Electricity and natural gas consumption from County-owned buildings and facilities.
- **Outdoor lighting:** Electricity use resulting from the operation of outdoor lighting operated by the County.
- **Vehicle Fleet:** Gasoline and diesel for various motor vehicles used by County-owned vehicles such as passenger cars, heavy equipment, Sheriff's vehicles, and marine vehicles.
- **Waste:** Amount and composition of waste generated at the buildings and facilities operated by the County.

Forecasting for the County government inventory assume "business-as-usual" conditions. Therefore, it is presumed that emissions from County operations will not change unless there is specific evidence to the contrary.

### ***Baseline and Forecast Years***

The year selected for which to conduct the government and community inventory, the *baseline year*, is 1998. This was the earliest year for which reliable, quality data could be obtained, yet is far enough in the past that the effects of measures intended to reduce greenhouse gas emissions undertaken by the County government since 1998 can be quantified. Although every effort was made to gather and use data from 1998 for all aspects of this inventory, certain isolated circumstances caused 1998 data to be impossible to collect or be otherwise erroneous. Exceptions and explanations for use of figures other than 1998 are included in the methodology section of this report.

The year 2020 was chosen to project future emissions forecasts. The community forecast is constructed by applying demand projections, population growth rates, and general consumption trends to the baseline year figures. A major assumption for government forecasting is that emissions derived from this inventory will not change unless there is specific evidence to the contrary.

### ***CCP Greenhouse Gas Emissions Software***

Torrie Smith Associates Inc. developed the *Cities for Climate Protection Greenhouse Gas Emissions Software* used by members of CCP. The software is a user-friendly, “point-and-click” software tool that makes it easier for local governments to accomplish the five ICLEI milestones. Using automated energy conversions and embedded emission coefficients, the software translates data on energy use, transportation patterns, solid waste amounts, and other inputs into greenhouse gas emissions. The CCP software is also useful as a planning tool to calculate the energy, money, and greenhouse gas savings from both existing and proposed greenhouse gas reducing policies and measures and was used in this inventory.

All output from the CCP Greenhouse Gas Emissions Software used in this report are in units of *equivalent CO<sub>2</sub>* (eCO<sub>2</sub>). Equivalent CO<sub>2</sub> is a common unit that allows emissions of greenhouse gases of different strengths to be added together and allows each greenhouse gas to be weighted according to its relative contribution to global climate change. For carbon dioxide itself, emissions in tons of CO<sub>2</sub> and tons of eCO<sub>2</sub> are the same thing. However, for nitrous oxide, an example of a stronger greenhouse gas, one ton of emissions is equal to 310 tons eCO<sub>2</sub>, while one ton of methane emissions is equal to 21 tons of eCO<sub>2</sub>. In essence, converting all emissions to eCO<sub>2</sub> accounts for the varying impact of different gases, thus allowing the user to compare apples and oranges quantitatively.

The Software Users Guide contained in the Cities for Climate Protection Toolkit provides detailed instructions regarding software use and applications.

## Community Inventory and Forecast Methodology

---

### *Residential*

To measure emissions from residential homes in Tompkins County in 1998, the consumption of electricity and fuel use by utility customers was calculated. Total electricity and natural gas utilization from May 2000 to June 2001 came directly from the primary utility provider in the Tompkins County area, New York State Electric and Gas (NYSEG). Though information from 1998 would have been ideal for such a large segment of the community inventory, there is likely to be little change between consumption in 1998 and 2000-01.

Approximately 15 different private suppliers provide propane and heating oil to Tompkins County residencies and establishments. Rather than collect consumption data from 15 separate companies, propane and heating oil use was estimated using data from the United States Department of Energy (DOE) and the Assessment Department. In 1997, the DOE conducted a study on heating oil use in the mid-Atlantic region (comprised of the states of New York, New Jersey, and Pennsylvania) to find that the average size of households using heating oil was 1,731 square feet and consumed an average 744 gallons of heating oil per year. Thus, the average consumption rate is 0.43 gallons per square foot. Although the Assessment Department maintains data on the utility and fuel type available to a residential property, it does not have information about what is actually used by that household. It was assumed that if natural gas were available to a consumer, they would heat with gas rather than with heating oil. Therefore, all residential properties listed as having gas or gas and electric at their disposal were eliminated. From those properties, all that listed anything but oil as their fuel type were eliminated. Of those that remained, there was a total of 8,649,152 square feet. The total square footage of residential property in Tompkins County using heating oil was then multiplied by the average heating oil use per square foot in the mid-Atlantic region to arrive at the total annual amount of heating oil consumed. Data sets and computations for figures used in calculating energy and fuel use for the residential sector can be found in Appendix D.

Propane use was derived in a similar manner. The DOE study found that of households using propane in New York State in 1997, the average consumption was 184 gallons. Using the same type of assumptions explained above, information from the Assessment Department determined the number of properties in Tompkins County that use propane to be 17,767. The average annual consumption per household in NYS was multiplied by the total number of households in Tompkins County to arrive at total annual propane use by residential properties.

Projections for 2020 are based on predictions of overall energy use published by the Energy Information Administration, a division of the DOE. Consumption estimates are given through 2020 for the mid-Atlantic region for each sector by energy type, assuming population growth rates and business-as-usual conditions. For the residential sector in

the mid-Atlantic census region, electricity and natural gas is expected to rise by 1.3% and 0.6% respectively. Heating oil use is expected to decline by 0.8% and propane by 2.1%.

### *Commercial*

The process for calculating energy use from the commercial sector is very similar to that of residential housing. NYSEG provided electricity and natural gas consumption for 2000-01. In order to arrive at commercial heating oil and propane use, Department of Energy statistics were again used, from a commercial consumption study conducted in 1995. Data sets and computations for figures used in calculating energy and fuel use for the commercial sector can be found in Appendix E.

NYSEG classifies their electricity customers into five categories: residential, commercial, industrial, public authority, and lighting. Public authority is defined as any publicly owned establishment. As instructed by ICLEI, electricity use for the public authority group is considered a commercial property. According to NYSEG, the lighting category is comprised primarily of streetlights and traffic signals, although a small proportion is the result of outdoor lighting at commercial and industrial properties (e.g., parking lot lighting). Streetlights and traffic signals are considered a part of the commercial sector and were assumed to be 75% of the total electricity consumption in the lighting category. Another 10% was assumed to be commercial outdoor lighting, while the remaining 5% is attributed to industrial outdoor lighting. Therefore, 95% of NYSEG's lighting sector is included in the commercial sector of the inventory. It is also important to note that all educational facilities are also classified as commercial property.

NYSEG natural gas consumption is divided into four separate categories: residential, commercial and industrial combined, public authority, and transportation. Since it is impossible to separate commercial natural gas use from industrial natural gas use, it was estimated that 75% of the natural gas consumption in the commercial and industrial category is a result of commercial property use. As with the electricity use data, public authority properties are considered commercial property.

Heating oil use was computed in the same manner as natural gas consumption. The Assessment Department supplied a listing of all commercial properties in Tompkins County using heating oil following the same assumptions outlined for the residential sector. The DOE study found that each commercial property in the mid-Atlantic region used an average of 3,608 gallons of heating oil annually. This figure was multiplied by 138, the total number of commercial establishments in Tompkins County using heating oil to arrive at the total amount of heating oil used.

Heating oil use was also estimated using data on consumption per square foot. The 1995 DOE study found that commercial properties in the mid-Atlantic census region used an average of 0.19 gallons of heating oil per square foot. The RPS database was used to gather aggregate square foot data for commercial properties in Tompkins County for a total of 1,003,993. This total was then multiplied by the mid-Atlantic average use per square foot. The mean of results from both methods was then computed.

Propane use in commercial enterprises in Tompkins County is uncommon and the establishments are generally quite small. The Energy Information Administration does not gather information on commercial propane use due to the low numbers of commercial properties listed as using propane heat in a 1998 Department of Labor Statistics study. Therefore, propane use for this sector was not considered.

Forecasting of consumption in the commercial sector was again based on the predictions of overall energy use published by the Energy Information Administration. For the commercial sector in the mid-Atlantic census region, electricity and natural gas is expected to rise by 1.4% and 0.9% respectively. Heating oil use is expected to decline by 0.2%.

### ***Industrial***

Electricity and natural gas information for the industrial sector was obtained from NYSEG. Electricity use was defined as data from the industrial customers category, plus the 5% from the lighting sector as described on page 14. Natural gas use was estimated to be 25% of the utilization in the commercial and industrial customer category. Heating oil and propane consumption was derived using data from the Assessment Department and 1994 statistics from the Energy Information Administration of the DOE. All estimates were performed using the per establishment method and the per square foot method; the average of the two was used in the inventory. Data sets and computations for figures used in calculating energy and fuel use for the industrial sector can be found in Appendix F.

Heating oil use was computed in a similar manner. The Assessment Department supplied a listing of all industrial properties in Tompkins County using heating oil following the same assumptions outlined in the residential sector methodology. According to the DOE each industrial property in the United States used an average of 17,875 gallons of heating oil annually in 1994. This figure was multiplied by 5, the total number of industrial establishments in Tompkins County using heating oil to arrive at the total amount of heating oil used for this sector.

Heating oil use was also estimated using data on consumption per square foot. The 1994 DOE study found that industrial properties in the United States used an average of 0.36 gallons of heating oil per square foot. The Assessment RPS database was used to gather aggregate square foot data for industrial properties in Tompkins County for a total of 33,059. This total was then multiplied by the average use per square foot. The mean of results from both methods was then computed.

Propane is used at a total of 12 industrial establishments in Tompkins County, according to the RPS database. This figure was multiplied by 78,330, the average number of gallons of propane used per industrial facility in the United States, according to the DOE in 1994. The same study showed the average use per square foot to be 1.57 gallons. When multiplied by the total area of industrial space in Tompkins County, 77,137, an estimate of propane use using the square foot method is arrived at. As done before, the average of the two methods was taken and imputed in the inventory.

Forecasting of consumption in the industrial sector was again based on the predictions of overall energy use published by the Energy Information Administration. For the industrial sector in the mid-Atlantic census region, electricity and natural gas is expected to rise by 1.0% and 0.09% respectively. Heating oil use is expected to increase by 0.2% and propane use by 4.7%.

### ***Transportation***

Emissions from vehicles were calculated using annual average daily traffic (AADT) data generated by the Ithaca-Tompkins County Transportation Council, using a transportation system model based on regional mobility studies for 1996. All roads in the County are divided into three categories based on the traffic patterns on a particular road. Collector roads are primarily composed of residential streets. Major arterial streets have heavy traffic, generally found in the commercial or downtown districts. Limited access highways are highways with exit ramps. The total miles of each type of road was multiplied by its respective AADT. This result was then multiplied by 330 days to account for lighter traffic on weekends and holidays in order to arrive at annual vehicle mile traveled (VMT) for all roads in Tompkins County. This VMT data is used in combination with New York State average data for vehicle fuel efficiency and vehicle types provided by the software to calculate total fuel use.

In addition to the fuel estimates embedded in the software, NYSEG provided more specific data regarding natural gas use by vehicles. This data was substituted for the results generated by the software's default values.

The Ithaca-Tompkins County Transportation Council suggested using a transportation model system of peak hour travel (5 to 6 pm on weekdays) as an indicator of growth in the transportation sector. Peak hour VMT for 1996 and a 2020 model were gathered and showed a rise of 7.72% by 2020.

### ***Solid Waste***

In 1998, the New York State Department of Environmental Conservation collected waste and recycling data from all Planning units in the State. The Tompkins County Division of Solid Waste submitted information regarding amount of each waste type recycled in the County in 1998 along with the type of recycling program the County has for specific materials. The total amount of waste generated was given as 106,555 tons, with 61,548 tons going to landfill. The remaining 45,007 tons was recycled.

All landfilled waste generated in the County in 1998 was transported by a private hauler to Seneca Meadows Landfill in Waterloo, New York. The landfill site in 1998 was lined with clay on all sides, though was not covered with a plastic cover sheet. Methane recovery is relatively high, as 7 generators operate as a result of methane recovery efforts. Seneca Meadows did not have information available concerning the amount of methane recovery in 1998, though the estimate was that it was around 70%. Neither the landfill personnel nor the Division of Solid Waste had specific data regarding the breakdowns of



waste going to landfill. Therefore, the default breakdown of waste composition available in the CCP software was used.

In 2001, landfilled waste is not longer transported to Seneca Meadows Landfill, but to a facility in Ontario County. The Ontario County Landfill has is estimated to have the same methane recovery rate as Seneca Meadows did in 1998, at approximately 70%. It was assumed that in 2020, waste would continue to be transported to this facility and that methane recovery would remain at 70% capacity. The Tompkins County Division of Solid Waste projects waste qualities through 2010. With the help and input of officials there, it was extrapolated that the amount of waste generated from Tompkins County would increase by 1.19%. This figure accounts for projected increases in recycling estimated by the Tompkins County Division of Solid Waste.

### ***Agriculture***

In certain cases, a community may contribute greenhouse gas emissions from other significant sources, depending on the land use in that community. Given the fact that over 30% of the land use in Tompkins County is devoted to agriculture, the section remaining in the inventory was used to calculate methane from livestock. The National Agriculture Statistics Service for the U.S. Department of Agriculture conducted an Agriculture Census in 1997. Data for New York State is broken down by county from which head counts of beef cows, milk cows, goats, horses, sheep and lambs, and swine in Tompkins County was obtained. Torrie Smith Associates suggested obtaining data on methane emissions per livestock type from the United States Environmental Protection Agency's publication on greenhouse gas emissions and sinks. This report detailed methane emissions factors per type of livestock per head per year. The emissions factor for each livestock type was multiplied by the respective number of animals in the County in order to arrive at the total annual amount of methane emitted as a result of livestock.

### ***Data Sources***

Detailed information regarding all organizations and contacts mentioned in this section can be found in the Appendix B of this report.

# Government Operations Inventory and Forecast Methodology

---

## *Buildings*

Nearly all buildings owned and operated by Tompkins County have the County Buildings and Grounds Department process and store utility bills. The Department of Buildings and Grounds provided electricity and natural gas consumption and expenditure data from 1998 for all buildings for which they retained documents. Floor area data for each building accompanied the utility bills provided from buildings and grounds.

Four County-owned buildings did not have records stored at the Buildings and Grounds Department and these had to be gathered from individual departments in order to complete the building emissions inventory. This is the case for the buildings that comprise the Ithaca-Tompkins Regional Airport, the Department of Public Works on Bostwick Road, and the Solid Waste Facility. The Assessment department provided area data for these four properties.

It is important to note that, although the airport buildings are owned and operated by Tompkins County, the airport is fiscally self-sustaining in a manner similar to a private business enterprise. No County taxpayer funds are used to pay for expenses generated as a result of airport operations. Airport expenses are paid from revenues generated by airlines and other aviation users, concessionaires providing services to passengers, and airport parking fees. However, since the airport falls under the authority of the County, it is included in the government inventory.

Certain individual County buildings have their utility consumption and expenditures grouped together, therefore it is impossible to determine individual energy use for each separate building in a given cluster. This is the case for the Public Safety building and the Courthouse Complex. The Public Safety buildings include the Crash, Fire and Rescue building and the County Jail. The Courthouse Complex is comprised of the Main Courthouse (320 North Tioga Street), Old Jail building (125 East Court Street), and the Old Courthouse (121 East Court Street).

Forecasts for building energy use in 2020 were assumed to be constant between the base year and the forecast year except where building changes had actually occurred by the time the inventory was conducted. Therefore, only two changes have been made between the base year and the forecast year. The first is a change in utility bills for the old library on Cayuga Street. The building is currently being used as office space, though future use is being evaluated. Electric bills for the months of January 2001 through April 2001 and natural gas bills for January 2001 through March 2001 were obtained and use for the remainder of the year extrapolated. The second change to the forecast year is the addition of the new county library at 115 East Green Street. Energy use for the new library does not include the energy savings garnered with the addition of the solar panels in June 2001. Once the solar panels have been in operation long enough to quantify benefits in

energy-use reduction, the lowering of emissions due to the solar panels can be shown as a government-initiated measure to reduce greenhouse gas emissions. The energy savings can then be subtracted from the government inventory.

### ***Vehicle Fleets***

The Administration Department provided a list of all vehicles in the County fleet in 1998. Each vehicle was sorted according to department, with 1998 mileage for each vehicle, and amount spent on gas and oil combined in that year. The amount spent on oil was thought to be a negligible proportion of the oil and gas expenses, therefore the amount was taken as including only gasoline.

The Sheriff Department and airport vehicles were not included in this database and had to be gathered from the individual departments. Airport personnel provided listings of vehicles, mileage per vehicle, and gallons of fuel used for airport vehicles. Specific data for the sheriff department vehicles in 1998 was unavailable. Sheriff Peter Meskill, knew that the fleet in 1998 was comprised of between 17 passenger cars and one boat, though miles traveled or gallons of gas used in that year was unobtainable. Upon consultation with the Sheriff's department, the consensus was that all passenger vehicles operated by the Sheriff's Department traveled an estimated 400,000 miles per year combined. Gasoline efficiency for these vehicles was estimated to be an average of 16 miles per gallon, due to the presence of an 8-cylinder engine in the Sheriff Department's passenger cars, larger than the typical passenger vehicle.

All County-owned vehicles fill their tanks at Andree Petroleum, with the exception of select vehicles at the County airport that obtain fuel from Agway. Andree Petroleum gathered data on the average price of a gallon of gas in 1998 and found it to be \$0.625. This price accounts for the \$0.50 per gallon tax that government vehicles are excluded from. In order to derive the gallons used for each vehicle, the total expense on gas was divided by the average price per gallon in 1998. Cost of fuel used by the airport vehicles was not derived in this manner, but was available directly from Airport personnel.

### ***Outdoor Lighting***

As a County government, Tompkins County does not operate park or outdoor recreation lights, streetlights or other traffic control lighting systems. However, the county does pay for the energy and maintenance cost of the outdoor lighting found at the Courthouse. The utility bills for this equipment are separate from the general Courthouse energy bills (part of the Courthouse Complex). In addition, the airport operates outdoor lighting at that facility. The Courthouse and airport outdoor lighting are the only sources included in the streetlights sector of the government inventory.

### ***Solid Waste***

All trash from County buildings and offices is retrieved and brought to the Solid Waste Transfer Facility by Superior Disposal, one of 27 licensed haulers in Tompkins County. Once brought to the solid waste facility, all trash is lumped into the same area, regardless

of origin. Due to the fact that Superior Disposal may pick up trash from several locations with the same truck in one day, it is impossible to separate origin of trash once it arrives at the solid waste station.

The Personnel Department supplied a register of all employees of Tompkins County in 1998, a total of 760 employees. The Environmental Protection Agency Office of Solid Waste published statistics regarding the composition of the waste stream from a federal office building in 1997 and found that the employees generated an average of 2.9 pounds per day. These figures are before any recycling takes place. To account for recycling, it is assumed that the proportion recycled from Tompkins County offices is the same as that recycled from households in the county in 1998, approximately 42% of all waste. Thus, the total waste generated per employee per day becomes 1.7 pounds. This figure is multiplied by the number of employees, then by the number of working days in a year (accounts for weekends and federal holidays), 252, to arrive at 325,584 pounds per year. When converted to tons for the purposes of inserting the calculation into the software, the total annual amount of waste generated by County offices is found to be 163 tons.

### ***Water and Sewer***

The County does not have jurisdiction over providing and maintaining the water and sewer system located in Tompkins County. The energy use of the City of Ithaca Water Treatment Plant, the Water and Sewer Administration Building, and the Ithaca Area Wastewater Treatment Plant is beyond the authority of the county government, thus the impact of these emissions was eliminated from the government inventory for Tompkins County. If an inventory were to be conducted for the City of Ithaca, the water and sewer system would be included in this register.

### ***Data Sources***

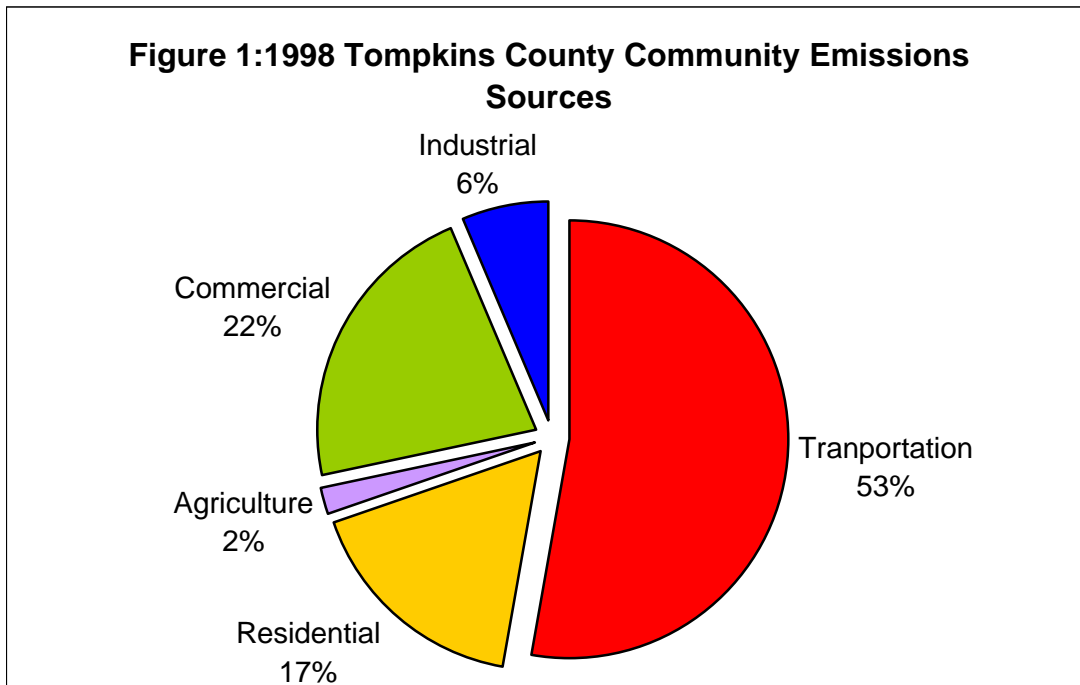
Detailed information regarding all organizations and contacts mentioned in this section can be found in the Appendix C of this report.

# Community Emissions Inventory Results

## *Total Greenhouse Gas Emissions*

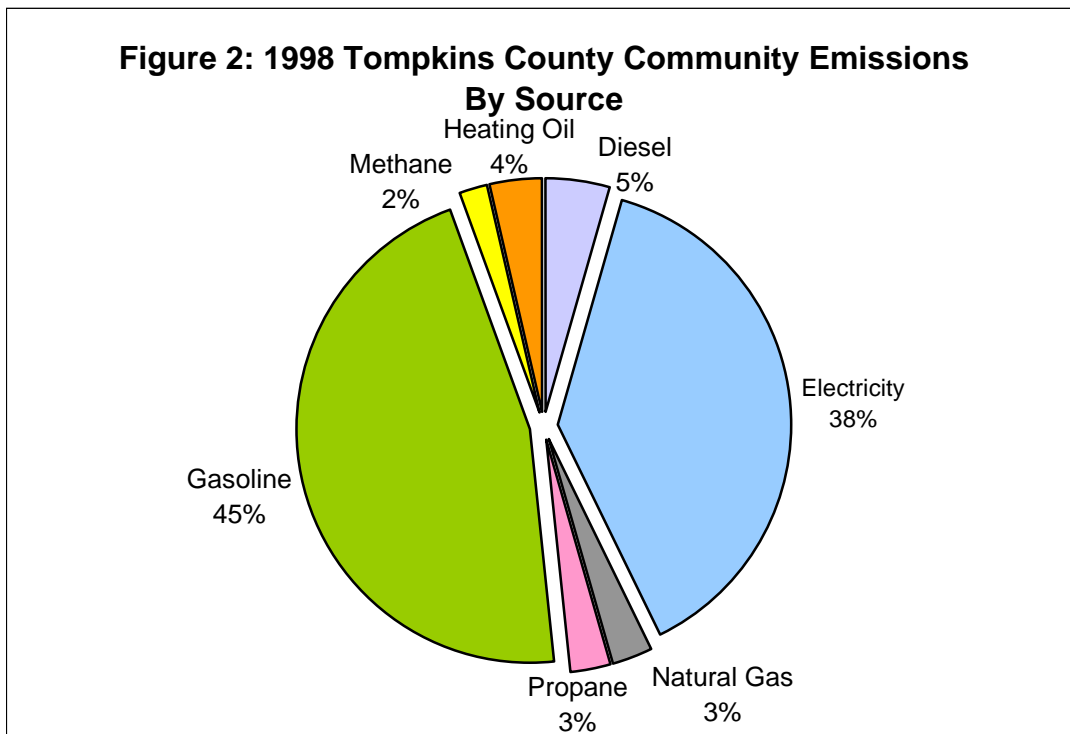
Year	Total eCO <sub>2</sub> (tons)	Energy Use (BTU)	Per Capita Emissions
1998	1,223,431.8	12,202,305.1	12.68 tons per capita
2020 (forecast)	1,264,120.1	12,804,927.8	12.44 tons per capita

In 1998, activities within Tompkins County resulted in a total of 1,223,432 tons eCO<sub>2</sub> to be released. Transportation as a result of automobile use contributed the most, releasing a total of 645,298 tons eCO<sub>2</sub> and making up 42.7% of the total emissions. Energy consumption from commercial establishments in the form of electricity, natural gas, and heating oil, was the second largest at 22.1%, producing 270,277 tons of eCO<sub>2</sub>. The residential sector produced the third highest amount through electricity, natural gas, heating oil, and propane use at a total of 206,803 tons eCO<sub>2</sub>, or 16.9% of the County's total emissions. Methane attributed to livestock released 24,886.7 tons eCO<sub>2</sub>, or 2.0%. Due to high methane recovery factors at the landfill where solid waste from County residents and businesses is taken, emissions from solid waste generated by Tompkins County are shown to be a negative number and thus account for 0% of emissions. According to the 2000 US Census, Tompkins County had a population of 96,501. Therefore, for each person in the County, 12.68 tons eCO<sub>2</sub> is released.



An examination of greenhouse gas emissions by source reflects the domination of automobile use as the major emitter of greenhouse gas emissions in Tompkins County. Gasoline use accounts for 46.3% of emissions; when combined with diesel use, the third-largest contributor to emissions, the two fuels produce 50.9% of emissions. Of sectors where electricity was used (residential, commercial, and industrial sectors), electricity use resulted in the second-highest emissions at 38.4%. Heating oil use in the residential, commercial, and industrial sectors composed the fourth-largest source of emissions, at 3.7% of total emissions.

The per capita emissions are projected to decrease by the year 2020, due to the fact that the population of Tompkins County is forecasted to increase at a faster rate than emissions. The US Census projects the population of Tompkins County to increase to 101,587, a rise of 5.27%. Emissions, meanwhile, are forecasted to rise by 3.33%, resulting in per capita emissions of 12.44 tons eCO<sub>2</sub> per person.



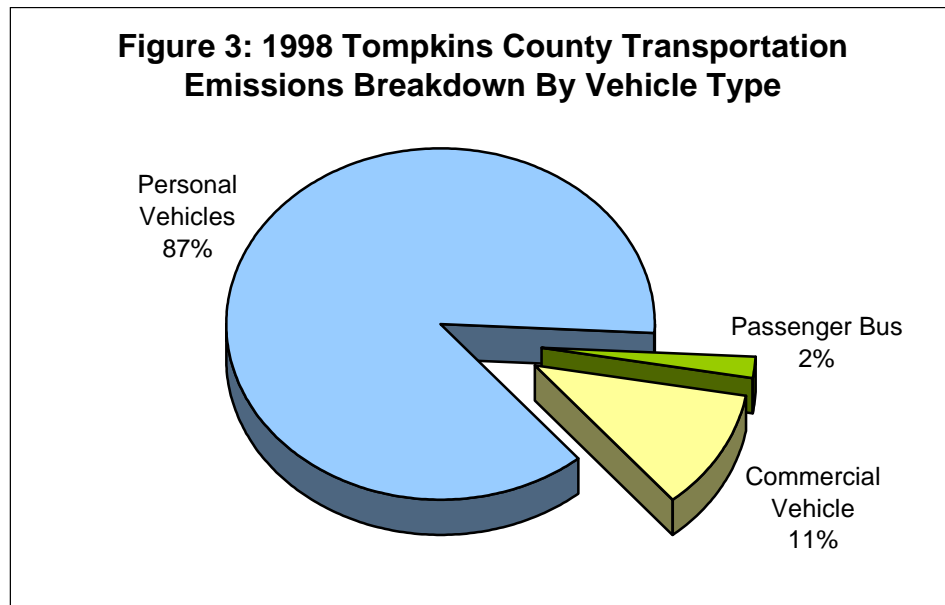
***Transportation***

Transportation and automobile use in particular recorded the highest emissions in Tompkins County on numerous levels. The transportation sector registered the highest proportion of emissions in the County at 52.7%, with 645,297 tons of eCO<sub>2</sub> in 1998. In addition, greenhouse gas emissions from the combustion of gasoline was by far the highest single source of emissions. Perhaps even more telling is the fact that transportation is the only sector in Tompkins County that is projected to increase in emissions by 2020—all other sectors report a decrease in emissions. Therefore, the

increase in community emissions from within Tompkins County borders comes solely from a 7.7% increase in automobile use.

Emissions from automobile gasoline combustion are the highest emitter of all fuels in the community inventory. Gasoline use accounts for 46.3% of emissions, releasing a total of 566,237 tons eCO<sub>2</sub>. When combined with diesel use, the two fuels produce 50.9% of emissions. The consumption of these two fuels combined is projected to increase in the 2020 forecast to 53% of total emissions. This is reflective of the increase in transportation predicted for 2020—as the number of vehicles on the roads in Tompkins County increases, the amount of fuel purchased for those vehicle follows the same trend.

High emissions from transportation is not surprising for an inventory done on a County scale as opposed to a city or town. Because the County is characterized by a central, more urban center surrounded by smaller towns and villages, vehicle use is likely to be high as residents commute to businesses and places of employment in the City of Ithaca. In addition, although public transportation within the County is extremely effective in terms of reducing single-passenger travel within the boundaries of the City of Ithaca, bus routes become less frequent towards the outskirts of the County. Taking the bus as a form of transportation to the more rural regions of Tompkins County is less convenient and therefore travel to corners of the County is more frequently done in a personal vehicle. If an inventory were to be done for the City of Ithaca, it is likely that the distribution of emissions would be radically different and transportation would not be as large a portion of total emissions as it is at the County level.

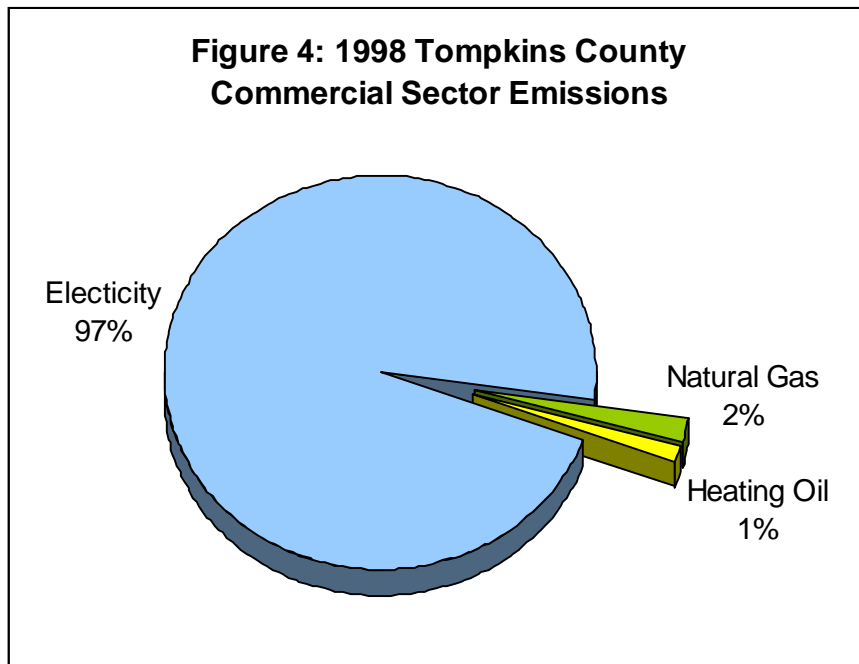


The dominance of personal automobile use as the single largest source of greenhouse gas emissions in Tompkins County presents a viable opportunity for the County to focus emissions reduction efforts on transportation patterns.

## *Commercial*

Energy use from the commercial sector comprises approximately one-fifth of all greenhouse gas emissions in the Tompkins County community and is the second-highest source of emissions, behind transportation. Activities in the commercial sector resulted in 270,277 tons of eCO<sub>2</sub> to be released. With approximately 2,100 commercial properties in the County, each commercial establishment emits 129 tons eCO<sub>2</sub> on average.

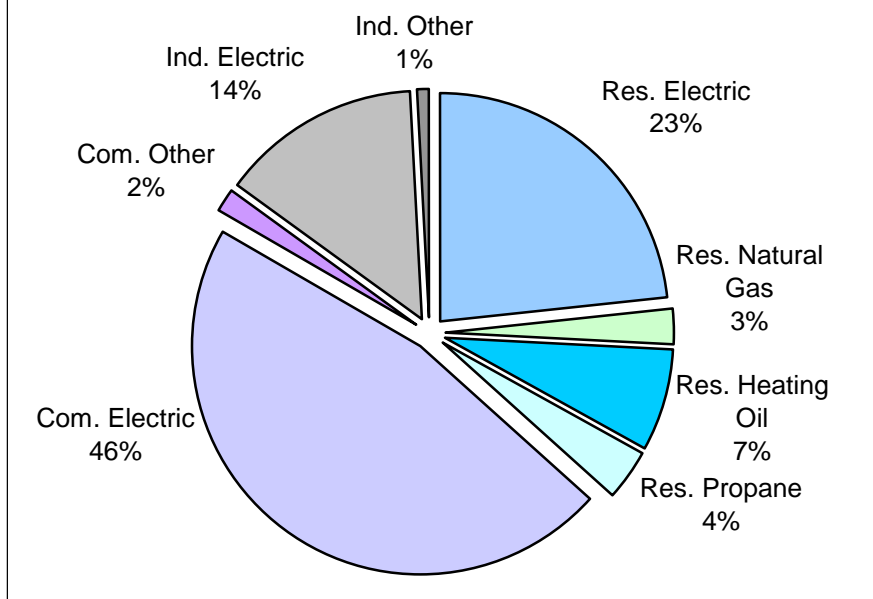
Within the commercial sector itself, electricity accounts for 97% of emissions. Natural gas makes up another 2%, while emissions from heating oil use is minute at 1.4%. Propane use was not considered a factor in the commercial sector given the low number of commercial properties reporting propane use. The low amount of heating oil and propane use is consistent with the fact that the majority of commercial properties are within the City of Ithaca where electricity and natural gas are available, making use of heating oil and propane unnecessary.



As can be seen in Figure 5, electricity use alone from the commercial sector is responsible for over a fifth of all energy use in the residential, commercial, and industrial sectors. In the community as a whole, commercial electricity use produces 21.3% of emissions, second only to gasoline use from the transportation sector. Commercial natural gas use is also the highest of that fuel use in any sector.



**Figure 5: 1998 Tompkins County Fuel Use From Residential, Commercial, and Industrial Sectors**



Data from the commercial sector is likely to be higher than expected because educational establishments were classified as a commercial enterprise. Therefore, all dorm space at Cornell University and Ithaca College are grouped in this sector. In other municipalities, the assumption of education buildings as commercial may not make a large difference in results. However, Tompkins County is home to large educational institutions (Cornell University alone has over 14.5 million square feet of building space), thus making emissions from the commercial sector appear largely enhanced. In addition, Cornell University is divided into 3 parcels, thus the entire campus within Tompkins County is only deemed three commercial properties. The same is true for Ithaca College. Therefore, energy use derived from estimates (natural gas and heating oil) from these two properties may be significantly underrepresented.

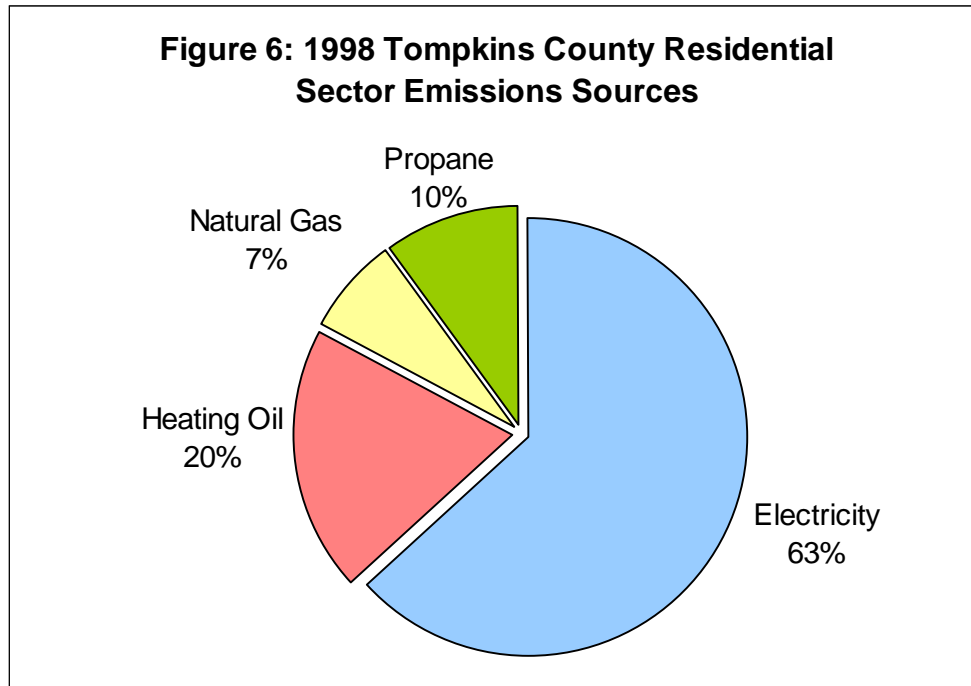
Forecasting to 2020 indicates a slight decrease in emissions from the commercial sector to 267,447 tons eCO<sub>2</sub>, a decrease on a mere 1.05% from 1998. Electricity use is projected to increase the most of all fuels, a change of 1.4%. Natural gas use is expected to increase by 0.9% with heating oil decreasing by 0.2%. Distribution of fuel use is not expected to change between the base year and the forecast year.

***Residential***

The residential energy sector was the third-largest contributor to greenhouse gas emissions with 16.9% of total community emissions, releasing 270,277 tons of eCO<sub>2</sub> in 1998. Given that there are 36,420 households in Tompkins County, each household released an average of 7.42 tons of eCO<sub>2</sub>.

Electricity use in households across the County accounted for over 60% of annual home energy use in 1998 at 247,063,922 total kWh. Natural gas, which is available to 11,433

of the 36,420 households in Tompkins County, recorded the second-highest source of emissions within the residential sector at 7.4%.



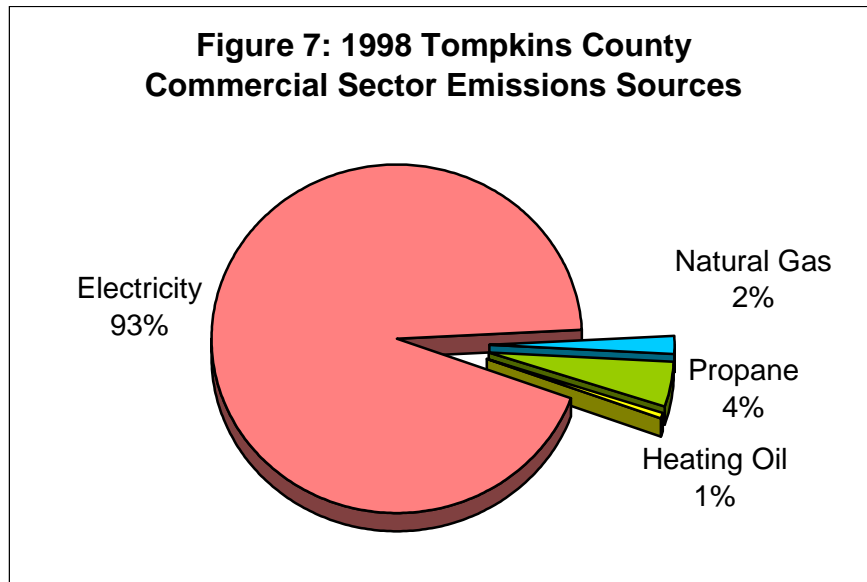
Weather is a significant factor when considering annual home energy use. According to National Weather Service data, 1998 had the fourth-warmest winter season of the century with only 5062 degree-days. (A degree-day is a unit used to measure building energy needs. It is calculated by summing of degrees in Fahrenheit each day the average temperature is below or above 65 degrees. For example, one 90-degree day equals 25 degree-days.) Thus, overall heating energy use in 1998 can be expected to be slightly lower than surrounding years. The summer of 1998 was of average degree-days, therefore no change can be anticipated in terms of abnormal energy use with regards to cooling.

The U.S. Department of Energy predicts that in 2020, electricity use will rise by 1.3% and natural gas use by 0.6%. Heating oil consumption will likely drop by 0.8% and propane use is expected to decrease by 2.1% as more residences switch to using natural gas. This will only slightly alter the picture of energy consumption in households, as electricity use will account for a slightly higher percentage than in 1998 at 54% and propane will increase to make up 8%. Overall, however, the greenhouse gas emissions from the residential sector are projected to fall from in 2020 to 204,574, a decrease of 1.08% from 1998.

### ***Industrial***

Tompkins County is not considered to be an area of high industry, though 6.9% of total community emissions can be attributed to the industrial sector. In all, there are 55 properties in the County that are classified as manufacturing and processing facilities.

These 55 establishments released a total of 84,918 tons of eCO<sub>2</sub> in 1998, an average of 1,544 tons of eCO<sub>2</sub> per industrial property.



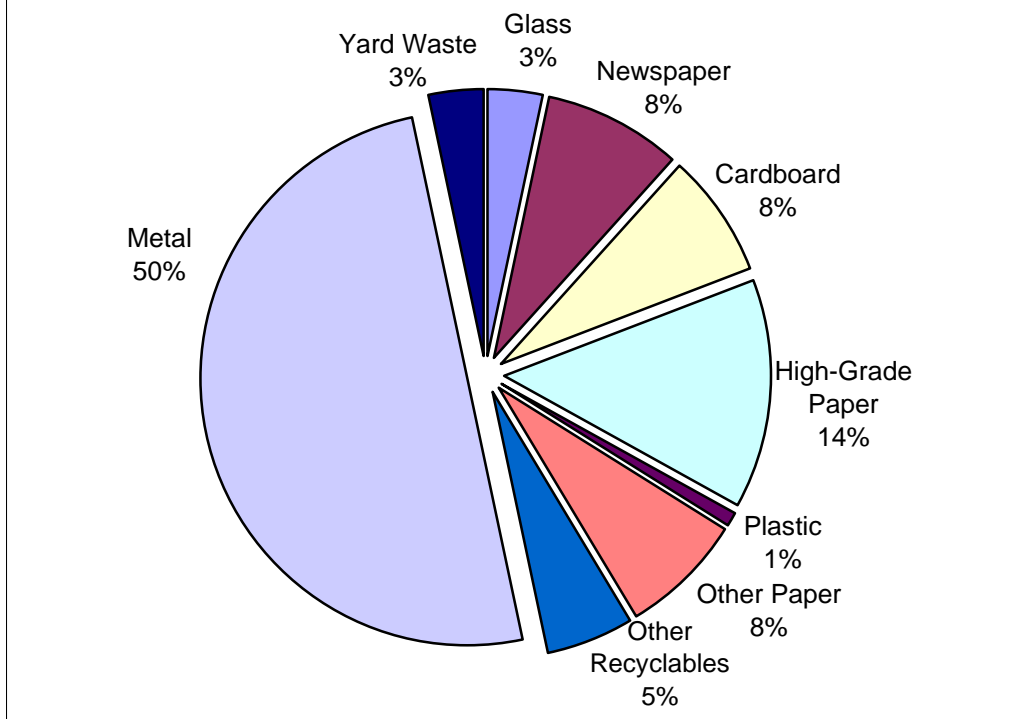
Much like the commercial and residential sectors, where electricity overwhelmingly dominated the emissions by fuel type, electricity use in the industrial sector accounts for 93% of emissions, as can be seen in Figure 7. Heating oil, natural gas, and propane combine to account for the remaining 7% of the total emissions from the industrial sector, with propane claiming 4% of that. The high use of propane compared to natural gas is indicative of the fact that numerous industrial properties are located outside the City of Ithaca where it becomes necessary to use heating oil as the primary heating fuel. Because industrial facilities are generally large in size, especially when compared to residential or commercial properties, a considerable amount of propane may be required.

As with the community forecast as a whole, emissions from the industrial are projected to decrease in 2020 to 83,911 tons of eCO<sub>2</sub>. This is a slight decrease of 1.2% from 1998. Emissions from electricity and natural gas register a decrease, while heating oil and propane show slight increases in emissions.

### ***Solid Waste***

Results from the waste sector of the community inventory is encouraging, presumably thanks to the success of mandatory curbside recycling of certain materials as well as the garbage hauling fees instituted by the County prior to the baseline year. In 1998, 106,555 tons of waste was generated from Tompkins County. Of that amount, 42%, or 45,007 tons were recycled and the remainder, 61,548 tons of solid waste, was taken to Seneca Meadows Landfill in Waterloo, New York. If the amount that had been recycled had instead been sent to a typical landfill with no methane recovery, the County would have been responsible for an additional 100,248 tons of eCO<sub>2</sub>.

**Figure 8: Composition of Recycled Materials in Tompkins County, 1998**



Waste contributes to greenhouse gas emissions through the release of methane gas as the waste decomposes in a landfill. At Seneca Meadows Landfill, recovery of that methane is performed, thus capturing the methane emitted from that waste for use as energy in the Waterloo area. Methane recovery at the landfill in 1998 was approximately 70%, yet the total emissions from waste is -8,751 tons eCO<sub>2</sub>. The science behind this negative number is important in understanding the importance of methane recovery and what a negative number means.

Landfills have two effects: The first is that because the trash is packed on top of itself, there isn't oxygen available. As a result, much of the trash decays anaerobically, becoming methane rather than carbon dioxide. In essence, there is the same amount of carbon, but more global warming because methane is a much more potent greenhouse gas than carbon.

The second effect is that, because the trash is packed on top of itself, some of the trash is so deeply compacted that it never decays at all, even after extremely long periods of time. The perspective of the Environmental Protection Agency on this phenomena is that to a certain extent landfills "sequester" carbon. Therefore, if landfill methane recovery rate is high it may be taking away most of the carbon leaking out from entering the atmosphere at all, either as methane or carbon dioxide, so in effect there is a net decrease in eCO<sub>2</sub>.

This result must be examined with a great deal of consideration. The fact that emissions from waste are a negative does not imply that County should encourage its residents to

produce more waste, thus placing waste numbers further in the negatives. Nor should it be an indication that emissions can be “made up” by further engaging in activities that further produce emissions. Negative waste numbers do not reflect the fact that production of new materials requires energy and an increase in emission-causing processes.

Solid waste going to landfill is projected to increase in 2020 to 68,872 tons, an increase of 11.9% from the baseline year of 1998, largely a result of increases in the population. This increase will produce total emissions of -9,792 tons of eCO<sub>2</sub>. This projection takes into account anticipated increases in recycling by residents and expansion of recycling programs by the County.

### ***Agriculture***

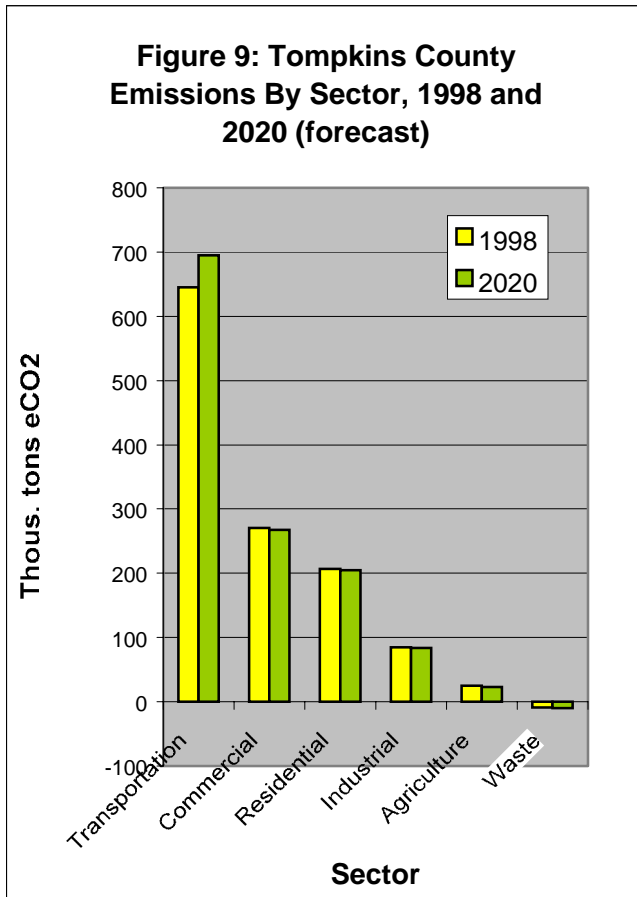
Livestock animals such as beef cows, dairy cows, goats, horses, sheep, lambs, and swine, release methane as a byproduct of the production of biological waste. The amount of methane depends largely on the diet and size of the animal. Due in part to the fact that methane is an extremely potent greenhouse gas and land use in the County is largely for agricultural purposes, methane from livestock accounts for 24,887 tons eCO<sub>2</sub>, or 2% of total community emissions.

Type of Livestock	Number in Tompkins County	Emission Factor (kg methane/head/year)	Total Emissions (tons methane/year)
Beef Cows	1,171	83	107.14
Dairy Cows	8,679	109	1,042.79
Goats	23	5	0.13
Horses	859	18	17.04
Sheep and Lambs	1,992	8	17.57
Swine	263	1.5	0.43
Total	12,987		1,185.10

The agricultural sector in Tompkins County is projected to decrease in 2020 and, as a result, the number of livestock will also be reduced. In 2020, emissions will lower to an estimated 22,995 tons eCO<sub>2</sub> and only be responsible for 1.8% of community emissions.

### ***2020 Projections***

Emissions from the Tompkins County community are expected to increase to 1,264,120.1 tons eCO<sub>2</sub> in the year 2020, an increase of 3.33% from 1998. The per capita emissions are projected to decrease, due to the fact that the population of Tompkins County is forecasted to increase at a faster rate than emissions. The US Census projects the population of Tompkins County to increase to 101,587, a rise of 5.27%. Emissions, meanwhile, are forecasted to rise by only 3.33%, resulting in per capita emissions of 12.44 tons eCO<sub>2</sub> per person.



The only sector in Tompkins County that is projected to increase in emissions by 2020 is the transportation sector—all other sectors report a decrease in emissions. Therefore, the 3.33% increase in community emissions from within Tompkins County borders between 1998 and 2020 comes solely from a 7.7% increase in automobile use. The waste sector registers the largest change, positive or negative, from any sector with a decrease of 11.9% eCO<sub>2</sub> from 1998 to 2020. The agricultural sector, although not a major contributor to greenhouse gas emissions in 1998, is expected to decline in 2020 by 7.6%. The commercial, residential, and industrial sectors also show predicted decreases in emissions by 1.05%, 1.08%, and 1.19% respectively.

Because transportation is predicted to increase steadily over the next 20 years, it provides a distinct and unique opportunity for the County to move toward reduction in this sector.

### *CCP Community Comparison*

Of the 75 communities in the United States that have joined the Cities for Climate Protection Campaign and have conducted greenhouse gas emissions inventory, 15 representative communities are listed below. Direct comparison between communities must be done with caution and conclusion should not be made without consideration to factor specific to individual communities. There are numerous assumptions and conditions specific to each municipality that greatly influence the final emissions count. For example, solid waste is incinerated in some communities, thus producing no emissions, while others mount waste in landfills with no methane recovery, resulting in thousands of tons of eCO<sub>2</sub> attributed to that community. In addition, drawing conclusions between an inventory done at the County level and one done for a city or town may not be accurate.

<b>City, Town or County</b>	<b>Population</b>	<b>Total Community Emissions</b>	<b>Per Capita Emissions</b>	<b>Baseline Year for Inventory</b>
August, ME	18,553	349,552	18.8	2000
Brookline, MA	54,718	626,512	11.4	1995
Burlington, VT	39,127	438,931	11.2	1990
Fort Collins, CO	87,758	1,673,861	19.1	1990
Glouster, MA	29,758	351,908	11.8	1998
Medford, MA	57,400	696,112	12.1	1995
New Haven, CT	123,626	2,026,201	16.4	1999
New Rochelle, NY	72,182	985,112	13.6	2000
Newton, MA	82,585	1,973,540	23.9	1990
Santa Cruz, CA	54,575	747,679	13.7	1990
Santa Fe, NM	55,859	1,418,819	25.4	1990
Saratoga Springs, NY	26,186	422,445	16.1	2000
Suffolk County, NY	1,419,420	35,500,392	25.0	2000
Tompkins County, NY	96,501	1,223,432	12.7	1998
Watertown, MA	33,284	695,675	20.9	1999

# Government Operations Emissions Inventory Results

## *Total Greenhouse Gas Emissions*

Year	Total eCO <sub>2</sub> (tons)	Energy Use (BTU)	Per Employee eCO <sub>2</sub> (tons)
1998	6,849	72,232.0	95
2020 (forecast)	6,981	77,536.8	102

In 1998, activities associated with the operation of government of Tompkins County resulted in a total of 6,849 tons eCO<sub>2</sub> to be released. Electricity and natural gas use as a result of maintaining County-owned buildings contributed the most, releasing a total of 6,113 tons eCO<sub>2</sub> and making up 89.3% of the total government emissions. Gasoline and diesel use from County vehicles second largest contributor of emissions at 11.0%, producing 752 tons of eCO<sub>2</sub>. Emissions of eCO<sub>2</sub> from outdoor lighting associated with buildings and facilities operated by the County accounted for a fraction of total emissions, though still produced 8 tons of eCO<sub>2</sub>, or 0.1% of total government emissions. Due to high methane recovery factors at the landfill where all waste from Tompkins County is taken, emissions from waste generated by government are shown to be a negative number and thus account for 0% of emissions. Greenhouse gas emissions as a result of the Tompkins County government operations equal 0.5% of the total emissions in the County as a whole.

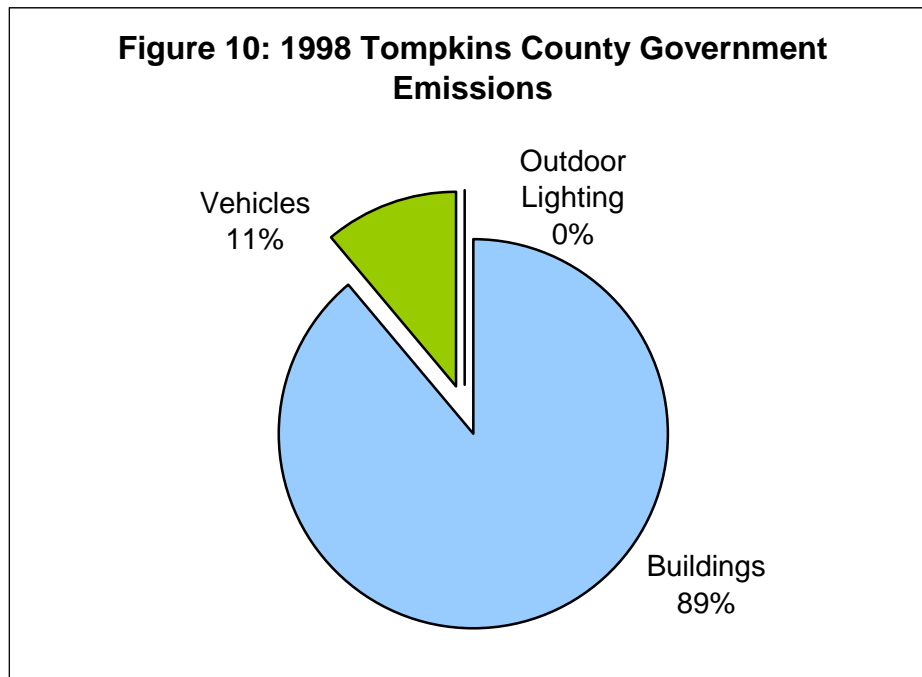
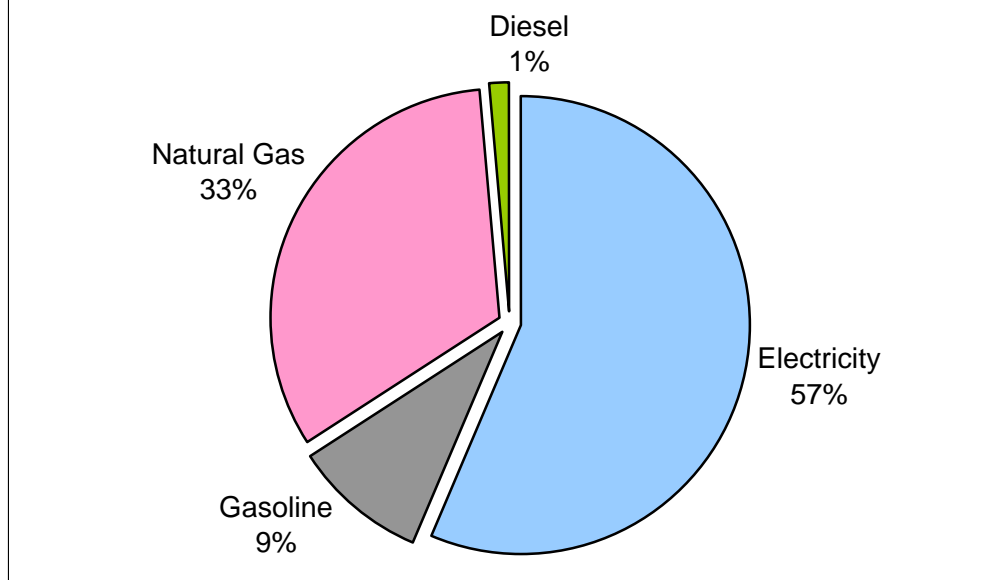




Figure 11: 1998 Tompkins County Government Emissions By Energy Source



Tompkins County employed a total of 760 people in 1998. Therefore, for each employee of County government was responsible for an average of 95 tons eCO<sub>2</sub> in 1998. The emissions per employee are projected to increase, as the number of buildings under the authority of the County increases slightly and the number of employees remains constant. Emissions produced by the County government are projected to increase by 1.9% in 2020 to a total of 77537 tons eCO<sub>2</sub>. Emissions per employee will rise to 102 tons eCO<sub>2</sub> per worker.

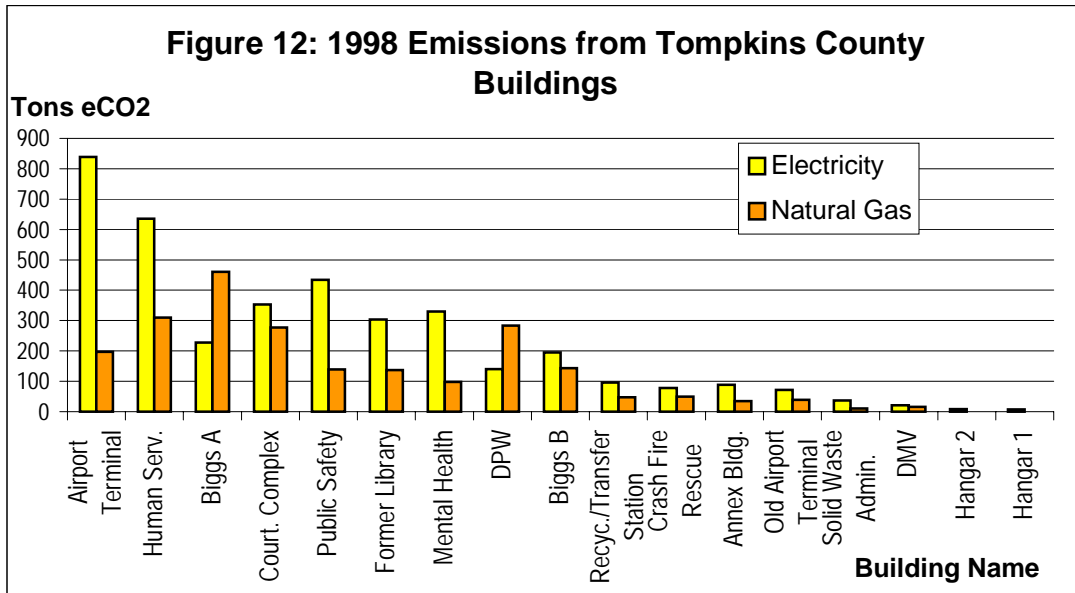
### ***Buildings***

The County's buildings are both the largest and the fastest growing contributor to greenhouse gas emissions within the government inventory. Collectively, energy use from Tompkins County government buildings resulted in 89.3% of emissions and producing 6,113 tons of eCO<sub>2</sub>. In addition, providing electricity and natural gas to its buildings cost the County \$1,086,814 in 1998 and is expected to rise in 2020.

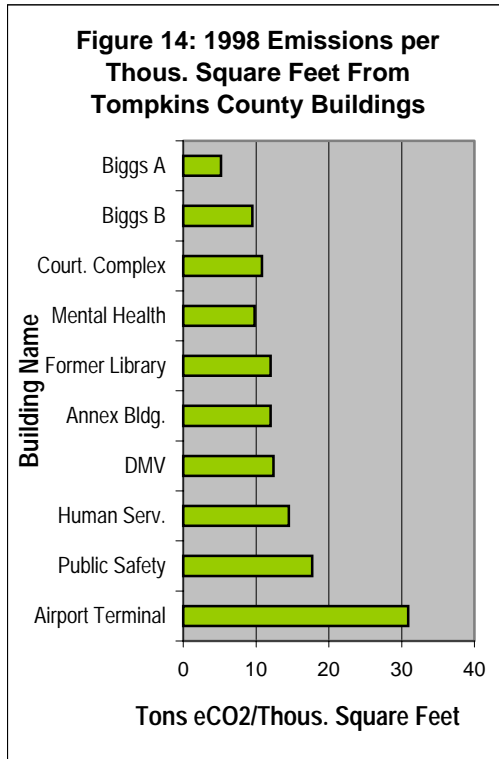
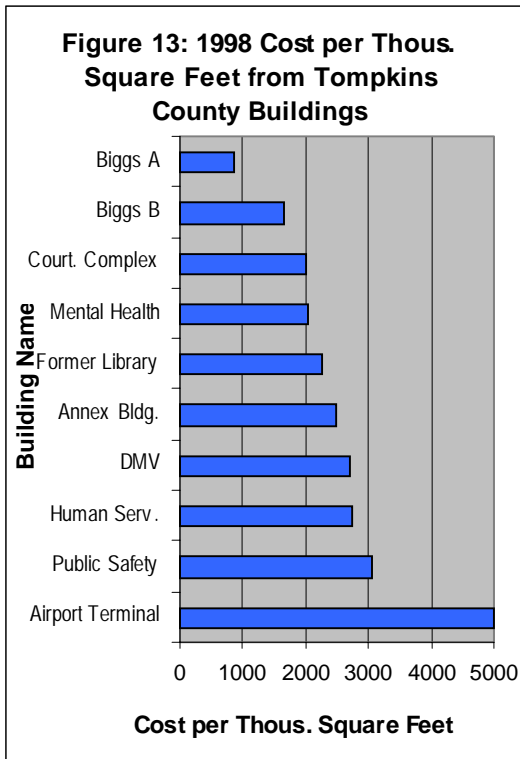
Energy consumption at the airport terminal at the Ithaca Tompkins Regional Airport was the largest single contributor to greenhouse gas emissions in 1998. When accounting for the area of the building, the airport terminal was also the largest emitter on a per square foot basis. Electricity use alone at this facility was responsible for 12.3% of the total County government emissions. As a result of such high energy use, the airport terminal was also the most expensive to operate, as a total of \$164,635 was spent in 1998, an average of \$4,989 per thousand square feet.

Although the Human Services Building was the second-highest overall emitter of greenhouse gases, it was the Public Safety Building that emerged as the second-highest highest emitter when building area was taken into consideration. In 1998, the Public

Safety Building emitted a total of 573 tons of eCO<sub>2</sub> at a cost of \$98,263 to Tompkins County government. Once divided by the area of the building, the Public Safety Building is responsible for 17.9 tons of eCO<sub>2</sub> and a cost of \$3,070 per thousand square feet.



The Human Services Building, though only a year old at the time of the baseline year, was also one of the top emitters per square foot at 14.6 tons eCO<sub>2</sub> and costing \$2,724 annually per thousand square feet.

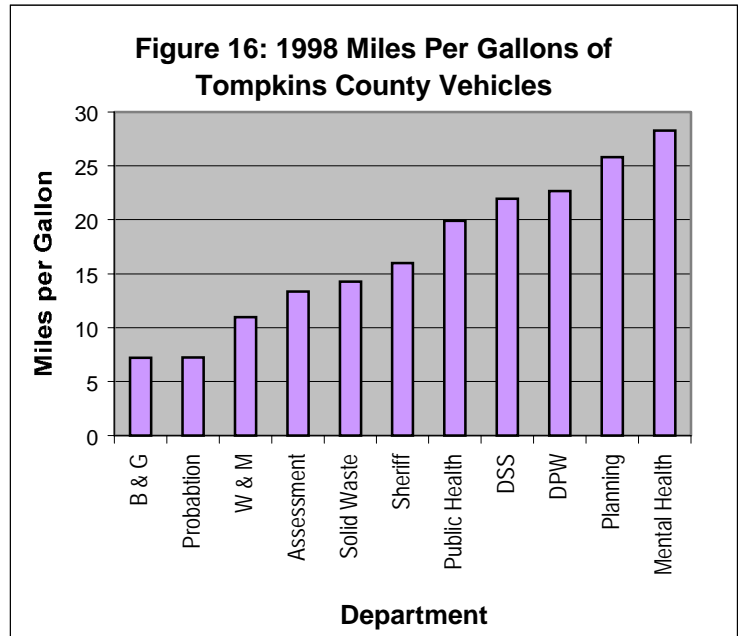


It is important to note that taking into consideration the square footage of a building does not account for many other factors that cannot be quantified when comparing the energy efficiency of facilities. The operations performed at a given building may play a large role in the energy use at a site. In addition, there are instances, such as the Courthouse Complex, where utility bills for many buildings are grouped together, making comparisons of energy use from one building to another virtually impossible.

Tompkins County government officials have already begun to improve energy efficiency at County buildings, as evidenced by the addition in of a solar rooftop photovoltaic system on the new Tompkins County Library in 2001. The site of the new library is the only facility that was added to the 2020 forecast for County government operations. Though the addition of this building increases emissions by 1.9% to 2,981 tons of eCO<sub>2</sub> in 2020, this projection is calculated without the addition of the solar panels and associated reduction in eCO<sub>2</sub>. Therefore, it is likely that in 20 years emissions will be significantly lower than projected.

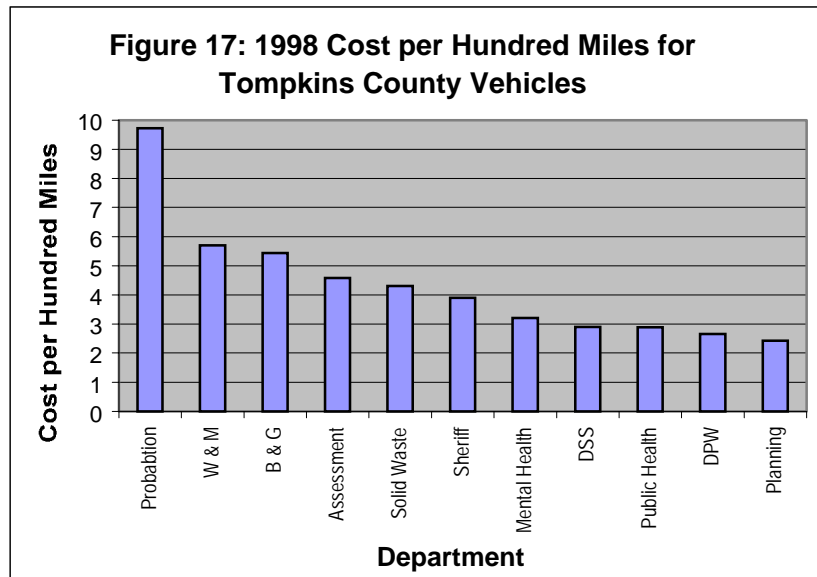
***Vehicle Fleet***

County vehicles consumed a total of 62,201 gallons of unleaded fuel and 8,837 gallons of diesel fuel in 1998 resulting in the production of 752 tons of eCO<sub>2</sub>. The County spent a total of \$41,570 in 1998 on fuel. Fuel efficiency of vehicles is closely tied to the amount of emissions produced—the more fuel combusted, the greater the production of greenhouse gases.



Of the 122 vehicles owned and operated by the County, the Public Health Department drove 36 and that is responsible for 116 tons of eCO<sub>2</sub>. It is more telling, however, to examine fuel efficiency and cost per vehicle mile. The top three departments with the

lowest average fuel efficiency per vehicle are the same three found at the top of the cost graph at left. The Buildings and Grounds and Probation Departments both show average miles per gallon to be 7.2, Weights and Measures with 10.9. The cost per hundred miles, however, is highest for the vehicles in the probation department, at \$9.70 per hundred miles. Beyond the top three in fuel efficiency and cost, the order of departments are nearly mirror images from one graph to another.



Generally speaking, the newer the vehicle, the more fuel efficient the vehicle is. It is not surprising, therefore, that the vehicles used by the Probation, Weights and Measures, and Buildings and Grounds have the oldest vehicles in the fleet, some dating to 1985. Therefore, although purchasing new vehicles may cost a fair amount of initial capital, it may save money and fuel in the long run.

***Outdoor Lighting***

There are only two units of outdoor lighting controlled by the County; one group found at the Ithaca Tompkins Regional Airport, the other outside the County Courthouse. Both components use electricity and cost the County \$11,663 in 1998. Combined, the two lighting devices produce 8 tons of eCO<sub>2</sub> and account for only 0.1% of government emissions.

***Solid Waste***

It is estimated that in 1998, 230 tons of waste was generated from Tompkins County government offices. Of that amount, 42% was recycled and the remainder, 163 tons of solid waste, was taken to Seneca Meadows Landfill in Waterloo, New York.

Waste contributes to greenhouse gas emissions through the release of methane gas as the waste decomposes in a landfill. At Seneca Meadows Landfill, recovery of that methane is performed, thus capturing the methane emitted from that waste for use as energy in the Waterloo area. Methane recovery at the landfill in 1998 was approximately 70%, yet the

total emissions from waste are -8,751 tons eCO<sub>2</sub>. The science behind this negative number is important in understanding the importance of methane recovery and what a negative number means.

Landfills have two effects: The first is that because the trash is packed on top of itself, there isn't oxygen available. As a result, thus much of the trash decays anaerobically, becoming methane rather than carbon dioxide. In essence, there is the same amount of carbon, but more global warming because methane is a much more potent greenhouse gas than carbon.

The second effect is that, because the trash is packed on top of itself, some of the trash is so deeply compacted that it never decays at all, even after extremely long periods of time. The perspective of the Environmental Protection Agency on this phenomena is that to a certain extent landfills "sequester" carbon. Therefore, if landfill methane recovery rate is high it may be taking away most of the carbon leaking out from entering the atmosphere at all, either as methane or carbon dioxide, so in effect there is a net decrease in eCO<sub>2</sub>.

This result must be examined with a great deal of consideration. The fact that emissions from waste are a negative does not imply that County should encourage its residents to produce more waste, thus placing waste numbers further in the negatives. Nor should it be an indication that emissions can be "made up" by further engaging in activities that further produce emissions. Negative waste numbers do not reflect the fact that production of new materials requires energy and an increase in emission-causing processes.

## Conclusion

---

### *Community Inventory*

Tompkins County produced a total of 1,223,432 tons eCO<sub>2</sub> in 1998, or 12.68 tons eCO<sub>2</sub> per capita. Transportation (includes personal and commercial vehicles) was by far the largest contributor to emissions, as it accounted for 52.7% of the total. Commercial energy consumption (includes electricity, natural gas, and heating oil use) resulted in another 22.1% of emissions. Data from the commercial sector is likely to be higher than expected because educational establishments were classified as a commercial enterprise. Tompkins County is home to large educational institutions (Cornell University alone has over 14.5 million square feet of building space), thus making emissions from the commercial sector appear largely enhanced. The two largest sources of emissions came from gasoline and electricity, in that order. These sources combined accounted for 84.7% of emissions in 1998. In 2020, community emissions are forecasted to rise to 1,264,120 tons eCO<sub>2</sub>, an increase of 3.33% from 1998. This projected increase comes exclusively from a 7.7% increase in emissions as a result of automobile use. Due to the fact that the population in Tompkins County is increasing at a faster rate than emissions, per capita emissions are projected to decrease to 12.44 tons in 2020.

Greenhouse gas emissions are likely highest from the transportation sector for numerous reasons. Although Tompkins County has a vast public bus system, the concentration of the route is in the more urban areas of the County, closer to the City of Ithaca. Taking the bus as a form of transportation to the more rural regions of Tompkins County is less convenient and therefore travel to corners of the County is more frequently done in a personal vehicle. If an inventory were to be done for the City of Ithaca, it is likely that the distribution of emissions would be radically different and transportation would not be as large a portion of total emissions as it is at the County level. The dominance of personal automobile use as the single largest source of greenhouse gas emissions in Tompkins County presents a viable opportunity for the County to focus emissions reduction efforts on transportation patterns.

Electricity consumption dominated the emissions by fuel type in the residential, commercial, and industrial sectors. Electricity use from these areas resulted in 38.4% of total emissions in Tompkins County. This data presents a viable opportunity for electricity users in all sectors to move to ultra-efficient lighting systems, timed lights, and energy-saving appliances. It is likely that small shifts in everyday practices could lead to a significant reduction in electricity use in Tompkins County.

Results from the waste sector of the community inventory is encouraging, presumably thanks to the success of mandatory curbside recycling of certain materials as well as the garbage hauling fees instituted by the County prior to the baseline year. In 1998, 106,555 tons of waste was generated from Tompkins County. Of that amount, 42%, or 45,007 tons were recycled and the remainder, 61,548 tons of solid waste, was taken to Seneca Meadows Landfill in Waterloo, New York. If the amount that had been recycled had

instead been sent to a typical landfill with no methane recovery, the County would have been responsible for an additional 100,248 tons of eCO<sub>2</sub>. The importance of the continuation and expansion of curbside recycling as a method of reducing greenhouse gas emissions is evident from success of the program in 1998.

### ***Government Operation Inventory***

In 1998, Tompkins County government operations generated 6,849 tons of eCO<sub>2</sub>, with the overwhelming majority of those emissions coming as a result of building energy use. The energy source responsible for the greatest percentage of emissions was electricity use in County-owned buildings, which accounted for 56.7%. Natural gas consumption resulted in another 32.8%. Emissions from the County vehicle fleet created 752 tons of eCO<sub>2</sub>, or 11% of emissions. Tompkins County government spent a total of \$1,140,047 on energy in 1998, 95% of which went to building energy consumption. Government operations made up 0.5% of total community emissions in the baseline year. The forecast for 2020 expects emissions to rise to 6,981 tons of eCO<sub>2</sub> as a result of expanding facilities, an increase of 1.9%

Energy consumption at the airport terminal at the Ithaca Tompkins Regional Airport was the largest single contributor to greenhouse gas emissions in the government operation inventory in 1998. When accounting for the area of the building, the airport terminal was also the largest emitter on a per square foot basis. Electricity use alone at this facility was responsible for 12.3% of the total County government emissions. As a result of such high energy use, the airport terminal was also the most expensive for the County operate, as a total of \$164,635 was spent in 1998, an average of \$4,989 per thousand square feet.

Although the Human Services Building was the second-highest overall emitter of greenhouse gases, it was the Public Safety Building that emerged as the highest emitter when building area was taken into consideration. In 1998, the Public Safety Building emitted a total of 573 tons of eCO<sub>2</sub> at a cost of \$98,263 to Tompkins County government. Once divided by the area of the building, the Public Safety Building is responsible for 17.9 tons of eCO<sub>2</sub> and a cost of \$3,070 per thousand square feet.

County vehicle use accounted for only 11% of emission from the government operation inventory, consuming a total of 62,201 gallons of unleaded fuel and 8,837 gallons diesel fuel in 1998. The County spent a total of \$41,570 in 1998 on unleaded and diesel fuel combined. Vehicles in the Buildings and Grounds Department showed the lowest fuel efficiency of all County departments at 7.2 miles per gallon.

Generally speaking, the newer the vehicle, the more fuel efficient the vehicle is. It is not surprising, therefore, that the vehicles used by the Probation, Weights and Measures, and Buildings and Grounds have the oldest vehicles in the fleet, some dating to 1985. Therefore, although purchasing new vehicles may cost a fair amount of initial capital, it may save money and fuel in the long run.

## Glossary of Terms

---

**Baseline Year:** The year for which the CCP member conducts their emissions inventory. For Tompkins County, the baseline year is 1998.

**Carbon Dioxide:** Also called CO<sub>2</sub>, carbon dioxide is essential to living systems and is released by animal respiration, decay of organic matter, and fossil fuel burning. It is removed from the atmosphere by photosynthesis in green plants. The amount of CO<sub>2</sub> in the atmosphere has increased by about 25% since the burning of coal and oil began on a large scale.

**Chlorofluorocarbons:** Also called CFCs, chlorofluorocarbons are carbon compounds that also contain some chlorine and some fluorine. CFCs do not occur naturally: they are synthetic products used in various industrial processes and also as propellant gas for sprays. CFCs are typically used in refrigerants, solvents, foam-makers, and for use in aerosol sprays. CFCs are significant contributors to ozone depletion and also contribute to global warming.

**Cities for Climate Protection:** A campaign of the International Council for Local Environmental Initiatives (ICLEI), CCP is a performance-oriented campaign that offers a framework for local governments to develop a strategic agenda to reduce global warming and air pollution emissions, with the benefit of improving community livability. Over 400 local governments are participating in the Campaign representing 8% of global greenhouse gas emissions.

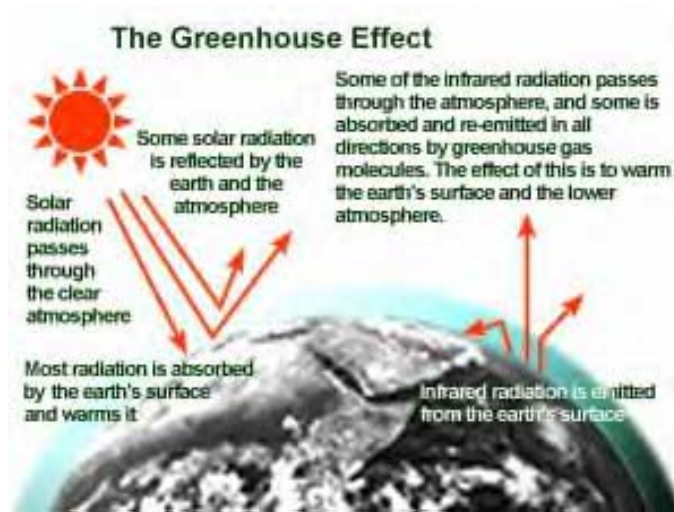
**Cities for Climate Protection Greenhouse Gas Emissions Software:** Developed by Torrie Smith Associates for the Cities for Climate Protection members, the computer software makes it easier for local governments to analyze and organize data from a community and from the local government operations. The software translates data on energy use and solid waste information into greenhouse gas emissions and quantifies the greenhouse gas emissions reduction of potential programs and actions. More information on specific uses of the software can be found in the Cities for Climate Protection Toolkit.

**Equivalent Carbon Dioxide (eCO<sub>2</sub>):** Also known as global warming potential (GWP) weighted greenhouse gas emissions, eCO<sub>2</sub> is a unit that allows emissions of greenhouse gases of different strengths to be added together. For carbon itself, emissions in tons of CO<sub>2</sub> and tons of eCO<sub>2</sub> are the same thing, whereas for methane, an example of a stronger greenhouse gas, one ton of methane emissions has the same GWP as 21 tons of CO<sub>2</sub>. Thus 1 ton of methane emissions can be expressed as 21 tons of eCO<sub>2</sub>.

**Greenhouse Effect:** The Earth's climate is determined by a delicate balance between the solar energy that arrives from space and the heat energy that the earth creates from the sun's rays. Atmospheric greenhouse gases such as water vapor, carbon dioxide, methane, and nitrous oxide naturally present in the atmosphere in small amounts trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse and



heating the earth. The earth normally stays at a constant temperature by shedding heat into space at the same rate it absorbs the energy from the sun. This process is depicted in the diagram below.



However, problems arise when the atmospheric concentration of greenhouse gases increases and upsets the equilibrium of these gases naturally present in the atmosphere. Therefore, the greenhouse effect refers to the increasing warming of the earth because of gases in the atmosphere that trap the sun's energy on earth. In other words, the sun's energy passes through to the earth, but more energy than usual is prevented from escaping back into space. This energy remains trapped on earth and gradually warms the earth beyond its normal temperature.

**International Council for Local Environmental Initiatives (ICLEI):** The international environmental agency for local governments. Its mission is to build and serve a worldwide movement of local governments to achieve tangible improvements in global environmental and sustainable development conditions through cumulative local actions. ICLEI serves as an information clearinghouse on sustainable development by providing policy guidance, training and technical assistance, and consultancy services to increase local governments' capacity to address global challenges. The Cities for Climate Protection Campaign is one of several ICLEI programs.

**Kyoto Protocol:** Adopted by consensus at the third session of the Conference of the Parties (COP-3) in December 1997 in Kyoto, Japan. When ratified by a certain percentage of participating countries, it contains legally binding emissions targets for developed countries in the post-2000 period. In the Protocol, developed countries commit themselves to reducing their collective emissions of six key greenhouse gases by at least 5%. In July 2001, international climate change negotiators meeting in Bonn, Germany, and reached an agreement on most of the key political issues relating to implementation of the Kyoto Protocol. All countries except the United States, which has announced that it does not intend to ratify the Protocol, hailed the agreement as a major breakthrough.

**Methane:** Also called CH<sub>4</sub>, methane is produced by anaerobic decomposition of solid waste in landfills and sewage treatment facilities, wetlands, and as a byproduct of fossil fuel energy production and transport and also from outgassing of livestock. It is also the principle constituent of natural gas and can leak from natural gas production and distribution systems and is emitted in the process of coal production.

**Ozone:** An ozone molecule consists of three atoms of oxygen. In contrast, the normal oxygen in the atmosphere exists as a molecule with two atoms of oxygen. Ozone is much more reactive than oxygen and is toxic to human beings and living matter. At ground level it forms smog and causes damage to forests and humans. Ground level ozone formation is closely connected to climate change since the sources of emissions that cause it such as motor vehicle use and fossil fuel power plants, are also global warming pollutants. Additionally, the formation of ground level ozone requires not only pollutants but also heat and sunlight—As regions get hotter due to global warming, ozone smog increases. High ozone levels often occur during the warm summer months, especially in the afternoon once sunlight has had the chance to “cook” exhaust fumes from peak morning traffic.

## Appendix A: General Inventory Contacts

---

***Cities for Climate  
Protection (CCP):***

International Council for Local Environmental Initiatives  
U.S. Office  
15 Shattuck Square, Suite 215  
Berkeley, CA 94704  
510-540-8843  
iclei\_usa@iclei.org  
<http://www.iclei.org>

***CCP Greenhouse Gas  
Emissions Software:***

Torrie Smith Associates, Inc.  
95 Beach Street, Unit 108  
Ottawa, Ontario, K1S 3J7, Canada  
613-238-3045  
info@torriesmith.com  
<http://www.torriesmith.com>

## Appendix B: Community Inventory Data Sources and Contacts

---

<b><i>Residential, Commercial, Industrial Electricity:</i></b>	New York State Electric and Gas (NYSEG) Corporate General Office Ithaca/Dryden Rd. Etna, NY 13062 607-347-4131
<b><i>Residential Natural Gas, Heating Oil, and Propane:</i></b>	Energy Information Administration, U.S. Department of Energy (1997). <i>1997 Residential Energy Consumption Survey</i> . Retrieved 6/14/01. Available on the Internet at <a href="http://www.eia.doe.gov/emeu/recs/">http://www.eia.doe.gov/emeu/recs/</a>  Tompkins County Assessment Department Jay Franklin 607-574-5517
<b><i>Commercial Natural Gas, Heating Oil, and Propane:</i></b>	Energy Information Administration, U.S. Department of Energy (1995). <i>Commercial Buildings Energy Consumption and Expenditures, 1995</i> . Retrieved 7/12/01. Available on the Internet at <a href="http://www.eia.doe.gov/emeu/cbecs/ce951b.html">http://www.eia.doe.gov/emeu/cbecs/ce951b.html</a>
<b><i>Industrial Natural Gas, Heating Oil, and Propane:</i></b>	Energy Information Administration, U.S. Department of Energy (1997). <i>Manufacturing Consumption of Energy 1994</i> . Retrieved 7/12/01. Available on the Internet at <a href="http://www.eia.doe.gov/mecs">http://www.eia.doe.gov/mecs</a>
<b><i>Projections, Residential, Commercial, Industrial, Sectors, All Fuel Types:</i></b>	Energy Information Administration, U.S. Department of Energy (2000). <i>Annual Energy Outlook 2001, With Projections to 2020</i> . Retrieved 7/5/01. Available on the Internet at <a href="http://www.eia.doe.gov/oiaf/aeo/">http://www.eia.doe.gov/oiaf/aeo/</a>
<b><i>Transportation:</i></b>	Ithaca-Tompkins County Transportation Council Kim Triggs 607-274-5570
<b><i>Waste:</i></b>	New York State Department of Environmental Conservation, Division of Solid & Hazardous Materials (1999). <i>New York State Recycling Bulletin 1999 Edition</i> . Retrieved 6/28/01. Available on the Internet at <a href="http://www.dec.state.ny.us/website.dshh.redrecy/bulletin.html">http://www.dec.state.ny.us/website.dshh.redrecy/bulletin.html</a>

Tompkins County Solid Waste Management Program  
Ken Thompson  
607-273-6632

Seneca Meadows Landfill  
Gary D'Amico  
1786 Salcman Road  
Waterloo, NY 13165  
315-539-8049

***Agriculture:***

National Agriculture Statistics Service, U.S. Department of Agriculture (1997). *1997 Census of Agriculture, New York State and County Data*. Retrieved 7/23/01. Available on the Internet at <http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm>

United States Environmental Protection Agency (2001). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1999, Appendix J*. Retrieved 7/24/01. Available on the Internet at <http://www.epa.gov/globalwarming/publications/emissions/us2001/index.html>

## Appendix C: Government Inventory Data Sources and Contacts

---

<b><i>Buildings:</i></b>	Arel Lemaro	Buildings and Grounds Dep.	274-0355
	Roxan Noble	Airport	257-0456
	Michelle Eighmey	Highway Dept.	274-0315
	Susan Dence	Solid Waste	273-6632
	Kathy Snyder	Waste Management, Inc. 4545 Morgan Place Liverpool, NY 13090	
	Jay Franklin	Assessment Dept.	274-5517
<b><i>Vehicle Fleets:</i></b>	Kathy Smithers	Administration	274-5551
	Roxan Noble	Airport	257-0456
	Peter Meskill	Sheriff	257-1345
	Lynn Watros	Sheriff	257-1345
	Wendy Morgan	Andree Petroleum	
<b><i>Street Lights:</i></b>	Arel Lemaro	Buildings and Grounds Dep.	274-0355
<b><i>Solid Waste:</i></b>	Roxanne Iacovelli	Personnel	274-5526

United States Environmental Protection Agency (1997).  
*Municipal Solid Waste* Retrieved 7/24/01. Available on the  
 Internet at <http://www.epa.gov/epaoswer/non-hw/muncpl/factbook>

## Appendix D: Residential Sector Data and Computations

---

Computations may not appear correct due to rounding effects.

### ***Electricity:***

Electricity consumption by all residential properties in Tompkins County: **247,063,922 kWh**

### ***Natural Gas:***

Natural gas consumption by all residential properties in Tompkins County: **2,575,366 therms**

### ***Heating Oil:***

Average size of households using heating oil in mid-Atlantic region: 1,731 square feet

Average annual consumption of heating oil per household: 744 gallons

Average annual consumption per square foot: 0.43 gallons

Total household area in Tompkins County using heating oil: 8,649,152 square feet

Total estimated consumption of heating oil in Tompkins County: **3,719,135 gallons**

### ***Propane:***

Total number of households in Tompkins County using propane: 17,767 gallons

Average annual consumption of propane per household: 184 gallons

Total estimated consumption of heating oil in Tompkins County: **3,269,128 gallons**

### ***Projections to 2020:***

Change in residential electricity use: increase 1.3% to 250,275,753 kWh

Change in residential natural gas use: increase 0.6% to 678,929,280 cubic feet

Change in residential heating oil use: decrease 0.8% to 3,689,382 gallons

Change in residential propane use: decrease 2.1% to 3,200,476 gallons

## Appendix E: Commercial Sector Data and Computations

---

Computations may not appear correct due to rounding effects.

### *Electricity:*

Electricity consumption by commercial properties in Tompkins County:	215,123,266 kWh
Electricity consumption by public authority properties in Tompkins Cnty:	279,099,940 kWh
Electricity consumption by 95% lighting sector in Tompkins County:	3,044,320 kWh
Total electricity consumption for commercial uses in Tompkins County:	<b>497,267,526 kWh</b>

### *Natural Gas:*

Natural gas consumption by commercial and industrial properties in TC:	9,480,317 therms
Natural gas consumption by 75% of commercial and industrial properties:	7,110,238 therms
Natural gas consumption by public authority properties in Tompkins Cnty:	2,065,729 therms
Total natural gas consumption by for commercial uses in Tompkins Cnty:	<b>9,175,967 therms</b>

### *Heating Oil:*

Total number of commercial properties in Tompkins using heating oil:	138
Annual consumption of heating oil per establishment in mid-Atlantic:	3,608 gallons
Estimated commercial heating oil consumption using establishment method:	497,904 gallons
Total area of commercial properties in Tompkins using heating oil:	1,003,993 square feet
Average annual consumption of heating oil per square foot in mid-Atlantic:	0.19 gallons
Estimated commercial heating oil consumption using square foot method:	190,759 gallons
Average of establishment method and square foot method:	<b>344,332 gallons</b>

### *Projections to 2020:*

Change in commercial electricity use:	increase 1.4%	to	504,229,271 kWh
Change in commercial natural gas use:	increase 0.9%	to	1,334,342,492 cubic feet
Change in commercial heating oil use:	decrease 0.2%	to	343,643 gallons



## Appendix F: Industrial Sector Data and Computations

---

Computations may not appear correct due to rounding effects.

### *Electricity:*

Electricity consumption by industrial properties in Tompkins County:	151,396,246 kWh
Electricity consumption by 5% lighting sector in Tompkins County:	160,227 kWh
Total electricity consumption for industrial uses in Tompkins County:	151,556,473 kWh

### *Natural Gas:*

Natural gas consumption by 25% of commercial and industrial properties:	2,370,079 therms
---	------------------

### *Heating Oil:*

Total number of industrial properties in Tompkins using heating oil:	5
Annual consumption of heating oil per establishment in U.S.:	17,875 gallons
Estimated industrial heating oil consumption using establishment method:	89,374 gallons
Total area of industrial properties in Tompkins County using heating oil:	33,059 square feet
Average annual consumption of heating oil per square foot in U.S.:	0.36 gallons
Estimated industrial heating oil consumption using square foot method:	11,848 gallons
Average of establishment method and square foot method/TC estimate:	50,611 gallons

### *Propane:*

Total number of industrial properties in Tompkins County using propane:	12
Annual consumption of propane per establishment in U.S.:	78,330 gallons
Estimated industrial propane consumption using establishment method:	939,964 gallons
Total area of industrial properties in Tompkins County using propane:	77,137 square feet
Average annual consumption of propane per square foot in U.S.:	1.57 gallons
Estimated industrial propane consumption using square foot method:	121,147 gallons
Average of establishment method and square foot method/TC estimate:	530,555 gallons

***Projections to 2020:***

Change in industrial electricity use:	increase 1.0%	to	153,072,038 kWh
Change in industrial natural gas use:	increase 0.09%	to	992,377,085 cubic feet
Change in industrial heating oil use:	increase 1.1%	to	51,168 gallons
Change in industrial propane use:	increase 4.7%	to	555,491 gallons