City of Columbia Emissions Inventory

Introduction

On July 17th, 2006 the Columbia City Council passed a resolution adopting the U.S. Mayors Climate Protection Agreement. (Appendix A) The resolution states that the City of Columbia will strive to meet or exceed Kyoto Protocol* targets for reducing global warming pollution by taking actions in the city operations and in the community. City staff was charged with the first step in accomplishing the goal, completing an inventory of CO2 emissions within the city limits.

*[The Kyoto Protocol is a legally binding agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 (but note that, compared to the emissions levels that would be expected by 2010 without the Protocol, this target represents a 29% cut)]

Background

In December 1997 at Kyoto, Japan, the Parties to the UN Framework Convention on Climate Change adopted the Kyoto Protocol. This agreement calls for the reduction of greenhouse gases in developed countries. Over the next decade 141 countries signed the agreement and 38 are now legally required to reduce greenhouse gas emissions. The U.S. has signed the agreement but has not been ratified by the U.S. Congress.

The U.S. Mayors Climate Protection Agreement is an initiative started by Seattle Mayor Greg Nickels in 2005. It calls for support of the Kyoto Protocol's goals through the action of local governments. As of March 19, 2007, 425 U.S. mayors and cities have given varying degrees of commitment to the agreement.

In response to the July resolution, the City of Columbia has joined ICLEI - Local Governments for Sustainability USA - for guidance and support in conducting a citywide emissions inventory. ICLEI has partnered with the U.S. Conference of Mayors to provide software and technical assistance to help calculate emissions based upon energy use, fuel consumption, and waste generation. ICLEI is pioneering efforts to help cities implement climate protection measures both in the U.S. and internationally.

The data collection strategies in this plan are largely based on similar plans developed by other cities and states. The inventory is based on accepted international protocols and keeps with a similar approach. The inventory is not meant to be precise GHG accounting; rather it is examination based on the best data available. In the course of researching data for the ICLEI software, it became clear that finding reliable data from 1990 was not possible due to lack of such data locally. Natural gas, gas transport, and transportation data is not available from 1990. A portion of the transportation data is based off of 2000 census data and there are no transportation numbers available since then. In the interest of accuracy and repeatability, 2000 was chosen as the baseline year for the emissions inventory. Other participatory cities, such as Kansas City, Missouri, have taken this approach with much success.

The inventory only considers carbon dioxide and methane, the most predominate emitted greenhouse gasses. The study does not include other greenhouse gasses covered under the Kyoto protocol, such as nitrous oxide, sulfur hexafluoride, HFCs, and PFCs the reasoning behind this is that the gasses resulting from fossil fuel combustion and waste decay account for the large majority of climate influencing emissions.

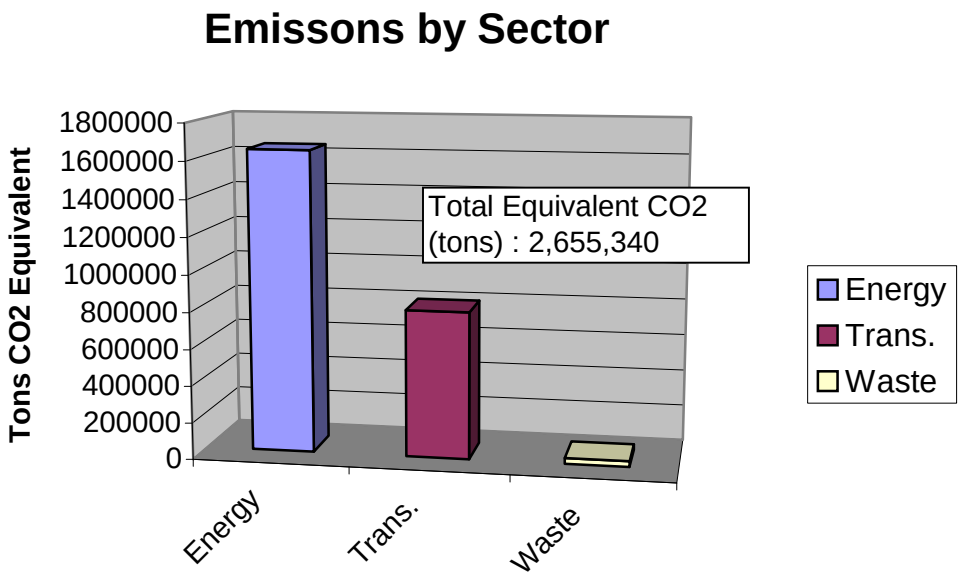
Study Methodology

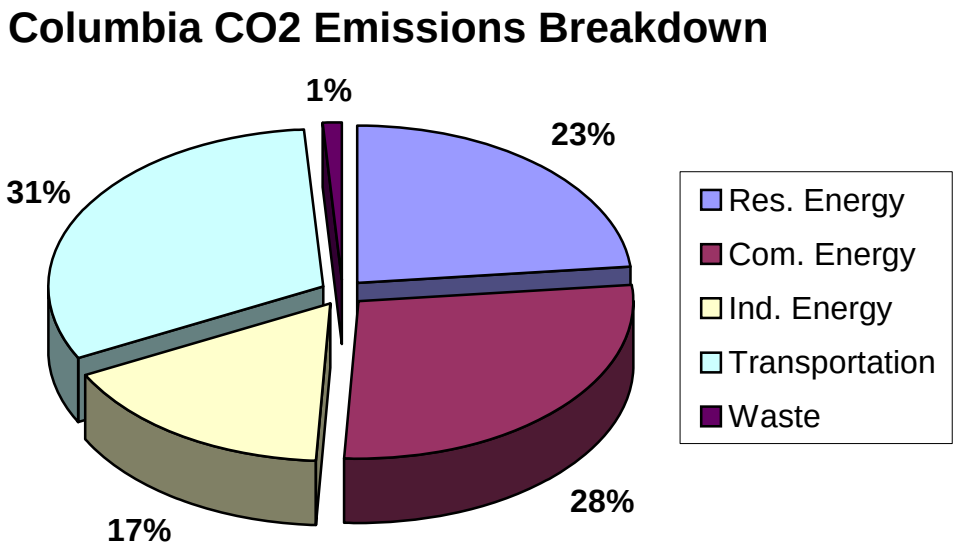
Water and Light Staff completed the City of Columbia greenhouse gas inventory. The staff contacted the various entities to collect and combine the necessary data required to run the ICLEI software analysis. The data inputs feed algorithms of the worksheet that tabulate the results. For the purposes of the inventory and identifying areas in which the City can realize climate change objectives, emissions were disaggregated on source basis. The three areas of consideration are transportation, waste and energy. Only in the electricity consumed by Columbia Water and Light customers is a breakdown by customer sector provided as a reference for the year 2000.

The City of Columbia Water and Light, Columbia Public Works Solid Waste division and Wastewater Treatment facilities, Columbia Planning Department, the University of Missouri, the Missouri Department of Transportation, the Missouri Department of Natural Resources, Division of Energy, Ameren UE and Boone Electric were consulted to obtain the data for the report.

The following charts are a direct result of the data collection and analysis using the ICLEI software, which details CO2 emissions by sector.

All Charts and graphs represent numbers from 2000.





CO2 Source Data

Transportation

The amount of CO2 produced by all transportation within Columbia city limits was found using data from The Federal Highway Administration and the City of Columbia Planning Department. The FHWA publishes daily vehicle mileage in urbanized areas corresponding to each census. To further refine the FHWA numbers, roadway mileage was obtained from the City of Columbia and added to transportation totals. These were used in conjunction with the FHWA report to estimate the annual vehicle miles traveled within Columbia. It is important to note that Highway 70 is included in this total. E-85 and Biodiesel were not considered in this report.

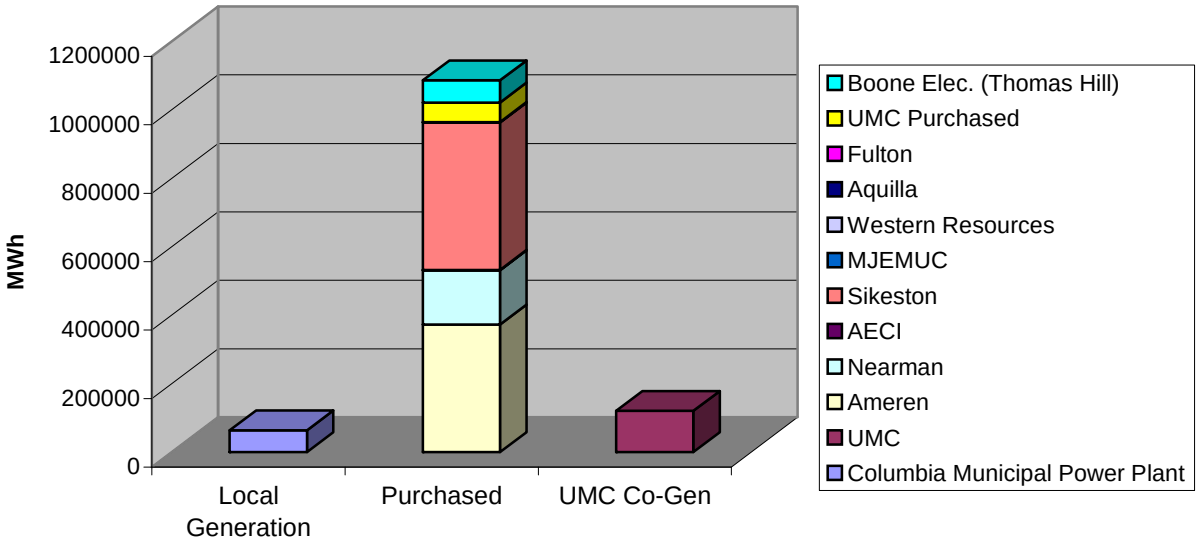
Energy

Natural Gas: Ameren UE is the sole supplier of Natural Gas to Columbia residences. They provided 2000 usage data showing 2,552,290 Mcf sold that year. Deregulated commercial transport customers, mostly industrial customers who purchase natural gas from independent sources, were not accounted in this report.

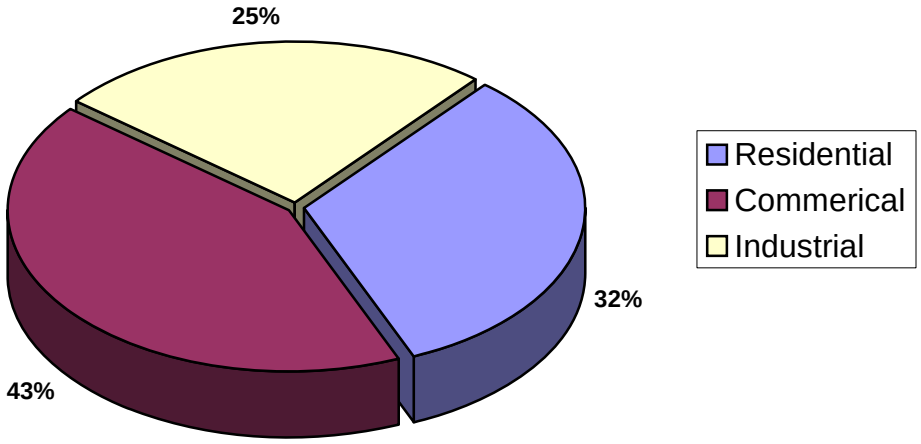
Electricity: Three main electricity suppliers provide power within the City of Columbia: Columbia Water and Light, Boone County Electric Cooperative, and UMC power plant. The Columbia Municipal Power Plant is a public owned utility operated by the City of Columbia to provide reliable, responsive, not-for-profit electric service. Public power utilities are directly accountable to the people they serve through local elected officials. The University of Missouri, Columbia power plant is a cogeneration facility, which provides highly reliable utility service to over 13 million square feet of facilities. Boone Electric Cooperative is a non-profit electric utility owned by the consumer-

members who use the electricity and other services it provides. Headquartered in Columbia, Missouri, the cooperative serves Boone County with a small portion of customers inside Columbia city limits. Annual 2000 production quantities were obtained from each entity to account for the city's usage, 1,212,957 MWh. Most electrical power used in Columbia originates from providers outside of the city limits. This power is purchased and distributed through Columbia Water and Light. An average weighted CO2 emissions rate per kWh was generated using EPA emissions information for each specific generation facility.

Columbia Total Electric Consumption by Source



CWL Customer Class Usage



Waste

Solid Waste: The Columbia Sanitary Landfill operated by the Columbia Public Works department operates using environmentally sound engineering practices for disposal of municipal solid waste while complying with state and federal regulations. Organic landfill contains carbon compounds from a variety of sources and produces methane as it decomposes. The Missouri Department of Natural Resources funded a 1999 study to classify and quantify the waste entering all Missouri landfills. This report was used to characterize the incoming Columbia landfill waste and estimate methane production. Methane has 21 times the potency of CO_2 as a greenhouse gas. The Columbia landfill captures this gas to be flared and in this process the methane is converted into CO_2 and H_2O. Not all of the carbon that enters the landfill as waste is converted to methane in decomposition. Some of the carbon remains in the ground and therefore landfills are sometimes considered carbon sinks rather than emitters. In this inventory, all landfill emissions add to the total emitted CO_2 amount.

Wastewater: The Columbia Wastewater system is managed by Public Works. Columbia Regional Wastewater Treatment Plant is called the complete-mix activated sludge process plant. The methane gas is produced by this anaerobic digestion and is used as fuel for an engine-generator providing 240 kW of electrical power used in the treatment process. Waste heat from the engine is recovered for heating the treatment plant buildings and to provide heating to improve the sludge digestion process and produce more gas. The annual amount of gas produced is recorded and was readily available for analysis.

Analysis

The ICLEI software, called Clean Air and Climate Protection, uses established and estimated coefficients for CO2 production to help calculate a citywide "carbon footprint." The software categorizes CO2 production in three categories; energy, transportation, and waste. After finalizing a baseline inventory, the software also provides forecasted results from implemented CO2 reduction measures.

2000 Columbia Detailed CO2 Emissions Report

Columbia, Missouri	**2000 Eq. CO2 (tons)**	**2000 Eq. C02 (%)**
Transportation		
Vehicles		
Gasoline	669,002	25.19%
Diesel	133,150	5.01%
Subtotal Vehicles	802,152	30.21%
Subtotal Transportation	802,152	30.21%
Waste		
Columbia Landfill		
Paper Products	19,523	0.74%
Food Waste	6,288	0.24%
Wood/Textiles	1,967	0.07%
Subtotal Columbia Landfill	27,778	1.05%
Wastewater Treatment		
Flared Methane	3,100	0.12%
Subtotal Wastewater Treatment	3,100	0.12%
Subtotal Waste	30,878	1.16%
Energy		
Ameren		
Natural Gas*	190,437	7.17%
Subtotal Ameren Customers	190,437	7.17%
Boone Electric Coop		
Electricity	72,712	2.74%
Subtotal Boone Electric Coop	72,712	2.74%
Columbia Municipal Power (Produced and Purchased)		
Electricity	1,152,917	43.42%
Subtotal Columbia Municipal Power	1,152,917	43.42%
UMC Power		
Coal and Alternative Fuels	388,916	14.65%
Natural Gas	17,328	0.65%
Subtotal UMC Power	406,244	15.30%
Subtotal Energy	1,822,310	68.63%
Total	**2,655,340**	100.00%

*Natural Gas delivered and used at the UMC power plant is included under *UMC Power*.

It should be noted that the software used for CO2 baseline, also provides forecasted results from implemented CO2 reduction measures. Other municipalities that have conducted a baseline inventory have developed action plans to reduce greenhouse gas emissions. The processes followed to develop action plans varied only slightly by municipalities. Typically the following steps were adopted:

- Acceptance of the baseline inventory report by the City Council.
- Development of focus groups in the three areas: Energy, transportation, and waste
- Focus Groups establish measurable reductions goals
- Set an action plan for the goals in each area

Addendum

2000 and 2005 Detailed Columbia CO2 Emissions Report

Columbia, Missouri	2000 Eq. CO2 (tons)	2000 Eq. C02 (%)	2005 Eq. CO2 (tons)	2005 Eq. CO2 (%)	Percent Change
Transportation					
Vehicles					
Gasoline	669,002	25.19%	695,945	23.93%	4.03%
Diesel	133,150	5.01%	138,513	4.76%	4.03%
Subtotal Vehicles	802,152	30.21%	834,458	28.69%	4.03%
Subtotal Transportation	802,152	30.21%	834,458	28.69%	4.03%
Waste					
Columbia Landfill					
Paper Products	19,523	0.74%	22,053	0.76%	12.96%
Food Waste	6,288	0.24%	7,103	0.24%	12.96%
Wood/Textiles	1,967	0.07%	2,222	0.08%	12.96%
Subtotal Columbia Landfill	27,778	1.05%	31,378	1.08%	12.96%
Wastewater Treatment					
Flared Methane	3,100	0.12%	3,100	0.11%	0.00%
Subtotal Wastewater Treatment	3,100	0.12%	3,100	0.11%	0.00%
Subtotal Waste	30,878	1.16%	34,478	1.19%	11.66%
Energy					
Ameren					
Natural Gas*	190,437	7.17%	206,998	7.12%	8.70%
Subtotal Ameren Customers	190,437	7.17%	206,998	7.12%	8.70%
Boone Electric Coop					
Electricity	72,712	2.74%	102,716	3.53%	41.26%
Subtotal Boone Electric Coop	72,712	2.74%	102,716	3.53%	41.26%
Columbia Municipal Power (Produced and Purchased)					
Electricity	1,152,917	43.42%	1,353,671	46.54%	17.41%
Subtotal Columbia Municipal Power	1,152,917	43.42%	1,353,671	46.54%	17.41%
UMC Power					
Coal and Alternative Fuels	388,916	14.65%	362,433	12.46%	-6.81%
Natural Gas	17,328	0.65%	13,793	0.47%	-20.40%
Subtotal UMC Power	406,244	15.30%	376,226	12.94%	-7.39%
Subtotal Energy	1,822,310	68.63%	2,039,611	70.12%	11.92%
Total	**2,655,340**	100.00%	**2,908,547**	100.00%	9.54%

*Natural Gas delivered and used at the UMC power plant is included under *UMC Power*.