GREENHOUSE GAS EMISSIONS INVENTORY REPORT
LOUISVILLE/JEFFERSON COUNTY METRO GOVERNMENT

Prepared by:

TRINITY CONSULTANTS
One Copley Parkway, Suite 310
Morrisville, North Carolina 27560

TRINITY CONSULTANTS
1717 Dixie Hwy, Suite 900
Covington, Kentucky 41011
www.trinityconsultants.com

and

LOUISVILLE METRO AIR POLLUTION CONTROL DISTRICT
850 Barret Avenue
Louisville, KY 40204
www.louisvilleky.gov/APCD

November 2008

Project 081801.8001

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ALAPCO	Association of Local Air Pollution Control Officials
APCD	Louisville Metro Air Pollution Control District
Brookings report	*Shrinking the Carbon Footprint of Metropolitan America*
CACP	Clean Air and Climate Protection
CCAR	California Climate Action Registry
CCC	Climate Change Committee
CCP	Cities for Climate Protection
CFC	Chlorofluorocarbon
CH_4	Methane
CNG	Compressed Natural Gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DOE	U.S. Department of Energy
E-10	Gasoline blended with 10% Ethanol
EIA	Energy Information Administration (DOE)
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GRP	General Reporting Protocol
GWP	Global Warming Potential
Halons	Halocarbons containing bromine
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbon
ICLEI	International Council for Local Environmental Initiatives
IPCC	Intergovernmental Panel on Climate Change
JCPS	Jefferson County Public Schools
KIPDA	Kentuckiana Regional Planning & Development Agency
KSDC	Kentucky State Data Center
kWh	Kilowatt-hour
lb	Pound
LG&E	Louisville Gas and Electric
LMG	Louisville Metro Government
LRAA	Louisville Regional Airport Authority
LWC	Louisville Water Company
MCF	1,000 cubic feet
Montreal Protocol	*Montreal Protocol on Substances that Deplete the Ozone Layer*
MPO	Metropolitan Planning Organization
MSD	Metropolitan Sewer District
N_2O	Nitrous oxide
NACAA	National Association of Clean Air Agencies
NMVIC	Non-methane Volatile Organic Compounds
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Nitrogen oxides
O_3	Ozone

OH	Hydroxyl radicals
Partners	Partnership for a Green City Entities
PFC	Perfluorocarbon
PGC	Partnership for a Green City
ppb	Parts per billion
ppm	Parts per million
scf	Standard cubic foot
SF_6	Sulfur hexafluoride
SO_2	Sulfur dioxide
STAPPA	State and Territorial Air Pollution Program Administrators
TARC	Transit Authority of River City
TCR	The Climate Registry
Trinity	Trinity Consultants, Inc.
ULSD	Ultra-Low Sulfur Diesel
UNEP	United Nations Environmental Program
UofL	University of Louisville
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1. EXECUTIVE SUMMARY

In April 2005, Louisville's Mayor Jerry Abramson signed the U.S. Mayors Climate Protection Agreement, a voluntary pledge to reduce greenhouse gas (GHG) emissions. The Agreement was later endorsed by the U.S. Conference of Mayors and is now signed by more than 800 U.S. Mayors. Under the U.S. Conference of Mayors Climate Protection Agreement, participating cities commit to several goals:

- Strive to meet or beat the Kyoto Protocol targets in their own communities (i.e., reduction of GHG emissions by 7% from 1990 levels by 2012);
- Urge the state and federal government to enact policies and programs to meet or beat the Kyoto Protocol targets; and
- Urge the U.S. Congress to pass the bipartisan GHG reduction legislation.

In order to meet the 7% GHG reduction target and address environmental sustainability goals, Louisville Metro Government (LMG) decided to determine historical and projected anthropogenic GHG emissions from its jurisdiction. The historical GHG emissions inventory and forecasts included in this report are the first steps towards achieving the emissions reduction target. Assessing a city's GHG emissions profile assists with identifying the major contributing sources and demonstrates any apparent trends.

LMG sought to develop comprehensive, transparent, and verifiable entity-level GHG emissions inventories for itself; other members of the Partnership for a Green City (PGC), which include Jefferson County Public Schools (JCPS) and the University of Louisville (UofL); and for Jefferson County at large. In 2003, Jefferson County and the City of Louisville merged to form a consolidated local government that now serves a community of 700,000 residents located in 386 square miles and is referred to as Louisville Metro. Jefferson County also includes several smaller cities, which each have their own governments. Accordingly, the community-level emissions inventory is for Jefferson County, as opposed to only Louisville Metro.

Based on the data received from LMG, Trinity Consultants (Trinity) completed preliminary GHG emissions inventories for the community[1] as well as individual PGC entities (or Partners).[2] The following inventories have been prepared:

- Community inventory for a baseline year of 1990;

[1] The community-level inventory is for Jefferson County, as opposed to only Louisville Metro.

[2] Since entity-specific data was available for the quasi-governmental entities, emissions for these entities were quantified separately.

- Community inventory for 2006;[3]
- Entity inventories for LMG, JCPS, and UofL for 2006; and
- Entity inventories for quasi-governmental entities, including Metropolitan Sewer District (MSD), Transit Authority of River City (TARC), Louisville Water Company (LWC), and the Louisville Regional Airport Authority (LRAA)[4].

The next step after finalizing the above-mentioned GHG emissions inventories will be to develop and recommend strategies for achieving the reduction targets. These efforts are being undertaken by a community-wide stakeholder group under the auspices of the PGC. The goal of the PGC's Climate Change Committee (CCC) is to prepare a report for the leadership of the PGC entities that recommends strategies to mitigate the community's GHG emissions and to prepare for the impacts climate change may have locally. In order to complete this task, the PGC has established seven subcommittees to carry out this work, each with a different area of focus. The subcommittees are as follows:

- GHG Emissions Inventory and Mechanisms – Responsibilities include reviewing inventories, trading, registries, offsets and other related mechanisms;
- Land Use, Transportation, and Urban Forestry – Responsibilities include examining issues of land use planning and how we travel through our community;
- Energy Efficiency and Renewable Energy – Responsibilities include identifying opportunities to promote energy efficiency and renewable energy;
- Education and Outreach – Responsibilities include raising the community's awareness, changing behaviors and addressing students' curricula and related opportunities;
- Utility Regulations, Policies, and Procedures – Responsibilities include examining barriers and incentives such as net metering, demand side management, renewable portfolio standards and related approaches;
- Local Impacts – Responsibilities include understanding meteorological, ecological, and public health impacts and seeking opportunity for mitigation and adaptation; and
- Waste – Responsibilities include examining waste stream practices and reduction strategies.

In order to facilitate the work of the CCC and its subcommittees, the Louisville Metro Air Pollution Control District (APCD), which is chairing the CCC and providing staffing as needed for the process,

---

[3] Based on discussions during the work plan development, LMG made the decision to use 2006 data. Where 2006 calendar year data was unavailable, 2006 fiscal year (July 1, 2005 to June 30, 2006) data or available annual data was used to calculate emissions for the entities. The 2006 fiscal year and 2004 calendar year data are currently used to estimate emissions from the UofL and Louisville Regional Airport Authority (LRAA) operations, respectively.

[4] LRAA emissions are from 2004 emissions inventory. Trinity assumes that the 2004 emissions profile is similar to that for 2006 and is used in lieu of conducting an updated 2006 inventory.

has also established a website to provide useful information and data about the work of the CCC and its subcommittees.[5]

1.1 COMMUNITY INVENTORY SUMMARY

Emissions calculations were performed for the years 1990 and 2006. GHG emissions, measured in tons of carbon dioxide equivalent (CO_2e)[6], were calculated for the energy used by the community in the residential, commercial, and industrial sectors, as well as for onroad and nonroad transportation, public transit, and waste disposal. Similar calculations were performed for each PGC entity. The GHG emissions inventory data was calculated using the International Council for Local Environmental Initiatives' (ICLEI) Clean Air and Climate Protection (CACP) software.[7] The total community 1990 and 2006 GHG emissions (for which records were made available) from Jefferson County are calculated to be 18,208,833 and 19,249,306 tons CO_2e respectively. These emissions are primarily generated from residential, commercial, and industrial fuel and electricity usage emissions. A summary of total GHG emissions by sector is provided below in Table 1-1 and Figure 1-1.

TABLE 1-1. COMMUNITY CO_2E EMISSIONS BY SECTOR – BASELINE YEARS

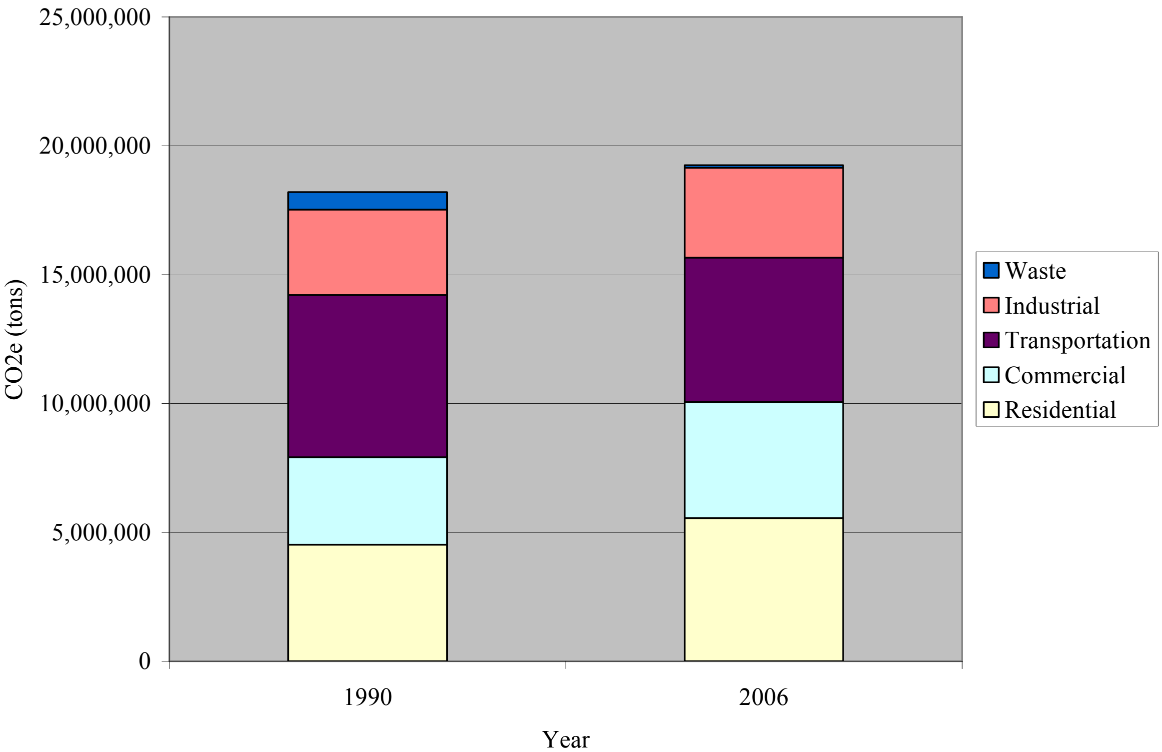
Sector	CO_2e (tons)	
	1990	2006
Residential	4,522,223	5,554,793
Commercial	3,399,389	4,501,454
Transportation	6,286,333	5,611,642
Industrial	3,318,719	3,483,336
Waste	682,169	98,081
Total	**18,208,833**	**19,249,306**
Population	**665,123**	**703,998**
CO_2e (tons) per Capita	**27.38**	**27.34**

[5] http://www.louisvilleky.gov/APCD/ClimateChange/

[6] See Section 2.1.2 for more explanation of CO_2 equivalents.

[7] ICLEI is an international association of local governments as well as national and regional local government organizations that have made a commitment to sustainable development. More information about ICLEI can be obtained at http://www.iclei.org/.

FIGURE 1-1. COMMUNITY CO_2E EMISSIONS SUMMARY



For 1990 and 2006, the largest sources of CO_2e emissions were determined to be the transportation and residential sectors, respectively, both of which are responsible for about one-third of the total CO_2e emissions from community sources. These emissions are a result of indirect emissions from electricity usage and direct emissions from fuel usage in residential buildings, as well as direct emissions from fuel usage in community vehicles. The details supporting these GHG emissions calculations are included in Appendix C. Total emissions have risen steadily over the period studied, increasing by approximately 5.7% between 1990 and 2006. For Jefferson County to achieve its target of a 7% reduction below 1990 levels by 2012, this increasing trend in total emissions will have to be evaluated and relevant mitigation steps developed.

Using the data provided by LMG and Louisville Gas and Electric (LG&E) along with population growth data, the CO_2e emissions for 2012 and 2020 were forecasted. Without any emissions mitigation measures, it is anticipated that the community will contribute 19,553,954 and 20,233,123 tons of CO_2e, in 2012 and 2020, respectively. A summary of total historical and projected GHG emissions is provided in Table 1-2.

TABLE 1-2. COMMUNITY CO_2E EMISSIONS SUMMARY WITH PROJECTIONS

Sector	CO_2e (tons)		CO_2e (tons)	
	1990	2006	2012	2020
Residential	4,522,223	5,554,793	5,555,285	5,720,207
Commercial	3,399,389	4,501,454	4,491,233	4,625,475
Transportation	6,286,333	5,611,642	5,939,909	6,212,786
Industrial	3,318,719	3,483,336	3,467,348	3,571,680
Waste	682,169	98,081	100,179	102,975
Total	**18,208,833**	**19,249,306**	**19,553,954**	**20,233,123**
Population	**665,123**	**703,998**	**723,541**	**738,732**
CO_2e (tons) per Capita	**27.38**	**27.34**	**27.03**	**27.39**

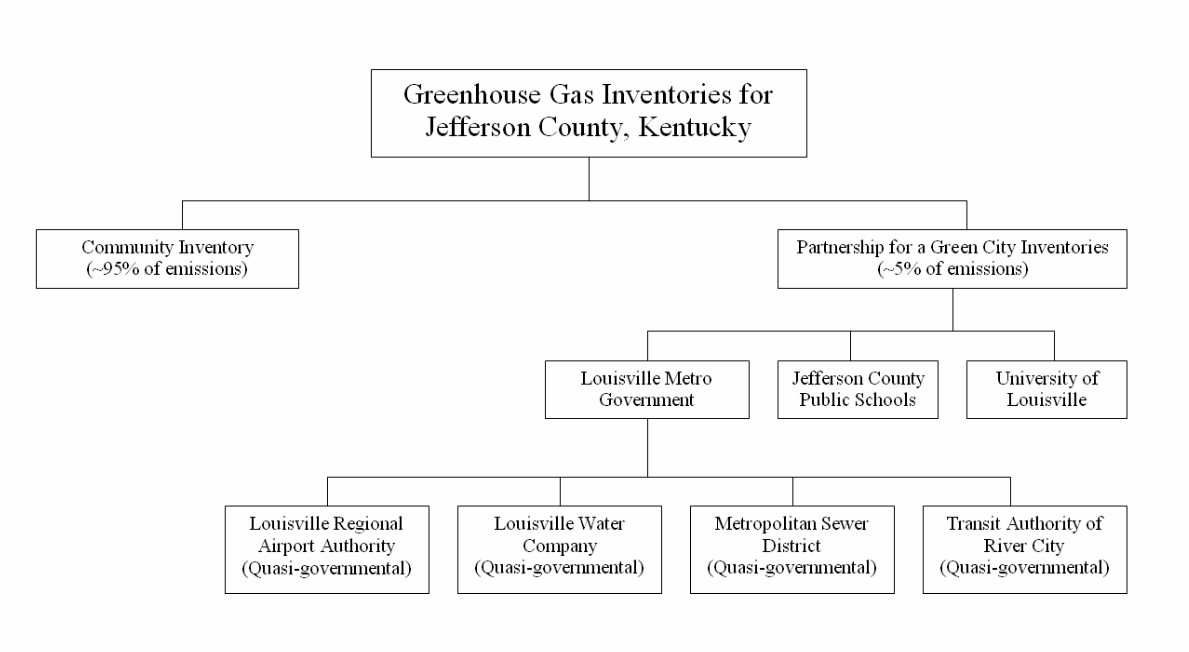
1.2 PGC ENTITIES INVENTORY SUMMARY

Emissions calculations were performed for 2006 for the following PGC entities:

- Louisville Metro Government (LMG);
- Jefferson County Public Schools (JCPS);
- University of Louisville (UofL);
- Metropolitan Sewer District (MSD);
- Transit Authority of River City (TARC);
- Louisville Water Company (LWC); and
- Louisville Regional Airport Authority (LRAA).

Figure 1-2 shows the relationship between LMG and the quasi-governmental entities, which is different from the relationship between JCPS, UofL, and LMG. JCPS, UofL, and LMG are voluntary partners. However, LMG does not have operational control over the quasi-governmental entities nor are they subsidiaries of LMG. Rather, LMG plays some role in the leadership, management, and/or budgetary decisions that affect the quasi-governmental entities. LMG does not affect any leadership, management, and/or budgetary roles for JCPS or UofL.

FIGURE 1-2. JEFFERSON COUNTY EMISSIONS INVENTORY ORGANIZATION CHART



The GHG emissions for each PGC entity were quantified for buildings, vehicle fleets, waste, and other sectors. The buildings sector includes indirect GHG emissions occurring from electricity usage and direct emissions from fuel combustion. The other sector includes emissions from coal handling and storage at UofL. The emissions from LRAA are rolled into the vehicle fleet sector in this analysis.[8] Table 1-3 provides a summary of 2006 emissions from the PGC entities:

TABLE 1-3. PGC ENTITIES CO_2E EMISSIONS SUMMARY

Sector	CO_2e (tons)						
	JCPS	**UofL**	**LMG**	**LRAA**	**LWC**	**TARC**	**MSD**
Buildings	218,297	201,802	107,107	0	131,639	5,958	178,329
Vehicle Fleet	4,267	65	2,259	13,215	747	5,150	774
Waste	26,143	0	15,436	0	0	0	0
Total	**248,707**	**201,867**	**124,802**	**13,215**	**132,386**	**11,108**	**179,103**
						Grand Total	**911,188**

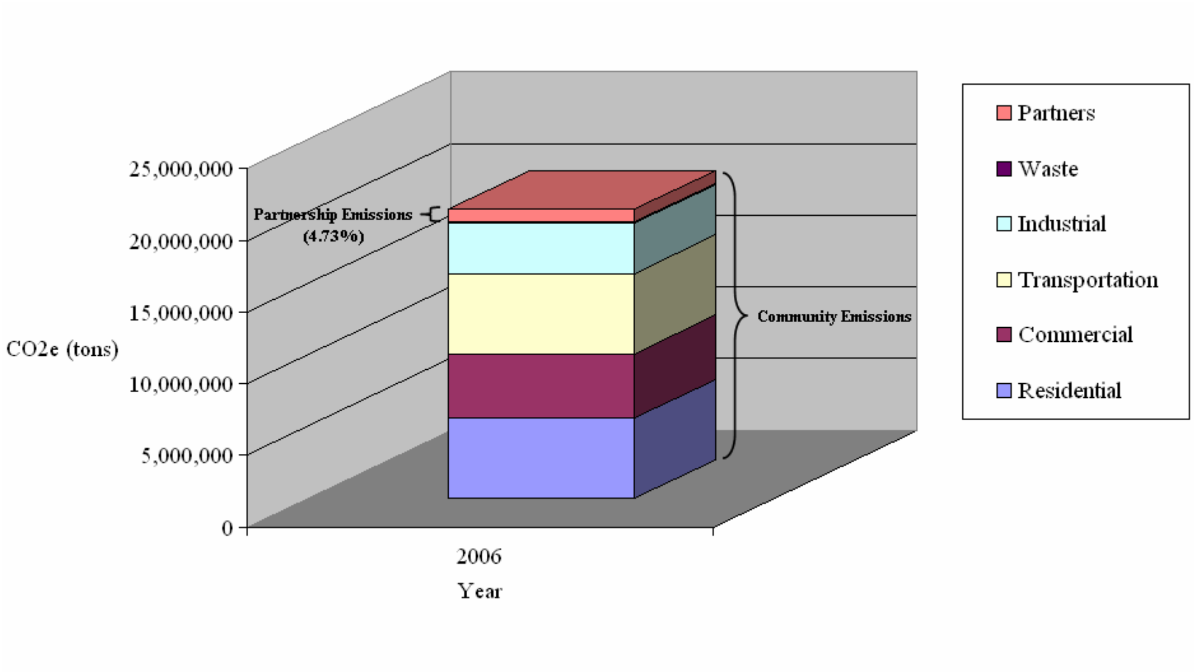
1.3 EMISSIONS ANALYSIS

In order for the recommended strategies to target the appropriate sectors and sources within the community to achieve required reductions, it is helpful to compare community level emissions to

[8] The LRAA emissions were not quantified using the CACP software but were made available by LRAA. The coal handling and storage emissions for UofL were also calculated outside the CACP software and were entered directly into the software.

entity-level emissions. Note that only 4.73% of the total community emissions are contributed by the Partners. Figure 1-3 shows the total emissions inventory for the Louisville Metro area.[9]

FIGURE 1-3. 2006 PARTNERSHIP AND COMMUNITY EMISSIONS BY SOURCE



Total GHG emissions per capita within the Louisville Metro area are among the highest in the nation for large municipalities. "Per capita emissions" is an efficiency metric also referred to as Population Emissions Intensity.[10] According to a recent report issued by the Brookings Institution (hereinafter, the Brookings report)[11], the Louisville Metro area has per capita GHG emissions of 3.23 tons – ranking 96th among the 100 largest metropolitan areas and well above the estimated national average of 2.24 tons per capita.[12] The Brookings report points to five common factors that determine a metropolitan area's carbon footprint. Electricity prices and the carbon intensity of the region's electric generation (determined by type of fuel) are major aspects of a region's GHG emissions profile. Also important are population density, the availability of public transit (particularly rail), and weather.

To provide additional context, it is useful to compare the Brookings report estimate for Louisville Metro's GHG emissions with estimates from a similar metropolitan area within the region, as well as

---

[9] Waste emissions are not visible due to scale.

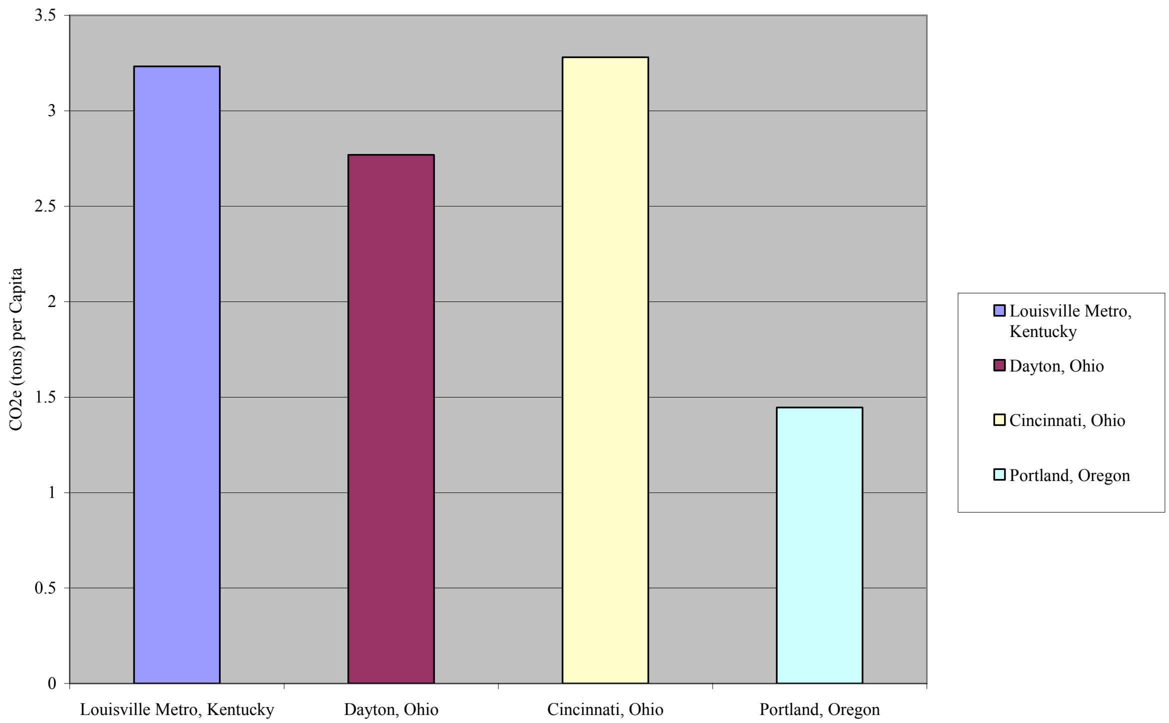
[10] See section 5.2.1 for a discussion of calculation methodology

[11] The Brookings Institution Report is based on national databases for passenger and freight highway transportation and for energy consumption in residential buildings. The report does not include emissions from commercial buildings, industry, or non-highway transportation.

[12] Brookings Institution, Shrinking the Carbon Footprint of Metropolitan America. May 2008.

a metropolitan area from a different region. According to the Brookings report, the Cincinnati, Ohio area has slightly higher per capita GHG levels (3.28 tons) and the Dayton, Ohio area has slightly lower per capita GHG emissions (2.77 tons) than Louisville. Alternatively, the Portland, Oregon area, which relies primarily on hydropower for its electricity, has substantially lower per capita GHG emissions levels (1.45 tons). Figure 1-4 shows the comparison of per capita emissions for Louisville and the other selected areas as reported by the Brookings Institution.

FIGURE 1-4. PER CAPITA EMISSIONS COMPARISON FROM BROOKINGS REPORT



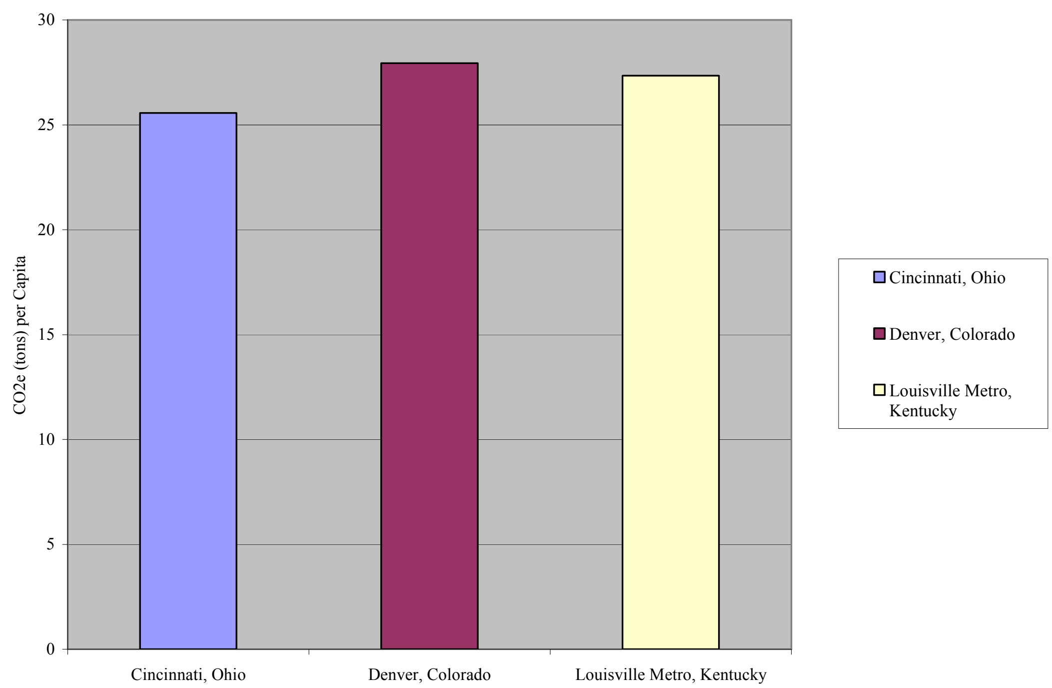
For further analysis, emissions inventory data was also collected from available GHG emissions reports prepared by selected municipalities using the CACP software. Unlike the Brookings report, these inventories included emissions from sectors beyond residential energy use and transportation. The Cincinnati, Ohio and Denver, Colorado area total GHG emissions estimates are 8.5 and 16.08 million tons, respectively.[13,14] These emissions estimates are less than the Louisville area estimate of 19.2 million tons. Figure 1-5 shows the comparison of emissions per capita for Louisville, Cincinnati, and Denver based on the information presented in individual inventory reports prepared by each respective community. The total community emissions on a per capita basis indicate that

[13] City of Cincinnati, Proposed Climate Protection Action Plan. April 28, 2008. The Cincinnati emissions inventory only included emissions from the City of Cincinnati and Cincinnati's City Government.

[14] City of Denver Climate Action Plan October 2007. The Denver emissions inventory included emissions from the community and government (buildings and facilities, transportation, and materials) and two local airports (Denver International Airport and Stapleton International Airport).

Louisville Metro per capita total emissions are higher than Cincinnati, Ohio and slightly lower than Denver, Colorado.

FIGURE 1-5. PER CAPITA EMISSIONS COMPARISON FROM RELEVANT INVENTORY REPORTS



As pointed out in the Brookings report, higher community GHG emissions levels tend to occur in the Ohio Valley and Eastern United States, where carbon intensive fuels, such as coal, are used for heating/cooling. Many of these areas also exhibit lower residential housing densities, as well as lower public transportation ridership.

2. INTRODUCTION

This report presents the results of the first Jefferson County specific GHG emissions inventory and will be the baseline against which future emissions will be compared. Initial estimates of historical and projected GHG emissions for the period from 1990 to 2020 are presented. Historical GHG emissions estimates (1990 through 2006) were developed using a set of generally accepted principles and guidelines for calculating GHG emissions, as described in Section 3, relying to the extent possible on community specific data and inputs. The emissions projections for 2012 and 2020 are based on the population growth data for Jefferson County.

This report encompasses emissions and metrics for six GHGs. The central intent of this inventory is to account for emissions from sources within Jefferson County limits. The emissions reported here are for the year 2006, with historical data from 1990. The 2006 emissions rates are used to predict future emissions rates for the years 2012 and 2020.

2.1 CLIMATE CHANGE SCIENCE

Climate change refers to long-term fluctuations in temperature, precipitation, wind, and other elements of the Earth's climate system. Natural processes such as solar-irradiance variations, variations in the Earth's orbital parameters, and volcanic activity can produce variations in climate. The climate system can also be influenced by changes in the concentration of various gases in the atmosphere, which affect the Earth's absorption of radiation. The Earth naturally absorbs and reflects incoming solar radiation and emits longer wavelength terrestrial (thermal) radiation back into space. On average, the absorbed solar radiation is balanced by the outgoing terrestrial radiation emitted into space. A portion of this terrestrial radiation, though, is absorbed by gases in the atmosphere. The energy from this absorbed terrestrial radiation warms the Earth's surface and atmosphere, creating what is known as the "natural greenhouse effect."

The Earth's atmosphere is naturally composed of a number of gases that act like the glass panes of a greenhouse, retaining heat to keep the temperature of the Earth stable and hospitable for life at an average temperature of 60ºF. Water vapor and carbon dioxide (CO_2) are the most prolific of these gases. Other contributing gases include methane (CH_4), nitrous oxide (N_2O), ozone (O_3) and halocarbons. Without the natural warming effect of these gases, the Earth's surface temperature would be too cold to support life.

However, climate change scientists state that the recently elevated concentrations of these gases in the atmosphere have had a destabilizing effect on the global climate, fueling the phenomenon commonly referred to as global warming. The global average surface temperature increased during the 20th century by about 1°F.[15] According to NASA scientists, the 1990s was the warmest decade of the century, and the first decade of the 21st century is well on track to be another record-breaker. The

[15] United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. "Climate Change 2007: Synthesis Report." http://www.ipcc.ch/ipccreports/ar4-syr.htm.

years 1998, 2002, 2003, 2004, 2005, and 2007 were the warmest five years since the 1890s, with 2005 being the warmest year in over a century.[16,17]

2.1.1 THE GREENHOUSE EFFECT

GHGs are trace amounts of natural or synthetic gases that warm the Earth by reducing the atmosphere's ability to radiate heat to outer space. The resulting heating of the planet's atmosphere, land, and oceans is called global warming or climate change. NASA scientists state that anthropogenic emissions have added significantly to atmospheric concentrations of these gases, especially over the last century's rapid growth in global energy use. Ice coring in Antarctica shows that CO_2 and CH_4 levels are now higher than at any time during the last 650,000 years. While the planet's climate has varied enormously over geologic time, a broad consensus has emerged in the scientific community that global warming is related to anthropogenic emissions and that action to reduce emissions is warranted.

As human population and consumption has increased, so has the amount of GHG emitted into the Earth's atmosphere. In the mid 1850s there were about 280 parts per million (ppm) of carbon dioxide in the atmosphere; but by 1998, CO_2 levels reached 360 ppm and are projected to rise to 450-600 ppm by the middle of this century. The overall warming of the Earth's surface has been rapid, pronounced, and well documented. According to the Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body set up by the World Meteorological Organization and by the United Nations Environment Program (UNEP), the global average surface temperature increased about 0.6ºC over the 20th century — "the largest [increase] of any century during the past 1,000 years."[18] The IPCC projects that by 2100, the average global surface temperature will increase by 1.4º to 5.8°C (3º to 10ºF). To put these numbers in context, the last ice age was accompanied by temperatures only 5º to 9ºC (9º to 16ºF) cooler than those to which we have been accustomed. Moreover, the current rate of increase is unprecedented during at least the past 20,000 years. Some of this increase in CO_2 can be attributed to natural processes, but human activities, such as the burning of fossil fuels and deforestation are pumping massive amounts of CO_2 into the atmosphere where it will remain for hundreds of years.

2.1.2 TYPES AND STRENGTHS OF GREENHOUSE GASES

Although the Earth's atmosphere consists mainly of oxygen and nitrogen, neither plays a significant role in enhancing the greenhouse effect because both are essentially transparent to terrestrial radiation. Naturally occurring GHGs include water vapor, CO_2, CH_4, N_2O, and O_3. Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also GHGs, but they are, for the most part, a product of industrial activities.

---

[16] NASA Goddard Institute for Space Studies, http://www.nasa.gov/centers/goddard/news/topstory/2008/earth_temp.html.

[17] According to the NASA Goddard Institute for Space Studies, 2007 and 1998 tied for the second warmest year in a century.

[18] United Nations Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report. "Climate Change 2001: The Scientific Basis, Summary for Policymakers." http://www.grida.no/CLIMATE/IPCC_TAR/wg1/005.htm.

Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are halocarbons that contain chlorine, while halocarbons that contain bromine are referred to as bromofluorocarbons (halons). Because CFCs, HCFCs, and halons are stratospheric ozone depleting substances, they are covered under the *Montreal Protocol on Substances that Deplete the Ozone Layer* (*Montreal Protocol*)[19]. Consequently, these gases are not included in this GHG inventory. Some other fluorine containing halogenated substances, namely hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), do not deplete stratospheric ozone but are potent GHGs. Therefore, the latter substances are often accounted for in GHG inventories. [20]

Global Warming Potentials (GWPs) are intended as a quantified measure of the globally averaged relative impacts of a particular GHG. GWP values allow the comparison of the impacts of emissions and reductions of different gases. According to the IPCC, GWPs typically have an uncertainty of roughly 35%; however, some GWPs have larger uncertainty than others, especially those in which atmospheric lifetimes have not yet been ascertained. The decision has been made to use consistent GWPs from the *IPCC Second Assessment Report*.[21] GHGs with relatively long atmospheric lifetimes (e.g., CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) tend to be evenly distributed throughout the atmosphere, making it possible for global average concentrations to be determined and a GWP to be assigned. GWP values are generally not attributed to short-lived gases that vary spatially in the atmosphere making it difficult to quantify their global impacts. These gases include water vapor, carbon monoxide (CO), tropospheric ozone, other ambient air pollutants (e.g., nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs)), and tropospheric aerosols (e.g., sulfur dioxide (SO_2) products, black carbon).

CO_2 was chosen as the reference gas for describing relative global warming potentials and has a GWP of 1. The global warming potentials of other GHG impacts are then compared to the GWP of CO_2. This gives rise to the concept of a "CO_2 equivalent," or CO_2e, which is calculated by converting non-CO_2 GHG emissions to CO_2e using the relative GWPs of the individual GHGs. These factors were developed in 1996 (and updated in 2001) by the IPCC to quantify the relative effects of a given GHG using CO_2 as the reference gas. To maintain the value of the CO_2 "currency," the U.S and international convention is to use the *IPCC Second Assessment Report* factors. Relevant GWPs are listed in Table 2-1.

---

[19] United Nations Environmental Program. "The Montreal Protocol on Substances that Deplete the Ozone Layer." 2000. <http://www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf>.

[20] Note that no PFCs, HFCs, and SF_6 were quantified for this baseline inventory because of unavailability of relevant data in a reasonable timeframe.

[21] Nations Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report. "Climate Change 1995: The Science of Climate Change." < http://www.ipcc.ch/ipccreports/assessments-reports.htm>

TABLE 2-1. GLOBAL WARMING POTENTIALS

Greenhouse Gas	GWP
CO_2	1
CH_4	21
N_2O	310
SF_6	23,900
HFCs (8 types)	140 – 11,700*
PFCs (6 types)	6,500 – 9,200*

* Once the individual component is specified, the appropriate GWP will be applied.

A general overview of GHGs, those with and without assigned GWPs, is given below.

Water Vapor

Overall, the most abundant and dominant GHG in the atmosphere is water vapor. Water vapor is neither long-lived nor well mixed in the atmosphere, varying spatially from 0 to 2%.[22] In addition, atmospheric water can exist in several physical states including gaseous, liquid, and solid. Human activities are not believed to directly affect the average global concentration of water vapor.

Carbon Dioxide (CO_2)

In nature, carbon is cycled between various atmospheric, oceanic, land biotic, marine biotic and mineral reservoirs. The largest fluxes occur between the atmosphere and terrestrial biota, and between the atmosphere and surface water of the oceans. In the atmosphere, carbon predominantly exists in its oxidized form as CO_2. Atmospheric CO_2 is part of this global carbon cycle; thus its fate is a complex function of geochemical and biological processes. CO_2 is released to the atmosphere when fossil fuels such as gasoline, diesel, oil, natural gas, coal, wood, or wood products are burned. It is the most prevalent of all GHGs. Forest clearing, other biomass burning, and some non-energy production processes (e.g., cement production) also emit notable quantities of CO_2.

Methane (CH_4)

CH_4 is primarily produced through anaerobic decomposition of organic matter in biological systems. Agricultural processes such as wetland rice cultivation, enteric fermentation in animals, and the decomposition of animal wastes emit CH_4, as does the decomposition of municipal solid wastes. CH_4 is also emitted during the production and distribution of natural gas and petroleum, and is released as a by-product of coal mining and incomplete fossil fuel combustion. Atmospheric concentrations of CH_4 have increased by about 150% since pre-industrial times, although the rate of increase has been declining. CH_4 is removed from the atmosphere by reacting with hydroxyl radicals (OH) and is ultimately

[22] Nations Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report. "Climate Change 1995: The Science of Climate Change." < http://www.ipcc.ch/ipccreports/assessments-reports.htm>

converted to CO_2. Minor removal processes also include reaction with chlorine in the marine boundary layer and stratospheric reactions.

Nitrous Oxide (N_2O)

Anthropogenic sources of N_2O emissions include agricultural soils, especially the use of synthetic and manure fertilizers; fossil fuel combustion, especially from mobile combustion; adipic (nylon) and nitric acid production; wastewater treatment and waste combustion; and biomass burning. The atmospheric concentration of N_2O has increased by 16% since 1750, from a pre-industrial value of about 270 parts per billion (ppb) to 314 ppb in 1998, a concentration that has not been exceeded during the last thousand years. N_2O is primarily removed from the atmosphere by the photolytic action of sunlight in the stratosphere.

Ozone (O_3)

O_3 is present in both the upper stratosphere, where it shields the Earth from harmful levels of ultraviolet radiation, and at lower concentrations in the troposphere, where it is the main component of anthropogenic photochemical "smog." During the last two decades, emissions of anthropogenic chlorine and bromine-containing halocarbons, such as CFCs, have depleted stratospheric ozone concentrations. An increase since the pre-industrial era in tropospheric ozone, which is also a GHG, is estimated to provide the third largest increase in direct radiative forcing, behind only CO_2 and CH_4. Tropospheric ozone is produced from complex chemical reactions of volatile organic compounds (VOCs) mixing with NO_x in the presence of sunlight. The tropospheric concentrations of O_3 and these other pollutants are short-lived and, therefore, spatially variable.

Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and Sulfur Hexafluoride (SF_6)

HFCs, PFCs, and SF_6 are man-made chemical gases used or generated by a variety of industrial activities. They are not ozone depleting substances, and therefore are not covered under the *Montreal Protocol*. They are, however, powerful GHGs. HFCs are primarily used as replacements for ozone depleting substances, but are also emitted as a by-product of the HCFC-22 manufacturing process. PFCs and SF_6 are predominantly emitted from various industrial processes including aluminum smelting, semiconductor manufacturing, electric power transmission and distribution, and magnesium casting. Currently, the impact of PFCs and SF_6 is small; however, they have a significant growth rate, extremely long atmospheric lifetimes, and are strong absorbers of infrared radiation. These gases therefore have the potential to influence climate far into the future.[23]

Halocarbons

Halocarbons are, for the most part, man-made chemicals used or generated by a variety of industrial activities. Halocarbons that contain chlorine, (e.g., CFCs, HCFCs, methyl chloroform, carbon tetrachloride) and bromine (e.g., halons, methyl bromide,

---

[23] Nations Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report. "Climate Change 2001: Synthesis Report." < http://www.ipcc.ch/ipccreports/assessments-reports.htm>

hydrobromofluorocarbons) result in stratospheric ozone depletion and are therefore controlled under the *Montreal Protocol*. Although CFCs and HCFCs include potent global warming gases, their net radiative forcing effect on the atmosphere is reduced because they cause depletion of stratospheric ozone, which is an important GHG in addition to shielding the Earth from harmful levels of ultraviolet radiation. Under the *Montreal Protocol*, the United States phased out the production and importation of halons by 1994 and of CFCs by 1996. Under the *Copenhagen Amendments to the Protocol*, a cap was placed on the production and importation of HCFCs by non-Article 5 countries beginning in 1996, and then followed by a complete phase-out by the year 2030.[24,25]

Carbon Monoxide (CO)

CO elevates concentrations of CH_4 and tropospheric ozone through chemical reactions with other atmospheric constituents (i.e., hydroxyl radicals) that would otherwise assist in destroying CH_4 and tropospheric ozone. CO is created when carbon-containing fuels are burned incompletely. Through natural processes in the atmosphere, it is eventually oxidized to CO_2. CO concentrations are both short-lived in the atmosphere and spatially variable.

Nitrogen Oxides (NO_x)

The primary climate change effects of NO_x (e.g., NO, NO_2) result from their role in promoting the formation of O_3 in the troposphere and, to a lesser degree, in the lower stratosphere. Additionally, NO_x emissions from aircraft are also likely to decrease CH_4 concentrations. NO_x can be created from lightning, soil microbial activity, biomass burning, both natural and anthropogenic fires, fuel combustion, and, in the stratosphere, from the photo-degradation of N_2O. Concentrations of NO_x are both relatively short-lived in the atmosphere and spatially variable.

Non-methane Volatile Organic Compounds (NMVOCs)

NMVOCs include compounds such as propane, butane, and ethane. These compounds participate, along with NO_x, in the formation of tropospheric ozone and other photochemical oxidants. NMVOCs are emitted primarily from transportation and industrial processes, as well as biomass burning and non-industrial consumption of organic solvents. Concentrations of NMVOCs tend to be both short-lived in the atmosphere and spatially variable.

Aerosols

Aerosols are extremely small particles or liquid droplets found in the atmosphere. They can be produced by natural events such as dust storms and volcanic activity, or by anthropogenic processes such as fuel combustion and biomass burning. They scatter and absorb solar and thermal infrared radiation and increase droplet counts that modify the

[24] United Nations Environment Programme. "The Copenhagen Amendment (1992)
The amendment to the Montreal Protocol agreed by the Fourth Meeting of the Parties (Copenhagen, 23–25 November 1992)." June 14, 1994. http://ozone.unep.org/Ratification_status/copenhagen_amendment.shtml.

[25] Article 5 countries represent developing nations.

formation, precipitation efficiency, and radiative properties of clouds. Aerosols are removed from the atmosphere relatively rapidly by precipitation. Aerosols generally have short atmospheric lifetimes, and have concentrations and compositions that vary regionally, spatially, and temporally. Various categories of aerosols exist, including naturally produced aerosols such as soil dust, sea salt, biogenic aerosols, sulfates, and volcanic aerosols, and anthropogenically manufactured aerosols such as industrial dust and carbonaceous aerosols (e.g., black carbon, organic carbon) from transportation, coal combustion, cement manufacturing, waste incineration, and biomass burning. The primary anthropogenic emission sources of elemental carbon, another constituent of aerosols, include diesel exhaust, coal combustion, and biomass burning.

2.2 ACTION BEING TAKEN ON CLIMATE CHANGE

In 1999, the two major national associations of air pollution control agencies, State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) issued a substantial education resource guide to help state and local officials identify and assess harmonized strategies and policies to reduce air pollution and address climate change simultaneously.[26] STAPPA/ALAPCO have recently merged and changed their organization name to the National Association of Clean Air Agencies (NACAA). Together with ICLEI, NACAA released the CACP software in 2003 to help state and local governments track criteria air pollutants and GHG emissions.[27] The CACP software was used to quantify emissions for Jefferson County.

2.2.1 ICLEI AND THE CITIES FOR CLIMATE PROTECTION CAMPAIGN

A great deal of work is being done at the local level on climate change. ICLEI - Local Governments for Sustainability has been a leader on both the international and local level for more than ten years, representing over 770 local governments around the world. ICLEI USA was launched in 1995 and has grown to over 200 cities and counties, providing national leadership on climate protection and sustainable development.

ICLEI’s mission is to improve the global environment through local action. The Cities for Climate Protection (CCP) Campaign is ICLEI’s flagship campaign designed to educate and empower local governments worldwide to take action on climate change. ICLEI provides resources, tools, and technical assistance to help local governments measure and reduce GHG emissions in their communities and their internal municipal operations.

ICLEI's International CCP Campaign was launched in 1990 when municipal leaders, invited by ICLEI, met at the United Nations in New York and adopted a declaration that called for the establishment of a worldwide movement of local governments to reduce GHG emissions, improve air quality, and enhance urban sustainability. The CCP Campaign achieves these results by linking climate change mitigation with actions that

---

[26] “Reducing Greenhouse Gases and Air Pollution: A Menu of Harmonized Options,” October 1999, STAPPA/ALAPCO, http://www.4cleanair.org/comments/execsum.PDF.

[27] http://www.cacpsoftware.org.

improve local air quality, reduce local government operating costs, and improve quality of life by addressing other local concerns. The CCP Campaign seeks to achieve significant reductions in U.S. GHG emissions by assisting local governments in taking action to reduce emissions and realize multiple benefits for their communities.

ICLEI uses the performance oriented framework and methodology of the CCP Campaign's Five Milestones to assist U.S. local governments in developing and implementing harmonized local approaches for reducing global warming and air pollution emissions, with the additional benefit of improving community livability. The milestone process consists of:

- Milestone 1: Conduct a baseline emissions inventory and forecast
- Milestone 2: Adopt an emissions reduction target
- Milestone 3: Develop a Climate Action Plan for reducing emissions
- Milestone 4: Implement policies and measures
- Milestone 5: Monitor and verify results

2.2.2 ROLE OF LOCAL GOVERNMENTS

As stated above, the PGC entities are responsible for approximately 5% of total GHG emissions generated within the community. Leadership from the Mayor's Office may be needed to communicate and coordinate with local communities to optimize CO_2 reduction efforts and to ensure that, where possible, joint efforts and partnerships increase the opportunities for energy efficiency and sustainability. The PGC has a pivotal role to play in the successful implementation of the strategies recommended by the CCC. As part of subcommittee discussions, PGC has already shown strong support for measures to increase energy efficiency and to encourage environmentally sustainable practices.

2.3 COMMUNITY AND GOVERNMENT PROFILE

The Climate Registry (TCR) [28] Protocol states that an organization developing an emissions inventory should determine the following:

- Geographic Boundary
- Organizational Boundary
- Operational Boundary

[28] The Climate Registry is a nonprofit collaboration between North American states, provinces, territories, and Native Sovereign Nations to record and track the greenhouse gas emissions of businesses, municipalities and other organizations. The Climate Registry's Board of Directors is made up of 39 states of the USA, 13 provinces/territories of Canada, six states of Mexico, and three Native Sovereign Nations. The Climate Registry establishes consistent, transparent standards throughout North America for businesses and governments to calculate, verify and publicly report their carbon footprints.

In addition, because of the nature of the community's emissions inventory, ICLEI also advises that community inventories should determine geopolitical boundaries. These boundaries are discussed in the following section.

2.3.1 GEOGRAPHIC BOUNDARIES

As stated above, LMG decided to complete a report of GHG emissions for the following reasons:

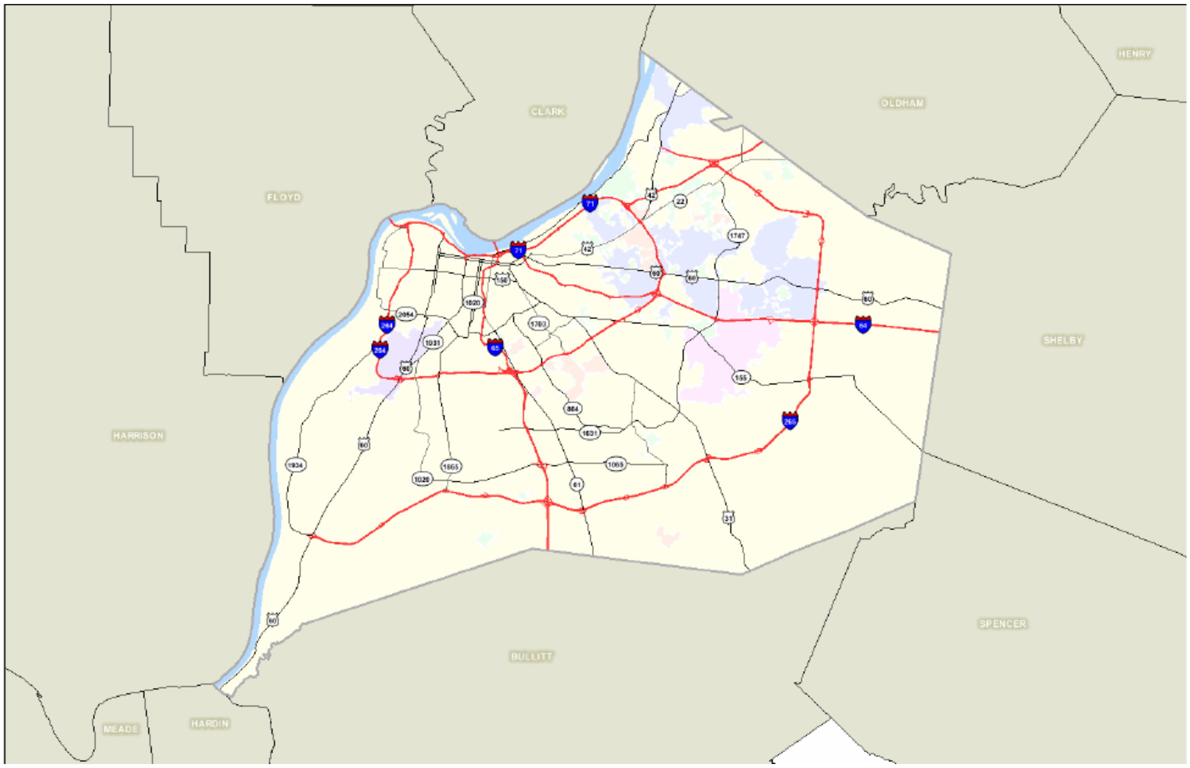
- Establish a benchmark for achieving reduction goals for the Louisville Metro community and PGC entities; and
- Demonstrate Louisville Metro's progress towards achieving environmental sustainability.

In 2003, Jefferson County and the City of Louisville merged to form a consolidated local government that now serves a community of 700,000 residents located in 386 square miles. This local government is referred to as Louisville Metro. Jefferson County also includes several smaller cities, which each have their own governments. After merger, those services previously provided by the former Jefferson County government were continued under the new Louisville Metro.

The necessary data sets for the community inventory, such as vehicle miles traveled (VMT) or solid waste collected, represent the entire county. Consequently, the community-level emissions inventory is for Jefferson County, as opposed to only Louisville Metro.[29] The geographic scope of the GHG inventory includes all emission sources from within the Jefferson County area. Figure 2-1 represents the existing geographic boundaries of Jefferson County.

[29] Refer to Section 2.3.2 for a discussion regarding operational and organizational boundaries to identify specific emission sources.

FIGURE 2-1. LOUISVILLE METRO – JEFFERSON COUNTY



(Map source from Louisville/Jefferson County Information Consortium, http://www.lojic.org/)

The geographic scope of the GHG inventory included all community-level data, which was comprised of aggregated energy use, transportation, industry type, and waste disposal data. Data from individual facilities was not examined.

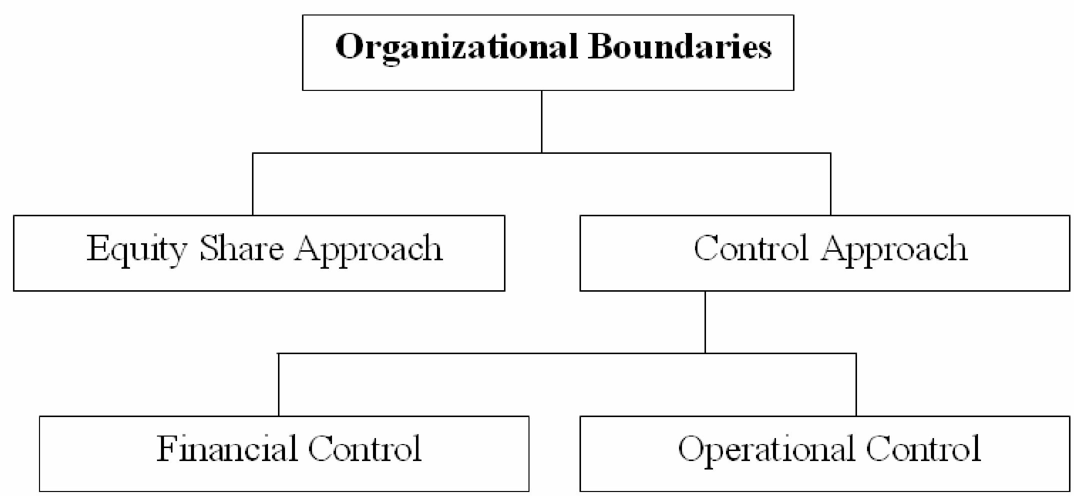
The geographical boundaries for Jefferson County are unlikely to change, but the emission sources and county population may over time. For the purposes of the inventory described in this report, it was assumed that the emission sources would remain constant for the projected years. Furthermore, it was assumed that population growth would remain constant, so population growth data was used to estimate projected emissions rates for 2012 and 2020. Figure 2-1 represents the existing geographic boundaries of Jefferson County.

2.3.2 ORGANIZATIONAL BOUNDARY

Information on facilities and operations that the PGC entities own and/or control were evaluated. For operations and facilities that are wholly owned, 100% of the associated emissions were included in the Partner's inventory. For operations and facilities that the PGC entities have a partial ownership share or working interest, hold an operating license, lease, or otherwise represent joint ventures or partnerships of some kind, there are two ways of reporting GHG emissions – by either the equity share approach or the control approach (Figure 2-2).

According to the World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol, an organization should account for 100% of the GHG emissions from operations over which it has control (control approach). However, control can be based on whether the organization has financial or operational control over the operation. For financial control reporting, the entity would have financial control over the operations with an interest in gaining economic benefit from the activities. For operational control, an entity would have full authority to introduce and implement its operating policies at the operation. Governmental reporting and emissions trading programs are typically based on the operational control approach, since responsibility for compliance typically falls to the operator and not the equity holders of the operation. Moreover, service sector industries mostly utilize the operational control approach.

FIGURE 2-2. ORGANIZATIONAL BOUNDARIES



For the PGC entity GHG inventories, the operational control approach was used for setting the organizational boundaries of each Partner's reported GHG emissions. According to the operational control approach, the PGC entities have only reported GHG emissions from sources where they have full authority to introduce and implement operating policies, including environmental, health, and safety policies.

The Governmental Module of the CACP software was used for all PGC entities' inventories. The GHG inventories for PGC entity operations were organized into six sectors: Buildings, Vehicle Fleet, Streetlights, Water/Sewage, Waste, and Other.[30] The inventories only accounted for the emissions from facilities, operations, programs, and

[30] GHG emissions from employee commute was classified as Scope 3 emissions and was not included in this inventory.

vehicles owned and/or operated directly by the PGC entities. According to the California Climate Action Registry (CCAR) and TCR General Reporting Protocols (GRP), reporting based on control requires reporting 100% of material emissions from entities that are operationally controlled.

2.3.3 GEOPOLITICAL BOUNDARY

The community's operations were evaluated based on its geopolitical boundary. The geopolitical boundary consists of activities that occur under the jurisdiction of the local government's policies.[31] The community-level GHG emissions inventory should separately account for emissions associated with operations of the government and all activities that occur in the geopolitical area. Activities that occur within the community boundary can be controlled or influenced by jurisdictional policies, educational programs, and the establishment of a precedent. Although some local governments may have only limited influence over the level of emissions from some activities, it is important that every effort be made to compile a complete analysis of all activities that result in the emission of GHGs. LMG has decided to include 100% of emissions from the community and PGC entities because they exist within the geopolitical boundary.

Specifically, the GHG emissions were reported from the Community and Governmental Modules of the CACP software. The Community Analysis was broken down into six sectors: Residential, Commercial, Industrial, Transportation, Waste, and Other.

2.3.4 OPERATIONAL BOUNDARY

An organization's operational boundary defines the type of emissions to be calculated. Generally, emissions are separated into three different categories:

- Scope 1: All direct GHG emissions (e.g., direct emissions from stationary combustion, mobile combustion emissions);
- Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling (e.g., indirect electricity emissions); and
- Scope 3: All other indirect emissions not covered in scope 2 (e.g., employee commuting and business travel, outsourced activities, etc.).

PGC's operational boundary includes scope 1 and scope 2 emissions. No scope 3 emissions have been included in this inventory.

2.4 INCLUDED EMISSIONS

The community inventory includes all of the major GHG emissions that actually occur within the geographic boundary defined above, including the emissions from electricity and natural gas usage in

[31] The geopolitical boundary approach is discussed in the ICLEI International Local Government Greenhouse Gas Protocol. The geopolitical boundary is not addressed in any other GHG inventory protocol and is used in conjunction with other protocols for the development of GHG emissions for local governments.

residential, commercial, and industrial sectors, waste disposal, and fleet emissions. The Partner's inventories include all major GHG emissions resulting from each entity's operations. While emissions due to PGC entity operations represent a small percentage of total GHG emissions in Jefferson County, they are the emission sources over which the Partners often have more direct influence or control.[32]

Calculations for the community's GHG emissions profile included as much of the energy consumed within the relevant geographic boundaries as could be quantified. The electricity used by Jefferson County residents is produced at LG&E's power generating stations. The decision to calculate all relevant emissions in this manner reflects the general philosophy that a community should take full ownership of the impacts associated with its energy consumption.

The following emissions sources are included, as they occur directly within the geographic boundary.

- GHG emissions from the combustion of natural gas as reported by LG&E within the emissions boundary. This includes natural gas usage in residential, commercial, and industrial sectors.
- GHG emissions from all electricity distribution as reported by LG&E. This includes electricity usage in residential, commercial, and industrial sectors.[33]
- GHG emissions from combustion of transportation fuel within the community boundary. This includes both onroad and nonroad vehicles operating within the community for which the data was provided. Onroad emissions were calculated using ICLEI's CACP software. Nonroad emissions were calculated by APCD for the community using the U.S. Environmental Protection Agency's (EPA) NONROAD 2005 model. Nonroad emissions for 2005 were directly entered as provided into the CACP software under the "other" subsector. These emissions are included in this report in the transportation sector.
- Emissions from community waste disposal, compost, and wastewater facilities.
- Fugitive emissions from coal handling and storage.
- GHG emissions from the LRAA. These emissions were calculated as part of a separate inventory process previously completed by LRAA and were entered directly as provided into the CACP software under the "other" subsector. These emissions are included in this report in the transportation sector.

Based on available electricity and gas usage data from LG&E for the residential, commercial, and industrial sectors, GHG emissions from these sectors are included in the community's GHG inventory. Since industry-specific emissions inventories are not available, these emissions have not been quantified separately. Other GHG emissions from the manufacturing and electricity generation sectors may also be included in their entity-level inventories and are not included as part of the community's GHG inventory. For example, a facility may have process emissions that are GHGs that result from the combustion of organic compounds in a thermal oxidizer.

---

[32] Entity operations represent approximately 4.7% of the total GHG Emissions in Jefferson County.

[33] Natural gas and electricity usage accounts for at least 90% of energy consumption sources per the Energy Information Administration 2005 Energy Consumption Estimates by Source (Tables S1, S4, and S5).

Table 2-2 provides a list of relevant community and PGC GHG emission sources, as well as the type of GHG emissions associated with each source, the sector to which these emissions are associated, and the source of the data used to calculate the GHG emissions.

TABLE 2-2. JEFFERSON COUNTY GHG EMISSIONS SOURCES

Category	Type of Source	GHGs	Expected Fuel	Sector (ICLEI)	Data Source
Emissions from Stationary Combustion – PGC Entities (i.e., fuel usage at PGC entities)	Boilers Generators/Engines	CO_2 CH_4 N_2O	Coal Natural Gas Propane Diesel Fuel Distillate Fuel	Buildings and facilities Water/Sewer	Fuel and electricity consumption.
Emissions from Stationary Combustion – Community	Boilers Generators/Engines	CO_2 CH_4 N_2O	Coal Natural Gas	Residential Commercial Industrial	Local Utility FERC Form records
Emissions from Mobile Combustion – PGC Entities	Fleet Vehicle Emissions from Partner owned and operated vehicles	CO_2 CH_4 N_2O	Gasoline Diesel CNG and Others	Vehicle Fleet	Vehicle Miles Traveled and type of vehicle or fuel tickets
Emissions from Mobile Combustion – Community	Fleet Vehicle Emissions from onroad and nonroad vehicles operating within the community	CO_2 CH_4 N_2O	Gasoline/E-10 Diesel/Ultra-Low Sulfur Diesel	Transportation	MPO Travel Demand Model, County vehicle registration, EPA's MOBILE 6.2, and NONROAD 2005 models, FHWA data.
Fugitive Emissions – PGC/Community	Coal Handling & Storage	CH_4	--	Other	Coal purchase/use records
Emissions from landfill incineration, compost, and wastewater facilities - Community	Solid waste disposal and wastewater treatment discharge	CH_4	--	Waste	County solid waste records for waste generated and disposal method
Emissions from landfill - PGC Entities	Solid waste disposal	CH_4	--	Waste	PGC Entity solid waste records
Emissions from LRAA – PGC Entity	Fleet Emissions from vehicle fleet and airplanes	CO_2	Gasoline/E-10 Diesel and Aviation Fuel	Vehicle Fleet	Louisville International Airport and Bowman Field 2004 Emissions Inventory

2.5 EXCLUDED EMISSIONS

GHG emissions from the manufacturing and electricity generation sectors may be included in their entity-level inventories and are not included as part of the community's GHG inventory. A brief summary of possible emission sources that are not included in the community inventory are provided below:[34]

[34] Note that the emissions associated with electricity and natural gas usage at these facilities are included in the community analysis.

- Fugitive emissions from the use of refrigerants in air conditioning systems, chillers, etc. (Applies to both community- and entity-level inventories)
- Emissions from harvesting, processing, manufacturing, or transportation of:
    - Construction materials (e.g., lumber, concrete & cement, steel, copper);
    - Agriculture industries (e.g., vegetables, fruits, meat, fowl);
    - Other processed materials (e.g., fertilizers, consumer chemicals); and
    - Other items (e.g., appliances, vehicles, aircraft, backhoes, heating and cooling equipment, asphalt for road construction).
- Transportation of the foregoing materials, goods, and equipment, often over thousands of miles.
- Emissions from the oil and natural gas industries, such as emissions from exploration, production, transportation, refining, and delivery of gasoline, diesel, and jet fuel.
- Scope 3 emissions associated with employee commuting (applies to entity-level inventories).

3. EMISSIONS ESTIMATION METHODOLOGY

The methodology used to create this report follows the same approach to emissions accounting used by the EPA in its national GHG emissions inventory and its guidelines for states.[35] These inventory guidelines were developed based on the guidelines from the IPCC, the international organization responsible for developing coordinated methods for national GHG inventories.[36] These inventory methods provide flexibility to account for local conditions.

ICLEI's CCP methodology allows local governments to systematically estimate and track GHG emissions from energy and waste related activities at the community-wide scale and those resulting directly from municipal operations. Once completed, these inventories provide the basis for creating emissions forecasts.

Emissions of GHG are presented using a common metric, CO_2e, which indicates the relative contribution of each gas to global average radiative forcing on a GWP weighted basis. That is, CO_2e is the concentration of CO_2 that would cause the same level of radiative forcing as a given type and concentration of GHG.

This report discusses emissions estimates for the year 1990, 2006, 2012, and 2020. Historical data for 1990 was collected to calculate 1990 baseline GHG emissions. The years 2012 and 2020 were chosen to project future emissions forecasts.

The community inventory consists of the following sectors:

- Residential: Electricity and natural gas consumption in residential buildings.
- Commercial: Electricity and natural gas consumption in commercial facilities.
- Industrial: Electricity and natural gas consumption in industrial facilities.
- Transportation: Gasoline/ethanol blended gasoline (E-10) and diesel/ultra-low sulfur diesel (ULSD) fuel used by onroad vehicles.[37] Airport emissions as calculated by LRAA and nonroad vehicles emissions as provided by APCD.
- Waste: Amount and composition of waste generated by residential and business sectors.
- Other: Fugitive emissions from coal handling that were calculated outside the CACP software.[38]

The base year, 1990, was chosen based on the U.S. Mayors Climate Protection Agreement and aligns with the typical method employed in the CCP Program, which is to establish a base year as

[35] http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsStateInventoryGuidance.html

[36] http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm

[37] E-10 and gasoline are interchangeable fuels. E-10 is comprised of 90% gasoline and 10% ethanol.

[38] The California Climate Registry. "The Power/Utility Reporting Protocol Version 1.0." (April 2005).

far into the past for which reliable data can be obtained. An inventory for current year (2006) was also established to show historical trends, and to predict future community GHG emission levels. The results in Section 4 summarize community and PGC emissions. Detailed emissions estimation methodology and data sources are also provided.

3.1 GENERAL PRINCIPLES OF REPORTING

WRI/WBCSD Greenhouse Gas Protocol sets forth generally accepted GHG accounting and reporting principles.[39] The following reporting principles, as established by WRI/WBCSD, form the basis for developing this GHG protocol for Jefferson County.[40]

- Relevance - The GHG inventory should appropriately reflect the GHG emissions of the company and serve the decision-making needs of users, both internal and external to the company.
- Completeness - The GHG inventory should account for and report on all GHG emission sources and activities within the chosen inventory boundary. Exclusions should be disclosed and justified. Baseline and annual emissions should include all significant sources (i.e., those above the de minimis level) and both vertical and horizontal integration should be considered. TCR GRP requires that at least 95% of emissions are reported.[41]
- Consistency - The GHG inventory should use consistent methodologies to allow for meaningful comparisons of emissions over time. Changes to the data, inventory boundary, methods, or any other relevant factors in the time series should be documented transparently. For example, LMG may follow the procedural and calculation methods outlined by TCR in the general reporting protocol.
- Transparency - The GHG inventory should address all relevant issues in a factual and coherent manner, based on a clear audit trail. Relevant assumptions and appropriate references to the accounting and calculation methodologies and data sources used should be disclosed.
- Accuracy - The GHG inventory should ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. In addition, the GHG inventory should achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

---

[39] WRI/ WBCSD, *The Greenhouse Gas Protocol, A Corporate Accounting and Reporting Standard* (Revised Edition), pp. 7.

[40] These principles are for companies; however, most of principles should be applied for the Jefferson County inventory.

[41] According to a memo from TCR's Programs and Protocols Committee and Executive Committee to the Board of Directors, dated January 9, 2008, reporters must calculate 95% of emissions using the prescribed calculation methods in the TCR GRP, but may estimate up to 5% of emissions using alternative or simpler methods.

Emissions included in a GHG inventory are calculated for fossil fuel combustion and electricity usage, mobile combustion, waste disposal, and fugitive sources.[42] CO_2 emissions comprise the largest percentage of a community's GHG emissions, due to direct emissions from fossil fuel combustion and indirect emissions from electricity consumption. Since CO_2 is a product of complete combustion, these emissions are largely dependent on the carbon content of the fuel, the type and amount combusted, and the percentage of the fuel that is oxidized (i.e., the yield). Not all fuel carbon is oxidized to CO_2, and inherent combustion inefficiencies cause carbon to remain unburned as soot or ash or emitted as a hydrocarbon. Unlike CO_2, the CH_4 and N_2O emissions are dependent on the type of firing configuration (e.g., boilers, gas fired turbines, dual fired engines), which have varying degrees of combustion efficiencies.

3.1.1 CACP SOFTWARE

To facilitate local government efforts to identify and reduce GHG emissions, ICLEI developed the CACP software package. The majority of Jefferson County and PGC GHG emissions were computed directly using this software. The software estimates emissions derived from energy consumption and waste generation within a community using specific factors (or coefficients) according to the type of fuel used. In addition, the software quantifies the benefit of actions that have the effect of avoiding or reducing CO_2e emissions. Emissions are aggregated and reported in units of metric tons of CO_2e. Converting all emissions to CO_2e units allows for the consideration of different GHG in comparable terms. For example, CH_4 is twenty-one times more powerful than CO_2 in its capacity to trap heat, so the model converts one ton of CH_4 emissions to 21 tons of CO_2e. CO_2e is calculated by converting non-CO_2 GHG emissions to CO_2e using the GWPs of the individual GHGs, which can be found in Table 2-1.

The CACP software has been and continues to be used by over 200 U.S. cities and counties to track their GHG emissions. However, it is worth noting that although the software provides Jefferson County with a useful tool, calculating emissions from energy use with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quantity and quality of available data. With this in mind, it is useful to think of the numbers generated by the model as approximations, rather than exact values.

The emissions coefficients and methodology employed by the software are consistent with national and international inventory standards established by the IPCC and the U.S. Voluntary GHG Reporting Guidelines.[43, 44]

[42] Fugitive emissions sources in the inventory included CH_4 emissions from coal handling and storage.

[43] 1996 Revised IPCC Guidelines for the Preparation of National Inventories.

[44] Energy Information Administration (EIA) Form 1605

3.1.2 DATA COLLECTION

The creation of an emissions inventory required the collection of information from a variety of sectors and sources. For Jefferson County, the main sources of data were:

- Community fuel use (i.e., natural gas) and electricity usage data gathered from the primary energy provider (LG&E) and PGC entities;
- Fuel type, fuel usage, and VMT for the community and PGC entity vehicles;
- Quantity of waste disposed in the community and disposal method(s) of waste generated within the community;
- Amount of coal handled and stored at UofL to estimate fugitive CH_4 emissions[45]; and
- Information for nonroad sources (NONROAD 2005 models), which includes emissions from forklifts, backhoes, lawn mowers, etc., and LRAA.

This data was entered into the software to create community and PGC entity emissions inventories. The community inventory represents all energy use within Jefferson County, including residential, commercial, and industrial sectors, and its contribution to GHG emissions. The PGC inventories are a subset of the community inventory, and include energy use and emissions derived from the PGC entities and quasi-government operations.

There are two main reasons for completing separate emissions inventories for community and PGC entity operations. First, once the Partners have committed to taking action on climate change, they have a higher degree of control to achieve reductions in their own emissions than those created by the community at large. Second, by proactively reducing PGC entity emissions the Partners take a visible leadership role in the effort to save energy, reduce operating costs, and address climate change. This is important for inspiring local action in Jefferson County and other nearby communities.

The community and PGC entity inventories are based on the calendar year 2006. In addition, a community emissions inventory was compiled for 1990 to aid in emissions projections and the development of reduction strategies. In collecting this data, all reasonable attempts were made to include all sources of energy used. For more information on sources of data see Table 2-2.

3.2 SOURCE SPECIFIC EMISSIONS CALCULATIONS

This section of the report documents CO_2e emissions calculation methodology for sources in the community. The majority of the calculations were performed using the CACP software, but in

---

[45] Note that the fugitive CH_4 emissions were quantified outside the CACP software.

some cases further analysis was necessary. The Jefferson County emissions inventory consists of the following sectors:

- Government Emissions: Includes the emissions from PGC entity owned and operated buildings and vehicles, waste, and water/sewage operations.
- Residential: Electricity and natural gas consumption in residential buildings in Jefferson County.
- Commercial: Electricity and natural gas consumption in commercial facilities in Jefferson County.
- Industrial: Electricity and natural gas consumption in Jefferson County industrial facilities.
- Transportation: Fuel used by onroad and nonroad vehicles in Jefferson County.
- Waste: Amount and composition of waste generated by residents, businesses, and by the construction and demolition sector.
- Other: Emissions not calculated using the CACP software, such as fuel used by planes leaving airports within Jefferson County. The transportation and waste emissions entered into the other sector of the CACP software were aggregated in their appropriate sector in the emissions analysis portions of this report.

General descriptions of the calculation methods and data sources for some general categories are included below. All data was obtained after initial review performed by APCD. Further information on the calculation methodologies can also be found in the appendices. To the furthest extent practicable, quantities, values, and coefficients used in the generation of these inventories have been documented and are organized in the appendices, which include:

- Appendix A: Emissions Summary Tables
- Appendix B: Summary of Data Collected
- Appendix C: Community and PGC Entity Emissions Analysis
- Appendix D: Emission Factors

3.2.1 EMISSIONS FROM STATIONARY COMBUSTION AND ELECTRICITY USAGE

Community fuel use (i.e., natural gas) and electricity usage data from Jefferson County's primary energy provider (LG&E) was obtained to calculate CO_2 emissions from the combustion of fossil fuel used within the community's geopolitical boundary. Wherever possible, the data was segregated by the energy provider into sectors of the economy (residential, commercial, and industrial). The community electricity and fuel usage for 1990 and 2006 was obtained from the Federal Energy Regulatory Commission (FERC) Financial Report Form No. 1: Annual Report of Major Electric Utilities and FERC Financial Report Form No. 2: Annual Report of Major Natural Gas Companies for LG&E. For the Partners, the energy usage data was provided by the responsible individuals at each entity. For UofL, it was assumed that the 2006 fiscal year (July 1, 2005 to June 30, 2006) data is representative of the 2006 calendar year to estimate the entity emissions for UofL.

Stationary source fuel combustion CO_2, CH_4 and N_2O emission factors were obtained from ICLEI's CACP software and the community usage data was entered in the software to estimate emissions.

3.2.2 EMISSIONS FROM MOBILE COMBUSTION

Community mobile source GHG emissions were calculated for vehicles that operated within the geopolitical boundary of the community. The community fuel type, fuel usage, and VMT was provided by LMG based on aggregate data available for the onroad vehicles of Jefferson County. This data was based on information from the local metropolitan planning organization (MPO), Kentuckiana Regional Planning & Development Agency (KIPDA), travel demand model, county vehicle registration, EPA's MOBILE 6.2 model, and Federal Highway Administration (FHWA) data. The usage data categorized by vehicle and fuel type was entered directly into the CACP software and mobile source combustion CO_2, CH_4, and N_2O emission factors were obtained from ICLEI's CACP software. Nonroad vehicle emissions were provided by LMG for 2005. Nonroad emissions were calculated by APCD using EPA's NONROAD 2005 emissions model and therefore, emissions were directly entered into the CACP software under the "other" emissions sector. The 2012 and 2020 emissions projections were calculated using these same methods.

The PGC entities provided the fuel type, fuel usage, and VMT data for the vehicles owned and operated by the Partners. The LRAA emissions were not quantified using the CACP software and were made available by LRAA for use in this project. LRAA data was for 2004 but it was assumed to be representative of the inventory year (2006) since no major operational changes took place in the interim.

3.2.3 EMISSIONS FROM WASTE

Waste related GHG emissions may come from a variety of disposal scenarios including solid waste disposal, land filling, open dumping, controlled incineration, open burning, and composting. In order to accurately calculate emissions from waste, the following information was obtained:

- Disposal method(s) of waste generated within the community and by PGC entities; and
- Quantity of waste disposed by the community.

Emissions from waste disposal were calculated using the methane commitment method in the CACP software to estimate the release of GHGs from waste disposed in any year. Waste deposited in landfills may sequester carbon (i.e., be a "negative" source or sink of carbon) because a large portion of the CH_4 generated from the anaerobic decomposition of these waste types is recovered. Wastes that sequester carbon include plant debris, wood, and textiles; this causes total carbon sequestration to exceed the CO_2e emissions from the landfill. The amount of waste that is recycled was also excluded from emissions calculations. Only the amount of waste generated in Jefferson County and by PGC entities were included in the respective inventories.

Waste Management Inc.'s Outer Loop Landfill in Jefferson County applies methane recovery operations wherein landfill gas is captured and/or flared. Captured CH_4 is sent to a local manufacturing facility for use in their boilers. These activities greatly reduce the amount of CO_2e emissions that are released into the atmosphere. The remaining fugitive emissions (i.e., those landfill gas emissions that are not recovered) have also been calculated and are included in the total waste sector emissions.

3.2.4 FUGITIVE EMISSIONS

Fugitive emissions are unintentional releases of GHGs. Fugitive emissions may include:

- CH_4 from coal handling and storage;
- HFCs from air conditioning and refrigeration systems (both stationary and mobile); and
- PFCs from fire suppression equipment.

Fugitive CH_4 emissions from coal handling and storage were only estimated on an entity-level basis for UofL because coal is used in the on-site boilers. It is assumed that all coal used in the fiscal year was purchased in that year. Different types of coal off-gas CH_4 at different rates, but since coal is usually removed from a mine within hours or days of being mined, some CH_4 remains and is liberated from the coal during handling operations. In addition, the method used to mine the coal determines the emission factor used to calculate the emissions. It is assumed the coal combusted was obtained by underground coal mining, which is associated with a conservative emission factor. The actual mining and transportation activity emissions are not included in the UofL inventory. The emission calculation methodology specified is derived from CCAR's Power/Utility Protocol (Table 3-1).[46]

[46] CCAR Power/Utility Protocol, Section 10.1.2, Version 1.0, April 2005.

TABLE 3-1. FUGITIVE EMISSIONS CALCULATION METHODOLOGY

Fugitive CH_4 Emissions (scf/yr)	=	Coal Purchased (tons) x Emission Factor (scf CH_4/ton)
Fugitive CH_4 Emissions (metric tons/yr)	=	Fugitive CH_4 Emissions (scf/yr) x 0.04228 (lb CH_4/scf)/2,204.6 (lb/metric ton)[47]
Carbon Dioxide Equivalent (CO_2e)	=	CH_4 Emissions (metric tons) x CH_4 GWP

Note: scf means standard cubic foot and lb means pound.

No HFC and PFC emissions were quantified because no relevant data is available at this time.

3.3 DE MINIMIS EMISSIONS

When inventorying GHG emissions, it is important to ensure that a majority of material emissions are included in the inventory. This can be accomplished by setting a de minimis or materiality threshold. For example, a de minimis threshold of 5% would mean that the inventory accounts for 95% of emissions and that the remaining 5% of emissions from one or more sources (or one or more gases) are immaterial. This materiality threshold is important because tracking of small sources may be unduly burdensome and costly.

Based on the developing TCR guidance, it is recommended that a 5% de minimis threshold be adopted. After completion of the historical and current year (1990 and 2006) inventories, this de minimis threshold could be adopted to streamline data gathering efforts for future years. For those sources and/or gases that fall within the de minimis threshold, emissions need not be calculated in the future unless the underlying assumptions used to calculate emissions from these sources change materially.

[47] Methane density [0.04228 (lb CH4/scf)] is derived from Equation 10a of CCAR Power/Utility Protocol, Page 54.

4. LOUISVILLE METRO GREENHOUSE GAS EMISSIONS 2006

GHG emissions cannot be well *managed* unless they are accurately *quantified*. Therefore, in order meet the GHG emissions reduction goal of 7% of 1990 levels by 2012 and to meet environmental sustainability goals, Louisville Metro has initiated an effort to determine its historical and projected anthropogenic GHG emissions. This effort involves the development of comprehensive, transparent, and verifiable GHG inventories for Louisville Metro's municipal operations and the Jefferson County community. This project also includes inventories for LMG's cohorts in the PGC. The sections below provide the results of the analysis of 1990 and 2006 emissions for the community and 2006 emissions for the PGC entities.

As stated above, 2006 was used as the current year for the analysis, while a historical inventory was gathered for 1990. GHG emissions, measured in tons of CO_2e, were calculated for the energy used in municipal, residential, commercial, and industrial sectors, as well as for onroad and nonroad transportation. Emissions resulting from the decomposition of solid waste were also estimated. ICLEI's CCP methodology does not require that the emissions inventory of an individual city include all emissions resulting from air travel or refrigerant usage from air conditioning units within a city – due to the complexity of acquiring accurate data. Accordingly, Louisville Metro has not, in general, included any emissions from refrigerant usage in air conditioning units. Notwithstanding this approach, LRAA calculated 2004 GHG emissions, so these emissions have been included in the inventory.[48]

The results of this analysis comprise the remainder of this section, where the emissions are broken down into individual sectors. The general methodology used to create the following inventory is outlined in Section 3, while a more detailed explanation of the specific emission sources are given in Appendices A and B.

4.1 COMMUNITY EMISSIONS

The GHG emissions inventory data was calculated using ICLEI's CACP software. The community inventory includes all the major GHG emissions that actually occur within the geographic boundary defined above, including the emissions from energy used in municipal, residential, commercial, and industrial sectors, as well as for onroad and nonroad transportation, public transit, and waste disposal. Trinity calculated the total community 1990 and 2006 GHG emissions from Jefferson County to be approximately 18,208,833 and 19,249,306 metric tons CO_2e respectively. A summary of total GHG emissions by sector for 1990 and 2006 is provided in Figure 4-1 and Figure 4-2, respectively. The emissions summary in Table 1-1 is also provided here in Table 4-1.

[48] It is assumed that 2004 emissions estimates provided by LRAA is representative of their 2006 emissions profile.

FIGURE 4-1. 1990 JEFFERSON COUNTY COMMUNITY CO_2E EMISSIONS BY SECTOR

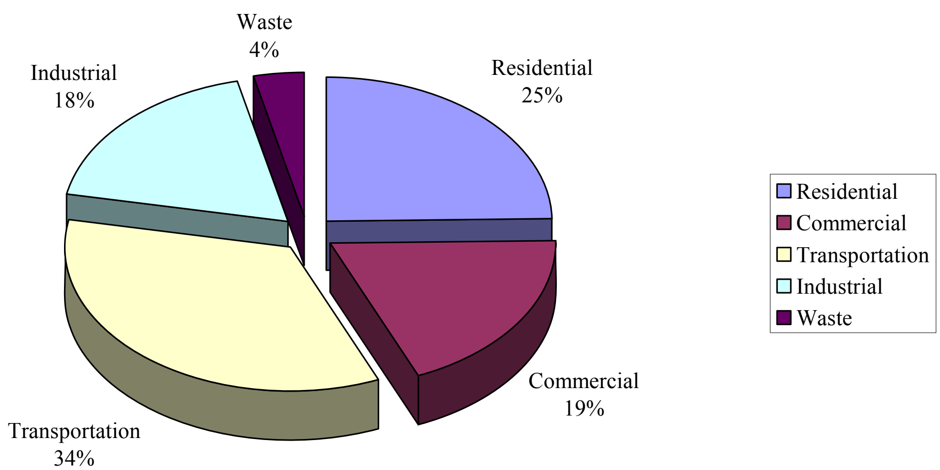
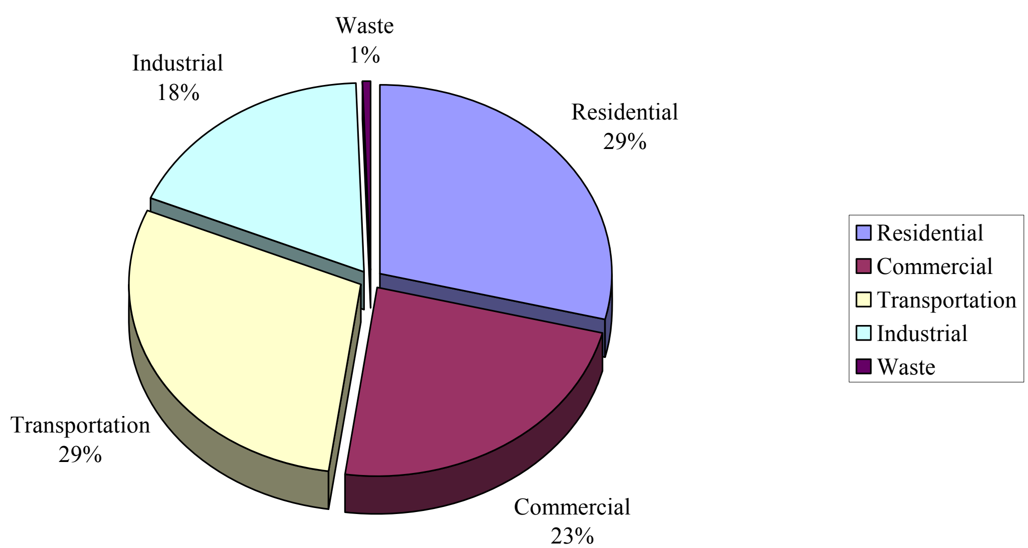


FIGURE 4-2. 2006 JEFFERSON COUNTY COMMUNITY CO_2E EMISSIONS BY SECTOR



The following sector specific analysis is provided for 1990 and 2006 emissions.

TABLE 4-1. 1990 AND 2006 EMISSIONS BY SECTOR

Sector	CO_2e (tons)	
	1990	2006
Residential	4,522,223	5,554,793
Commercial	3,399,389	4,501,454
Transportation	6,286,333	5,611,642
Industrial	3,318,719	3,483,336
Waste	682,169	98,081
Total	**18,208,833**	**19,249,306**
Population	**665,123**	**703,998**
CO_2e (tons) per Capita	**27.38**	**27.34**

For 1990 and 2006, the two largest sources of CO_2e emissions are the transportation and residential sectors, both of which combined are responsible for about one-half of the total CO_2e emissions from community sources.[49] These emissions result from indirect emissions from electricity usage, direct emissions from fuel usage in the residential buildings, and direct emissions from fuel usage in community vehicles.[50] The emission factors in the CACP software are specific to the geographic region and are affected by the local fuel characteristics.

The details supporting all GHG emissions calculations are included in Appendix C. Based on the FERC data made available from LG&E, it was determined that the use of natural gas and electricity accounted for most of the community emissions.[51] It is important to note that the total emissions have risen steadily over the period studied. Emissions increased by a total of approximately 5.7% between 1990 and 2006. For Jefferson County to achieve its target of a 7% reduction below 1990 levels by 2012, this upward trend in total emissions will have to be studied and relevant mitigation steps developed accordingly.

4.1.1 RESIDENTIAL SECTOR

For the residential sector, only electricity and natural gas data was provided. Figure 4-3 shows the breakdown of CO_2e emissions by source for the residential sector in 1990. As shown, 71% of emissions are attributable to the electricity usage, which is 3,233,095 tons of CO_2e. Natural gas usage is responsible for 29%, or 1,289,128 tons of CO_2e. Figure 4-4 shows the breakdown of CO_2e emissions by source for the residential sector in 2006. As shown, 80% of emissions are attributable to electricity

[49] The "other" sector as defined by the CACP software includes emissions from nonroad sources. Those emissions are included in the transportation sector in this analysis.

[50] Note that only natural gas usage is included to estimate emissions associated with fuel usage because only this data was available from FERC forms.

[51] Emissions may occur from usage of other fuel types by industries in Jefferson County; however, these emissions would be quantified by the specific industries and would accrue to them. Also, emissions from coal combustion at UofL are included in its entity inventory.

usage, which is 4,431,943 tons of CO_2e. Natural gas usage is responsible for 20%, or 1,122,850 tons of CO_2e.

FIGURE 4-3. 1990 JEFFERSON COUNTY RESIDENTIAL SECTOR CO_2E EMISSIONS BY SOURCE

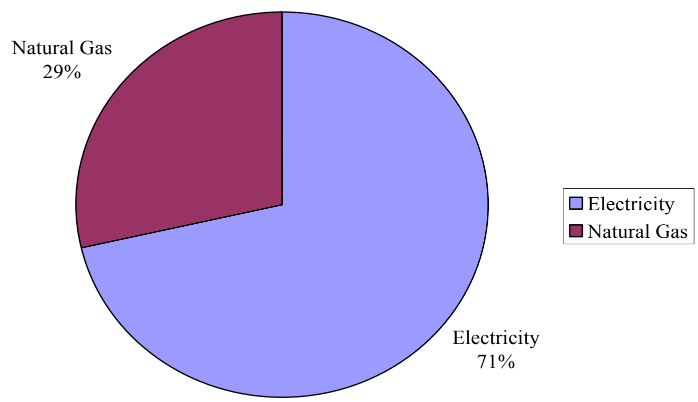
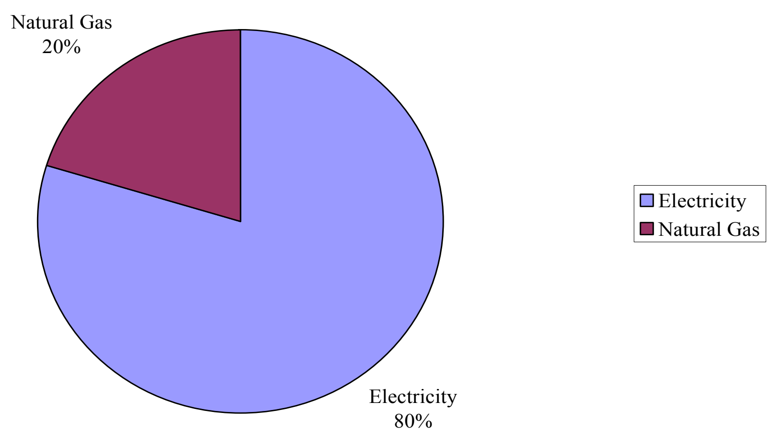


FIGURE 4-4. 2006 JEFFERSON COUNTY RESIDENTIAL SECTOR CO_2E EMISSIONS BY SOURCE



4.1.2 COMMERCIAL SECTOR

As with the residential sector, only electricity and natural gas usage data was provided for the commercial sector. Figure 4-5 shows the breakdown of CO_2e emissions by source for the commercial sector in 1990. As shown, 84% of emissions are attributable to the electricity usage, which is 2,863,559 tons of CO_2e. Natural gas usage is responsible for 16%, or 535,830 tons of CO_2e. Figure 4-6 shows the breakdown of CO_2e emissions by source for the commercial sector in 2006. As shown, 89% of emissions are attributable to the electricity usage, which is 3,989,092 tons of CO_2e. Natural gas usage is responsible for 11%, or 512,362 tons of CO_2e. Emissions contribution from other fuels could also be included in the commercial sector upon availability of the usage data.

FIGURE 4-5. 1990 JEFFERSON COUNTY COMMERCIAL SECTOR CO_2E EMISSIONS BY SOURCE

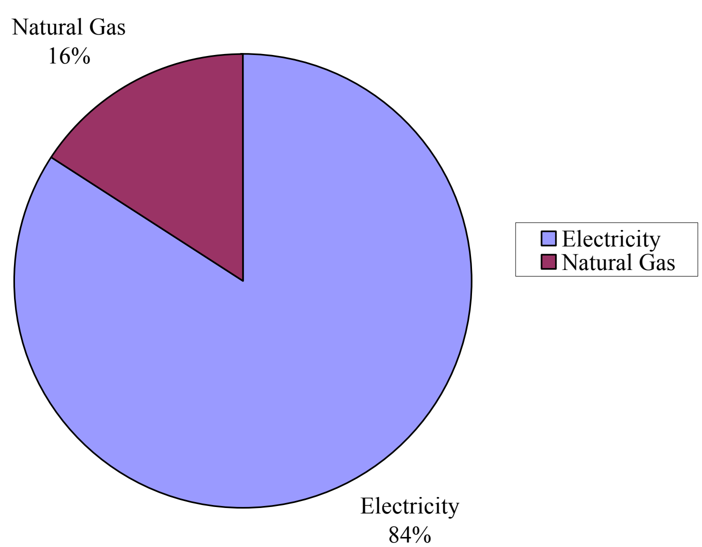
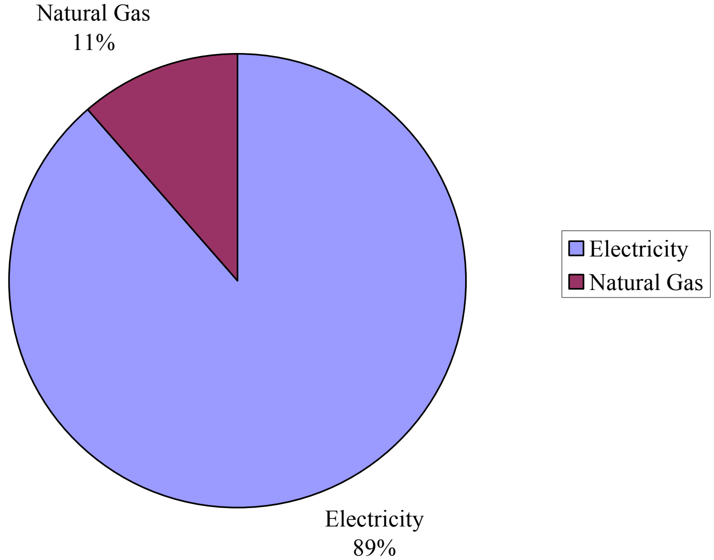


FIGURE 4-6. 2006 JEFFERSON COUNTY COMMERCIAL SECTOR CO_2E EMISSIONS BY SOURCE



4.1.3 INDUSTRIAL SECTOR

Only electricity and natural gas usage data was provided for the industrial sector, as with the residential and commercial sectors. Figure 4-7 shows the breakdown of CO_2e emissions by source for the industrial sector in 1990. As shown, 91% of emissions are attributable to the electricity usage, which is 3,019,561 tons of CO_2e. Natural gas usage is responsible for 9%, or 299,158 tons of CO_2e. Figure 4-8 shows the breakdown of CO_2e emissions by source for the industrial sector in 2006. As shown, 97% of emissions are attributable to the electricity usage, which is 3,389,344 tons of CO_2e. Natural gas usage is responsible for 3%, or 93,992 tons of CO_2e. Emissions contribution from other fuels could also be included in the industrial sector upon availability of the usage data. Other possible fuels could include natural gas (purchased from a wholesale power broker), coal, or process waste.

FIGURE 4-7. 1990 JEFFERSON COUNTY INDUSTRIAL SECTOR CO_2E EMISSIONS BY SOURCE

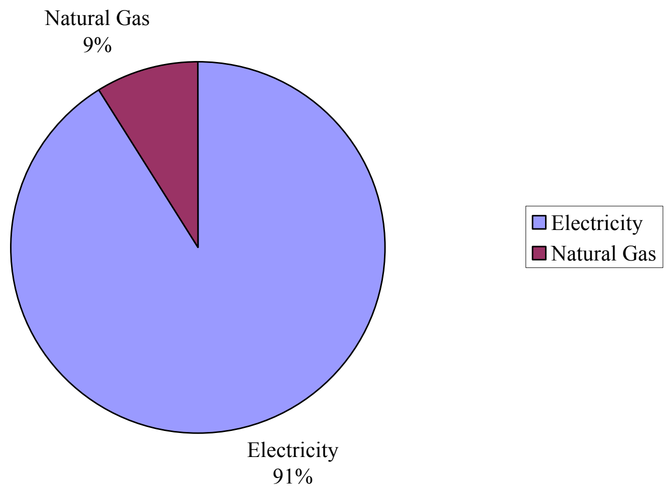
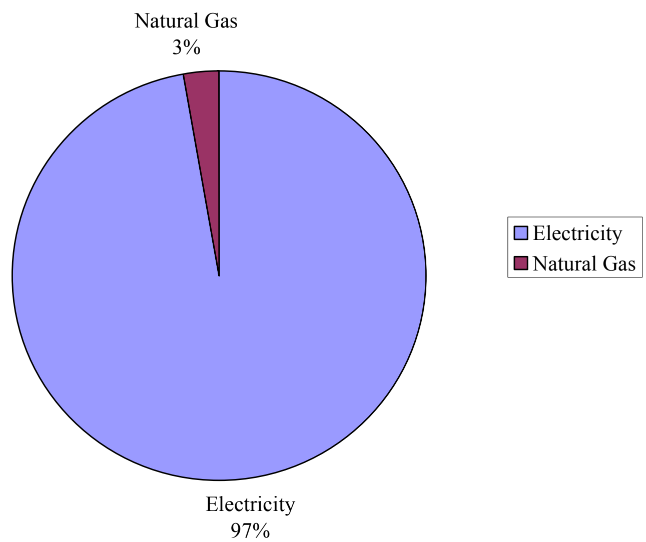


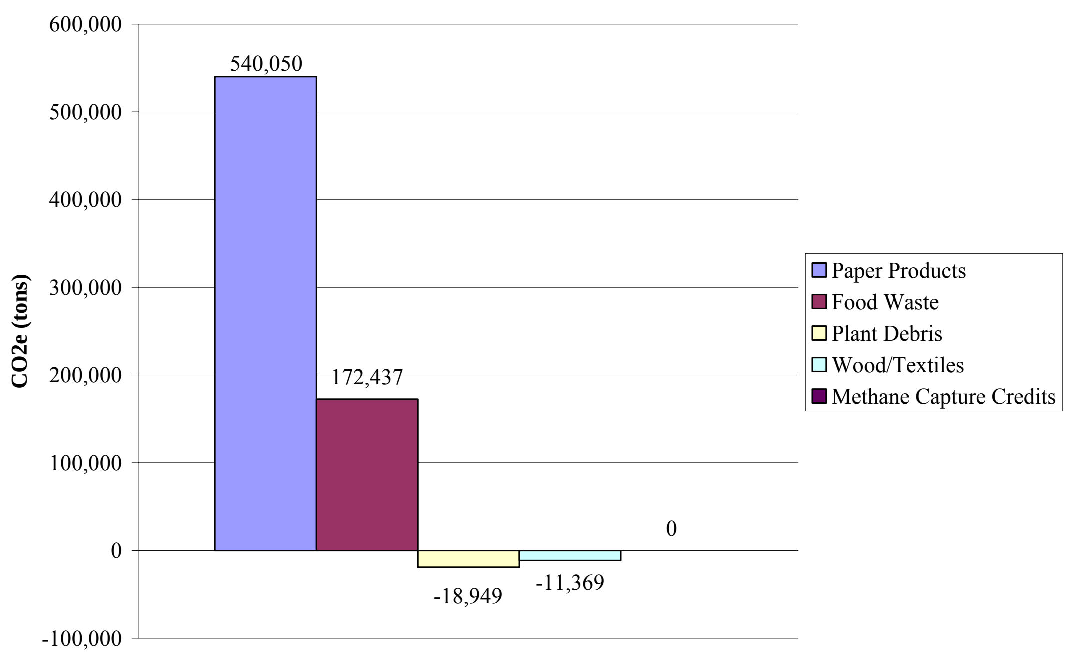
FIGURE 4-8. 2006 JEFFERSON COUNTY INDUSTRIAL SECTOR CO_2E EMISSIONS BY SOURCE



4.1.4 WASTE SECTOR

It is estimated that during 2006, approximately 1,048,089 metric tons of solid waste were generated from the Jefferson County community. The majority of this was sent to the Outer Loop Landfill in Jefferson County.[52] As a portion of the landfilled waste decomposes, CH_4 gas is created. The decomposable portion of Jefferson County's waste was assumed to have consisted of 35% paper products, 12% food waste, 12% plant debris, 13% wood and textiles, and 28% other waste.[53] These emissions are accounted for in the community inventory. The waste sector emissions profile for 1990 and 2006 is highlighted in Figure 4-9 and Figure 4-10, respectively.

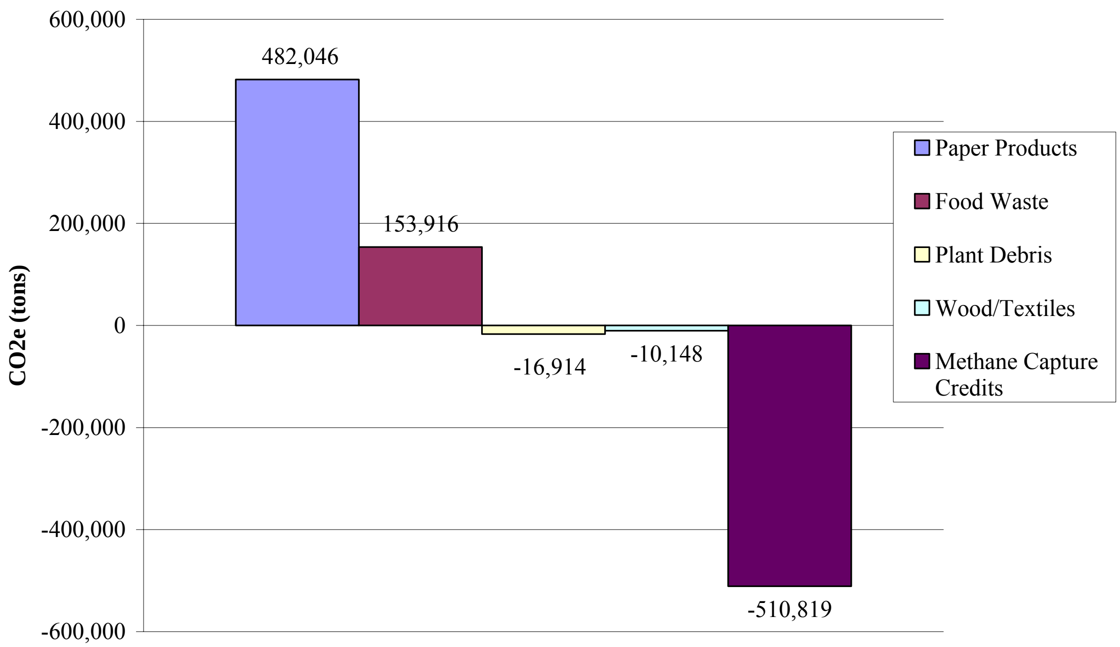
FIGURE 4-9. 1990 JEFFERSON COUNTY WASTE SECTOR CO_2E EMISSIONS BY SOURCE



[52] Data provided by the Louisville Metro Division of Solid Waste Management.

[53] The waste composition values were derived from ICLEI's CACP software. The values represent typical U.S. waste streams and were used as defaults.

FIGURE 4-10. 2006 JEFFERSON COUNTY WASTE SECTOR CO_2E EMISSIONS BY SOURCE



The Outer Loop Landfill is engaged in methane capture operations. The reduction of emissions from methane capture operations is calculated by adding the volume of gas that was captured either by flaring at the landfill, or by collecting and transmitting to General Electric for use as a fuel. The total volume of gas captured is converted to total metric tons of CO_2e. This value is the total emissions diverted from entering the atmosphere as fugitive emissions from the landfill. Because the GWP of CH_4 is high, the total CO_2e diverted is significantly greater than the total CO_2 emitted from CH_4 flaring or use as a fuel. This total, a carbon sink, is subtracted from the emissions calculated by the CACP software for the waste sector to estimate the net emission rate.

In 1990, emissions from the waste sector accounted for 682,169 metric tons of CO_2e.[54] This resulted from 540,050 metric tons of CO_2e from paper products, 172,437 metric tons from food waste, -18,949 metric tons from plant debris, and -11,369 metric tons from wood and textiles. Negative emissions indicate carbon sinks. Wastes that sequester carbon consist of plant debris, wood, and textiles. The amount of the CH_4 generated by the anaerobic decomposition of these waste types causes total carbon sequestration to exceed the CO_2e emissions from the landfill. For example, the

[54] In 1991, data for two quarters were provided, as well as an average ton per day value. Based on the ton per day value, an annual waste generated total was calculated by multiplying the ton per day value of waste generated by 365 days.

decomposition of newsprint in a managed landfill, even with no CH_4 collection, acts as a carbon sink, with the amount of carbon sequestered exceeding the CH_4 emitted. The amount of waste that is recycled was also excluded from emissions calculations. Only the amount of waste generated in Jefferson County and by PGC entities were included in their respective inventories. The methane capture and control data was only provided for 2006; therefore, the data for 2012, and 2020 was estimated based on the population data. Based on available data, it was confirmed that methane capture and control operations were active in 1992. However, it could not be confirmed in the time available that methane capture and control operations were conducted in 1990. Therefore no emission credits corresponding to methane capture and control were applied for 1990.

In 2006, the emissions from the waste sector accounted for 98,081 metric tons of CO_2e. This resulted from 482,046 metric tons of CO_2e from paper products, 153,916 metric tons from food waste, -16,914 metric tons from plant debris, and -10,148 metric tons from wood and textiles (again, negative emissions indicate carbon sinks). The CH_4 capture operations discussed above accounted for -510,819 metric tons of CO_2e for 2006. Figure 4-10 shows a breakdown of the CO_2e emissions by source for the waste sector in 2006.

4.1.5 TRANSPORTATION SECTOR

Jefferson County onroad vehicles used gasoline, E-10 and diesel (normal and ULSD) fuels to power cars, trucks, and mass transit, which resulted in the emissions of approximately 5,887,782 tons of CO_2e in 1990 and 5,174,358 tons of CO_2e in 2006. Nonroad transportation emissions were calculated by APCD. It was estimated that in 1990, 398,551 tons of CO_2e and in 2006, 437,284 tons of CO_2e were emitted by nonroad vehicles. These emissions were entered into the "other" sector of the CACP software, but were added to the overall transportation sector emissions total.

Figure 4-11 shows that in 1990, 73% of GHG emissions, or 4,564,634 tons of CO_2e, came from the use of gasoline, while diesel accounted for 21%, or 1,323,148 tons of CO_2e. Total 1990 emissions from the transportation sector, including emissions from nonroad sources, were 6,286,333 CO_2e tons. In 2006 all gasoline sold in Louisville Metro was required to be E-10. Also, by October 2006 onroad diesel vehicles were required to use ULSD. As shown in Figure 4-12, 68% of GHG emissions, or 3,793,654 tons of CO_2e, came from the use of E-10, while diesel and ULSD accounted for the remaining 24%, or 1,380,704 tons of CO_2e. Total 2006 emissions from the transportation sector, including nonroad sources, were 5,611,642 CO_2e tons.[55]

[55] Since the nonroad emissions are attributed to LRAA, these emissions are included in the emissions distribution chart.

FIGURE 4-11. 1990 JEFFERSON COUNTY COMMUNITY TRANSPORTATION CO_2E EMISSIONS BY FUEL TYPE

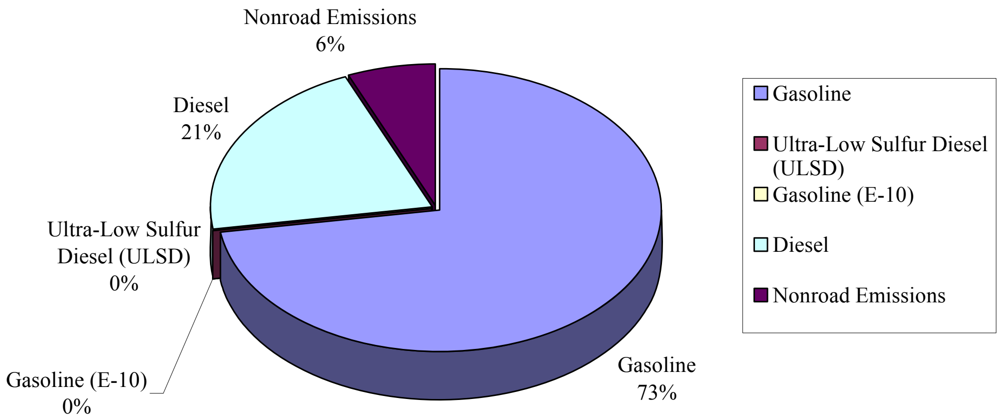
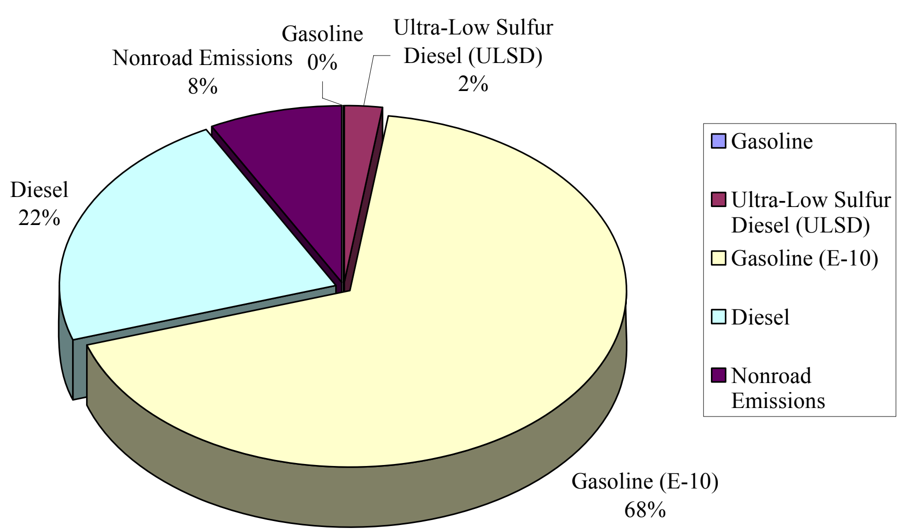


FIGURE 4-12. 2006 JEFFERSON COUNTY COMMUNITY TRANSPORTATION CO_2E EMISSIONS BY FUEL TYPE



Transportation emissions were analyzed using the CACP software to examine the effects of increased vehicle efficiencies. The CACP software contains default vehicle efficiency factors that change over time. The factors for the vehicle fleet incorporate the effect of gradual implementation of increasingly stringent emission reduction requirements, as reflected by federal regulations. The analysis provided in Table 4-2 indicates that the reduction in emissions from 1990 to 2006 emissions would not have occurred if increased vehicle efficiency standards were not required, despite the switch from gasoline usage to E-10 and an increase in ULSD usage.

TABLE 4-2. 1990 AND 2006 TRANSPORTATION EMISSIONS FOR JEFFERSON COUNTY – STATIC FUEL EFFICIENCY STANDARDS

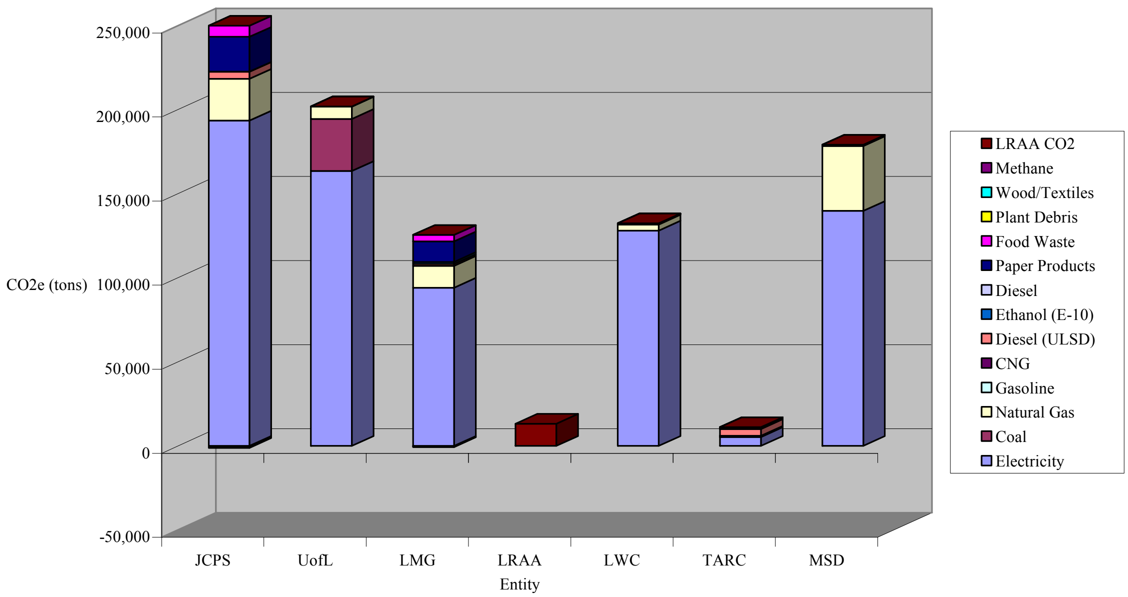
	CO_2e (tons)	
Sub-Sector	**1990**	**2006**
Gasoline	4,564,634	0
Ultra-Low Sulfur Diesel (ULSD)	0	128,981
Gasoline (E-10)	0	3,793,654
Diesel	1,323,148	1,251,723
Nonroad Emissions	398,551	437,284
Total	**6,286,333**	**5,611,642**

4.2 PARTNERSHIP FOR A GREEN CITY GREENHOUSE GAS EMISSIONS INVENTORIES

The majority of GHG emissions for the PGC entities were calculated using the CACP software. Trinity calculated that the total 2006 GHG emissions from PGC entities, for which records were available, were approximately 911,188 metric tons of CO_2e, as shown in Figure 4-13 below. PGC entities include the following:

- Louisville Metro Government (LMG);
- Jefferson County Public Schools (JCPS);
- University of Louisville (UofL);
- Metropolitan Sewer District (MSD);
- Transit Authority of River City (TARC);
- Louisville Water Company (LWC); and
- Louisville Regional Airport Authority (LRAA).

FIGURE 4-13. 2006 PGC ENTITY CO_2E EMISSIONS BY SECTOR



GHG emitted as a result of the PGC entity operations in 2006 are a subset of the community emissions, representing approximately 4.73% of the citywide total. Emissions from PGC entity operations were categorized into three different sectors:

- Buildings – Emissions based on fuel usage in combustion units and electricity/natural gas/coal used in PGC entity operations. Emissions based on coal handling/storage fugitive emissions.
- Vehicle Fleet – Emissions based on fuel usage from PGC entity fleets and LRAA emissions data.
- Waste – Emissions based on the waste generated from PGC entities.

As shown in Figure 4-13, the electricity usage and the combustion of natural gas and fuel oil in buildings owned or leased by PGC entities accounted for the largest portion of CO_2e emissions in 2006. Buildings were responsible for approximately 843,132 metric tons of CO_2e, or 93% of the total emissions attributable to PGC operations. Emissions of CO_2e generated by waste accounted for the second largest contribution of emissions at 5%, producing approximately 41,579 metric tons of CO_2e. The remaining emissions from vehicle fleets and other sources accounted for less than 3% of the PGC entity emissions, or about 26,477 metric tons of CO_2e. Table 4-3 lists CO_2e emissions by sector.

TABLE 4-3. 2006 PGC ENTITY CO_2E EMISSIONS BY SECTOR

Sector	CO_2e (tons)						
	JCPS	**UofL**	**LMG**	**LRAA**	**LWC**	**TARC**	**MSD**
Buildings	218,297	201,802	107,107	0	131,639	5,958	178,329
Vehicle Fleet	4,267	65	2,259	13,215	747	5,150	774
Waste	26,143	0	15,436	0	0	0	0
Total	**248,707**	**201,867**	**124,802**	**13,215**	**132,386**	**11,108**	**179,103**
						Grand Total	**911,188**

4.2.1 BUILDINGS SECTOR

Energy use in buildings is the largest contributing sector to the GHG emissions inventory from PGC entity sources. Collectively, energy use in the form of electricity and natural gas to heat, cool, power, and light PGC entity buildings accounted for 93% of emissions in 2006, producing approximately 843,132, metric tons of CO_2e.

As seen in Figure 4-14, emissions from electricity consumption dominated the GHG emissions from the buildings sector in 2006, responsible for 724,053 of the 843,132 metric tons of CO_2e emissions from this sector, or 86%. The remaining 119,079 metric tons, or 14%, of CO_2e results from the combustion of natural gas and coal. Coal emissions not only include the emissions from the combustion of coal but also the fugitive emissions associated with coal handling and storage. Because coal is removed from a mine within hours or days of being mined, emissions may be emitted while the coal is processed and handled. These emissions were calculated outside of the CACP software and were added to the buildings sector emissions total.

FIGURE 4-14. 2006 PGC ENTITY BUILDINGS CO_2E EMISSIONS BY SOURCE

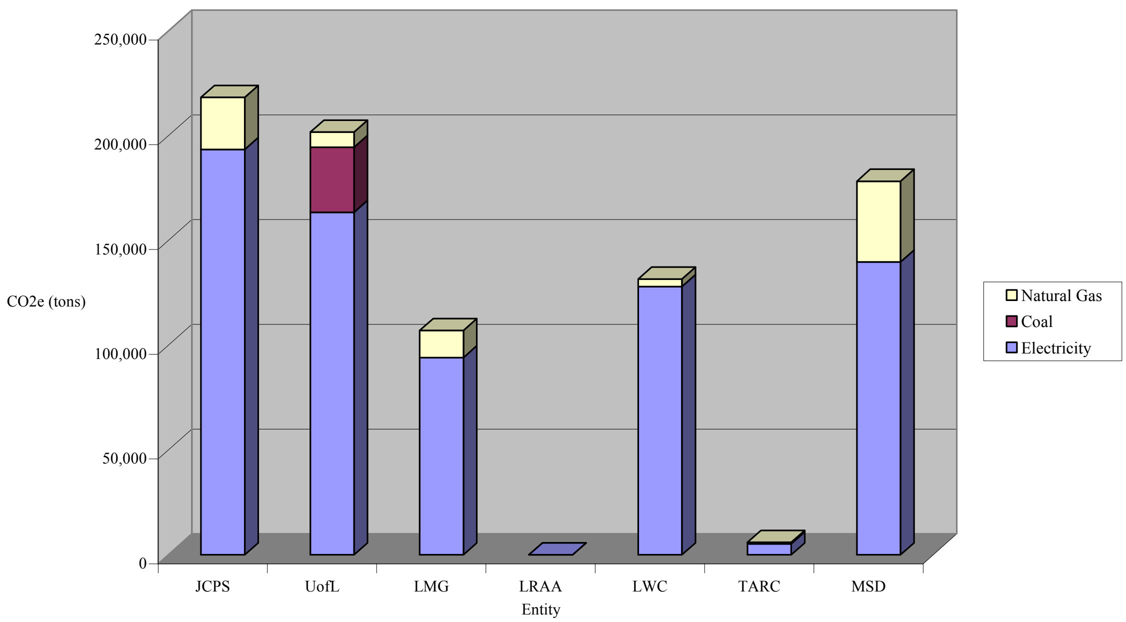


Table 4-4 highlights total emissions from building operations from the PGC entities. And Table 4-5 indicates the percentage breakdown of emissions from the various fuel sources for each PGC entity. For all of the PGC entities, the majority of emissions come from electricity usage.

TABLE 4-4. 2006 PGC ENTITY BUILDINGS CO_2E EMISSIONS TOTAL BY SOURCE

	CO_2e (tons)						
Sub-Sector	**JCPS**	**UofL**	**LMG**	**LRAA**	**LWC**	**TARC**	**MSD**
Electricity	193,467	163,486	94,101	0	128,026	5,236	139,737
Coal	0	31,030	0	0	0	0	0
Natural Gas	24,830	7,286	13,006	0	3,613	722	38,592
Total	**218,297**	**201,802**	**107,107**	**0**	**131,639**	**5,958**	**178,329**
						Grand Total	**843,132**

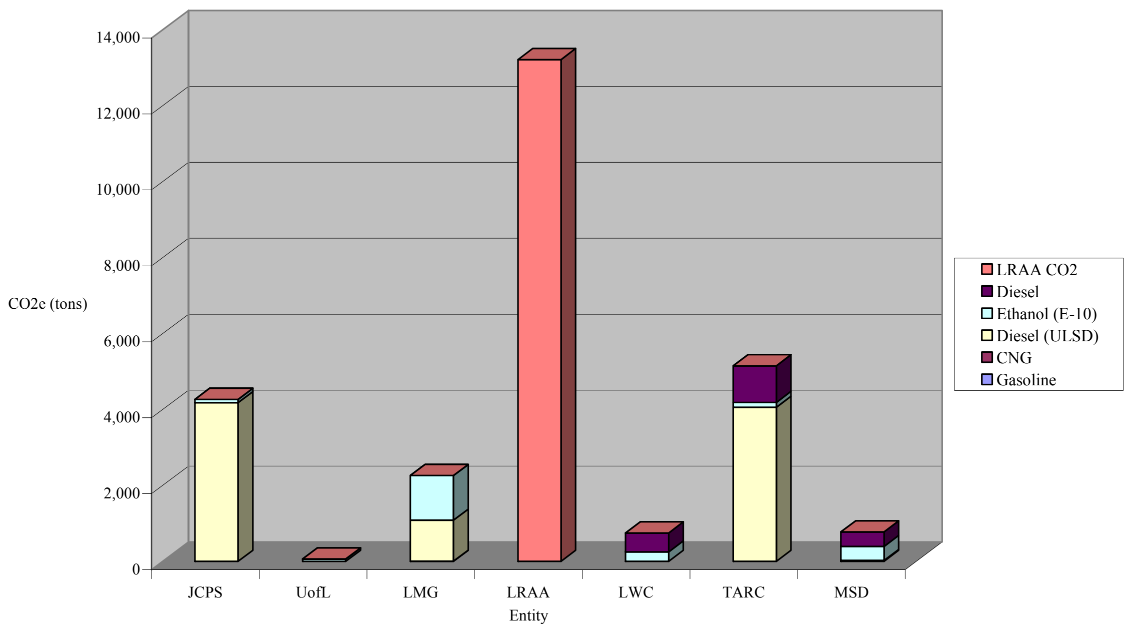
TABLE 4-5. 2006 PGC ENTITY BUILDINGS CO_2E EMISSIONS BY SOURCE CONTRIBUTION PERCENTAGES

	CO_2e Contribution (%)						
Sub-Sector	**JCPS**	**UofL**	**LMG**	**LRAA**	**LWC**	**TARC**	**MSD**
Electricity	89%	81%	88%	0%	97%	88%	78%
Coal	0%	15%	0%	0%	0%	0%	0%
Natural Gas	11%	4%	12%	0%	3%	12%	22%
Total	**100%**	**100%**	**100%**	**0%**	**100%**	**100%**	**100%**

4.2.2 VEHICLE FLEET SECTOR & LOUISVILLE REGIONAL AIRPORT AUTHORITY EMISSIONS

PGC entities' fleets (onroad and nonroad equipment) consumed a total of 958,621 gallons of diesel fuel, 37,343 gallons of compressed natural gas (CNG), 5,041,863 gallons of ULSD, and 2,972,797 gallons of E-10 in 2006. This resulted in the generation of 26,477 metric tons of CO_2e. Figure 4-15 illustrates the breakdown of fuel types that comprise the vehicle fleet's CO_2e emissions.

FIGURE 4-15. 2006 PGC ENTITIES VEHICLE FLEET CO_2E EMISSIONS BY FUEL TYPE



LRAA shared its 2004 GHG emissions results for inclusion in this project. It is assumed that 2004 emissions are representative of 2006 LRAA emissions. LRAA's inventory included mobile sources, including aircraft operations, as well as some stationary sources such as boilers, emergency equipment, etc. LRAA emissions were directly entered into the CACP software as total CO_2e. However, the emissions are included in vehicle fleet sector for the purpose of this report. The emissions are referenced in the figure above as "LRAA CO2." Table 4-6 highlights total emissions from transportation operations for PGC entities. Table 4-7 indicates the percentage breakdown of emissions from the various fuel sources by the Partners.

TABLE 4-6. 2006 PGC ENTITY VEHICLE FLEET CO_2E EMISSIONS TOTAL BY SOURCE

Sub-Sector	CO_2e (tons)								
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total
Gasoline	0	0	0	0	0	0	0	0	0%
CNG	0	0	5	0	0	0	23	28	0%
Diesel (ULSD)	4,182	0	1,075	0	0	4,059	0	9,316	35%
Ethanol (E-10)	85	57	1,179	0	249	125	371	2,066	8%
Diesel	0	8	0	0	498	966	380	1,852	7%
LRAA CO2	0	0	0	13,215	0	0	0	13,215	50%
Total	**4,267**	**65**	**2,259**	**13,215**	**747**	**5,150**	**774**		
						Grand Total	**26,477**		

TABLE 4-7. 2006 PGC ENTITY VEHICLE FLEET CO_2E EMISSIONS BY SOURCE CONTRIBUTION PERCENTAGES

Sub-Sector	CO_2e Contribution (%)						
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Gasoline	0%	0%	0%	0%	0%	0%	0%
CNG	0%	0%	0%	0%	0%	0%	3%
Diesel (ULSD)	98%	0%	48%	0%	0%	79%	0%
Ethanol (E-10)	2%	88%	52%	0%	33%	2%	48%
Diesel	0%	12%	0%	0%	67%	19%	49%
LRAA CO2	0%	0%	0%	100%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

4.2.3 WASTE SECTOR

It is estimated that during 2006, approximately 71,570 metric tons of solid waste were generated from JCPS and LMG employees and sent to the landfill. No data could be obtained in a reasonable amount of time for the other PGC entities (UofL, LRAA, LWC, TARC, and MSD). Therefore, their emission contribution from the waste sector is listed as zero.

Waste contributes to GHG emissions through the release of CH_4 gas as some of the waste decomposes. The emissions from the waste sector accounted for only 41,579 metric tons of CO_2e, which is 4% of the total PGC entity GHG emissions. The waste that resulted in GHG emissions was assumed to have consisted of 38% paper products, 13% food waste, 10% plant debris, 4% wood and textiles, and 35% other waste.[56] This resulted in 32,917 metric tons of CO_2e from paper products, 10,510 metric tons from food waste, -1,155 metric tons from plant debris, and -693 emissions from other waste categories, as shown in Figure 4-16 (again, negative emissions indicate carbon sinks).

[56] The waste composition values were derived from ICLEI's CACP software. The values represent typical U.S. waste streams and were used as defaults.

FIGURE 4-16. 2006 PGC WASTE SECTOR CO_2E EMISSIONS BY SOURCE

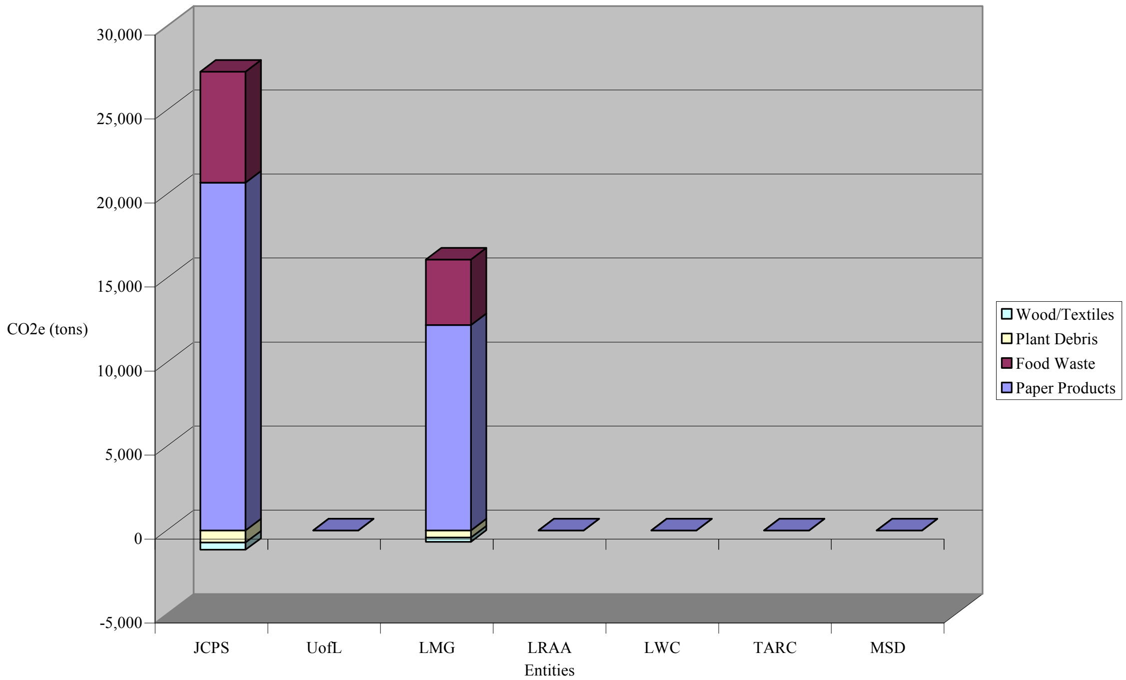


Table 4-8 highlights total emissions from waste operations for PGC entities. As noted earlier, JCPS and LMG waste emissions are the only emissions accounted for in the waste sector analysis.

TABLE 4-8. 2006 PGC ENTITY WASTE CO_2E EMISSIONS TOTAL BY SOURCE

Sub-Sector	CO₂e (tons)								
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total
Paper Products	20,697	0	12,220	0	0	0	0	32,917	79%
Food Waste	6,608	0	3,902	0	0	0	0	10,510	25%
Plant Debris	-726	0	-429	0	0	0	0	-1,155	-3%
Wood/Textiles	-436	0	-257	0	0	0	0	-693	-2%
Total	**26,143**	**0**	**15,436**	**0**	**0**	**0**	**0**		
						Grand Total	**41,579**		

4.3 EMISSIONS ANALYSIS

Total community and PGC entity emissions totaled 18,203,167 and 19,249,306 metric tons of CO_2e in 1990 and 2006, respectively. Between 1990 and 2006, residential sector emissions increased by 23%, commercial sector emissions increased by 32% and industrial sector emissions increased by 5%. Transportation and waste emissions decreased by 11% and 86% respectively. For the transportation sector, total fuel usage within the community increased between 1990 and 2006 while emissions decreased. Increased onroad vehicle fuel economies significantly contributed to the decline of transportation emissions. In addition, an analysis of the data indicates that changes to types of fuel consumed also contributed to the decrease in transportation emissions. For the waste sector, it is believed that the emissions decline is attributable to the implementation of the recycling program that was not present in 1990. No emissions are accrued from the recycled waste.

As indicated in Figure 4-1 above, in 1990 the main contributors to community GHG emissions were transportation followed by residential. The gap between transportation emissions and residential emissions is less in 2006, where they are roughly equal. As shown in Table 4-1, these sectors together represent approximately 59% of Jefferson County's emissions in 1990 and 58% of Jefferson County's emissions in 2006. Overall, community emissions have increased by 5.7% between 1990 and 2006.

As indicated in Table 4-3 and Figure 4-13 above, the main contributor to PGC entity GHG emissions was the building sector in 2006. This sector represents approximately 93% of PGC entity GHG emissions. As illustrated in Figure 1-3 above, PGC entity sources only contributed to 4.73% of overall community emissions.

The emissions results for both the community and government analysis are expected due to the higher energy intensity and consumption of higher carbon intensity fuels used for the transportation and residential sectors.

Based on GHG inventories conducted by other communities, GHG emissions profiles are highly dependent upon fuel type used for heating and cooling, public transportation infrastructure and deployment, and residential density. These factors all present challenges to this community. Reaching the GHG reduction goal in the U.S. Mayors Climate Protection Agreement will be a formidable task for Louisville.

Future anticipated trends of GHG emissions from the various sectors are shown in Section 5, while more information regarding the calculation methodologies are included in Appendix B.

5. Baseline and Forecasting Emissions

5.1 Baseline Tracking

A baseline is a reference point against which GHG emissions performance can be measured over time. The baseline allows an organization to determine if overall GHG emissions are increasing or decreasing from year to year. The baseline should generally remain static and should only be adjusted to reflect structural or organizational changes of an entity.

In the United States, baselines are commonly used for voluntary emission registries, such as the CCAR, TCR, or the Department of Energy (DOE) 1605(b) registry. For each registry, the rules may be different with regard to how the baseline year is calculated and when the baseline year is recalculated. For example, the DOE 1605(b) allows an entity to use an average of four years of GHG emissions to establish a baseline, which allows for normalization of annual variations and economic conditions. It is a good practice to compile an emissions inventory for the earliest year for which complete and accurate data can be gathered. The base year for the United Nations Framework Convention on Climate Change and subsequent Kyoto Protocol is calendar year 1990.

Given that the priority for a GHG management program should be based on practical results, it is more important that the base year be documented with enough detail to provide a good basis for local action planning than it is that all participants in a program produce an inventory with the same, stipulated base year. TCR defines a base year as the first year for which a comprehensive emissions inventory is submitted and requires the base year to be reflective of current organizational boundaries. TCR mandates that an organization should only adjust previously reported base year emissions to reflect changes in the structure of an organization and/or changes in methodology when they have a significant (5% or larger) impact on the organization’s total emissions.

Using these considerations, 1990 was selected as the baseline against which to track changes in community GHG emissions over time. Data was also collected for 2006 to demonstrate historical trends and to be used to project future emissions inventories.

5.2 Efficiency Metrics

In addition to setting a baseline and comparing aggregate GHG emissions over time, GHG intensity metrics can be a useful tool for comparing operations and evaluating efficiency. As a community’s population increases, its total GHG emissions may also increase. However, as it grows, the community may also become more efficient at generating electricity, processing waste, and reducing GHG emissions. Other local governments may also be interested in comparing the environmental performance of municipalities of different sizes, which is not easy to evaluate on the basis of absolute emissions. For the purposes of this inventory project’s protocol, there are two main reasons for developing the efficiency metrics:

- To provide a basis for consistent comparison across the various local governments and communities regardless of size.
- To track carbon intensity performance over time and complement the entity-wide absolute emissions reporting.

5.2.1 METRICS CALCULATION METHODS

GHG guidance protocols state that the reporting of relevant performance metrics is optional and may be provided as supplemental information on public emissions reports. However, in the future, registries may develop and require the reporting of sector specific performance metrics that assist in fully capturing an organization's emissions in a way that is most relevant to users. Two efficiency metrics have been developed for the 1990 and 2006 community analysis emissions.

The Consumption Emission Intensity metric was calculated based on the annual consumption values of Jefferson County. Annual GHG emissions were divided by fuel consumption. Table 5-1 lists all of the consumption emissions intensities for Jefferson County for 1990 and 2006. Potential intensities are also forecasted for 2012 and 2020 based on the emissions forecasted and discussed in Section 5.3 of this report.

Electricity Consumption Emissions Intensity = Mass of CO_2e emissions per unit of electricity consumed by Louisville Metro [lbs CO_2e from Electricity Consumption/kilowatt-hour (kWh) Electricity Consumed from All Energy Sources]

Natural Gas Consumption Emissions Intensity = Mass of CO_2e emissions per unit of natural gas consumed by Louisville Metro [lbs CO_2e from Natural Gas Consumption/ 1,000 cubic feet (MCF) Natural Gas Consumed from All Energy Sources]

TABLE 5-1. CONSUMPTION EMISSIONS INTENSITY

Sector	1990	2006	2012	2020
CO_2e from Electricity	9,116,215	11,810,379	11,747,657	12,101,871
Electricity Usage (kWh)	8,224,028,000	10,759,956,010	10,990,219,069	11,296,877,815
CO_2e (tons) per Unit of Electricity Consumed (kWh)	**1.11E-03**	**1.10E-03**	**1.07E-03**	**1.07E-03**
CO_2e from Natural Gas	2,124,116	1,729,204	1,766,209	1,815,491
Natural Gas Usage (MCF)	33,703,007	27,436,998	28,024,150	28,806,104
CO_2e (tons) per Unit of Natural Gas Consumed (MCF)	**0.06**	**0.06**	**0.06**	**0.06**

The second efficiency metric, Population Emissions Intensity, or per capita emissions, was calculated based on the total annual community CO_2e emissions and community population. Annual GHG emissions were divided by Jefferson County population in that year. The emissions summary data in Table 1-12 is also provided here in Table 5-2 and lists all of the population emissions intensities for Jefferson County for 1990 and 2006.

Potential intensities are also forecasted for 2012 and 2020 based on the emissions and populations forecasted and discussed in Section 5.3 of this report.

Population Emissions Intensity = Mass of CO_2 emissions per person in the Jefferson County area [lbs CO_2 Total Emissions/Jefferson County Population].

TABLE 5-2. POPULATION EMISSIONS INTENSITY

Sector	CO_2e (tons)		CO_2e (tons)	
	1990	**2006**	**2012**	**2020**
Residential	4,522,223	5,554,793	5,555,285	5,720,207
Commercial	3,399,389	4,501,454	4,491,233	4,625,475
Transportation	6,286,333	5,611,642	5,939,909	6,212,786
Industrial	3,318,719	3,483,336	3,467,348	3,571,680
Waste	682,169	98,081	100,179	102,975
Total	**18,208,833**	**19,249,306**	**19,553,954**	**20,233,123**
Population	**665,123**	**703,998**	**723,541**	**738,732**
CO_2e (tons) per Capita	**27.38**	**27.34**	**27.03**	**27.39**

5.3 FORECAST METHODOLOGY FOR COMMUNITY ANALYSIS

Future emissions were forecasted based on the 1990 and 2006 community emissions inventories developed for Jefferson County and population growth factors. The data used to calculate projected GHG emissions does not take into account unforeseeable impacts on energy demand; rather, the figures assumed current business-as-usual scenarios. No economic impacts are considered to estimate projected emissions.

The selected forecast years are based on the U.S. Mayors Climate Protection Agreement and are in accordance with ICLEI's recommendation that forecasts are built 15 to 20 years out from the base year, which, in this case, can be 1990 or 2006. The emissions forecasts for the community were based only on population growth rates within Jefferson County, as determined through information obtained from the Kentucky State Data Center (KSDC), and no other factors (i.e., economic factors) were used to calculate future growth rates.[57] From the available data, projected population growth rates for 2012 and 2020 were estimated. These population growth rates were based on the KSDC population estimates and projections.[58] Between 1990 and 2015, Jefferson County has and will continue to experience an average percent population increase of 0.36% per year. The projected emissions for 2012 and 2020 were conservatively estimated using this growth factor.[59]

[57] http://ksdc.louisville.edu/

[58] KSDC projects populations for the years 2010, 2015 and 2020. The annual average population percentage increase was calculated from 1990 to 2015. Annual average population percentage values are similar when looking at 2010 and 2020 (~0.36%). 1990 and 2015 were arbitrarily used based on the information provided at http://ksdc.louisville.edu/kpr/pro/Ky%20city%20population%20estimates%20and%20projections.xls.

[59] For the transportation sector, the total projected VMT for 2012 and 2020 were provided by APCD. Assuming the same vehicle distribution as for 2006, the VMT for 2012 and 2020 were estimated for the individual vehicle types.

The growth factor is also used to calculate increases in fuel usage (i.e., natural gas) for residential, commercial, and industrial sectors. This factor was applied to the fuel usage values of the community (i.e., values from 1990 or 2006). Once a future fuel usage value was calculated, the usage data was then entered into the CACP software. The usages were entered as a future use (i.e., usage in 2012 or 2020).

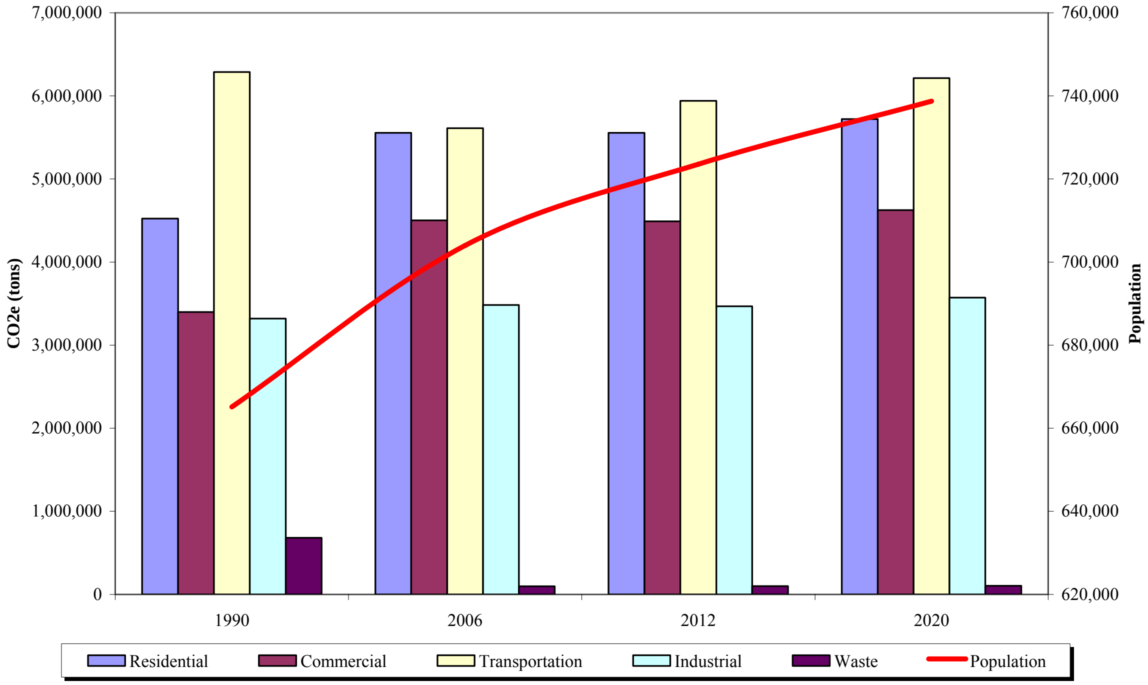
The CACP software links all entered years to an associated emission factor that is based on future scenarios. These factors can greatly affect the overall future emissions because they may decrease over time. For example, transportation emission factors decrease over time because the CACP software assumes that vehicle efficiencies will greatly increase. As a result, even though the calculated fuel usage increases from 1990 to 2020, the forecasted GHG emissions decrease over time as shown in Table 5-3.

The total community GHG emissions from Jefferson County for 1990 and 2006 were calculated to be 18,208,833 and 19,249,306 tons CO_2e, respectively. Using the data provided, Trinity forecasted 2012 and 2020 CO_2e emissions for the community. Without any mitigation, it is anticipated that the community will contribute 19,553,954 and 20,233,123 tons of CO2e, in 2012 and 2020, respectively. A summary of CO2e emissions from 1990 to 2020 is provided in Table 5-3 and Figure 5-1.

TABLE 5-3. FORECASTED COMMUNITY EMISSIONS INVENTORY (CO_2E)

Sector	CO_2e (tons)		CO_2e (tons)		Percentage Increase from 1990 (%)		
	1990	2006	2012	2020	2006	2012	2020
Residential	4,522,223	5,554,793	5,555,285	5,720,207	23%	23%	26%
Commercial	3,399,389	4,501,454	4,491,233	4,625,475	32%	32%	36%
Transportation	6,286,333	5,611,642	5,939,909	6,212,786	-11%	-6%	-1%
Industrial	3,318,719	3,483,336	3,467,348	3,571,680	5%	4%	8%
Waste	682,169	98,081	100,179	102,975	-86%	-85%	-85%
Total	**18,208,833**	**19,249,306**	**19,553,954**	**20,233,123**	**5.7%**	**7.4%**	**11.1%**
Population	**665,123**	**703,998**	**723,541**	**738,732**			
CO_2e (tons) per Capita	**27.38**	**27.34**	**27.03**	**27.39**			

FIGURE 5-1. COMMUNITY LEVEL CO_2E (TONS) EMISSIONS



As indicated in
Table 5-3, in 2006 the main contributors to community GHG emissions are the transportation and residential sectors, each accounting for 29% of the total GHG emissions. Accordingly, these sectors may be the primary focus for potential GHG reductions and mitigation strategies.

6. ASSUMPTIONS AND RECOMMENDATIONS

6.1 KEY UNCERTAINTIES

Further research may be necessary to resolve key data gaps and uncertainties in the initial GHG inventory and projections described in this report. The inventory could be further refined with an improved understanding of electricity growth rates, future oil and gas usage, and economic growth. These growth rates are driven by economic, demographic, and land use trends (including growth patterns and transportation system impacts), all of which are subject to uncertainty.

The following sections describe several key assumptions and associated recommendations relevant to the data collected, inventory results, and emissions projections.

6.1.1 PROJECTED EMISSIONS

- Only population growth factors are used to estimate projected emissions for 2012 and 2020. Population and economic growth are the principal drivers for electricity and fuel use and are subject to significant uncertainties. The projections assume no large, long-term changes in relative fuel and electricity prices as compared with current levels and DOE projections. If major fluctuations occur, this may have significant influence on consumption levels and may encourage switching among fuels. In this case, the current projected usage data that assumes the same type of fuel may not be applicable. Therefore, economic growth factors may be considered to estimate projected usage.
- Population growth factors are also applied to estimate projected emissions for the industrial sector. Growth of major industries is highly uncertain since the electricity and fuel usage consumption projections assume no new large energy consuming facilities will be constructed in Jefferson County. A few new large facilities, or similarly the decline of major industries, could significantly impact energy consumption and consequently emissions. Therefore, industrial growth and decline factors may be considered to estimate projected emissions.

6.1.2 RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL SECTORS

- The usage data on FERC forms is the only data source used for estimating community emissions associated with natural gas and electricity usage. No additional sector specific data was used. Therefore, further categorization of the usage data among different sectors may be required to focus mitigation strategies on groups with higher emissions. Based on the results, the residential sector has one of the highest emissions (29 %) contributions among the emissions source sectors for the community.
- On FERC Form 1, there is overlap between the electricity usage sectors (i.e., the commercial sector is listed as small commercial/industrial sales and large commercial sales). The electricity usage for the industrial sector is listed as large industrial sales. It

was assumed that the categories of small commercial/industrial sales and large commercial sales represent the commercial sector and only the category of large industrial sales represents the industrial sector. Therefore, if the emissions need to be further categorized, sector specific electricity usage data will be needed.

- Based on the FERC Form 2 data, only natural gas usage was used to quantify fuel usage emissions. Therefore, it is assumed that no other fuel (e.g., propane, wood) is used in the community. That is a highly unlikely assumption and other fuel usage data may need to be obtained to include their contribution to the community emissions. According to the EIA, only 3% of Kentucky households use heating oil and 10% use liquefied petroleum gas (i.e., propane). These percentages are likely to be lower in an urban area such as Louisville than for the rest of the state, but more research may be necessary to confirm this.[60]
- Note that the natural gas usage listed on FERC Form 2 for 1990 is greater than that for 2006 for residential, commercial, and industrial sectors; therefore, the associated emissions are also higher for 1990.
- The public street and highway lighting electricity usage listed on FERC Form 1 is distributed equally among the residential, commercial, and industrial sectors and no usage is attributed to the government sector.
- As specified previously, the community inventory does not include process emissions from individual facilities. However, the emissions associated with electricity and fuel usage for the industrial sector are included in the community emissions profile. The process emissions may be quantified by the individual facilities and included in the community inventory to help establish a complete GHG emissions footprint for the community.

6.1.3 WASTE SECTOR

- For estimating 1990 waste sector emissions 1990 data was not available. It was therefore assumed that the data on waste collected for 1991 is representative of the 1990 data. Relevant data was only provided for two quarters in 1991; therefore, the data for the first two quarters was extrapolated to estimate usage for the full year. Consequently, it may need to be confirmed that the projected usage data for 1991 is representative of usage for the full year of 1990.
- Total waste disposed (in-county and out-of-county) was used to estimate emissions for 1990 and 2006.
- The default waste percent values in the CACP software are used to estimate contribution share for paper products (38%), food waste (13%), plant debris (10%), wood/textiles (4%), and other waste (35%) because site-specific values were not available. If these waste profile values can be made available from the landfills used

---

[60] http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=KY#overview

by the community or waste haulers, it may be worthwhile to include these in the calculations.

- Waste recycling programs were inactive in 1990. The Jefferson County recycling program started in mid-1991. No recycled waste values were applied to calculate 1990 waste emissions. Waste emissions from 2006 were calculated from waste sent to managed landfills; no recycled waste was incorporated into 2006 emission calculations.

6.1.4 OTHER SECTOR AND MISCELLANEOUS

- No emissions associated with refrigerant usage are included in the community or PGC entity emissions profiles because no data is currently available. For the same reason, no employee commute emissions (Scope 3) are included in the PGC entity emissions profile. In order to establish a complete emissions footprint for the community and PGC entities, additional data may need to be collected.
- For UofL, it was assumed that the 2006 fiscal year (July 1, 2005 to June 30, 2006) data is representative of the 2006 calendar year to estimate GHG emissions for UofL. Similarly, 2004 calendar year data was used to estimate emissions for LRAA. Therefore, 2006 calendar year data may need to be collected to quantify emissions for a time period consistent with the other PGC entities and to be more accurate for 2006.
- Additional community emissions may also be calculated for Jefferson County. Community profiles vary and may include sources that are not captured by the CACP software. These emissions are often considered Scope 3 emissions and may be calculated in the future in order to establish a complete emissions footprint for the community and PGC entities. Examples of additional GHG sources include, tourism emissions, other transportation emissions (including emissions from trains), and prescribed burning, while forested land can provide an additional carbon sink. Working with local agencies, fire departments, and tourism centers, these emissions may be quantifiable for Jefferson County.

6.2 CONCLUSION

Climate change is an issue of growing concern for communities across the United States and around the world. Louisville Metro has displayed great leadership and foresight in choosing to confront this issue now. This GHG inventory report acts as a benchmark for Louisville Metro while the city works towards achieving its emissions reduction target for 2012. By developing a clear understanding of the key sources contributing to the community's emissions profile and the trends that it has experienced, Louisville Metro will be able to develop a plan to achieve its reduction target.

To allow the community to monitor progress toward achieving its reduction target, it is necessary to continually monitor emissions and repeat the inventory process on a periodic basis. By developing and implementing data compilation and analysis protocols, Louisville Metro will be able to complete annual updates to its inventory. Louisville Metro should also work to develop the infrastructure necessary to allow for ease of data reporting and analysis, both internally for Louisville Metro agencies, and externally for utilities and other organizations. In addition, Louisville Metro should collaborate with other cities around the country and the world to share analytical techniques and methodologies, with the goal of ensuring consistency in approaches used to quantify and report GHG emissions.

ICLEI encourages jurisdictions to conduct a re-inventory of community and municipal buildings and operations. The re-inventory should be conducted on or before the target year so that Louisville Metro can quantify and compare emissions with those from the base year. This is also encouraged because ICLEI, with other partnering organizations, has developed a Government Operations Protocol that assists public entities in calculating GHG emissions. The new protocol references updated emission factors and establishes calculation methodologies currently being used in many other protocols and industries.

Successive inventories will define progress in terms of GHG reduction and provide an opportunity to implement new measures and/or improve existing ones. Louisville Metro Government, the other PGC entities, and the private sector will need to work together and lead by example to achieve the City's reduction target. Collective action within the community will allow Louisville Metro to significantly reduce GHG emissions over the next decade. Meeting the U.S. Mayors Climate Protection Agreement reduction target will require both persistence and adaptability over the next several years. While this report completes an important milestone, it is just the beginning of a much larger process for the Louisville community.

APPENDIX A. EMISSIONS SUMMARY TABLES

COMMUNITY ANALYSIS - CALCULATION AND RESULTS

Table 1. Community Analysis Total

Sector	CO_2e (tons)		CO_2e (tons)		CO_2e Contribution (%)				Percentage Increase from 1990 (%)		
	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Residential	4,522,223	5,554,793	5,555,285	5,720,207	25%	29%	28%	28%	23%	23%	26%
Commercial	3,399,389	4,501,454	4,491,233	4,625,475	19%	23%	23%	23%	32%	32%	36%
Transportation	6,286,333	5,611,642	5,939,909	6,212,786	34%	29%	30%	31%	-11%	-6%	-1%
Industrial	3,318,719	3,483,336	3,467,348	3,571,680	18%	18%	18%	18%	5%	4%	8%
Waste	682,169	98,081	100,179	102,975	4%	1%	1%	1%	-86%	-85%	-85%
Total	**18,208,833**	**19,249,306**	**19,553,954**	**20,233,123**	**100%**	**100%**	**100%**	**100%**	**5.7%**	**7.4%**	**11.1%**
Population	**665,123**	**703,998**	**723,541**	**738,732**							
CO_2e (tons) per Capita	**27.38**	**27.34**	**27.03**	**27.39**							

[a] The change is waste sector emissions are mainly due to the implementation of methane capture operations post-1990. Nonroad emissions were calculated using APCD's NONROAD 2005 emissions model and therefore, emissions were directly entered into the CACP software under the "Other" emissions sector.

[b] As specified in recommendations section in the report, the change in transportation sector emissions from 1990 would be further reviewed.

Table 2. Subsector Summary

	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
Sub-Sector	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Electricity	9,116,215	11,810,379	11,747,657	12,101,871	50%	61%	60%	60%	30%	29%	33%
Natural Gas	2,124,116	1,729,204	1,766,209	1,815,491	12%	9%	9%	9%	-19%	-17%	-15%
Gasoline	4,564,634	0	0	0	25%	0%	0%	0%	-100%	-100%	-100%
Ultra-Low Sulfur Diesel (ULSD)	0	128,981	1,498,338	1,602,625	0%	1%	8%	8%	0%	0%	0%
Gasoline (E-10)	0	3,793,654	3,995,984	4,152,184	0%	20%	20%	21%	0%	0%	0%
Diesel	1,323,148	1,251,723	0	0	7%	7%	0%	0%	-5%	-100%	-100%
Nonroad Emissions	398,551	437,284	445,587	457,977	2%	2%	2%	2%	10%	12%	15%
Food Waste	172,437	153,916	157,210	161,597	1%	1%	1%	1%	-11%	-9%	-6%
Paper Products	540,050	482,046	492,362	506,100	3%	3%	3%	3%	-11%	-9%	-6%
Plant Debris	-18,949	-16,914	-17,276	-17,758	0%	0%	0%	0%	-11%	-9%	-6%
Wood/Textiles	-11,369	-10,148	-10,366	-10,655	0%	0%	0%	0%	-11%	-9%	-6%
Methane Capture Credits	0	-510,819	-521,751	-536,309	0%	-3%	-3%	-3%	0%	0%	0%
Total	**18,208,833**	**19,249,306**	**19,553,954**	**20,233,123**	**100%**	**100%**	**100%**	**100%**			

Table 3. Residential Sector

	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
Sub-Sector[c]	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Electricity	3,233,095	4,431,943	4,408,406	4,541,327	71%	80%	79%	79%	37%	36%	40%
Natural Gas	1,289,128	1,122,850	1,146,879	1,178,880	29%	20%	21%	21%	-13%	-11%	-9%
Total	**4,522,223**	**5,554,793**	**5,555,285**	**5,720,207**	**100%**	**100%**	**100%**	**100%**	**23%**	**23%**	**26%**

[c] The emissions are based on usage data derived for LG&E FERC Form 1 & 2. Please also refer to the recommendations section of the report regarding further review of this data.

Table 4. Commercial Sector

Sub-Sector[c]	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Electricity	2,863,559	3,989,092	3,967,907	4,087,547	84%	89%	88%	88%	39%	39%	43%
Natural Gas	535,830	512,362	523,326	537,928	16%	11%	12%	12%	-4%	-2%	0%
Total	**3,399,389**	**4,501,454**	**4,491,233**	**4,625,475**	**100%**	**100%**	**100%**	**100%**	**32%**	**32%**	**36%**

[c] The emissions are based on usage data derived for LG&E FERC Form 1 & 2. Please also refer to the recommendations section of the report regarding further review of this data.

Table 5. Industrial Sector

Sub-Sector[c]	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Electricity	3,019,561	3,389,344	3,371,344	3,472,997	91%	97%	97%	97%	12%	12%	15%
Natural Gas	299,158	93,992	96,004	98,683	9%	3%	3%	3%	-69%	-68%	-67%
Total	**3,318,719**	**3,483,336**	**3,467,348**	**3,571,680**	**100%**	**100%**	**100%**	**100%**	**5%**	**4%**	**8%**

[c] The emissions are based on usage data derived for LG&E FERC Form 1 & 2. Please also refer to the recommendations section of the report regarding further review of this data.

Table 6. Transportation Sector

Sub-Sector[d]	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Gasoline	4,564,634	0	0	0	73%	0%	0%	0%	e	e	e
Ultra-Low Sulfur Diesel (ULSD)	0	128,981	1,498,338	1,602,625	0%	2%	25%	26%	0%	0%	0%
Gasoline (E-10)	0	3,793,654	3,995,984	4,152,184	0%	68%	67%	67%	0%	0%	0%
Diesel	1,323,148	1,251,723	0	0	21%	22%	0%	0%	-5%	-100%	-100%
Nonroad Emissions	398,551	437,284	445,587	457,977	6%	8%	8%	7%	10%	12%	15%
Total	**6,286,333**	**5,611,642**	**5,939,909**	**6,212,786**	**100%**	**100%**	**100%**	**100%**	**-11%**	**-6%**	**-1%**

[d] Diesel usage in 2006 was distributed between ULSD and regular diesel. Therefore, the diesel column shows a negative change in emissions from 1990, however, when added with the ULSD emissions, an increase in emissions is still seen. For 2012 and 2020, it is assumed that all diesel usage is of ULSD type.

[e] In 2006, E-10 (90% gasoline and 10% ethanol) was used in the community. It is assumed E-10 will also be used in 2012 and 2020. Therefore, there is no 100% gasoline contribution for 2006, 2012, and 2020.

Table 7. Waste Sector [f]

Sub-Sector	CO_2e (tons)				CO_2e Contribution (%)				Percentage Increased from 1990 (%)		
	1990	2006	2012	2020	1990	2006	2012	2020	2006	2012	2020
Paper Products	540,050	482,046	492,362	506,100	79%	491%	491%	491%	-11%	-9%	-6%
Food Waste	172,437	153,916	157,210	161,597	25%	157%	157%	157%	-11%	-9%	-6%
Plant Debris	-18,949	-16,914	-17,276	-17,758	-3%	-17%	-17%	-17%	f	f	f
Wood/Textiles	-11,369	-10,148	-10,366	-10,655	-2%	-10%	-10%	-10%	f	f	f
Methane Capture Credits	0	-510,819	-521,751	-536,309	0%	-521%	-521%	-521%	f	f	f
Total	**682,169**	**98,081**	**100,179**	**102,975**	**100%**	**100%**	**100%**	**100%**	**-86%**	**-85%**	**-85%**

[f] Negative emissions are associated with emissions sinks. Refer to the report for further details. Negative percent increase in emissions from 1990 may be due to implementation of the recycling program that was not present in 1990. No emissions are accounted from the recycled waste. Emissions credits from the landfill emissions were calculated based on information provided by LMAPCD. Information was only provided for 2006. Therefore, 2012 and 2020 landfill emission credits are forecasted based on population growth rates.

Table 8. Partnership Analysis Total

Sector	CO_2e (tons)									CO_2e Contribution (%)						
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Buildings	218,297	201,802	107,107	0	131,639	5,958	178,329	843,132	93%	88%	100%	86%	0%	99%	54%	100%
Vehicle Fleet	4,267	65	2,259	13,215	747	5,150	774	26,477	3%	2%	0%	2%	100%	1%	46%	0%
Waste	26,143	0	15,436	0	0	0	0	41,579	5%	11%	0%	12%	0%	0%	0%	0%
Total	**248,707**	**201,867**	**124,802**	**13,215**	**132,386**	**11,108**	**179,103**			**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
						Grand Total	**911,188**									

Table 9. Subsector Summary

Sub-Sector	CO_2e (tons)									CO_2e Contribution (%)						
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Electricity	193,467	163,486	94,101	0	128,026	5,236	139,737	724,053	79%	78%	81%	75%	0%	97%	47%	78%
Coal	0	31,030	0	0	0	0	0	31,030	3%	0%	15%	0%	0%	0%	0%	0%
Natural Gas	24,830	7,286	13,006	0	3,613	722	38,592	88,049	10%	10%	4%	10%	0%	3%	6%	22%
Gasoline	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%
CNG	0	0	5	0	0	0	23	28	0%	0%	0%	0%	0%	0%	0%	0%
Diesel (ULSD)	4,182	0	1,075	0	0	4,059	0	9,316	1%	2%	0%	1%	0%	0%	37%	0%
Ethanol (E-10)	85	57	1,179	0	249	125	371	2,066	0%	0%	0%	1%	0%	0%	1%	0%
Diesel	0	8	0	0	498	966	380	1,852	0%	0%	0%	0%	0%	0%	9%	0%
Paper Products	20,697	0	12,220	0	0	0	0	32,917	4%	8%	0%	10%	0%	0%	0%	0%
Food Waste	6,608	0	3,902	0	0	0	0	10,510	1%	3%	0%	3%	0%	0%	0%	0%
Plant Debris	-726	0	-429	0	0	0	0	-1,155	0%	0%	0%	0%	0%	0%	0%	0%
Wood/Textiles	-436	0	-257	0	0	0	0	-693	0%	0%	0%	0%	0%	0%	0%	0%
LRAA CO2	0	0	0	13,215	0	0	0	13,215	1%	0%	0%	0%	100%	0%	0%	0%
Methane	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%
Total	**248,707**	**201,867**	**124,802**	**13,215**	**132,386**	**11,108**	**179,103**			**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
						Grand Total	**911,188**									

Table 10. Buildings Sector

Sub-Sector	CO_2e (tons)									CO_2e Contribution (%)						
	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Electricity	193,467	163,486	94,101	0	128,026	5,236	139,737	724,053	86%	89%	81%	88%	0%	97%	88%	78%
Coal	0	31,030	0	0	0	0	0	31,030	4%	0%	15%	0%	0%	0%	0%	0%
Natural Gas	24,830	7,286	13,006	0	3,613	722	38,592	88,049	10%	11%	4%	12%	0%	3%	12%	22%
Total	**218,297**	**201,802**	**107,107**	**0**	**131,639**	**5,958**	**178,329**			**100%**	**100%**	**100%**	**0%**	**100%**	**100%**	**100%**
						Grand Total	**843,132**									

Table 11. Vehicle Fleet

	CO_2e (tons)									CO_2e Contribution (%)						
Sub-Sector	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Gasoline	0	0	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%	0%
CNG	0	0	5	0	0	0	23	28	0%	0%	0%	0%	0%	0%	0%	3%
Diesel (ULSD)	4,182	0	1,075	0	0	4,059	0	9,316	35%	98%	0%	48%	0%	0%	79%	0%
Ethanol (E-10)	85	57	1,179	0	249	125	371	2,066	8%	2%	88%	52%	0%	33%	2%	48%
Diesel	0	8	0	0	498	966	380	1,852	7%	0%	12%	0%	0%	67%	19%	49%
LRAA CO2	0	0	0	13,215	0	0	0	13,215	50%	0%	0%	0%	100%	0%	0%	0%
Total	**4,267**	**65**	**2,259**	**13,215**	**747**	**5,150**	**774**			**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
						Grand Total	**26,477**									

Table 12. Waste Sector

	CO_2e (tons)									CO_2e Contribution (%)						
Sub-Sector	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD	Total	% of Total	JCPS	UofL	LMG	LRAA	LWC	TARC	MSD
Paper Products	20,697	0	12,220	0	0	0	0	32,917	79%	79%	0%	79%	0%	0%	0%	0%
Food Waste	6,608	0	3,902	0	0	0	0	10,510	25%	25%	0%	25%	0%	0%	0%	0%
Plant Debris	-726	0	-429	0	0	0	0	-1,155	-3%	-3%	0%	-3%	0%	0%	0%	0%
Wood/Textiles	-436	0	-257	0	0	0	0	-693	-2%	-2%	0%	-2%	0%	0%	0%	0%
Total	**26,143**	**0**	**15,436**	**0**	**0**	**0**	**0**			**100%**	**0%**	**100%**	**0%**	**0%**	**0%**	**0%**
						Grand Total	**41,579**									

APPENDIX B. SUMMARY OF DATA COLLECTED

COMMUNITY ANALYSIS - CACP INPUT SUMMARY

Table 1. Summary of Data Input into ICLEI CACP Software [1, 2]

Sector	Unit	1990	2006	2012	2020
Residential [3,4,5]					
Electricity	kWh	2,916,678,000	4,037,762,670	4,124,170,791	4,239,247,027
Natural Gas	MCF	20,454,378	17,816,080	18,197,344	18,705,102
Commercial [3,4,5]					
Electricity	kWh	2,583,308,000	3,634,299,670	3,712,073,683	3,815,651,224
Natural Gas	MCF	8,501,935	8,129,557	8,303,530	8,535,222
Industrial [3,4,5]					
Electricity	kWh	2,724,042,000	3,087,893,670	3,153,974,595	3,241,979,564
Natural Gas	MCF	4,746,694	1,491,361	1,523,276	1,565,780
Transportation [6]					
Gasoline	VMT				
Auto - Full-Size		470,704,703	0	0	0
Auto - Mid-Size		1,052,163,454	0	0	0
Auto - Sub-Compact/Compact		2,115,402,314	0	0	0
Heavy Truck		71,647,156	0	0	0
Light Truck/SUV/Pickup		2,406,995,718	0	0	0
Motorcycle		23,727,030	0	0	0
Passenger Vehicle		0	0	0	0
Vanpool Van		0	0	0	0
Diesel	VMT				
Auto - Full-Size		609,391	1,494,135	0	0
Auto - Sub-Compact/Compact		846,500	2,137,327	0	0
Heavy Truck		635,675,396	646,130,681	0	0
Light Truck/SUV/Pickup		1,379,693	2,031,714	0	0
Marine		0	0	0	0
Passenger Vehicle		0	0	0	0
Rail - Commuter		0	0	0	0
Transit Bus		0	0	0	0
Vanpool Van		0	0	0	0
Diesel (ULSD)	VMT				
Auto - Full-Size		0	0	1,623,758	1,736,814
Auto - Sub-Compact/Compact		0	0	2,322,750	2,484,473
Heavy Truck		0	66,726,060	774,700,355	828,639,492
Light Truck/SUV/Pickup		0	0	2,207,975	2,361,707
Marine		0	0	0	0
Passenger Vehicle		0	0	0	0
Rail - Commuter		0	0	0	0
Transit Bus		0	0	0	0
Vanpool Van		0	0	0	0
Ethanol (E-10)	VMT				
Auto - Full-Size		0	527,950,217	573,752,336	613,700,305
Auto - Mid-Size		0	1,180,124,014	1,282,505,222	1,371,800,683
Auto - Sub-Compact/Compact		0	2,372,670,386	2,578,510,498	2,758,041,373
Heavy Truck		0	75,056,134	81,567,601	87,246,811
Light Truck/SUV/Pickup		0	2,705,011,209	2,939,683,422	3,144,361,253
Motorcycle		0	26,620,991	28,930,485	30,944,793
Passenger Vehicle		0	0	0	0
Vanpool Van		0	0	0	0

COMMUNITY ANALYSIS - CACP INPUT SUMMARY

Table 1. Summary of Data Input into ICLEI CACP Software [1, 2]

Sector	Unit	1990	2006	2012	2020
Waste [7]					
Amount of Waste	ton	1,174,205	1,048,089	1,070,518	1,100,389
Percentage Share	%				
Paper Products		38	38	38	38
Food Waste		13	13	13	13
Plant Debris		10	10	10	10
Wood/Textiles		4	4	4	4
All Other Waste		35	35	35	35
Other - Nonroad Transportation Emissions & Landfill Emission Credits[8]					
Carbon Dioxide	ton	398,551	-73,535	-76,163	-78,332
Nitrogen Oxides	ton	9,620	10,555	10,756	11,055
Sulfur Oxides	ton	1,236	1,357	1,382	1,421
Carbon Monoxide	ton	52,516	57,619	58,713	60,346
VOC	ton	3,381	3,709	3,779	3,885
PM	ton	1,123	1,232	1,256	1,291
Louisville Metro Population [9]		665,123	703,998	723,541	738,732

[1] No emissions quantified for refrigerant usage.

[2] Employee commute is scope 3 and not included.

[3] FERC form data is the only data source relied on for community analysis emissions. No sector specific data used. Further categorization of usage may be required to structure mitigation strategy on a focused group having high emissions.

[4] Assumed that all kWh sold are attributed to J. County (i.e., the geographic boundary of the FERC Form 1 data is only J. County). Assumed that no portion of natural gas on FERC Form 2 is used for electricity generation listed on Form 1 i.e., all NG usage is used by the community consumers. There is overlap of usage sectors on the FERC form, e.g., small commercial and industrial sales is listed as one sector. Based on the FERC form data, only natural gas usage is listed. Therefore, assumed that there is no propane, green electricity, etc. usage in the community.

[5] Streetlight contribution is equally attributed to community residential, commercial, and industrial sectors. FERC forms aggregated all streetlighting usage.

[6] Per conversation with LMG assumed that there is no contribution from gasoline usage for 2006 because E10 is used instead. Projections for 2012 and 2020 are based on the higher usage between 1990 or 2006 usage. Also assumed in 2012 and 2020 all diesel usage will be converted to ULSD.

[7] Methane recovery is accounted for in the “other” sector as Landfill Emission Credits. Landfill Emission Credits are calculated from recovered and flared carbon dioxide emissions. 1991 waste data is used to calculate 1990 data. In 1991, data for two quarters were provided, as well as an average ton per day value. Based on the ton per day value, an annual waste generated total was calculated by multiplying the ton per day value by 365 days. Default % values were used from CACP. 2006 waste only included waste not recycled and sent to managed landfill.

[8] Landfill emission credits are calculated from carbon dioxide emissions, which were calculated from the methane flaring and methane capture operations.

[9] Population growth factor is applied across all sectors to estimate 2012 and 2020 emissions.

Table 2. Summary of 2006 Entity Data Input into ICLEI CACP Software - Buildings

Source	Entity	Partnership Energy	Partnership Fuel Use	
		Electricity (Grid Average) (kWh)	Coal (Tons)	Natural Gas (MCF)
Buildings [1, 2]	JCPS - Non-Schools	15,445,418	0	39,683
	JCPS - Schools	160,814,368	0	354,297
	UofL - Belknap Campus	90,813,897	5,379	94,923
	UofL - Shelby Campus	3,456,782	0	11,540
	UofL - Health Science Campus	41,388,187	0	9,155
	UofL - S&C Plant Apportion	13,287,319	9,375	0
	MSD - All Buildings	127,308,531	0	612,340
	LMG	85,731,928	0	206,365
	TARC - Operations Building	2,738,692	0	2,711
	TARC - Union Station	1,553,603	0	1,206
	TARC - Bus Storage Barn	0	0	2,103
	TARC - 29th Street	376,951	0	5,429
	TARC - 925 W. Broadway	100,932	0	0
	Louisville Water Company	116,639,290	0	57,333

[1] Electricity data provided for JCPS usage was provided in kW. Assumed units were kWh.

[2] All data provided for UofL is for fiscal year 2006 (July 1, 2005-June 30, 2006)

Table 3. Summary of 2006 Entity Data Input into ICLEI CACP Software - Transportation

Source	Entity	Partnership Fuel Use				
		Gasoline (Gallons)	Diesel (Gallons)	CNG (Gallons)	Diesel (ULSD) (Gallons)	Ethanol (E-10) (Gallons)
Vehicle Fleet [1,2,3]	UofL	0	4,363	0	0	83,859
	LMG	0	0	6,094	622,398	2,160,075
	JCPS	0	0	0	2,319,465	126,314
	MSD	0	196,855	31,249	0	215,837
	TARC	0	500,000	0	2,100,000	260,000
	Louisville Water Company	0	257,403	0	0	126,712

[1] All data provided for UofL is for fiscal year 2006 (July 1, 2005-June 30, 2006)

[2] Specific vehicle types were provided for MSD fleet data. To enter usage information into the CACP software, vehicle types had to be categorized in a specific format. The table below outlines how vehicles were categorized for data entry into the CACP software.

[3] Fuel consumption by vehicle type was calculated by multiply total fuel used for each fuel type by a percentage value provied by LMG. It is assumed that the percentage value provided reflects the portion of the total fuel use (within each fuel type) that each of those vehicle classes used

Articulated Loader	Heavy Truck - Large	Sewer Flusher (Super)	Heavy Truck - Large	Sedan - 4 Dr	Auto - Full-Size	P/U - Crew Cab 4x4	Heavy Truck - Large
Cab/Chassis - Flatbed	Heavy Truck - Large	Tanker Trailer 6,000 gal	Heavy Truck - Large	Cargo Van	Vanpool Van	Dump - Tandem Axle w/LP Bed	Heavy Truck - Large
Cab/Chassis - Flatbed (Oil Truck)	Heavy Truck - Large	Tanker Truck - Vacuum 2,300 gal	Heavy Truck - Large	Jeep	Light Truck/SUV/Pickup - Small	Tractor	Heavy Truck - Large
Concrete Mixer	Heavy Truck - Large	Tanker Truck - Vacuum 3,000 gal	Heavy Truck - Large	Mini Van	Vanpool Van	Cab/Chassis - Utility	Heavy Truck - Large
Crawler Dump	Heavy Truck - Large	Tanker Truck -3,500 gal	Heavy Truck - Large	Passenger Van - 15	Transit Bus	P/U - Reg Cab	Heavy Truck - Large
Dump - Flatbed	Heavy Truck - Large	Tanker Truck -4,000 gal	Heavy Truck - Large	Passenger Van - 8	Transit Bus	Compact Excavator	Heavy Truck - Large
Forklift - 6,000 lb. Capacity	Heavy Truck - Large	Tractor - 4x4	Heavy Truck - Large	Passneger Van - 8	Transit Bus	E-Cutaway w/Supreme Body	Heavy Truck - Large
GENERATOR	Heavy Truck - Large	TRACTOR/MOWER	Heavy Truck - Large	Step Van - Grumman	Vanpool Van	Dump - Single Axle	Heavy Truck - Large
Mower Deck - Zero Turn Radius	Heavy Truck - Large	Trash Pump - 4"	Heavy Truck - Large	Step Van - Utlimaster	Vanpool Van	P/U - Ext Cab	Heavy Truck - Large
P/U - Crew Cab 4x4 w/Utility Body	Heavy Truck - Large	TRUCK FLATBED 2 TON	Heavy Truck - Large	SUV 4x4	Light Truck/SUV/Pickup - Medium Large	Air Compressor	Auto - Sub-Compact/Compact
Power Sweeper	Heavy Truck - Large	Utility Vehicle - Mule 2150 4x4	Heavy Truck - Large	VAN PANEL 3/4 TON W/AC	Vanpool Van	SEDAN COMPACT 4 DOOR	Auto - Full-Size
Wrecker 4x4 2.5 Ton	Heavy Truck - Large	Wood Chipper	Heavy Truck - Large	VAN STEP 1 TON	Vanpool Van	Sedan - 4 Dr Hybrid	Auto - Full-Size
BACKHOE	Heavy Truck - Large	Wrecker - Rollback	Heavy Truck - Large	VAN STEP 1 TON TELEINSPECTION	Vanpool Van	Sedan - 4 Dr CNG	Auto - Full-Size
Cab/Chassis - Flatbed (Barricade)	Heavy Truck - Large	Wrecker 4x4 1 Ton	Heavy Truck - Large	VAN WINDOW COMPACT W/AC	Vanpool Van	Plate Truck w/Crane	Heavy Truck - Large
Cab/Chassis - Flatbed (Barricade)	Heavy Truck - Large	Road Tractor-Tandem Axle	Heavy Truck - Large	Backhoe/Loader	Heavy Truck - Large	Backhoe/Loader 4x4	Heavy Truck - Large
Road Tractor - Tandem Axle	Heavy Truck - Large	Tanker Trailer 6,000 gal	Heavy Truck - Large	Compact Excavator - Mini	Heavy Truck - Large	Dump - Tandem Axle	Heavy Truck - Large
TRUCK DUMP SINGLE AXLE	Heavy Truck - Large	Tanker Truck - 3,500 gal	Heavy Truck - Large	Dump - Tandem Axle	Heavy Truck - Large		
TRUCK UTILITY SPORT 4X4	Heavy Truck - Large	Trailer - 3 Ton (Enclosed)	Heavy Truck - Large	Mobile Crane - 8.5 Ton	Heavy Truck - Large		
Cab/Chassis - Utility 4x4	Heavy Truck - Large	TRUCK DUMP TANDEM AXLE	Heavy Truck - Large	P/U - Club Cab	Heavy Truck - Large		
Dump - Tandem Axle	Heavy Truck - Large	VACCUM CATCH BASIN CLEANE	Heavy Truck - Large	PICKUP COMPACT EXT CAB	Heavy Truck - Large		
P/U - Ext Cab 4x4	Heavy Truck - Large	Utility Vehicle - Gator 6x4	Heavy Truck - Large	Telespection E-Cutaway	Heavy Truck - Large		
SEWER FLUSHER	Heavy Truck - Large	Vaccum Catch Basin Cleaner	Heavy Truck - Large	TRUCK UTILITY 3/4 TON	Heavy Truck - Large		
Skid Steer Loader	Heavy Truck - Large	Catch Basin Cleaner	Heavy Truck - Large	Generator - 60 KW	Heavy Truck - Large		

Table 4. Summary of 2006 Entity Data Input into ICLEI CACP Software - Waste

Source	Entity	Waste Generated Waste (Ton)
Waste[1]	JCPS	45,000
	LMG	26,570

[1] JCPS reported 25,000 dumpster pick-ups of waste in 2006. Dumpsters are each 8 cubic yards. To calculate total weight, Trinity used the following document (http://www.recyclemaniacs.org/doc/measurement-tracking/conversions.pdf). It is assumed that one cubic yard is approximately 450 pounds. Therefore, one dumpster is approximately 450 * 8 = 3,600 pounds. With 25,000 dumpster pick ups and assuming each dumpster was full during each pickup, it can be assumed that JCPS generated 45,000 tons of trash. Assumed general US waste composition. A specific waste value was provided for LMG waste.

Table 5. Summary of 2006 Entity Data Input into ICLEI CACP Software - Other

		Emissions						
Source	Entity	Carbon Dioxide (Tons)	Methane (Tons)	Nitrogen Oxides (Tons)	Sulphur Oxides (Tons)	Carbon Monoxide (Tons)	Volatile Organic Compounds (Tons)	Particulate Matter (Tons)
Other	JCPS Coal Handling	0	263	0	0	0	0	0
	LRAA - Louisville International Airport	11,557	0	807	76	2,472	2,472	52
	LRAA - Bowman Field Airport	1,658	0	10	3	2,168	2,168	2

APPENDIX C. COMMUNITY AND PGC ENTITY EMISSIONS ANALYSIS

Community Greenhouse Gas Emissions in 1990
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Louisville, Kentucky			
Residential			
Residential - FERC Data			
Electricity	3,210,431	17.6	9,884,751
Natural Gas	1,289,128	7.1	20,865,674
Subtotal Residential - FERC Data	4,499,558	24.7	30,750,425
Residential - FERC Data Streetlight Usage			
Electricity	22,664	0.1	69,782
Subtotal Residential - FERC Data Streetlight Usage	4	0.1	69,782
Subtotal Residential	4,522,223	24.8	30,820,207
Commercial			
Commercial - FERC Data			
Electricity	2,840,895	15.6	8,746,969
Natural Gas	535,830	2.9	8,672,892
Subtotal Commercial - FERC Data	3,376,726	18.5	17,419,861
Commercial - FERC Data Streetlight Usage			
Electricity	22,664	0.1	69,782
Subtotal Commercial - FERC Data Streetlight Usage	4	0.1	69,782
Subtotal Commercial	3,399,390	18.7	17,489,643
Industrial			
Industrial - FERC Data Streetlight Usage			
Electricity	22,664	0.1	69,782
Subtotal Industrial - FERC Data Streetlight Usage	664	0.1	69,782
Industrial - FERC Form			
Electricity	2,996,897	16.5	9,227,290
Natural Gas	299,158	1.6	4,842,140
Subtotal Industrial - FERC Form	3,296,055	18.1	14,069,431
Subtotal Industrial	3,318,719	18.2	14,139,212

Community Greenhouse Gas Emissions in 1990
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation			
Jefferson County			
Gasoline	4,564,634	25.1	53,080,452
Diesel	1,323,148	7.3	15,260,583
Subtotal Jefferson County	5,887,782	32.3	68,341,035
Subtotal Transportation	5,887,782	32.3	68,341,035
Waste			
Louisville and Jefferson County			*Disposal Method - Managed Landfill*
Paper Products	540,050	3.0	
Food Waste	172,437	0.9	
Plant Debris	-18,949	-0.1	
Wood/Textiles	-11,369	-0.1	
All Other Waste	0	0.0	
Subtotal Louisville and Jefferson County	682,168	3.7	
Subtotal Waste	682,168	3.7	
Other			
Non-Road Emissions			
Carbon Dioxide	398,551	2.2	
Subtotal Non-Road Emissions	398,551	2.2	
Subtotal Other	398,551	2.2	
Subtotal Louisville, Kentucky	18,208,832	100.0	130,790,096
Total	18,208,832	100.0	130,790,096

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Louisville, Kentucky			
Residential			
Residential - FERC Data			
Electricity	4,409,728	22.9	13,711,686
Natural Gas	1,122,850	5.8	18,174,325
Subtotal Residential - FERC Data	5,532,578	28.7	31,886,011
Residential - FERC Data Streetlight Usage			
Electricity	22,214	0.1	69,074
Subtotal Residential - FERC Data Streetlight Usage	4	0.1	69,074
Subtotal Residential	5,554,793	28.9	31,955,085
Commercial			
Commercial - FERC Data			
Electricity	3,966,878	20.6	12,334,679
Natural Gas	512,362	2.7	8,293,026
Subtotal Commercial - FERC Data	4,479,239	23.3	20,627,705
Commercial - FERC Data Streetlight Usage			
Electricity	22,214	0.1	69,074
Subtotal Commercial - FERC Data Streetlight Usage	4	0.1	69,074
Subtotal Commercial	4,501,454	23.4	20,696,779
Industrial			
Industrial - FERC Data Streetlight Usage			
Electricity	22,214	0.1	69,074
Subtotal Industrial - FERC Data Streetlight Usage	214	0.1	69,074
Industrial - FERC Form			
Electricity	3,367,130	17.5	10,469,812
Natural Gas	93,992	0.5	1,521,349
Subtotal Industrial - FERC Form	3,461,122	18.0	11,991,162
Subtotal Industrial	3,483,337	18.1	12,060,236

Community Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	
Transportation				
Jefferson County				
Diesel	1,251,723	6.5	14,431,352	
Diesel (ULSD)	128,981	0.7	1,487,067	
Ethanol (E-10)	3,793,654	19.7	49,122,983	
Subtotal Jefferson County	5,174,357	26.9	65,041,401	
Subtotal Transportation	5,174,357	26.9	65,041,401	
Waste				
Louisville and Jefferson County - Waste Generated				*Disposal Method - Managed Landfill*
Paper Products	482,046	2.5		
Food Waste	153,916	0.8		
Plant Debris	-16,914	-0.1		
Wood/Textiles	-10,148	-0.1		
All Other Waste	0	0.0		
Subtotal Louisville and Jefferson County - Waste Generated		3.2		
Subtotal Waste	608,900	3.2		
Other				
Landifll Emission Credits				
Carbon Dioxide	-510,819	-2.7		
Subtotal Landifll Emission Credits	-510,819	-2.7		
Non-Road Emissions				
Carbon Dioxide	437,284	2.3		
Subtotal Non-Road Emissions	437,284	2.3		
Subtotal Other	-73,535	-0.4		
Subtotal Louisville, Kentucky	19,249,305	100.0	129,753,501	
Total	19,249,305	100.0	129,753,501	

Community Greenhouse Gas Emissions in 2012
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Louisville, Kentucky			
Residential			
Residential - FERC Data			
Electricity	4,386,310	22.4	14,005,116
Natural Gas	1,146,879	5.9	18,563,256
Subtotal Residential - FERC Data	5,533,189	28.3	32,568,372
Residential - FERC Data Streetlight Usage			
Electricity	22,096	0.1	70,552
Subtotal Residential - FERC Data Streetlight Usage	6	0.1	70,552
Subtotal Residential	5,555,285	28.4	32,638,924
Commercial			
Commercial - FERC Data			
Electricity	3,945,811	20.2	12,598,641
Natural Gas	523,326	2.7	8,470,497
Subtotal Commercial - FERC Data	4,469,137	22.9	21,069,138
Commercial - FERC Data Streetlight Usage			
Electricity	22,096	0.1	70,552
Subtotal Commercial - FERC Data Streetlight Usage	[illegible]	0.1	70,552
Subtotal Commercial	4,491,234	23.0	21,139,690
Industrial			
Industrial - FERC Data Streetlight Usage			
Electricity	22,096	0.1	70,552
Subtotal Industrial - FERC Data Streetlight Usage	096	0.1	70,552
Industrial - FERC Form			
Electricity	3,349,248	17.1	10,693,866
Natural Gas	96,004	0.5	1,553,906
Subtotal Industrial - FERC Form	3,445,252	17.6	12,247,772
Subtotal Industrial	3,467,348	17.7	12,318,325

Community Greenhouse Gas Emissions in 2012
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation			
Jefferson County 1			
Diesel (ULSD)	139,976	0.7	1,613,854
Ethanol (E-10)	3,995,984	20.4	51,823,719
Subtotal Jefferson County 1	4,135,960	21.2	53,437,573
Jefferson County 2			
Diesel (ULSD)	1,358,362	6.9	15,660,994
Subtotal Jefferson County 2	1,358,362	6.9	15,660,994
Subtotal Transportation	5,494,322	28.1	69,098,567
Waste			
Louisville and Jefferson County - Waste Generated			*Disposal Method - Managed Landfill*
Paper Products	492,362	2.5	
Food Waste	157,210	0.8	
Plant Debris	-17,276	-0.1	
Wood/Textiles	-10,366	-0.1	
All Other Waste	0	0.0	
Subtotal Louisville and Jefferson County - Waste Generated		3.2	
Subtotal Waste	621,930	3.2	
Other			
Landfill Emissions			
Carbon Dioxide	-521,751	-2.7	
Subtotal Landfill Emissions	-521,751	-2.7	
Non-Road Emissions			
Carbon Dioxide	445,587	2.3	
Subtotal Non-Road Emissions	445,587	2.3	
Subtotal Other	-76,164	-0.4	
Subtotal Louisville, Kentucky	19,553,956	100.0	135,195,506
Total	19,553,956	100.0	135,195,506

Community Greenhouse Gas Emissions in 2020
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Louisville, Kentucky			
Residential			
Residential - FERC Data			
Electricity	4,518,564	22.3	14,395,899
Natural Gas	1,178,880	5.8	19,081,224
Subtotal Residential - FERC Data	5,697,445	28.2	33,477,123
Residential - FERC Data Streetlight Usage			
Electricity	22,763	0.1	72,521
Subtotal Residential - FERC Data Streetlight Usage	3	0.1	72,521
Subtotal Residential	5,720,207	28.3	33,549,644
Commercial			
Commercial - FERC Data			
Electricity	4,064,784	20.1	12,950,180
Natural Gas	537,928	2.7	8,706,848
Subtotal Commercial - FERC Data	4,602,712	22.7	21,657,028
Commercial - FERC Data Streetlight Usage			
Electricity	22,763	0.1	72,521
Subtotal Commercial - FERC Data Streetlight Usage	3	0.1	72,521
Subtotal Commercial	4,625,475	22.9	21,729,548
Industrial			
Industrial - FERC Data Streetlight Usage			
Electricity	22,763	0.1	72,521
Subtotal Industrial - FERC Data Streetlight Usage	763	0.1	72,521
Industrial - FERC Form			
Electricity	3,450,234	17.1	10,992,256
Natural Gas	98,683	0.5	1,597,265
Subtotal Industrial - FERC Form	3,548,916	17.5	12,589,521
Subtotal Industrial	3,571,679	17.7	12,662,041

Community Greenhouse Gas Emissions in 2020
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)
Transportation			
Jefferson County 1			
Diesel (ULSD)	149,720	0.7	1,726,220
Ethanol (E-10)	4,152,184	20.5	53,838,416
Subtotal Jefferson County 1	4,301,905	21.3	55,564,636
Jefferson County 2			
Diesel (ULSD)	1,452,905	7.2	16,751,209
Subtotal Jefferson County 2	1,452,905	7.2	16,751,209
Subtotal Transportation	5,754,809	28.4	72,315,845
Waste			
Louisville and Jefferson County - Waste Generated			*Disposal Method - Managed Landfill*
Paper Products	506,100	2.5	
Food Waste	161,597	0.8	
Plant Debris	-17,758	-0.1	
Wood/Textiles	-10,655	-0.1	
All Other Waste	0	0.0	
Subtotal Louisville and Jefferson County - Waste Generated		3.2	
Subtotal Waste	639,284	3.2	
Other			
Landifll Emission Credits			
Carbon Dioxide	-536,309	-2.7	
Subtotal Landifll Emission Credits	-536,309	-2.7	
Non-Road Emissions			
Carbon Dioxide	457,977	2.3	
Subtotal Non-Road Emissions	457,977	2.3	
Subtotal Other	-78,332	-0.4	
Subtotal Louisville, Kentucky	20,233,122	100.0	140,257,079
Total	20,233,122	100.0	140,257,079

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Louisville, Kentucky				
Buildings				
JCPS - Non-Schools				
Electricity	16,953	1.9	52,715	899,792
Natural Gas	2,501	0.3	40,481	513,457
Subtotal JCPS - Non-Schools	19,454	2.1	93,196	1,413,249
JCPS - Schools				
Electricity	176,514	19.4	548,854	11,123,748
Natural Gas	22,329	2.5	361,421	4,801,125
Subtotal JCPS - Schools	198,843	21.8	910,276	15,924,873
LMG				
Electricity	94,101	10.3	292,600	0
Natural Gas	13,006	1.4	210,515	0
Subtotal LMG	107,107	11.8	503,115	0
Louisville Water Company				
Electricity	128,026	14.1	398,086	5,448,341
Natural Gas	3,613	0.4	58,486	85,890
Subtotal Louisville Water Company	131,639	14.4	456,573	5,534,231
MSD - All Buildings				
Electricity	139,737	15.3	434,500	0
Natural Gas	38,592	4.2	624,653	0
Subtotal MSD - All Buildings	178,329	19.6	1,059,153	0
TARC - 29th Street				
Electricity	414	0.0	1,287	28,116
Natural Gas	342	0.0	5,538	52,366
Subtotal TARC - 29th Street	756	0.1	6,825	80,482
TARC - 925 W. Broadway				
Electricity	111	0.0	344	7,785
Subtotal TARC - 925 W. Broadway	111	0.0	344	7,785

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
TARC - Bus Storage Barn				
Natural Gas	133	0.0	2,145	22,643
Subtotal TARC - Bus Storage Barn	133	0.0	2,145	22,643
TARC - Operations Building				
Electricity	3,006	0.3	9,347	141,227
Natural Gas	171	0.0	2,765	30,356
Subtotal TARC - Operations Building	3,177	0.3	12,112	171,583
TARC - Union Station				
Electricity	1,705	0.2	5,302	80,265
Natural Gas	76	0.0	1,230	12,993
Subtotal TARC - Union Station	1,781	0.2	6,532	93,257
UofL - Belknap Campus				
Electricity	99,679	10.9	309,945	4,278,202
Coal	11,217	1.2	103,350	589,999
Natural Gas	5,982	0.7	96,832	1,327,408
Subtotal UofL - Belknap Campus	116,879	12.8	510,127	6,195,609
UofL - Health Science Campus				
Electricity	45,429	5.0	141,257	1,893,273
Natural Gas	577	0.1	9,339	168,576
Subtotal UofL - Health Science Campus	46,006	5.0	150,596	2,061,849
UofL - S&C Plant Apportion				
Electricity	14,584	1.6	45,349	651,563
Coal	19,550	2.1	180,128	994,765
Subtotal UofL - S&C Plant Apportion	34,134	3.7	225,477	1,646,328
UofL - Shelby Campus				
Electricity	3,794	0.4	11,798	161,052
Natural Gas	727	0.1	11,772	139,250
Subtotal UofL - Shelby Campus	4,522	0.5	23,570	300,302
Subtotal Buildings	842,871	92.5	3,960,040	33,452,192

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Vehicle Fleet				
JCPS				
Diesel (ULSD)	4,182	0.5	48,196	5,172,405
Ethanol (E-10)	85	0.0	1,108	277,890
Subtotal JCPS	4,267	0.5	49,304	5,450,295
LMG				
CNG	5	0.0	76	56,546
Diesel (ULSD)	1,075	0.1	12,391	5,311,110
Ethanol (E-10)	1,179	0.1	15,315	10,532,701
Subtotal LMG	2,260	0.2	27,782	15,900,357
Louisville Water Company				
Diesel	498	0.1	5,737	696,274
Ethanol (E-10)	249	0.0	3,282	497,302
Subtotal Louisville Water Company	747	0.1	9,018	1,193,576
MSD				
Diesel	380	0.0	4,385	0
CNG	23	0.0	360	0
Ethanol (E-10)	371	0.0	4,880	0
Subtotal MSD	774	0.1	9,626	0
TARC				
Diesel	966	0.1	11,143	0
Diesel (ULSD)	4,059	0.4	46,801	0
Ethanol (E-10)	125	0.0	1,620	0
Subtotal TARC	5,151	0.6	59,564	0
UofL				
Diesel	8	0.0	97	10,736
Ethanol (E-10)	57	0.0	735	206,378
Subtotal UofL	65	0.0	832	217,114
Subtotal Vehicle Fleet	13,264	1.5	156,127	22,761,342

Government Greenhouse Gas Emissions in 2006
Detailed Report

	Equiv CO_2 (tons)	Equiv CO_2 (%)	Energy (MMBtu)	Cost ($)
Waste				
JCPS - Mixed			*Disposal Method - Managed Landfill*	
Paper Products	20,697	2.3		0
Food Waste	6,608	0.7		0
Plant Debris	-726	-0.1		0
Wood/Textiles	-436	0.0		0
All Other Waste	0	0.0		0
Subtotal JCPS - Mixed	26,143	2.9		0
LMG			*Disposal Method - Managed Landfill*	
Paper Products	12,220	1.3		0
Food Waste	3,902	0.4		0
Plant Debris	-429	0.0		0
Wood/Textiles	-257	0.0		0
All Other Waste	0	0.0		0
Subtotal LMG	15,436	1.7		0
Subtotal Waste	41,579	4.6		0
Other				
Bowman Field				
Carbon Dioxide	1,658	0.2		
Subtotal Bowman Field	1,658	0.2		
Louisville Regional Airport Authority				
Carbon Dioxide	11,557	1.3		
Subtotal Louisville Regional Airport Authority	11,557	1.3		
UofL - Coal Handling				
Methane	263	0.0		
Subtotal UofL - Coal Handling	263	0.0		
Subtotal Other	13,477	1.5		
Subtotal Louisville, Kentucky	911,191	100.0	4,116,167	56,213,534
Total	911,191	100.0	4,116,167	56,213,534

APPENDIX D. EMISSION FACTORS

Average Grid Electricity Emission Factors

Region	Year	Emissions Unit	Per Energy Unit	CO2 Coefficient	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient
01 - East Central Area Reliability Coordination Agreement	1990	(tons)	(GWh)	1102.90	0.02	0.01	3.19	8.29	0.13	0.01	0.12
01 - East Central Area Reliability Coordination Agreement	2006	(tons)	(GWh)	1092.27	0.02	0.01	1.80	4.67	0.14	0.02	0.11
01 - East Central Area Reliability Coordination Agreement	2012	(tons)	(GWh)	1063.89	0.02	0.01	1.69	4.05	0.15	0.02	0.11
01 - East Central Area Reliability Coordination Agreement	2020	(tons)	(GWh)	1066.36	0.01	0.01	1.64	3.66	0.16	0.02	0.10

Average CHP Heat Emission Factors

Region	Year	Emissions Unit	Per Energy Unit	CO2 Coefficient	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient
USA total	1990	(lbs)	(MMBtu)	153.744	0	0.015	0.368	0.176	0.104	0.018	0.013
USA total	2006	(lbs)	(MMBtu)	153.744	0	0.015	0.368	0.176	0.104	0.018	0.013
USA total	2012	(lbs)	(MMBtu)	153.744	0	0.015	0.368	0.176	0.104	0.018	0.013
USA total	2020	(lbs)	(MMBtu)	153.744	0	0.015	0.368	0.176	0.104	0.018	0.013

Average RCI Emission Factors

Fuel	Sector	Emissions Unit	Per Energy Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient
Coal	Commercial	(lbs)	(MMBtu)	0.003	0.023	1.109	5.936	0.451	0.028	0.520
Coal	Industrial	(lbs)	(MMBtu)	0.003	0.023	0.622	1.507	0.126	0.008	0.085
Coal	Residential	(lbs)	(MMBtu)	0.003	0.023	1.109	5.936	0.451	0.028	0.520
Heavy Fuel Oil	Industrial	(lbs)	(MMBtu)	0.001	0.007	0.911	4.323	0.479	0.077	0.261
Kerosene		(lbs)	(MMBtu)	0.001	0.023	0.265	0.826	0.054	0.009	0.032
Light Fuel Oil	Commercial	(lbs)	(MMBtu)	0.001	0.023	0.265	0.826	0.054	0.009	0.032
Light Fuel Oil	Industrial	(lbs)	(MMBtu)	0.001	0.005	0.148	0.321	0.511	0.105	0.011
Light Fuel Oil	Residential	(lbs)	(MMBtu)	0.001	0.023	0.264	0.147	0.054	0.009	0.032
Natural Gas	Commercial	(lbs)	(MMBtu)	0.000	0.012	0.168	0.007	0.043	0.009	0.005
Natural Gas	Industrial	(lbs)	(MMBtu)	0.000	0.012	0.294	0.141	0.083	0.015	0.010
Natural Gas	Residential	(lbs)	(MMBtu)	0.000	0.012	0.176	0.007	0.043	0.009	0.005
Propane	Commercial	(lbs)	(MMBtu)	0.000	0.002	0.153	0.000	0.021	0.005	0.004
Propane	Industrial	(lbs)	(MMBtu)	0.000	0.002	0.208	0.000	0.035	0.005	0.007
Propane	Residential	(lbs)	(MMBtu)	0.000	0.002	0.153	0.000	0.021	0.005	0.004
Stationary Diesel		(lbs)	(MMBtu)	0.005	0.007	4.410	0.290	0.950	0.350	0.310
Stationary Gasoline	Industrial	(lbs)	(MMBtu)	0.012	0.018	1.630	0.084	62.700	2.100	0.100
Agricultural Waste		(lbs)	(MMBtu)	2.883	14.650	0.233	0.093	11.627	1.395	0.330
Biomethane		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.010
Charcoal		(lbs)	(MMBtu)	2.883	9.767	0.233	0.000	16.278	0.233	0.520
Fuelwood (Air Dry)		(lbs)	(MMBtu)	0.009	0.697	0.100	0.014	8.129	1.498	1.060
Heat Plants		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Landfill Methane		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.010
MSW		(lbs)	(MMBtu)	2.883	14.650	0.233	0.009	11.627	1.395	0.330
Peat		(lbs)	(MMBtu)	1.009	8.247	0.425	3.332	2.868	0.292	0.330
Refuse Derived Fuel		(lbs)	(MMBtu)	2.883	14.650	0.233	0.009	11.627	1.395	0.330
Sewage Gas		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Solar		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wood (Freshly Cut)		(lbs)	(MMBtu)	0.009	0.021	0.490	0.025	0.600	0.038	0.330
Wood (Oven Dry)		(lbs)	(MMBtu)	0.009	0.021	0.220	0.025	0.600	0.038	0.400
Green Electricity		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Landfill Gas Electricity		(lbs)	(MMBtu)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Fuel CO2 Emission Factors

Fuel	Emissions Unit	Per Energy Unit	CO2 Coefficient
Heavy Fuel Oil	(lbs)	(MMBtu)	183.012
Kerosene	(lbs)	(MMBtu)	167.839
Light Fuel Oil	(lbs)	(MMBtu)	164.408
Natural Gas	(lbs)	(MMBtu)	123.248
Propane	(lbs)	(MMBtu)	144.642
Stationary Diesel	(lbs)	(MMBtu)	171.850
Stationary Gasoline	(lbs)	(MMBtu)	164.873
Coal	(lbs)	(MMBtu)	215.568
Anthracite	(lbs)	(MMBtu)	227.893
Bituminous	(lbs)	(MMBtu)	205.569
Coke	(lbs)	(MMBtu)	251.147
Lignite	(lbs)	(MMBtu)	215.800
Subbituminous	(lbs)	(MMBtu)	213.010
Agricultural Waste	(lbs)	(MMBtu)	0.000
Biomethane	(lbs)	(MMBtu)	0.000
Charcoal	(lbs)	(MMBtu)	0.000
Fuelwood (Air Dry)	(lbs)	(MMBtu)	0.000
Heat Plants	(lbs)	(MMBtu)	0.000
Landfill Methane	(lbs)	(MMBtu)	0.000
MSW	(lbs)	(MMBtu)	0.000
Peat	(lbs)	(MMBtu)	246.031
Refuse Derived Fuel	(lbs)	(MMBtu)	0.000
Sewage Gas	(lbs)	(MMBtu)	0.000
Solar	(lbs)	(MMBtu)	0.000
Wood (Freshly Cut)	(lbs)	(MMBtu)	0.000
Wood (Oven Dry)	(lbs)	(MMBtu)	0.000
Green Electricity	(lbs)	(kWh)	0.000
Landfill Gas Electricity	(lbs)	(kWh)	0.000
Biodiesel (B-20)	(tonnes)	(TJ)	59.100
Biodiesel (B100)	(tonnes)	(TJ)	0.000
CNG	(lbs)	(MMBtu)	123.248
Diesel	(lbs)	(MMBtu)	171.850
Diesel (ULSD)	(tonnes)	(TJ)	73.900
Ethanol (E-10)	(lbs)	(MMBtu)	148.386
Ethanol (E-85)	(lbs)	(MMBtu)	24.731
Ethanol (E100)	(lbs)	(MMBtu)	0.000
Ethanol-Diesel	(lbs)	(MMBtu)	158.686
Gasoline	(lbs)	(MMBtu)	164.873
Hydrogen	(lbs)	(MMBtu)	147.200
LPG	(lbs)	(MMBtu)	144.642
Methanol (M-85)	(lbs)	(MMBtu)	139.991
Electricity from Anthracite	(lbs)	(kWh)	2.723
Electricity from Bituminous	(lbs)	(kWh)	2.458
Electricity from Coke	(lbs)	(kWh)	3.001
Electricity from Lignite	(lbs)	(kWh)	2.579
Electricity from Subbituminous	(lbs)	(kWh)	2.547
Electricity from Natural Gas	(lbs)	(kWh)	1.472
Electricity from Propane	(lbs)	(kWh)	1.729
Electricity from Heavy Fuel Oil	(lbs)	(kWh)	2.186
Electricity from Light Fuel Oil	(lbs)	(kWh)	1.966
Electricity from Wood (Freshly Cut)	(lbs)	(kWh)	0.000
Electricity from Wood (Oven Dry)	(lbs)	(kWh)	0.000

Transportation Average Emission Factors

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Biodiesel (B100)	Auto - Full-Size	1990	(grams)	(miles)	0.02	0.02	1.83	0.09	0.70	0.17	0.21	17.25
Biodiesel (B100)	Auto - Full-Size	2006	(grams)	(miles)	0.02	0.02	1.15	0.02	0.71	0.14	0.05	20.29
Biodiesel (B100)	Auto - Full-Size	2012	(grams)	(miles)	0.02	0.02	0.74	0.02	0.68	0.11	0.03	20.29
Biodiesel (B100)	Auto - Full-Size	2020	(grams)	(miles)	0.02	0.02	0.43	0.02	0.51	0.09	0.03	20.29
Biodiesel (B100)	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.02	0.02	1.83	0.09	0.70	0.17	0.21	35.24
Biodiesel (B100)	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.02	0.02	1.15	0.02	0.71	0.14	0.05	39.58
Biodiesel (B100)	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.02	0.02	0.74	0.02	0.68	0.11	0.03	41.21
Biodiesel (B100)	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.02	0.02	0.43	0.02	0.51	0.09	0.03	42.29
Biodiesel (B100)	Heavy Truck	1990	(grams)	(miles)	0.05	0.08	20.85	0.44	5.53	0.78	1.00	5.24
Biodiesel (B100)	Heavy Truck	2006	(grams)	(miles)	0.05	0.07	13.65	0.08	5.07	0.39	0.24	5.64
Biodiesel (B100)	Heavy Truck	2012	(grams)	(miles)	0.05	0.07	11.58	0.08	5.07	0.39	0.14	5.64
Biodiesel (B100)	Heavy Truck	2020	(grams)	(miles)	0.05	0.06	11.43	0.08	5.07	0.39	0.10	5.64
Biodiesel (B100)	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.03	0.02	2.13	0.08	0.73	0.22	0.18	15.19
Biodiesel (B100)	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.03	0.02	1.16	0.03	0.59	0.12	0.10	16.87
Biodiesel (B100)	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.03	0.02	0.70	0.02	0.42	0.09	0.07	16.93
Biodiesel (B100)	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.03	0.02	0.36	0.03	0.20	0.07	0.05	16.93
Biodiesel (B100)	Marine	0	(grams)	(miles)	2.69	8.42	5234.68	200.91	337.08	50.46	111.44	0.09
Biodiesel (B100)	Passenger Vehicle	1990	(grams)	(miles)	0.02	0.02	1.93	0.09	0.71	0.19	0.20	16.10
Biodiesel (B100)	Passenger Vehicle	2006	(grams)	(miles)	0.02	0.02	1.15	0.02	0.66	0.13	0.07	17.60
Biodiesel (B100)	Passenger Vehicle	2012	(grams)	(miles)	0.02	0.02	0.72	0.02	0.54	0.10	0.05	17.60
Biodiesel (B100)	Passenger Vehicle	2020	(grams)	(miles)	0.03	0.02	0.39	0.02	0.34	0.07	0.04	18.40
Biodiesel (B100)	Rail - Commuter	1990	(grams)	(miles)	0.08	0.25	88.34	1.64	5.42	1.41	2.35	3.05
Biodiesel (B100)	Rail - Commuter	2006	(grams)	(miles)	0.07	0.21	53.07	1.49	3.67	0.82	0.86	3.64
Biodiesel (B100)	Rail - Commuter	2012	(grams)	(miles)	0.06	0.20	44.09	1.45	3.57	0.70	0.73	3.74
Biodiesel (B100)	Rail - Commuter	2020	(grams)	(miles)	0.06	0.19	37.50	1.39	3.43	0.60	0.61	3.89
Biodiesel (B100)	Transit Bus	1990	(grams)	(miles)	0.05	0.08	20.85	0.44	5.53	0.78	1.00	5.24
Biodiesel (B100)	Transit Bus	2006	(grams)	(miles)	0.05	0.07	13.65	0.08	5.07	0.39	0.24	5.64
Biodiesel (B100)	Transit Bus	2012	(grams)	(miles)	0.05	0.07	11.58	0.08	5.07	0.39	0.14	5.64
Biodiesel (B100)	Transit Bus	2020	(grams)	(miles)	0.05	0.06	11.43	0.08	5.07	0.39	0.10	5.64
Biodiesel (B100)	Vanpool Van	1990	(grams)	(miles)	0.03	0.02	2.13	0.08	0.73	0.22	0.18	15.19
Biodiesel (B100)	Vanpool Van	2006	(grams)	(miles)	0.03	0.02	1.16	0.03	0.59	0.12	0.10	16.87
Biodiesel (B100)	Vanpool Van	2012	(grams)	(miles)	0.03	0.02	0.70	0.02	0.42	0.09	0.07	16.93
Biodiesel (B100)	Vanpool Van	2020	(grams)	(miles)	0.03	0.02	0.36	0.03	0.20	0.07	0.05	16.93
Biodiesel (B-20)	Auto - Full-Size	1990	(grams)	(miles)	0.02	0.02	1.65	0.48	1.18	0.43	0.35	17.25
Biodiesel (B-20)	Auto - Full-Size	2006	(grams)	(miles)	0.02	0.02	1.03	0.09	1.20	0.34	0.09	20.29
Biodiesel (B-20)	Auto - Full-Size	2012	(grams)	(miles)	0.02	0.02	0.67	0.09	1.14	0.27	0.06	20.29
Biodiesel (B-20)	Auto - Full-Size	2020	(grams)	(miles)	0.02	0.02	0.39	0.09	0.86	0.21	0.05	20.29
Biodiesel (B-20)	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.02	0.02	1.65	0.48	1.18	0.43	0.35	35.24
Biodiesel (B-20)	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.02	0.02	1.03	0.09	1.20	0.34	0.09	39.58
Biodiesel (B-20)	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.02	0.02	0.67	0.09	1.14	0.27	0.06	41.21
Biodiesel (B-20)	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.02	0.02	0.39	0.09	0.86	0.21	0.05	42.29
Biodiesel (B-20)	Heavy Truck	1990	(grams)	(miles)	0.05	0.08	18.82	2.29	9.29	1.93	1.69	5.24
Biodiesel (B-20)	Heavy Truck	2006	(grams)	(miles)	0.05	0.07	12.32	0.40	8.51	0.97	0.41	5.64
Biodiesel (B-20)	Heavy Truck	2012	(grams)	(miles)	0.05	0.07	10.45	0.40	8.51	0.97	0.24	5.64
Biodiesel (B-20)	Heavy Truck	2020	(grams)	(miles)	0.05	0.06	10.32	0.39	8.51	0.97	0.16	5.64
Biodiesel (B-20)	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.03	0.02	1.92	0.42	1.22	0.54	0.31	15.19
Biodiesel (B-20)	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.03	0.02	1.05	0.13	1.00	0.30	0.17	16.87
Biodiesel (B-20)	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.03	0.02	0.64	0.10	0.70	0.22	0.12	16.93
Biodiesel (B-20)	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.03	0.02	0.32	0.13	0.33	0.16	0.09	16.93
Biodiesel (B-20)	Marine	0	(grams)	(miles)	2.69	8.42	4725.11	1042.20	566.03	124.41	189.03	0.09
Biodiesel (B-20)	Passenger Vehicle	1990	(grams)	(miles)	0.02	0.02	1.74	0.46	1.19	0.46	0.34	16.10
Biodiesel (B-20)	Passenger Vehicle	2006	(grams)	(miles)	0.02	0.02	1.04	0.11	1.10	0.32	0.12	17.60

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Biodiesel (B-20)	Passenger Vehicle	2012	(grams)	(miles)	0.02	0.02	0.65	0.09	0.91	0.24	0.09	17.60
Biodiesel (B-20)	Passenger Vehicle	2020	(grams)	(miles)	0.03	0.02	0.35	0.11	0.56	0.18	0.07	18.40
Biodiesel (B-20)	Rail - Commuter	1990	(grams)	(miles)	0.08	0.25	79.74	8.50	9.10	3.48	3.99	3.05
Biodiesel (B-20)	Rail - Commuter	2006	(grams)	(miles)	0.07	0.21	47.90	7.73	6.17	2.02	1.46	3.64
Biodiesel (B-20)	Rail - Commuter	2012	(grams)	(miles)	0.06	0.20	39.80	7.52	6.00	1.73	1.24	3.74
Biodiesel (B-20)	Rail - Commuter	2020	(grams)	(miles)	0.06	0.19	33.85	7.23	5.77	1.47	1.04	3.89
Biodiesel (B-20)	Transit Bus	1990	(grams)	(miles)	0.05	0.08	18.82	2.29	9.29	1.93	1.69	5.24
Biodiesel (B-20)	Transit Bus	2006	(grams)	(miles)	0.05	0.07	12.32	0.40	8.51	0.97	0.41	5.64
Biodiesel (B-20)	Transit Bus	2012	(grams)	(miles)	0.05	0.07	10.45	0.40	8.51	0.97	0.24	5.64
Biodiesel (B-20)	Transit Bus	2020	(grams)	(miles)	0.05	0.06	10.32	0.39	8.51	0.97	0.16	5.64
Biodiesel (B-20)	Vanpool Van	1990	(grams)	(miles)	0.03	0.02	1.92	0.42	1.22	0.54	0.31	15.19
Biodiesel (B-20)	Vanpool Van	2006	(grams)	(miles)	0.03	0.02	1.05	0.13	1.00	0.30	0.17	16.87
Biodiesel (B-20)	Vanpool Van	2012	(grams)	(miles)	0.03	0.02	0.64	0.10	0.70	0.22	0.12	16.93
Biodiesel (B-20)	Vanpool Van	2020	(grams)	(miles)	0.03	0.02	0.32	0.13	0.33	0.16	0.09	16.93
CNG	Auto - Full-Size	0	(grams)	(miles)	0.03	0.03	0.04	0.00	2.76	0.06	0.01	25.40
CNG	Auto - Mid-Size	0	(grams)	(miles)	0.03	0.03	0.04	0.00	2.76	0.06	0.01	27.20
CNG	Auto - Sub-Compact/Compact	0	(grams)	(miles)	0.03	0.03	0.04	0.00	2.76	0.06	0.01	30.90
CNG	Heavy Truck - Large	0	(grams)	(miles)	0.02	1.07	4.87	0.06	11.43	1.98	0.02	6.93
CNG	Heavy Truck - Medium	0	(grams)	(miles)	0.02	1.07	4.87	0.06	11.43	1.98	0.01	8.30
CNG	Heavy Truck - Small	0	(grams)	(miles)	0.02	1.07	4.87	0.06	11.43	1.98	0.01	9.70
CNG	Light Truck/SUV/Pickup - Large	0	(grams)	(miles)	0.04	0.04	0.09	0.00	4.14	0.07	0.01	12.40
CNG	Light Truck/SUV/Pickup - Medium Large	0	(grams)	(miles)	0.04	0.04	0.09	0.00	4.14	0.07	0.01	13.10
CNG	Light Truck/SUV/Pickup - Medium Small	0	(grams)	(miles)	0.04	0.04	0.09	0.00	4.14	0.07	0.01	15.30
CNG	Light Truck/SUV/Pickup - Small	0	(grams)	(miles)	0.04	0.04	0.09	0.00	4.14	0.07	0.01	18.60
CNG	Passenger Vehicle	0	(grams)	(miles)	0.03	0.04	0.06	0.00	3.35	0.07	0.01	21.55
CNG	Transit Bus	0	(grams)	(miles)	0.02	1.07	4.87	0.06	11.43	1.98	0.02	6.93
CNG	Vanpool Van	0	(grams)	(miles)	0.04	0.04	0.09	0.00	4.14	0.07	0.01	13.10
Diesel	Auto - Full-Size	1990	(grams)	(miles)	0.02	0.02	1.62	0.58	1.33	0.54	0.39	17.25
Diesel	Auto - Full-Size	2006	(grams)	(miles)	0.02	0.02	1.01	0.11	1.35	0.43	0.10	19.38
Diesel	Auto - Full-Size	2012	(grams)	(miles)	0.02	0.02	0.66	0.11	1.28	0.34	0.06	19.38
Diesel	Auto - Full-Size	2020	(grams)	(miles)	0.02	0.02	0.38	0.11	0.97	0.27	0.05	19.38
Diesel	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.02	0.02	1.62	0.58	1.33	0.54	0.39	35.24
Diesel	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.02	0.02	1.01	0.11	1.35	0.43	0.10	39.58
Diesel	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.02	0.02	0.66	0.11	1.28	0.34	0.06	41.21
Diesel	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.02	0.02	0.38	0.11	0.97	0.27	0.05	42.29
Diesel	Heavy Truck	1990	(grams)	(miles)	0.05	0.08	18.45	2.76	10.44	2.45	1.88	5.24
Diesel	Heavy Truck	2006	(grams)	(miles)	0.05	0.07	12.08	0.49	9.56	1.23	0.45	5.64
Diesel	Heavy Truck	2012	(grams)	(miles)	0.05	0.07	10.25	0.48	9.56	1.23	0.26	5.64
Diesel	Heavy Truck	2020	(grams)	(miles)	0.05	0.06	10.11	0.47	9.56	1.23	0.18	5.64
Diesel	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.03	0.02	1.88	0.50	1.37	0.68	0.34	15.19
Diesel	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.03	0.02	1.03	0.16	1.12	0.38	0.19	16.87
Diesel	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.03	0.02	0.62	0.12	0.79	0.27	0.13	16.93
Diesel	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.03	0.02	0.32	0.16	0.37	0.21	0.10	16.93
Diesel	Marine	0	(grams)	(miles)	2.69	8.42	4632.46	1255.66	635.99	157.68	210.26	0.09
Diesel	Passenger Vehicle	1990	(grams)	(miles)	0.02	0.02	1.71	0.55	1.34	0.59	0.38	16.10
Diesel	Passenger Vehicle	2006	(grams)	(miles)	0.02	0.02	1.02	0.13	1.24	0.41	0.14	17.60
Diesel	Passenger Vehicle	2012	(grams)	(miles)	0.02	0.02	0.64	0.11	1.02	0.31	0.10	17.60
Diesel	Passenger Vehicle	2020	(grams)	(miles)	0.03	0.02	0.35	0.14	0.63	0.23	0.08	18.40
Diesel	Rail - Commuter	1990	(grams)	(miles)	0.08	0.25	78.18	10.25	10.22	4.42	4.44	3.05
Diesel	Rail - Commuter	2006	(grams)	(miles)	0.07	0.21	46.97	9.31	6.93	2.56	1.62	3.64
Diesel	Rail - Commuter	2012	(grams)	(miles)	0.06	0.20	39.02	9.06	6.74	2.19	1.38	3.74
Diesel	Rail - Commuter	2020	(grams)	(miles)	0.06	0.19	33.18	8.71	6.48	1.87	1.16	3.89
Diesel	Transit Bus	1990	(grams)	(miles)	0.05	0.08	18.45	2.76	10.44	2.45	1.88	5.24
Diesel	Transit Bus	2006	(grams)	(miles)	0.05	0.07	12.08	0.49	9.56	1.23	0.45	5.64

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Diesel	Transit Bus	2012	(grams)	(miles)	0.05	0.07	10.25	0.48	9.56	1.23	0.26	5.64
Diesel	Transit Bus	2020	(grams)	(miles)	0.05	0.06	10.11	0.47	9.56	1.23	0.18	5.64
Diesel	Vanpool Van	1990	(grams)	(miles)	0.03	0.02	1.88	0.50	1.37	0.68	0.34	15.19
Diesel	Vanpool Van	2006	(grams)	(miles)	0.03	0.02	1.03	0.16	1.12	0.38	0.19	16.87
Diesel	Vanpool Van	2012	(grams)	(miles)	0.03	0.02	0.62	0.12	0.79	0.27	0.13	16.93
Diesel	Vanpool Van	2020	(grams)	(miles)	0.03	0.02	0.32	0.16	0.37	0.21	0.10	16.93
Diesel (ULSD)	Auto - Full-Size	1990	(grams)	(miles)	0.02	0.02	1.62	0.02	1.33	0.54	0.37	17.25
Diesel (ULSD)	Auto - Full-Size	2006	(grams)	(miles)	0.02	0.02	1.01	0.00	1.35	0.43	0.09	20.29
Diesel (ULSD)	Auto - Full-Size	2012	(grams)	(miles)	0.02	0.02	0.66	0.00	1.28	0.34	0.06	20.29
Diesel (ULSD)	Auto - Full-Size	2020	(grams)	(miles)	0.02	0.02	0.38	0.00	0.97	0.27	0.05	20.29
Diesel (ULSD)	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.02	0.02	1.62	0.02	1.33	0.54	0.37	35.24
Diesel (ULSD)	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.02	0.02	1.01	0.00	1.35	0.43	0.09	39.58
Diesel (ULSD)	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.02	0.02	0.66	0.00	1.28	0.34	0.06	41.21
Diesel (ULSD)	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.02	0.02	0.38	0.00	0.97	0.27	0.05	42.29
Diesel (ULSD)	Heavy Truck	1990	(grams)	(miles)	0.05	0.08	18.45	0.09	10.44	2.45	1.79	5.24
Diesel (ULSD)	Heavy Truck	2006	(grams)	(miles)	0.05	0.07	12.08	0.02	9.56	1.23	0.43	5.64
Diesel (ULSD)	Heavy Truck	2012	(grams)	(miles)	0.05	0.07	10.25	0.02	9.56	1.23	0.25	5.64
Diesel (ULSD)	Heavy Truck	2020	(grams)	(miles)	0.05	0.06	10.11	0.02	9.56	1.23	0.17	5.64
Diesel (ULSD)	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.03	0.02	1.88	0.02	1.37	0.68	0.33	15.19
Diesel (ULSD)	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.03	0.02	1.03	0.01	1.12	0.38	0.18	16.87
Diesel (ULSD)	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.03	0.02	0.62	0.00	0.79	0.27	0.12	16.93
Diesel (ULSD)	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.03	0.02	0.32	0.01	0.37	0.21	0.10	16.93
Diesel (ULSD)	Marine	0	(grams)	(miles)	2.69	8.42	4632.46	40.18	635.99	157.68	199.75	0.09
Diesel (ULSD)	Passenger Vehicle	1990	(grams)	(miles)	0.02	0.02	1.71	0.02	1.34	0.59	0.36	16.10
Diesel (ULSD)	Passenger Vehicle	2006	(grams)	(miles)	0.02	0.02	1.02	0.00	1.24	0.41	0.13	17.60
Diesel (ULSD)	Passenger Vehicle	2012	(grams)	(miles)	0.02	0.02	0.64	0.00	1.02	0.31	0.09	17.60
Diesel (ULSD)	Passenger Vehicle	2020	(grams)	(miles)	0.03	0.02	0.35	0.00	0.63	0.23	0.08	18.40
Diesel (ULSD)	Rail - Commuter	1990	(grams)	(miles)	0.08	0.25	78.18	0.33	10.22	4.42	4.22	3.05
Diesel (ULSD)	Rail - Commuter	2006	(grams)	(miles)	0.07	0.21	46.97	0.30	6.93	2.56	1.54	3.64
Diesel (ULSD)	Rail - Commuter	2012	(grams)	(miles)	0.06	0.20	39.02	0.29	6.74	2.19	1.31	3.74
Diesel (ULSD)	Rail - Commuter	2020	(grams)	(miles)	0.06	0.19	33.18	0.28	6.48	1.87	1.10	3.89
Diesel (ULSD)	Transit Bus	1990	(grams)	(miles)	0.05	0.08	18.45	0.09	10.44	2.45	1.79	5.24
Diesel (ULSD)	Transit Bus	2006	(grams)	(miles)	0.05	0.07	12.08	0.02	9.56	1.23	0.43	5.64
Diesel (ULSD)	Transit Bus	2012	(grams)	(miles)	0.05	0.07	10.25	0.02	9.56	1.23	0.25	5.64
Diesel (ULSD)	Transit Bus	2020	(grams)	(miles)	0.05	0.06	10.11	0.02	9.56	1.23	0.17	5.64
Diesel (ULSD)	Vanpool Van	1990	(grams)	(miles)	0.03	0.02	1.88	0.02	1.37	0.68	0.33	15.19
Diesel (ULSD)	Vanpool Van	2006	(grams)	(miles)	0.03	0.02	1.03	0.01	1.12	0.38	0.18	16.87
Diesel (ULSD)	Vanpool Van	2012	(grams)	(miles)	0.03	0.02	0.62	0.00	0.79	0.27	0.12	16.93
Diesel (ULSD)	Vanpool Van	2020	(grams)	(miles)	0.03	0.02	0.32	0.01	0.37	0.21	0.10	16.93
Electricity	Auto - Full-Size	0										82.00
Electricity	Auto - Mid-Size	0										82.00
Electricity	Auto - Sub-Compact/Compact	0										82.00
Electricity	Heavy Truck - Large	0										38.00
Electricity	Heavy Truck - Medium	0										38.00
Electricity	Heavy Truck - Small	0										38.00
Electricity	Light Truck/SUV/Pickup - Large	0										68.10
Electricity	Light Truck/SUV/Pickup - Medium Large	0										71.50
Electricity	Light Truck/SUV/Pickup - Medium Small	0										83.00
Electricity	Light Truck/SUV/Pickup - Small	0										100.00
Electricity	Passenger Vehicle	0										82.00
Electricity	Rail - Commuter	0										6.18
Electricity	Rail - Light	0										4.19
Electricity	Rail - Streetcar	0										6.95
Electricity	Transit Bus	0										38.00

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Electricity	Vanpool Van	0										71.50
Ethanol (E-10)	Auto - Full-Size	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	19.45	2.36	0.03	15.94
Ethanol (E-10)	Auto - Full-Size	2006	(grams)	(miles)	0.05	0.05	1.44	0.07	13.45	1.58	0.03	18.79
Ethanol (E-10)	Auto - Full-Size	2012	(grams)	(miles)	0.05	0.05	1.21	0.06	13.45	1.49	0.03	19.85
Ethanol (E-10)	Auto - Full-Size	2020	(grams)	(miles)	0.05	0.05	1.06	0.05	13.45	1.42	0.03	21.28
Ethanol (E-10)	Auto - Mid-Size	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	19.45	2.36	0.03	17.11
Ethanol (E-10)	Auto - Mid-Size	2006	(grams)	(miles)	0.05	0.05	1.44	0.07	13.45	1.58	0.03	20.16
Ethanol (E-10)	Auto - Mid-Size	2012	(grams)	(miles)	0.05	0.05	1.21	0.06	13.45	1.49	0.03	21.30
Ethanol (E-10)	Auto - Mid-Size	2020	(grams)	(miles)	0.05	0.05	1.06	0.05	13.45	1.42	0.03	22.82
Ethanol (E-10)	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	19.45	2.36	0.03	23.10
Ethanol (E-10)	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.05	0.05	1.44	0.07	13.45	1.58	0.03	25.82
Ethanol (E-10)	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.05	0.05	1.21	0.06	13.45	1.49	0.03	26.84
Ethanol (E-10)	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.05	0.05	1.06	0.05	13.45	1.42	0.03	28.20
Ethanol (E-10)	Heavy Truck	1990	(grams)	(miles)	0.07	0.28	6.59	0.20	92.19	8.57	0.20	4.20
Ethanol (E-10)	Heavy Truck	2006	(grams)	(miles)	0.13	0.18	4.06	0.16	33.79	3.82	0.09	4.85
Ethanol (E-10)	Heavy Truck	2012	(grams)	(miles)	0.13	0.17	3.55	0.14	31.07	3.72	0.06	4.88
Ethanol (E-10)	Heavy Truck	2020	(grams)	(miles)	0.13	0.17	3.51	0.12	31.07	3.72	0.04	4.88
Ethanol (E-10)	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.10	0.13	2.47	0.10	23.18	3.15	0.06	10.85
Ethanol (E-10)	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.07	0.07	1.37	0.09	14.52	1.72	0.03	13.80
Ethanol (E-10)	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.07	0.06	1.07	0.08	13.60	1.54	0.02	14.03
Ethanol (E-10)	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.06	0.06	0.91	0.07	13.08	1.44	0.01	14.11
Ethanol (E-10)	Motorcycle	1990	(grams)	(miles)	0.01	0.44	1.04	0.00	15.28	5.19	0.00	20.93
Ethanol (E-10)	Motorcycle	2006	(grams)	(miles)	0.01	0.23	0.85	0.00	20.02	2.89	0.00	25.23
Ethanol (E-10)	Motorcycle	2012	(grams)	(miles)	0.01	0.22	0.85	0.00	20.02	2.89	0.00	25.40
Ethanol (E-10)	Motorcycle	2020	(grams)	(miles)	0.01	0.22	0.85	0.00	20.02	2.89	0.00	25.40
Ethanol (E-10)	Passenger Vehicle	1990	(grams)	(miles)	0.08	0.10	2.14	0.09	22.98	2.66	0.04	16.10
Ethanol (E-10)	Passenger Vehicle	2006	(grams)	(miles)	0.06	0.06	1.41	0.09	15.20	1.66	0.03	17.60
Ethanol (E-10)	Passenger Vehicle	2012	(grams)	(miles)	0.06	0.06	1.14	0.08	14.65	1.53	0.02	17.60
Ethanol (E-10)	Passenger Vehicle	2020	(grams)	(miles)	0.06	0.05	0.98	0.07	14.28	1.44	0.02	18.40
Ethanol (E-10)	Vanpool Van	1990	(grams)	(miles)	0.10	0.13	2.47	0.10	23.18	3.15	0.06	10.85
Ethanol (E-10)	Vanpool Van	2006	(grams)	(miles)	0.07	0.07	1.37	0.09	14.52	1.72	0.03	13.80
Ethanol (E-10)	Vanpool Van	2012	(grams)	(miles)	0.07	0.06	1.07	0.08	13.60	1.54	0.02	14.03
Ethanol (E-10)	Vanpool Van	2020	(grams)	(miles)	0.06	0.06	0.91	0.07	13.08	1.44	0.01	14.11
Ethanol (E100)	Auto - Full-Size	0	(grams)	(miles)	0.03	0.13	0.49	0.00	3.39	0.20	0.00	25.40
Ethanol (E100)	Auto - Mid-Size	0	(grams)	(miles)	0.03	0.13	0.49	0.00	3.39	0.20	0.00	27.20
Ethanol (E100)	Auto - Sub-Compact/Compact	0	(grams)	(miles)	0.03	0.13	0.49	0.00	3.39	0.20	0.00	30.90
Ethanol (E100)	Heavy Truck - Large	0	(grams)	(miles)	0.08	0.22	1.65	0.00	13.70	1.36	0.55	6.93
Ethanol (E100)	Heavy Truck - Medium	0	(grams)	(miles)	0.08	0.22	1.65	0.00	13.70	1.36	0.55	8.30
Ethanol (E100)	Heavy Truck - Small	0	(grams)	(miles)	0.08	0.22	1.65	0.00	13.70	1.36	0.55	9.70
Ethanol (E100)	Light Truck/SUV/Pickup - Large	0	(grams)	(miles)	0.03	0.13	0.41	0.02	3.23	0.20	0.00	12.40
Ethanol (E100)	Light Truck/SUV/Pickup - Medium Large	0	(grams)	(miles)	0.03	0.13	0.41	0.02	3.23	0.20	0.00	13.10
Ethanol (E100)	Light Truck/SUV/Pickup - Medium Small	0	(grams)	(miles)	0.03	0.13	0.41	0.02	3.23	0.20	0.00	15.30
Ethanol (E100)	Light Truck/SUV/Pickup - Small	0	(grams)	(miles)	0.03	0.13	0.41	0.02	3.23	0.20	0.00	18.60
Ethanol (E100)	Passenger Vehicle	0	(grams)	(miles)	0.03	0.13	0.46	0.01	3.32	0.20	0.00	22.80
Ethanol (E100)	Vanpool Van	0	(grams)	(miles)	0.03	0.13	0.41	0.02	3.23	0.20	0.00	13.10
Ethanol (E-85)	Auto - Full-Size	0	(grams)	(miles)	0.03	0.13	0.55	0.01	3.64	0.21	0.00	25.40
Ethanol (E-85)	Auto - Mid-Size	0	(grams)	(miles)	0.03	0.13	0.55	0.01	3.64	0.21	0.00	27.20
Ethanol (E-85)	Auto - Sub-Compact/Compact	0	(grams)	(miles)	0.03	0.13	0.55	0.01	3.64	0.21	0.00	30.90
Ethanol (E-85)	Heavy Truck - Large	0	(grams)	(miles)	0.08	0.21	1.86	0.01	14.67	1.40	0.75	6.93
Ethanol (E-85)	Heavy Truck - Medium	0	(grams)	(miles)	0.08	0.21	1.86	0.01	14.67	1.40	0.75	8.30
Ethanol (E-85)	Heavy Truck - Small	0	(grams)	(miles)	0.08	0.21	1.86	0.01	14.67	1.40	0.75	9.70
Ethanol (E-85)	Light Truck/SUV/Pickup - Large	0	(grams)	(miles)	0.03	0.13	0.47	0.06	3.46	0.20	0.00	12.40
Ethanol (E-85)	Light Truck/SUV/Pickup - Medium Large	0	(grams)	(miles)	0.03	0.13	0.47	0.06	3.46	0.20	0.00	13.10
Ethanol (E-85)	Light Truck/SUV/Pickup - Medium Small	0	(grams)	(miles)	0.03	0.13	0.47	0.06	3.46	0.20	0.00	15.30

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Ethanol (E-85)	Light Truck/SUV/Pickup - Small	0	(grams)	(miles)	0.03	0.13	0.47	0.06	3.46	0.20	0.00	18.60
Ethanol (E-85)	Passenger Vehicle	0	(grams)	(miles)	0.03	0.13	0.51	0.03	3.56	0.20	0.00	22.80
Ethanol (E-85)	Transit Bus	0	(grams)	(miles)	0.08	0.21	1.86	0.01	14.67	1.40	0.75	6.93
Ethanol (E-85)	Vanpool Van	0	(grams)	(miles)	0.03	0.13	0.47	0.06	3.46	0.20	0.00	13.10
Ethanol-Diesel	Auto - Full-Size	1990	(grams)	(miles)	0.03	0.02	1.69	0.39	1.03	0.62	0.21	15.88
Ethanol-Diesel	Auto - Full-Size	2006	(grams)	(miles)	0.03	0.02	0.77	0.16	0.74	0.33	0.10	16.93
Ethanol-Diesel	Auto - Full-Size	2012	(grams)	(miles)	0.03	0.02	0.46	0.16	0.47	0.23	0.07	16.93
Ethanol-Diesel	Auto - Full-Size	2020	(grams)	(miles)	0.03	0.02	0.30	0.16	0.29	0.21	0.07	16.93
Ethanol-Diesel	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.02	0.02	1.64	0.55	1.03	0.59	0.25	28.45
Ethanol-Diesel	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.02	0.02	0.98	0.13	0.95	0.41	0.09	28.62
Ethanol-Diesel	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.02	0.02	0.61	0.11	0.78	0.31	0.06	28.20
Ethanol-Diesel	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.03	0.02	0.33	0.14	0.49	0.23	0.05	28.10
Ethanol-Diesel	Heavy Truck	1990	(grams)	(miles)	0.08	0.25	75.05	10.25	7.87	4.42	2.93	3.05
Ethanol-Diesel	Heavy Truck	2006	(grams)	(miles)	0.07	0.21	45.09	9.31	5.34	2.56	1.07	3.64
Ethanol-Diesel	Heavy Truck	2012	(grams)	(miles)	0.06	0.20	37.46	9.06	5.19	2.19	0.91	3.74
Ethanol-Diesel	Heavy Truck	2020	(grams)	(miles)	0.06	0.19	31.85	8.71	4.99	1.87	0.76	3.89
Ethanol-Diesel	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.05	0.08	17.71	2.76	8.04	2.45	1.24	5.24
Ethanol-Diesel	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.05	0.07	11.59	0.49	7.36	1.23	0.30	5.64
Ethanol-Diesel	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.05	0.07	9.84	0.48	7.36	1.23	0.17	5.64
Ethanol-Diesel	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.05	0.06	9.71	0.47	7.36	1.23	0.12	5.64
Ethanol-Diesel	Marine	0	(grams)	(miles)	2.95	9.10	4447.16	1255.66	489.72	157.68	138.77	0.09
Ethanol-Diesel	Passenger Vehicle	1990	(grams)	(miles)	0.02	0.02	1.64	0.55	1.03	0.59	0.25	16.10
Ethanol-Diesel	Passenger Vehicle	2006	(grams)	(miles)	0.02	0.02	0.98	0.13	0.95	0.41	0.09	17.60
Ethanol-Diesel	Passenger Vehicle	2012	(grams)	(miles)	0.02	0.02	0.61	0.11	0.78	0.31	0.06	17.60
Ethanol-Diesel	Passenger Vehicle	2020	(grams)	(miles)	0.03	0.02	0.33	0.14	0.49	0.23	0.05	18.40
Ethanol-Diesel	Rail - Commuter	1990	(grams)	(miles)	0.02	0.02	1.47	0.01	1.03	0.53	0.20	18.18
Ethanol-Diesel	Rail - Commuter	2006	(grams)	(miles)	0.02	0.02	0.80	0.00	1.04	0.39	0.05	20.29
Ethanol-Diesel	Rail - Commuter	2012	(grams)	(miles)	0.02	0.02	0.49	0.00	0.89	0.31	0.03	20.29
Ethanol-Diesel	Rail - Commuter	2020	(grams)	(miles)	0.02	0.02	1.50	0.02	1.02	0.53	0.22	36.64
Ethanol-Diesel	Transit Bus	1990	(grams)	(miles)	0.02	0.02	1.47	0.01	1.03	0.53	0.20	35.76
Ethanol-Diesel	Transit Bus	2006	(grams)	(miles)	0.02	0.02	0.80	0.00	1.04	0.39	0.05	40.40
Ethanol-Diesel	Transit Bus	2012	(grams)	(miles)	0.02	0.02	0.49	0.00	0.89	0.31	0.03	42.02
Ethanol-Diesel	Transit Bus	2020	(grams)	(miles)	0.05	0.08	17.11	0.07	7.89	2.18	1.03	5.36
Ethanol-Diesel	Vanpool Van	1990	(grams)	(miles)	0.05	0.08	17.11	2.25	7.89	2.18	1.09	5.36
Ethanol-Diesel	Vanpool Van	2006	(grams)	(miles)	0.05	0.07	10.91	0.48	7.36	1.23	0.25	5.64
Ethanol-Diesel	Vanpool Van	2012	(grams)	(miles)	0.05	0.07	9.75	0.48	7.36	1.23	0.14	5.64
Ethanol-Diesel	Vanpool Van	2020	(grams)	(miles)	0.03	0.02	1.77	0.46	1.05	0.66	0.22	15.46
Gasoline	Auto - Full-Size	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	22.88	2.41	0.04	15.94
Gasoline	Auto - Full-Size	2006	(grams)	(miles)	0.05	0.05	1.44	0.08	15.82	1.61	0.03	18.79
Gasoline	Auto - Full-Size	2012	(grams)	(miles)	0.05	0.05	1.21	0.07	15.82	1.52	0.03	19.85
Gasoline	Auto - Full-Size	2020	(grams)	(miles)	0.05	0.05	1.06	0.06	15.82	1.45	0.03	21.28
Gasoline	Auto - Mid-Size	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	22.88	2.41	0.04	17.11
Gasoline	Auto - Mid-Size	2006	(grams)	(miles)	0.05	0.05	1.44	0.08	15.82	1.61	0.03	20.16
Gasoline	Auto - Mid-Size	2012	(grams)	(miles)	0.05	0.05	1.21	0.07	15.82	1.52	0.03	21.30
Gasoline	Auto - Mid-Size	2020	(grams)	(miles)	0.05	0.05	1.06	0.06	15.82	1.45	0.03	22.82
Gasoline	Auto - Sub-Compact/Compact	1990	(grams)	(miles)	0.07	0.08	1.97	0.08	22.88	2.41	0.04	23.10
Gasoline	Auto - Sub-Compact/Compact	2006	(grams)	(miles)	0.05	0.05	1.44	0.08	15.82	1.61	0.03	25.82
Gasoline	Auto - Sub-Compact/Compact	2012	(grams)	(miles)	0.05	0.05	1.21	0.07	15.82	1.52	0.03	26.84
Gasoline	Auto - Sub-Compact/Compact	2020	(grams)	(miles)	0.05	0.05	1.06	0.06	15.82	1.45	0.03	28.20
Gasoline	Heavy Truck	1990	(grams)	(miles)	0.07	0.26	6.59	0.22	108.46	8.74	0.21	4.20
Gasoline	Heavy Truck	2006	(grams)	(miles)	0.13	0.17	4.06	0.18	39.75	3.90	0.10	4.85
Gasoline	Heavy Truck	2012	(grams)	(miles)	0.13	0.16	3.55	0.16	36.55	3.79	0.07	4.88
Gasoline	Heavy Truck	2020	(grams)	(miles)	0.13	0.16	3.51	0.13	36.55	3.79	0.04	4.88
Gasoline	Light Truck/SUV/Pickup	1990	(grams)	(miles)	0.10	0.13	2.47	0.11	27.27	3.21	0.06	10.85

Fuel	VehicleType	Year	Emissions Unit	Per Distance Unit	N2O Coefficient	CH4 Coefficient	Nox Coefficient	Sox Coefficient	CO Coefficient	VOC Coefficient	PM10 Coefficient	Fuel Efficiency
Gasoline	Light Truck/SUV/Pickup	2006	(grams)	(miles)	0.07	0.06	1.37	0.10	17.08	1.76	0.03	13.80
Gasoline	Light Truck/SUV/Pickup	2012	(grams)	(miles)	0.07	0.06	1.07	0.09	16.00	1.57	0.02	14.03
Gasoline	Light Truck/SUV/Pickup	2020	(grams)	(miles)	0.06	0.06	0.91	0.08	15.38	1.47	0.01	14.11
Gasoline	Motorcycle	1990	(grams)	(miles)	0.01	0.42	1.04	0.00	17.97	5.30	0.00	20.93
Gasoline	Motorcycle	2006	(grams)	(miles)	0.01	0.22	0.85	0.00	23.55	2.95	0.00	25.23
Gasoline	Motorcycle	2012	(grams)	(miles)	0.01	0.21	0.85	0.00	23.55	2.95	0.00	25.40
Gasoline	Motorcycle	2020	(grams)	(miles)	0.01	0.21	0.85	0.00	23.55	2.95	0.00	25.40
Gasoline	Passenger Vehicle	1990	(grams)	(miles)	0.08	0.09	2.14	0.09	24.37	2.68	0.04	16.10
Gasoline	Passenger Vehicle	2006	(grams)	(miles)	0.06	0.06	1.41	0.09	16.42	1.68	0.03	17.60
Gasoline	Passenger Vehicle	2012	(grams)	(miles)	0.06	0.05	1.14	0.08	15.92	1.55	0.03	17.60
Gasoline	Passenger Vehicle	2020	(grams)	(miles)	0.06	0.05	0.98	0.07	15.58	1.46	0.02	18.40
Gasoline	Vanpool Van	1990	(grams)	(miles)	0.10	0.13	2.47	0.11	27.27	3.21	0.06	10.85
Gasoline	Vanpool Van	2006	(grams)	(miles)	0.07	0.06	1.37	0.10	17.08	1.76	0.03	13.80
Gasoline	Vanpool Van	2012	(grams)	(miles)	0.07	0.06	1.07	0.09	16.00	1.57	0.02	14.03
Gasoline	Vanpool Van	2020	(grams)	(miles)	0.06	0.06	0.91	0.08	15.38	1.47	0.01	14.11
Hydrogen	Heavy Truck	0	(grams)	(miles)	0.00	0.03	0.16	0.19	0.90	0.09	0.04	5.63
Hydrogen	Light Truck/SUV/Pickup	0	(grams)	(miles)	0.00	0.01	0.59	0.03	0.13	0.02	0.01	45.25
Hydrogen	Passenger Vehicle	0	(grams)	(miles)	0.00	0.01	0.45	0.03	0.12	0.02	0.01	49.21
Hydrogen	Transit Bus	0	(grams)	(miles)	0.00	0.03	0.16	0.19	0.90	0.09	0.04	5.63
Hydrogen	Vanpool Van	0	(grams)	(miles)	0.04	0.04	0.35	0.36	0.04	0.43	0.04	45.25
LPG	Auto - Full-Size	0	(grams)	(miles)	0.03	0.10	0.04	0.00	2.76	0.06	0.01	25.40
LPG	Auto - Mid-Size	0	(grams)	(miles)	0.03	0.10	0.04	0.00	2.76	0.06	0.01	27.20
LPG	Auto - Sub-Compact/Compact	0	(grams)	(miles)	0.03	0.10	0.04	0.00	2.76	0.06	0.01	30.90
LPG	Heavy Truck - Large	0	(grams)	(miles)	0.04	0.24	4.87	0.00	11.43	2.47	0.02	6.93
LPG	Heavy Truck - Medium	0	(grams)	(miles)	0.04	0.24	4.87	0.00	11.43	2.47	0.01	8.30
LPG	Heavy Truck - Small	0	(grams)	(miles)	0.04	0.24	4.87	0.00	11.43	2.47	0.01	9.70
LPG	Light Truck/SUV/Pickup - Large	0	(grams)	(miles)	0.04	0.12	0.09	0.00	4.14	0.07	0.01	12.40
LPG	Light Truck/SUV/Pickup - Medium Large	0	(grams)	(miles)	0.04	0.12	0.09	0.00	4.14	0.07	0.01	13.10
LPG	Light Truck/SUV/Pickup - Medium Small	0	(grams)	(miles)	0.04	0.12	0.09	0.00	4.14	0.07	0.01	15.30
LPG	Light Truck/SUV/Pickup - Small	0	(grams)	(miles)	0.04	0.12	0.09	0.00	4.14	0.07	0.01	18.60
LPG	Passenger Vehicle	0	(grams)	(miles)	0.03	0.11	0.06	0.00	3.35	0.07	0.01	22.80
LPG	Transit Bus	0	(grams)	(miles)	0.04	0.24	4.87	0.00	11.43	2.47	0.02	6.93
LPG	Vanpool Van	0	(grams)	(miles)	0.04	0.12	0.09	0.00	4.14	0.07	0.01	13.10
Methanol (M-85)	Auto - Full-Size	0	(grams)	(miles)	0.03	0.07	0.04	0.01	2.76	0.06	0.01	25.40
Methanol (M-85)	Auto - Mid-Size	0	(grams)	(miles)	0.03	0.07	0.04	0.01	2.76	0.06	0.01	27.20
Methanol (M-85)	Auto - Sub-Compact/Compact	0	(grams)	(miles)	0.03	0.07	0.04	0.01	2.76	0.06	0.01	30.90
Methanol (M-85)	Heavy Truck - Large	0	(grams)	(miles)	0.04	0.11	4.87	0.05	14.29	2.47	0.04	6.93
Methanol (M-85)	Heavy Truck - Medium	0	(grams)	(miles)	0.04	0.11	4.87	0.05	14.29	2.47	0.03	8.30
Methanol (M-85)	Heavy Truck - Small	0	(grams)	(miles)	0.04	0.11	4.87	0.05	14.29	2.47	0.03	9.70
Methanol (M-85)	Light Truck/SUV/Pickup - Large	0	(grams)	(miles)	0.04	0.08	0.09	0.01	4.14	0.07	0.02	12.40
Methanol (M-85)	Light Truck/SUV/Pickup - Medium Large	0	(grams)	(miles)	0.04	0.08	0.09	0.01	4.14	0.07	0.02	13.10
Methanol (M-85)	Light Truck/SUV/Pickup - Medium Small	0	(grams)	(miles)	0.04	0.08	0.09	0.01	4.14	0.07	0.02	15.30
Methanol (M-85)	Light Truck/SUV/Pickup - Small	0	(grams)	(miles)	0.04	0.08	0.09	0.01	4.14	0.07	0.02	18.60
Methanol (M-85)	Passenger Vehicle	0	(grams)	(miles)	0.03	0.07	0.06	0.01	3.35	0.07	0.02	22.80
Methanol (M-85)	Transit Bus	0	(grams)	(miles)	0.04	0.11	4.87	0.05	14.29	2.47	0.04	6.93
Methanol (M-85)	Vanpool Van	0	(grams)	(miles)	0.04	0.08	0.09	0.01	4.14	0.07	0.02	13.10

Transportation Standard Vehicle Efficiencies

SetName	Fuel	VehicleType	DistanceUnit	PerEnergyUnit	FuelEfficiency
CA Standards	Biodiesel (B-20)	Auto	(miles)	(US gal gasoline eq)	40.2
CA Standards	Biodiesel (B-20)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
CA Standards	Biodiesel (B-20)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
CA Standards	Biodiesel (B-20)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
CA Standards	Biodiesel (B-20)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
CA Standards	Biodiesel (B-20)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
CA Standards	Biodiesel (B-20)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
CA Standards	Biodiesel (B-20)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
CA Standards	Biodiesel (B-20)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
CA Standards	Biodiesel (B-20)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
CA Standards	Biodiesel (B-20)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
CA Standards	Biodiesel (B100)	Auto	(miles)	(US gal gasoline eq)	40.2
CA Standards	Biodiesel (B100)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
CA Standards	Biodiesel (B100)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
CA Standards	Biodiesel (B100)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
CA Standards	Biodiesel (B100)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
CA Standards	Biodiesel (B100)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
CA Standards	Biodiesel (B100)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
CA Standards	Biodiesel (B100)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
CA Standards	Biodiesel (B100)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
CA Standards	Biodiesel (B100)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
CA Standards	Biodiesel (B100)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
CA Standards	Diesel	Auto	(miles)	(US gal gasoline eq)	40.2
CA Standards	Diesel	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
CA Standards	Diesel	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
CA Standards	Diesel	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
CA Standards	Diesel	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
CA Standards	Diesel	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
CA Standards	Diesel	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
CA Standards	Diesel	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
CA Standards	Diesel	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
CA Standards	Diesel	Transit Bus	(miles)	(US gal gasoline eq)	5.63
CA Standards	Diesel	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
CA Standards	Diesel (ULSD)	Auto	(miles)	(US gal gasoline eq)	40.2
CA Standards	Diesel (ULSD)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
CA Standards	Diesel (ULSD)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
CA Standards	Diesel (ULSD)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
CA Standards	Diesel (ULSD)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
CA Standards	Diesel (ULSD)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
CA Standards	Diesel (ULSD)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
CA Standards	Diesel (ULSD)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
CA Standards	Diesel (ULSD)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
CA Standards	Diesel (ULSD)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
CA Standards	Diesel (ULSD)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
CA Standards	Ethanol (E-10)	Auto	(miles)	(US gal gasoline eq)	28.5
CA Standards	Ethanol (E-10)	Auto - Full-Size	(miles)	(US gal gasoline eq)	25.4
CA Standards	Ethanol (E-10)	Auto - Mid-Size	(miles)	(US gal gasoline eq)	27.2
CA Standards	Ethanol (E-10)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	30.9
CA Standards	Ethanol (E-10)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	6.93
CA Standards	Ethanol (E-10)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.3
CA Standards	Ethanol (E-10)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	9.7
CA Standards	Ethanol (E-10)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	12.4
CA Standards	Ethanol (E-10)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	13.1
CA Standards	Ethanol (E-10)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	15.3
CA Standards	Ethanol (E-10)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	18.6
CA Standards	Ethanol (E-10)	Vanpool Van	(miles)	(US gal gasoline eq)	13.1
CA Standards	Ethanol-Diesel	Auto	(miles)	(US gal gasoline eq)	40.2
CA Standards	Ethanol-Diesel	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
CA Standards	Ethanol-Diesel	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
CA Standards	Ethanol-Diesel	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
CA Standards	Ethanol-Diesel	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11

SetName	Fuel	VehicleType	DistanceUnit	PerEnergyUnit	FuelEfficiency
CA Standards	Ethanol-Diesel	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
CA Standards	Ethanol-Diesel	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
CA Standards	Ethanol-Diesel	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
CA Standards	Ethanol-Diesel	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
CA Standards	Ethanol-Diesel	Transit Bus	(miles)	(US gal gasoline eq)	5.63
CA Standards	Ethanol-Diesel	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
CA Standards	Gasoline	Auto	(miles)	(US gal gasoline eq)	28.5
CA Standards	Gasoline	Auto - Full-Size	(miles)	(US gal gasoline eq)	25.4
CA Standards	Gasoline	Auto - Mid-Size	(miles)	(US gal gasoline eq)	27.2
CA Standards	Gasoline	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	30.9
CA Standards	Gasoline	Heavy Truck - Large	(miles)	(US gal gasoline eq)	6.93
CA Standards	Gasoline	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.3
CA Standards	Gasoline	Heavy Truck - Small	(miles)	(US gal gasoline eq)	9.7
CA Standards	Gasoline	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	12.4
CA Standards	Gasoline	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	13.1
CA Standards	Gasoline	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	15.3
CA Standards	Gasoline	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	18.6
CA Standards	Gasoline	Vanpool Van	(miles)	(US gal gasoline eq)	13.1
Default	Biodiesel (B-20)	Auto	(miles)	(US gal gasoline eq)	40.2
Default	Biodiesel (B-20)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
Default	Biodiesel (B-20)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
Default	Biodiesel (B-20)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
Default	Biodiesel (B-20)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
Default	Biodiesel (B-20)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
Default	Biodiesel (B-20)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
Default	Biodiesel (B-20)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
Default	Biodiesel (B-20)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
Default	Biodiesel (B-20)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
Default	Biodiesel (B-20)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
Default	Biodiesel (B100)	Auto	(miles)	(US gal gasoline eq)	40.2
Default	Biodiesel (B100)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
Default	Biodiesel (B100)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
Default	Biodiesel (B100)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
Default	Biodiesel (B100)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
Default	Biodiesel (B100)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
Default	Biodiesel (B100)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
Default	Biodiesel (B100)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
Default	Biodiesel (B100)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
Default	Biodiesel (B100)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
Default	Biodiesel (B100)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
Default	Diesel	Auto	(miles)	(US gal gasoline eq)	40.2
Default	Diesel	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
Default	Diesel	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
Default	Diesel	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
Default	Diesel	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
Default	Diesel	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
Default	Diesel	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
Default	Diesel	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
Default	Diesel	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
Default	Diesel	Transit Bus	(miles)	(US gal gasoline eq)	5.63
Default	Diesel	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
Default	Diesel (ULSD)	Auto	(miles)	(US gal gasoline eq)	40.2
Default	Diesel (ULSD)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
Default	Diesel (ULSD)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
Default	Diesel (ULSD)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
Default	Diesel (ULSD)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
Default	Diesel (ULSD)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
Default	Diesel (ULSD)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
Default	Diesel (ULSD)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
Default	Diesel (ULSD)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
Default	Diesel (ULSD)	Transit Bus	(miles)	(US gal gasoline eq)	5.63
Default	Diesel (ULSD)	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
Default	Ethanol (E-10)	Auto	(miles)	(US gal gasoline eq)	28.5
Default	Ethanol (E-10)	Auto - Full-Size	(miles)	(US gal gasoline eq)	25.4

SetName	Fuel	VehicleType	DistanceUnit	PerEnergyUnit	FuelEfficiency
Default	Ethanol (E-10)	Auto - Mid-Size	(miles)	(US gal gasoline eq)	27.2
Default	Ethanol (E-10)	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	30.9
Default	Ethanol (E-10)	Heavy Truck - Large	(miles)	(US gal gasoline eq)	6.93
Default	Ethanol (E-10)	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.3
Default	Ethanol (E-10)	Heavy Truck - Small	(miles)	(US gal gasoline eq)	9.7
Default	Ethanol (E-10)	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	12.4
Default	Ethanol (E-10)	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	13.1
Default	Ethanol (E-10)	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	15.3
Default	Ethanol (E-10)	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	18.6
Default	Ethanol (E-10)	Vanpool Van	(miles)	(US gal gasoline eq)	13.1
Default	Ethanol-Diesel	Auto	(miles)	(US gal gasoline eq)	40.2
Default	Ethanol-Diesel	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	40.2
Default	Ethanol-Diesel	Heavy Truck - Large	(miles)	(US gal gasoline eq)	5.63
Default	Ethanol-Diesel	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.34
Default	Ethanol-Diesel	Heavy Truck - Small	(miles)	(US gal gasoline eq)	11
Default	Ethanol-Diesel	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	15.7
Default	Ethanol-Diesel	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	16.5
Default	Ethanol-Diesel	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	19.3
Default	Ethanol-Diesel	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	23.5
Default	Ethanol-Diesel	Transit Bus	(miles)	(US gal gasoline eq)	5.63
Default	Ethanol-Diesel	Vanpool Van	(miles)	(US gal gasoline eq)	16.5
Default	Gasoline	Auto	(miles)	(US gal gasoline eq)	28.5
Default	Gasoline	Auto - Full-Size	(miles)	(US gal gasoline eq)	25.4
Default	Gasoline	Auto - Mid-Size	(miles)	(US gal gasoline eq)	27.2
Default	Gasoline	Auto - Sub-Compact/Compact	(miles)	(US gal gasoline eq)	30.9
Default	Gasoline	Heavy Truck - Large	(miles)	(US gal gasoline eq)	6.93
Default	Gasoline	Heavy Truck - Medium	(miles)	(US gal gasoline eq)	8.3
Default	Gasoline	Heavy Truck - Small	(miles)	(US gal gasoline eq)	9.7
Default	Gasoline	Light Truck/SUV/Pickup - Large	(miles)	(US gal gasoline eq)	12.4
Default	Gasoline	Light Truck/SUV/Pickup - Medium Large	(miles)	(US gal gasoline eq)	13.1
Default	Gasoline	Light Truck/SUV/Pickup - Medium Small	(miles)	(US gal gasoline eq)	15.3
Default	Gasoline	Light Truck/SUV/Pickup - Small	(miles)	(US gal gasoline eq)	18.6
Default	Gasoline	Vanpool Van	(miles)	(US gal gasoline eq)	13.1

Waste Emission Factors

Type Name	Disposal Tech Name	Emissions Unit	Per Waste Unit	Methane Coef	Sequest At Site Coef	Sequest Forest Coef	Upstrm Enrgy Coef	Upstrm Non Enrgy Coef
Paper Products	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Food Waste	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Plant Debris	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Wood/Textiles	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
All Other Waste	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Aluminum	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Cardboard	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Food Waste	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Glass	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Mixed MSW	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Mixed Recyclables	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
MSW	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper - Household	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper - Mixed General	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper - Mixed Office	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper - Newsprint	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper - Office Paper	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - HDPE	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - LDPE	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - PET	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Steel	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Wood	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Yard Waste	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Fibreboard	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Magazines	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Phonebooks	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Textbooks	Uncollected	(tonnes)	(tonnes)	0	0	0	0	0
Paper Products	Open Dump	(tonnes)	(tonnes)	1.282957721	-0.927925396	0	0	0
Food Waste	Open Dump	(tonnes)	(tonnes)	0.726202484	-0.080689165	0	0	0
Plant Debris	Open Dump	(tonnes)	(tonnes)	0.411514741	-0.847236231	0	0	0
Wood/Textiles	Open Dump	(tonnes)	(tonnes)	0.363101242	-0.847236231	0	0	0
All Other Waste	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Aluminum	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Cardboard	Open Dump	(tonnes)	(tonnes)	1.161923974	-0.887580813	0	0	0
Food Waste	Open Dump	(tonnes)	(tonnes)	0.726202484	-0.080689165	0	0	0
Glass	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Mixed MSW	Open Dump	(tonnes)	(tonnes)	0.629375486	-0.403445824	0	0	0
Mixed Recyclables	Open Dump	(tonnes)	(tonnes)	1.007000777	-0.847236231	0	0	0
MSW	Open Dump	(tonnes)	(tonnes)	0.629375486	-0.403445824	0	0	0
Paper - Household	Open Dump	(tonnes)	(tonnes)	1.186130723	-0.968269978	0	0	0
Paper - Mixed General	Open Dump	(tonnes)	(tonnes)	1.282957721	-0.927925396	0	0	0
Paper - Mixed Office	Open Dump	(tonnes)	(tonnes)	1.403991468	-0.847236231	0	0	0
Paper - Newsprint	Open Dump	(tonnes)	(tonnes)	0.556755237	-1.452404967	0	0	0
Paper - Office Paper	Open Dump	(tonnes)	(tonnes)	2.63853569	-0.16137833	0	0	0
Plastic - HDPE	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - LDPE	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - PET	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Steel	Open Dump	(tonnes)	(tonnes)	0	0	0	0	0
Wood	Open Dump	(tonnes)	(tonnes)	0.363101242	-0.847236231	0	0	0
Yard Waste	Open Dump	(tonnes)	(tonnes)	0.411514741	-0.847236231	0	0	0
Fibreboard	Open Dump	(tonnes)	(tonnes)	0.363	-0.847	0	0	0
Magazines	Open Dump	(tonnes)	(tonnes)	0.629	-1.17	0	0	0
Phonebooks	Open Dump	(tonnes)	(tonnes)	0.557	-1.452	0	0	0
Textbooks	Open Dump	(tonnes)	(tonnes)	2.639	-0.161	0	0	0
Paper Products	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Food Waste	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Plant Debris	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Wood/Textiles	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
All Other Waste	Open Burning	(tonnes)	(tonnes)	0.484134989	0	0	0	0

Type Name	Disposal Tech Name	Emissions Unit	Per Waste Unit	Methane Coef	Sequest At Site Coef	Sequest Forest Coef	Upstrm Enrgy Coef	Upstrm Non Enrgy Coef
Cardboard	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Food Waste	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Mixed MSW	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Mixed Recyclables	Open Burning	(tonnes)	(tonnes)	0.484134989	0	0	0	0
MSW	Open Burning	(tonnes)	(tonnes)	0.484134989	0	0	0	0
Paper - Household	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Mixed General	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Mixed Office	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Newsprint	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Office Paper	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Plastic - HDPE	Open Burning	(tonnes)	(tonnes)	3.106532846	0	0	0	0
Plastic - LDPE	Open Burning	(tonnes)	(tonnes)	3.106532846	0	0	0	0
Plastic - PET	Open Burning	(tonnes)	(tonnes)	2.259296615	0	0	0	0
Wood	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Yard Waste	Open Burning	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Fibreboard	Open Burning	(tonnes)	(tonnes)	0.081	0	0	0	0
Magazines	Open Burning	(tonnes)	(tonnes)	0.081	0	0	0	0
Phonebooks	Open Burning	(tonnes)	(tonnes)	0.081	0	0	0	0
Textbooks	Open Burning	(tonnes)	(tonnes)	0.081	0	0	0	0
Paper Products	Managed Landfill	(tonnes)	(tonnes)	2.138262868	-0.927925396	0	0	0
Food Waste	Managed Landfill	(tonnes)	(tonnes)	1.210337473	-0.080689165	0	0	0
Plant Debris	Managed Landfill	(tonnes)	(tonnes)	0.685857901	-0.847236231	0	0	0
Wood/Textiles	Managed Landfill	(tonnes)	(tonnes)	0.605168736	-0.847236231	0	0	0
All Other Waste	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Aluminum	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Cardboard	Managed Landfill	(tonnes)	(tonnes)	1.936539956	-0.887580813	0	0	0
Food Waste	Managed Landfill	(tonnes)	(tonnes)	1.210337473	-0.080689165	0	0	0
Glass	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Mixed MSW	Managed Landfill	(tonnes)	(tonnes)	1.048959143	-0.403445824	0	0	0
Mixed Recyclables	Managed Landfill	(tonnes)	(tonnes)	1.678334629	-0.847236231	0	0	0
MSW	Managed Landfill	(tonnes)	(tonnes)	1.048959143	-0.403445824	0	0	0
Paper - Household	Managed Landfill	(tonnes)	(tonnes)	1.976884538	-0.968269978	0	0	0
Paper - Mixed General	Managed Landfill	(tonnes)	(tonnes)	2.138262868	-0.927925396	0	0	0
Paper - Mixed Office	Managed Landfill	(tonnes)	(tonnes)	2.33998578	-0.847236231	0	0	0
Paper - Newsprint	Managed Landfill	(tonnes)	(tonnes)	0.927925396	-1.452404967	0	0	0
Paper - Office Paper	Managed Landfill	(tonnes)	(tonnes)	4.397559483	-0.16137833	0	0	0
Plastic - HDPE	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - LDPE	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Plastic - PET	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Steel	Managed Landfill	(tonnes)	(tonnes)	0	0	0	0	0
Wood	Managed Landfill	(tonnes)	(tonnes)	0.605168736	-0.847236231	0	0	0
Yard Waste	Managed Landfill	(tonnes)	(tonnes)	0.685857901	-0.847236231	0	0	0
Fibreboard	Managed Landfill	(tonnes)	(tonnes)	0.605	-0.847	0	0	0
Magazines	Managed Landfill	(tonnes)	(tonnes)	1.049	-1.17	0	0	0
Phonebooks	Managed Landfill	(tonnes)	(tonnes)	0.928	-1.452	0	0	0
Textbooks	Managed Landfill	(tonnes)	(tonnes)	4.398	-0.161	0	0	0
Paper Products	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Food Waste	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Plant Debris	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Wood/Textiles	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
All Other Waste	Controlled Incineration	(tonnes)	(tonnes)	0.484134989	0	0	0	0
Cardboard	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Food Waste	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Mixed MSW	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Mixed Recyclables	Controlled Incineration	(tonnes)	(tonnes)	0.484134989	0	0	0	0
MSW	Controlled Incineration	(tonnes)	(tonnes)	0.484134989	0	0	0	0
Paper - Household	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Mixed General	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Mixed Office	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Newsprint	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Paper - Office Paper	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Plastic - HDPE	Controlled Incineration	(tonnes)	(tonnes)	3.106532846	0	0	0	0

Type Name	Disposal Tech Name	Emissions Unit	Per Waste Unit	Methane Coef	Sequest At Site Coef	Sequest Forest Coef	Upstrm Enrgy Coef	Upstrm Non Enrgy Coef
Plastic - LDPE	Controlled Incineration	(tonnes)	(tonnes)	3.106532846	0	0	0	0
Plastic - PET	Controlled Incineration	(tonnes)	(tonnes)	2.259296615	0	0	0	0
Wood	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Yard Waste	Controlled Incineration	(tonnes)	(tonnes)	0.080689165	0	0	0	0
Fibreboard	Controlled Incineration	(tonnes)	(tonnes)	0.081	0	0	0	0
Magazines	Controlled Incineration	(tonnes)	(tonnes)	0.081	0	0	0	0
Phonebooks	Controlled Incineration	(tonnes)	(tonnes)	0.081	0	0	0	0
Textbooks	Controlled Incineration	(tonnes)	(tonnes)	0.081	0	0	0	0
Paper Products	Compost	(tonnes)	(tonnes)	0	-0.201722912	0	0	0
Food Waste	Compost	(tonnes)	(tonnes)	0	-0.201722912	0	0	0
Plant Debris	Compost	(tonnes)	(tonnes)	0	-0.201722912	0	0	0
Wood/Textiles	Compost	(tonnes)	(tonnes)	0	-0.201722912	0	0	0
All Other Waste	Compost	(tonnes)	(tonnes)	0	0	0	0	0
Food Waste	Compost	(tonnes)	(tonnes)	0	0.201722912	0	0	0
Yard Waste	Compost	(tonnes)	(tonnes)	0	0.201722912	0	0	0
Aluminum	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-13.19267845	-4.558937813
Cardboard	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	0.121033747	0
Glass	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-0.16137833	-0.16137833
Mixed Recyclables	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.541708692	-0.443790407	-0.080689165
Paper - Household	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	0.443790407	0
Paper - Mixed General	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	0.443790407	0
Paper - Mixed Office	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	-0.645513319	0
Paper - Newsprint	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	-1.00861456	0
Paper - Office Paper	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.945154516	0.403445824	-0.040344582
Plastic - HDPE	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-1.775161626	-0.201722912
Plastic - LDPE	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-2.218952033	-0.201722912
Plastic - PET	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-2.057573703	-0.121033747
Steel	Recycling of Waste	(tonnes)	(tonnes)	0	0	0	-2.017229121	0
Wood	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.017229121	0.080689165	0
Fibreboard	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.02	0.08	0
Magazines	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.95	0	0
Phonebooks	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.95	-1.05	0
Textbooks	Recycling of Waste	(tonnes)	(tonnes)	0	0	-2.95	-0.08	0
Aluminum	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-7.665470659	-2.380330363
Cardboard	Reduction in Waste	(tonnes)	(tonnes)	0	0	-1.210337473	-0.968269978	0
Food Waste	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	0	0
Glass	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-0.403445824	-0.121033747
Mixed Recyclables	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.541708692	-0.443790407	-0.080689165
Paper - Household	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-1.533094132	0
Paper - Mixed General	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-1.533094132	0
Paper - Mixed Office	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-3.429289505	0
Paper - Newsprint	Reduction in Waste	(tonnes)	(tonnes)	0	0	-1.452404967	-1.855850791	0
Paper - Office Paper	Reduction in Waste	(tonnes)	(tonnes)	0	0	-1.976884538	-1.210337473	0
Plastic - HDPE	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-1.775161626	-0.201722912
Plastic - LDPE	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-2.259296615	-0.201722912
Plastic - PET	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-1.855850791	-0.080689165
Steel	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	-2.218952033	-0.968269978
Wood	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.017229121	-0.403445824	0
Yard Waste	Reduction in Waste	(tonnes)	(tonnes)	0	0	0	0	0
Fibreboard	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.02	-0.4	0
Magazines	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.46	-1.86	0
Phonebooks	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.66	-2.58	0
Textbooks	Reduction in Waste	(tonnes)	(tonnes)	0	0	-2.58	-2.38	0

Fuel Densities

Fuel	Density Volume UNum	Density Volume UDenom	Density Volume	Density Weight UNum	Density Weight UDenom	Density Weight	Density Gas UNum	Density Gas UDenom	Density Gas
Heavy Fuel Oil	(GJ)	(liters)	0.042	(GJ)	(tonnes)	44.38			
Kerosene	(GJ)	(liters)	0.039	(GJ)	(tonnes)	46.06			
Light Fuel Oil	(GJ)	(liters)	0.039	(GJ)	(tonnes)	46.06			
Natural Gas				(GJ)	(tonnes)	53.97	(GJ)	(cubic meters)	0.038
Propane	(GJ)	(liters)	0.026	(GJ)	(tonnes)	49.87192118			
Stationary Diesel	(GJ)	(liters)	0.034	(GJ)	(tonnes)	43.33			
Stationary Gasoline	(GJ)	(liters)	0.035	(GJ)	(tonnes)	47.5			
Coal				(GJ)	(tonnes)	22.34			
Anthracite				(GJ)	(tonnes)	26.38			
Bituminous				(GJ)	(tonnes)	27.91			
Coke				(GJ)	(tonnes)	28.98			
Lignite				(GJ)	(tonnes)	15.03			
Subbituminous				(GJ)	(tonnes)	20.03			
Agricultural Waste				(GJ)	(tonnes)	15			
Biomethane							(GJ)	(cubic meters)	0.039
Charcoal				(GJ)	(tonnes)	29			
Fuelwood (Air Dry)	(GJ)	(liters)	0.0069	(GJ)	(tonnes)	11.5			
Landfill Methane							(GJ)	(cubic meters)	0.039
MSW				(GJ)	(tonnes)	11			
Peat				(GJ)	(tonnes)	8.37			
Refuse Derived Fuel				(GJ)	(tonnes)	11			
Sewage Gas							(GJ)	(cubic meters)	0.039
Wood (Freshly Cut)	(GJ)	(liters)	0.009	(GJ)	(tonnes)	10.9			
Wood (Oven Dry)	(GJ)	(liters)	0.016	(GJ)	(tonnes)	20			
Biodiesel (B-20)	(GJ)	(liters)	0.0336	(GJ)	(tonnes)	42.68			
Biodiesel (B100)	(GJ)	(liters)	0.0315	(GJ)	(tonnes)	40.04			
CNG	(GJ)	(liters)	3.80E-05				(GJ)	(cubic meters)	0.038
Diesel	(GJ)	(liters)	0.034	(GJ)	(tonnes)	43.33			
Diesel (ULSD)	(GJ)	(liters)	0.0341	(GJ)	(tonnes)	43.33			
Ethanol (E-10)	(GJ)	(liters)	0.033	(GJ)	(tonnes)	45.43			
Ethanol (E-85)	(GJ)	(liters)	0.022	(GJ)	(tonnes)	29.9			
Ethanol (E100)	(GJ)	(liters)	0.02	(GJ)	(tonnes)	26.79			
Ethanol-Diesel	(GJ)	(liters)	0.032962254	(GJ)	(tonnes)	42.05679346			
Gasoline	(GJ)	(liters)	0.035	(GJ)	(tonnes)	47.5			
Hydrogen	(GJ)	(liters)	0.003				(GJ)	(cubic meters)	0.014
LPG	(GJ)	(liters)	0.026	(GJ)	(tonnes)	49.87192118			
Methanol (M-85)	(GJ)	(liters)	0.018992369	(GJ)	(tonnes)	24.16863871			