

Partnership for a Green City Climate Action Report

April 22, 2009



Partnership for a Green City
Louisville

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Acknowledgements

This climate action report (Report) would not have been possible without the support and hard work of numerous people in the community, but there are a few individuals essential to bringing the report to fruition.

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There are a number of great things happening in Louisville Metro Government, JCPS, UofL and in Louisville - Possibility City. From the website www.possibilitycity.com, "There is a place unlike any other. A city alive with potential. Where dreams flourish in the fertile soils of can-do, and ideas are ultimate currency." To all the participants in this process: thank you for taking your time to make such a positive contribution for your community. Your ideas and dreams will help lead the efforts to reduce greenhouse gas emissions and keep our city alive with potential.

Brent Fryrear, CHMM
Director, Partnership for a Green City
brent@partnershipforagreencity.org

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Executive Summary

On April 22, 2005, Earth Day, Louisville's Mayor Jerry Abramson signed the U.S. Mayor's Climate Protection Agreement, which was later unanimously endorsed by the U.S. Conference of Mayors. Under this agreement, participating cities seek to reduce greenhouse gas (GHG) emissions from city operations and the community at large to 7% below 1990 levels by 2012. As a member of the Partnership for a Green City (PGC), Louisville Metro Government (LMG) worked with the other Partners, Jefferson County Public Schools (JCPS) and the University of Louisville (UofL), to undertake a process that would help the community meet this goal. The outcome of these efforts was the formation of the Climate Change Committee (CCC) of the PGC in December 2006. Furthermore, in 2007 UofL President Ramsey signed the American College & University Presidents Climate Commitment to reduce GHG emissions and work toward achieving climate neutrality.

The aim of the CCC was to prepare a report for the leadership of the PGC entities that recommended strategies to mitigate the community's GHG emissions and to prepare for the impact climate change may have locally. In order to complete the task and work towards achieving emissions reductions, the CCC established seven subcommittees, each with a different area of focus. Nearly 120 representatives from PGC entities, local industry and businesses, the local gas and electric utility, environmental concerns, neighborhoods, and other community interests met frequently in these seven subcommittees to identify major GHG emissions sources and any notable trends, to develop and recommend strategies for achieving the reduction targets, and to prepare for the impacts that climate change may have locally. Committee reports and recommendations are included in each group's section of the report and a comprehensive list of 175 recommendations is listed in Appendix D.

LMG hired a consultant to conduct a comprehensive inventory of greenhouse gas emissions resulting from the three PGC entities' operations and emissions from Jefferson County at large. This unique undertaking was comprised of three endeavors: 1) a community inventory for a baseline year of 1990, 2) a community inventory for 2006 and projected ones for 2012 and 2020, 3) entity inventories for JCPS, UofL, and LMG (including the Metropolitan Sewer District, Transit Authority of River City, Louisville Water Company, and the Louisville Regional Airport Authority) for 2006. The results of the inventory project showed that in order to achieve a 7% emissions reduction from 1990, we need to decrease our footprint by over 2 million tons of carbon dioxide per year. That is the equivalent to the annual GHG emissions from nearly 400,000 passenger vehicles, or from the electricity used annually in nearly 300,000 homes or from carbon sequestered from over 50 million tree seedlings grown for 10 years. The results also indicated that the community at large generated over 95% of the GHG emissions in Jefferson County and the PGC's portion was only 4.7%. However, it quickly became apparent that strategies to reduce GHG emissions must start with leadership from JCPS, LMG and UofL.

Increases in the frequency of heavy precipitation, flooding, droughts and heat waves each have the potential to affect negatively public health and the economy in Louisville. The **Local Impacts** subcommittee offers recommendations for dealing with these challenges and mitigating their impact. These include strategies to address stormwater run-off, agricultural/horticultural shifts, and preparedness planning for natural hazards among others. There are also recommendations in this report from the **GHG Inventory and Mechanisms** subcommittee for data gathering and collaboration building to facilitate the creation of future GHG emission inventories.

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The emissions reductions recommendations in this report cover a broad range of strategies to reduce GHG emissions from the Partner entities and the community. The areas that the PGC entities can achieve the most effective GHG reductions in their own operations are at facilities, particularly in building energy use and in their vehicle fleets. Emissions reduction strategies for the community will be broader and emphasize transportation, residential energy use, commercial energy use, and industrial facilities.

Energy use in buildings and facilities was examined from many perspectives, including those of the user, the utility and the regulator, by the **Energy Efficiency and Renewable Energy** subcommittee and the **Utility Regulations, Policies, and Procedures** subcommittee. These groups then made recommendations that speak to what kind of energy the community uses, with recommendations to increase renewable energy generation and use, as well as recommendations to each end use sector and the Partners on how energy can be used most efficiently.

Similarly, the **Land Use, Transportation and Urban Forestry** subcommittee took a wide-ranging look at how we develop our land, how we travel within our community, and what impact these factors have on the community's carbon footprint. Recommendations from this group are also broad in their outlook, ranging from increasing infill development and land uses that are transit and pedestrian friendly to urging the Partners to green their fleets with more efficient vehicles and operating policies to protecting and increasing Jefferson County's tree canopy. The **Waste** subcommittee reviewed information and crafted recommendations regarding Louisville's waste stream. These suggestions include ideas for reducing the amount of waste landfilled through increased recycling and composting, as well as using the methane generated at the landfill for energy generation.

All of these subcommittees recognized the importance of public outreach and education on climate change and the issues relating to it in order to meet the community reduction goal. To this end, the **Education and Outreach** subcommittee made recommendations to all of the Partners to engage their employees, students and the community at large in a discussion of themes common to many aspects of climate change science. These suggestions range from specific events to recommended tools for delivering information to the public.

The CCC is aware that in the current economic crisis funding some recommendations may be difficult initially, but many of the recommendations are low-cost or no-cost and often have relatively short payback periods. It is hopeful that some of the American Recovery and Reinvestment Act of 2009 stimulus dollars the Partner entities receive will be committed to implementing the CCC's recommendations. Reducing the city's carbon footprint can bring multiple environmental benefits, with cleaner air and better public health, and stimulate the economic sector with job opportunities.

The CCC continues to be an active PGC Committee, meeting on a quarterly basis to track goals, monitor progress on climate action plans, make additional recommendations and reconvene working groups as new information becomes available. The CCC will continue to inform and educate the Partner's employees and students, as well as the community, about the local impacts of climate change and what Louisville Metro residents can do to decrease their personal greenhouse gas emissions. Only by keeping the issue on the forefront will we be able to work toward continuous reductions and meet the goals of the Mayor's Climate Protection Agreement.

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Section 1 Introduction

1.1 Climate Change: Introduction

Earth's environmental health is at risk. The byproducts of technological progress since the Industrial Revolution have taken a toll on the planet. Much of our progress has been built on the combustion of carbon-based fossil fuels, yet burning wood, coal, natural gas, oil, etc. releases greenhouse gases (GHGs) into the global atmosphere.

Naturally-occurring GHGs (the ones help maintain a comfortable, warm planet) are not the problem. It is the excess GHG production from man-made sources (from the burning of fossil fuels and aggravated by deforestation, wetland loss and overdevelopment) that creates higher than normal temperatures. For instance, the concentrations of GHG carbon dioxide (CO₂) alone increased by 100 parts per million (ppm) (two thirds of which are attributed to fossil fuel burning and the remaining third to land use activities) between 1750 and 2006.¹ According to the Climate Change 2007 Synthesis Report of the Intergovernmental Panel for Climate Change (IPCC) working on behalf of the United Nations, temperature increases are widespread globally: a consistent trend in the past 100 years, with particular concern in recent years (1995-2006), eleven of which are ranked among the warmest since 1850.

CO₂ emissions comprise the largest percentage of a community's GHG emissions, due to direct emissions from fossil fuel combustion and indirect emissions due to electricity consumption. Since CO₂ 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 CO₂ and inherent combustion inefficiencies cause carbon to remain unburned as soot or ash or emitted as a hydrocarbon.

Unrestrained GHG emissions and their ensuing warming trends have the potential to compromise air quality, render human systems vulnerable to natural disasters (hurricanes, flooding, drought and landslides), ease the spreading of certain diseases, cause food scarcity or costlier production and trigger species extinctions. This is why citizens, communities and governments have united to mitigate and hopefully reverse what has often been perceived as an irreversible process.

Our planet's health must become one of our priorities. In the words of Walter K. Dodds, there are four arguments for protecting Earth: (1) morality (it is the right thing to do), (2) sustainability (a subset of morality, it is not right to deprive future generations), (3) the precautionary principle (avoiding unpredicted catastrophe) and (4) economic benefit.²

¹ S. Ichtiaque Rasool and Jean-Claude Duplessy, "Conclusions," in *Facing Climate Change Together*, ed. Catherine Gautier and Jean-Louis Fellous (Cambridge, UK: Cambridge University Press, 2008), 218.

² Walter K. Dodds, *Humanity's Footprint: Momentum, Impact and Our Global Environment* (New York: Columbia University Press, 2008), 139.

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1.2 Climate Change Leadership Agreements

The lack of swift United States government support or enforcement of strict environmental regulations did not deter national and local leaders such as Seattle Mayor Greg Nickels and the U.S. Conference of Mayors from taking responsibility. They created an agreement in which participating cities would commit to the advancement of the targets suggested by the Kyoto Protocol of 2005 with emphasis in reduction of GHG emissions by 7% or more below 1990 levels by the year 2012. Louisville's Mayor Jerry Abramson signed this agreement in April 2005. Additionally, in 2007 UofL President Ramsey signed the American College & University Presidents Climate Commitment to reduce GHG emissions and work toward achieving climate neutrality.

1.3 Partnership for a Green City (PGC)

Louisville was already involved in environmentally sound practices before the U.S. Conference of Mayors brought green initiatives to the forefront. One example is the [Partnership for a Green City](#). It began in 2004 when representatives from the three major Louisville public entities (Louisville Metro Government, University of Louisville and Jefferson County Public School District) came together because of shared common interest and concern—a vision of a greener, more sustainable Louisville. These representatives began building the foundation for their shared vision—that the health and education of our children, establishment of waste reduction, energy use, natural resource management and green infrastructure establishment are the keys to our success in a city.

As the Partnership evolved, the linkages between education, the greening of the Metro area and quality-of-life issues became opportunities. These encompass treating the environment as a unifying theme to change current practices for achieving better program outcomes, improving student test scores and reducing costs of the three partner organizations. The Partnership defined three objectives important for Louisville:

- **Environmental Education** – develop strategies to further holistic environmental education within all three organizations.
- **Public Health** – conduct research to assess the correlation between environmental pollutant exposures and health impacts that may affect student cognitive learning abilities, behavior, or both.
- **Environmental Management** – identify strategies and tactics for JCPS, UofL and Louisville Metro Government (LMG) to create sustainable, green public infrastructures.

1.4 Climate Change Committee

Louisville's GHG emissions reduction efforts are being led by a community-wide stakeholder group, working under the auspices of the [Partnership](#). Louisville's Climate Change Committee (Committee) had its first meeting in December 2006. Its goal was to prepare a report to the leadership of the Partner entities that he

The Committee established seven working groups to carry out the principal work of developing recommendations for successfully meeting the Climate Protection Agreement.

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The working groups are:

Greenhouse Gas Emissions Inventory and Mechanisms, which includes inventories, trading, registries, offsets and other related mechanisms.

Land Use, Transportation, Urban Forestry and related policies.

Energy Efficiency and Renewable Energy seeks opportunities to promote energy efficiency and renewable energy.

Education and Outreach focuses on raising the community's awareness, changing behaviors and addressing students' curricula and related opportunities.

Utility Regulations, Policies and Practices examines the barriers, incentives, etc., such as net metering, demand side management, renewable portfolio standards and related approaches.

Local Impacts reviews meteorological changes, ecological impacts, public health impacts, etc., as well as needs and opportunities for mitigation, adaptation.

Waste seeks opportunities to reduce GHG emissions resulting from disposal of municipal solid waste.

To facilitate the work of the Committee and its working groups, the Louisville Metro APCD, chaired the Committee and staffed the working groups throughout the process. APCD established a [web site](#) to provide a centralized location for logistical management and important documents utilized by the stakeholders.

This undertaking was a community-wide and inclusive effort and participation by interested members of the community was welcomed. Lists of working group participants are included in Appendix A.

Implementation of the recommendations from this report will require a variety of funding sources. Adequate funding is critical to the successful implementation of a majority of the recommendations contained herein. The Committee expects that parties adopting these recommendations will identify and secure the requisite funding. There are many resources available for undertaking the types of projects recommended. For example, the U.S. Environmental Protection Agency's (EPA) 2008 revision of its [Guidebook of Financial Tools](#) is a wealth of quick information and helpful referrals.

Despite the relative novelty of many of the recommended initiatives, there exists a range of established funding solutions that are appropriate and that should be considered. These include:

- taxation relief, such as is provided through tax increment financing bonds or land conservation tax;
- redevelopment and infill grants that support brownfields reuse;
- Clean Water State Revolving Fund Loans for projects that improve water quality;

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- financial incentives such as net metering to support alternative energy generation or location efficient mortgages to reduce sprawl;
- non-financial incentives, such as fast-track permitting processes or exemptions from code restrictions and requirements, to promote adoption of best practices;
- rebates that provide cash payments for projects that meet identified design standards; and
- any number of pricing schemes, such as per-unit waste collection or tiered utility pricing, which can influence individual behavior.

Upon culmination of the working groups' efforts, the Committee identified seven overarching recommendations integral to meeting the PGC's greenhouse gas emissions reduction goals:

Recommendations for PGC Implementation of this Report

Recommendation 1:

PGC should adopt this Report as its guidance and its Partners should use it to prepare Climate Action Plans for their organizations. These plans should include funding resources, implementation timelines and metrics to monitor the progress of initiatives towards achieving their emissions reduction goals.

Recommendation 2:

PGC and the Partners should have a joint event to present this Report to the public.

Recommendation 3:

PGC should ask the full committee to meet quarterly to track goals, make recommendations and reconvene working groups as new information becomes available.

Recommendation 4:

PGC entities should each have public stakeholder processes established as they develop their action plans based on the Climate Change Committee's recommendations.

Recommendation 5:

PGC entities should evaluate the economic impact of business-as-usual practices versus implementing the actions in their CAPs.

Recommendation 6:

PGC should tie all of the recommendations to outreach and education themes.

Recommendation 7:

PGC should provide an annual climate change progress report to the public.

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Section 2 Louisville's Greenhouse Gas Emissions

In January 2008, Louisville Metro Government (LMG), with the APCD as the lead agency, selected Trinity Consultants (Trinity) to develop a greenhouse gas (GHG) inventory work plan, prepare emissions inventories, develop an inventory management plan, prepare an emissions inventory report and present its findings to the Climate Change Committee (Committee). In February 2008, Trinity representatives met with APCD staff to develop the work plan, met with entity data holders and provided brief introductory remarks to the Committee. Data holders then made great efforts to provide their best and most accurate data. A list of the data providers from each organization is provided in Appendix C. Trinity then compiled the inventories and presented its preliminary findings during the Committee's August 2008 meeting. A summary of its final report is included here. The full Greenhouse Gas Emissions Inventory Report with supporting details is available online at http://www.louisvilleky.gov/NR/rdonlyres/9C5722BB-62FD-481B-A8D0-5FD5F29A4640/0/Louisville_Metro_GHG_Inventory_Report_v420081120.pdf.

2.1 Overview of Greenhouse Gas Inventories

To help determine how Louisville Metro would meet the U.S. Mayor's Climate Protection Agreement GHG reduction goal of 7% below 1990 levels by 2012, the city needed to determine historical and projected anthropogenic, i.e., human-generated, GHG emissions within its jurisdiction. Trinity calculated a baseline inventory for Jefferson County for 1990 and 2006, with projections to 2012 and 2020. It also completed individual inventories for the PGC entities for 2006. Figure 2-1 illustrates the relationship of the organizations included in these inventories.

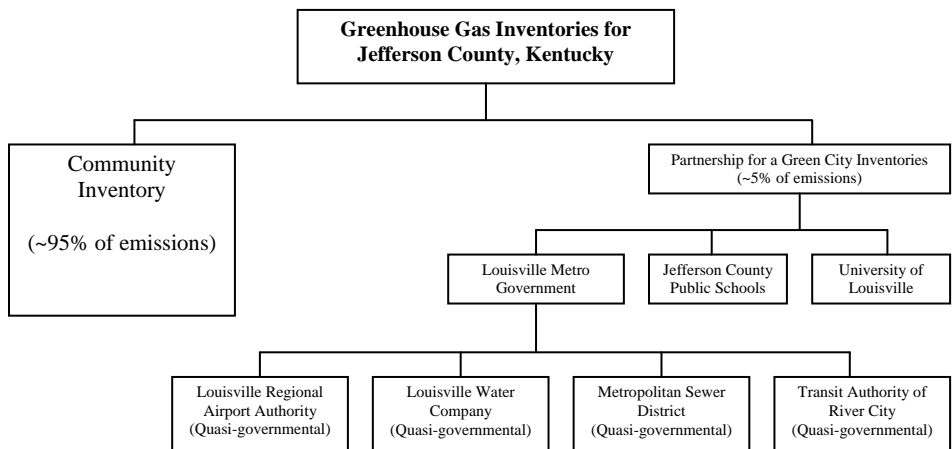


Figure 2-1. Jefferson County Emissions Inventory Organization Chart

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The majority of GHG emissions data were calculated using the International Council for Local Environmental Initiatives' (ICLEI) Clean Air and Climate Protection software (CACP).³ GHG emissions were calculated for CO₂, methane, nitrous oxide (N₂O), ozone (O₃), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆). Emissions were presented using a common metric, carbon dioxide equivalent (CO₂e), which is the concentration of CO₂ that would cause the same warming effect as other specific GHGs.

GHG emissions inventory methodologies and software techniques will be refined over time. Fundamental changes to evaluation methods in calculating inventories, improved source data, changes in regulatory requirements and new ways to characterize and report emissions are all possible. Entities responsible for future inventories should follow refined methodologies and apply them when applicable.

2.2 Community-Level Inventory

Community-level emissions calculations were performed for the years 1990 and 2006 and projected for 2012 and 2020. A summary of historical and projected GHG emissions by sector is provided below in Table 2-1. GHG emissions, measured in tons of carbon dioxide equivalent (CO₂e), 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. Emissions for the residential, commercial and industrial sectors are based on natural gas and electricity sales as provided by Louisville Gas and Electric (LG&E), the utility serving Jefferson County and much of the surrounding community. This is likely to represent the vast majority of the residential and commercial sectors' energy use; however, industrial sector emissions resulting from natural gas purchased through a source other than LG&E, from coal-fired boilers on site, or from manufacturing processes are not included in this inventory. See the complete report link for further discussion of emissions that are included in the inventory. The recommendations in 2.5.2 of this Report include suggestions for improving the accuracy of the industrial sector inventory. Given available data, community 1990 and 2006 GHG emissions from Jefferson County were calculated to be 18,208,833 and 19,249,306 tons CO₂e respectively.

Table 2-1. Community CO₂e Emissions Summary with Projections

Sector	CO ₂ e (tons)		CO ₂ e (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
CO₂e (tons) per Capita	27.38	27.34	27.03	27.39

³ ICLEI is an international association of local governments that have made a commitment to sustainable development. <http://www.iclei.org/>.

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In all four years, based on the data that was readily available, the largest sources of CO₂e emissions were determined to be the transportation and residential sectors, respectively. Combined, these two sectors are responsible for over half of the inventoried CO₂e emissions from community sources. This is similar to the results of the [EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006](#), which found the transportation sector to be the largest, followed by industrial and then residential. These emissions are a result of indirect emissions from electricity usage and direct emissions from fuel usage (i.e., natural gas) in the residential buildings, as well as direct emissions from fuel usage (e.g., gasoline, E-10, diesel, ultra-low sulfur diesel ULSD) in onroad and nonroad vehicles operating within the community. See the link at the end of the section to view the report for further discussion of emissions that are included in the inventory. Emissions for all sectors combined have risen steadily over the period studied, increasing by approximately 5.7% between 1990 and 2006.

Using the data provided by LMG and LG&E, along with population data, the CO₂e emissions for 2012 and 2020 were projected. Without any emissions mitigation measures, it is anticipated that the community will contribute 19,553,954 and 20,233,123 tons of CO₂e, in 2012 and 2020, respectively.

GHG emissions per capita within the Louisville Metro area are among the highest in the nation for large municipalities. According to a recent report issued by the Brookings Institution (hereinafter, the Brookings Report),⁴ the Louisville Metro area has the fourth highest per capita GHG emissions among the 100 largest metropolitan areas and is well above the estimated national average. The Brookings Report is based only 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.

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.

A comparison of inventory results from other communities that used a methodology similar to that used by Louisville to develop its inventory illustrates that we face similar challenges. Figure 2-2 (on the following page) shows the comparison of emissions per capita based on the information presented in individual inventory reports for Louisville, Cincinnati and Denver. Louisville's per capita total emissions are higher than those for Cincinnati and slightly lower than Denver.

⁴ Zarzynski, Brown and Southworth, Brookings Institution, *Shrinking the Carbon Footprint of Metropolitan America*. May 2008.

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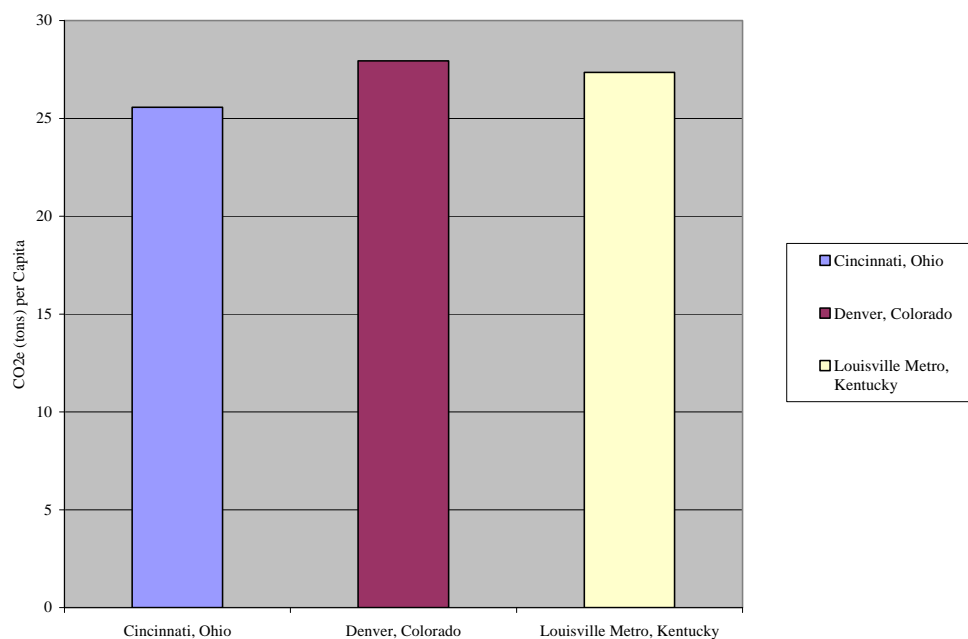


Figure 2-2. Per Capita Emissions Comparison from Relevant Inventory Reports

2.3 Partnership Inventories

PGC entity emissions calculations were performed for 2006. The GHG emissions for each PGC entity were quantified for buildings, vehicle fleets, waste and other sectors. The reporting entities were JCPS, UofL, LMG, Louisville Regional Airport Authority (LRAA), Louisville Water Company (LWC), Transit Authority of River City (TARC) and the Metropolitan Sewer District (MSD). The buildings sector includes indirect GHG emissions occurring from electricity usage and direct emissions from fuel combustion (i.e., natural gas and coal). Emissions from LRAA were calculated with different tools during a separate inventory process and have been listed entirely in the fleet sector for the purposes of this Report. LRAA’s inventory total includes both fleets and facilities. For more information about LRAA emissions see section 4.2.2 of the complete report as listed at the end of this section. A summary of 2006 emissions from the PGC entities is provided in Table 2-2.

Table 2-2. PGC Entities 2006 CO₂e Emissions Summary

Sector	CO ₂ e (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

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2.4 Reduction Targets

To meet the reduction goal of 7% below 1990 levels by 2012 and taking into account the increase in emissions from 1990 to 2006, the community will need to institute mitigation measures that will result in decreases of over two-million tons, or a 12% reduction, from 2006 inventoried emissions. To achieve the necessary reductions, it is important that emission reduction strategies target the appropriate sectors and sources within the community. Because the PGC desires to lead by example, it is helpful to compare community level emissions to PGC emissions. Figure 2-3 below illustrates the emissions inventory for the Louisville Metro area, noting that only 4.73% of the total community emissions are contributed by the PGC.⁵

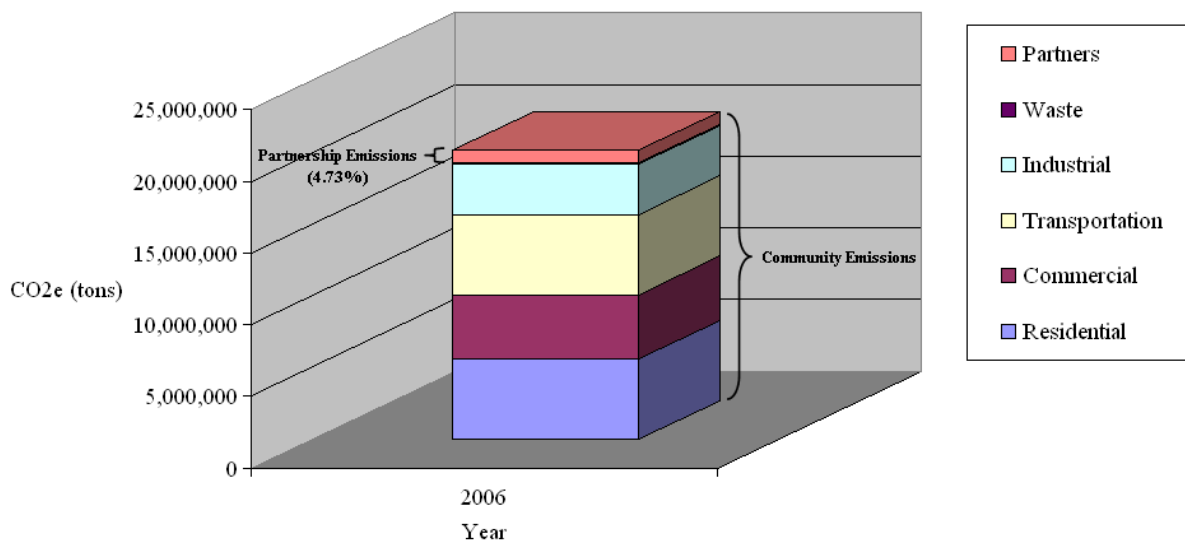


Figure 2-3. 2006 Partnership and Community Emissions by Source

2.5 Recommendations for Future Inventory Efforts

The GHG subcommittee reached consensus on the following nineteen recommendations.

2.5.1 General Recommendations

During the process of reviewing the available data, potential data gaps were identified and, recognizing that the tools available for the evaluation and projection of information may improve, the following recommendations were made for consideration when undertaking future GHG inventory efforts.

⁵ Waste emissions are not visible due to scale.

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Recommendation 8:

PGC should conduct GHG inventories biannually through 2014 and then reevaluate frequency by monitoring the impact of data and methodology changes from existing or pending programs or legislation.

Recommendation 9:

If new tools and methodologies or more accurate data sources are identified, subsequent inventory efforts should incorporate these developments as needed and apply retroactively to prior inventories to make consistent year-to-year comparisons. For instance, if data from the Federal Energy Regulatory Commission (FERC) forms are refined or a more accurate source of data is identified this could improve the residential, industrial and commercial sector data. Another example of an improved tool for the transportation sector is EPA's forthcoming MOVES (Motor Vehicle Emission Simulator).

Recommendation 10:

LMG should maintain its ICLEI membership in order to receive support, guidance and recognition for its efforts to reduce GHG emissions.

Recommendation 11:

LMG should investigate participation in The Climate Registry and evaluate how it may assist in future GHG reductions.

Recommendation 12:

PGC entities should evaluate opportunities as programs are developed to document GHG reductions as a monetized funding source for future initiative implementation.

2.5.2 Community Inventory

While gathering data and reviewing the greenhouse inventory results, several broad community level opportunities were identified. By addressing the following recommendations, a wide-ranging benefit to the community as a whole may be accomplished:

Recommendation 13:

PGC should create a repository for future GHG emissions data submissions.

Recommendation 14:

PGC should identify and implement criteria for what additional sources should be quantified in future inventories (data availability, feasibility and quantity of emissions reductions).

Recommendation 15:

PGC should work with members of the industrial sector to develop a plan to further refine the Sector information in the community inventory.

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Recommendation 16:

PGC should seek refined GHG emissions projections using sector specific factors in addition to population growth.

Recommendation 17:

PGC should encourage local companies to calculate their GHG emissions reductions.

Recommendation 18:

PGC should quantify fuel usage (e.g., propane, wood) in addition to natural gas.

Recommendation 19:

PGC should encourage expansion of demand side management and utility energy efficiency programs and quantify related reductions to evaluate program effectiveness.

Recommendation 20:

PGC should coordinate the timing of data collection with reporting agencies for future GHG inventory updates.

Recommendation 21:

PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from marine vessels – port and underway.

Recommendation 22:

PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from railroad equipment – rail yard and hauling.

Recommendation 23:

PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from refrigerant usage.

2.5.3 Partner Inventories

The Partners can demonstrate leadership to the community in their own GHG inventories by addressing the following recommendations:

Recommendation 24:

The Partners should demonstrate leadership by evaluating emissions and available data sources to determine levels (de minimis?) of emissions from refrigerant usage.

Recommendation 25:

The Partners should demonstrate leadership by evaluating emissions and available data sources to identify and quantify Scope 3 emissions where possible and determine levels (de minimis?) of emissions, e.g., from employee/student commutes.

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Recommendation 26:

The Partners should include emissions reduction potential in prioritizing future project evaluations.

To read the entire GHS Emissions Report on the web, use the following url:

[http://www.louisvilleky.gov/NR/rdonlyres/9C5722BB-62FD-481B-A8D0-5FD5F29A4640/0/Louisville Metro GHG Inventory Report v420081120.pdf](http://www.louisvilleky.gov/NR/rdonlyres/9C5722BB-62FD-481B-A8D0-5FD5F29A4640/0/Louisville%20Metro%20GHG%20Inventory%20Report%20v420081120.pdf).

Section 3 Local Impacts

Many municipalities are assessing the possible impacts of climate change at the local level. Several coastal communities have performed in-depth studies of population displacement and infrastructure losses due to sea level rise. Other communities have focused on public health issues. In some cases, climate change impacts are being observed and measured. Predicted impacts must be estimated from the analyses of available standard climatological data in conjunction with well-established relationships between the local climate and various impact sectors described in this section.

3.1 Louisville Metro's Climate History and Projected Changes

Detailed records of Louisville's temperature and precipitation have been collected and archived by the National Oceanic Atmospheric Agency (NOAA) since 1948. These data were obtained and analyzed to provide a detailed history of recent climate trends with the intent of prediction to the year 2020.

From the 60-year data set, (1948-2007) the following climate trends are evident:

- The mean annual air temperature over the 60-year interval indicates a gradual warming from 1948-2007.
- The mean, maximum and minimum temperatures over the 60-year interval reflect a period of cooling from 1950 to approximately 1970 followed by a systematic increase to 2007.
- Relative to the 1948-2007 interval, the period between 1970 and 2007 indicates a greater rate of increase in all three temperatures (minimum, maximum and mean).
- The minimum temperatures indicate the greatest rate of change - a trend that is particularly pronounced from 1970 onward.
- Annual precipitation totals (water equivalent) remain essentially invariant over the 60-year interval.
- Annual precipitation levels in the form of snowfall indicate systematic decline from 1960 to 2007.

3.1.1 Data Analysis and Extension of Results to 2020

Standard linear regression analysis was applied to the NOAA data set to identify the minimum, mean and maximum temperature trends for the 60-year interval. Two sets of calculations were performed: 1) for the time series of 1948-2007 and 2) for the interval from 1970-2007. The year 1970 was selected as a representative time in which all measures of air temperature indicate a consistent trend of warming to 2007. Trend lines were established for each time series and extended from 2007 to 2020. This effectively defined the likely range of temperature change from 2007 to 2020. Through direct application of the regression coefficients, projected changes in the temperature for the Louisville Metro area were derived from 2007 to 2020 with 2015 isolated for comparative purposes.

The range of the maximum, mean and minimum air temperatures as projected to 2020 using the regression coefficients derived from the 60-year NOAA data set for both time intervals are as follows (note the least predicted increase is derived from the 1948-2007 interval and the maximum predicted increase determined from the trend over the interval 1970 to 2007):

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- Min temp. + 4.1 to 4.5° F (Fahrenheit)
- Mean temp. + 2.3 to 3.9° F
- Max temp. + 0.6 to 3.3° F

Notable in these projections is the expected increase in the minimum air temperature relative to the maximum temperature. However, it should be noted that the mean temperature is computed as the difference between the observed maximum and minimum temperatures and, therefore, is determined solely by the relationships between these two temperature measurements. Consequently, change in the mean temperature is driven largely by the increase in the minimum air temperature. Figure 3-1 presents the general structure of this projection methodology with respect to the two time series for measured data (in this example, mean air temperature). The uncertainty of prediction increases as time is extended outward from 2007.

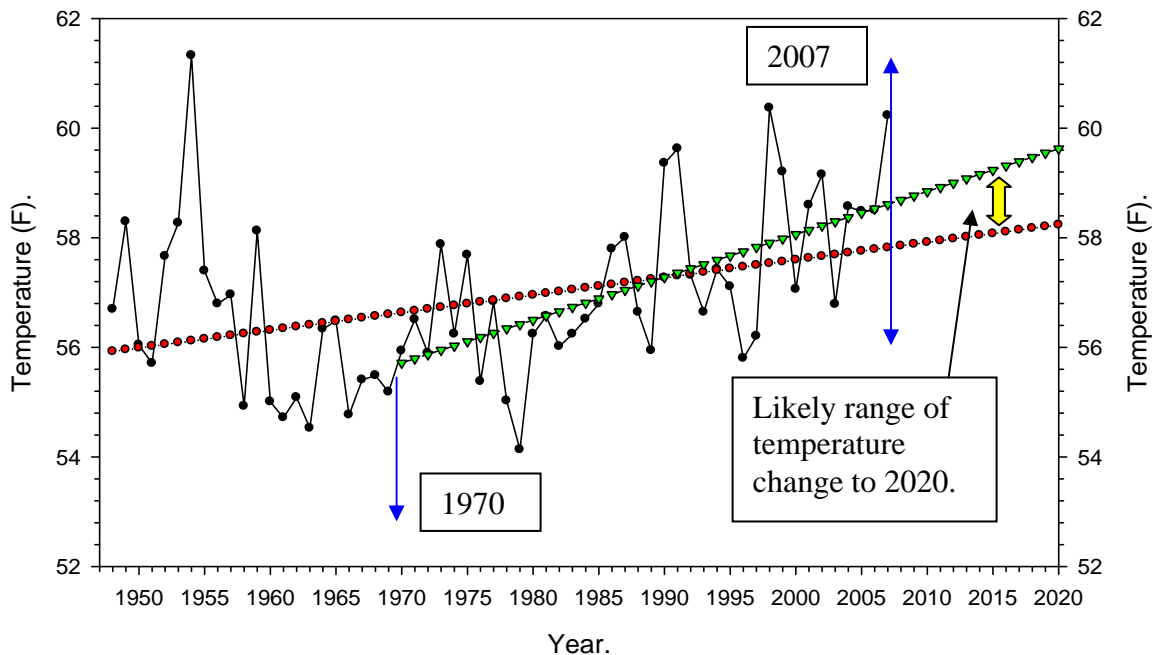


Figure 3-1. Extension of estimated temperature change in the mean air temperature from 2007 to 2020 using linear regression for the 1948-2007 and 1970 - 2007 time series.

Assessment of changes in precipitation over the 60-year interval for the Louisville Metro District is undertaken in two forms: 1) total liquid precipitation (water equivalent) and 2) snowfall. The contribution of snowfall to the liquid total is determined at a ratio of 10:1 (10 inches of snowfall is reduced to one inch of water). From Figure 3-2 it can be seen that, while annual totals of precipitation indicate substantial variability on a year-to-year basis, there is little to suggest any systematic change over the 60 years of record. Snowfall, however, indicates a persistent decline since the 1960's over the Metro area.

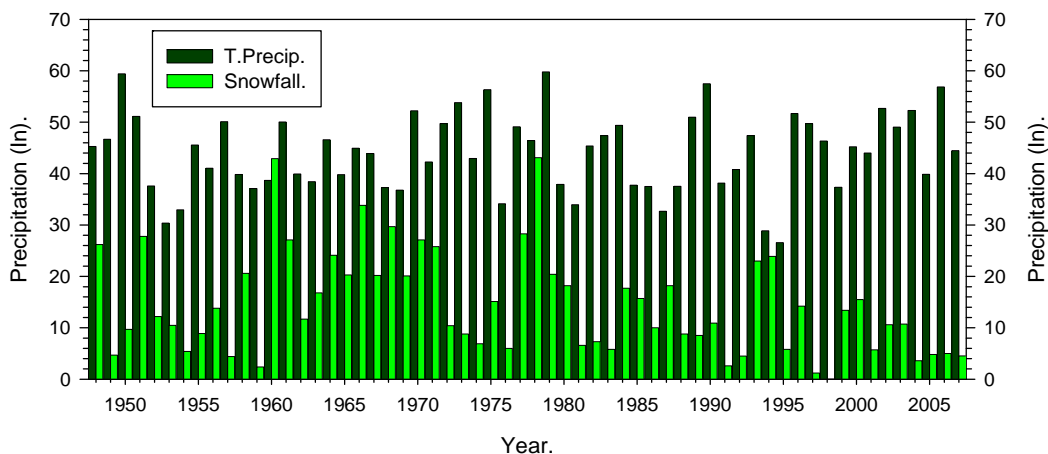


Figure 3-2. Time series for total precipitation (water equivalent) in inches and snowfall (inches) for Louisville from 1948 to 2007.

Predictions for changes in total precipitation to the years 2015 and 2020 indicate the possibility of only minor changes from existing totals. Regression analysis was performed over the two time series (1948-2007 and 1970-2007) with no distinction identified in the resultant trends for either case and with respect to current annual precipitation patterns. Therefore, it is reasonable to accept that there will be no significant changes in total precipitation from current conditions when projected to 2015 or 2020. However, for snowfall, a consistent and significant reduction in annual totals is estimated for both of the time series with a maximum possible reduction to approximately five (5) inches of annual snowfall for the Metro area in 2020 (declining from averaged mean total of 20 inches in the late 1940s and late 1960s). Preliminary investigations of monthly levels of snowfall indicate that this decline is occurring at extremes of the winter months (November and March).

To read the completed Climate Data Report, use the following url:
<http://www.louisvilleky.gov/APCD/ClimateChange/Documents.htm>

3.2 Sector Impacts and Recommendations

3.2.1 Public Health

Impacts on human health from increases in frequency of heavy precipitation, flooding, droughts and heat waves will vary in intensity across different geographic regions and each has the potential to negatively affect Louisville. The types of health impacts include not only disease and injury, but also impacts on physical, mental and social well being implicit in the World Health Organization (WHO) definition of health.⁶ Health impacts associated with climate change can be either direct or indirect.

⁶ The WHO defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”

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Data to support projections of indirect health impacts are less available and uncertainties are greater. Indirect impacts result from events occurring remotely but which may have a local impact, such as crop failures from droughts affecting the availability of food locally. Several possible indirect health impacts of climate change include:

- Changes in the distribution and abundance of plant and livestock pests and diseases, affecting agricultural production;
- Increased probability of crop failure through prolonged dry weather and famine;
- Increased population displacement due to natural disasters, crop failure, water shortages; and,
- Destruction of health infrastructure from natural disasters.

While these types of impacts may have local consequences for a community's physical health, mental health consequences from regional, national and global population dislocation and civil conflict may have a greater impact at the local level.

An example of a direct impact on human health related to climate change is increased mortality associated with heat waves. Other projected health impacts related to climate change include:

- Injuries and fatalities related to heat waves;
- Allergic illnesses related to increased allergen production;
- Respiratory and cardiovascular disease related to worsening air pollution;
- Injuries and fatalities related to extreme weather events; and
- Infectious diseases related to changes in pathogen and vector distribution.

Climate related increases in temperature are likely to cause increases in the frequency of heat waves. Increased temperatures may increase the incidence of respiratory illness related to airborne allergens. Levels of specific air pollutants such as ground-level ozone and fine particulates may also increase during heat waves. Increases in severe weather events associated with climate change can result in a variety of adverse health impacts, ranging from immediate effects including physical injury (i.e., accidents) to increases in disease morbidity (e.g., respiratory disease associated with mold contamination) and effects on mental health. Finally, climate change will affect the geographic distribution disease agents and vectors and affect the potential incidence of waterborne, food-borne and vector-borne diseases.

Health effects associated with heat waves will occur primarily in the summer, but with increasing temperatures may extend later into the fall or occur earlier in the spring. The impacts increased temperatures will likely be greater in urban areas than in surrounding suburban and rural areas, because of the heat island effect. Most of the excess mortality (death) and morbidity (disease) associated with heat waves will be related to cardiovascular, cerebrovascular and respiratory disease outcomes and will be concentrated in the elderly, the poor and other vulnerable populations. Furthermore, many of the climate change related health impacts might disproportionately affect individuals of lower socioeconomic status. In addition to health impacts, increased frequency and intensity of heat related events can affect worker productivity, which may influence the population's social well being.

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Recommendation 27:

The Partners should collaborate on preparedness planning used to develop and implement adaptive strategies, which at a minimum would include a heat stress action plan that includes targeted interventions for high-risk groups.

Recommendation 28:

The Partners should collaborate on asthma action plans that monitor changes in asthma incidence, utilize strategies to enhance adaptation to changes in airborne allergen levels and provide educational messages for both susceptible persons and professional health care providers.

Recommendation 29:

The Partners should support the maintenance of existing strategies for managing air pollution and the implementation of new control strategies as they become available.

Recommendation 30:

The Partners should develop adaptation strategies that ensure persons at risk are identified and that effective intervention programs are available to populations vulnerable to poor air quality.

Recommendation 31:

The Partners should support the maintenance and adaptation of the existing preparedness infrastructure. This offers the best strategy of managing severe weather-related health impacts.

Recommendation 32:

The Partners should limit the impact of changes in vector distribution and the introduction of new pest agents through the effective maintenance and minor modification of robust public health programs. Such programs, which include existing disease surveillance and vector control programs, may need modification to assure that emergence of new diseases or vectors can be detected and appropriate programs implemented.

3.2.2 Terrestrial Ecosystems

All organisms, including microorganisms, plants and animals, have both temperature and moisture thresholds that limit the environment in which they can survive. Over long, geologic timescales, some species are capable of adapting to changes in the environment. The current trends of climate change including higher minimum temperature, higher average temperature and more extreme rainfall events, have implications for species unable to adapt to this comparatively rapid environmental change. Impacts on terrestrial ecosystems related to climate change include:

- Life cycle timing;
- Migration/hibernation timing and patterns;
- Frequency and intensity of pest outbreaks;
- Geographic range and distribution; and
- Increased susceptibility to invasive/exotic species.

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Many species of both plants and animals control their life cycles with responses to temperature and moisture, which are closely associated with season and food availability. The timing of migration for feeding, mating and/or overwintering is also based on temperature changes for many species. Higher minimum temperatures in the winter and a shorter winter season create the potential for increases in the size and number of outbreaks of pests, such as mosquitoes. Many species that cannot tolerate higher temperatures will be forced to migrate northward to higher latitudes where temperatures are lower. This situation may lead to an increased susceptibility to invasive species, or species from other regions that, once present, outcompete and exclude native species.

Losses to biodiversity in terrestrial ecosystems through any of the above mechanisms tend toward fewer species, even if overall number of individuals present remains the same. In a diverse ecosystem, many of the species provide significant services such as carbon sequestration and flood mitigation. As ecosystems become less diverse, these services are often lost.

Recommendation 33:

The Partners should promote trade rules and practices that foster sustainable biodiversity.

Recommendation 34:

The Partners should improve education and public awareness about the value of biodiversity.

Recommendation 35:

The Partners should improve park initiatives by the University of Louisville and JCPS campuses and all departments of Louisville Metro Government (such as Brightside and Metro Parks), to encourage native species.

3.2.3 Aquatic Ecosystems

Aquatic species have specific temperature tolerances as well as optimum temperatures at which they experience maximum growth and reproduction. As with terrestrial species, aquatic species that require more moderate temperatures will be pushed northward as temperatures increase. Furthermore, the species may be lost if barriers to migration (dams) exist. This northward shift of species ranges also allows tropical species to invade higher latitudes where temperature previously excluded them. Their ability to tolerate higher temperatures may allow them to displace native species. Other impacts on aquatic ecosystems related to climate change include:

- Life cycle timing;
- Geographic range and distribution;
- Availability of food;
- Predation patterns; and
- Loss of habitat.

An increase in temperature may influence the timing of species' life cycle stages, including the laying of eggs and development of larvae. Temperature can also alter the timing of algal blooms, a major source of food in aquatic ecosystems, which could significantly impact higher levels of the food web. The timing and species composition of algal blooms may also affect Louisville's drinking water supply and

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water recreation opportunities, which must be taken into consideration in the water treatment process. Additionally, temperature increases may cause species to expend energy unnecessarily to develop defense mechanisms against predation when predators are not present.⁷ Some species may eventually evolve beyond these defenses to the detriment of the species.

Changes in hydrology, more thoroughly discussed in Section 3.2.5 of this Report, could also have an impact on aquatic ecosystems. Extreme precipitation events remove important debris and leaf litter inputs that are the basis of the aquatic ecosystem and provide energy and habitat for small organisms.

Mitigation and prevention strategies to cope with the potential changes to aquatic ecosystems do exist. Factors that compound climate change impacts in aquatic ecosystems can be mitigated by encouraging best management practices for agricultural areas within a watershed and requiring development standards to minimize urban runoff and habitat loss. Addressing the issue of urban runoff through alternatives to impervious surfaces can help alleviate the effects of climate change on aquatic systems. A decrease in impervious surfaces aids in reducing heat island effects in urban areas that exacerbate the temperature increases associated with climate change. In addition, making sure sidewalk drains are marked to indicate that inputs will feed directly into protected waters, can help prevent unwanted aquatic inputs. The protection of wetlands is also important because they help mitigate flood effects and act as a carbon sink. Finally, education of the community about the importance of aquatic ecosystems can help prevent continued deterioration of these systems.

Recommendation 36:

The Partners should work to protect the remaining wetlands in Jefferson County.

Recommendation 37:

The Partners should promote agricultural best management practices that reduce pollution and sediment runoff into aquatic ecosystems.

3.2.4 Horticulture and Agriculture

Louisville's horticultural sector includes several hundred sod farms, greenhouses and nurseries that produce a wide range of landscaping materials. Additionally, the 23-county metropolitan area includes 20,000 farms. These sectors contribute to climate change and likewise, may be impacted by climate change. Contributions to climate change from the horticultural and agricultural sectors are primarily indirect and include the GHGs emitted to transport food, often from distant locations. The impact from this transportation of food is known as *food miles*. Reliance on petroleum based fertilizers and pesticides have indirect GHG emissions.

As with terrestrial and aquatic ecosystems, the climate change related impacts on the horticultural and agricultural sectors are varied and potentially significant. These impacts include:

- A shift in plant hardiness zone;
- Increased susceptibility to invasive, exotic species;

⁷ Heike Kappes and Ulrich Sinsch, "Temperature- and predator-induced phenotypic plasticity in *Bosmina cornuta* and *B. pellucida* (Crustacea: Cladocera)," *Freshwater Biology* 47 (2002): 1944-1955.

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- Frequency and intensity of pest outbreaks;
- Decreased productivity of crops, livestock and dairy operations;
- Added cost of irrigation; and
- Degradation of arable land.

Warmer temperatures may accelerate the spread of exotic, invasive plant species to the detriment of native species and biodiversity. Warmer winters associated with climate change may allow indigenous diseases and pests to avoid previously higher winter die-off rates and allow new diseases and new pests such as bark beetles and fall armyworm, to invade.⁸ Proper formation of some fruits (e.g., apples and peaches) requires a variety and progression of temperatures, which may be compromised by climate change. Similarly, an increase in temperature will not necessarily result in a longer growing season, as flowering crops (e.g., corn and broccoli) depend on a variety of other inputs such as adequate sunlight.

In 2006, the Arbor Day Foundation re-designated the Louisville area from its plant hardiness Zone 6 to its Zone 7, meaning some plants that historically would not have weathered our winters now can be expected to do so. See hardiness zone maps below in Figure 3-3.⁹

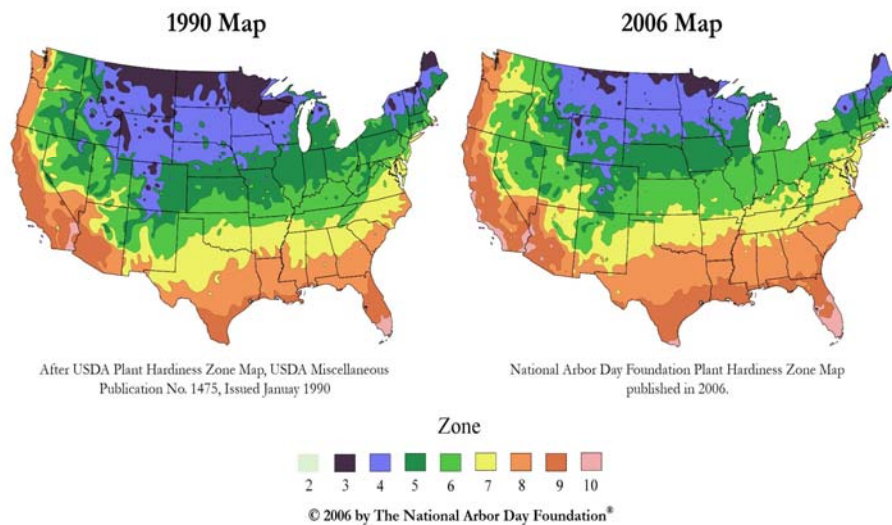


Figure 3-3. Comparison of North American Hardiness Zones for 1990 and 2006

Extended periods of drought and an increase in extreme weather events associated with climate change also pose significant potential risks to these sectors. During periods of drought, inadequate water supply impacts crop, livestock and dairy production and irrigation can be costly, if available and not financially impossible. Conversely, during periods of increased extreme weather events working wet soil may cause long-term damage to its structure and permeability. If rain patterns shift to disproportionately heavy in late winter and early spring, farmers will have to choose between plowing and sowing when the soil is too wet versus after the growing season has become shorter.

⁸ James Bruggers, "Kentuckiana begins to feel the heat of climate changes," *The Courier-Journal*, June 18, 2006.

⁹ "Hardiness Zones," Arbor Day Foundation, <http://www.arborday.org/media/zones.cfm>.

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Recommendation 38:

The Partners should adopt a reduced food miles traveled purchasing policy.

Recommendation 39:

The Partners should support educational programs, which use research to facilitate the sustainability of the horticultural and agricultural sector.

Recommendation 40:

The Partners should avoid using pesticides known to kill pollinators.

Recommendation 41:

The Partners should avoid using exotic, invasive plant species.

Recommendation 42:

The Partners should promote water conservation practices such as drip irrigation.

Recommendation 43:

The Partners should encourage food producers and gardeners to select plant and livestock species that are more naturally resistant to diseases, pests and climatic variances, including droughts and excessively wet periods.

Recommendation 44:

The Partners should encourage participation with programs that assist farmers in improving the energy efficiency of their operations.

Recommendation 45:

The Partners should promote programs to the general public that connect people with locally produced products.

3.2.5 Infrastructure, Hydrology and Water Resources

The IPCC Technical Paper VI, Climate Change and Water, predicts the likelihood of flooding to increase during the 21st century due to more extreme precipitation events. Statistically significant increases in the occurrence of heavy precipitation events have already been observed across Europe and North America.¹⁰ Although precipitation events are expected to be more intense, there are likely to be fewer in total; therefore, there will be more drying in the summer, which also increases the risk of droughts. These conditions are likely to affect infrastructure, hydrology and water resources.

Louisville Metro is located along the Ohio River. The Ohio River basin includes 204,000 square miles across 14 states, therefore extreme weather events both locally and upstream can cause flooding in the Louisville area. To protect Louisville from Ohio River flooding, the Army Corps of Engineers began building a floodwall and levee system in 1948. The 29.9 mile long floodwall and levee system was completed in the late 1980s and includes 16 flood-pumping stations. It was built three feet higher than

¹⁰ B.C. Bates and others, eds, *Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change* (Geneva: IPCC Secretariat, 2008), 16.

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the 1937 flood stage, which is Louisville's highest recorded flood level as shown in Figure 3-4. At 52.2 feet, the benchmark flood of 1937 is more than ten feet higher than any other recorded flood. Therefore, it is unlikely the floodwall would need to be raised to a higher elevation. It is important, however, to continue to maintain the floodwall and levees as well as maintain and replace the flood pumping stations throughout the system as necessary.

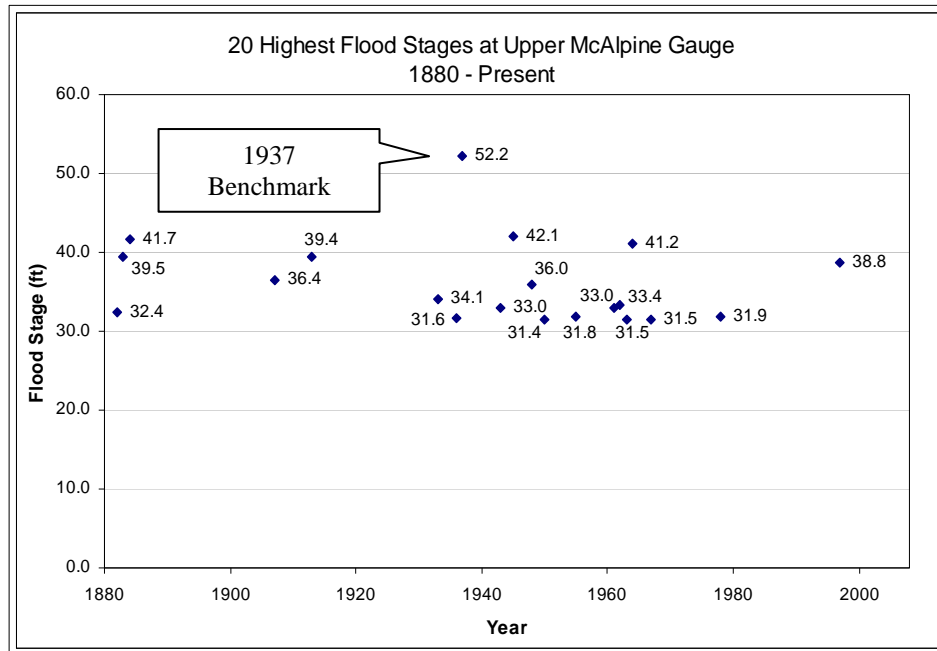


Figure 3-4. Twenty Highest Flood Stages at Upper McAlpine Gauge 1880-Present

Besides being located on the Ohio River, there are approximately 400 miles of mapped streams within the metro area and approximately 15% of Louisville Metro is designated as floodplain. The mapped floodplain includes over 8,000 residential and commercial properties. Increased flooding could expand the existing floodplains and affect thousands of people. The 1997 flood, which was the largest flood in recent history, was estimated to include up to \$200 million in public and private damage.

Increased occurrences of extreme precipitation will also likely affect the following:

- Erosion control structures for construction sites currently designed for 10 year storms;
- Stormwater conveyance systems such as pipes, culverts and ditches currently designed for 100-yr storms;
- Combined sanitary sewers that already experience problems in many areas; and
- More frequent landslides and road washouts from soil erosion.

Water availability issues will largely result from distribution patterns of precipitation and not on direct temperature effects. Studies have shown that transpiration rates will slow in relation to increased atmospheric CO₂ thus reducing the net effect of the associated global warming on direct streamflow and the overall water budget. Changes in the distribution of rainfall throughout the year (driven by climate change) could change streamflow in terms of response to soil-moisture conditions and other driving

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factors making forecasts of future flooding, droughts and competition for water resources much more difficult. In effect, the CO₂-induced climate change required to impact streamflow would likely occur so slowly that determining any specific statistically significant trend could take as long as 50 to 100 years. Droughts could also increase competition for water needed for geothermal heating and cooling, as well as for agricultural, industrial and residential use. As a result, there is a potential economic benefit for Louisville from a drought scenario if water from the Ohio River could be sold to nearby communities lacking sufficient supplies. In order to mitigate negative impacts of the increased competition, procedures could be implemented by Louisville Metro to more closely monitor existing resources and water use. This should result in more efficient management and distribution of water should supplies become diminished.

Increased flooding and drought in Louisville Metro could decrease water quality and increase water treatment costs. Currently, most water companies can manage elevated contaminants during flooding events and prolonged droughts. However, changes in the frequency and timing of these events might pose an economic, environmental and health risk. Recreational uses of local streams and aquatic ecosystems are also impacted with decreased water quality. These impacts are not necessarily linked entirely to climate change as natural climate variability and urban development can mask or exceed the effects of climate change.

Through the capital improvements program, Project Drainage Response Initiative (DRI) and Project Waterway Improvements Now (WIN), MSD is working to reduce sanitary sewer overflows, improve drainage, improve water quality and reduce flooding. Projects have included building regional basins, upgrading stormwater systems and improving drainage channels. The Emergency Management Agency (EMA) and MSD have also bought-out homes in areas that repeatedly flood and returned those areas to open space. MSD is planning to spend \$800 million on various projects.

Louisville Metro and MSD are encouraging green practices including the use of pervious pavement, green roofs, rain gardens, rain barrels, infiltration basins and other means to increase infiltration of water. The Land Development Code requires stream buffers along protected waterways within Louisville Metro, which also encourages infiltration and lower water temperatures. Intermittent streams currently have no stream buffer requirements.



Rain garden planted by MSD on Harvard Street

Recommendation 46:

The Partners should update design standards for stormwater conveyance systems and erosion control structures.

Recommendation 47:

The Partners should continue to encourage property owners to reduce sewer overflows by disconnecting downspouts and sump pumps, redirecting downspouts to encourage infiltration into yards or gardens and to have private plumbing inspected and repaired if damage is found.

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Recommendation 48:

The Partners should encourage water conservation programs and stormwater reuse, such as cisterns and rain barrels, to minimize water demand.

Recommendation 49:

The Partners should continue to encourage "green" construction methods to increase infiltration and thereby reduce water temperatures and increase water quality.

Recommendation 50:

The Partners should expand existing blue line stream buffer to include intermittent blue line streams.

Recommendation 51:

The Partners should evaluate wetland function, restoration and protection efforts.

Recommendation 52:

Louisville Metro government should adopt a post-construction erosion control ordinance.

3.3 Adaptive Capacity

ICLEI- Local Governments for Sustainability defines adaptive capacity as “the ability of built, natural and human systems to accommodate changes in climate (including climate variability and climate extremes) with minimal potential damage or cost.” Louisville Metro has several systems in place that could help mitigate and adapt to the impacts of climate change. The following sections of this Report include several examples of the City’s adaptive capacity.

3.3.1 Natural Hazards Mitigation

In 2005, Louisville Metro adopted the Natural Hazards Mitigation plan to comply with federal regulations in the Disaster Mitigation Act of 2000. The Plan Development Team responsible for developing the plan is an extensive partnership of local agencies, businesses and the public coordinated by the Louisville Metro Emergency Management Agency (LM EMA). The team performed a risk analysis to identify hazards, profile hazard events, identify assets, estimate potential losses and analyze development trends. The analysis resulted in a list of identified hazards categorized by risk level, which is shown in Table 3-1 below. The team continues to meet quarterly to discuss ongoing mitigation initiatives, review new data and learn about response capabilities.

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Table 3-1. Ranking of Louisville Metro’s Natural Hazards

Ranking of Louisville Metro’s Natural Hazards				
Severe Risk	High Risk	Moderate Risk	Limited Risk	Low Risk
Flooding	Hailstorm	Earthquake	Dam Failure	Drought
Severe Thunderstorm	Tornado	Severe Winter Storms	Karst Sinkhole	
			Extreme Heat	
			Landslides	
			Wildfire	

Climate change due to anthropogenic (human-induced) warming was not considered when the Natural Hazards Mitigation Plan was developed. However, a majority of the potential hazards identified in the plan are directly influenced by climate. If climate change begins to alter the frequency or intensity of natural hazards, the Plan Development Team could review the corresponding data, discuss mitigation strategies and make recommendations to the proper Louisville Metro agencies.

3.3.2 Syndromic Surveillance

As discussed in the Public Health section (3.2.1) of this Report, increases in the range of disease vectors in another geographic location could increase the likelihood of imported cases of infectious disease in Louisville Metro. Moreover, population dislocation associated with climate change could lead to increases in the number of disease carrying hosts and demand on the local health care system as Louisville Metro’s immigrant and refugee populations increase.

Syndromic surveillance provides local officials early warnings of outbreaks or changes in patterns of morbidity and mortality. Syndromic surveillance is a database networked to local health care providers and coroners’ offices. It collects, analyzes, interprets and disseminates information regarding public mortality and morbidity. Key parameters of syndromic surveillance include cause of death, hospital emergency data and ambulance dispatch data. Statistically significant increases in the number of coroner cases or people needing medical care will trigger an alarm. Health care providers would then be notified for heightened awareness and an investigation to determine the cause of the trigger will begin.

3.3.3 Monitoring and Improving Air Quality

As discussed in section 3.2.1 of this Report, climate change could negatively affect the city’s air quality and create challenges for the city to meet the National Ambient Air Quality (NAAQ) standards. Louisville Metro’s APCD has the technical capability to monitor the air quality of the city and inform residents of air quality concerns. APCD also has experience working with public stakeholders to adapt to new air quality standards.

APCD has ambient air monitoring stations located throughout Louisville Metro. These stations monitor carbon monoxide, sulfur dioxide, oxides of nitrogen, ozone and particulate matter (PM_{2.5}, PM₁₀ and speciated PM_{2.5}). Air Quality Alerts can be issued if any of these pollutants approach unhealthy levels.

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In addition to constantly monitoring the air quality, APCD must continue to improve Louisville's air quality to meet new federal regulations. APCD has developed a public stakeholder process that provides a forum for input from the public and private sectors. Past stakeholder groups have reviewed air quality data, considered mitigation strategies and developed recommendations that help reduce a variety of air pollutants. Public processes such as these could be used in the future for adaptation if climate change produces negative impacts on Louisville's air quality.

To read the complete Local Impacts Report, use the following url:

<http://www.louisvilleky.gov/APCD/ClimateChange/Documents.htm>

Section 4 Emission Reduction Strategies

4.1 Energy Use in Buildings and Facilities and Climate Change

GHG emissions associated with buildings and facilities in the Louisville Metro area result almost entirely from the combustion of fossil fuels. These fuels, primarily coal (combusted either onsite or at the electric utility) and natural gas, are the decomposed and compacted remains of once living organisms. As a product of fossil fuel combustion, CO₂ is the predominant greenhouse gas (GHG) emitted by human activity. Many other GHGs are more potent than CO₂ and some, such as methane, are also related to energy use; however, because of the sheer quantity of CO₂ emitted, it is predicted to be responsible for half of the anticipated effects of climate change.

Louisville Metro's electric utility, Louisville Gas and Electric Company (LG&E), an E.ON company, has coal-fired generating units providing approximately 97% of LG&E's net kilowatt generation for 2007. According to their FERC filings, LG&E's remaining net generation for 2007 was provided by a hydroelectric plant and natural gas or oil fueled combustion turbine (CT) peaking units. The Ohio Falls Hydro Station (OFHS), which has a capacity of 80MW (based on nameplate ratings), is a run-of-river facility, meaning that it operates only when water level and flow conditions permit. This often means that during summer's peak hours, when electricity demands are at their highest, OFHS is not operating due to low river levels. LG&E has begun the process of [updating and refurbishing](#) the facility, which will result in an increase of capacity to 101MW (based on nameplate ratings).

When the demand for electricity exceeds the amount that can be produced by the baseload facilities, small units are put into service to cover this peak load. These units are largely natural gas fired CTs, although some fuel oil may be used at start-up. Although natural gas is less carbon intensive than coal, producing electricity with it is also generally more expensive than coal.

LG&E also supplies natural gas for consumers in the industrial, commercial and residential sectors. Sales of natural gas from LG&E declined in all three sectors from 1990 to 2006. This is likely due to fuel and technology switching among customers spurred by natural gas price increases over that same period. Carbon management regulations, which could increase energy costs in order to control CO₂ emissions, may shift the price comparison with coal, a more carbon intensive fuel, in favor of natural gas.

Energy Efficiency and Renewable Energy (E2/RE) and Utility Regulation Policies and Practices (URPP) subcommittees reviewed approaches to reduce Louisville Metro's carbon footprint and made recommendations accordingly. The groups used a variety of resources to develop their recommendations, including the climate action plans of other communities, state energy plans and reports from several non-profit and consulting firms. These strategies ranged from regulatory action to community outreach and education. The resulting recommendations are presented in the following sections.

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4.1.1 Energy Efficiency

Kentucky's abundant coal resources have led to a predominance of coal-fired electric generation. Consequently, Kentuckians have enjoyed some of the lowest electric rates in the nation. These low rates have attracted energy-intensive industries and have also led to some of the highest residential per capita consumption levels in the US.¹¹ In 2005, there were 20 states with lower monthly residential electricity bills than Kentucky. In that year, Kentucky's residential ratepayers consumed more electricity than our counterparts in 43 other states; our businesses, more than 19 other states; and our industries, more than counterparts in 47 other states.¹²

There are many factors on the horizon that may significantly increase electric rates. It appears as though a cap-and-trade system or other mechanism that would essentially function as a carbon tax may be forthcoming at the federal level. Such mechanisms are expected to place additional costs on electric generating utilities; these costs will be passed on to the ratepayers. A recent report produced by La Capra Associates on behalf of the KY Department of Energy Development and Independence (at that time the Governor's Office of Energy Policy) shows that the implementation of carbon management policies by the federal government could increase the marginal cost of electricity in Kentucky by 15 to 65%.

In the interim, increased demand for Kentucky coal from overseas markets could continue upward pressure on local electricity costs. American consumers may be prompted to rethink how they use electricity, natural gas and other non-automotive fossil fuels. Louisville would serve itself well to incorporate energy efficiencies as soon as possible to buffer those coming economic shocks.

For the foreseeable future, energy efficiency (E2) will be our fastest, cheapest and cleanest energy option. Erecting drilling rigs and pumps, building new power plants, creating new mines, etc, are all likely to take longer, cost more per unit of energy and pollute more than employing existing technology to reduce demand. There is a tremendous untapped potential in all sectors for greater efficiency.¹³

Society faces several on-going crises: a workforce in need of meaningful employment, a housing-construction sector facing significant lay-offs, an economy reeling from energy-cost volatility and a need to lower GHG emissions. Yet, good leadership and a comprehensive program to retrofit housing stock across the community for efficiency and clean energy could elegantly turn these crises into opportunities.

E2 offers significant socioeconomic and geopolitical benefits. From household budgets to corporate bottom lines, lower utility and automotive fuel bills boost financial sustainability. A large-scale commitment to insulating buildings and upgrading heating, ventilating and air conditioning (HVAC) equipment, windows, doors, etc, would create jobs that require craftsmanship, offer livable wages and benefits and cannot be shipped overseas.

¹¹ Department for Energy Development and Independence, *Intelligent Energy Sources for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*, 2. <http://www.energy.ky.gov/energyplan2008/plan.htm>.

¹² "Energizing Kentucky Conference: Final Remarks by Tom Fitzgerald. 4 June 2008," in Kentucky Resources Council, <http://www.kyrc.org/webnewspro/121311564239489.shtml>.

¹³ *An Overview of Kentucky's Energy Consumption and Energy Efficiency Potential*, Kentucky Pollution Prevention Center, University of Louisville, August 2007, 3. http://louisville.edu/kppc/files/kppc/KYE2PotentialStudyFinalReport82207_508.pdf.

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The recently announced improvements to the vocational training programs offered to JCPS students will include courses for preparing students to work in environmental technologies, construction, etc. These programs could be aligned with the Jefferson Community and Technical College (JCTC) and university majors to ensure that the Louisville area has residents trained to fill those jobs. The [IPCC](#) and other research organizations assure us that the technology needed for reducing demand through efficiency and replacing carbon-intensive energy sources with low-carbon and carbon-neutral renewable energies are available to us today.

With the exception of LG&E's on-going demand side management (DSM) program, there are currently few constraints on the consumption of electricity in Louisville. The absence of constraint is illustrated by the growth in consumption and the corresponding growth in GHG emissions, attributable to electricity generation in Louisville since 1990.

Given the relatively low cost of coal-based electricity, there are few incentives presently available to encourage the development of cleaner alternatives. That will perhaps change as Kentucky's new energy plan is implemented. This plan, Intelligent Energy Choices for Kentucky's Future, outlines seven strategies to improve the state's energy security, reduce CO₂ emissions and ensure economic development. The first of these strategies aims to offset at least 18% of projected energy demand in 2025 with energy efficiency. The second strategy seeks to triple renewable energy generation by 2025. These goals and others in the plan, align with Louisville Metro's goal to reduce its GHG emissions.

There are several programs already in place to promote energy efficiency. These range from tax credits at the federal and state levels to local programs to help citizens weatherize their homes. Energy efficiency programs offered in Jefferson County stem from a variety of sources: government, Gleaned non-profit groups. An excellent example of such a program is the Kilowatt Crackdown. A product of Louisville's participation in the Energy Star® program as a Partner City, the Kilowatt Crackdown challenges commercial building owners and operators to improve their facilities' energy efficiency and will recognize those that make the greatest strides during the contest period (the 2009 calendar year). The Kilowatt Crackdown program, already on its way to success with the number of registered buildings exceeding initial goals, is the result of public-private partnerships among Louisville Metro Government, the KY Department for Energy Development and Independence and five commercial real estate associations: Building Owners and Managers Association (BOMA), International Facility Management Association (IFMA), Certified Commercial Investment Members (CCIM), Institute of Real Estate Management (IREM) and the International Council of Shopping Centers (ICSC).

The E2/RE subcommittee, as well as the URPP, recognized this program and many more in developing the recommendations herein. Some recommended strategies include the continuance and expansion of these programs while others suggest new strategies for increasing the community's energy efficiency. The sections below include references to several existing programs within the discussion of each sector.

4.1.1.1 **Recommendations to Improve the Energy Efficiency of the Community's Buildings and Facilities**

Buildings and facilities in Louisville Metro are divided into 3 categories in the GHG inventory: Residential (homes), commercial (office buildings, businesses, malls and retail rental space) and

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industrial (industrial and manufacturing). The cumulative emissions from these three categories are responsible for 70% of the community's 2006 GHG inventory as illustrated in Figure 4-1.

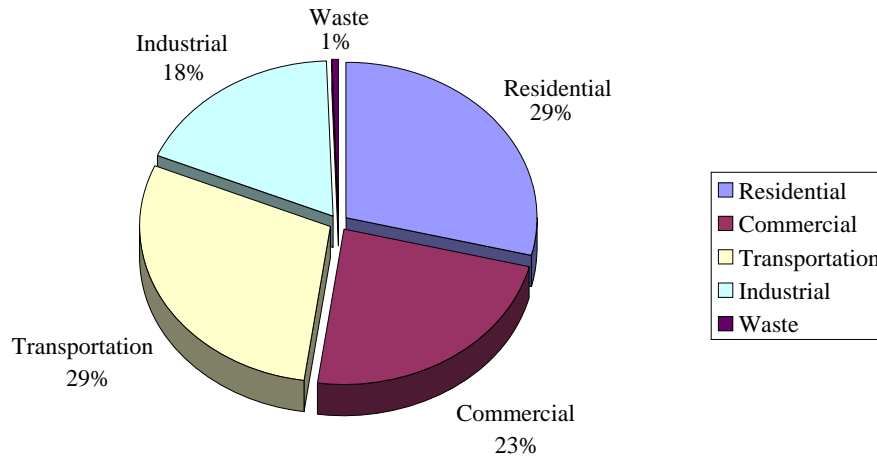


Figure 4-1. 2006 Jefferson County Community CO₂e Emissions by Sector

4.1.1.2 Recommendations Affecting Multiple Sectors

The recommendations in this section deal with actions that can be taken by the Partners, primarily Metro Government, and are expected to reduce the greenhouse gas emissions in more than one sector. Government leadership is needed for an effective response to the problem of global warming by Louisville. Proactive efforts by the Partners, especially Metro Government, can set a tone for the community, which will potentially have a significant impact in marshalling the resources in the Louisville Metro area.

Recommendation 53:

LMG should require an energy rating disclosure for all energy-consuming buildings in Jefferson County at the time they are placed on the market.

Recommendation 54 (Similar to Recommendations 94, 102 and 114):

LMG should provide incentives for builders, contractors and building owners to renovate or construct buildings to a green standard. These buildings would include features such as energy efficiency that goes beyond state energy code requirements, sustainable use of water and building materials and/or use of renewable energy resources. Examples of possible incentives include expedited permit processing, waived fees and property tax rebates.

Recommendation 55 (Similar to Recommendation 95):

The Partners should lobby the state legislature in the following areas: (1) stronger energy standards in state building codes, (2) the ability for local governments with local code enforcement capability to go beyond state standards in energy codes, (3) state tax credits for highly energy efficient buildings, (4) tax code adjustments for accelerated depreciation on

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energy efficient equipment and (5) the establishment of a fund for local governments to implement energy efficiency projects.

Recommendation 56 (Similar to Recommendation 106):

LMG, working with community resources, should establish a revolving loan program to provide low-cost financing to commercial and residential energy efficiency and renewable energy projects.

Recommendation 57:

LMG should examine its historic buildings preservation framework and work to remove barriers to increasing the energy efficiency of these buildings.

Recommendation 58:

LMG should investigate and work to remove barriers and provide incentives to stimulate greater adoption of combined heat and power systems (CHP). This includes issues of appropriate environmental regulations, utility interconnection policies, utility tariffs and reasonable financial incentives for high performance CHP systems.

4.1.1.2.1

Residential

The largest contribution from buildings to the community's GHG emissions comes from the residential sector. The residential sector is responsible for 29% of Jefferson County's CO₂e emissions (see Figure 4-1). As shown in Figure 4-2, 80% of emissions are attributable to electricity usage, which is 4,431,943 tons of CO₂e. Natural gas usage is responsible for 20%, or 1,122,850 tons of CO₂e.

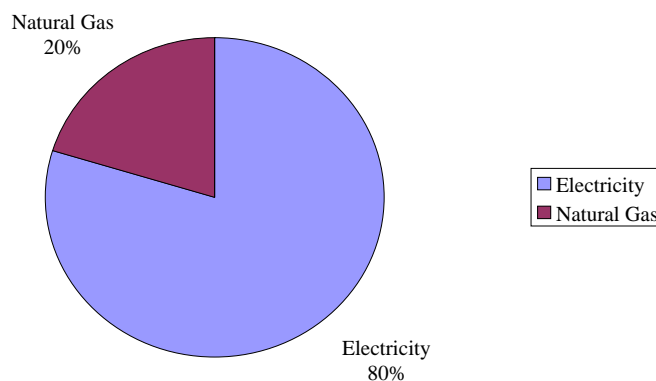


Figure 4-2. 2006 Jefferson County Residential Sector CO₂e Emissions by Source

There are several programs already in place in the community and at state and national levels to assist residential energy users to increase their energy efficiency. These include government programs such as federal and state tax incentives for energy efficient appliances and home renovations and outreach initiatives like [Energy Star®](#) that empower consumers to make energy-wise choices. Local programs

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include weatherization assistance from Project Warm, information resources from sources like the Louisville Metro Go Green program and several nonprofits like the Sierra Club and the Louisville Climate Action Network. LG&E offers home energy audits, the WeCare (Weatherization, Conservation Advice and Recycling Energy) program for low-income customers and the Demand Conservation [program](#).

Recommendation 59:

LMG should adopt a Residential Energy Conservation Ordinance (RECO) to upgrade the energy efficiency of existing housing stock. This ordinance would establish energy efficiency requirements to be met at the time a home or residential rental property is sold.

Recommendation 60 (Similar to Recommendation 104):

LMG should expand city-sponsored weatherization programs for owner-occupied households that meet established income qualifications to reach a target of at least twice the current number served. Require anyone receiving this assistance to attend an energy education program.

4.1.1.2.2 Commercial

Figure 4-3 shows the breakdown of CO₂e 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 CO₂e. Natural gas usage is responsible for 11%, or 512,362 tons of CO₂e.

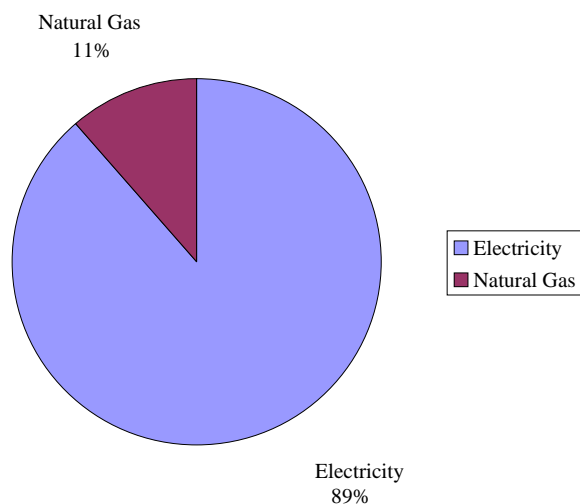


Figure 4-3. 2006 Jefferson County Commercial Sector CO₂e Emissions by Source

There are also existing programs to help commercial customers reduce their energy use. [Energy Star](#)[®] provides information and offers energy management software free of charge. This software, Portfolio Manager, is an integral part of the Kilowatt Crackdown initiative sponsored by the [Louisville Energy Alliance](#). Commercial consumers can also receive valuable assistance from the [KPPC](#) in the form of energy audits, training and information. Likewise, LG&E offers commercial energy audits and energy calculators to help customers [control energy use](#).

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Recommendation 61 (Similar to Recommendations 158 and 163):

LMG should establish a program aimed at greening the community's business sector. This program would serve as an engagement tool for business involvement and a recognition tool for highlighting best practices implemented locally. Importantly, this program would also serve as a resource center for the business community, making available information on local resources, such as local contractors/energy service providers that are Energy Star® certified or a list of contractors that pick-up spent fluorescent lights and on technologies and policies that will help them achieve their energy use reduction goals. This subcommittee recommends that the program be built upon the previously established Green Inc. program.

Recommendation 62:

All commercial building operators should be encouraged to investigate and install energy efficient lighting and utilize daylighting where possible.

4.1.1.2.3 Industrial

Only electricity and natural gas provided by LG&E is accounted for in the community inventory. In addition, no data on process emissions were available. Emissions contributions from other fuels and from the manufacturing process could also be included in the industrial sector upon availability of the usage data. Other possible fuels could include natural gas that is purchased from a source other than LG&E, coal and process waste. See Section 2 of this Report for the recommendation on refining the industrial sector inventory.

Figure 4-4 shows the breakdown of CO₂e 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 CO₂e. Natural gas usage is responsible for 3%, or 93,992 tons of CO₂e.

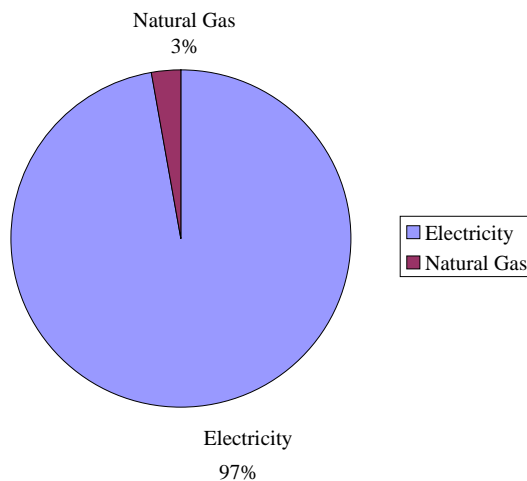


Figure 4-4. 2006 Jefferson County Industrial Sector CO₂e Emissions by Source

Due to the large amount of energy that most industrial consumers use, many of these entities employ energy management professionals to implement measures that reduce their energy use. Nevertheless,

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there are additional resources that industrial consumers can draw upon to increase their facilities' energy efficiency. Examples include [KPPC](#) and the [Energy Star® for Industry](#) program.

Recommendation 63:

LMG should engage the industrial sector with an energy efficiency challenge program, similar to the Kilowatt Crackdown program for the commercial sector and encourage industrial sector participation in Energy Star® programs. This initiative should include outreach and educational opportunities directed toward this sector's needs.

Recommendation 64:

Industrial entities should survey their facilities for waste heat utilization opportunities.

4.1.1.3 Recommendations to Improve the Energy Efficiency of Partner Buildings

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 CO₂e.

Recommendation 65 (Similar to Recommendation 99):

The Partners should continue to pursue and implement energy savings performance contracts (ESPC). The Partners should highlight their ESPC projects using them as case studies to promote this practice throughout the industrial and commercial sectors.

Recommendation 66:

After performing energy audits (through an ESPC or otherwise), the Partners should implement those measures that result in an immediate positive cash flow.

Recommendation 67:

The Partners should each adopt energy and resource-efficient building standards for all new construction and consider adoption of a national standard, such as LEED, Green Globes and/or Energy Star®.

Recommendation 68:

The Partners should develop and make publicly available as examples, policies regarding energy use, including building operations and maintenance, purchasing and employee resource use (this would include turning off lights in offices or facilities that are not in use, personal appliance use, computer policies, etc.).

Recommendation 69:

When purchasing energy-consuming devices, the Partners should specify Energy Star® or an equivalent standard is met when available. If equipment is not rated by this type of standard and the equipment purchase is over \$15,000, a life-cycle cost analysis should be performed.

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Recommendation 70:

The Partners should periodically re-evaluate purchasing lists for new information and more efficient products.

Recommendation 71:

The Partners should give preference in their contracting processes to those contractors with Energy Star® certification.

Recommendation 72:

The Partners should survey their facilities for waste heat utilization opportunities and implement as possible, using these projects as case studies to promote this practice throughout the industrial sector.

Recommendation 73:

The Partners should identify opportunities for water conservation since water treatment and pumping are significant energy uses. A priority should be placed on identifying and correcting higher-profile practices that normalize waste to passers-by, e.g., spray-pool fountains that run from dawn to dusk during summer months even when not in use by the public.

Recommendation 74:

The Louisville Water Company should evaluate its treatment and distribution facilities to maximize operational energy efficiencies and minimize water losses. Similarly, MSD should optimize its collection and treatment facilities to maximize operational energy efficiencies and minimize the conveyance and treatment of clean groundwater and surface run-off.

Recommendation 75 (Similar to Recommendation 103):

Each Partner should have two cool roofs (meaning it has either high solar reflectance or is vegetated) installed by 2010.

Recommendation 76:

The Partners should work to establish a 501(c)(3) to accept and administer funds for the implementation of energy efficiency and renewable energy projects in the community.

4.1.1.4 Recommendations for Educating the Community

Without an adequately informed public, few of this Report's recommendations can succeed. Quality outreach and education programs—thoughtfully employing social marketing—will be imperative and should commence as soon as possible. The U.S. prompted most adults to use safety belts, stop smoking and start recycling via the pleas of their K-12 children and grandchildren responding to what they had learned in school. That same bottom-up approach could be employed to lift up adult awareness of the opportunities for and benefits of E2. However, additional programs targeting post-secondary schools, both academic and vocational, contractors and adult consumers will be integral to a successful plan.

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Recommendation 77:

The PGC should encourage local organizations, such as the KY Division of Energy Development and Independence – Department of Renewable Energy and Energy Efficiency, KY Chapter of the US Green Building Council, Louisville Home Builder’s Association, Energy Pros, KY Solar Partnership, hardware stores, etc., to periodically provide educational opportunities to both professionals (continuing education credits) and homeowners.

Recommendation 78:

JCPS should expand energy efficiency and renewable energy education through its vocational and construction technology programs.

Recommendation 79:

All schools in Jefferson County, including private and parochial schools, should incorporate energy education materials into their curriculum.

Recommendation 80:

JCPS should provide E2 classes through their Lifelong Education program.

Recommendation 81:

The PGC should establish an annual Energy Expo.

Recommendation 82:

The PGC should revive and expand its “When Not In Use, Turn Off the Juice” program.

Recommendation 83:

Expand Partnership web resources to include energy efficiency and renewable energy information for homeowners, e.g., a clickable house that shows energy-saving opportunities throughout that is customized to Louisville residents. Establish similar web resources for commercial and industrial facilities.

4.1.2 Recommendations to Increase the Availability and Use of Renewable or Alternative Energy

Increased use of renewable energy is another key component of any community strategy to reduce carbon emissions. Renewable resources are those that are replenished in relatively short periods of time. These sources include solar, wind, hydropower and biomass. These energy sources are important because they are generally either low carbon or carbon neutral.

Solar energy can be used in a variety of ways. Passive solar energy use from space heating and daylighting make direct use of sunlight without mechanical systems. Alternatively, active solar may use some technology to capture the heat of the sun. An example of this is solar hot water heating, which uses pumps to circulate the water being heated. In addition, photovoltaics (PV) employ technologies that convert solar energy into electricity. While this region has less solar potential than other areas of the nation, there are many opportunities to add solar energy to our local portfolio.

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Wind energy is also less viable in Kentucky than other regions. However, with ongoing research into microturbines and with more refinement of wind resource maps wind energy may have a role to play in reducing the community's carbon emissions.

Hydropower is currently being employed in Kentucky, although it is only responsible for 2.6% of the state's energy portfolio.¹⁴ There is great potential for increased hydropower in Kentucky from bodies of water that have already been dammed for other reasons. By some estimates, the potential from these untapped resources could be almost 900 MW. Much of this potential is in some stage of development, but without significant financial investment, many projects may not make it beyond the initial permitting stages. This is because, currently, coal-fired generation is far more cost competitive. Adding carbon constraints into the equation could change this balance.

Biomass is a resource that Kentucky has in abundance. Although the combustion of biomass releases CO₂, these fuels also sequester carbon while growing, making them carbon neutral. Biomass is most often used in Kentucky as a feedstock for transportation fuels (ethanol and biodiesel); however, there are uses for many types of biomass in stationary energy production. Sawdust, for instance, is a waste product of the forest products industry that is often used as a fuel in those facilities. When more sawdust is produced than can be used onsite, some utilities may be able to utilize it as a fuel for generating electricity.

Other alternative sources of energy, those that are not fossil fuels, but do not fit the definition of renewables, include landfill gas and solid waste combustion. The capture and combustion as a fuel of methane produced at landfills can offset some coal-based energy production. Because methane has a very high global warming potential (GWP), the CO₂ released by its combustion result in lower CO₂e levels. All GHGs have a GWP. This value is used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the heat-absorbing ability of each gas relative to that of carbon dioxide (CO₂), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years). Waste to energy strategies on the other hand, can result in lower CO₂e levels by combusting waste before it decomposes and forms methane in a landfill. This strategy also results in offsetting coal-based energy production.

As is the case with energy efficiency, growth in the renewable energy sector could result in increased job opportunities in manufacturing, installing and maintaining the necessary technologies. Renewable energy production also has the benefit of reducing demands on the electric grid through distributed generation of energy.

Although renewable energy sources are often more expensive, particularly in the short run, rising energy costs will continue to change this equation. There are currently no mandatory fees or required sources of investment to aid in the development of renewable fuels; however, LG&E has introduced a voluntary fee program, Green Energy, to give customers the opportunity to support the development of renewable generation facilities. [The URPP section that follows has more information about this program and recommendations that could result in funding sources to increase renewable use in Louisville Metro.]

¹⁴ Department for Energy Development and Independence, *Intelligent Energy Sources for Kentucky's Future: Kentucky's 7-Point Strategy for Energy Independence*, 32. <http://www.energy.ky.gov/energyplan2008/plan.htm>.

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4.1.2.1 Recommendations for Community

Recommendation 84:

LMG should investigate and work to remove barriers and provide incentives to stimulate greater adoption of solar photovoltaic (PV) systems. This includes issues of zoning, homeowner association restrictions, solar easements, environmental regulations, utility interconnection policies, utility tariffs and reasonable financial incentives for high performance PV systems.

Recommendation 85:

The Partners should track other cities' efforts in utilizing renewable energy, looking specifically for projects that are applicable to Louisville. Specifically, the Partners should engage with those cities in our region (Knoxville, Ann Arbor, Milwaukee, Pittsburgh) that have become United States Department of Energy (DOE) Solar Cities in order to take advantage of experience gained.

4.1.2.2 Recommendations for Partner Operations

Recommendation 86 (Similar to Recommendation 98):

The Partners should commit to purchase or produce 20% of their electricity needs from renewable resources by 2020.

Recommendation 87:

The Partners should evaluate the feasibility of emerging technologies for producing energy using alternative fuels, such as solid waste, process waste, or biomass.

Recommendation 88:

The Partners should survey their facilities for opportunities to use solar hot water heating and implement as possible, using these projects as case studies to promote this practice throughout the community.

Recommendation 89:

The Partners should collaborate with the Center for Renewable Energy Research and Environmental Stewardship (established in Kentucky Revised Statutes (KRS) 152.713) "to actively pursue federal research and development resources that are dedicated to renewable energy" and should continue to look for similar opportunities elsewhere.

Recommendation 90:

The Partners should evaluate the feasibility of solar heating for any Partnership swimming pools that are heated.

4.1.3 Utility Regulations, Policies and Practices

The scope of work of the Utility Regulation, Policies and Practices (URPP) Subcommittee was to evaluate the regulations and policies that govern the utility industry, as well as utility and community practices as they relate to climate change issues and then make recommendations aimed at reducing

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GHGs from the utility sector. The group reviewed Louisville Gas and Electric Company's (LG&E) Demand-Side Management (DSM) and Energy Efficiency (E2) programs, LG&E's 2008 Integrated Resource Plan (IRP) and other cities' Climate Action Plans. The Subcommittee also reviewed applicable Kentucky Public Service Commission (PSC) Administrative Cases, state statutes and regulations. One key objective of this assessment was to determine if there were any barriers in Kentucky laws that impede adoption of progressive and innovative renewable energy and energy efficiency strategies.

The URPP subcommittee developed recommendations, generally relating to the electric and gas utility sector, that address energy efficiency measures and renewable energy standards within the community. The recommendations require both behavioral and structural changes (i.e., in some cases legislation and/or action by the PSC). Some recommendations may help fund the implementation of other recommendations included in the overall PGC initiative. A few proposals focus primarily on educating consumers on existing resources, while other recommendations will require additional analysis before implementation. Because this group looked at a myriad of issues and processes that were far ranging in nature and often effecting multiple sectors, throughout this section the group's recommendations are presented and then followed with further information or explanation instead of being grouped after a topical discussion as is the case with many other sections of this Report.

4.1.3.1 Regulation

Recommendation 91:

LMG should renegotiate the LG&E franchise agreement when it is next up for renewal to incorporate any additional measures deemed necessary to implement the recommendations.

A franchise agreement grants permission to operate and maintain public utilities in the local government's right-of-way. LMG should review the franchise agreement upon renewal and determine if funds could be used to implement recommendations from the PGC initiative.

Recommendation 92:

LMG should work to establish Louisville Metro Carbon Offset Commission.

The establishment of a Louisville Metro Carbon Offset Commission will allow residents interested in lowering their carbon footprint or having a "zero carbon footprint" to pool their resources in order to buy offsets for their carbon producing activities from organizations locally, in other regions and even other countries. A department within Louisville Metro Government would need to develop the appropriate checks and balances that would allow residents to buy "carbon offsets." Promotional funding would be required to inform the public of this new program.

Recommendation 93:

Louisville Metro Government should implement a System Benefit Fund that will help finance the recommendations in the Partner's Climate Action Plans.

A System Benefit Fund is a funding mechanism producing a predictable stream of revenue, usually imposed as a small surcharge on electric bills that are used to support energy efficiency, renewable energy, energy research and development and low-income energy assistance projects. These investments

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produce a reduction in GHGs by providing for energy conservation and lessening dependence on carbon-producing energy supplies. The revenue could be generated from any number of energy consumption link assessments, including a fixed fee for each electric meter and/or a variable rate on kilowatt-hour (kWh) usage in Louisville Metro. For example, a \$0.10 per meter per month surcharge in Jefferson County would provide approximately \$400,000 annually. Louisville Metro Government should rescind the local fund if a State System Benefit Fund is established.

Recommendation 94 (Similar to Recommendations 54, 102 and 114):

LMG should implement a Green Permitting process to incentivize green building. To assist with this process, each approving agency within the city should have a Green Building Professional designated to oversee approval of “green” projects.

Louisville Metro’s Green Permitting program could be modeled after similar programs in Chicago, Burbank, San Antonio and San Francisco and could take the form of reduced/waived permitting fees, expedited review time, or both.

Recommendation 95 (Similar to Recommendation 55):

The PGC should encourage the Legislature to pass bills and the PSC to amend regulations so as to: 1) require industrial customers to participate fully in energy efficiency programs, 2) assure that all cost-effective energy efficiency programs and DSM measures be deployed prior to approval of new generating capacity, 3) restore adequate funding to the PSC and 4) require the PSC to work on adoption of rate decoupling.

[House Bill 1](#), commonly known as the 2007 Energy Act for Kentucky, included a provision requiring the PSC to examine its statutes and regulations. The PSC issued Administrative Case No. 2007-00477 as an investigation into the energy and regulatory issues enumerated in Section 50 of House Bill 1. The PSC submitted a report to the Legislative Research Commission on July 1, 2008, that included an analysis and response to 28 recommendations that were submitted by the consultant engaged for this project and an additional 11 recommendations from various participants. The entire report is available by contacting the Kentucky Public Service Commission. Further investigation needs to be completed on the four items mentioned above in order to remove impediments for implementing energy efficiency programs.

4.1.3.2 Policies

Recommendation 96:

LG&E and LMG should partner to develop a program to increase the use of renewable distributed generation in the Residential, Commercial, Industrial and Institutional Sectors.

Homeowners, businesses and institutions in Louisville Metro need information and assistance on how to utilize renewable technology and how to take advantage of the financial incentives, rebates and tax credits currently available. In addition, as an incentive, Louisville Metro should consider a small property tax credit or subsidy to aid these sectors in financing renewable systems. This action would demonstrate a strong idealistic and financial commitment by city officials.

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Another program of benefit to customers and to LG&E is the net metering tariff required to be made available by LG&E by state law. Net metering makes clean peak energy available to LG&E at regulated cost. New standardized net metering and interconnection guidelines that have been developed as a result of Kentucky PSC Administrative Case No. 2008-00169 will streamline and control costs of net metering. LG&E should provide the option of net metering to customer-generators up to 10 megawatt (MW), where appropriate, rather than the 30 kilowatt (kW) required by state law.

LG&E should also provide low- or no-interest financing for the installation of renewable energy technologies. The PGC entities should lead by example. Solar water heaters and photovoltaic arrays on the visible roofs of the entities' high-profile buildings could help acclimate the public to the sight of these technologies.

Recommendation 97:

LG&E should reduce the carbon intensity of its generation portfolio as rapidly as possible and the PGC should lobby vigorously for legislation, which will enable the process.

The state legislature in House Bill 299 recognized the value of energy efficiency and renewable energy in assisting the State of Kentucky to respond to issues of carbon management, by diversifying the resources used to meet the State's energy needs. Among the provisions of the bill was a directive to the Kentucky Department for Energy Development and Independence (KYDEDI) to produce a report and recommendations regarding the adoption of a renewable-energy and energy efficiency portfolio standard and funding mechanisms for financing incentives of energy efficiency and renewables. PGC entities should encourage the General Assembly to adopt a renewable and energy efficiency portfolio standard and funding mechanisms for energy efficiency and renewable energy measures. The details of HB299 can be found at the following website link:

<http://www.lrc.ky.gov/record/08RS/HB299.htm>

Recommendation 98 (Similar to Recommendation No. 86):

By 2020, PGC entities should purchase at least 20% of their electric and gas usage from renewable resources and explore cost-effective opportunities to invest directly in new larger-scale renewable projects (such as photovoltaic and landfill gas).

LG&E's main source of energy comes from coal-fired generating stations. The company continues to undertake a comprehensive review of generation technology options as noted in their [2008 Integrated Resource Plan \(IRP\)](#). The IRP includes analysis of a variety of renewable supply options and the potential CO₂ cost impacts, including an evaluation of the economics of alternative carbon capture and sequestration technologies. Metro Government should continue to encourage LG&E to reduce the carbon intensity of its generation portfolio.

Recommendation 99 (Similar to Recommendation No. 65):

PGC entities should continue to promote the use of energy-savings performance contracts (ESPC), when appropriate, by businesses, government and non-profit agencies.

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As described by the US Department of Energy:

An ESPC project is a partnership between the customer and an energy services company (ESCO). The ESCO conducts a comprehensive energy audit and identifies improvements that will save energy at the facility. In consultation with the agency customer, the ESCO designs and constructs a project that meets the agency's needs and arranges financing to pay for it. The ESCO guarantees that the improvements will generate savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency. Contract terms up to 25 years are allowed.

Additional information on ESPCs can be found on the U.S. Department of Energy, Energy Efficiency and Renewable Energy webpage at: <http://www1.eere.energy.gov/femp/financing/superespcs.html>

4.1.3.3 Practices

Recommendation 100:

The PGC should encourage Louisville Metro residents and commercial businesses to sign-up for LG&E's Load Management Program and receive a free programmable thermostat.

This initiative is two-fold. First, it will increase the number of homes and businesses participating in the load control program, which helps reduce the need to generate electricity from less efficient peaking stations of LG&E or to purchase peak power. Second, the programmable thermostat allows people to control the heating and cooling of their homes during sleeping hours or at times when the house is empty. As a rule of thumb, for each degree of change from "normal" temperature settings, a 1-2% energy savings is realized.

In addition to the Load Management program, residents and commercial customers can receive benefits from the HVAC Diagnostic and Tune-Up Program now offered by LG&E. Furthermore, on March 31, 2008, the PSC issued an Order in Case No. 2007-00319 approving LG&E and Kentucky Utilities' (KU) request to expand their energy efficiency program offerings. The plan proposes to continue installing load control switches and load control programmable thermostats for an additional 100,000 residential and 5,000 commercial LG&E and KU customers between 2008 and 2014. The plan includes an average annual program budget of \$10 million for the period of 2008-2014.

Recommendation 101:

The PGC should encourage Louisville Metro residents to participate in the LG&E Energy Efficiency Residential High-Efficiency Lighting program

The objective of this program is to facilitate market transformation by creating a shift in consumer purchasing from incandescent light bulbs to compact fluorescent lighting (CFL). To facilitate the introduction of CFLs into customer's homes, LG&E plans to provide CFLs through different mechanisms such as providing coupons to be used at local retailers and through giveaway programs.

The PSC issued an Order in Case No. 2007-00319 approving LG&E and KU's request to expand their energy efficiency program offerings. The plan proposes to partner with retail outlets and provide

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incentives to place 5.8 million Energy Star[®] rated CFLs to LG&E and KU customers over the next seven years. The plan includes an average annual program budget of \$3.4 million for the period of 2008-2014.

Recommendation 102 (Similar to Recommendations 54, 94 and 114):

LMG should encourage all new residential construction to meet Energy Star[®] standards and upgrade energy code requirements for new commercial buildings.

DOE's Energy Star[®] is a widely known and universally accepted certification program requiring home energy performance to exceed the 2004 International Residential Code (IRC) by a minimum of 15%. A joint study by the University of Kentucky College of Agriculture and the KYDEDI found that the cost of building an Energy Star[®]-compliant home was only \$1,800 over the cost of a non-certified home (based on 2,000 sq. ft.).

LG&E will implement a Residential New Construction Program as a part of its DSM/Energy Efficiency plan that will partner with homebuilders associations within the state of Kentucky to adopt and implement the Energy Star[®] new homes energy efficiency program. New home inspections are required under Energy Star[®] guidelines to be completed by Home Energy Rating System (HERS) qualified raters, the number of which in Kentucky is inadequate. To promote the entry of new raters into the market, LG&E will provide equipment purchase incentives to new raters who complete HERS training, pass the national exam, provide proof of insurance and purchase testing equipment. In addition, LG&E plans to sponsor educational seminars, training classes and reference materials for Raters and Builders.

PGC should also work with other organizations like the American Institute of Architects (AIA Kentucky and AIA Central Kentucky), Associated Builders and Contractors, and Air Conditioning Contractors of America to develop an education program for the construction industry of "best practices." This could include a list of high-performance/energy efficient practices and a set of incentives/disincentives to encourage adoption of best practices.

As noted earlier, the PSC issued an Order in Case No. 2007-00319 approving LG&E and KU's request to expand their energy efficiency program offerings. In addition to education and infrastructure support, the Residential New Construction Program will create sufficient supply to spur growth and support for service to over 4,400 residential sites for LG&E and KU over the next seven years. The plan includes an average annual program budget of \$1.1 million for the period of 2008-2014.

Recommendation 103 (Similar to Recommendation 75):

LMG should encourage roofs with high Solar Reflectance Indexes (SRI)/ white roofs/ vegetated roofs similar to a Chicago Program already in place.

The City of Chicago has two programs in place offering grants for Green Roofs (vegetated roofs) and Cool Roofs (roofs with a high solar reflective index SRI value, which are made with highly reflective or white material) to property owners. Additionally, MSD should create incentives for the construction of green roofs and interior tree yards for parking lot pavement, by amending its regulations to significantly reduce or eliminate drainage fees for properties where these features are installed. MSD should promote installation of both features via its regular outreach methods, including design standards, workshops and site visits.

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Drainage fees for non-residential parcels are assessed based on impervious area, in increments of 2,500 ft² or Equivalent Service Unit (ESU). At \$5.35/ESU/mo, the drainage fee is not big enough to serve as an incentive to incur the cost of a green roof or replacing pavement with tree-yards. Cost-benefit calculations would have to include reduced microclimate temperatures, building cooling loads and wear on parked automobiles. Still, both features reduce run-off and Louisville has a number of flat-roofed buildings and over-sized parking lots that would be suited to these features. Adding an incentive of at least \$10.70/ESU removed per month may be an adequate incentive.

Recommendation 104 (Similar to Recommendation 60):

LMG should develop a program to leverage state financing, university support and job creation and training programs, as well as attract private investment to spur a community-wide effort to retrofit existing housing stock for efficiency and renewable energy.

The share of a local household's total income spent on utility bills varies greatly. The Metropolitan Housing Coalition reports that while the average local household spends only 2% of its income on electricity, low-income households spend about 8% and very low-income households (at 50% or below the poverty level), up to 23%.¹⁵ Each year in Louisville government agencies and private charities spend millions of dollars on emergency heating programs and countless volunteer hours are spent in stopgap weatherization. Many beneficiaries of these efforts dwell in the community's almost 100,000 rental units—a sizeable share of which were built during the first half of the 20th Century when insulation was relatively uncommon. There is no real incentive for property owners to invest in energy efficiency in their buildings because they do not observe any direct benefit. Renters may not invest in efficiency projects because they may not live there long enough to recoup that investment and may not have access to capital to make an investment.

Investments into rental housing could be recouped via a range of methods. A lien could be placed on the property until the property owner repaid the investment over time. The reductions on monthly utility bills could be shared between repaying the investment and making household budgets more sustainable.

This activity would add to LG&E's current residential low-income weatherization program, WeCare. The PSC issued an Order in Case No. 2007-00319 approving LG&E and KU's request to expand their energy efficiency program offerings. The WeCare program plans to provide an energy audit, energy education and home weatherization services to 8,400 low-income participants in the LG&E and KU service territories over the next seven years on qualified houses (includes rental properties).. The plan includes an average annual program budget of \$1.8 million for the years 2008-2014.

Unfortunately, for rental housing stock there are few incentives for an owner or tenant to invest in durable conservation and energy efficiency measures. Another benefit of expanding available programs to encourage retrofitting of existing low-income housing stock, both owner-occupied and rental units, is the reduced the need for Low Income Home Energy Assistance Program (LIHEAP) dollars and for other less permanent weatherization programs.

¹⁵ Metropolitan Housing Coalition, "2008 State of Metropolitan Housing Report," 2008, 1. <http://www.metropolitanhousing.org>.

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Recommendation 105:

LG&E should provide more current and informative electric meter usage data to customers.

Meter usage information that conveniently displays both dollars to date as well as the real-time dollars/minute usage allows the building occupants receive economically-quantified cause and effect feedback to encourage lowered consumption. On July 12, 2007, the PSC issued an Order approving LG&E's Responsive Pricing and Smart Meter Pilot program. The pilot combines responsive pricing rates with smart metering technology, appliance control and energy information displays to display usage and pricing information. The energy information displays are capable of displaying data in units of usage or cost; current rate of use, usage per day, and usage for the month to date and projected usage for the current billing month. LG&E will need to conduct a feasibility analysis based on the results of this pilot to determine if these types of displays can be implemented in other parts of the service territory.

Recommendation 106 (Similar to Recommendation 56):

LMG should partner with LG&E to offer financing for the purchase of high-efficiency furnaces, heat pumps, air-conditioning systems, replacement windows, insulation, water heaters, appliances and other large energy-using systems.

Because energy efficiency improvements typically involve an up-front capital cost followed by a stream of savings over time, financing structures can be an important part of effective efficiency programs. LMG and LG&E should work with the state and other partners to offer financing for these types of purchases. The proposed program could function like MSD's program for assisting homeowners that must borrow money to connect to sewers. It is predicated on the assumption that companies such as large utilities can borrow money at a lower interest rate than most of its customers. For example, residential and commercial customers could apply to borrow the needed amount of money from local lenders but they would a) receive whatever interest rate those lenders would offer to LG&E and b) repay the loans via the electronic funds transfer (EFT) for their monthly utility bills. This program might also offer longer payback periods than these borrowers would otherwise be eligible to get on their own.

Recommendation 107:

LG&E should broaden standard residential energy audits to include watts meter testing of major appliances.

The LG&E Residential Conservation Program was recently expanded to provide two options for a home energy analysis. Customers may complete an online audit at no charge or may choose a more comprehensive onsite audit by a qualified energy audit professional for a nominal charge. Part of the information assessed during the onsite audits is the age and size of the major appliances. The Kentucky PSC issued an Order in Case No. 2007-00319 approving LG&E and KU's request to expand their energy efficiency program offerings. The plan includes an average annual program budget of \$.7 million for the period of 2008-2014.

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4.1.3.4 Education

Recommendation 108:

PGC and LG&E should develop an education strategy that results in the reduction of electric use in the residential sector.

Recommendation 109:

LG&E should develop an education program providing tools to local residents and business to estimate their greenhouse gas emissions and emission reductions.

LG&E currently provides an estimate of GHGs produced based on electric usage, on customer's monthly bills. The group proposes that LG&E add the CO₂ equivalent of natural gas consumption to customer's bills and move the estimates to the front-page of the bill.

Recommendation 110:

PGC and LG&E should develop an education program that highlights the available federal and state tax credits available for implementation of energy efficiency measures.

Since the passage of the federal Energy Policy Act of 2005, numerous tax incentives for consumers and businesses have become available. For example, these website links provide information on incentives at the state and federal level to encourage the implementation of energy efficiency measures:

<http://energy.ky.gov/2005federalenergybill.htm>;

<http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=KY&RE=1&EE=1>.

Recommendation 111:

LG&E should encourage consumer use of “Kill-A-Watt” or other similar products to identify, monitor and control “phantom” electricity usage.

The PGC and LG&E should educate the residents of Louisville Metro on the simple, low/no cost ways to reduce the electric consumption through strategies such as an enhanced PGC web site showcasing green strategies, useful links to Federal and State incentives and programs and yearly mailings of the Department of Energy's “Energy Savers” booklet. Additionally, LG&E and PGC should consider expanded funding of Project Warm's energy management workshops or equivalent.

4.2 Land Use and Climate Change

GHG emissions associated with land use in the Louisville Metro area result primarily from the influence land use has on the spatial layout of the city and the quantities of fossil fuels required for transporting people, goods and services. CO₂ is the predominant GHG emitted by fossil fuel combustion.

Using land use strategies to reduce CO₂ emissions has multiple co-benefits for any community such as decreasing congestion on roads, protecting the economy from fluctuations in fuel prices, attracting green industry, improving the quality of life for residents, increasing the health of residents and increasing the city's resilience to climate change through green infrastructure planning.

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4.2.1 Impacts of Land Use on Climate Change

4.2.1.1 Development Patterns

Since the 1950's, most U.S. cities have been designed and built with automobiles as their primary mode of transportation. As a result, the annual number vehicle miles traveled (VMT) by Americans increases faster than new technology and cleaner burning fuels can reduce CO₂e generated from transportation sources. Data from Louisville Metro's GHG inventory confirms that this trend is occurring locally.

Figure 4-5 presents annual trends in VMT and corresponding tons of CO₂e. Cleaner burning fuels and vehicle technology produced a drop in tons of CO₂e between 1990 and 2006 but steady increases in VMT are projected to negate most of this reduction by 2012.

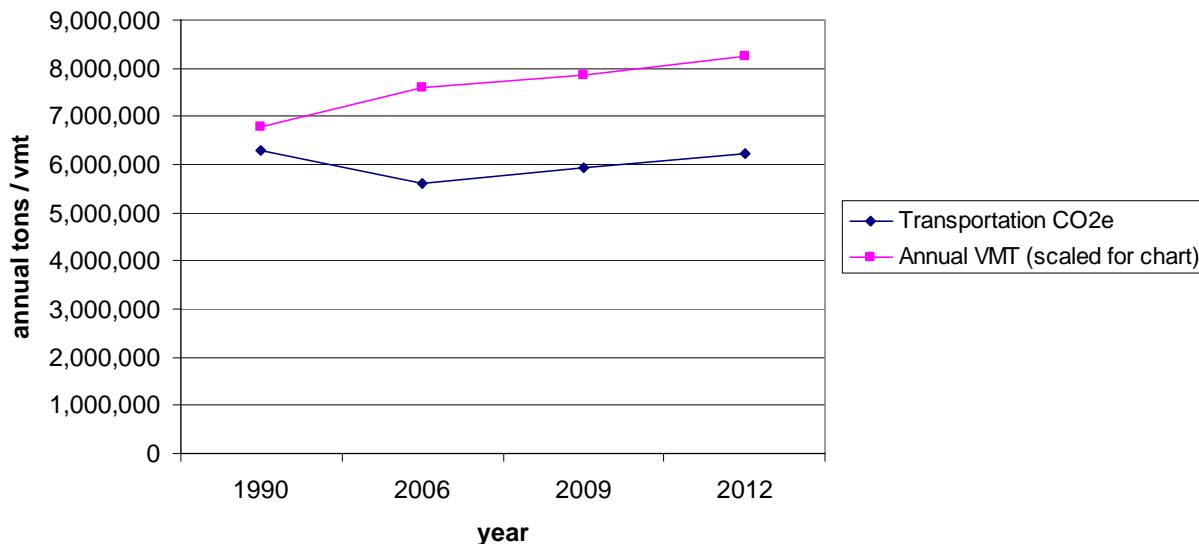


Figure 4-5. Comparison of 2006 CO₂e (tons) and VMT for Jefferson County, KY

Development patterns directly influence transportation options and choices. Research consistently shows that low density development with segregated land uses creates automobile dependence and results in high VMT. Dense development with a mixture of land uses promotes pedestrian activity, supports mass transit and effectively reduces VMT, therefore any effort to reduce VMT and associated CO₂e must contain a land use component. The concept of achieving dense development patterns with mixed land uses is commonly referred to as smart growth.

A recent study published by the Urban Land Institute shows that “it is realistic to assume a 30% cut in VMT with compact development.”¹⁶ The report goes on to say that in conjunction with “reasonable assumptions about growth rates, the market share of compact development and the relationship between

¹⁶ Reid Ewing and others, *Growing Cooler: Evidence of Urban Development on Climate Change* (Washington, D.C.: Urban Land Institute, 2007).

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CO₂ reduction and VMT reduction,”¹⁷ smart growth alone could reduce total transportation related CO₂ emissions 7 to 10% by 2050.

Louisville Metro faces the same challenges as other communities dealing with impacts of land use and transportation on climate change. The relatively low cost of gasoline and abundant land has allowed residents to live in neighborhoods distant from employment centers, goods and services. In addition, many neighborhoods built since the 1950’s lack adequate pedestrian infrastructure and the densities necessary to expand the city’s existing mass transit service. These factors create physical and financial challenges in providing automobile alternatives to many of the city’s residents.

The GHG inventory shows that transportation is consistently the largest contributor of annual CO₂e. Capping and reducing emissions from this sector is needed to balance future economic growth with CO₂e emissions targets. This cannot be accomplished with vehicle technology and cleaner burning fuels alone. Development patterns will play an important role in determining whether or not the city meets those targets.

4.2.1.2 Land as a Carbon Sink

The two most commonly discussed sources of CO₂ are mobile sources (e.g., cars and trucks) and point sources (e.g., electric plants and cement manufacturers). However, the larger CO₂ picture is incomplete without a discussion of carbon “sinks.” A carbon sink is a carbon reservoir that is constantly increasing in size. Carbon sinks are composed of organisms that use photosynthesis to remove CO₂ from the atmosphere, release oxygen and store carbon as biomass. When the organisms die, some of the carbon is released back into the atmosphere through decomposition and some of the carbon becomes stored in the soil as terrestrial organic carbon. Altering land from its natural state reduces its biomass and subsequently its capacity to remove CO₂ from the atmosphere and can also release carbon stored in the soil.¹⁸

Building a human environment usually requires disturbance of ecosystems such as the clearing of forests, which has an impact on local and global climate. Kentucky’s natural landscape was altered by European settlement beginning approximately 200 years ago. Clearing, farming and urban development has occurred throughout Metro Louisville. As a result, the land’s capacity to store carbon in biomass and terrestrial soil organic carbon has been reduced. In some cases, its capacity has been eliminated. However, there are opportunities to improve the land’s ability to act as a carbon sink through land preservation, urban forestry, conservation design and low impact agriculture.

4.2.2 Impacts of Climate Change on Land Use

Climate change is already affecting environmental and land use conditions. Moreover, even if communities worldwide were to implement immediate substantial GHG emissions reductions, the results of these reductions would not be experienced immediately. Existing emissions would continue to

¹⁷ Reid Ewing and others, *Growing Cooler: Evidence of Urban Development on Climate Change* (Washington, D.C.: Urban Land Institute, 2007).

¹⁸ H.W. Markewich and G.R. Buell, United States Geological Survey, *A Guide to Potential Soil Carbon Sequestration: Land-Use Management for Mitigation of Greenhouse Gas Emissions*, 2001.

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influence climate change for years before tapering off. Attention should be given to five categories of relationships between climate change reduction strategies and climate change adaptation strategies.

1. The effects of climate change on our local environment are likely to counteract or offset some of our climate change reduction efforts. For example, the carbon sequestration benefits of tree planting and tree conservation policies could be offset, perhaps even entirely negated, by the release of carbon and other GHGs by trees dying due to extreme flood, fire and windstorm events associated with climate change.
2. Land use policies to avoid or reduce climate change could face implementation obstacles from changing land use conditions related to climate change. For example, land use policies promoting infill and compact urban development could increase impervious surfaces, increase urban runoff and widen floodplains.
3. Policies focused on reducing the human contributions to climate change do not address other major environmental and social problems caused by climate change. For example, the likely changes in storm events, precipitation cycles and stream channels call for a set of policies to address runoff issues, which are not likely to be a part of policies aimed solely at reducing GHGs.
4. Climate change impacts on local environmental, land use and social conditions will likely result in public demands for policies with adverse environmental impacts. For example, increases/changes in the range and populations of disease-carrying insects are likely to result in increased use of chemicals to control their populations. However, this increase may result in adverse impacts to the environment and human health.
5. We do not know enough about the magnitude or in some cases the direction of synergistic interactions between climate change impacts and climate change reduction strategies. For example, how will efforts to increase supplies of locally grown foods (thus reducing the impacts of long-distance food transportation and creating stronger agricultural markets for non-development uses of land) be affected by the likely climate-related changes in the types, varieties and health of crops grown locally?

Established and emerging research show the following impacts that climate change is having, is likely to have, or may have on land use (see also Section 3):

1. Water-Related Impacts

Predicted changes in climate patterns will increase the intensity of weather patterns, including the intensity of storm events and storm cycles, the incidence of extreme weather and the length and intensity of periods of drought and precipitation. This will likely produce several conditions that will affect land use including:

- Widened flood plains;
- Increased flooding during storm events;
- Heightened effects of urban and suburban runoff; and

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- A series of water scarcity periods, as well as demands for area water from other parts of the state or nation.

2. Heat-Related Impacts

Climate change will likely increase average temperatures in the Louisville, causing:

- Increased risks to human health;
- Increased demands for energy consumption to cool buildings;
- Increased demands for water consumption for pools, lawns/landscape maintenance and human cooling;
- Exacerbated heat island effect. Thus, temperatures within the urban area are likely to increase even more than general regional increases in temperature; and
- Reduced overall air quality resulting from increased number of days with warmer temperatures.

3. Forest-Cover Impacts

Forests are adapted to specific climate conditions and changes in these climate conditions will impact forests in the following ways:

- Changes in the composition (variety, numbers and proportions) of tree species^{19,20} (i.e., eastern hardwoods being replaced by pines and scrub oaks); and
- Increased flooding, drought and fire from climate change could kill a substantial number of trees²¹.

4. Agricultural-Related Impacts

Climate change will likely affect the composition, range, yield and production of agricultural crops and livestock. Various models for the United States show climate-caused shifts in zones of agricultural production northward, which would change the types, variety and perhaps even numbers of crops grown in Kentucky and specifically the areas in and surrounding Jefferson County. Likely impacts to local agriculture include:

- Rise in demand for irrigation for crops and livestock during periods of drought;
- Increased agricultural pest infestations; and
- Estimated changes in crop yields according to crop type and many different other variables, but the overall picture is one of both global and regional short-term increases in crop yield, followed by long-term decreases in crop yield.

¹⁹ L.R. Iverson and A.M. Prasad, "Potential Changes in Tree Species Richness and Forest Community Types Following Climate Change," *Ecosystems* 4 (2001): 186-199.

²⁰ A.H. Hansen and others, "Global Change in Forests: Responses of Species, Communities and Biomes," *Bioscience* 51 (2001): 765-79.

²¹ V.H. Dale and others, "Climate Change and Forest Disturbances," *Bioscience* 51 (2001): 723-34.

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5. Biodiversity Impacts

The life cycles, distribution and ranges of all organisms are controlled by their threshold limits of temperature and precipitation. Changes in temperature and precipitation due to climate change are very likely to produce the following impacts on biodiversity.^{22,23}

- Alteration of life cycle timing;
- Alteration of migration/hibernation timing and patterns;
- Increased frequency and intensity of pest outbreaks;
- Shifts in species' geographic ranges;
- Increased competition from invasive/exotic species; and
- Extinction of rare, threatened, or endangered species.

4.2.3 Examples of Land Use Responses to Climate Change

Over 900 cities have signed on to the U.S. Conference of Mayors Climate Protection Agreement. Many have already created, or are in the process of creating, their own climate action plans. Land use strategies commonly found in existing climate action plans include but are not limited to effectively integrating transportation and land use planning; fast track approval of green/infill developments; creating compact urban growth boundaries, mixed-use requirements and the utilization of transit-oriented developments to support mass transit systems.

Prior to joining the U.S. Conference of Mayors Climate Protection agreement, Louisville Metro was involved in several major initiatives that promoted urban infill and redevelopment. The transformation of industrial sites into 85 acres of Waterfront Park is one example. Since the park's opening in 1989, the city's downtown has seen a significant increase in infill developments, adaptive reuses, new jobs and housing units. Another example is the effort to redevelop the Park Hill Corridor – once the city's industrial core. The city has partnered with the University of Louisville to facilitate extensive community involvement on a new master plan for the corridor. Three brownfield revitalization grants have been acquired to address site contamination issues and prepare contaminated sites for new uses.

4.2.4 Land Use Recommendations

Land use practices that will minimize and mitigate local contributions to climate change and adapt to climate change are integrally related to land use practices that will promote a high quality of life for Louisville Metro region residents, a sustainable regional economy, ecologically sustainable practices, wise and efficient growth and development patterns and a strong, vibrant community. Wherever possible, the land use recommendations and implementation actions of this climate change report should be linked to other sustainable land use policies.

In addition, the principle of choice is important if new policies are to be effective at achieving more environmentally responsible land use practices and behaviors. Whenever possible, requirements, restrictions, incentives and encouraged actions should contain menus of options with associated results

²² V.H. Dale and others, "Climate Change and Forest Disturbances," *Bioscience* 51 (2001): 723-34..

²³ G.R. Shaver and others, "Global Warming and Terrestrial Ecosystem: a Conceptual Framework for Analysis," *Bioscience* 50 (2000): 871-82.

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and environmental benefits, harm avoidance or mitigation, allowing developers, landowners, users of land and community residents to select the options that best fit their own goals and circumstances while achieving comparable minimization, mitigation and/or adaptation outcomes.

Land development regulations should be clear and offer predictability to developers, landowners, neighbors and the public. These regulations should be flexible enough to provide incentives when projects exceed basic regulatory standards of environmentally sustainable development, while allowing decision makers discretion in application of standards to each particular place-based and project-specific context. Decisions should be made on the basis of good evidence, careful analysis and policies of environmental responsibility for the overall public health, safety and welfare.

Finally, an essential principle is full and effective public participation in – and deliberation about – climate change and land use policies, whether at regional, local, or neighborhood/area levels. This principle is at the heart of democracy, fairness and community building at the local level. Moreover, proposed policies will likely face overwhelming barriers to adoption or effective implementation if the public is not fully engaged with and generally supportive of these policies.

4.2.4.1 **Alternatives to Automobile-Dependent Development**

Land use practices should offer alternatives to automobile-dependent sprawl development and should encourage development that promotes walking, cycling and the use of public transit as alternatives to vehicle trips.

Recommendation 112:

LMG should adopt new and use existing land development policies, regulations and incentives that facilitate compact development, transit oriented development and pedestrian-friendly development. Discourage low-density sprawling residential and commercial development on the outer edges of the Louisville Metro area.

4.2.4.2 **Efficient Use of Existing Sites, Areas and Infrastructure**

Land use practices should make efficient and effective use of existing developed sites, areas and infrastructure, often with public sector assistance to address existing site conditions (e.g., environmental contamination, deteriorating structures and barriers to revitalization).

Recommendation 113:

LMG should adopt new and use existing land development policies, regulations and incentives that facilitate infill development, effective and efficient use of existing infrastructure and clean-up, re-use and rehabilitation of already-developed sites.

4.2.4.3 **Energy-Efficient Buildings and Sites**

A critical element of any local climate change policy will be to improve energy efficiencies in the built environment, this is especially critical for the Louisville Metro area ranks among the worst large metropolitan areas in the nation for contributions to climate change from coal-generated electricity.

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Recommendation 114: (Similar to Recommendations 54, 94 and 102)

LMG should require all new development, whether by the private or public sector, to meet minimum standards of energy efficiency for buildings, other structures and infrastructure, while providing incentives, assistance and public education to owners or users of existing development to retrofit their buildings, other structures and/or infrastructure for maximum energy efficiency improvements.

4.2.4.4 **Environmental Impact Information**

Decisions about future growth and development, including specific projects, should be made on good information about the environmental impacts of these projects so that: a) appropriate design choices and mitigation strategies can be made; b) all participants (i.e., landowners, developers, government officials, planners, neighbors and the public at large) can be aware of the likely impacts and any trade-offs involved in continuing to pursue a project or plan with substantial impacts on the environment; c) local progress towards achieving reductions in GHGs, increases in sequestration of GHGs and mitigation of climate change impacts can be tracked and evaluated; and d) multiple environmental policy goals can be coordinated in rational and coherent ways.

Recommendation 115:

LMG should require all major development plans, projects and permit applications, submitted by the private or public sector, to complete a basic environmental impact assessment that identifies the likely environmental impacts of the proposed plan or project, including net contributions to GHGs.

4.2.4.5 **Long-Range Planning with Climate Change Scenarios**

Long-range land-use and infrastructure planning that considers various climate change scenarios is necessary to achieve targeted reductions in development-related contributions to climate change and to adapt effectively, efficiently and fairly to the impact of climate change on the local region.

Recommendation 116:

LMG should engage in long-range (i.e., 50-year) comprehensive planning for transportation that includes consideration of land use, land development, infrastructure development (including transportation and green infrastructure), emergency preparedness, growth scenarios, economic development, social equity, natural resources, public health and energy conservation. This planning process should be linked to long-range regional planning with Kentuckiana Regional Planning & Development Agency (KIPDA) and to neighborhood-based planning.

4.2.4.6 **Green Infrastructure and Land Conservation**

Sustainable land use practices feature substantial amounts of high-quality green infrastructure, such as trees and vegetation (especially native trees and vegetation), protected surface water and groundwater features, soil conservation and replenishment, parks and recreation areas, greenways and greenbelts, natural or nature-mimicking stormwater runoff features and protected species' habitats. Sustainable land use practices also require thoughtful conservation of land and related natural resources as natural capital,

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supporting ecosystem services to society and nature and defining a sense of place in our local communities.

Recommendation 117:

The community should conserve land and natural resources as natural capital. This supports ecosystem services to society and defines a sense of place in our local communities.

4.2.4.7 **Urban Runoff and Low-Impact Development**

The need for minimization and mitigation of runoff and for low-impact development practices will only increase with changing precipitation patterns, watershed processes and topography due to climate change. Current land use practices contribute to substantial stormwater runoff, degraded quality of surface waters and groundwater, flooding and degradation of watershed features such as stream channels and banks. Current federal, state and local policies call for increasing modifications to land development patterns, design, construction methods and ongoing uses to minimize and mitigate water runoff and to achieve low-impact development standards. Failure to make major modifications will result not only in serious harm to natural environments but also in flooding that harms property, economic activity and human life.

Recommendation 118:

The community should modify land development patterns, design, construction methods and ongoing uses to minimize and mitigate water runoff and to achieve low-impact development standards.

4.2.4.8 **Sustainable Local Agriculture and Food Access**

Local and regional agriculture focuses on ensuring local and regional food availability, reduces the use of long-distance transportation to bring food to the Louisville Metro and Kentuckiana region, assists in achieving greater food equity in our communities, supports the local and regional economy, supports healthy lifestyles among the publican often allows for sustainable agricultural practices that can sequester carbon, minimize runoff and erosion and conserve land and energy.

Recommendation 119:

LMG should develop a comprehensive local and regional food system and sustainable agriculture policy.

4.2.4.9 **Regional Collaboration**

Local land-use contributions to climate change and the impacts of climate change on local conditions and land uses are regional problems, requiring regional solutions and regional collaborative problem solving.

Land use planning for adaptation to climate change conditions and their impacts should be accompanied by comprehensive long-range planning for water supplies and demand, water conservation, water quality and watershed health and integrity. The most likely climate change scenarios for the Louisville Metro

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area will feature increased demand (both local and from other water-scarce communities), periods of scarcity, growing degradation of water quality and watershed features (e.g., stream bed and bank integrity) and higher environmental, energy, economic and social costs to the extraction and distribution of water supplies, especially if demand increases.

Recommendation 120:

LMG should develop a regional network of Kentuckiana local governments, KIPDA and stakeholders throughout the region (including major businesses, major institutions and representative community-based groups) to engage in collaborative problem solving to address regional issues related to climate change and land development patterns.

4.2.4.10 **Improved Enforcement Tools**

The land use requirements and restrictions (including conditions of land development approvals) needed to achieve the goals of these Climate Action Recommendations and environmentally, economically and socially sustainable land use practices will be effective only if they are enforced adequately.

Recommendation 121:

LMG should increase and enhance enforcement mechanisms for local land use requirements, restrictions and land development approval conditions sufficient to strongly deter non-compliance, assure those who comply of the fairness of the system and fully mitigate any harm to the public, community and neighbors from non-compliance. Increase penalties for non-compliance and improve both governmental and public oversight of compliance with land development laws and regulations.

4.2.4.11 **Public Education & Engagement about Sustainable & Responsible Land Use**

Any meaningful achievement in the minimization or mitigation of local contributions to climate change will require widespread public support and engagement, as well as substantial changes in individual, institutional and social behaviors. Lasting policy changes and cultural changes occur only with public engagement, deliberation and understanding. The legitimacy of land use planning and regulation in democracies is premised on broad, deep and meaningful opportunities for public participation and deliberation. A necessary (yet insufficient) element of change in land use practices requires widespread public and stakeholder knowledge about the impacts of our land use practices on our environment and methods of avoiding, minimizing, or mitigating these impacts.

Recommendation 122:

PGC and partner entities should develop public education and engagement programs about sustainable and responsible land use, the impacts of our land use practices on our environment (especially climate change) and methods of avoiding, minimizing, or mitigating these impacts. Develop specific programs for land developers, the construction industry, other real estate professionals, land use planners, homeowners, businesses, landscape architects, vegetation/food growers and others. Increase the quantity and quality of public participation in – and thoughtful deliberation about – land use planning, policy and practices.

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To read the complete Land Use Report, use the following url:

<http://www.louisvilleky.gov/APCD/ClimateChange/Documents.htm>

4.3 Transportation Greenhouse Gas Emissions

In 2006, Louisville Metro GHG emissions from transportation accounted for 29.2% of inventoried GHG emissions. Sources in this sector, which includes onroad and nonroad (e.g., construction equipment, lawn care, agricultural, rail) vehicles in Jefferson County, released 5.6 million tons of CO₂e emissions. Since the transportation sector accounted for such a large portion of the local GHG emissions, it warrants investigation as to how to reduce these emissions. A significant portion of these transportation related emissions results from to single occupancy vehicles.

Nationally, according to EPA inventory data for 2003, the transportation sector is the source of 29% of U.S. GHG emissions. This sector is the fastest-growing source of U.S. GHGs, accounting for 47% of the net increase in total U.S. emissions since 1990. Transportation is also the largest end-use source of CO₂, which is the most prevalent greenhouse gas.²⁴ Production of CO₂ is related to the amount of fuel combusted and its carbon content. The emission rate of CO₂ cannot be affected by vehicle emissions control technologies. Methane and nitrous oxide (N₂O), also significant GHGs, can be affected; however, they only account for a small percent of the transportation sector's GHG total (2% nationally in 2003).²⁵

Much of the development that has occurred in the greater Louisville region over the last 50 years has been predicated on automobile ownership. As a result, the percentage of people who travel by car for work during 2007 was 96.3%.²⁶ Also, total trips by TARC in 2009 were estimated to be only 2.4% of all vehicle trips in the county.²⁷ According to KIPDA, since 1980, the amount of driving done by Kentuckians rose at a rate 4.6 times the rate of population growth, though nationally the rate is three times faster than population.

The recommendations that follow attempt to address locally the goals expressed in the U.S. Mayors' Climate Protection Agreement, especially the primary goal of reducing GHG emissions 7% below 1990 levels by 2012. This Report presents analysis and strategies to help the Louisville Metro area meet this GHG reduction goal as well as acting as a guide for improving Louisville Metro's quality of place. The more livable a metro area is, the more population retention it experiences and the more prosperous it becomes by attracting and retaining vital industry and business interests. Many strategies intended to reduce transportation sector emissions depend more on policies and programs shaped at the national, state and regional level than the local level; nevertheless, as the "[*Greater Louisville Project, 2005 Competitive City*](#)" has clearly stated: "NOW is the time to forge a broad community consensus to formulate a comprehensive mobility strategy."

²⁴ These estimates of transportation GHGs do not include emissions from additional lifecycle processes, such as the extraction and refining of fuel and the manufacture of vehicles, which are also a significant source of domestic and international GHG emissions: U.S. Environmental Protection Agency, "Transportation and Climate," <http://www.epa.gov/otaq/climate/>.

²⁵ U.S. Environmental Protection Agency, Office of Transportation and Air Quality, *Greenhouse Gas Emissions from the U.S. Transportation Sector, 1990-2003*, March 2006, 34, <http://www.epa.gov/otaq/climate/420r06003.pdf>.

²⁶ ACS Census, 2007.

²⁷ Estimated with current statistics and projections provided by KIPDA and TARC for county and public transit trips for Jefferson County, Kentucky.

4.3.1 Reducing Annual VMT Through Mode Shift

4.3.1.1 Integrate Land Use and Transportation Planning

The promotion of compact and transit-oriented development patterns is potentially one of the most effective strategies to reduce GHG emissions from transportation in the long-term, but it also requires a great degree of collaboration among agencies and among plans. Transportation planning that considers cross-linkages with land use plans and involves agencies with jurisdiction over those plans will ensure that transportation investment decisions support a regional vision for growth. The Louisville region needs a well thought out and coordinated transportation plan. [Horizon 2030](#), our region's long range transportation plan, is simply a listing of projects sponsored by individual agencies of the local and the state governments. The [Cornerstone 2020](#) Comprehensive Plan's chapter titled "Mobility Strategy" addresses many of the factors identified below, but lacks the specific roles/responsibilities, priorities, implementation activities and schedule that a strategy requires.

Recommendation 123:

LMG and KIPDA should develop a mobility strategy for Louisville. The new strategy will form the foundation of an integrated multi-modal transportation plan focused on mobility for people and freight.

4.3.1.2 Transit-Oriented Development

Well-planned communities that offer a variety of transportation options and attractive urban neighborhoods are better positioned to sustain long-term investment prospects. Cities like Austin, Denver, Madison and Chicago have programs underway that integrate economic development, transportation and land use strategies. This new type of program is an integral part of planning for a vital city. Studies in historical (traditional) non-integrated development have pointed out the sprawl that occurs without this type of planning. In addition, "[b]y fostering or requiring low density development with a high separation of uses, Euclidean zoning is one of the great generators of suburban sprawl, with all of its environmental, economic, and social costs."²⁸

Most development in Louisville is occurring at densities and locations that do not support multi-modal activity or mass transit. This needs to be addressed by promoting high density/mixed-use development along transit service routes to encourage reduction of vehicle miles traveled (VMT) through transit-oriented development (TOD).

Recommendation 124:

LMG, KIPDA, developers and the public should promote and invest in transit-oriented development as a way of planning for more livable, sustainable communities through the integration of transit and development at the regional, community, corridor and neighborhood levels.

²⁸ Jay Wickersham, *Jane Jacob's Critique of Zoning: From Euclid to Portland and Beyond*, 28 B.C. ENVTL. AFF. L. REV. 547, 557 (2001).

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4.3.1.3 Public Transit

Public transportation can be an attractive alternative to driving. Public transit can attract more riders in a variety of ways: through increased reliability and frequency, increased convenience and number of routes, improved customer service and lower fares. These factors are contingent on the amount of funding available for public transportation. More funding would allow TARC to add vehicles to busy routes, add new routes, invest in customer service improvements and keep fares low. However, funding is secondary to providing a context in which mass transit can truly be successful. In corridors where buses are given priority, as with designated lanes, traffic signal priority and limited or even eliminated street parking, a framework is created in which transit can be competitive. Once that exists, transit investments can lead to very significant reductions in GHG emissions, as illustrated in Table 4-1.

Table 4-1. Public Transportation Mode Share Increase

PUBLIC TRANSPORTATION MODE SHARE INCREASE (passenger vehicles)				
Target Public Transportation Share (VMT)	Current Public Transportation VMT	Current Non-Public Passenger VMT	Passengers / Transit Vehicle	CO2e Savings (tons/year)
20.00%	0.10%	85.00%	25	580,627
<i>10/31/08 - APCD, using 2008 data derived from Mobile6.2 and KIPDA data (VMT = Vehicle Miles Traveled).</i>				

Recommendation 125:

PGC should support increased funding for TARC services as well as a transportation strategy that consciously meshes with initiatives for economic development and land use as an integral part of full community planning.

4.3.1.4 Multimodal Infrastructure

A well-developed multi-modal infrastructure, which supports walking and bicycling as alternative modes of transportation, will result in reduction of VMT and, therefore, a reduction of GHG emissions. At the same time, air quality, citizen health and safety and the livability of the metro area will also improve. Louisville Metro should build on the success already achieved in developing bicycle lanes and multi-modal paths (LMG was awarded a Bronze designation from the [League of American Bicyclists](#)) by also supporting public-private partnership arrangements to increase the availability and use of bicycles throughout Jefferson County.

Recommendation 126:

PGC and public should fully support the expansion of services and infrastructure that promote bicycling and walking.

4.3.2 Reducing VMT with Transportation Demand Management

[Travel Demand Management](#) principles are applied to manage both the growth of and the periodic shifts in traffic. These could be implemented in five specific categories to effect greenhouse reductions for the

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Louisville Metro area: parking, driving reduction incentives, telecommuting, compressed workweeks and speed limit changes.

4.3.2.1 **Parking**

Minimum parking requirements are built into city codes. Locally, the Louisville Metro Land Development Code sets the Motor Vehicle Parking and Loading Standards²⁹. By doing away with or adjusting the method of allocating land to parking purposes, LMG would (at least partially) satisfy a number of sustainability goals while also addressing a root cause of traffic congestion and personal vehicle reliance.³⁰ In addition, increasing parking lot albedo (solar reflectance) with plantings and better design (less heat absorbing and more reflective) has a beneficial effect on area weather and local warming patterns – a factor in climate change. Louisville Metro should consider the following goals:

- Eliminating minimum parking requirements and charging market rates for curbside and city owned parking. This can reduce the costs of urban development, improve walkability, reduce auto dependence and improve urban form.³¹
- Changing minimum parking requirements to reduce parking lot development (concurrent with the availability of other forms of transportation), resulting in a 10% reduction in the surface area of parking lots within the central business district by 2020.

4.3.2.2 **Driving Reduction Incentives**

Driving reduction incentives that the PGC should consider are:

- Guaranteed Ride Home programs provide assurance to commuters where little or no transit service is offered during non-peak (rush) hours. This can reimburse commuters for cab fare when transit alternatives aren't available.
- Pay As You Drive (PAYD) insurance. This is a market-based approach that is expected to reduce driving and related emissions by 10-12%.³² In addition to being more efficient, this insurance structure is a more politically palatable way to reduce gasoline consumption than is a gasoline tax; and "as opposed to many other approaches, it has no technological, financial or practical barriers and could be implemented in time to help meet Kyoto targets."³³
- A "downtown Eco-Pass" could be sold to support transit, bicycle rental and other low or no emission modes of transportation through employer subsidies.
- Promote voluntary "give your car one day off a week" programs. Salt Lake City offers a business tax deduction for employers who encourage this concept.

²⁹ Land Development Code (LDC) – March 2006 – In Effect in Louisville Metro Only, "Chapter 9: Parking and Loading, Part 1: Motor Vehicle Parking Standards," <http://www.louisvilleky.gov/NR/rdonlyyears/D21D1A76-75B1-4C45-9EF8-A263674F7FBA/0/C09P01March06.pdf>.

³⁰ For a typical example of the benefits argument, see Livable Places, "Rethinking Parking Requirements," <http://www.livableplaces.org/policy/parking.html>.

³¹ Douglas Kolozsvari and Donald Shoup, "Turning Small Change into Big Changes," *Access* 23 (Fall 2003): 2-7. <http://shoup.bol.ucla.edu/SmallChange.pdf>.

³² Environmental Defense Fund estimate.

³³ Todd Litman, Victoria Transport Policy Institute's (VTPI) review of this approach in British Columbia.

Recommendation 127:

PGC and public should reduce VMT by providing public and private incentives for public transit use and high occupancy vehicle trips.

4.3.2.3 Telecommuting

Telecommuting gives an employee the ability to perform their work from somewhere other than their office location, generally from home. One of the best-studied locations making use of telecommuting is Tokyo, Japan. Research into the growth of telecommuting in Tokyo estimates that this arrangement will result in a 6.9 - 10.9% reduction of traffic congestion by 2010.³⁴ Another study³⁵ looks at two years worth of empirical data on the pilot telecommuting programs, known as "ecommute" programs, that were established in five major US metropolitan areas in 1999 under the National Air Quality and Telecommuting Act. The authors describe the major goal of the ecommute program as using economic incentives, in this case tradable emissions credits from telecommuting, to promote behavioral change. The authors predict this would not be a viable strategy for reducing VMT; however, the GHG reduction benefit would be realized due to mitigation of congestion, despite a constant VMT. The PGC and Metro community should promote teleconferencing as well as the availability of pedestrian and bicycle transit and carpool options for business commutes and trips.

4.3.2.4 Compressed Work Week

A compressed workweek can reduce GHG emissions and other air pollutants. For some employers, four ten hour workdays could reduce commuter VMT. Alternating three-day weekends with a 9-hour workday may be another option.

Recommendation 128:

PGC and local partners should evaluate whether implementing a 4-day, forty-hour workweek will reduce VMT and energy consumption.

4.3.2.5 Speed Limit Reduction

Vehicle speed affects fuel economy. Passenger vehicle models in 1984 had the best fuel economy at speeds of approximately 40 miles per hour (mph). With recent vehicle technology developments, the speed at which maximum fuel economy is found rose to approximately 55 to 60 mph.³⁶ The Louisville Metro area's current vehicle fleet mix is most efficient at speeds ranging from approximately 40 to 60 mph. With reduced fuel usage via more optimal fuel economy speeds, and barring increased congestion, GHG emissions should be reduced.

³⁴ Hitoshi Mitomo and Toshiya Jitsuzumi, "Impact of Telecommuting on Mass Transit Congestion: the Tokyo Case," *Telecommunications Policy*, 23, no. 10-11 (1999), 5.

³⁵ Peter Nelson et. al., "Telecommuting and Environmental Policy: Lessons from the Ecommute Programs," *Transportation Research: Part D* 12, no. 3 (2007), 195-207.

³⁶ "Driving More Efficiently," [www.fueleconomy.gov, http://www.fueleconomy.gov/feg/driveHabits.shtml](http://www.fueleconomy.gov/feg/driveHabits.shtml).

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Recommendation 129:

PGC and the public should advocate reduced speed limits on state and federal highways to improve fuel efficiency.

4.3.3 Freight Mobility

In less than 20 years, the nation's freight traffic is expected to increase by 67% according to the U.S. Department of Transportation.³⁷ Since 1980, interstate lane-miles have increased by 16% while associated VMT has increased by 125%. Among all modes of freight transportation, trucks are used to haul about 70% of all commodities and overall truck traffic has doubled.³⁸ Locally, this is evident on the Kennedy Bridge, where trucks account for 12% of the total traffic during the peak hours and on I-65 where, during non-peak hours (9:00am-3:00pm), trucks make up as much as 25% of the total traffic volume. Freight congestion problems are noticed mostly at bottlenecks on highways.³⁹ **Bottlenecks** are defined as, “[a] localized section of highway that experiences reduced speeds and inherent delays due to a recurring operational influence or a nonrecurring impacting event.” These situations often occur at highways serving major international freight gateways (ports) or major domestic freight hubs like Chicago. In major urban areas, they can occur where transcontinental freight lanes intersect congested urban freight routes. This is particularly important for Louisville given its economic reliance on United Parcel Service (UPS).

Congestion plays a central role in the major challenges to freight mobility. The limited visibility and attention that freight-specific projects receive in the process of planning and prioritizing transportation investments are the principal limitations in addressing freight mobility. Integrated freight transport planning is an important part of a larger transportation plan. Scenario planning should accomplish this, along with an over-all sustainable and well thought out multi-year plan. **Scenario planning** is an analytical tool that “provides a framework for developing a shared vision for the future by analyzing various forces (e.g., health, transportation, economic, environmental, land use, etc.) that affect growth.”

The following are suggested goals for the Metro area:

- A 90% or greater satisfaction level with freight mobility in a survey of business leaders responsible for companies that move freight within Louisville Metro by 2020.
- Intra-Metro rail transport of freight increase by 5% (by volume) by 2015.
- The region's long-range transportation plan identifies Freight Priority Corridors by 2010.

Recommendation 130:

LMG and KIPDA should integrate freight transport planning into the metro area transportation plan.

³⁷ Office of Operations, “Freight Professional Development Program,” U.S. Department of Transportation, Federal Highway Administration, http://www.ops.fhwa.dot.gov/aboutus/one_pagers/freight_fpd.htm.

³⁸ “Relationships Between Asset Management and Travel Demand:

Findings and Recommendations from Four State DOT Site Visits,” U.S. Department of Transportation, Federal Highway Administration, <http://www.fhwa.dot.gov/infrastructure/asstgmt/vmt01.cfm>.

³⁹ Ohio River Bridges Project, *Ohio River Major Investment Study (ORMIS) Final Report*, April 1997.

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4.3.4 Reducing GHGs from Existing and New Sources

4.3.4.1 Vehicle Operating Practices

Vehicle operator behavior and practices, such as unnecessary idling, contribute to GHG emissions. Idling Reduction through city ordinance and/or education and outreach has been demonstrated in other communities as a viable way to achieve significant emissions reductions, including GHGs. APCD's Idling Reduction Work Group has been working with APCD Staff to provide community input for an idling restriction. A regulation and/or city ordinance is expected to be implemented soon.

Recommendation 131:

PGC and public should implement practices and policies to reduce unnecessary idling and acquaint Partner entity employees and the public with related regulations and APCD recommendations.

4.3.4.2 Vehicle Technology

Vehicle technology has evolved over the years to meet EPA's National Ambient Air Quality Standards (NAAQS), which were established in order to reduce the impact of mobile vehicle emissions on human health. Better fuel formulations and vehicle emissions control technologies have greatly reduced emissions, especially from gasoline-powered passenger vehicles. A growing number of vehicle options under development or making market entry might significantly reduce emissions, such as high efficiency/smart cars, compressed natural gas vehicles and hydrogen fuel cell powered and rotary air engines. More established vehicle technologies for emissions reduction are diesel emission controls, hybrids and electrification (for truck stops and loading/unloading locations). The PGC Green Fleets Team is working to integrate the newest vehicle efficiency technologies for PGC vehicles as an example for the community.

Recommendation 132:

Partners should continue to participate actively in the Green Fleets Team.

Recommendation 133:

PGC should adopt a high-efficiency vehicle purchasing policy.

4.3.4.3 Fuel and Energy Efficiency Standards

The vehicle fuel economies and fuel mix for Louisville Metro is represented in Table 4-2, below:

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Table 4-2. Jefferson Co. – 2002 Fleet Mix

JEFFERSON Co. – 2002 Fleet Mix*	
Vehicle Class	MPG
LDG:	17.94
HDG:	8.21
LDD:	24.33
HDD:	12.2
MC:	50
All (average):	19

*derived from county vehicle emissions testing program and FWHA data
etOH (ethanol) : 10% at near 100% market share (reformulated gasoline)
LD = Light Duty HD = Heavy Duty G = Gasoline D = Diesel
MC = motorcycles

Fuel economy standards are currently under debate by federal, state and regional agencies. The National Association of Clean Air Agencies (NACAA) [recommends](#) 35 miles per gallon (mpg) for passenger and non-passenger automobiles as a minimum by 2020. The National Highway Traffic Safety Administration's (NHTSA) [recommendation](#) is 31.6 mpg by 2015 for cars and light trucks. In addition, the energy density of biodiesel fuel is slightly less than that of regular diesel fuel; for vehicles running on 20% biodiesel (B20), this may result in 2.2% fewer miles per gallon of fuel.⁴⁰ Lower carbon fuel resulting from improved fuel formulation (mainly ethanol in Jefferson County, with some biodiesel) and improved vehicle technology has already resulted in a reduction of GHG emissions from 1990 to 2006 in Jefferson County; however, the increase in VMT is rapidly displacing the gain from fuel formulation and vehicle technology improvements. See section 4.1.5 of the complete report for more information.

Recommendation 134:

PGC, public, state and federal governments should fully support the most stringent fuel efficiency and GHG reduction measures that either federal or individual states are seeking to implement.

Recommendation 135:

PGC should consider the energy replacement value, GHG emissions per mile/km and the complete life-cycle and upstream emissions impact when using bio-fuels in fleet operations.⁴¹

Recommendation 136:

PGC should establish clear fleet operating policies including procurement, idling and fuel use guidelines and should make them publicly available as an example to other fleet operators.

4.3.4.4 Heat Island Effect Mitigation Measures

Current research is considering the linkages between "Urban Heat Island" effects, higher energy use due to increased temperatures in urban areas and the amount of impervious cover. Impervious cover "units"

⁴⁰ Anthony Radish, "Biodiesel Performance, Costs and Use," Energy Information Administration, <http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/>.

⁴¹ See work done by Center for Agricultural and Rural Development, Iowa State University, Iowa Ag Review online, http://www.card.iastate.edu/iowa_ag_review/fall_07/article1.aspx#.

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in the city, such as parking lots and sidewalks, decrease evapotranspiration (cooling effect from vegetation) and increase solar reflectivity and heat storage capacity; this in turn prompts greater energy use (e.g., for cooling), which results in increased GHG emissions. The Transportation working group considered parking lot design as a mitigation measure.

Recommendation 137 (Similar to Recommendation 150):

PGC should encourage measures (including cool roof and green roof installation, tree planting along sidewalks and throughout parking lots and increased use of pervious materials to augment soil water holding capacity) to decrease the urban heat island effect caused by transportation infrastructure.

4.3.4.5 **Nonroad: Construction Equipment and Marine**

Construction equipment has been identified by air quality agencies as a significant source of emissions affecting a metropolitan area's ability to meet national air quality standards. Furthermore, GHG emissions from construction equipment in the Louisville Metro area have been found to contribute approximately 7% of the inventoried transportation sector GHG emissions and approximately 2% of the community's (Jefferson County) GHG inventory. Therefore, the Metro area should seek to reduce construction GHG emissions by supporting emissions control technology retrofits, fleet replacement, idle reduction practices, incentives and collaboration with state and federal agencies. Nationally, marine diesel has been found to be a significant source of pollutants. As a river port city, the Louisville Metro area experiences some impact from river traffic emissions, especially barges, due to their diesel engine emissions. Pleasure boating and other recreational activities also contribute to GHG emissions. To achieve reductions in GHG emissions in the marine sector, LMG should support marine emission controls, port electrification, loading and unloading equipment emission controls and other best practices.

Recommendation 138:

LMG should seek ways to reduce non-road greenhouse gas emissions by fully supporting regional and national efforts, as well as implementing local measures to restrict GHG emissions.

4.3.4.6 **Other Nonroad**

Other non-road sources of GHGs in the Louisville Metro area are agricultural equipment, lawn care engines, wood burning, outdoor grilling and chain saws. Airline operations at the two airport locations in Jefferson County under the Louisville Regional Airport Authority (Louisville International/Standiford Field and less significantly in terms of GHG emissions, Bowman Field) accounted for 50% of the 'entities vehicle fleet' CO₂e emissions and 0.2% of the community transportation emissions. For more information on how LRAA's emissions were included in the inventory see section 4.2.2 of the complete report. The PGC and the community should support programs such as the Kentuckiana Air Education (KAIRE) Lawn Care for Cleaner Air program⁴² and other opportunities funded by the Federal Highway Administration (FHWA) Congestion Mitigation and Air Quality (CMAQ) program.

⁴² "Lawn Care Rebate Program," City of Louisville, <http://www.louisvilleky.gov/APCD/lawncare/> (a CMAQ funded program)

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4.3.5 Additional Community Benefits of Proposed Recommendations

4.3.5.1 Economic Security

With gasoline prices recently as high as \$4.00+ per gallon, the cost of transportation approaches 25% of the average family budget. The cost of fuel is currently determined not only by unpredictable market forces and commodity pricing, but also by limits based on fuel production capabilities tied to remaining accessible oil reserves (and the cost of accessing undiscovered reserves). Families in areas with fewer transportation choices carry the greatest economic burdens. Transportation policies should reduce these burdens by investing in more transportation options. Rising gasoline prices are also a concern for local and state economies that suffer as household retail spending and consumer confidence is weakened by rising gas prices. Louisville has been found to be ill suited to deal with the effects of rising oil prices, ranked 49th of the 50 largest US cities surveyed for the ability to maintain economic viability and quality of life as energy prices rise.⁴³ In response to these issues, Louisville area employers are shortening the workweek (Key Electronics), planning to offer incentives such as tax-free flex accounts specifically for transportation expenses (Humana) and promoting carpooling. Employees who utilize these options are able to save a minimum of 1/5 of normal fuel costs, although several report much larger savings.⁴⁴

4.3.5.2 Congestion Mitigation

In May of 2006, U.S. Secretary of Transportation, Norman Mineta, identified congestion as one of the single largest threats to the economy. Congestion time, wastes time, energy and money. Each year, Americans lose 4.2 billion hours and 2.9 billion gallons of fuel sitting in traffic jams for a total cost of \$78 billion.⁴⁵ Recent studies demonstrate that emissions of CO₂ increase with greater congestion.⁴⁶ Highway congestion has increased dramatically over the past two decades in extent, duration and intensity. Congestion is spreading to suburban and rural areas and no longer is viewed as a 'big city' problem. Louisville's traffic congestion is growing in severity faster than our population is growing in size. We spend almost one workweek a year sitting in traffic jams, with the annual price tag of \$865 per driver, or approximately \$335 million for the entire local population.⁴⁷ Louisville is among the top 25 metro areas in terms of congestion.⁴⁸ Though current transportation planning makes an effort to mitigate congestion, if the structural issue of sprawl is not addressed, attempts to relieve congestion through transportation engineering will result in still more traffic (and thus increased VMT and associated GHG emissions).

⁴³ Warren Karlenzig, "Major US City Preparedness For an Oil Crisis Which Cities and Metro Areas are Best Prepared for \$4 a Gallon Gas and Beyond?," March 4, 2008. http://postcarboncities.net/files/CommonCurrents_Oil%20Crisis_final_4Mar08.pdf

⁴⁴ Local news, "Some employers restructuring work week to compensate for commuting costs," WHAS 11, Wednesday, June 4, 2008, http://www.whas11.com/news/local/stories/WHAS11_080603_Consumer_ScheduleChange.5b1facb7.html.

⁴⁵ David Schrank and Tim Lomax, Texas Transportation Institute, *The 2007 Urban Mobility Report*, September 2007, 8. http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf.

⁴⁶ Barth and Boriboonsomsin, Annual Meeting of Transportation Research Board, *Real-World CO₂ Impacts of Traffic Congestion* (Washington, D.C., Nov. 15, 2007).

⁴⁷ David Schrank and Tim Lomax, Texas Transportation Institute, *The 2007 Urban Mobility Report*, September 2007, 8. http://tti.tamu.edu/documents/mobility_report_2007_wappx.pdf.

⁴⁸ Schrank and Lomax, *2007 Urban Mobility Report*, 38.

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The community's recommended goals should be to:

- Reduce VMT by 5% by the year 2012, 10% by 2015, 20% by 2020. This would result in CO₂e reductions as listed in table 4-3.

Table 4-3. Projected CO₂e Levels Based on VMT Reductions

	base year 2009	2012	2015	2020
Daily VMT	21,542,590	20,465,461	19,388,331	17,234,072
CO₂e gr/mi (all vehicles)	530.6	530.6	530.6	530.6
% VMT reduction		5.0%	10.0%	20.0%
tons/year CO₂e reduced from 2009 base year		229,949	459,898	919,797

Hypothetical relative savings only. The above does not factor in the current projected increase in VMT, which would add another 11.1% to be reduced by 2020. gr/mi = grams per mile

- By 2020, Louisville should rank in the lower 25% of cities in the Texas Transportation Institute's annual survey of the most congested urban areas in the U.S.

Recommendation 139:

LMG and KIPDA should develop a network of High Occupancy Vehicle lanes, Bus Only lanes or "Green Lanes" throughout Jefferson County.

4.3.5.3 **Spatial Mismatch between Jobs and Workers**

According to the [2000 census](#), nearly 100,000 workers commute to Louisville for their jobs. Bullitt County led, with more than 20,000 commuters, followed by Clark County with 16,300 and Oldham County with 12,700. The figures confirm that Louisville is the economic engine for the region and that people are increasingly living in nearby communities and commuting to Louisville for work. The current trend represents a 38% increase over the 1990s, when 72,100 people commuted to Louisville for their jobs. Between 1982 and 1992, Louisville Metro urbanized land much faster (by a factor of ten) than it added population; the region's population increased 6% while the amount of land developed grew 60%. This is an unsustainable trend. Accommodating and providing transportation infrastructure and services in newly developed areas competes for resources needed to preserve and sustain existing transportation infrastructure.

4.3.5.4 **The Age Wave and Transportation Access**

Another issue of concern to transportation planners is our aging population. One in every five Americans, or 20% of the population, will be in the "over-65-years" age category in the next 10-15 years. This figure is closer to one in every four citizens in Kentucky or 25% of the total state population.⁴⁹ These statistics describe what is known as the 'age wave.' As the ability to drive is diminished because of aging, this population segment will require different means of transportation to

⁴⁹ Federal Interagency Forum on Aging-Related Statistics, *Older Americans 2004: Key Indicators of Well-Being* (Washington, DC: U.S. Government Printing Office, 2006). <http://www.AgingStats.gov>.

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maintain mobility. Mobility security will be needed to sustain the basic essentials of life, such as access to medical services, employment, grocery shopping, visiting relatives and friends and attending social and religious gatherings. Today's transportation system, if unchanged, will not be able to respond to the mobility needs of the aging and elderly population. Our pattern of development, where we live in relation to where services are provided, makes us dependent on the automobile. Some minimal and basic transportation services are offered through public or private social service agencies; however, this effort lacks coordination, is for the most part under-funded, is not prepared for the age wave and is inherently inefficient. The most basic and fundamental form of transportation, walking, is frustrated by the conditions of the majority of our streets. One-half of our main thoroughfares, not counting local streets, do not have sidewalks and another 20% have partial or disconnected sidewalks.⁵⁰ Transit routes in the city, especially in suburban parts of the community, are inaccessible and lack basic infrastructure to make them accessible and practical for the public.

4.3.5.5 Public Health Concerns

Although GHGs are not generally studied for their direct effects on health, other concurrent emissions from transportation have been linked to a variety of health problems affecting the pulmonary, cardiovascular and autonomic systems. In addition, automobile dependency correlates with increased weight: relative to adults in non-car households, adult drivers lose 56 minutes of walking time per week. This loss of activity equates to 28 additional pounds of body weight over the course of decades.⁵¹ Current walking patterns account for an increase of 5.7% of all passenger car emissions, relative to 1975 walking habits.⁵² Health benefits, and the resulting savings to individuals and society, should be included when calculating the costs of various transportation options.⁵³

The impacts of transportation policy on human health go far beyond highly visible auto accidents to include access to health care, food services and community support services. In the absence of an adequate public transportation system, the result could be intense isolation and a widening of disparities between car and non-car households that is likely to most seriously affect the poorest of the poor⁵⁴. Civil rights and equity issues affecting minorities have been found to be linked to transportation policy decisions that give funding preference to projects (such as light rail and highways) that serve suburban and/or wealthier commuters and consistently under-fund the infrastructure that is most valuable to poor and minority populations. Notably, "[i]n 1998, those in the lowest income quintile, making \$11,943 or

⁵⁰ Howard Turner, *Suitability of Louisville Metro Roads for Bicycling and Walking*, prepared for Louisville Metro Planning and Design Services, August 2004, http://www.kipda.org/files/PDF/Transportation_Division/Information/BPSui8-14-04.pdf.

⁵¹ Summarized in Professor Arnold's Matrix (2008). Davis, Valsechi and Ferguson, *Unfit for Purpose: How Car Use Fuels Climate Change and Obesity* (London: Institute for European Environmental Policy, 2007). http://www.ieep.eu/publications/pdfs/2007/IEEP%20%20Unfit%20for%20purpose_transport%20climate%20change%20and%20obesity.pdf

⁵² Ibid.

⁵³ Carlos Dora, "A Different Route to Health: Implications of Transport Policies," *BMJ: Education and Debate* 318 (June, 1999):1686-1689. <http://bmj.bmjournals.com/cgi/content/full/318/7199/1686>.

⁵⁴ S.P. Wolff and C.J. Gillham, "Public Health versus Public Policy: An Appraisal of British Urban Transport Policy," *Public Health* 105 no. 3 (May 1991): 217-28. <http://www.ncbi.nlm.nih.gov/pubmed/2062994>.

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less, spent 36% of their household budget on transportation, compared with those in the highest income quintile, making \$60,535 or more, who spent only 14%.”⁵⁵

4.3.6 Requirements to Facilitate Recommendations

4.3.6.1 Political / Institutional Factors

See the full transportation report for a full summary of the regional transportation planning process for the Louisville Metro area.

There exists in the Louisville Metropolitan area a disjuncture between land use and transportation planning that is typical of many U.S. cities of its size. The 1956 Federal Highway Act and the Federal Housing Administration’s (FHA) mortgage financing and subdivision regulation are largely responsible for helping to create this pervasive condition. This produced the multi-centered, low-density, automobile-dependent metropolises that we know today. According to the Metropolitan Housing Coalition, “Market-driven development continues apace, with transit infrastructure struggling to serve such far-flung growth. Unfortunately, even for planners and civic leaders who realize the important connection between transportation and land-use, there often exists few opportunities to integrate the two.”⁵⁶ In order for the recommendations of this committee to be successful, these institutions and the public must undergo a shift in culture. The National Surface Transportation Policy and Revenue Study Commission's report to Congress provides an example regarding "cultural shift": “Our Nation will need to put more emphasis on transit and intercity passenger rail and make them a priority for our country. A cultural shift will need to take place across America to encourage our citizens to take transit or passenger rail when the option is given.”⁵⁷ Such a shift requires political as well as corporate leadership. Whether the recommendations listed in this document can be accomplished in the absence of such leadership is doubtful.

4.3.6.2 Transportation Project Funding

Federal agencies currently report that receipts from gasoline taxes flowing into the transportation trust fund are running far short of projections and that this shortage will threaten promised funding under the 2005 reauthorization of the federal surface transportation law.⁵⁸ The fund, based on the federal gas tax, provides dedicated funding for the nation’s surface transportation program. The Government Accountability Office and the legislative branch are increasingly concerned over the future of the transportation trust fund, as gas tax revenue going into the fund will be insufficient to cover funding authorization in SAFETEA-LU.⁵⁹ The situation may well worsen as high gas prices lead a number of states to consider cutting fuel taxes that fund transportation projects. In addition, the introduction of

⁵⁵ Thomas Sanchez and others, "Moving to Equity: Addressing Inequitable Effects of Transportation Policies on Minorities," Joint report of the Civil Rights Project and the Center for Community Change, June 2003.

http://www.civilrightsproject.ucla.edu/research/transportation/trans_paper03.php.

⁵⁶ Metropolitan Housing Coalition, *State of Metropolitan Housing Report*, 2007. <http://www.metropolitanhousing.org/>.

⁵⁷ National Surface Transportation Policy and Revenue Study Commission, *Transportation for Tomorrow: Report of the National Surface Transportation Policy and Revenue Study Commission*, December 2007, http://www.transportationfortomorrow.org/final_report/.

⁵⁸ Transportation Research Board, *The Fuel Tax and Alternatives for Transportation Funding*, special report 285.

<http://onlinepubs.trb.org/Onlinepubs/sr/sr285.pdf>

⁵⁹ Ibid.

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fuel-efficient cars, coupled with advances in hybrid vehicles, undermines the funding projections that constitute the primary source of funding for nearly all transportation projects. In Jefferson County alone, the Kentucky Transportation Cabinet's (KYTC) 2005 estimate of unfunded road projects is \$1.54 billion, excluding the Ohio River Bridges Project.⁶⁰

Despite record gas prices leading more and more people to use transit, public transportation is still funded at only a fraction of highway spending. In Kentucky, legal barriers still exist that prevent use of state road tax funds for transit.⁶¹ While demand for transit service is growing in Louisville, TARC is faced with the need to consider cutting service in order to remain within its budget.

Fire, police protection, patching of the potholes and paving of the streets cannot be outsourced: the cost of service provision must be met. In addition, the prices of primary materials used in infrastructure - steel, asphalt and concrete - have risen sharply. From 2005 to 2010, the federal government will allocate over \$286 billion for transportation projects across the country.⁶² State gasoline taxes provide additional funding sources: in Kentucky, the tax contributes over \$1 billion annually to state road and highway projects, with multiple sources of funds (each with its own set of regulations) at both federal and state levels.⁶³ Recently, however, state gasoline taxes have begun a downturn.⁶⁴

While renewed investment in the physical fabric of our cities is compelling, our task is more daunting. The issue is not simply about raising more money, but about creating public policy that leads to better investment. Louisville Metro should develop transportation funding mechanisms that support sustainable development as well as maintain existing needed transportation infrastructure. Development of innovative state/local/regional funding may need to compensate for the current state and national transportation funding shortfalls. "Public-private partnership" arrangements should be carefully reviewed with ample opportunity for public comment to prevent short-term gain over long-term loss for communities involved.

4.3.7 Transportation Summary Conclusion

Recent data with respect to climate change and GHGs necessitates a greater environmental concern in addition to the growing societal and logistical problems of sprawl, congestion, fuel resources and related costs. The Louisville Metro region needs a truly visionary and integrated transportation plan to meet the current and future needs of its citizens and to augment its economic prosperity in a way that enhances the health, vibrancy and livability of its neighborhoods. This Report with recommendations is presented in order to provide guidance for developing this plan.

To read the complete Transportation Report, use the following url:

<http://www.louisvilleky.gov/APCD/ClimateChange/Documents.htm>

⁶⁰ Daryl Greer, Kentucky Transportation Cabinet, *Presentation: Importance of Scenario Planning Locally*. March 2007.

<http://transportation.ky.gov/planning/Scenario/2%20Greer%20KYTC.pdf>

⁶¹ TRIP, A National Transportation Research Group, *Key Facts About Kentucky's Road and Bridge Conditions and Federal Funding*, April 2008. http://www.nssga.org/government/2008_Trip_Files/Kentucky.pdf

⁶² Carlos Dora, "A Different Route to Health: Implications of Transport Policies," *BMJ: Education and Debate* 318 (June, 1999):1686-1689. <http://bmj.bmjournals.com/cgi/content/full/318/7199/1686>.

⁶³ Metropolitan Housing Coalition, *State of Metropolitan Housing Report*, 2007.

⁶⁴ *KENTUCKY Transportation News* XX no. 14 (10 June 2008). http://www.kbnet.org/uploads/TransportationNews2008_06_10.doc.

4.4 Urban Forests and Climate Change

For the last 20 years there has been a growing realization that reducing threats to societal stability and welfare from planetary-wide climate disruption will depend to a great degree in making cities more efficient in their consumption of energy and materials. Since cities are our economic engines and places where most of the world's people live, they contribute most of the greenhouse gases derived from fossil fuel emissions.⁶⁵ Solutions to the global problem of climate change will ultimately be local and urban, requiring cooperation among different levels of government, businesses, institutions and individuals. The purpose of the Urban Forestry section is to provide information and recommendations as to how our city's natural areas and managed vegetation, particularly trees, can also contribute to reducing our collective carbon footprint and in addition, provide a buffer against imminent climate change impacts.

The total cover and distribution of all vegetation in cities and suburbs (synonymous with Urban Forest) are important aspects in making cities more livable and play key roles in making urban regions more economically and ecologically sustainable - roles that will become even more important as climate changes.^{66,67} If we are to optimize the benefits society derives from its investment in urban forests, then policy makers and the public must more broadly appreciate that urban vegetation functions as a city's "green" infrastructure and, therefore, requires similar attention to its development, maintenance and repair as does our built "gray" infrastructure.

4.4.1 How the Urban Forest Reduces the Urban Carbon Footprint

4.4.1.1 Direct Carbon Uptake and Sequestration

An urban forest, especially trees, provides the ecosystem service of reducing a city's carbon footprint in two major ways: directly, by carbon uptake from the atmosphere and long-term storage in wood, and indirectly, by reducing a city's energy use (carbon emission avoidance). All plants take up CO₂ from the atmosphere and convert the carbon into their living tissues. Unlike grasses and other herbaceous plants, only shrubs and trees store carbon in woody tissue for decades to centuries, keeping enough CO₂ out of atmospheric circulation over a sufficient time frame to reduce the rate of climate change.

Urban and suburban housing lots in total typically store and sequester most of a city's tree carbon, particularly if neighborhoods are old and contain mature trees and if larger trees were not removed during development. The potential to plant more trees in yards and on streets exists and, if realized, could increase tree density and the multiple ecosystem benefits trees provide for both individual households and the city as a whole.

4.4.1.2 Avoided Carbon Emissions via Reduced Energy Use

Vegetation buffers urban climate and therefore reduces energy use, particularly in summer by providing shade, serving as windbreaks and transpiring water into the atmosphere. If sited properly, trees

⁶⁵ L. R. Brown, *Eco-Economy: Building an Economy for the Earth* (New York: W. W. Norton, 2001).

⁶⁶ Margaret M. Carreiro and others, *Ecology, Planning and Management of Urban Forests: International Perspectives* (New York: Springer Science+Business Media, 2008).

⁶⁷ Richard Register. *Ecocities: Building Cities in Balance with Nature* (Berkeley, CA: Berkeley Hills Books, 2002).

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physically reduce the amount of sunlight that reaches buildings, especially buildings less than three stories tall. Shading decreases the energy needed to cool buildings in summer, but trees can also reduce building energy demand in winter. While deciduous trees planted along the south and west of a building provide shade in summer, they allow sunlight through in winter when they lose their leaves, thereby reducing heating costs over the entire year in north temperate climates.

The main contributors to the [urban heat island](#) effect are low amounts of vegetation, high coverage by impervious surfaces (e.g., buildings, roads) with high thermal absorption properties and low coverage by unpaved soil, which would otherwise hold cooling moisture between rain events.. Buildings and roads contribute greatly to the heat island because they are usually made of materials that absorb a high percentage of incident solar energy and have a high heat storage capacity.

The most important means by which the urban forest reduces the heat island effect is via the ecosystem process of transpiration, the transference of water from the soil through a plant and into the atmosphere in the form of water vapor. This process cools the air because energy (the latent heat of vaporization) is absorbed from the air to convert liquid water inside leaf pores to gaseous water as the moisture is evaporated into the air. Unlike paved surfaces, exposed, moisture-storing soil also cools the city environment as soil water evaporates into the air.

4.4.2 Quantification and Monetary Valuation of the Ecosystem Services Provided by the Urban Forest and Associated With Reducing Urban Carbon Footprints

4.4.2.1 Ecosystem Service Quantification

Many studies have quantified the extent to which vegetation can reduce urban temperatures, from the scale of the whole city to that of the residential lot, and have also estimated the resulting energy savings.⁶⁸ By reducing the urban heat island effect, increases in urban forest cover can reduce energy use. Patches of green space with and without trees can also have a localized cooling effect on their neighborhoods. Forested parks can potentially have a greater cooling effect on built areas immediately surrounding them, particularly at night. The “cool spots” caused by Louisville’s urban parks is evident in an infrared satellite image of our inner city area (Figure 4-6), which shows the spatial variation in temperature recorded on July 8, 2000.

⁶⁸ W.Y. Chen and C.Y. Yim, “Assessment and Valuation of Ecosystem Services Provided by Urban Forests,” in *Ecology, Planning and Management of Urban Forests: International Perspectives*, eds. Margaret M. Carreiro and others (New York: Springer Science+Business Media, 2008), 53-83.

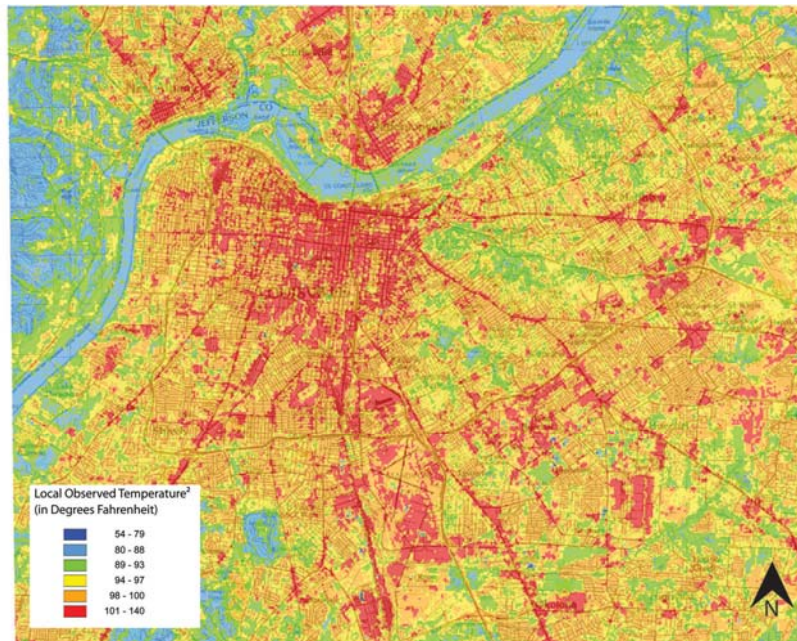


Image courtesy of Chris Choi, U.S. EPA Region 5

Figure 4-6. Infrared Satellite Image of the City of Louisville

Increasing tree cover in commercial areas, such as streets and paved parking lots, also reduces local temperatures and decreases the urban heat island effect. In Davis, California as little as 8% tree shading coverage reduced parking lot temperatures by as much as 36° F.⁶⁹ Tree shading of parking lots is important to the heat budget of a city, since parking lots comprise about 10% of all impervious surface area in U.S. cities.⁷⁰

4.4.2.2 Ecosystem Service Valuation

Translating quantified ecosystem service benefits provided by urban forests (e.g., kWh saved or tons of CO₂ sequestered) into their respective monetary values would improve the likelihood that urban forest preservation and budgetary needs will be incorporated more objectively and frequently into municipal planning and management. Model simulations of Chicago's urban forest determined that a 10% increase in tree cover would reduce energy use from heating and cooling by 5% to 10%. Various scenarios were also modeled to provide a more detailed assessment of the value of increased tree planting in the city. Street trees provided nearly half of the energy saved and yard trees contributed an additional 37%. The highest benefit-to-cost ratios were found for trees in residential yards and public housing, suggesting the importance of funding urban forestry outreach and education programs that target homeowners and the general public.

⁶⁹ E. G. McPherson, "Sacramento's Parking Lot Shading Ordinance: Environmental and Economic Costs of Compliance," *Landscape and Urban Planning* 57 (2001): 105–123.

⁷⁰ J. R. Geiger. "Where Are All the Cool Parking Lots?," (Davis, CA: Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, 2002), 2. http://www.fs.fed.us/psw/programs/cufr/products/3/cufr_151.pdf

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4.4.3 Additional Ecosystem Services Provided by Urban Forests That Increase Urban Resilience to Anticipated Climate Change Impacts

IPCC climate forecasts, based on mid-range reductions in greenhouse gas emissions, indicate that by 2080 cities in our region can expect a summer (June–August) climate that will be 7° F warmer than the 1980–2000 average.⁷¹ While predicted *average* rainfall during the summer will likely remain within 10% of mean values from 1980–2000, the hotter environment will translate into greater drought risk due to increased evapotranspiration rates from plants and soil. In addition, while average rainfall over the year may not change much, we can expect more intense rainfall per event interspersed with longer intervals between rain events. An intelligently distributed and well-managed urban forest in our parks, riparian areas, streets, yards, parking lots and institutional campuses can contribute to reducing the negative impacts of hotter summer temperatures and flooding/drought cycles on our urban built infrastructure and our citizenry.

4.4.3.1 Air Quality Benefits

Unless fossil fuels are rapidly reduced as an energy source for home cooling and transportation, hotter summer temperatures will increase both primary pollutant (e.g., particulates, NO_x and SO₂) emissions and secondary pollutant (e.g., O₃, peroxyacetyl nitrates (PANs) and aldehydes) formation in the atmosphere. For every 2° F rise in temperature above 78° F, smog increases by 7% to 18%.⁷² By intercepting particulates and taking up many gaseous pollutants, urban tree canopies cleanse the air of pollutants that adversely affect human cardio-pulmonary health and that damage materials. In 1991, urban forests in the Chicago metropolitan area were estimated to remove a total of 6,145 tons of air pollutants valued at \$9.2 million dollars per year.⁷³ Pollutant removal by trees (at 11% tree cover levels) in the inner city of Chicago was valued at \$1 million, with large healthy trees removing between 60 to 70 times more pollutants than smaller trees. In Sacramento, shaded parking lots reduced asphalt temperatures by 36° F, vehicle temperatures by 47° F and fuel tank temperatures by 7° F over unshaded lots. That results in fewer organics volatilized from vehicle gas tanks and materials (hoses, fabrics) to contribute to O₃ formation. By increasing the amount of parking lot area shaded by trees from the current 8.1% to the 50% as stipulated in Sacramento's city ordinance, annual benefits from all ecosystem services (including storm water management, improved air quality, reduced heat island and others) would also increase from \$700,000 to approximately \$4 million per year.⁷⁴

4.4.3.2 Stormwater Management Benefits

Since cities have a large percentage of impervious surfaces (up to 95% in downtown areas), less ground water is recharged and more local neighborhoods are prone to flooding. Stormwater runoff, particularly

⁷¹ J. H. Christensen and others, "Regional Climate Projections," in *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, eds. S. Solomon and others (U.K.: Cambridge University Press, 2007). <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter11.pdf>

⁷² Melvin Pomerantz and others, "Physics and Public Policy for Urban Heat Island Mitigation: Summary of a presentation to the American Physical Society, Atlanta, GA, March 1999." Heat Island Group, 2000, <http://eetd.lbl.gov/HeatIsland/PUBS/APS-PressRelease/>

⁷³ D.J. Nowak, "Air Pollution Removal by Chicago's Urban Forest," in *Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project*, ed. E.G. McPherson (Randnor, PA: United States Department of Agriculture, Forest Service, Northeastern Forest Experimental Station, 1994), 63–81.

⁷⁴ E. G. McPherson, "Sacramento's Parking Lot Shading Ordinance: Environmental and Economic Costs of Compliance," *Landscape and Urban Planning* 57 (2001): 105–123.

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that running through combined sewer outlets, has also caused great damage to local streams and riparian areas through stream bank undercutting and erosion. Cities have had to make large investments in the construction of stormwater management systems to replace the flood prevention services formerly supplied by our green infrastructure (i.e., permeable soils and vegetation). The urban forest can also mitigate the severity of this urban flooding syndrome by intercepting and storing rainwater in tree canopies and by collecting and directing more water flow down the trunk to the soil at the tree base instead of paved surfaces. Increasing urban tree cover is a viable strategy for alleviating the costs of storing and discharging stormwater. The costs of flood damage could also be included in the ecosystem service valuation of an urban forest. Investments in greater tree planting and management will be needed soon if we are to buffer cities like Louisville from the negative impacts of more intense rain events and hotter weather that climate change will likely bring.

4.4.3.3 Biodiversity Support and Other Benefits

There are many other recognized ecological services provided by green space in parks, streets, yards and institutional campuses. Parks and other natural areas within urban and suburban communities provide important habitat for local biodiversity as well as places for recreation and spiritual rejuvenation for stressed city dwellers.⁷⁵ Even though some of these services have been quantified in a few locations, their dollar values are in need of improved estimation.⁷⁶ There is even less focus on the fact that some species (e.g., fish, frogs, dragonflies, insectivorous birds, bats, birds of prey), which often require larger areas of natural land or good quality aquatic habitats for their survival, serve as a vanguard for protecting people and pets from insect and rodent-vectored diseases and even some water borne illnesses.⁷⁷

Greater attempts are needed to quantify the value of ecosystem services provided by biodiversity in forested ecosystems and other green spaces in and around cities if nature's beneficial contributions to society are to become tangibly visible and not regarded solely as theoretical. Valuation of nature's ecosystem services can redress some of the present imbalance in decision-making as development options are discussed and planned.

Establishment of effective urban forestry programs is one of the top priorities identified by urban planners, managers and scientists involved in the sustainable cities movement across the world.⁷⁸ Use of decision tools that incorporate valuation of benefits provided by the urban forest and other natural areas into planning and management should be considered vital in securing Louisville's sustainability.

⁷⁵ E. A. Johnson and M. W. Klemens, eds., "The Impacts of Sprawl on Biodiversity," in *Nature In Fragments: the Legacy of Sprawl*, eds. E. A. Johnson and M. W. Klemens (New York: Columbia University Press, 2005), 18-53.

⁷⁶ S. C. Farber, "The Economics of Biodiversity in Urbanizing Ecosystems," in *Nature In Fragments: The Legacy of Sprawl*, eds. E. A. Johnson and M. W. Klemens (New York: Columbia University Press, 2005), 263-283.

⁷⁷ P. R. Epstein, "Climate, Ecology and Human Health," *Consequences* 3, no. 2 (1997).

<http://www.gcio.org/CONSEQUENCES/vol3no2/climhealth.html>

⁷⁸ M. M. Carreiro and W. C. Zipperer, W. C., "Urban Forestry and the Eco-City: Today and Tomorrow," in *Ecology, Planning and Management of Urban Forests: International Perspectives*, eds. M. M. Carreiro and others (New York, Springer Science+Business Media, 2008) 435-456.

4.4.4 Urban Forestry Recommendations

4.4.4.1 Urban Forester

Management of the entire green infrastructure of a major Metropolitan area requires staff with an educational background that goes beyond arboricultural understanding of how best to plant and care for individual trees. An urban forester needs to have the background, skills and resources to obtain data directly about the status and functioning of our green infrastructure within the metropolitan landscape. In addition, the urban forester should be able to synthesize information obtained by other city agencies and the scientific community for making sound management decisions about the distribution and maintenance of our city's green infrastructure in varied land use contexts.

Recommendation 140:

LMG should create a new position of Urban Forester to develop plans to reduce the community carbon footprint by using urban trees to offset carbon emissions, to buffer the city from adverse climate change impacts by strategically distributing different kinds of vegetation around the city and to advise government and private property owners about the selection, installation and maintenance of trees.

Recommendation 141:

LMG should implement more science-based forestry planning at the county scale.

Recommendation 142:

LMG should provide the Urban Forester with resources to acquire information for inclusion in an Annual or Biannual "State of Our Trees" report to the Mayor.

4.4.4.2 Preventing Net Tree Loss

Trees, particularly older and larger ones, store orders of magnitude more carbon both above and below ground than small or young trees. Their removal, either intentionally during development or unintentionally due to flood, wind and ice storm events, results in a net loss of stored carbon, more CO₂ emitted to the atmosphere and loss of future carbon sequestration. Tree losses, especially larger trees, also enlarge the city's carbon footprint by increasing compensatory energy use for heating and cooling buildings.

Recommendation 143:

LMG should strengthen the land development code so that developers must address tree protection prior to filing the site development plan to reduce the number of trees lost during construction and other related activities.

Recommendation 144:

LMG should establish a tree ordinance that includes strengthening tree canopy maintenance and the mandatory replacement of trees lost.

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Recommendation 145:

LMG should increase recognition of heritage and champion trees in our county and urge that a plan be filed that encourages their preservation.

4.4.4.3 **Louisville Metro Community**

Trees in residential land use comprise a large proportion of a city's total forest canopy. Privately owned residential trees around homes provide a large proportion of the energy savings and avoided carbon emissions in urban areas. Trees on home lots benefit not only the homeowner but also the city at large via reducing the urban heat island. Trees dispersed through the urban landscape contribute to a unique sense of place for our citizens and serve to maintain native wildlife, some of which provide ecosystem service benefits such as disease control.

Recommendation 146:

The Partners should create an Urban Forest website with information to increase public awareness of the value of trees in reducing household and collective city carbon footprints.

Recommendation 147:

The Partners should create programs and incentives for residents to plant trees, native shrubs and herbaceous materials.

Recommendation 148:

The Partners should encourage the planting of a greater diversity of native trees through education of the public, tree planting agencies and tree nursery owners.

Recommendation 149:

The Partners should work toward achieving the criteria needed for Louisville Metro to become a [TREE CITY USA](#)[®].

4.4.4.4 **Tree Cover in Densely Paved Areas**

Across most U.S. cities, parking lots constitute about 10% of all impervious cover. Without appropriate tree cover, parking lots contribute substantially to stormwater run-off, pollutant loading to streams and to volatile organic compounds emissions to the atmosphere from heated gas tanks and other materials in parked vehicles. Increasing tree cover in parking lots has been proven to reduce costs to stormwater detention and degradation of water and air quality.

Recommendation 150 (Similar to Recommendation 137):

The Partners should establish requirements for minimum percent tree cover in locations with high pavement density such as parking lots.

4.4.4.5 **Highway Forests**

Trees growing alongside our major transportation corridors, such as interstate highways, are low maintenance yet store and annually sequester large amounts of carbon per acre. These highway forests

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are buffers that take up numerous air pollutants emanating from the vehicles on the highways and muffle noise pollution to residential areas adjacent to these roads. On a per acre basis, these trees rank highly in terms of the ecosystem services they provide to our urban community. These trees have high benefit to cost ratios, in large measure, because we rely on natural processes for tree reproduction. However, the capacity of these highway forests to regenerate is being greatly compromised by the spread of an exotic honeysuckle shrub and other invasive plants along highway corridors. Therefore, we recommend that Louisville Metro work with relevant city, state and federal agencies to improve conditions along our highways.

Recommendation 151:

The Partners should encourage removal of non-native bush honeysuckle, which has been proven to reduce greatly the natural regeneration of tree seedlings in wooded areas along highway verges.

Recommendation 152:

The Partners should encourage decreased mowing along our transportation corridors to allow more tree growth in appropriate locations.

Recommendation 153:

The Partners should seek opportunities and locations along highways for planting more native trees.

To read the complete Urban Forestry Report, use the following url:

<http://www.louisvilleky.gov/APCD/ClimateChange/Documents.htm>

4.5 Waste and Climate Change

The field of waste management generally includes all aspects of managing waste, beginning with the production and acquisition of materials and progressing through the collection and disposition of those materials, through recycling, composting or land filling. GHG emissions associated with the waste sector arise from a variety of sources. Key factors on the disposition side include transportation (collection of wastes/recyclables and delivery to recycler or landfill) and decomposition of waste. Although the manufacture of new materials might not be considered a traditional source of GHG emissions in the waste sector, recycling can provide a significant reduction in GHGs generated while obtaining virgin raw materials and manufacturing products from scratch, as compared to manufacturing from recycled content stock.

The GHG emissions inventory reported the portion of GHG CO₂e emissions attributed to the waste sector decreased from 4% in 1990 to 3% in 2006 and the 1990 CO₂ tonnage of 676,503 dropped to 608,900 in 2006. The most likely causes of this decline include increased recycling activity, including the implementation of curbside recycling collection across the City of Louisville (now Louisville Metro) and many other cities and the addition of numerous drop-off recycling centers; and efforts by the Outer Loop Landfill (OLL) to collect and distribute landfill/methane gas.

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Reducing GHG emissions in the Louisville waste sector can most effectively be achieved by expanding and promoting waste reduction, recycling and composting opportunities for both the residential and commercial sectors, as well as promoting the effective capture, collection and distribution of landfill/methane gas as an alternative energy source. Louisville Metro Government already maximizes waste collection and disposal efficiency through data analysis and frequent review of route efficiencies.

Waste reduction is the most basic approach to reducing GHG emissions by avoiding the creation of waste in the first place which reduces the energy needed to manufacture the original material, transport and recycle, or dispose it. It is also a valuable approach, as it requires no additional infrastructure and is as simple as redefining processes. Waste reduction techniques can range from avoiding packaging, planned purchasing and changes in process or materials.

Recycling is also a potent tool for reducing GHG emissions. Although energy is consumed in the collection, processing and shipping of recycled contents to the recycler and by the recycling process, it is less energy intensive and polluting than the logging/mining/extraction of raw materials, followed by transporting the materials and manufacturing the products. According to the Kentucky Department for Environmental Protection, the amount of energy saved by manufacturing goods from recycled content versus virgin materials ranges from 30% for plastics and glass to 95% for aluminum. In addition, recycling paper and fiber products reduces the need to remove trees, thus allowing those trees to continue to sequester carbon by removing CO₂ from the atmosphere.

Composting is a variation of recycling that diverts organic material from landfills and converts it to a valuable product. Since 1994, local regulations have required that all yard waste generated in Louisville-Jefferson County be directed to a beneficial reuse process such as composting. Further, landfills in Louisville Metro are prohibited from accepting yard waste from any other sources outside of Louisville Metro. At present, almost all commercial composting in Louisville consists of yard waste.

4.5.1 Recommendations to Partners

All three members of the PGC currently track their waste collection and operate internal recycling programs. Although LMG provides waste collection for residents and certain small businesses within the Urban Service District (USD), the recommendations within 4.5.1 pertain only to waste generated by LMG operations and buildings. The waste audit recommendation can provide a model for businesses and organizations in the community, as well as a valuable learning experience for students.

Recommendation 154:

The Partners should analyze and monitor waste generation by: 1)performing waste audits (dumpster dives) of respective waste streams to identify opportunities for reduction, reuse and recycling and to provide a model for the community and 2)measuring solid waste streams annually, including materials disposed and materials recycled and reporting the totals for inclusion in the PGC's Annual Report.

Recommendation 155:

The Partners should review and improve where appropriate internal recycling and reduction programs and expand the programs where possible.

4.5.2 Recommendations to Louisville Metro Government for the Community

In addition to providing yard waste and recycling collection for residents of the USD, LMG also provides a wide range of recycling and waste diversion programs that have been honored both by state government and national organizations and are available to all residents of Louisville Metro. Many other cities in the U.S. provide curbside recycling. In 2006, Sustain Lane's City Sustainability rankings of the 50 largest cities ranked Louisville Metro's waste diversion program as #9, partly because it had one of the higher rates in the Eastern U.S.

4.5.2.1 Recycling Recommendations Affecting Multiple Sectors

LMG currently operates five staffed recycling centers and 12 drop-off centers. Numerous for-profit centers are also operated by local businesses. The Waste Management District Board is responsible for setting waste management policy in Louisville Metro.

Recommendation 156:

LMG should pursue the expansion of community recycling opportunities by expanding the material waste stream and increasing the number of drop-off locations and expanding companion recycling education programs.

Recommendation 157:

LMG's Waste Management District Board, working with its Advisory Committee, should evaluate the feasibility, benefits, barriers and potential costs of implementing additional mechanisms for increasing community-wide recycling, including, but not limited to, standard service packages, mandatory recycling, prohibiting disposal of various recyclable materials in local landfills (i.e., yard waste ban) and volume based waste disposal system (also known as variable can rate and pay-as-you-throw).

4.5.2.2 Recommendations Relating to the Commercial Sector

The following recommendations seek to provide information and resources to assist not only businesses who wish to implement reduction/recycling programs but also entities who wish to develop or locate waste-related businesses in Louisville.

Recommendation 158 (Similar to Recommendations 61 and 163):

LMG should revive the Green Inc. program to promote waste reduction and recycling resources to help local businesses implement or expand waste reduction and recycling programs and to provide recognition for those that do so.

Recommendation 159:

LMG's Economic Development Department, working with the Waste Management Division, should develop a waste-based economic development initiative.

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4.5.2.3 Recommendations Relating to Composting

The Outer Loop Landfill operates a commercial composting operation in compliance with the terms of its Host Agreement with Louisville Metro Government. At present this composting operation accepts only yard waste. At present several institutions and organizations have expressed interest in switching to compostable food service ware should a composting operation that accepts those products be available. There is also ongoing interest in commercially composting food scraps.

Recommendation 160:

LMD should work with the privately-owned Outer Loop Landfill, Breaking New Grounds and any other appropriate entities to explore the possibility of expanding or developing a compost operation that will include food scraps and other compostable materials such as compostable food service ware.

4.5.2.4 Recommendations Relating to Landfill Operations

Landfilling results in the production of methane gas, which is far more potent a GHG than CO₂, but which can be captured and used as an alternative energy source. Outer Loop Landfill is the only landfill presently operating in Louisville Metro. It is reviewing its current arrangement to collect and sell landfill/methane gas to a distributor which sells some of the gas to local businesses but which also flares off some of the gas.

Recommendation 161:

LMG should provide support for Waste Management of KY and its Outer Loop Landfill (OLL) to fully market methane/landfill gas generated at OLL and review other closed landfills in Louisville Metro to see if there are opportunities for capture and marketing of methane/landfill gases.

4.5.3 Recommendations for Educating the Community

Having implemented any of the above recommendations, LMG must ensure that information about the new resources is conveyed to the pertinent sectors of the community so that they will be able to take advantage of the programs. LMG should enlist all resources and networks throughout the community to assist in this effort.

Recommendation 162:

LMG should identify and coordinate community resources for educating the public about existing and expanded recycling opportunities implemented by LMG and other entities.

Recommendation 163 (Similar to Recommendations 61 and 158):

LMG should promote waste reduction and recycling to community businesses by reviving the Green Inc. outreach program.

Section 5 Outreach & Education

According to the Louisville GHG inventory, PGC entities were responsible for less than 5% of total GHG emissions in 2006. The community, which includes residents, businesses and industry, was responsible for the remainder. Therefore, significant opportunities exist for the PGC to impact community emissions through education and outreach efforts. By supporting the development, planning and evaluation of outreach opportunities the PGC can build knowledge and awareness of global climate change (climate literacy) throughout the community to enable the reduction of greenhouse gas emissions in the Louisville Metro area.

5.1 Education and Outreach Goals

Climate change outreach plans should aim to influence the behavior of a target audience so as to make them more likely to produce a change in behavior, use climate change impact strategies and/or understand climate change. A successful outreach campaign should lead to behavioral change such as increased energy efficiency, increased action and/or decreased negative impacts on the climate. Education and outreach can also lead to greater support of public policy changes that can reduce GHG emissions.

The following were identified as important community education and outreach goals:

- Lower greenhouse gas emissions,
- Increase climate literacy in Louisville Metro,⁷⁹
- Increase understanding of the economic benefits of climate change initiatives,
- Increase the self-efficacy of citizens and empower individual and group impacts on the climate in positive ways,
- Develop and strengthen an effective “green communication” infrastructure and network in Louisville Metro,
- Support the Climate Action Plans of the PGC entities through background research and a baseline survey of existing programs and resources, and
- Serve as a model for other outreach initiatives by promoting the research and evaluation of Climate Action Plans.

5.2 Climate Literacy

The National Oceanic Atmospheric Administration (NOAA) partnered with various scientists and educators to produce a standard guide for climate change terminology and principles called *Climate Literacy: The Seven Essential Principles of Climate Science*. The seven principles include:

1. Life on Earth has been shaped by, depends on and affects climate;
2. We increase our understanding of the climate system through observation and modeling;

⁷⁹ Climate literacy refers to the concept defined in the National Oceanic and Atmospheric Administration (NOAA) document *Climate Literacy: The Essential Principles of Climate Science* that can be found at http://www.climate.noaa.gov/index.jsp?pg=/education/edu_index.jsp&edu=literacy.

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3. The Sun is the primary source of energy for the climate system;
4. Earth's carbon cycle and climate system are the results of complex interactions;
5. Earth's climate varies over time and space;
6. Evidence indicates that human activities are impacting the climate system; and
7. Human decisions involving economic costs and social values influence Earth's climate system.

These NOAA's principles of climate literacy should become the standard for communicating climate change principles within the PGC and to the community as a whole. By effectively engaging the community with these seven basic principles, individuals within the community will develop a foundation of knowledge regarding climate change. This will help inform decisions about potential behavior changes that can reduce GHG emissions in the community. It is also critical that community leaders understand these principles when considering complex policy changes that could affect GHG emissions.

Recommendation 164:

UofL should formally adopt NOAA's Climate Literacy principles during the April 16th, 2009 Energizing Kentucky conference.

Recommendation 165:

JCPS should align its core curriculum with the NOAA Climate Literacy Framework.

Recommendation 166:

JCPS should develop a collection of field trip experiences that are connected to the core curriculum and NOAA Climate Literacy framework.

Recommendation 167:

JCPS and UofL should support the development of a curriculum from Dr. Keith Mountain's historic climate data, making it available to Louisville and state students for climate research.

Recommendation 168:

UofL should create a degree track in sustainability.

Recommendation 169:

The Partners should create public exhibits illustrating the volume of one ton of CO₂ at room temperature and the average human annual impact. A public, traveling display could accompany a "Know Your Carbon Footprint" campaign that will travel through the state.

Recommendation 170:

The Partners offer expertise and a range of professional development programming. As a climate change coalition, they should work together with JCPS to determine the needs and develop a framework of professional development programming and resources that will support educators who are teaching climate change topics in their classroom curriculum.

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5.3 “Green Communication” Infrastructure

There are many active environmental groups and businesses in Louisville Metro that are trying to improve the environment and “green” the community. However, these groups have varied missions and may not be easily identified or vetted by residents. Louisville needs tools to identify, locate and network the “green” community.

Recommendation 171:

The Partners should support a website that contains a comprehensive calendar and list of events, programs, interest groups, retail centers and other resources related to sustainability and available locally.

Recommendation 172:

The Partners should develop and populate a community wide "Green Map." This map should identify the locations of events, interest groups, retail centers and other items related to sustainability and available locally.

Recommendation 173:

The Partners should work together to host a sustainability/energy expo for Louisville.

Recommendation 174:

The Partners should work together to host a Climate Change forum for key members of Louisville media outlets (meteorologists, journalists, etc.).

Recommendation 175:

The Partners should work together to host a State Climate Summit in Frankfort for local and state policy-makers.

5.4 Education and Outreach Themes and Messages

This Report includes education and outreach recommendations from each of the seven subcommittees, which have been compiled and are included as Appendix D. While these recommendations vary from overarching information needs to sector specific strategies, four unifying themes were identified:

1. Our Local Climate – The atmospheric conditions averaged over a long period of time and over a large area.
2. Carbon Footprint – A measure of the impact that human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide equivalents.
3. Sustainability – The ability of an ecosystem to maintain ecological processes, functions, biodiversity and productivity into the future.
4. Biodiversity – Variations of life forms within a given ecosystem, biome, or for the entire Earth. Biodiversity is often used as a measure of the health of biological systems.

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These themes were used to develop messages, talking points and learning goals for education and outreach activities and programs. With guidance from the NOAA Climate Literacy Framework, the following key messages were developed for each theme:

Our Local Climate

- Life on Earth has been shaped by, depends on and affects climate.
- Changes in environmental conditions can affect the survival of individual organisms as well as entire species.
- Human societies have developed interconnected food, energy, transportation and socioeconomic systems that take advantage of existing climate conditions and are vulnerable to climate changes.
- We gain understanding of climate and how it has changes over time from observational data from weather stations, buoys, satellites and many other sources.

Carbon Footprint

- Evidence indicates human activities are impacting the climate system.
- Human activities have affected the land, oceans and atmosphere and have altered regional and global climate. These activities include burning fossil fuels, releasing chemicals into the atmosphere, reducing the amount of forest cover and rapidly expanding farming, development and industrial activity.
- The increased burning of fossil fuels has increased the amount of greenhouse gases in the atmosphere, which has contributed to Earth's warming.

Sustainability

- Earth's climate system is influenced by complex human decisions involving economic costs and social values.
- Climate information can be used to reduce the vulnerability and enhance the resilience of human communities and ecosystems; the importance of continuing to improve understanding of climate system is crucial.
- Decisions of one generation both provide opportunities and limit the range of possibilities open to the next generation.
- Slowing or reversing human impact on climate change trends might be accomplished by combining short-term with long-term investments in technology research and implementation and by adopting sustainable development strategies.

Biodiversity

- Throughout the evolution of life on Earth, organisms have and will continue to influence climate substantially.
- Changes in environmental conditions can affect the survival of individual organisms as well as entire species.

By engaging the community through these messages, the PGC can further reduce GHG emissions in Louisville and expand its impact on the climate locally and globally.

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APPENDICIES

APPENDIX A - List of Acronyms and Abbreviations

AIA	American Institute of Architects
APCD	Air Pollution Control District
B20	Fuel containing 20% biodiesel
BOMA	Building Owners and Managers Association
CACP	Clean Air and Climate Protection Software
CAP	Climate Action Plan
CCIM	Certified Commercial Investment Members
CES	Consumer Expenditure Survey
CFL	Compact Fluorescent Lighting
CHP	Combined Heat and Power
CMAQ	Congestion Mitigation and Air Quality
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
Committee	Climate Change Committee
CSA	Community Sponsored Agriculture
CSO	Combined Sewer Overflow
DOE	Department of Energy
DRI	Drainage Response Initiative
DSM	Demand-Side Management
E2	Energy Efficiency
EFT	Electronic Funds Transfer
EIA	Energy Information Administration
EMA	Emergency Management Agency
EPA	Environmental Protection Agency
ESCO	Energy Services Company
ESPC	Energy Savings Performance Contract
ESU	Equivalent Service Unit
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHA	Federal Housing Administration
GHG	Greenhouse gas
GIS	Geographic Information Systems
gr/mi	grams per mile
GWP	Global Warming Potential
HDD	Heavy duty diesel
HDG	Heavy duty gasoline
HERS	Home Energy Rating System

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HFC	Hydrofluorocarbons
HVAC	Heating, Ventilating and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
ICSC	International Council of Shopping Centers
IFMA	International Facility Management Association
IPCC	Intergovernmental Panel for Climate Change
IRC	International Residential Code
IREM	Institute of Real Estate Management
IRP	Integrated Resource Plan
JCPS	Jefferson County Public Schools
KAIRE	Kentuckiana Air Education
KIPDA	Kentuckiana Regional Planning & Development Agency
KPPC	Kentucky Pollution Prevention Center
KRS	Kentucky Revised Statute
KU	Kentucky Utilities
kW	Kilowatt
kWh	Kilowatt-hour
KYTC	Kentucky Transportation Cabinet
LCAN	Louisville Climate Action Network
LDC	Land Development Code
LDD	Light duty diesel
LDG	Light duty gasoline
LG&E	Louisville Gas & Electric
LIHEAP	Low Income Home Energy Assistance Program
LM EMA	Louisville Metro Emergency Management Agency
LMG	Louisville Metro Government
LOJIC	Louisville Jefferson County Information Consortium
LRAA	Louisville Regional Airport Authority
LWC	Louisville Water Company
MC	Motorcycle
MOVES	Motor Vehicle Emission Simulator
mpg	miles per gallon
mph	miles per hour
MSD	Metropolitan Sewer District
MW	Megawatt
N ₂ O	Nitrous Oxide
NAAQ	National Ambient Air Quality
NAAQS	National Ambient Air Quality Standards
NACAA	National Association of Clean Air Agencies
NAREL	National Air and Radiation Environmental Laboratory

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NHTSA	National Highway Traffic Safety Administration
NOAA	National Oceanic Atmospheric Agency
NO _x	Nitrogen oxide gases
O ₃	Ozone
OE&PHP	Wellness Office of Emergency and Public Health Preparedness
OFHS	Ohio Falls Hydroelectric Station
OLL	Outer Loop Landfill
PAN	Peroxyacylnitrates
Partners	The three entities of the PGC: LMG, UofL and JCPS
Partnership	Partnership for a Green City
PAYD	Pay As You Drive
PFC	Perfluorocarbons
PGC	Partnership for a Green City
PPM	Parts per million
PSC	Kentucky Public Service Commission
PV	Photovoltaic
RadNet	Radiation Network
RECO	Residential Energy Conservation Ordinance
SAFETEA-LU	Safe, Accountable, Flexible, Efficient, Transportation Equity Act: A Legacy for Users
SF ₆	Sulfur Hexafluoride
SRI	Solar Reflectance Index
TARC	Transit Authority of River City
TOD	Transit Oriented Development
Trinity	Trinity Consultants
UFORE	Urban Forest Effect Model
UofL	University of Louisville
UPS	United Parcel Service, Inc.
USD	Urban Service District
USDA	United States Department of Agriculture
VMT	Vehicle Miles Traveled
VOC	Volatile organic compound
VTPI	Victoria Transport Policy Institute
WeCare	Weatherization, Conservation Advice and Recycling Energy
WHO	World Health Organization
WIN	Waterway Improvements Now

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APPENDIX B - Climate Change Committee Subcommittee List of Participants

GHG Inventory and Mechanisms Subcommittee

Cynthia Lee, Chair – APCD
Michelle Stites – APCD
Craig Butler – APCD
Shane Corbin – APCD
Russ Barnett – UofL/PGC Steering Committee
David Wicks – JCPS/PGC Steering Committee
Brent Fryrear – Director, PGC
Bob Slattery – LRAA
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council
Sarah Scheetz – E.ON U.S.
Chantel Gifford – Cemex
Shannon Graves – Cemex
Kevin Spangler – Oxy Vinyls, LP
James McDonald – URS Corporation
Gil Alexander – MACTEC
Farrah Thervil – DuPont Fluoroproducts
Heidi McKenzie – Ford Motor Company
Blake Burchell – E.I. du Pont de Nemours & Company, Inc.
John Gant – Carbide Industries LLC
Reggie Van Stockum – Citizen
Art Williams – Citizen

Energy Efficiency and Renewable Energy Subcommittee

Michelle Stites, Chair – APCD
Cynthia Lee – APCD
Craig Butler – APCD
Shane Corbin – APCD
Cass Harris – LMG/PGC Steering Committee
John Ackerman – LMG
Matt Maskey – LMG
Robert Kirchdorfer – LMG
Kevin Slaughter – MSD
Geoffrey Hobin – TARC
Mike Mulheirn – JCPS
Russ Barnett – UofL/PGC Steering Committee
Brent Fryrear – Director, PGC
Elvin Serrano – PGC
Mark Issacs – Legacy Development
George Perkins – Louisville Peak Oil Group
Wallace McMullen – Sierra Club
Kevin Spangler – Oxy Vinyls, LP
Tim Darst – Buchenberger, Darst & Eggers
Greg Brotzge – Louisville Chemistry Partnership, Inc.
Art Williams – Citizen
Chris Cieminski – Louisville Energy Alliance
Paul Brooks – Citizen
Richard Meisenhelder – KPPC
Kelly Doyle – The Energy Pros
Greg Guess – Citizen
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council

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Land Use, Transportation, and Urban Forestry Subcommittee

Tony Arnold, Co-chair – UofL
Margaret Carreiro, Co-chair – UofL
Shane Corbin – APCD
Craig Butler – APCD
Chris French – LMG
John Hamilton – LMG
Susan Hamilton – LMG
Steve Sizemore – LMG
John Ackerman – LMG
Bob Slattery – LRAA
Geoffrey Hobin – TARC
Mike Mulheirn – JCPS
Clara Leuthart – UofL
Lauren Heberle – UofL
Wei Song – UofL
Isabella Christensen – UofL
Brent Fryrear – Director, PGC
Chester Hicks – REACH of Louisville, Inc.
Janice Weber – Coalition for the Advancement of Regional Transportation
Mohammad Nouri – HNTB Corporation
Cathy Franck – Citizen
Jason Greenberg – Sullivan University
Art Williams – Citizen
Charles Cash – Metro

Education and Outreach Subcommittee

Rachel Connolly, Chair – UofL/Planetarium
Shane Corbin – APCD
Cynthia Lee – APCD
Michelle Stites – APCD
Ann Wethington – LMG
Marcelle Gianelloni – Louisville Zoo
John Walczak – Louisville Zoo
David Wicks – JCPS/PGC Steering Committee
Angela Page – JCPS
Beth Inman - JCPS
Hawk L. Hart-Suk – JCPS
Al Dittmer – UofL/PGC Steering Committee
Teddie Phillipson Mower – UofL
Rodger Payne – UofL
Keith Mountain – UofL
Brent Fryrear – Director, PGC
Michael O’Toole – St. X
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council
Portia Brown – Kentucky Association for Environmental Education (KAEE)
Elizabeth Robb – KAEE
Joan Lindop – Sierra Club
Jennifer Oladipo – Citizen
Art Williams – Citizen
Debbie Goldstein – Citizen
Emily Goldstein – Citizen

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Utility Regulations, Policies, and Practices Subcommittee

Rick Lovekamp, Chair – E.ON U.S.
Michelle Stites – APCD
Shane Corbin – APCD
Cynthia Lee – APCD
Rodger Payne – UofL
Brent Fryrear – Director, PGC
Bob Ehrler – E.ON U.S.
Tom FitzGerald – Kentucky Resources Council
Liz Edmundson – Kentucky Resources Council
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council
Wallace McMullen – Sierra Club
Gil Alexander – MACTEC. Inc
Todd Royer – URS Corporation
Art Williams – Citizen
Paul Brooks – Citizen
Greg Guess – Citizen
Sarah Scheetz – E.ON U.S.

Local Impacts Subcommittee

Judy Nielsen, Co-chair – LMG
Bill Wetter, Co-chair – LMG
Shane Corbin – APCD
Doug Hamilton – LMG
Jim McKinney – LMG
Vince Guenthner – LWC
Lori Rafferty – MSD
Russ Barnett – UofL/PGC Steering Committee
Robert Jacobs – UofL
Keith Mountain – UofL
Brent Fryrear – Director, PGC
Peter Cinotto – USGS
Craig Dauphinee – Carbide Industries, LLC
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council
George Perkins – Louisville Peak Oil Group
Cathy Franck – Citizen
Art Williams – Citizen
Allison Smith – Citizen

Waste Subcommittee

Cass Harris, Chair - LMG/PGC Steering Committee
Brent Fryrear – Director, PGC
Keith Hackett – LMG
Kevin Slaughter – MSD
Sarah Lynn Cunningham – Louisville Climate Action Network/Kentucky Resources Council
Marie Burnett – Waste Management, Inc.
Pat Stallard – Stites and Harbison, PLLC.
Paul Brooks – Citizen

APPENDIX C - GHG Inventory Data Providers

John Ackerman – LMG
Craig Butler – APCD
Jeffrey Dean – UofL
Pete Flood – LMG
Geoffrey Hobin – TARC
James Mok – LWC
Ike Pinkston – JCPS
Sarah Scheetz – E.ON U.S.
Bob Slattery – LRAA
Kevin Slaughter – MSD
Kevin Stoltz – JCPS
Ben Tipton – LMG
Tim Tyree – LMG

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APPENDIX D - List of Recommendations

Recommendations from the report	Responsible Agency	E&O Theme	Audience Focus
Implementation Recommendations			
1: PGC should adopt this Report as its guidance and its Partners should use it to prepare Climate Action Plans (CAP) for their organizations. These plans should include funding resources, implementation timelines and metrics to monitor the progress of initiatives towards achieving their emissions reduction goals.			
2: PGC should have a joint event to present this Report to the public.			
3: PGC should ask the full committee to meet quarterly to track goals, make recommendations, and reconvene working groups as new information becomes available.			
4: PGC entities should each have public stakeholder processes established as they develop their action plans based on the Climate Change Committee's recommendations.			
5: PGC should evaluate the economic impact of business-as-usual practices versus implementing the actions in their CAPs.			
6: PGC should tie all of the recommendations to outreach and education themes.			
7: PGC should provide an annual climate change progress report to the public.			
Greenhouse Gas Emissions Inventory Recommendations			
8: PGC should conduct GHG inventories biannually through 2014 and then reevaluate frequency by monitoring the impact of data and methodology changes from existing or pending programs or legislation.			
9: If new tools and methodologies or more accurate data sources are identified, subsequent inventory efforts should incorporate these developments as needed and applied retroactively to prior inventories as necessary to make consistent year to year comparisons. For instance, if data from the Federal Energy Regulatory Commission (FERC) forms are refined or a more accurate source of data is identified this could improve the residential, industrial and commercial sector data. Another example of an improved tool for the transportation sector is EPA's Motor Vehicle Emission Simulator (MOVES).			
10: LMG should maintain its ICLEI membership in order to receive support, guidance and recognition for its efforts to reduce GHG emissions.			

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11: LMG should investigate participation in The Climate Registry and evaluate how that may assist in future GHG reductions.			
12: PGC entities should evaluate opportunities as programs are developed to document GHG reductions as a monetized funding source for future initiative implementation.			
13: PGC should create a repository for future GHG emissions data submissions.			
14: PGC should identify and implement criteria for what additional sources should be quantified in future inventories (data availability, feasibility and quantity of emissions reductions).			
15: PGC should work with members of the industrial sector to develop a plan to further refine the Sector information in the community inventory.			
16: PGC should seek refined GHG emissions projections using sector specific factors in addition to population growth.			
17: PGC should encourage local companies to calculate their GHG emissions reductions.			
18: PGC should quantify fuel usage (e.g., propane, wood) in addition to natural gas.			
19: PGC should encourage expansion of demand side management and utility energy efficiency programs and quantify related reductions to evaluate program effectiveness.			
20: PGC should coordinate the timing of data collection with reporting agencies for future GHG inventory updates.			
21: PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from marine vessels—port and underway.			
22: PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from railroad equipment—rail yard and hauling.			
23: PGC should evaluate emissions and available data sources to determine levels (de minimis?) of emissions from refrigerant usage.			
24: The Partners should demonstrate leadership by evaluating emissions and available data sources to determine levels (de minimis?) of emissions from refrigerant usage.			
25: The Partners should demonstrate leadership by evaluating emissions and available data sources to identify and quantify Scope 3 emissions where possible and determine levels (de minimis?) of emissions, e.g., from employee/student commutes.			
26: The Partners should include emissions reduction potential in prioritizing future project evaluations.			

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Local Impacts Recommendations			
27: The Partners should collaborate on preparedness planning used to develop and implement adaptive strategies, which at a minimum would include a heat stress action plan that includes targeted interventions for high-risk groups.			
28: The Partnership should collaborate on asthma action plans that monitor changes in asthma incidence, utilize strategies to enhance adaptation to changes in airborne allergen levels, and provide educational messages for both susceptible persons and professional health care providers.			
29: The Partners should support the maintenance of existing strategies for managing air pollution and the implementation of new control strategies as they become available.			
30: The Partners should develop adaptation strategies that ensure persons at risk are identified and that effective intervention programs are available to populations vulnerable to poor air quality.			
31: The Partners should support the maintenance and adaptation of the existing preparedness infrastructure. This offers the best strategy of managing severe weather-related health impacts.			
32: The Partners should limit the impact of changes in vector distribution and the introduction of new pest agents through the effective maintenance and minor modification of robust public health programs. Such programs, which include existing disease surveillance and vector control programs, may need modification to assure that emergence of new diseases or vectors can be detected and appropriate programs implemented.			
33: The Partners should promote trade rules and practices that foster sustainable biodiversity.			
34: The Partners should improve education and public awareness about the value of biodiversity.			
35: The Partners should improve park initiatives by the University of Louisville and JCPS campuses and all departments of Louisville Metro Government (such as Brightside and Metro Parks) to encourage native species.			
36: The Partners should work to protect the remaining wetlands in Jefferson County.			
37: The Partners should promote agricultural best management practices that reduce pollution and sediment runoff into aquatic ecosystems.			
38: The Partners should adopt a reduced food miles traveled purchasing policy.			

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39: The Partners should support educational programs, which use research to facilitate the sustainability of the horticultural and agricultural sector.			
40: The Partners should avoid using pesticides known to kill pollinators.			
41: The Partners should avoid using exotic, invasive plant species.			
42: The Partners should promote water conservation practices such as drip irrigation.			
43: The Partners should encourage food producers and gardeners to select plant and livestock species that are more naturally resistant to diseases, pests and climatic variances, including droughts and excessively wet periods.			
44: The Partners should encourage participation with programs that assist farmers in improving the energy efficiency of their operations.			
45: The Partners should promote programs to the general public that connect people with locally produced products.			
46: The Partners should update design standards for stormwater conveyance systems and erosion control structures.			
47: The Partners should continue to encourage property owners to reduce sewer overflows by disconnecting downspouts and sump pumps, redirecting downspouts to encourage infiltration into yards or gardens, and to have private plumbing inspected and repaired if damage is found.			
48: The Partners should encourage water conservation programs and stormwater reuse, such as cisterns and rain barrels, to minimize water demand.			
49: The Partners should continue to encourage "green" construction methods to increase infiltration and thereby reduce water temperatures and increase water quality.			
50: The Partners should expand existing blue line stream buffer to include intermittent blue line streams.			
51: The Partners should evaluate wetland function, restoration and protection efforts.			
52: LMG should adopt a post-construction erosion control ordinance.			
Energy Efficiency and Renewable Energy Recommendations			
53: LMG should require an energy rating disclosure for all energy-consuming buildings in Jefferson County at the time they are placed on the market.			

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<p>54: (Similar to Recommendations 94, 102 and 114) LMG should provide incentives for builders, contractors and building owners to renovate or construct buildings to a green standard. These buildings would include features such as energy efficiency that goes beyond state energy code requirements, sustainable use of water and building materials and/or use of renewable energy resources. Examples of possible incentives include expedited permit processing, waived fees and property tax rebates.</p>			
<p>55: (Similar to Recommendation 95) The Partners should lobby the state legislature in the following areas: (1) stronger energy standards in state building codes, (2) the ability for local governments with local code enforcement capability to go beyond state standards in energy codes, (3) state tax credits for highly energy efficient buildings, (4) tax code adjustments for accelerated depreciation on energy efficient equipment, and (5) the establishment of a fund for local governments to implement energy efficiency projects.</p>			
<p>56: (Similar to Recommendation 106) LMG, working with community resources, should establish a revolving loan program to provide low-cost financing to commercial and residential energy efficiency and renewable energy projects.</p>			
<p>57: LMG should examine its historic buildings preservation framework and work to remove barriers to increasing the energy efficiency of these buildings.</p>			
<p>58: LMG should investigate and work to remove barriers and provide incentives to stimulate greater adoption of combined heat and power systems (CHP). This includes issues of appropriate environmental regulations, utility interconnection policies, utility tariffs and reasonable financial incentives for high performance CHP systems.</p>			
<p>59: LMG should adopt a Residential Energy Conservation Ordinance (RECO) to upgrade the energy efficiency of existing housing stock. This ordinance would establish energy efficiency requirements to be met at the time a home or residential rental property is sold.</p>			
<p>60: (Similar to Recommendation 104) LMG should expand city-sponsored weatherization programs for owner-occupied households that meet established income qualifications to reach a target of at least twice the current number served. Require anyone receiving this assistance to attend an energy education program.</p>			

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<p>61: (Similar to Recommendations 158 and 163) LMG should establish a program aimed at greening the community's business sector. This program would serve as an engagement tool for business involvement and a recognition tool for highlighting best practices implemented locally. Importantly, this program would also serve as a resource center for the business community, making available information on local resources, such as local contractors/energy service providers that are Energy Star® certified or a list of contractors that pick-up spent fluorescent lights, and on technologies and policies that will help them achieve their energy use reduction goals. This subcommittee recommends that the program be built upon the previously established Green Inc. program.</p>			
<p>62: All commercial building operators should be encouraged to investigate and install energy efficient lighting and utilize daylighting where possible.</p>			
<p>63: LMG should engage the industrial sector with an energy efficiency challenge program, similar to the Kilowatt Crackdown program for the commercial sector, and encourage industrial sector participation in Energy Star® programs. This initiative should include outreach and educational opportunities directed toward this sector's needs.</p>			
<p>64: Industrial entities should survey their facilities for waste heat utilization opportunities.</p>			
<p>65: (Similar to Recommendation 99) The Partners should continue to pursue and implement energy savings performance contracts (ESPC). The Partners should highlight their ESPC projects using them as case studies to promote this practice throughout the industrial and commercial sectors.</p>			
<p>66: After performing energy audits (through an ESPC or otherwise), the Partners should implement those measures that result in an immediate positive cash flow.</p>			
<p>67: The Partners should each adopt energy and resource-efficient building standards for all new construction. Consider adoption of a national standard, such as LEED, Green Globes and/or Energy Star®.</p>			
<p>68: The Partners should develop, and make publicly available as examples, policies regarding energy use, including building operations and maintenance, purchasing and employee resource use (this would include turning off lights in offices or facilities that are not in use, personal appliance use, computer policies, etc.).</p>			
<p>69: When purchasing energy-consuming devices, the Partners should specify Energy Star® or an equivalent standard is met when available. If equipment is not rated by this type of standard and the equipment purchase is over \$15,000, a life-cycle cost analysis should be performed.</p>			

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70: The Partners should periodically re-evaluate purchasing lists for new information and more efficient products.			
71: The Partners should give preference in their contracting processes to those contractors with Energy Star® certification.			
72: The Partners should survey their facilities for waste heat utilization opportunities and implement as possible, using these projects as case studies to promote this practice throughout the industrial sector.			
73: The Partners should identify opportunities for water conservation since water treatment and pumping are significant energy uses. A priority should be placed on identifying and correcting higher-profile practices that normalize waste to passers-by, e.g., spray-pool fountains that run from dawn to dusk during summer months even when not in use.			
74: The Louisville Water Company should evaluate its treatment and distribution facilities to maximize operational energy efficiencies and minimize water losses. Similarly, MSD should optimize its collection and treatment facilities to maximize operational energy efficiencies and minimize the conveyance and treatment of clean groundwater and surface runoff.			
75: (Similar to Recommendation 103) Each Partner should have two cool roofs (meaning it has either high solar reflectance or is vegetated) installed by 2010.			
76: The Partners should work to establish a 501(c)(3) to accept and administer funds for the implementation of energy efficiency and renewable energy projects in the community.			
77: The PGC should encourage local organizations, such as the KY Division of Energy Development and Independence – Department of Renewable Energy and Energy Efficiency, KY Chapter of the US Green Building Council, Louisville Home Builder’s Association, Energy Pros, KY Solar Partnership, hardware stores, etc., to periodically provide educational opportunities to both professionals (continuing education credits) and homeowners.			
78: JCPS should expand energy efficiency and renewable energy education through its vocational and construction technology programs.			
79: All schools in Jefferson County, including private and parochial schools, should incorporate energy education materials into their curricula.			
80: JCPS should provide E2 classes through their Lifelong Education program.			
81: The PGC should establish an annual Energy Expo.			

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82: The PGC should revive and expand its “When Not In Use, Turn Off the Juice” program.			
83: Expand Partnership web resources to include energy efficiency and renewable energy information for homeowners, e.g., a clickable house that shows energy-saving opportunities throughout that is customized to Louisville residents. Establish similar web resources for commercial and industrial facilities.			
84: LMG should investigate and work to remove barriers and provide incentives to stimulate greater adoption of solar photovoltaic (PV) systems. This includes issues of zoning, homeowner association restrictions, solar easements, environmental regulations, utility interconnection policies, utility tariffs and reasonable financial incentives for high performance PV systems.			
85: The Partners should track other cities' efforts in utilizing renewable energy, looking specifically for projects that are applicable to Louisville. Specifically, the Partners should engage with those cities in our region (Knoxville, Ann Arbor, Milwaukee, Pittsburgh) that have become United States Department of Energy (DOE) Solar Cities in order to take advantage of experience gained.			
86: (Similar to Recommendation 98) The Partners should commit to purchase or produce 20% of their electricity needs from renewable resources by 2020.			
87: The Partners should evaluate the feasibility of emerging technologies for producing energy using alternative fuels, such as solid waste, process waste or biomass.			
88: The Partners should survey their facilities for opportunities to use solar hot water heating and implement as possible, using these projects as case studies to promote this practice throughout the community.			
89: The Partners should collaborate with the Center for Renewable Energy Research and Environmental Stewardship (established in Kentucky Revised Statutes (KRS) 152.713) "to actively pursue federal research and development resources that are dedicated to renewable energy" and should continue to look for similar opportunities elsewhere.			
90: The Partners should evaluate the feasibility of solar heating for any Partnership swimming pools that are heated.			
Utility Regulations, Policies & Practices Recommendations			
91: LMG should renegotiate the LG&E franchise agreement when it is next up for renewal to incorporate any additional measures deemed necessary to implement the recommendations.			

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92: LMG should work to establish Louisville Metro Carbon Offset Commission.			
93: LMG should implement a System Benefit Fund that will help finance the recommendations in the PGC's Climate Action Plans.			
94: (Similar to Recommendations 54, 102 and 114) LMG should implement a Green Permitting process to incentivize green building. To assist with this process, each approving agency within the city should have a Green Building Professional designated to oversee approval of "green" projects.			
95: (Similar to Recommendation 55) The PGC should encourage the Legislature to pass bills and the PSC to amend regulations so as to: 1) require industrial customers to participate fully in energy efficiency programs, 2) assure that all cost-effective energy efficiency programs and DSM measures be deployed prior to approval of new generating capacity, 3) restore adequate funding to the PSC and 4) require the PSC to work on adoption of rate decoupling.			
96: LG&E and LMG should develop a program to increase the use of renewable distributed generation in the Residential, Commercial, Industrial, and Institutional Sectors.			
97: LG&E should reduce the carbon intensity of its generation portfolio as rapidly as possible, and the PGC should lobby vigorously for legislation which will enable the process.			
98: (Similar to Recommendation 86) By 2020, PGC entities should purchase at least 20% of their electric and gas from renewable resources and explore cost-effective opportunities to invest directly in new larger-scale renewable projects (such as photovoltaic and landfill gas).			
99: (Similar to Recommendation 65) Continue to promote the use of energy-savings performance contracts (ESPC), when appropriate, by businesses, government and non-profit agencies.			
100: Encourage Louisville Metro residents and commercial businesses to sign-up for LG&E's Load Management Program and receive a free programmable thermostat.			
101: The PGC should encourage Louisville Metro residents to participate in the LG&E Energy Efficiency Residential High-Efficiency Lighting program.			
102: (Similar to Recommendations 54, 94 and 114) LMG should encourage all new residential construction to meet Energy Star® standards and upgrade energy code requirements for new commercial buildings.			
103: (Similar to Recommendation 75) LMG should encourage roofs with high Solar Reflectance Indexes (SRI)/ white roofs/ vegetated roofs similar to a Chicago Program already in place.			

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104: (Similar to Recommendation 60) LMG should develop a program (could be patterned after the Clean Energy Corps proposal) to leverage state financing, university support, job creation and training programs as well as attract private investment to spur a community-wide effort to retrofit existing housing stock for efficiency and renewable energy.			
105: LG&E Should provide more current and informative electric meter usage data to customers.			
106: (Similar to Recommendation 56) Offer financing for the purchase of high-efficiency furnaces, heat pumps, air-conditioning systems, replacement windows, insulation, water heaters, appliances and other large energy-using systems.			
107: LG&E should broaden standard residential energy audits to include watts meter testing of major appliances.			
108: PGC and LG&E should develop an education strategy that results in the reduction of electric use in the residential sector.			
109: LG&E should develop an education program providing tools to local residents and business to estimate their greenhouse gas emissions and emission reductions.			
110: PGC and LG&E should develop an education program that highlights the available federal and state tax credits available for implementation of energy efficiency measures.			
111: LG&E should encourage consumer use of “Kill-A-Watt” or other similar products to identify, monitor and control “phantom” electricity usage.			
Land Use Recommendations			
112: LMG should adopt new and use existing land development policies, regulations and incentives that facilitate compact development, transit oriented development and pedestrian-friendly development. Discourage low-density sprawling residential and commercial development on the outer edges of the Louisville Metro area.			
113: LMG should adopt new and use existing land development policies, regulations and incentives that facilitate infill development, effective and efficient use of existing infrastructure, and clean-up, re-use and rehabilitation of already-developed sites.			

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<p>114: (Similar to Recommendations 54, 94 and 102) LMG should require all new development, whether by the private or public sector, to meet minimum standards of energy efficiency for buildings, other structures and infrastructure, while providing incentives, assistance and public education to owners or users of existing development to retrofit their buildings, other structures and/or infrastructure for maximum energy efficiency improvements.</p>			
<p>115: LMG should require all major development plans, projects and permit applications, submitted by the private or public sector, to complete a basic environmental impact assessment that identifies the likely environmental impacts of the proposed plan or project, including net contributions to green house gasses.</p>			
<p>116: LMG should engage in long-range (i.e., 50-year) comprehensive planning for transportation that includes consideration of land use, land development, infrastructure development (including transportation and green infrastructure), emergency preparedness, growth scenarios, economic development, social equity, natural resources, public health, and energy conservation. This planning process should be linked to long-range regional planning with Kentuckiana Regional Planning & Development Agency (KIPDA) and to neighborhood-based planning with Louisville Metro.</p>			
<p>117: The Community should conserve land and natural resources as natural capital. This supports ecosystem services to society and defines a sense of place in our local communities.</p>			
<p>118: The Community should modify land development patterns, design, construction methods and ongoing uses to minimize and mitigate water runoff and to achieve low-impact development standards.</p>			
<p>119: LMG should develop a comprehensive local and regional food system and sustainable agriculture policy.</p>			
<p>120: LMG should develop a regional network of Kentuckiana local governments, KIPDA, and stakeholders throughout the region (including major businesses, major institutions and representative community-based groups) to engage in collaborative problem-solving to address regional issues related to climate change and land development patterns.</p>			
<p>121: LMG should increase and enhance enforcement mechanisms for local land use requirements, restrictions and land development approval conditions sufficient to strongly deter non-compliance, assure those who comply of the fairness of the system, and fully mitigate any harm to the public, community and neighbors from non-compliance. Increase penalties for non-compliance, and improve both governmental and public oversight of compliance with land development laws and regulations.</p>			

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<p>122: PGC and partner entities should develop public education and engagement programs about sustainable and responsible land use, the impacts of our land use practices on our environment (especially climate change), and methods of avoiding, minimizing or mitigating these impacts. Develop specific programs for land developers, the construction industry, other real estate professionals, land use planners, homeowners, businesses, landscape architects, vegetation/food growers, and others. Increase the quantity and quality of public participation in—and thoughtful deliberation about—land use planning, policy and practices</p>			
Transportation Recommendations			
<p>123: LMG and KIPDA should develop a mobility strategy for Louisville. The new strategy will form the foundation of an integrated multi-modal transportation plan focused on mobility for people and freight.</p>			
<p>124: LMG, KIPDA, developers and the public should promote and invest in transit oriented development as a way of planning for more livable, sustainable communities through the integration of transit and development at the regional, community, corridor and neighborhood levels.</p>			
<p>125: PGC should support increased funding for TARC services as well as a transportation strategy that consciously meshes with initiatives for economic development and land use as an integral part of full community planning.</p>			
<p>126: PGC and public should fully support the expansion of services and infrastructure that promote bicycling and walking.</p>			
<p>127: PGC and public should reduce VMT by providing public and private incentives for public transit use and high occupancy vehicle trips.</p>			
<p>128: PGC and local partners should evaluate whether implementing a 4-day, forty-hour workweek will reduce VMT and energy consumption.</p>			
<p>129: PGC and the public should advocate reduced speed limits on state and federal highways to improve fuel efficiency.</p>			
<p>130: LMG and KIPDA should integrate freight transport planning into the metro area transportation plan.</p>			
<p>131: PGC and public should implement practices and policies to reduce unnecessary idling and acquaint partner entity employees and the public with related regulations and APCD recommendations.</p>			
<p>132: PGC should expand their participation level in Green Fleets.</p>			
<p>133: PGC should adopt a high-efficiency vehicle purchasing policy.</p>			

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134: PGC, public, state and federal governments should fully support the most stringent fuel efficiency and GHG reduction measures that either federal or individual states are seeking to implement.			
135: PGC should consider the energy replacement value, GHG emissions per mile/km and the complete life-cycle and upstream emissions impact when using bio-fuels in fleet operations.			
136: PGC should establish clear fleet operating policies including procurement, idling and fuel use guidelines, and should make them publicly available as an example to other fleet operators.			
137: (Similar to Recommendation 150) PGC should encourage measures (including cool roof and green roof installations, tree planting along sidewalks and throughout parking lots and increased use of pervious materials to augment soil water holding capacity) to decrease the urban heat island effect caused by transportation infrastructure.			
138: LMG should seek ways to reduce non-road greenhouse gas emissions by fully supporting regional and national efforts, as well as implementing local measures to restrict GHG emissions.			
139: LMG and KIPDA should develop a network of High Occupancy Vehicle lanes, Bus Only lanes, or “Green Lanes” throughout Jefferson County.			
Urban Forestry Recommendations			
140: LMG should create a new position of Urban Forester to develop plans to reduce the community carbon footprint by using urban trees to offset carbon emissions, to buffer the city from adverse climate change impacts by strategically distributing different kinds of vegetation around the city, and to advise government and private property owners about the selection, installation and maintenance of trees.			
141: LMG should implement more science-based forestry planning at the county scale.			
142: LMG should provide the Urban Forester with resources to acquire information for inclusion in an Annual or Biannual “State of Our Trees” report to the Mayor.			
143: LMG should strengthen the land development code so that developers must address tree protection prior to filing the site development plan so as to reduce the number of trees lost during construction and other related activities.			
144: LMG should establish a tree ordinance that includes strengthening tree canopy maintenance and the mandatory replacement of trees lost.			

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145: LMG should increase recognition of heritage and champion trees in our county and urge that a plan be filed that encourages their preservation.			
146: The Partners should create an Urban Forest website with information to increase public awareness of the value of trees in reducing household and collective city carbon footprints.			
147: The Partners should create programs and incentives for residents to plant trees.			
148: The Partners should encourage the planting of a greater diversity of native trees through education of the public, tree planting agencies and tree nursery owners.			
149: The Partners should work toward achieving the criteria needed for Louisville Metro to become a Tree City USA®.			
150: (Similar to Recommendation 137) The Partners should establish requirements for minimum percent tree cover in locations with high pavement density such as parking lots.			
151: The Partners should encourage removal of non-native bush honeysuckle, which has been proven to greatly reduce the natural regeneration of tree seedlings in wooded areas along highway verges.			
152: The Partners should encourage decreased mowing along our transportation corridors to allow more tree growth in appropriate locations.			
153: The Partners should seek opportunities and locations along highways for planting more native trees.			
Waste Recommendations			
154: The Partners should analyze and monitor waste generation by: 1) performing waste audits (dumpster dives) of respective waste streams to identify opportunities for reduction, reuse and recycling and to provide a model for the community and 2) measuring solid waste streams annually, including materials disposed and materials recycled, and reporting the totals for inclusion in the PGC's Annual Report.			
155: The Partners should review and improve where appropriate internal recycling and reduction programs and expand the programs where possible.			
156: LMG should pursue the expansion of community recycling opportunities by expanding the material waste stream and increasing the number of drop-off locations, and expanding companion recycling education programs.			

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<p>157: LMG’s Waste Management District Board, working with its Advisory Committee, should evaluate the feasibility, benefits, barriers and potential costs of implementing additional mechanisms for increasing community-wide recycling, including, but not limited to, standard service packages, mandatory recycling, prohibiting disposal of various recyclable materials in local landfills (i.e., yard waste ban) and volume based waste disposal system (also known as variable can rate and pay-as-you-throw).</p>			
<p>158: (Similar to Recommendations 61 and 163) LMG should revive the Green Inc. program to promote waste reduction and recycling resources to help local businesses implement or expand waste reduction and recycling programs and to provide recognition for those that do so.</p>			
<p>159: LMG’s Economic Development Department, working with the Waste Management Division, should develop a waste-based economic development initiative.</p>			
<p>160: LMD should work with the privately-owned Outer Loop Landfill, Breaking New Grounds, and any other appropriate entities to explore the possibility of expanding or developing a compost operation that will include food scraps and other compostable materials such as compostable food service ware.</p>			
<p>161: LMG should provide support for Waste Management of KY and its Outer Loop Landfill to fully market methane/landfill gas generated at OLL, and review other closed landfills in Louisville Metro to see if there are opportunities for capture and marketing of methane/landfill gasses.</p>			
<p>162: LMG should identify and coordinate community resources for educating the public about existing and expanded recycling opportunities implemented by LMG and other entities.</p>			
<p>163: (Similar to Recommendations 61 and 158) LMG should promote waste reduction and recycling to community businesses by reviving the Green Inc. outreach program.</p>			
Outreach and Education Recommendations			
<p>164: U of L should formally adopt NOAA's Climate Literacy principles during the April 16th, 2009 Energizing Kentucky conference.</p>			
<p>165: JCPS should align its core curriculum with the NOAA Climate Literacy Framework.</p>			
<p>166: JCPS should develop a collection of field trip experiences that are connected to the core curriculum and NOAA Climate Literacy framework.</p>			

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167: JCPS and U of L should support the development of a curriculum from Dr. Keith Mountain's historic climate data, making it available to Louisville and state students for climate research.			
168: U of L should create a degree track in sustainability.			
169: The Partners should create public exhibits illustrating the volume of one ton of CO ₂ at room temperature and the average human annual impact. A public, traveling display could accompany a "Know Your Carbon Footprint" campaign that will travel through the state.			
170: The Partners offer expertise and a range of professional development programming. As a climate change coalition, they should work together with JCPS to determine the needs and develop a framework of professional development programming and resources that will support educators who are teaching climate change topics in their classroom curriculum.			
171: The Partners should support a website that contains a comprehensive calendar and list of events, programs, interest groups, retail centers and other resources related to sustainability and available locally.			
172: The Partners should develop and populate a community wide "Green Map." This map should identify the locations of events, interest groups, retail centers and other items related to sustainability and available locally.			
173: The Partners should work together to host a sustainability/energy expo for Louisville.			
174: The Partners should work together to host a Climate Change forum for key members of Louisville media outlets (meteorologists, journalists, etc.).			
175: The Partners should work together to host a state Climate Summit in Frankfort for local and state policy-makers.			

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Partnership for a Green City

Louisville

**100-G Jouett Hall
University of Louisville
Louisville, KY 40292
502-852-8854**

www.partnershipforagreencity.org