
# City of Lafayette Energy Sustainability Master Plan

Fall 2009

**Lafayette's Energy Sustainability Advisory Committee, Fall 2009**

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## Executive Summary

Located in the southeast corner of Boulder County, Colorado, the historic mining community of Lafayette houses a residential population of 25,000 and covers a total land area of nine square miles. Over the last one hundred years, the City of Lafayette has gone through a number of transformations, evolving from agricultural farmland, to a coal mining boomtown during the early 1900s, to its present-day status as a residential commuter community.

However, the 21st century presents many challenges for the City of Lafayette. Recent oil and gas price spikes and increasing concerns regarding the impacts of global climate change questions our dependence on fossil fuels. At the same time, Lafayette is faced with an excess of underutilized commercial property along South Boulder Road, traffic congestion, as well as diminishing sales revenue and underfunded social and cultural services. Such challenges create an environment ripe for change. As the City embarks on its next marked transformation, can the City employ forward thinking to meet the energy and climate change challenges while at the same time fostering a diverse and vibrant local economy and cultural growth?

Addressing the global energy and climate challenges is a priority at all levels of government. Nationally, the federal government is instating energy polices, such as increasing vehicle fuel economy standards, and allocating economic stimulus money to green jobs. At the state-level, Colorado is taking a lead in developing clean energy policies and promoting a new energy economy. And, at the city-scale, cities across the country and state, much like Lafayette, are also rising to the challenge of transforming their communities toward a clean energy economy and lifestyle.

Lafayette's location near many state universities and colleges and the National Renewable Energy Laboratory, who are taking leading roles in the renewable energy and sustainable development fields, make it uniquely positioned to thrive through this transition. How else can the City foster this transformation? Could the underused commercial property along South Boulder Road be transformed into green district including mixed use, new urban housing and light industry? What opportunities might arise from regional Smart Grid efforts such as Fort Zed in Fort Collins and Xcel Energy's SmartGridCity in Boulder? These and related questions will need to be addressed by the City Council and other community partners and stakeholders.

As a first step toward meeting the energy challenges of the twenty-first century, the Lafayette City Council created the Energy Sustainability Advisory Committee (LESAC). Charged with providing advisory guidance to the City Council and educating the community, the Committee created an Energy Sustainability Master Plan (herein referred to as The Plan). The Plan provides guidance to the City and its citizens in making smart energy decisions that will save money and energy, strengthen the City's role in the new energy economy, and, at the same time, reduce the community's impact on global climate change.

To develop The Plan, LESAC completed three initial sustainable energy planning processes:

**Conducted an Energy Emissions Inventory:** Energy emission inventories quantify the amount of emissions currently being emitted from the community's use of fossil fuel energy and provide a baseline year to track progress. Inventories inform us of *where we are now.*

**Established Sustainable Energy Goals**: Goals and timeframes are tools used to provide direction as well as motivation. Emission reduction goals inform us of *where we want to be.*

**Assessed Sustainable Energy Actions:** An assessment of potential sustainable energy actions – in relation to Lafayette's energy emissions inventory - weighs the costs and benefits of different actions and leads to a prioritized list of targeted actions. An assessment of actions, and the development of a list of actions to undertake, informs us of *how we're going to get there*.

The Plan, and list of actions to be undertaken, will be revised periodically, based on an update of Lafayette's energy emissions inventory and completion of the fourth step in a sustainable energy program:

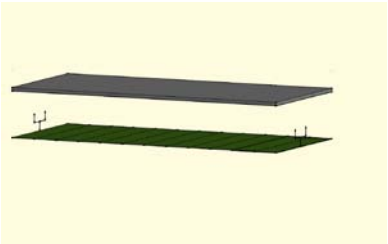
**Monitoring Results:** Performing outcome assessments and assessing updated data informs us of *how well did we do.* This step also helps us identify if goals need to be revised or added.

**Quantifying GHGs**: Greenhouse gas emissions are generally quantified in *metric-tonnes of carbon dioxide equivalent* or $CO_2e$.

The three dominant greenhouse gases—**carbon dioxide, methane, and nitrous oxide**—each have different heat-trapping characteristics. For example, methane is 21 times better at trapping heat than carbon dioxide. The *carbon dioxide equivalent* unit accounts for these differences.

**Visualizing a metric tonne of CO2 equivalent:**

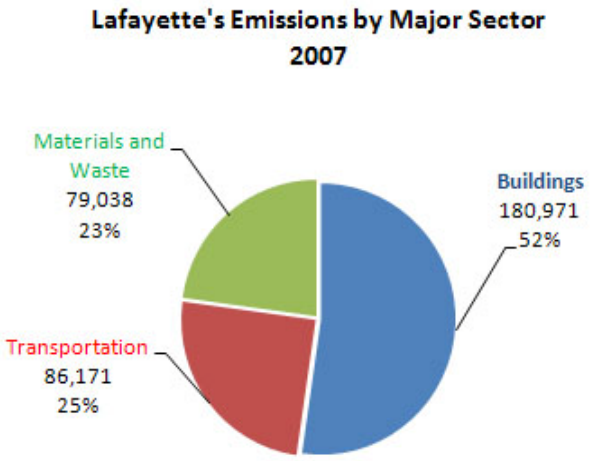
1 metric tonne = 2,200 lbs



One metric tonne of CO2e can be visualized as roughly a four inch layer of gases spanning the area of a standard football field. In 2007, Lafayette emitted 346 mt-CO2e—a volume of gas that is equivalent to a *115* feet layer over a football field.

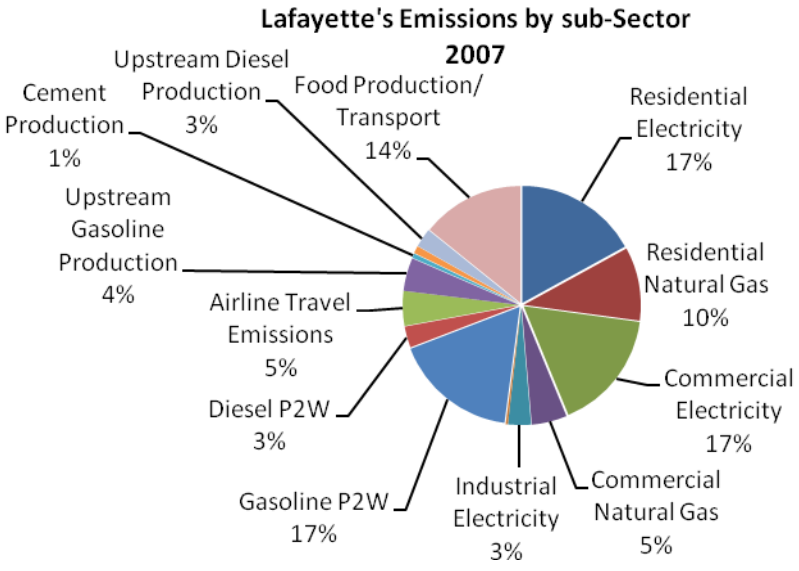
## Lafayette's 2007 Energy Emissions Inventory:

### Figure 1. Breakdown of Lafayette's Greenhouse Gas Emissions by Sector




In 2007, Lafayette's community-wide emissions totaled 346 mt. About 52 percent of Lafayette's emissions are associated with buildings (shown in shades of blue). The transportation sector (shown in red) contributes 25 percent. About 23 percent of Lafayette's emissions (shown in green) are associated with the embodied energy of materials (including fuel production, cement, food and waste) demanded by the citizens of the City.

### Figure 2. Lafayette's Greenhouse Gas Emissions by Energy Source




The greatest source of emissions from the buildings sector is electricity. Residential, commercial, and industrial combined electricity use contributes 37 percent of total emissions.

The greatest source of emissions from the transportation sector is gasoline, contributing 18 percent of total emissions.

**Lafayette's Goals:** LESAC is recommending that the City of Lafayette adopt the State of Colorado's greenhouse gas emission reduction goal of 20 percent below 2005 levels by 2020. This reduction will be measured using Lafayette's 2007 baseline data.

**Lafayette's Potential Sustainable Energy Actions:** LESAC compiled a draft list of energy efficiency and clean energy policies for the four main sectors: residential, commercial, municipal, and transportation as well as four sub-sectors: education, economic development, land use, and cooperation with other energy programs.

In the short-term, LESAC recommends the City encourages residents and business to participate in existing national, state and regional programs, such as the EPA's Energy Star Program and Boulder County's Residential Energy Action Program (REAP). Over the long-term, LESAC intends to aid the City in developing a culture for sustainable energy by employing urban planning strategies to encourage green economic development; produce a healthy, walkable and bikable community; decrease auto dependency; and enhance the carbon capturing capacity of the environment by promoting healthy trees, grasslands, farmland, and open space.

Below is a sampling of some of the quantifiable actions Lafayette could undertake in the buildings and transportation sectors. Estimated potential energy savings and emission reductions are provided.

**Building Sector:**
Energy and emission reductions in the building sector involve a mix of energy efficiency, energy conservation, as well as renewable and clean energy strategies.

| Program Scenario Examples | Potential Emission Reduction |
|---|---|
| Residential Efficiency: If 20 percent of Lafayette's households participated in the Insulate Colorado Program, 1,200 therms could be saved and each year. | 0.7 percent |
| Residential Efficiency: If 20 percent of Lafayette's households replaced two existing incandescent light bulbs with CFLs, 120,000 kWhs could be saved each year | 0.05 percent |
| Residential Clean Energy: Currently, 3.7 percent of Lafayette's residential electricity purchases are from WindSource. If residents purchased 50 percent more kWhs of WindSource, Lafayette's contribution to clean energy could increase by 3 million kWhs. | 1.4 percent |
| Commercial Efficiency: If Lafayette maximized its portion of Xcel's Demand Side Management Program, 760,000 kWhs and 20,000 therms could be saved. | 0.4 percent |
| | |
| **Initial Tally:** | 2.5 percent |

**Transportation Sector:**
Reductions in the transportation sector involves a mix of strategies to reduce fuel consumption through improved vehicle fuel economy, increased public transit ridership and using clean fuel sources.

| Program Scenario Examples | Potential Emission Reduction |
|---|---|
| *Fuel Efficiency: If over the next five years, the overall average fuel economy of vehicles increased to 25 mpg, (currently 20 mpg), 1.2 million gallons of gasoline could be saved.* | 3.4 percent |

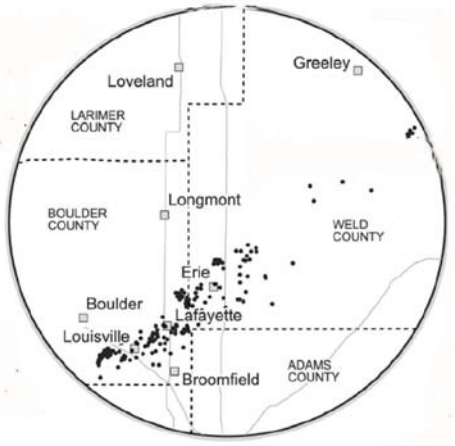
**Next Steps:**
LESAC and the City Council, with input from appropriate City department heads, will establish a comprehensive and prioritized Action Plan. The Action Plan will detail what strategies will be the primary focus of LESAC over a 2-year period, based on available funding, staff time and other city priorities. The Action Plan will include an assessment of outcomes for each implemented strategy.

With a combination of city-level actions as well as individual business and household actions, Lafayette's energy and emission reduction goals can be reached, the City's place in the new energy economy secured, and a sustainable, high quality of life will be reached. Many of the strategies will be implemented at the city-level, such as establishing a green development district and updating the zoning code. Other strategies will require participation from individual businesses and households, such as installing energy efficient lighting and purchasing fuel efficient vehicles. Still other strategies, such as improving the region's public transit system, may require intra-jurisdictional collaboration.

## Introduction

### Lafayette's Energy Heritage

Similar to the history of many Western towns, Lafayette originally developed as a supply town for the surrounding mining industry. In 1880, the thickest deposit of coal in the area was found under the farm owned by Mary Miller. The discovery of coal on the Miller farm led to the opening of the Simpson mine in 1887 and, within less than a year, the nearby Cannon coal mine also opened. The Boulder-Weld County coal boom had begun!




The Boulder-Weld County coal field runs diagonally across the region. Between 1860 and 1970, 163 coal mines operated in the area. (Source: Lafayette Coal Mining Brochure)

The region's burgeoning coal mines brought the railroad as well as a diversity of laborers to the area. Mary Miller, finding her farm transformed into a mining operation, platted 150 acres of her farm for the development of a town. Houses, a hotel, a general store and other businesses tailored to serve the mining industry quickly sprung-up, and, on October 7, 1889, Lafayette formally became a town.

Railroad spur lines were built to Lafayette to transport the coal from Lafayette's mines to regional markets in Denver and Boulder.

Coal continued to be a central part of Lafayette's economy for the next forty years. The Simpson Mine was active until 1927, and other mines immediately adjacent to Lafayette operated until the 1950s. The Black Diamond Mine—northwest of the current corner of US 287 and Baseline—was the last to produce in the immediate area.

In addition to supplying coal to the region, Lafayette's coal supply also played an early role in electricity generation. In 1907 the Waneka Lake power plant was built, providing electrical power to the Denver and Interurban Railroad. Although most of the electricity was allocated to the railroad, a portion of the electricity was used to power electric lights in the surrounding towns—some of the first towns in Colorado to have electricity. The larger Valmont power plant, east of Boulder, was built in 1924 and became the region's primary source of electricity. The Waneka Lake generating station transitioned to a sub-station and was eventually closed in 1957.

The Waneka Lake power plant was built in 1907 and supplied electricity to the Denver and Interurban Railroad.

By the 1950s the coal industry had wound down in the area. Improved mining technology coupled with the expansion of the railroad network, allowed higher quality and cheaper coal from Wyoming to be easily imported to

Colorado's Front Range. Other forms of energy were also becoming available in the 1950s, such as natural gas, which could be used for heating homes.

The region's natural resources continue to play a role in the energy market. In the 1970s, the Wallenberg natural gas field was discovered. The Wallenberg field, Colorado's second largest natural gas field, covers the counties of Adams, Boulder, Broomfield, and Larimer. However, the natural gas market does not dominate the region's economy the same way coal industry did at one time.

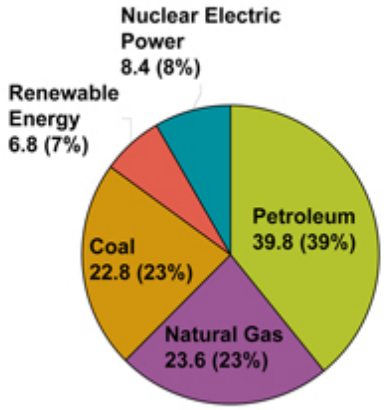
Once the coal industry shuttered, Lafayette transitioned to a predominately residential community. Since the 1970s, Lafayette's population has grown from 3,400 to today's 25,000. Lafayette is situated just twenty-five miles north of Denver and ten miles east of Boulder. Lafayette's proximity to the regional markets, a characteristic that at one time had made the town an ideal location for the early coal mining industry, now makes it an ideal place to live.

For the last two decades, the City of Lafayette has sought opportunities to diversify the local economy. Lafayette has attracted a number of large businesses, including the Exemplar-Kaiser Medical Complex—the City's largest employer. Alongside its central location and expanding local economy, Lafayette boosts a number of amenities that contribute to a high quality of life for its residents, including an extensive public park and trail system and a quintessential historic main street.

## The Current Energy Market

The 21st century energy market is much more diverse and complex than it was in the early 1900s. In the 1900s, coal was the dominant energy source; coal was used to heat homes, produce electricity, and fuel the railroads—the main form of transportation at the time. Today, the residents and businesses of Lafayette have the use of a variety of energy forms: electricity for appliances, lighting, and cooling; natural gas for heating; and gasoline and diesel for transport. Renewable energy sources are also available. Some residents have chosen to install solar energy technologies at their residences, purchase wind energy from Xcel Energy, or convert their vehicles to alternative fuels. However, for the most part, the community continues to depend on fossil fuels—coal, natural gas, and petroleum—for the majority of its energy.

**Primary Energy Use by Source, 2007, Quadrillion Btu and Percent**




Source: Energy Information Administration, *Annual Energy Review 2007*

## Climate Change

When fossil fuels are burned, carbon dioxide is released into the atmosphere. In pre-industrial times (pre-1780) the Earth's atmosphere was composed of about 280 particles per million (ppm) of carbon dioxide. In 2009, the Earth's atmosphere averaged 387 ppm of carbon

dioxide, according to a National Oceanic and Atmospheric Administration (NOAA) report.[1] Carbon dioxide, along with the other greenhouse gases—mostly nitrous oxide and methane—are heat- trapping gases. As the Earth's atmosphere thickens, greenhouse gases impede the ability of the Earth's radiative heat to escape causing the surface of the Earth to warm and the climate to change. Some scientists predict the Earth's atmosphere can hold a maximum of 420 ppm of carbon dioxide before the impact on the Earth's climate patterns will be irreversible.

Many citizens of Lafayette recognize that climate change is occurring and could, if not addressed, have a substantial detriment to the way of life for Lafayette's current and future residents, including impacts on Colorado's local agricultural production, mountain snow pack, and water supplies.

### Lafayette's Current Sustainable Energy Initiatives

The residents and businesses of Lafayette have already undertaken a number of initiatives to reduce community-wide greenhouse gas emissions. A number of residents have installed renewable energy technologies, such as photovoltaic and solar thermal panels, at their homes. Others have engaged in energy conservation and efficiency by consciously using less electricity, purchasing energy efficient appliances, and upgrading the insulating qualities of their homes. Still others have pursued passive solar design strategies, such as the Nyland Cohousing Community. A number of Lafayette's residents have sought to reduce transportation emissions by purchasing fuel efficient vehicles, hybrids, or commuting to work via public transportation and bicycling.

The City of Lafayette has sought to provide supporting services to those residents and businesses pursuing sustainable actions. Lafayette Public Works Department has contracted with Eco-Cycle to provide a city-wide single-stream recycling program to residents not living in Home Owners Association. To encourage energy efficient building practices, the City of Lafayette's Community Development Department closely monitors national building code standards and adopts the most recent as they are published, with a particular focus on energy efficiency. The City and its residents also agreed to allow public open space to be rented to local farmers to grow fresh food for the community, thereby reducing the greenhouse gas emissions associated with conventional farming practices and the transport of food.

In 2007, the City signed a $1.2 million energy-performance contract with Johnson Controls to perform cost and energy-effective upgrades to municipal buildings and operations. Target city buildings were weatherized and outdated HVAC systems and lighting systems were upgraded. Wastewater treatment plants and recreation centers are known to consume enormous amounts of energy. Focusing on these "big consumers," Lafayette's wastewater treatment plant's methane collection system was refurbished to collect the methane emitted during the anaerobic digestion process. Not only is the City preventing methane, one of the dominant greenhouse gases, from escaping into the atmosphere, but by using the "free" methane to heat the facility's equipment, both energy and money are being conserved. At the Recreation Center both solar electric and solar thermal panels were installed as well as a number of other upgrades. Overall, the project is estimated to reduce annual utility bills by $88,000 and

[1] NOAA. National Oceanic and Atmospheric Administration GHG Trend Report. *www.esrl.noaa.gov/gmd/ccgg/trends*

greenhouse gas emissions by 959 metric tonnes[2]. The success of this project is the result of a collaborative effort amongst City employees, City Council, Johnson Controls, and the Governor's Energy Office.

### Coinciding County, State, and National Efforts

Reducing greenhouse gas emissions has become a priority at all levels of government, including county, state, and national.

As part of Boulder County, Lafayette participates in many of the County's sustainable energy programs and initiatives. In 2005, Boulder County Commissioners adopted Resolution-137 "Adopting a Sustainable Energy Path for Boulder County." Within the resolution, the County pledged to reduce both county operations and countywide greenhouse gas emissions. The County of Boulder offers a number of partnership opportunities such as the Boulder County Resource Conservation Division, Boulder County Transportation Alternative Modes Division, Longs Peak Energy Conservation Program, and Climate Smart.

At the state-level, a number of sustainable energy initiatives have been enacted as well. In 2004, through a voter approved amendment, the State of Colorado enacted a renewable portfolio standard (RPS), requiring all investor-owned utilities to supply 10 percent of their electricity sales from renewable energy sources. In 2007, HB 1281 increased Colorado's RPS; the new mandate now requires renewable electricity generation to be 20 percent of a utility's electric sales by 2020.

States across the country are mandating electic utilities provide a percentage of their electricity from renewable resources.
(States shaded orange adopted RPSs)

In 2007, Colorado's Governor Ritter launched a campaign for a New Energy Economy. To jump-start the process, Governor Ritter re-tooled the state's energy department and developed the Governor's Energy Office, an information clearing house for energy efficiency and clean energy. And, in 2008, the State of Colorado officially committed the state to reducing greenhouse gas emissions by 20 percent by 2020.

As a country, the United States has yet to sign on to the Kyoto Protocol, an international agreement for the world's countries to collectively reduce greenhouse gas emissions. However, over 500 U.S. Cities have signed the U.S. Mayors Climate Protection Pledge thereby agreeing to meet or beat the Kyoto Protocol emission reduction standards of reducing emissions by 7 percent from 1990 levels.

[2] Information from the Governor's Energy Office, Lafayette case study.
http://www.colorado.gov/energy/images/uploads/pdfs/1324b58554f53087f85be25a237b92c6.pdf

## Development of the Lafayette Energy Sustainability Master Plan

### Purpose of the Energy Sustainability Master Plan

As Lafayette continues to move forward on the path toward a more sustainable energy future, The Plan will act as the community's roadmap. To be viewed as a "living document," the Energy Sustainability Plan will track the community's collective progress towards reducing energy demand and transitioning to cleaner energy sources. The Plan also provides background from which more detailed Action Plans will be developed. The initial Action Plan will be for a 2-year period and will include an assessment of the outcomes of each action item.

As noted earlier, today's global energy market is complex. The Plan offers an opportunity to weigh all of the available sustainable energy strategies and develop place-based strategies to reducing Lafayette's emissions. Developing an energy sustainability plan that is tailored to the circumstances of an individual community ensures actions will have the greatest impact possible. For example, a large proportion of Lafayette's citizens commute outside of the community to work. Lafayette may find it beneficial to focus more of its actions on the transportation sector, than other, less commuter oriented cities might.

Overall, the purpose of The Plan is to provide guidance to the City and its citizens in making smart energy decisions that will save money and energy, strengthen the City's role in the new energy economy, and, at the same time, reduce the community's greenhouse gas emissions.

### Overview of the Sustainable Energy Planning Process

To develop The Plan, LESAC completed three initial processes:

**Conducted an Energy Emissions Inventory:** To understand Lafayette's current energy use, LESAC contracted with the University of Colorado Denver's Program on Sustainable Infrastructure to conduct an emissions inventory. The community-wide inventory developed through this program organizes emissions into three main sectors: buildings, transportation, and materials. The inventory also provides baseline data from which to track progress.

**Established Sustainable Energy Goals**: LESAC is recommending the City of Lafayette adopt the State of Colorado's greenhouse gas emission reduction goal of 20 percent below 2005 levels by 2020. This reduction will be measured using Lafayette's 2007 baseline data.

**Assessed Sustainable Energy Actions:** Using the results of the energy emissions inventory, LESAC and City Council will create an Action Plan that details a prioritized list of targeted actions to help the city reach its energy goals. As actions are undertaken, results will be monitored through outcome assessment and data tracking.

The Plan will be revised periodically, and will include an updated energy emissions inventory, an assessment of all items on the 2-year Action Plan, and information related to new legislation, technologies, environmental changes, and public input.

## Lafayette's Community-Wide Greenhouse Gas Inventory

Because we use fossil fuel for almost all human activities – for cooling and heating our buildings, for transportation, and for industrial production - an accounting of CO2 emissions from burning fossil fuel promotes a comprehensive understanding of our fossil energy use community-wide. In addition, such Greenhouse gas accounting is also useful to represent human impact on Earth's carbon cycle.

### Greenhouse Gases (GHGs) Reported

The internationally recognized Greenhouse Gases (GHGs) include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$) and three replacements for chlorofluorocarbons—HFCs , PFCs , and sulphur hexafluoride ($SF_6$)[3]. The first three GHGs are dominant and account for more than 90 percent of GHGs emitted nationally[4]. Carbon dioxide ($CO_2$) is produced primarily from the burning of fossil fuels and is the largest contributor to global warming. Methane ($CH_4$) is produced largely from biodegradable waste decomposition (naturally or in landfills) and from fugitive emission in natural gas pipelines. Nitrous oxide is often emitted from fertilizers, combustion, and wastewater treatment plant effluent. HFC, PFC, and $SF_6$ are often found in vehicle and building air conditioning units and refrigerators and generally contribute trivially.

| Kyoto Protocol/Internationally Recognized Greenhouse Gases | 100-Year Global Warming Potential (GWP) |
|---|---|
| Carbon dioxide ($CO_2$) | **1** |
| Methane ($CH_4$) | **21** |
| Nitrous Oxide ($N_2O$) | **310** |
| HFCs | **Varies: 140-11,700** |
| PFCs | **Varies: 6,500-9,200** |
| Sulphur Hexafluoride ($SF_6$) | **23,900** |
| *The GWPs from the International Panel on Climate Change (IPCC) Second Assessment Report were used in this report as recommended by ICLEI Local Government Operations Protocol 2008, p166. | |

The different GHGs have different one hundred year global warming potentials (ability to trap heat in the atmosphere over time). For example, according to the Intergovernmental Panel of Climate Change's[5] 2nd Assessment Report, methane is twenty-one times better at trapping heat than carbon dioxide and nitrous oxide is 310 times better at trapping heat than carbon dioxide. The GHGs are reported together on a common standardized basis as metric tonnes (mt) of $CO_2e$, called *carbon dioxide equivalents*.

### Lafayette's Baseline Reporting Year: 2007

In 2005, the Boulder County Consortium of Cities Energy Strategy Task Force conducted a countywide greenhouse gas (GHG) inventory. Based on the 2005 Boulder County GHG Inventory, the City of Lafayette generated six percent of the county's emissions (272,813 mt-CO2e).

In 2008, LESAC sought to update and refine Lafayette's community-wide greenhouse gas

[3] United Nations Convention on Climate Change (UNFCCC): Kyoto Protocol. http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php
[4] EPA. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. 2007.
[5] Intergovernmental Panel on Climate Change (IPCC) http://www.ipcc.ch/

inventory. Data was collected for the 2007 baseline year and a more comprehensive methodology is employed to provide greater insight into Lafayette's current sources of emissions.

### GHG Inventory Methodology

The GHG inventory was conducted using the advanced method developed at the University of Colorado Denver's (UCD) Program on Sustainable Infrastructure (2008)[6] (See APPENDIX for details). UCD's methodology advances the World Resource Institute's (WRI)[7] and the Local Governments for Sustainability (ICLEI)[8] greenhouse gas accounting protocols. These protocols are applicable at the city-scale.

Under the WRI's corporate business accounting protocol, greenhouse gas emissions are classified into three scopes:

*Scope 1: Direct Emissions:* Includes the GHG emissions from the combustion of fossil fuels that occurs "in-boundary," such as the natural gas burned to heat of buildings and the fuel emissions from automobile tailpipes.

*Scope 2: Indirect Emissions from Electricity Production:* Electricity emissions are classified as indirect due to the fact that more often than not, the electricity used by residents and business is generated at a power plant that is located outside of city boundaries.

*Scope 3: Other Indirect Emissions:* Includes "out-of-boundary" emissions from the production and transport of materials (also termed upstream emissions) or the emissions associated with waste disposal at a landfill outside of city boundaries

The UCD's city-scale methodology uses the standardized WRI and ICLEI protocols to report emissions from *in-boundary activities*. Using the UCD's advanced methodology *out-of-boundary* activities at the city-scale are also accounted for. The emissions from vehicles commuting outside of city boundaries are allocated using an origin/destination methodology[9]. The emissions from the production of key urban materials demanded by a community – such as the provision of food, water, fuels and shelter (cement) – are also included. Using the out-of-boundary origin/destination methodology for tail-pipe emissions and including the upstream emissions from key urban materials yields a more holistic GHG footprint of a city.

To better communicate a community's overall energy use and GHG emissions, classifying end-use of energy in three different sectors is useful. In this report, we consistently report energy use and GHG emissions in the following three sectors:

[6] Ramaswami,Anu. A Demand-Centered, Hybrid Life-Cycle Methodology for City-Scale Greenhoue Gas Inventories. Environmental Science and Technology. Vol. 42. Issue 17. 2008.

[7] World Resource Institute (WRI). *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*. 2001. http://www.ghgprotocol.org/about-ghgp

[8] **ICLEI - Local Governments for Sustainability** is an international association of local governments as well as national and regional local government organizations that have made a commitment to sustainable development. http://www.iclei.org/index.php?id=iclei-home

[9] UCD's origin/destination methodology uses DRCOG daily surface vehicle mile data to allocate 50% of the emissions to a commuter's residence and 50% of the emissions to a commuter's place of employment, under the premise that both municipalities benefit from the resident living or working in their cities. Furthermore, under this methodology each municipality has the ability to instate policies to impact commuter behavior versus accounting for just "pass-through" traffic, of which a city itself as little control over.

*Buildings:* emissions from the electricity and natural gas used in residential, commercial, and industrial buildings
*Transportation:* tail-pipe emissions from surface vehicle travel and airline travel
*Materials:* Upstream emissions from producing key urban materials (concrete, food, and water) and the emissions from waste disposal.

**Inventory Results:**

In 2007, the City of Lafayette emitted 346,000 metric tonnes of greenhouse gases. This equates to 13.8mt-CO2e per resident. For comparison, Denver emitted 25.2 mt-CO2e in 2005 and the national per capita average in 2005 was 25.3 mt-$CO_2$e.[10] On the other hand, European countries average 15-mt-CO2e.

At the city-scale, comparing per capita greenhouse gas emissions is complicated due to the fact that not all cities are created equal. Some cities are employment or industrial centers, while others like Lafayette, are dominated by the residential sector. While cross-city comparisons provide valuable benchmarks and insight, realistically, it is more important for cities to compare their capita emission rate against themselves over time.

Figure 3 shows Lafayette's community-wide emissions broken down by major sector. The buildings sector contributes roughly half of all of Lafayette's emissions, while the transportation and materials sector each contributed approximately 25 percent of total emissions.

### Figure 3: Lafayette's Greenhouse Gas Emissions by Major Sector

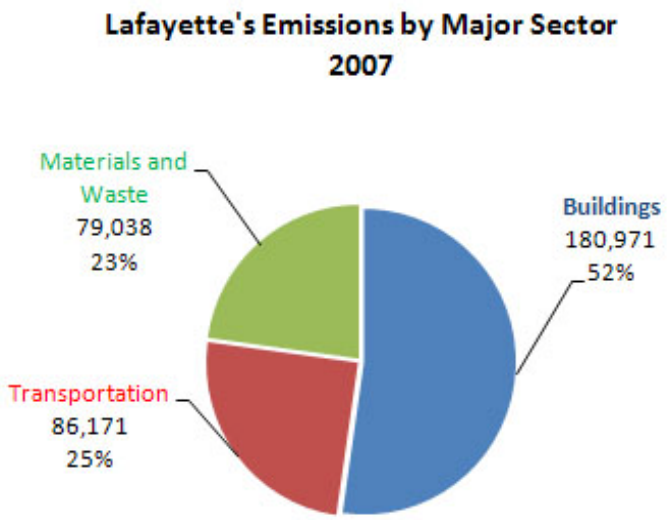
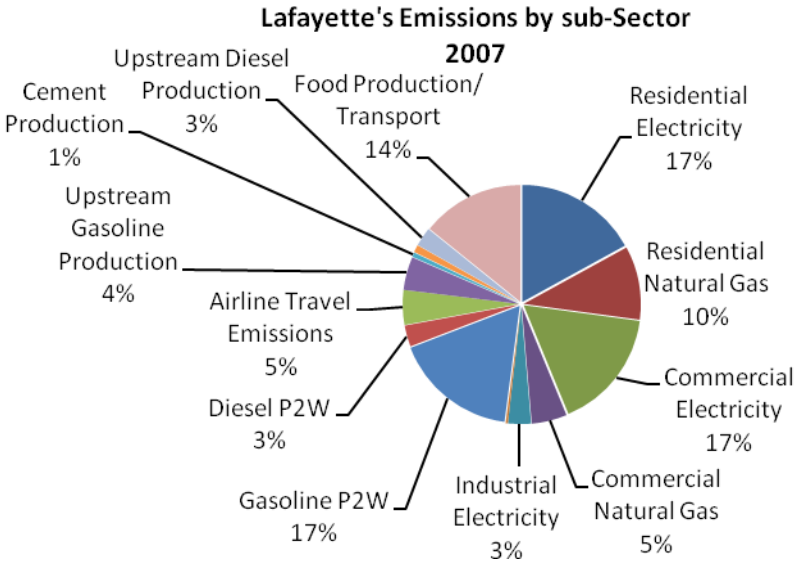



Figure 4 shows Lafayette's emissions by energy source. Electricity emits 37 percent of all emissions, including residential, commercial, and industrial electricity. The second largest source of emissions is the combustion of gasoline fuel, which emits 18 percent of all emissions.

[10] 1. **EPA.** Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. *Table: 1-5.* [Online] 2007. http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

## Figure 4: Lafayette's Greenhouse Gas Emissions by Energy Source




### Buildings Sector Highlights

Energy intensity benchmarks, such as kWh of electricity per square foot, help us compare how efficiently buildings use energy. In 2007, the average Lafayette household consumed 745 kWh per month. For every kWh saved, .75 kg-$CO_2$e (or 1.7 lbs) is avoided[11]. If the average monthly electricity consumption was decreased by 20 percent, to about 600 kWh/per month, one metric tonnes of CO2e could be avoided annually.

#### *Residential Sector Benchmarks*

| Residential Buildings: | Lafayette 2007 | Denver 2005 |
|---|---|---|
| Electricity (kWh/per HH/per mo | 745 | 568 |
| (therm/per sq. ft) | 57 | 63 |

[11]Based on Xcel Energy's 2007 generation mix.

### *Commercial Sector Benchmarks*

| Commercial Buildings: | Lafayette 2007 | CBECS Mountain Census Division 2003 | CBECS National 2003 |
|---|---|---|---|
| Electricity (kWh/sq.ft) | 23 | 15 | 14 |
| (therm/per sq. ft) | 1.08 | 1 | 0.9 |
| (kbtu/per sq. ft. ) | 91 | NA | NA |
| *Commercial Buildings Energy Consumption Survey (CBECS), 2003. (*The 2007 CBECS Report is set to be published for Fall 2009) | | | |

**Electricity and Natural Gas Emission Factors**

Emission factors reflect how clean a region's energy sources are. Utility companies generally produce electricity from a mix of sources. For example, Xcel Energy's electricity is produced from approximately 58 percent coal, 32 percent natural gas, and 10 percent renewable. As a greater percentage of Xcel Energy's electricity is produced from carbon-free sources and clean-coal technologies are introduced, the per kWh emission factor will decrease.

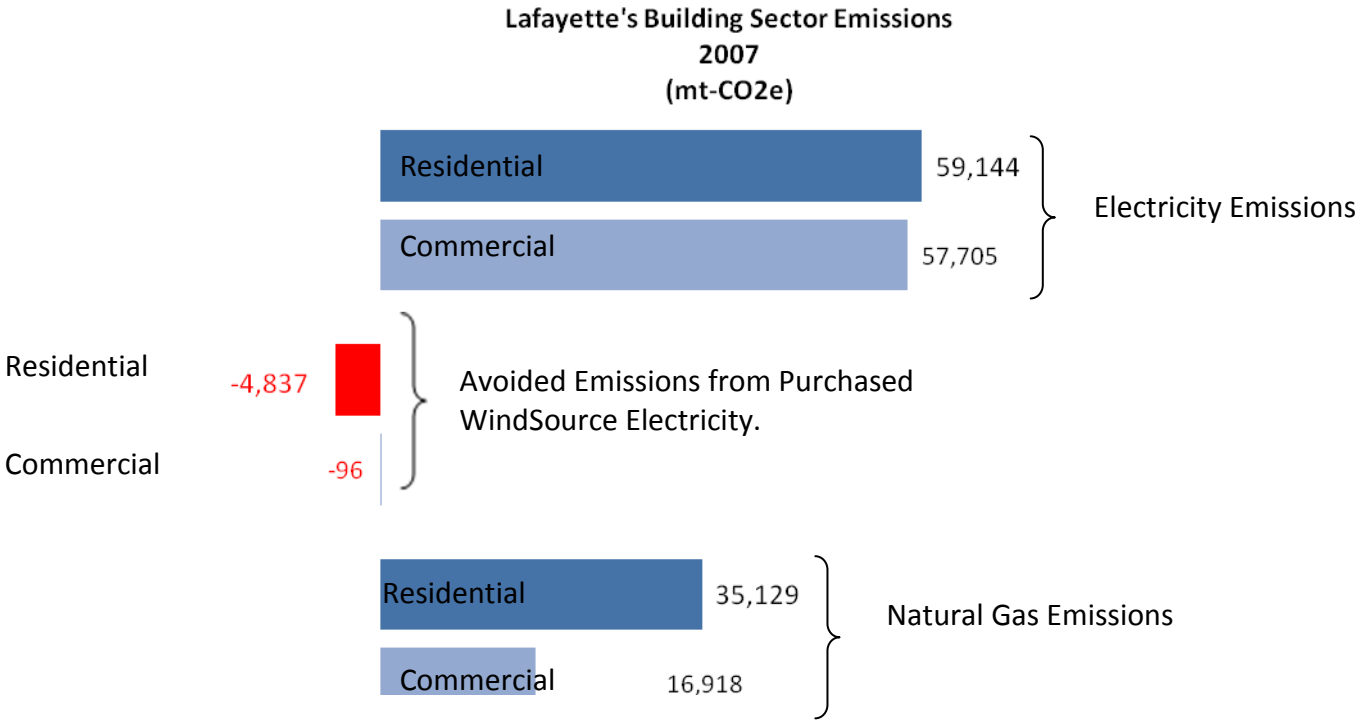
| Emission Factors/Clean Energy Indicators | Xcel Energy 2007 |
|---|---|
| Electricity (kg-CO2e/per kWh) | 0.75 |
| Natural Gas (kg-CO2e/per therm) | 5.4 |

**Building Sector Energy Use Summary**

| A. Residential Energy | 2007 |
|---|---|
| Total Number of Customers | 10,031 |
| Total Grid Electricity Used (MWh) | 78,858 |
| Total WindSource Electricity (MWh) | 6,449 |
| Electricity/household/month (kWh/hh/mo) | 688 |
| Total Natural Gas Used (Dth) | 963,832 |
| Natural Gas/household/month (therms/hh/mo) | 57 |
| **Total Residential GHG emissions ($mtCO_2e$)** | **94,272** |
| **Total Residential Per Capita GHG emissions ($mtCO_2e$ per person)** | **3.8** |
| **B. Commercial-Industrial Energy** | **2007** |
| Total Number of Customers | 1,248 |
| Total Commercial-Industrial Area (sf) | 3,431,859 |

| | |
|---|---|
| Total Electricity Used (MWh) | 93,041 |
| Total WindSource Electricity (MWh) | 128 |
| Total Natural Gas (Dth) | 3,132,970 |
| Total energy use per square foot (kBtu/sf) | 91 |
| **Total commercial–industrial GHG emissions ($mtCO_2e$)** | **74,623** |
| **C. Total Buildings and Facilities GHG Emissions ($mtCO_2e$)** | **180,971** |

Source: Xcel Energy, 2007

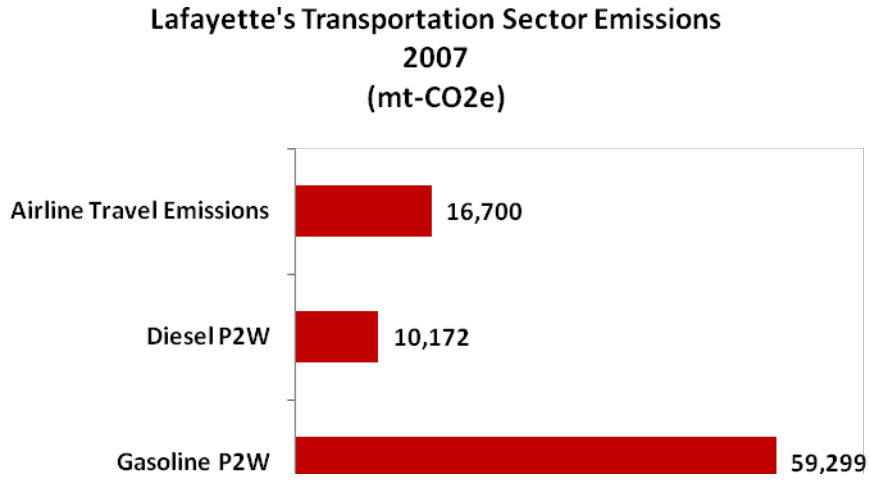


## Transportation Sector Highlights

### Benchmarks

Within the transportation sector, the majority of greenhouse gas emissions are from the burning of gasoline fuel. Based on the Denver Regional Council of Governments (DRCOG) daily vehicle miles traveled (VMT), the average Lafayette resident commutes 16 miles per day in 2007. This equates to the average Lafayette resident consuming 354 gallons of gasoline a year and emitting 3.3 mt-CO2e a year (7200 lbs-CO2e).

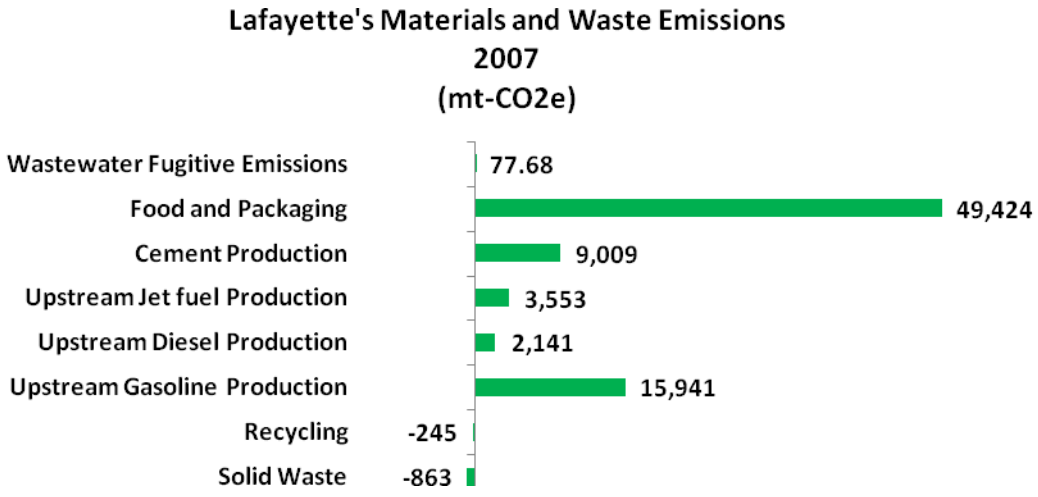
| **A. Personal & Commercial Motor Vehicles** | **2007** |
|---|---|
| *Annual Vehicle Miles Traveled (million VMT)* | 135 |
| VMT/person/day | 16 |
| *Annual Fuel Use* | |
| Gasoline (million gallons) | 6.38 |
| Diesel (million gallons) | 1.07 |
| *Total GHG Emissions* from Personal and Commercial Motor Vehicle Transport ($mtCO_2e$) | 69,471 |
| **B. Airline Travel (allocated to Denver – 22 percent)** | **2007** |
| *Annual Fuel Use* | |
| Jet Fuel (million gallons) | 1,776,600 |
| *Total GHG Emissions* from Airline Travel Allocated to Lafayette ($mtCO_2e$) | 16,700 |
| **C. Total GHG Emissions form Transportation Sector ( $mtCO_2e$)** | **86,171** |



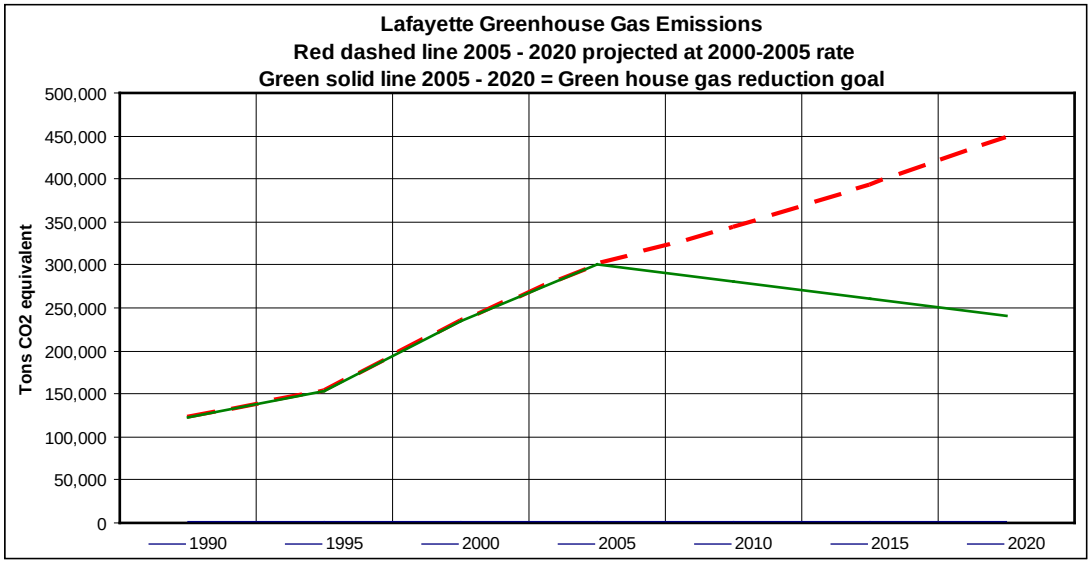

## Materials and Waste Sector Highlights

The materials and waste sector accounts for the upstream emissions of key urban materials. By far, food production and transport contributes the greatest amount of emission in the materials and waste sector followed by the upstream emissions from the production of gasoline. Solid waste this is disposed of in a landfill that properly flares the methane off-gasing receives credit for preventing the methane from entering the atmosphere.

| **A. Key Urban Material** | **Annual Material Flow** | **GHG Emissions ($mtCO_2e$)** |
|---|---|---|
| Fuel (gasoline, diesel, jet fuel) | 6,386, 1,070, and 1,736 thousand gallons of gasoline, diesel and jet fuel | 21,635 |
| Cement in Urban Concrete | 9,009 metric tonnes | 9,009 |
| Food & Packaging | 33 million U.S. $ (household expense) | 49,424 |
| **Total GHG Emissions for Producing Key Urban Materials** | | **80,069** |
| **B. Waste and Recycling** | | |
| Municipal Solid Waste | 157,664 | -863 |
| Recycling | 28,774 | -863 |
| Wastewater Treatment Plant Fugitive Emissions | | 78 |
| **Total GHG Emissions from Materials and Waste Sector** | | **78,420** |




## Figure 5: Lafayette's Greenhouse Gas Emissions Trends




The red dotted line in the graphic represents the business- as- usual model—Lafayette's projected greenhouse gas emissions if no action is taken. Instead of continuing to increase emissions, the goal is to a stabilize greenhouse gas emission growth within the next few years, and then begin to *decrease* emissions (the green line).

## Lafayette's Goals and Objectives

### Greenhouse Gas Reduction Targets

LESAC is recommending the City of Lafayette adopt the State of Colorado's greenhouse gas emission reduction goal of 20 percent below 2005 levels by 2020. This reduction will be measured using Lafayette's 2007 baseline data.

The City of Lafayette has established six overarching objectives in its Sustainable Energy Plan:

1. Reduce greenhouse gas emissions
2. Promote energy conservation
3. Promote clean renewable energy generation
4. Encourage economic development through local energy jobs
5. Reduce energy costs through reduced energy consumption
6. Develop and support sustainable energy education

## Initial Assessment of Sustainable Energy Actions

Below are initial recommendations, organized into eight sections, beginning with the four main sectors. As more detailed and comprehensive energy action assessments are developed, the most effective and appropriate actions will be compiled, prioritized and updated in a future LESAC Action Plan. These strategies are not meant to be exhaustive or limiting but rather represent those strategies currently known to LESAC and thought to be feasible and to have significant benefits. In addition, not all of these strategies will be included in every 2-year Action Plan that LESAC and the City Council develop. Instead, only those strategies identified by LESAC, City Council, and with input from appropriate City department heads, as being appropriate for further analysis and potential implementation based on available funding, staff time and other city priorities during a specific 2-year timeframe will be on an Action Plan.

### 1. Residential Sector

***Objective**:* Promote, support, and enable increased energy efficiency and renewable energy systems in residential buildings to achieve Lafayette's greenhouse gas reduction target.

***Key Indicator***: kwh/therm per household per month; kWhs of WindSource

***Potential Strategies**:*

*Energy Efficiency and Conservation*

- **Energy Star New Home Program**: Encourage new residential construction projects to build beyond the minimum buildings standards by voluntarily participating in the Energy Star Qualified New Home Program. (Generally, Energy Star Qualified New Homes are at least 15 percent more energy efficient than buildings built to the 2004 International Residential Code.
- **Residential Energy Action Program (REAP):** Encourage households to partake in The Center Resource Conservation's REAP program, which offers

all Boulder County residents subsidized home energy audits in coordination with Xcel Energy and GEO support.

- **Insulate Colorado Program:** Encourage residents to partake in the Insulate Colorado Program which offers a 20 percent rebate on the cost of upgrading insulation, up to $300.
- **Energy Sweep Programs** which provide education to homeowners on ways to be more energy efficient, as well as distribute and installs low cost items such as carbon fluorescent light bulbs, low flow showerheads, clothes drying racks, and referrals for subsidized insulation services
- **Energy Star Appliances and Computers**: Encourage and provide educational materials on purchasing Energy Star certified household appliances and electronics
- Identify best practices from other communities that encourage more energy efficient and sustainably built homes.
- Monitor the success of Boulder's smart-grid system and research the potential of a smart-grid system in Lafayette.
- Encourage and support the development of net zero energy homes.

*Clean Energy*

- **WindSource**: Encourage Lafayette's residents to voluntarily purchase cleaner electricity by participating in Xcel Energy's *Windsource*® Program
- **Solar Hot Water Systems**: Encourage Lafayette's residents to take advantage of the rebates on solar hot water systems from The Center for Resource Conservation
- **SolarRewards**: Encourage residents to partake in Xcel Energy's solar rewards program for installation of photovoltaic solar panel systems.

## 2. Commercial Sector

***Objective**:* Promote, support, and enable increased energy efficiency and use of renewable energy generation in commercial and industrial buildings to achieve Lafayette's greenhouse gas reduction target.

***Key Indicator***: average kWh/therm /kbtu per sq. ft

***Potential Strategies**:*

*Energy Efficiency and Conservation*

- **Xcel Energy DMS Program:** Encourage commercial residents to participate in Xcel Energy's Demand Side Management Program, such as their Commercial Energy Assessments.
- Encourage United States Green Building Council (USGBC) *Leadership in Energy and Environmental Design* (*LEED*) Certification for New Construction
- Develop a Green Business Advisory sub-Committee within LESAC

*Clean Energy Technologies*

- **WindSource:** Encourage commercial businesses to participate in Xcel Energy's *Windsource*® Program

## 3. Municipal Sector:

***Objective**:* Increase energy efficiency and use of renewable energy in Lafayette City buildings and operations to achieve Lafayette's greenhouse gas reduction target.

***Key Indicators:*** Emissions per citizen and employee; average miles per gallon of each department fleet.

***Potential Strategies***

- Establish a municipal utility or Co-op to pursue the generation, aggregation, management, and resale of non-traditional energy sources.
- Encourage LEED standards for new construction and renovations.
- Establish energy reduction goals for each City building and facility.
- Encourage the City to purchase Energy Star computers and office equipment
- Establish an average fuel efficiency goal for each City department's vehicle fleet.

## 4. Transportation Sector

***Objective**:* Reduce transportation energy consumption through a combination of increased vehicle mileage, reduced mileage traveled, increased transportation system efficiency and increased use of mass transit and non-polluting transportation options to achieve Lafayette's greenhouse gas reduction target.

***Key Indicators**:* Average daily commute distance; vehicle miles per gallon; percent of population driving alone.

***Potential Strategies**:*

*Encourage Mode-Shifts and Reduce Vehicle Miles Traveled*

- Encourage use of public transportation by encouraging Lafayette's major employers to participate in the Regional Transportation District's eco-pass program and Boulder's transit programs, and making bus stops more user friendly.
- Enable and encourage biking by adding and extending bike paths, increasing bike path connections, and by improving bicycle safety and usability of city streets.
- Encourage Lafayette's youth to use alternative modes of transportation, including programs through the high school level.
- Encourage car-pooling.
- Explore feasibility of installing electric recharging services and bio-fuel stations.

*Improve Vehicle Fuel Economy*

- Hybrid Rebates & Plug-In Hybrid Rebates: Encourage residents and businesses to purchase fuel-efficient vehicles.
- Provide education on ways to enhance the efficiency of vehicles, such as sufficient tire pressure and clean air filters.

*Promote Cleaner Transportation Fuels*

- Seek strategies to improve access to clean fuels, such as natural gas.

***Complimentary Strategy Types that Impact All Four Sectors:***
*The following strategy types can have synergistic impacts of reducing emissions from all four of the previously identified sectors. The strategy types described below are: education; economic development; land use; and cooperation with other energy programs. Underlying the varied strategies is the need to interweave energy efficiency and clean energy into our daily lives and business models.*

## 5. Education

***Objective**:* Facilitate sustainable energy education, discussion, and outreach to Lafayette citizens, schools, and businesses

***Potential Strategies**:*

- Continue energy efficiency education and outreach efforts directed at residential, commercial, and municipal energy use.
- Promote sustainable energy education and action in Lafayette city operations, and in schools, homes, and businesses.
- Develop the sustainable energy education center in library.
- Encourage citizen involvement in Energy Smart and other suitable programs.
- Maintain a LESAC web page to provide information about energy efficiency and alternative energy programs for both the residential and commercial sectors.

## 6. Economic Development

***Objectives**:* Lafayette has a substantial number of buildings that are ripe for redevelopment and could potentially be ideal for a mixed-use redevelopment project, perhaps particularly for a green technology company that seeks to enhance its "green" image by reusing existing space to allow employees to easily walk to lunch on Public Road and other amenities.

***Potential Strategies**:*

- Explore development of low-carbon, renewable, and non-traditional energy generation to stimulate economic development and job creation.
- Support green development that promotes local economic growth through clean energy jobs and that demonstrates energy sustainability living and learning solutions on varying scales.
- Be active in regional and national programs and projects that showcase the clean energy economy and lifestyles

## 7. Land Use

***Objectives**:* Use urban planning to produce a more walkable community, better bicycle access, and less car dependency. Improve the carbon capturing capacity of the environment by promoting healthy trees, grasslands, farmland, and open space.

***Potential Strategies**:*

- Make recommendations to City Council on ways to review and amend zoning regulations to meet this objective.
- Collaborate with city planners and committees to identify ways to increase the carbon capturing capacity of the environment.

## 8. Cooperation and Collaboration with Other Energy Programs

***Objective**:* Coordinate with government and non-government energy programs that affect Lafayette and develop financial incentives for energy sustainability.

***Potential Strategies***:

- Continue involvement in the Boulder County Consortium of Cities Energy Strategy Task Force.
- Take full advantage of energy and funding resources of regional, state, national energy efficiency and renewable energy programs.
- Investigate new financial incentive programs to consider for Lafayette.
- Be supportive of the City's Waste Reduction Advisory Committee's projects such as single-stream recycling and zero-waste events.

## City-Scale Sustainable Energy Futures Strategies: A Mix of Strategies

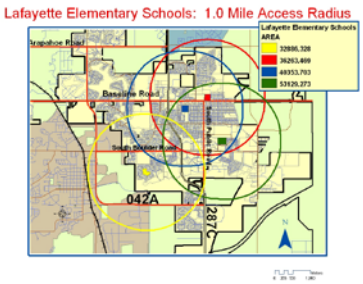
**Directly address the energy challenge:** reduce energy use and increase clean energy options for the residential, commercial, and municipal sectors.

**Energy Efficiency and Conservation**

**Clean Energy**

**Indirectly address the energy challenge:** Create a "sustainable" culture within the residential and business community**.**

**Social:**




Policies that create walkable communities and encourage students to walk to bike to school improve the health of Lafayette's residents well as reduce transportation emissions.

**Economic**:

Policies that encourage green development could help attract green industries and aid in diversifying and strengthening Lafayette's local economy.

**Environment:**

Open space and farmland not only provide space for the community to recreate and opportunities for local food production, but also act as carbon-sinks by absorbing atmospheric carbon.

## Appendix:

### Greenhouse Gas Inventory Method and Scopes:

The GHG inventory is conducted using the advanced method developed by Ramaswami et al (2008). The method uses the standardized ICLEI protocol to report GHG emissions from in-boundary activities. Out-of-boundary activities critical for a community – such as the provision of food, water, fuels and shelter – are added on to the in-boundary activities to yield a more holistic GHG footprint. The inclusion of additional out-of-boundary (WRI Scope 3) activities is highly recommended by EPA's Climate Leaders Program. The Ramaswami et al (2008) inventory-footprint method for GHG accounting was first pioneered by UCD with the City of Denver, and since by other cities such as Portland, OR, Seattle, WA, Arvada, CO, Austin, TX, Minneapolis, MN. This is the first application of the methodology to a small destination resort town such as Central City.

***In-boundary* activities** include the following energy uses and are required to be reported by all cities as per ICLEI and WRI guidelines.

- BUILDINGS ENERGY USE – Use of electricity, natural gas, and steam in residential, commercial and industrial sectors in a community
- TRANSPORT OPERATIONS ENERGY USE – Includes tailpipe emissions from operating personal and commercial vehicles associated with a community
- EMISSIONS FROM WASTE DISPOSAL: In ICLEI protocol, emissions from waste disposal by residential and commercial sectors are also included in the in-boundary accounting.

Formally, the GHGs emitted directly from burning natural gas in buildings and gasoline/diesel in vehicles are termed Scope 1 emissions by WRI, while CO2e emissions from powerplants to produce electricity used within our community is termed Scope 2 emissions. Scope 1-2 plus Waste emissions are included in the "In-boundary" activities and are required to be reported in a city's GHG inventory as per ICLEI protocols.

***Out-of-boundary* activities** designated by the WRI as Scope 3 are optional, but are highly recommended by the EPA as they can lead to win-win strategies for GHG mitigation. The

following out-of-boundary activities, when added to in-boundary activities, yield a more holistic account of a community's CO2e footprint:

- EMBODIED ENERGY OF CRITICAL URBAN MATERIALS: This includes energy use and associated GHG emissions from producing key urban materials such as water, transport fuels, food, and shelter (cement for concrete), necessary to support life in cities.
- AIRLINE TRAVEL: Energy use for airline travel is important as it appears in national and state-wide GHG inventories and in personal calculators. At the city-scale, these appear as out-of-boundary emissions, particularly when the airport is outside city boundaries (as in the case of Lafayette).

**Energy Use Sectors and Data**: To better communicate a community's overall energy use and GHG emissions, classifying end-use of energy in three different sectors is more useful. In this report, we consistently report energy use and GHG emissions in the following three sectors:

- Buildings Sector – Energy use in residential and commercial buildings and industrial facilities.
- Transport Sector (P2W) – Energy use to operate personal vehicles, commercial trucks and airplanes, termed Pump-to-Wheels (P2W) energy use.
- Materials Sector: Energy Use and associated GHG emission from producing critical urban materials (food, transport fuels, water, cement) and from waste disposal.

For energy (or materials use) in each sector, the following data were gathered:

- Annual Materials of Energy Consumption Data, e.g., total kWh of electricity consumed annually, total water consumed annually, total natural gas use, etc. The annual Material/Energy Flow Analysis tells us how much we consume as a community. By benchmarking these consumption data on a per person or per household or other metrics, we can represent how efficient the community is its consumption patterns.
- GHG Emission Factors: GHG emissions factors tell us how clean our energy or materials are in terms of how much CO2e is emitted per unit of the product consumed. For example, kg CO2e emitted per unit kWh of electricity consumed.

Total emissions are computed as the product of how much is consumed and the GHG emissions per unit of the product consumed.