M E M O R A N D U M

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TO: County Council

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SUBJECT: **OLO Research on Selected Local Government Strategies for Reducing Carbon Emissions**

This memorandum responds to the Council's assignment to research the experiences of other local governments that have adopted selected practices, programs, and policies to address global warming. Specifically, the Council asked OLO to provide research in three areas to complement the package of global warming legislation that the Council introduced on November 20, 2007.

Organization of Research. OLO's research is organized into three sections as shown below. The related bill number refers to the piece of global warming legislation that proposes adopting a program similar to those researched. The applicable sections of OLO's research will be included in the worksession packet on the related legislation.

Section	Related Council Bill	Page
Section 1. Energy Star Building Standards • Describes Energy Star building standards research, and reviews eight jurisdictions that have implemented Energy Star or energy efficiency requirements and/or incentives for new commercial or residential construction.	30-07, Buildings – Energy Efficiency	**3**
Section 2. Residential Energy Performance Audits • Describes approaches to residential energy audits and provides information about energy audit programs, costs, funding, and evaluations in five jurisdictions.	31-07, Real Property – Energy Performance Audits	**18**
Section 3. Climate Action Plans • Describes research on climate action plan results and provides information on climate action plan progress data and/or cost and funding data in five jurisdictions.	32-07, Environmental Sustainability – Climate Protection Plan	**31**

Project Background. The Council included a project in the Office of Legislative Oversight's FY 2008 Work Program to review local government strategies for reducing carbon emissions. The original project description, as recommended by Councilmember Ervin, stated that OLO staff would return to the Council with a refined project scope before beginning the project.

On November 20, 2007 the Council introduced a package of seven bills related to global warming/carbon emission reduction. OLO consulted with Council and Department of Environmental Protection staff in developing the final project scope. This finalized scope was designed to complement the work done in preparing and supporting the package of legislation, avoid duplication of staff effort, and allow completion of the research in time for Council Committee worksessions on the bills.

Scope of Research. The finalized scope of research was summarized by OLO in a December 2007 memorandum to Councilmembers. Specifically, the Council asked OLO to provide research in three areas to complement the package of global warming legislation that the Council introduced November 20, 2007. Each of the areas is included within a global warming bill.

- Energy Star building standards for new residential and commercial construction;
- Residential home energy audit programs; and
- Carbon reduction practices, programs, and policies that have been implemented as part of a formal climate action plan.

For each of the three areas, OLO sought information from other jurisdictions on the type and structure of relevant programs, data on program costs and sources of funding, and data on actual or estimated carbon reduction results.

SECTION 1: ENERGY STAR BUILDING STANDARDS

Proposed Montgomery County Council Bill 30-07, as introduced by the Council on November 20, 2007, is intended to "reduce the energy consumption of commercial, residential, and government buildings in the County." The bill would amend the County Code relating to buildings, energy, and environmental policy by requiring:

- Energy Star construction standards for new multi-family and single-family residential buildings;
- Energy Star construction standards for new commercial buildings;
- A study and report on incentives for energy efficiency retrofits of existing commercial, multi-family residential, and/or single family residential buildings;
- Building owners to pay an "Environmental Sustainability Fee" if the building does not comply with environmental design or energy efficiency standards;
- Energy performance contracting for County buildings; and
- Energy savings plans for reducing the amount of energy used by each County building, as well as reducing the building's operational and maintenance costs.

I. Introduction

OLO's research focused on Energy Star building standards for new commercial and/or residential construction. This section summarizes general research on Energy Star construction programs, and also summarizes the experiences of local governments that have adopted Energy Star and/or energy efficiency construction standards. OLO did not evaluate the merit of adopting Energy Star building standards for new construction.

OLO contacted eight jurisdictions that have implemented requirements and/or incentives for the use of Energy Star standards in new residential and commercial construction. Specifically, OLO requested information from each jurisdiction on:

- The method(s) used and steps taken by the jurisdiction to introduce and implement the program;
- Data on implementation costs and sources of funding; and
- Any measurement data that has been collected or how the jurisdiction intends to measure program results.

II. Executive Summary

The U.S. Environmental Protection Agency (EPA) created an Energy Star program for buildings in 1995. The Energy Star program for buildings currently includes commercial and residential new construction, and existing structure retrofits. According to the EPA:

- Energy Star labeled commercial buildings consume about 35% less energy and produce about 26% less carbon dioxide than the average commercial building.
- Energy Star labeled residential homes are between 15% and 30% more energy efficient than standard homes built to the 2004 International Residential Code.

OLO researched jurisdictions with Energy Star or other energy efficiency requirements and/or incentives for new residential and commercial construction. OLO found limited use of specific Energy Star or energy efficiency construction standards among local jurisdictions. However, many jurisdictions use some form of green building rating or standards (e.g., LEED) that can result in greater energy efficiency during construction.

OLO summarized information from eight jurisdictions that have Energy Star or other energy efficiency requirements and/or incentives. OLO found:

- Five jurisdictions require Energy Star and/or an energy efficiency standard for certain new residential and/or commercial construction: Frisco, Texas; Boulder, Colorado; Greenburgh, New York; West Chester, Pennsylvania; and Arlington County, Virginia.

- Three jurisdictions have energy efficiency incentive programs for residential and commercial construction: Austin, Texas; Chicago, Illinois; and Los Angeles, California. The incentives offered include expedited permitting, fee waivers and rebates, and assistance with publicity and marketing.

OLO was able to obtain information on the annual cost of these programs from two jurisdictions: Austin ($1.6 million) and Chicago ($560,000). For the other jurisdictions, the costs of the program were not readily distinguishable from other functions, such as permitting and plan review.

In addition, EPA Energy Star program staff estimate that, depending on a given builder's practices, it may cost about $2,000 to $2,500 more for a builder to construct a residential building to Energy Star levels.

OLO found data on program outcomes from two jurisdictions: Austin and Frisco. Both jurisdictions report energy and dollar value savings, and reductions in carbon emissions from their programs. Specifically:

- Austin reports that its energy efficiency construction program led to over 16,000 tons of CO_2 emissions avoided in FY07 from the residential and commercial sectors.
- Frisco reports that 12,000 Energy Star labeled residential homes were built under its program between 2001 and 2008, leading to around 26,000 tons of CO_2 emissions avoided and lower average annual utility costs of $430 per home.

III. General Research Findings

The U.S. Department of Energy's (DOE) *2007 Buildings Energy Data Book* provides data on energy consumption in the residential, commercial, industrial, and transportation sectors. According to the DOE *Data Book*, residential and commercial buildings made up 40% of total primary energy consumption in the U.S. in 2005, including 72% of electricity consumption and 55% of natural gas consumption.[1]

The DOE's *Data Book* also reports that in 2005, buildings comprised 630 million metric tons (39%) of the carbon dioxide (CO_2) emissions in the United States. This figure is approximately equal to the combined CO_2 emissions from all sources in Japan, France, and the United Kingdom.

1. Introduction to Green Building and Energy Star

Green Building. Green building is the design, construction, and operation of buildings that perform at a high environmental, economic, and engineering level.[2] The construction of "green buildings" requires the inclusion of environmental, health, and waste prevention criteria in building design, site planning, preparation, and construction. As a result, green buildings use less energy, consume less water, generate fewer air pollutants, and provide a healthier indoor environment.[3]

In the United States there are a number of green building rating systems and guidelines. According to the EPA, the most widely recognized program is the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) certification.

The green building certification systems rate buildings by awarding points for environmentally preferable construction, design, and operations. A building is rated on a range of factors, which may include energy efficiency. **A green building certification does not have to involve energy efficient design, construction, or operation, and may not necessarily be more energy efficient than a standard building.**[4]

Energy Star Program. The Energy Star program label relates solely to the energy efficiency of a building or product. The United States Environmental Protection Agency (EPA) created the Energy Star program in 1992, and it is now a joint program of the EPA and DOE. Energy Star applies its label to qualifying energy-saving products, that range in application from household appliances to homes. The Energy Star program for buildings includes commercial, residential, and existing structure retrofits.

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[1] *2007 Building Energy Data Book*, http://buildingsdatabook.eren.doe.gov.Primary energy is the total energy consumed by an end-user, including energy used in the generation and transmission of electricity.
[2] Montgomery County Council. "Environmental Policy Issues and Actions Report." Resolution 15-597. May 11, 2004.
[3] Metropolitan Washington Council of Governments, *Greening the Washington Metropolitan Region's Built Environment*. July 10, 2007.
[4] U.S. Environmental Protection Agency. "Off the Charts." Energy Star Newsletter. Summer 2006.

2. Energy Star for Commercial Buildings

Program Description. The Energy Star commercial building performance rating system uses national benchmarks of building energy efficiency to compare the energy use of individual commercial buildings to the national stock of similar buildings. The national benchmarks are based on the Commercial Building Energy Consumption Survey, a survey of buildings conducted every four years by the DOE. The Energy Star national energy performance rating system is a scale of one to 100, where a rating of 50 indicates average building energy performance.

To earn an Energy Star label, the owner of a commercial building must have an independent professional engineer verify that it has earned a rating of 75 or higher. The rating is based on at least 11 consecutive months of energy data, which cannot be more than 120 days old. The building must also conform to the current industry energy standards, including thermal comfort, ventilation, indoor air quality, and lighting.[5] Commercial Energy Star ratings are calculated for 11 commercial building types using the total amount of raw fuel that is required to operate a building.[6]

The EPA's Portfolio Manager program allows building owners to track the progress of energy efficiency efforts, compare the energy use of buildings to other peer facilities across the country, and target investments in energy efficiency. Using this program, building owners may re-apply and receive the Energy Star label each year, but are not required to do so.

Research on Energy Star Commercial Buildings. According to the EPA, Energy Star labeled buildings consume about 35% less energy and produce about 26% less CO_2 than the average commercial building.[7]

From 1999 to 2007, over 4,000 commercial buildings earned the Energy Star label. About 3,400 of those commercial buildings received the Energy Star label for the first time. In addition, more than 1,000 buildings have received the label two or more times. According to the EPA, these buildings cover almost 746 million square feet, and saved nearly $1.5 billion annually in lower energy bills relative to average commercial buildings.

One study that analyzed the energy use of almost 900 Energy Star labeled office buildings in 2004 found that the Energy Star buildings use one third less energy than an "average" office building. The Energy Star office buildings in the study saved, on average, $0.50 per square foot per year in energy costs.[8]

[5] Energy Star. www.energystar.gov
[6] Energy Star commercial building types include bank/financial institutions; courthouses; hospitals; hotel/motel; K-12 schools; medical offices; offices; dormitories/residence halls; retail stores; supermarket/grocery stores; and storage and warehouses.
[7] U.S. Environmental Protection Agency. "Off the Charts." Energy Star Newsletter. Summer 2006.
[8] Kats, Gregory. "Documenting the Financial Benefits of Energy Star Labeled Buildings." Capital E Analytics Report to EPA's Energy Star Program. February 2006.

Another study compared the direct real estate benefits between 223 Energy Star commercial buildings to 2,077 non-Energy Star commercial buildings. According to the study, the Energy Star buildings had:

- Higher occupancy rates;
- Higher rental rates; and
- Lower operating expenses per square foot.[9]

3. Energy Star for Residential Buildings

Program Description. The Energy Star rating system for residential buildings is designed for buildings with three stories or fewer, including single-family, low-rise multi-family, and manufactured homes. There are two methods, or "paths," for residential building to earn the Energy Star label.

- ***Performance Path*** – To earn the Energy Star label under this path, a newly constructed residential building must achieve a threshold Home Energy Rating System (HERS) score. A Residential Energy Services network (RESNET) certified inspector will conduct a prescribed set of tests on the home, including a blower door and duct blaster test. After tests, the building receives a HERS index score between 0 (zero net energy building) and 100 (standard energy use building). According to the EPA, a residential building in Maryland earns the Energy Star label if it achieves a HERS rating of 85 or lower.

- ***Prescriptive Path*** – To earn the Energy Star label under this path, builders construct homes using Energy Star's "Builder Option Package." The "Builder Option Package" provides a prescribed set of energy efficient construction specifications. After construction is complete, a RESNET-certified home energy rater verifies that the building complies with the Energy Star specifications.

Both paths require a qualified home energy rater to visually inspect framing areas where air barriers are commonly missed, and an inspection of insulation.

Staff from EPA's Energy Star Residential Program estimate that, depending on a given builder's practices, it may cost about $2,000 to $2,500 more for a builder to construct a residential building to Energy Star levels.

Research on Energy Star Residential Buildings. According to the EPA, Energy Star residential homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code, and include additional features that typically make them 20–30% more efficient than standard homes.[10] EPA staff report that as of 2007, about 850,000 Energy Star qualified homes had been built since the program began in 1995.

[9] Miller, Norm, Jay Spivey, and Andy Florance. "Does Green Pay Off?" November 2007. http://www.resourcesaver.org/file/toolmanager/CustomO16C45F95722.pdf

[10] U.S. Environmental Protection Agency. "Features of Energy Star Qualified New Homes." http://www.energystar.gov/index.cfm?c=new_homes.nh_features

Independent studies of Energy Star homes demonstrate improved energy efficiency compared to other homes. For example, Advanced Energy conducted a 2005 study for the EPA on monthly utility data for over 7,000 homes in Phoenix, Arizona. The study showed that the average Energy Star home consumed about 16% less kilowatt hours of electricity per square foot than the houses built to standard code from 1998 to 2004.[11]

Finally, a 2006 study by Opinion Dynamics Corporation evaluated the Energy Trust of Oregon's Efficient New Homes (ENH) program that began in 2004. The ENH program provides financial incentives for single-family homes that meet Energy Star Northwest specifications. To apply for the incentive, developers must construct single-family homes to Energy Star Northwest specifications and provide verification that the home is achieving its goal of energy savings. The study showed that from 2004-05 participating developers built 505 homes under the program. These homes achieved a total energy savings of 6.1 million kilowatt hours and 290,000 therms.[12]

IV. Findings from Other Jurisdictions

OLO contacted jurisdictions that have requirements and/or incentives for the use of Energy Star or energy efficiency standards in new residential and commercial construction.

The table below lists the eight jurisdictions OLO researched and the page where each summary begins. The amount and type of information OLO was able to compile varied among the jurisdictions.

[11] Geller, Howard, Larry Kinney and Jeff Schlegel. "Review of Energy-Efficient New Homes Programs in the Southwest: Phoenix Home Energy Efficiency Study." Prepared by Advanced Energy for U.S. Environmental Protection Agency. January 2006.

[12] Opinion Dynamics Corporation. "Process Evaluation of the Energy Trust of Oregon's Efficient New Homes Program PY 2004-2005." July 19, 2006.

ARLINGTON COUNTY, VIRGINIA

In 2003, Arlington County enacted requirements for development projects undergoing site plan review to incorporate green building components and processes into the projects. Arlington County's green building program for site plan developments includes requirements for:

- Inclusion of a LEED accredited staff member on the development team;
- Submission of a LEED scorecard with the site plan application;
- Tracking the progress of LEED requirements throughout the course of the project;
- Developing a construction waste management plan; and
- Following certain Energy Star requirements for multi-family residential projects.[13]

Energy Star requirements. Arlington's Energy Star requirement for multi-family, residential, site plan development projects includes two components. First, the developer must install Energy Star labeled appliances, fixtures, and building components for all the clothes washers, dishwashers, refrigerators, ceiling fans, ventilation fans, light fixtures, and exit signs installed as part of the project.

Second, the developer must choose two of the following types of components and use Energy Star qualified products for all of those components installed as part of the project: programmable thermostats, residential light fixtures, windows and doors, and HVAC systems.

CITY OF AUSTIN, TEXAS

The City of Austin has two different energy efficiency programs/policies that relate to new residential and/or commercial construction.

1. Energy Code for New Construction

Austin recently adopted the 2006 International Energy Code (IECC) with additional amendments from the City. The new energy code increases the minimum energy-efficiency standard for new construction or retrofits of existing buildings. City staff estimate that the 2006 IECC with the local amendments will to result in buildings that are about 19% more energy efficient than those built under the 2000 IECC, Austin's previous energy code standard.[14]

[13] Arlington County, Virginia. "Green Building." Environmental Services. 2007.
[14] Morgan, Richard. "Houston Green Building Roadmap." Austin Energy.

2. Green Buildings Program

Austin Energy, the City of Austin's municipal utility, administers a Green Building program that includes energy efficiency standards. The program educates builders about sustainable building practices, and assists participating builders through marketing services, consulting services, and identifying possible rebates and loans for energy efficiency measures. The program began in 1991 as a program for single-family homes. The program added a commercial building component was added in 1995, and a multi-family component in 1999.

Austin's Green Building program is required for certain affordable housing projects, and for buildings located in the central business district, planned unit developments, and other designated areas. It is also required for buildings built under certain incentive programs, such as added density, expedited review, or fee waivers. The program is voluntary for all other residential, commercial, and multi-family development.

The Green Building Program rates construction projects using a point structure for sustainable features, including energy efficiency, water efficiency, and materials efficiency. Minimum energy efficiency requirements along with the rating process for the different types of construction are summarized below:

- **Single-Family Residential** – Minimum energy efficiency requirements include HVAC efficiency and sizing standards, duct leakage testing, air barriers as per Energy Star standards, and a minimum of five fluorescent lights. The rating process includes construction plan reviews, inspection during construction, duct testing performed by a third party, and final certification.

- **Multi-Family Residential –** Minimum energy efficiency requirements include using Energy Star labeled windows or exceeding the Austin energy code's building envelope performance requirements by 15%, and testing/commissioning of HVAC units. The multi-family program applies to low-rise residential projects with three floors or less. Program staff assist participating builders to set sustainability goals and provide site, design, and plan review. Austin also assists developers in locating available incentives for the project, and will help market the project if it achieves a green rating.

- **Commercial** – Commercial buildings can either use the City's rating tool or apply for LEED certification. Minimum energy requirements include Energy Star qualified roof and exceeding Austin's lighting and building envelope energy requirements by 15%. Developers of commercial buildings submit a Request for Participation to Austin Energy to begin the green building certification process. Staff assist the developer to choose sustainable building measures, review project documents, analyze the project for efficiency, locate incentives, and market and promote the project. Multi-family residential projects of four or more stories and mixed use projects are rated as commercial projects.

Program Costs and Sources of Funding. The Fiscal Year 2008 budget for the program is about $1.6 million. The program has a staff of 20, and personnel costs account for 75% of the FY08 budget. The remainder of the budget is for marketing, training, public education, and other miscellaneous expenses.

Progress/Results. As of February 1, 2008, Austin Energy staff report that:

- Over 7,600 residential homes have been rated by the Green Building program, with 35 homes attaining the highest rating (five stars);
- 19 multi-family projects, totaling over 9,000 residential units have been rated; and
- 36 commercial buildings have been rated.

Austin Energy tracks the electricity demand reduction and energy savings resulting from the program and reports the following data for FY06 and FY07.

Table 1-1: Green Building Program Results, FY06–FY07

Fiscal Year	Demand Reduction (kilowatts)	Energy Savings (megawatt hours)	Dollar Value of Energy Saved	CO_2 Emissions Avoided
FY06	14,755 kW	24,974 mWh	$2,222,686	15,927 tons
FY07	15,914 kW	25,579 mWh	$2,276,531	16,546 tons

Source: Austin Energy, City of Austin

In FY07, Austin Energy also reported a reduction of 2,624,180 million BTU in gas energy from commercial buildings rated by the program.

Program Experience. City staff report that through the implementation of these programs, they have learned the importance of collaboration. Staff assert that the programs could not have been successful without the involvement of key stakeholders from the beginning, including: activists, contractors, home builders, and realtors.

City staff also report that a key to success was continually marketing the benefits of green building to the public. The City places advertisements in lifestyle publications, operates booths at building and environmental conferences, and holds a "Green by Design Seminar" four times a year. While there may have been some hesitance towards green building in the beginning, staff feel that the culture has changed, both in the workplace and in the community. Staff report that public acceptance and knowledge has reached the level that allows Green Building staff to focus more on marketing to the industry, while reducing the level of effort and funds spent on marketing to the public.

CITY OF BOULDER, COLORADO

The City of Boulder administers a Green Building and Green Points program that includes energy efficiency requirements for new construction. The Green Building and Green Points program is a mandatory energy and environmental rating program for the construction of single-unit, multi-unit, and mixed use residential developments.

Boulder originally enacted the Green Points program in 1996 to encourage "cost-effective and sustainable residential building methods, conservation of fossil fuels, water and other natural resources, recycling of construction materials, reduction of solid waste, and improvement of indoor air quality."[15] The City Council amended the program in 2007 to mandate green building requirements for energy efficiency and construction waste as part of the Green Points program.[16] Also, the City of Boulder adopted the 2006 International Energy Conservation Code (IECC) in 2007.

Green Points Program. This program requires residential building permit applications for new construction, remodels, or additions to earn "green points" for various environmental and energy efficient measures of a building. The number of green points required varies by the type and the square footage of the proposed building.

Energy Efficiency Requirements for New Construction. Boulder's amendments to the Green Points program went into effect on February 1, 2008 as part of the City's goal to reduce energy use and carbon emissions.

Applicants for new residential building permits must meet the minimum energy efficiency requirements listed in Table 1-2. New residential buildings must exceed the 2006 IECC and obtain a specified Home Energy Rating System (HERS) score, using a Residential Energy Services Network (RESNET) accredited rater.

Table 1-2: Energy Efficiency Requirements by Size of Project

Type of Project	Square Footage	Energy Efficiency Above 2006 IECC	Home Energy Rating System (HERS) Score
New Construction	3,000 or less	30% greater	70 HERS index score
	3,001 to 5,000	50% greater	60 HERS index score
	5,001 and greater	75% greater	35 HERS index score
Multi-unit Dwellings	---	30% greater	70 HERS index score

Source: City of Boulder, Colorado

Energy Efficiency Requirements for Additions/Remodels. Boulder requires that proposed residential remodels or additions of more than 500 square feet must get a home energy audit or HERS rating prior to submitting building plans.

[15] http://www.bouldercolorado.gov/files/greenpoints_booklet.pdf
[16] City Council of the City of Boulder. Ordinance No. 7565. November 13, 2007.

Boulder reports that the intent of this requirement is to ensure that the homeowner receives energy efficiency information on their home before finalizing the scope of work on their planned alteration.[17] In addition, prior to the final inspection for a residential remodel or addition permit, the applicant must install energy efficient light bulbs in at least 50% of the building's light fixtures.[18]

CITY OF CHICAGO, ILLINOIS

The City of Chicago has two energy efficiency programs for new residential and commercial construction: a Green Permit program and a Green Homes program.

1. Green Permit Program

Chicago's Green Permit Program is a voluntary incentive program that provides expedited permit review and potentially a wavier of plan review fees if the proposed project meets certain green building standards. The Chicago Department of Buildings (DOB) runs the program. The program began in 2005 as a mayoral policy directive and had its first full-year of operation in 2006.

The program establishes a three-tiered incentive system where a project qualifies for a specific tier depending on the amount and type of green building standards proposed, the type of project, and the size of the project. Depending on the tier qualified for, projects receive the following incentives:

- **Tier I** – Expedited permit review (within 30 business days).
- **Tier II** – Expedited permit review and partial waiver of consultant review fees.
- **Tier III** – Expedited permit review and full waiver of consultant review fees.

Progress/Results. The Green Permit program reports issuing 234 permits since the program's inception in 2005. In 2006, the first full year of operation, the program nearly doubled the goal of 40 green permits issued.[19]

Table 1-3: Green Building Permits Issued, 2005-2007

Calendar Year	Green Permits Issued
2005	19
2006	71
2007	144
Total	**234**

Source: Chicago Department of Buildings

[17] http://www.bouldercolorado.gov/files/PDS/Codes%20&%20Regs/greenpointshandout_dec07.pdf
[18] The ordinance requires energy efficient light bulbs that are 40 lumens per watt or above.
[19] Mayor's Press Release. "Daley Names Richard Rodriguez New Head of Department of Buildings." City of Chicago. June 14, 2007.

Program Costs and Sources of Funding. Chicago funds the Green Permit program from general permit fee revenue. The operating expenses for the program are about $560,000 for Calendar Year 2008. This includes consultant review fees and other miscellaneous expenditures, such as on-site project signage identifying the project as a part of the program. The program includes two positions dedicated to green building permitting, but a breakout of the cost of these two specific positions is not readily available.

Program Experience. Staff report that the program plans to alter the fee waiver system in 2008, although the net benefit to the developer will not change, and also begin offering a financial incentive for smaller projects. City staff stated that the feedback from participants has been positive, and developers/builders particularly appreciate the one-stop shop for both green building and all other building permit aspects within the Department.

City staff report that it is key to have good communication and coordination between departments (ongoing dialogue and periodic meetings) to make sure responsibilities are clear, staff are empowered to complete tasks, and questions of developers can be answered quickly.

2. Green Homes Program

Chicago's Green Homes Program is a required plan review process for all residential projects using City financing or land, and a voluntary incentive program for all other projects. All single-family and multi-family new construction projects or renovations are eligible for the incentive program.

The program gives points to residential developers and homeowners for sustainable techniques and materials used in the construction of a new home or residential building. Incentives include:

- Enhanced customer service;
- Eligibility for the Green Permit Program;
- Use of the Chicago Green Homes logo at the project site; and
- Recognition on the City's website.

Applicants enroll in the program during the design phase, and submit an Application for Certification and final documentation when the project is near completion. Program staff issue the project a rating based on the number of points the project attains in various categories (200 to 350 points depending on the type of project). The categories include energy efficiency, materials, sustainable sites, and resource conservation.

The program requires a project to earn a minimum of 90 points towards the project's total point value from the energy efficiency category, and gives significant credit for Energy Star certification. The program awards 30 points for an Energy Star index score of 85 or lower, and 40 points for an index score of 75 or lower.

CITY OF FRISCO, TEXAS

The City of Frisco has implemented two programs that relate to the energy efficiency of newly-constructed residential and commercial buildings:

- Energy Star standards for new residential construction; and
- Green building requirements for new commercial construction.

In addition, the City adopted the 2006 International Energy Conservation Code (IECC) with local amendments through Ordinance 08-01-07 in January 2008. The Code applies to new residential and commercial construction, increasing minimum energy efficiency building requirements.

Residential Green Building/Energy Star. Frisco requires that all new residential construction must meet EPA's Energy Star requirements. The program was adopted through local ordinance in 2001, and the most current version of the program applies to all homes receiving a building permit after July 1, 2007.

City Ordinance 06-10-111 requires that all new single-family homes be Energy Star qualified or attain a Home Energy Rating Systems (HERS) index score of 83 or below. A Residential Energy Services Network inspector must conduct the HERS rating. In addition, a residential building must have:

- A minimum of one programmable thermostat on every story;
- A return air path for any room that can be closed off by a door, except for baths, kitchens, closets, pantries, mechanical rooms, and laundry rooms; and
- Duct mastic sealing of all joints in the air distribution system including ducts, plenums, and equipment.

The residential green building requirements also incorporate water conservation, indoor air quality, and waste recycling.

Commercial Green Buildings. The City Council also adopted a commercial green building ordinance in 2006. Commercial building permit applications must include information showing that the structure meets the minimum 2006 IECC energy requirements, as well as minimum standards for shade trees, water conservation, and construction and demolition recycling. Commercial buildings must also comply with Energy Star's "Cool Roof" program.

Program Costs and Sources of Funding. Frisco staff report that since the programs are mandatory, they were incorporated into existing permitting and review processes and have not required a substantial funding increase. While the City did not add new positions when the programs were initiated, staff report that building inspectors have had to take on more responsibilities to address energy and indoor air quality standards.

Progress/Results. The City reports that from May 2001 to February 2008, over 12,000 Green Homes/Energy Star Homes were built under the residential program. Staff estimate an average of 4,650 kilowatts of energy savings per home per year, and an average utility savings of over $430 per home per year. In addition, staff estimate that 26,000 tons of CO_2 emissions were avoided over the seven-year period.

Frisco also reports that since November 2006, over 50 Commercial Green Building projects are either complete or underway. The City reports benefits from the program include improved energy efficiency and reduced utility costs, decreased heat island effect, and over 50% water savings.

CITY OF LOS ANGELES, CALIFORNIA

The City of Los Angeles has an energy efficiency incentive program through its municipal utility, the Los Angeles Department of Water and Power (LADWP). The program, which began in 2006, offers financial incentives per square foot for developers who build energy efficient buildings. The program has two versions, or "tracks":

- **Performance Track** is a program for new construction projects that include environmental improvements, energy efficiency, and sustainability, using either LEED or Collaborative for High Performance Schools certification. The performance track incentives are designed to cover the incremental cost of purchasing the higher efficiency equipment and a large portion of the LEED certification cost. To qualify, a developer must send a statement of interest letter to LADWP. Staff then meet with the developer to review the project, explore energy efficiency opportunities, explain the program requirements, and discuss potential incentives.

  Performance track incentives for projects receiving LEED certification are based on the number of LEED energy points received (1 to 10) and the square footage of the building's conditioned space. The higher the number of energy points received, the higher the incentive paid per square foot. Projects with a LEED energy score of one receive an incentive of $0.30 per square foot. At the high end, projects with a score of 10 receive an incentive of $1.20 per square foot.

- **Prescriptive Track** is a retrofit program for developers who improve the energy efficiency of a building's equipment. The program provides incentives based on type and number of qualifying products installed.

All projects require LADWP pre-approval and inspection. LADWP provides incentive funding on a first-come, first-served basis until funds for each budget year are claimed.

TOWN OF GREENBURGH, NEW YORK

The Town of Greenburgh, New York enacted an Energy Star requirement for residential home construction in 2002. The Town Code states:

> No building permit shall be issued for any one- or two-family dwelling or multifamily dwelling of three stories or less unless the applicant certifies that the dwelling will meet the requirements for a New York energy star-qualified home. (§ 100-15)

The Code defines New York Energy Star-qualified homes as residential buildings of three stories or less with an energy rating of 86 or better on the Home Energy Rating System (HERS). By definition, these homes must attain a total of 300 kilowatt hours of energy savings from energy star appliances and fixtures, and meet a ventilation standard of 15 cubic feet per minute for each bedroom and for the dwelling as a whole.

As mandated in the Code, the Town requires energy calculations as part of the required plan submissions for all new one- or two-family dwelling or multifamily residences. A builder must submit an affidavit to the Town's Department of Buildings when applying for a building permit. The affidavit states that the builder will use a certified HERS rater to rate the building for compliance to New York Energy Star standards in order to receive a Certificate of Occupancy.

BOROUGH OF WEST CHESTER, PENNSYLVANIA

The Borough of West Chester passed an ordinance in December 2007 that requires all new buildings over 45 feet in the Borough's town center or commercial district to earn the Energy Star label. The ordinance states that both new residential and commercial building construction must meet the most current version of the Energy Star program at the time of application and conditional use permit. New commercial construction must earn the Energy Star label and be benchmarked annually. The Borough can waive the Energy Star requirement if the new building achieves a rating of LEED-NC (new construction) Certified or higher.

Program Costs and Sources of Funding. Staff from the Department of Building, Housing, and Code Enforcement administer the new requirements along with all previously required submissions for new construction. Since the ordinance was passed recently, the Borough does not have any information on the implementation or costs of the program.

SECTION 2: RESIDENTIAL ENERGY PERFORMANCE AUDITS

Proposed Montgomery County Council Bill 31-07, as introduced by the Council on November 20, 2007, would amend the Montgomery County Code to require a home energy audit when a home inspection is completed at the time of sale of a single-family attached or detached home. The energy audit requirement would not apply to new home construction.

The proposed bill establishes the Department of Environmental Protection (DEP) as the department responsible for determining the tests to be included in the home energy audit to measure energy efficiency and identify steps to improve efficiency. The proposed bill also states that the energy audit must include a thermographic scan.

The proposed bill would also require a certified Residential Energy Services Network (RESNET) home energy performance rater, or an inspector with equivalent qualifications, to perform the energy audit. The auditor must provide a written report for the home buyer that describes findings and recommendations for improving energy efficiency, identifies potential cost savings, and identifies potential funding sources for improvements.

I. Introduction

OLO reviewed literature on home energy audits and contacted several jurisdictions that have regulations or programs that include home energy audits. This section presents this research in two parts:

- **General Research Findings**, describes approaches to energy audits and presents findings from two evaluations of home energy audit programs.
- **Jurisdictional Findings**, describes examples of mandatory and voluntary energy efficiency programs in five jurisdictions, including available information on costs and sources of funding, implementation, and program evaluation data.

OLO did not evaluate the merit of requiring home energy audits. Additionally, there are likely additional home energy audit programs that OLO did not come across during the course of our research.

II. Executive Summary

A home energy audit provides a homeowner or resident with information on how efficiently a home uses energy and ways to improve energy efficiency. There is no single standard for what an energy audit includes or who is qualified to conduct an audit. An energy audit can range from do-it-yourself inspections of doors, windows, lighting, insulation, and heating and cooling systems to professional audits that make use of technical equipment such as blower doors and infrared cameras.

OLO reviewed two jurisdictions – San Francisco and Berkeley, California – that require residential energy audit programs at the time of sale of a home. These jurisdictions also prescribe energy efficiency standards (e.g. insulation levels, use of weatherstripping) that a home must meet before it can be sold.

OLO also reviewed three jurisdictions – Washington D.C.; Boulder, Colorado; and Arlington County, Virginia – that offer voluntary energy audit programs that are not tied to the sale of a home. The programs in these jurisdictions provide recommended home improvements but do not mandate implementation.

All the programs OLO reviewed require that an energy audit include an inspection of attic and wall insulation; heating and cooling systems; and leaks in the building exterior that allow air infiltration. Other common audit elements include a review of utility bills; discussion of ways to save energy through lifestyle changes; window, appliance, and water heater inspections; and a blower door test.

Additionally, all the programs reviewed provide homeowners with a report describing energy audit findings and recommended improvements. Many of these reports also include information on potential cost savings.

OLO found that the cost of residential energy audits varied among the jurisdictions:

- The cost for energy audits in the mandatory programs ranged from $52 to $100 per audit, with the full cost borne by the homeowner.
- The cost for energy audits in the voluntary programs ranged from $150 to $410 per audit, with the cost partially or fully subsidized by the jurisdiction.

OLO found limited data on program outcomes, such as implementation rates or recommendations for energy savings. Of note:

- 53% of respondents to a survey of Washington D.C. energy audit program participants report making at least one improvement to their home based on the results of the energy audit.
- San Francisco estimates that the average homeowner saves 15% on energy costs after implementing mandated energy efficiency standards.
- Evaluations of energy audit programs sponsored by electric utilities and private companies report implementation rates for audit recommendations ranging from 31% to 57%, and energy savings per home ranging from 395 to 657 kWh/year.

Program staff that OLO spoke with note that it can be difficult to estimate energy savings resulting from a time-of-sale energy audit because of multiple factors that could influence energy use, including lifestyle differences between occupants.

III. General Research Findings

1. Approaches to Energy Audits

A home energy audit provides the homeowner or resident with information on how efficiently a home uses energy and ways to improve energy efficiency. There is no single standard for what an energy audit includes or who is qualified to conduct an audit. An energy audit can range from do-it-yourself inspections of doors, windows, lighting, insulation, and heating and cooling systems to professional audits that make use of technical equipment such as blower doors and infrared cameras.[20]

The following paragraphs about Home Performance with Energy Star and the Home Energy Rating System describe two approaches to professional audits.

Home Performance with Energy Star. The U.S. Department of Environmental Protection and U.S. Department of Energy have developed an energy audit program known as Home Performance with Energy Star. This program includes assessing air leakage and insulation, furnace ductwork, heating and cooling system efficiency, and lighting and appliance efficiency.[21]

Home Performance with Energy Star is offered by state and local sponsors. In Maryland, the Maryland Energy Administration sponsors Home Performance with Energy Star. Contractors for the program must earn certification from the Building Performance Institute and complete a specialized Maryland Home Performance training and mentorship.[22] In addition to performing the audit, these contractors provide a report for the homeowner and can make the recommended home improvements. Once contractors make improvements, they retest the home and provide the homeowner with a Home Performance Certificate.

Home Energy Rating System. The Home Energy Rating System (HERS) offers standards for measuring home energy efficiency. The HERS program requires home inspectors and raters to participate in a certification program. The Residential Energy Services Network (RESNET), which aims "to develop a national market for home energy rating systems and energy efficient mortgages," developed the HERS program.[23]

During the HERS assessment, the inspector considers the energy efficiency of insulation, windows, walls, heating and cooling systems, and water heating. HERS assessments include diagnostic measurements, such as a blower door test.[24]

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[20] Home Energy Audits: Energy Star. Accessed 2/7/08 at http://www.energystar.gov.
U.S. Department of Energy. *A consumer's guide to energy efficiency and renewable energy.* Accessed 2/1/08 at http://www.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11160.

[21] Home Performance with Energy Star. Accessed 2/7/08 at http://www.energystar.gov.

[22] Maryland has three contractors for this program; two service Montgomery County.

[23] Residential Energy Services Network. Accessed 2/12/08, http://www.resnet.us/about/default.

[24] A blower door uses a powerful fan to create a pressure differential between the home and the outdoors. This allows the auditor to detect drafts and leaks in the building's structure that may influence energy efficiency.

Based on the inspection, a HERS certified rater prepares a comprehensive report with a rating that allows homeowners to compare their home with similar homes. The report also includes findings about the home's energy efficiency and provides recommendations for improvements that will save energy and costs.[25]

In 2007, RESNET released draft standards for home energy audits, which would be a less comprehensive inspection than the HERS program. These proposed standards define an energy audit as:

> "…[A] visual inspection of the dwelling unit, and documentation of its general condition from a thermal, structural, appliance, lighting, and safety perspective. The audit shall include a review of utility billing history. The audit is a visual inspection only and does not include the use of a blower door, duct leakage test, or an infrared camera."[26]

2. Evaluations of Home Energy Audit Programs

This section presents findings from two evaluations of home energy audit programs:

- Southern California Edison's Residential Audit Programs; and
- GeoPraxis' EnergyCheckup Time-of-Sale Home Inspection Program.

Southern California Edison's Residential Audit Programs.[27] In 2002, the Southern California Edison (SCE) power company evaluated a number of voluntary energy audit programs it had sponsored in 2000. These audits included mail-in, online, telephone, in-home, and time-of-sale audits. The in-home and time-of-sale audits are described in more detail below.

- **In-Home Audits**. Electric company customers voluntarily participated in the in-home audits. After a professional on-site inspection, the inspector provided participants with a list of recommended lifestyle changes and updates to the home to improve energy efficiency. Participants included residents of single-family homes and apartments.

- **Time-of-Sale (TOS) Audits**. For the TOS audits, SCE contracted with a major home inspection company to add an energy audit to the routine home inspection. SCE paid inspectors $35 per audit, which added about 15 minutes to the inspection time. The inspector developed a report with results and recommended updates to improve energy efficiency. Audits occurred with either the seller or buyer present.

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[25] Energy Ratings and Mortgages. Residential Energy Services Network. Accessed 2/7/08. http://www.resnet.us/ratings/overview/default.htm.

[26] Residential Services Network. (December 14, 2007). DRAFT RESNET Standards. Chapter 7, RESNET National Standard for Home Energy Assessments. Accessed 2/1/2008. http://www.natresnet.org/standards/mortgage/audits/Standard_on_Comprehensive_Energy_Assessment.pdf

[27] Ridge & Associates. (September 2006). *Evaluation of Southern California Edison's Residential Audit Program: Final Report.*

Table 2-1 summarizes data on the number of audits performed, the average number of recommendations, the average implementation rate, and the average kilowatt hour (kWh) savings during the first year after the audit. In sum, the table shows that in 2000:

- 7,920 households received in-home audits and 4,170 received TOS audits.
- 88% of homeowners recalled receiving an in-home audit, while 21% of homeowners recalled receiving a TOS audit. According to the study, some of the TOS audits were conducted with the seller rather the buyer and that may account for the difference.
- On average, in-home audits resulted in a greater number of recommendations and a higher implementation rate than TOS audits.
- Average kWh savings was 611.7 kWh/year (6.3%) for in-home audits and 657.4 kWh/year (11.8%) for TOS audits. The report notes that vacancy between occupants may have magnified the energy savings for TOS audits

Table 2-1: SCE Findings on In-Home and Time-of-Sale Audits, 2000

Measure	In-Home Audit	TOS Audit
Number of audits	7,920	4,170
Percent recalling audit at time of survey	88%	23%
Average number of recommendations	14.5	11.8
Implementation rate of recommendations	57%	31%
Average annual kWh use before audit	9,565	5,592
Average kWh savings in first year	611.7	657.4

Source: SCE Report

GeoPraxis' EnergyCheckup Time-of-Sale Home Inspection Program.[28] From 2002-2003 GeoPraxis, an energy efficiency research company in California, trained home inspectors in northern California to offer an "EnergyCheckup" audit during regular home inspections. The original goal of the program was to offer 12,000 audits in 2002-2003.

Developed by GeoPraxis, the EnergyCheckup audit considers a number of measures of home energy efficiency including:

- Heating, ventilation, and air conditioning system condition, age, and efficiency;
- Attic, wall, and pipe insulation;
- Leaks in the building exterior that allow air infiltration;
- Efficiency of windows and skylights;
- Type of lighting;
- Type of thermostat and thermostat settings;
- Condition, age, and efficiency of appliances; and
- Water use.

[28] Robert Mowris & Associates. (2004.) *Evaluation Measurement and Verification Report for the Time-of-Sale Home Inspection Program #180-02.* Accessed 2/7/08 at http://www.calmac.org/publications/RMA_EMV_Final_Report_for_GeoPraxis_180-02.pdf.

After the audit, GeoPraxis prepares a report for the homeowner of findings from the audit. The report also lists recommended updates to the home, describes advantages of implementing the recommendations, estimates potential cost savings, and offers a list of contractors who can make the improvements to the home.

From 2002-2003, home inspectors completed 205 EnergyCheckup audits. A 2004 evaluation of the program surveyed 40 participating homeowners and 10 participating home inspectors. Results from the survey include:

- Participating inspectors indicated that they needed an average of 40 minutes to complete an EnergyCheckup.

- Participating homeowners reported implementing 46% of recommendations from the EnergyCheckup report. The report estimates that these homeowners saved an average of 395 kWh/year in electricity and 38.5 therms/year in natural gas.

- The evaluation also found that although the program trained 128 inspectors, it fell far short of the original goal of 12,000 EnergyCheckup audits. Participating inspectors reported that the program needed to be better advertised among homebuyers and real estate agents.

IV. Jurisdictional Findings

This part describes programs in selected other jurisdictions that require or make available in-home or time-of-sale home energy audits. Each description includes a summary of the program and any available information about implementation, cost and funding, and evaluation.

The table below lists the jurisdictions and the page where each description begins. The amount and type of information OLO was able to compile varied among the jurisdictions.

CITY OF SAN FRANCISCO, CALIFORNIA

Program Description. San Francisco implemented a Residential Energy Conservation Ordinance (RECO) in 1982.[29] The ordinance requires residential property owners to meet certain energy efficiency standards before selling the home or when making significant renovations. The standards vary depending on whether the property is a single- or two-family home or a property with multiple units, such as an apartment or condominium complex. This summary focuses on requirements for single and two-family homes.

The homeowner must have a building inspection that shows compliance with the standards at the time-of-sale or when the building undergoes renovations costing at least $20,000. RECO sets standards for:

- Attic, heating/cooling duct, and water heater insulation;
- Exterior door weatherstripping;
- Caulking and sealing cracks and holes in the building exterior; and
- Water conservation measures, including low flow showerheads, faucet aerators, and low flush toilets.

San Francisco's Department of Building Inspection/Housing Inspection Services and private inspection companies perform the required inspections. The City provides RECO inspection training to private inspectors. San Francisco estimates that private companies perform about 95% of inspections, and states that inspections last about 30 to 45 minutes for a single-family home.

The property owner may appeal the results of the initial inspection if: 1) the owner disagrees with the upgrades recommended by the inspector, or 2) if the cost of the upgrade is "unreasonable."

If the inspection is completed at the time-of-sale, the seller and the buyer may agree to transfer responsibility for compliance to the buyer. In this case, the seller must set up an escrow account of 1% of the selling price up, or to $1,300, for the buyer to upgrade the home to RECO standards.

Costs and Sources of Funding. San Francisco does not maintain a separate line item in the budget for RECO inspections and compliance monitoring. However, the fees collected from property owners for inspections and filing paperwork are expected to cover the city's costs.

[29] Department of Building Inspection. (2007) *What You Should Know about The Residential Energy Conservation Ordinance (RECO).* San Francisco.
http://www.ci.sf.ca.us/site/uploadedfiles/dbi/Key_Information/19_ResidEnergyConsBk1107v5.pdf

For an inspection performed by the city, a property owner pays $52. Private companies set their own rates. If an inspector finds that a property does not comply with RECO, the homeowner must invest up to $1,300 to retrofit the home. Once upgrades are complete, the home must be re-inspected at a cost of $26 and the homeowner must file paperwork with the city to verify RECO compliance. The city charges a $10 filing fee.[30]

Evaluation. San Francisco has not completed a formal evaluation of the RECO program. However, the city estimates that the average homeowner saves 15% on energy costs after implementing the RECO standards.[31]

CITY OF BERKELEY, CALIFORNIA

Program Description. Berkeley implemented a Residential Energy Conservation Ordinance (RECO) in 1987.[32] The ordinance requires owners of residential property to meet certain energy efficiency standards when the property is sold. It also requires properties to become compliant if the owner makes renovations of $50,000 or more. The regulations apply to single-family homes as well as apartment buildings.

The ordinance sets standards for:

- Ceiling, water heater, pipe, and furnace duct insulation;
- Exterior door weatherstripping;
- Furnace duct joint seals;
- Air flow barriers for fireplace chimneys;
- Water saving measures such as low flow toilets, faucet aerators, and low flow showerheads; and
- Compact florescent lighting in common areas of multi-unit residential buildings.

At the time-of-sale or during renovations, property owners must have the building inspected to verify that it meets RECO standards. If a property needs upgrades to meet RECO standards, the seller must invest up to 0.75% of the sale price in improvements for a single structure with one or two units. If a property must be upgraded during renovations, the owner must invest up to 1% of the renovation cost in RECO improvements.

A seller and buyer may agree to have the buyer implement any improvements required to meet the RECO standards. If this occurs, the buyer is expected to invest up to 0.75% of the selling price to bring the property into compliance within one year. This transfer of responsibility, however, is only permitted once per property. In future sales, any RECO standards that have not been met previously must be met by the seller.

[30] San Francisco Building Code. (2007) Chapter 1A, Administration.
[31] Dauncey, G. (N.D.) *San Francisco's Residential Energy Conservation Ordinance (RECO)*. Accessed 1/14/2008 at http://www.earthfuture.com/seconomy/seil3.asp.
[32] http://www.ci.berkeley.ca.us/sustainable/residents/ResSidebar/RECO.html

If the seller transfers responsibility for compliance to the buyer, the seller may, but is not required to, place funds of up to 0.75% of the selling price plus inspection and filing fees in an escrow account. If the buyer does not use the funds within a year, the money is returned to the seller.

The City contracts with a non-profit to conduct the time-of-sale home inspections. For renovations, the City's Building and Safety Office includes the RECO inspection in a routine building code compliance inspection. City staff provide some administrative support for the program, including communicating with real estate agents and monitoring a monthly report from the inspection agency on the number of inspections completed and the results of the inspections. Additionally, the Building and Safety Division maintains records on which homes have passed RECO inspections.

Introduction and Implementation. Berkeley introduced the RECO standards in 1987 as Chapter 19.16 of the Berkeley Municipal Code. The ordinance was revised in 1991. The ordinance states that the purpose of the standards is to "promote the wise and efficient use of energy and water by prescribing standards for physical components of residential structures."[33]

Costs and Funding. The seller of the home bears the costs of the inspection, fees for filing paperwork with the City of Berkeley, and the cost of required improvements. The cost of an initial inspection is $100, and a re-inspection if the building does not pass is $50. Sellers must also pay $15 to Berkeley to file a certificate of RECO compliance. If the seller transfers compliance to the buyer, two forms may be filed with the city: a Transfer of Responsibility and a Notice of Escrow Account. Each of these requires a $15 filing fee. When a property undergoes renovation, the RECO inspection cost is included in the City's routine building code compliance inspection.

Evaluation. Berkeley reports that 1,550 homes received RECO inspections between September 2003 and December 2007. The city has not been able to directly measure reductions in energy use due to RECO. City staff report facing two important barriers to measuring changes in energy use. First, city staff does not have access to a resident's utility records. Second, the change in home ownership can also influence utility use due to lifestyle differences between residents.

CITY OF BOULDER, COLORADO

Program Description. The City of Boulder subsidizes home energy audits for city residents through the Residential Energy Audit Program (REAP). The city contracts with the Center for ReSource Conservation (CRC) to administer the program and conduct the audits. Residents contact the CRC to set up an audit, and CRC staff conduct a short phone interview to gather basic information about the home and obtain a release for utility bills for one year pre- and post-audit.

[33] Berkeley Municipal Code. Chapter 19.16

CRC staff then set up two home visits: a one-hour energy education visit and an approximately two-hour energy audit. During the energy education visit, a staff person from the CRC reviews utility bill history with the homeowner and compares their energy use with average usage in the area. The CRC also distributes fact sheets on energy efficiency measures such as air sealing, duct sealing, and insulation, as well as opportunities for financial assistance with upgrades, including solar rebates and energy efficiency mortgages.

The educator also walks through the home with the participant to gather information about thermostat settings, areas of concern, information about remodeling done to or planned for the home, and descriptive information about major appliances. Finally, participants receive up to six compact florescent light bulbs to replace incandescent lighting. In 2008, the program plans to eliminate the educational visit and replace it with an in-depth telephone interview and a longer visit during the energy audit.

CRC staff share the information gathered during the educational visit with the inspector who will conduct the home energy audit. The audit includes a blower door test and inspection of the HVAC system, insulation, air sealing, appliances, and lighting. The inspector prepares a report for the homeowner that includes the findings of the audit and recommended upgrades.

In addition to the fact sheets from the educational visit and the report from the audit, program participants receive a list of contractors who can make recommended home improvements. Although the CRC does not evaluate contractors before adding them to the list, they remove contractors who receive three customer complaints.

Introduction and Implementation. In 2002, the Boulder City Council passed a resolution to reduce greenhouse gas emissions in the city. The resolution is in line with the Kyoto Protocol and aims to decrease emissions to 7% below 1990 levels by 2012.

The resolution resulted in a Climate Action Plan that was adopted in 2006. This plan includes initiatives, such as REAP, that aim to conserve energy and reduce emissions. Boulder introduced REAP as a pilot program in 2006 and provided 15 audits. In 2007, the city expanded the program and subsidized 224 audits. Staff project that the program will conduct 450 audits in 2008.

While the program has not experienced significant challenges to implementation, staff are working to implement recommendations from a recent evaluation of program design. The City contracted with a company that evaluated each step of the REAP process. The evaluation recommended:

- Using an improved and standardized format for auditor reports;
- Adding the expected costs and potential savings from recommended upgrades; and
- Expanding the program to include townhouses and apartments.[34]

[34] Kinney, L., W. Clute, & J. Huston. (May 2007). *The Single-Family Residential Energy Audit Program in Boulder: A Formative Evaluation.* Synertech Systems Corporation.

Costs and Funding. In 2008, the REAP program's total per audit cost is $356. This cost is shared by the homeowner, the city of Boulder, and Boulder County. Homeowners pay $100 for a home with up to 2,500 square feet. The city and county each pay $128 toward the remaining $256. For larger homes, the homeowner pays $50 for every additional 500 square feet.

The City of Boulder funds the program with revenue from a carbon tax that residents approved in 2006 to fund Climate Action Plan programs. This tax went into effect in 2007 and is authorized until 2013. Boulder County uses property tax revenue to fund its portion of the program.[35]

Evaluation. Boulder collects utility bill data from one year before and one year after each audit. Data from the 15 homes in the 2006 pilot program indicate that participants reduced energy use by 23% for natural gas and 21% for electricity. However, the city cautions that this is a small sample and may include a greater number of participants who were enthusiastic about making changes. For example, at least four of the 15 participants installed solar electric systems after the audit.

Although Boulder has not yet evaluated energy savings from audits conducted in 2007, a sample of the 224 reports indicated that the most commonly recommended improvements were air sealing and insulation.

WASHINGTON, DC

Program Description. In 2006, Washington, DC began offering free energy audits for residents living in single-family homes. The DC program uses the Home Energy Rating System (HERS), an assessment developed by the Residential Energy Services Network (RESNET).

This assessment considers the energy efficiency of insulation, windows, walls, heating and cooling systems, and water heating. It also considers factors such as the solar orientation of the home. HERS assessments include blower door tests and other diagnostic measurements. Based on the inspection, homes receive a rating that allows homeowners to compare their home with other similar homes. Homeowners also receive a comprehensive report that includes finding about the home's energy efficiency and provides recommendations for improvements that will save energy and costs.[36]

RESNET requires HERS programs to use certified inspectors for the home inspections and certified raters to produce the final report. The DC Office of Energy contracts with a private firm, selected through a competitive bidding process, to provide the inspections and final reports.

[35] Boulder County also subsidizes home energy audits through the CRC in other parts of the County.
[36] Energy Ratings and Mortgages. Residential Energy Services Network. Accessed 2/7/08. http://www.resnet.us/ratings/overview/default.htm.

Staff in the DC Office of Energy provide support for the program by conducting preliminary interviews with applicants and obtaining permission to get copies of utility bills from the past year. Staff pass this information on to the contractor for use during the HERS inspection and rating process. Staff also do outreach to advertise the program, monitor the contractor, and engage in evaluation activities.

Introduction and Implementation. The District of Columbia Retail Competition and Consumer Protection Act of 1999 requires the DC Public Service Commission (Commission) and the DC Office of Energy to establish programs to assist low-income residents with utility costs, increase use of renewable energy sources, and promote energy efficiency.

The Act also establishes the Reliable Energy Trust Fund to pay for these programs. Revenue for the fund comes from a per kilowatt hour surcharge that DC utility users pay on their electric bills. The utility company transfers funds collected from the surcharge to the City. In 2004, the Commission approved the HERS program as a two-year pilot to promote energy efficiency.

During initial implementation, the program staff report difficulties in finding a RESNET certified contractor to conduct the audits and provide the HERS reports. In October 2006, a contractor from outside the DC region bid on and was awarded the contract, under which the firm provided 640 audits through September 2007. In August 2007, the contract came up for bid again and was awarded to a local firm that serves as the current contractor.

Costs and Sources of Funding. Currently, the City pays $410 per audit and has an annual budget of $800,000. Funding for the program comes from the Reliable Energy Trust Fund. This funding is currently authorized through September 2008.

Evaluation. As of January 2008, the DC HERS program had completed 870 audits. An evaluation done by an independent contractor in June 2007 surveyed program participants about program satisfaction and implementation of recommendations. Over 400 program participants received surveys by mail or email. The program received 134 responses. Survey results indicated that:

- 76% of respondents believed the information they received during the HERS audit was "useful" or "extremely useful", and 73% believed the audit was "useful for making a decision to reduce energy use in their home."
- Approximately 53% (71) of respondents made improvements to their home based on the results of the energy audit. The most commonly reported improvement was caulking, weatherstripping, and other measures to seal leaks. Other common actions were adding insulation and replacing windows or doors. Of those who had not made improvements, cost was an often cited barrier.

- At the time of the survey, 21% of respondents reported energy savings as a result of the audit, 40% reported not experiencing savings, and 36% said it was too early to determine results.
- Respondents would like the DC Office of Energy to provide a list of recommended contractors to make improvements to their homes.

ARLINGTON COUNTY, VIRGINIA

Program Description. Arlington County began an initiative to reduce greenhouse gas emissions in 2000. In 2007, this initiative, known as Fresh AIRE (Arlington Initiative to Reduce Emissions), offered 20 free home energy audits to County residents. The goal of the audits was to increase awareness of ways to save energy and to create case studies to use as promotional tools for Fresh AIRE.

The audits were available regardless of the type of home (e.g., single-family or apartment) and to both homeowners and renters. Arlington received over 300 applications and randomly selected 20 homes.

County staff administered the program, but Arlington contracted with a private firm to conduct the audits. The three-hour audits included both a blower door test and thermal scanning with an infrared camera.

Introduction and Implementation. County staff initiated the program, and received support from the chair of the Fresh AIRE initiative. Although staff had concerns about finding a qualified auditor, they found that rising energy costs and increasing concern for energy conservation had already brought qualified auditors to Virginia.

Costs and Funding. Arlington paid $280 per audit. In 2007, program funding came from discretionary money in the County's General Fund. The County plans to continue the program in 2008, and the ongoing funding will be part of Fresh AIRE. Funding for Fresh AIRE comes from the County's residential utility tax.

Evaluation. Arlington has not conducted an evaluation, however, the county is preparing case studies from the 20 audits conducted in 2007. They plan to do additional evaluation after they complete more audits in 2008.

SECTION 3: CLIMATE ACTION PLANS

Proposed Montgomery County Council Bill 32-07, as introduced by the Council on November 20, 2007, would require that the Department of Environmental Protection prepare a Climate Protection Plan to reduce countywide greenhouse gas emissions to 80% below base-year inventory levels by 2050. As currently proposed, the Protection Plan would intend to stop increasing countywide greenhouse gas emissions by 2010 and achieve a 10% reduction every 5 years through 2050.

I. Introduction

In an effort to enhance the Council's understanding of the contents, results, costs, and other features of climate protection plans, OLO reviewed information on carbon reduction practices, programs, and policies that have been implemented by other local jurisdictions as part of a formal climate action plan.[37]

Many counties, cities, and states, both small and large, have adopted or are in the process of adopting climate action plans. In general, a climate protection plan is a plan developed by a local government that lists a series of actions that the government will take to reduce greenhouse gas emissions. The proposed initiatives and level of detail in the plan can vary widely from one government to another.

OLO reviewed literature on climate plans, and also reviewed climate action plans from over 30 different jurisdictions. This section summarizes the climate action plans for five jurisdictions were able to provide quantifiable progress results for carbon dioxide (CO_2) reduction efforts, and/or detailed program cost and funding information.

II. Executive Summary

OLO found that many jurisdictions have adopted climate action plans over the past two years, and as a result are still in the early stages of program design and implementation.

However, OLO also found some jurisdictions that were "early adopters" of climate protection plans and that have also completed periodic updates or assessments of their progress in meeting action plan goals. In addition, OLO found some action plans that included detailed cost breakdowns for plan implementation.

OLO found that many of the CO_2 reductions quantified by the jurisdictions reviewed are largely attributable to a small number of actions and/or primarily occurred in one sector. Commonly cited successful programs include capturing methane gas from landfills, purchasing renewable energy, converting traffic signals to LED lights, and implementing or improving recycling services.

[37] This section uses the terms "climate protection plan" and "climate action plan" synonymously.

OLO also found that climate action plan programs evidenced little progress in reducing CO_2 emissions within the transportation sector. Even in jurisdictions that showed decreases in overall CO_2 levels, CO_2 emissions in the transportation sector increased.

OLO summarized the climate action plans, results, costs, and evaluation information from five jurisdictions. Specific highlights from each jurisdiction include:

Portland/Multnomah County, Oregon

- 2004 CO_2 emissions were 4% lower than 2001 levels and nearly on par with 1990 levels, with the highest decreases from within the industrial sector.
- The statewide Energy Trust of Oregon is cited as a key factor in the successful implementation of action plan programs because it provides consistent funding.

Miami-Dade County, Florida

- From 1988 to 2005, overall CO_2 emissions increased by 8.5 million tons (36%).
- Program specific data show an annual average reduction of 2.5 million tons of CO_2, with 84% of the CO_2 reduction from within the solid waste sector.

City of St. Paul, Minnesota

- St. Paul reports 2004 CO_2 reductions of 950,000 tons per year, 40% of its 1993 reduction goal.
- The highest CO_2 decreases have come within energy efficiency and energy supply programs.

City of Seattle, Washington

- Seattle reports 2005 CO_2 emissions were 8% lower than 1990 levels, with the highest decreases in the residential and industrial sectors.
- Seattle's adopted 2007-2008 budget included $1.7 million for climate action plan programs in 2007 and $1.1 million in 2008.

City of Boulder, Colorado

- Boulder funds its climate action plan programs through a dedicated carbon tax approved by voters in 2006 that generates about $1 million annually.
- Boulder estimates spending $5.6 million between 2007 and 2012 to reduce 350,000 tons of CO_2 emissions, which results in an estimated cost to the city of $16 per ton of CO_2 reduced.

III. General Research Findings

A 2007 study from the Institute for Local Self-Reliance (ILSR) looked at formal climate change efforts among a subset of local governments.[38] The ILSR report reviewed climate change activities in 10 cities that had signed onto the U.S. Mayor's Climate Protection Agreement.[39] The selected cities were viewed as having successful and effective programs.

[38] Institute for Local Self-Reliance, *Lessons From the Pioneers: Tackling Global Warming at the Local Level*, January 2007.

[39] The Mayor's Climate Protection Agreement is an agreement where supporting mayors pledge to reduce carbon dioxide emissions by 7% below 1990 levels by 2012. The 10 cities reviewed are Austin, TX; Ann Arbor, MI; Berkeley, CA; Boulder, CO; Cambridge, MA; Minneapolis, MN; Portland, OR; San Francisco, CA; Salt Lake City, UT; and Seattle, WA.

The general conclusion of the ILSR report is that:

> "…despite their commitment and their elaboration of significant programs, reducing [greenhouse gas] emissions below 1990 levels will be a major challenge."[40]

Specific findings and "lessons learned" from the report include:

- The methodologies and assumptions used to create greenhouse gas inventories differ among communities.

- Many of the CO_2 reductions to date have come from a relatively small number of "targets of opportunity" under the control of a local jurisdiction. For example, many quantified reductions have come from capturing and/or flaring methane gas, purchasing renewable energy, and switching traffic signals to LED technologies.

- The different carbon content of fuels used to generate electricity creates emission variations among cities. For example, cities that receive electricity from coal fired power sources have a higher percentage of emissions from the electricity sector than cities with non-coal power sources.

- Some cities are relying on state or federal government to implement policies that will allow them to achieve their carbon reduction goals. This strategy is problematic if those policies are never implemented.

IV. Jurisdictional Findings

This part reviews climate protection plans and experiences of five jurisdictions. The table below lists the jurisdictions and the page where each description begins.

[40] Institute for Local Self-Reliance, January 2007, pg. 5.

CITY OF PORTLAND-MULTNOMAH COUNTY, OREGON

The City of Portland, Oregon – located within Multnomah County – was the first U.S. city to adopt a carbon dioxide (CO_2) reduction plan in 1993. In 2001, the City of Portland and Multnomah County created a joint climate action plan.[41] The Portland/Multnomah plan adopted a CO_2 reduction target of 10% below 1990 levels by 2010.

In 2001, when Portland/Multnomah County adopted its climate plan, a greenhouse gas emission inventory estimated that the region produced about 10.1 million metric tons of CO_2 annually, broken down by sector as detailed below:

- Transportation 36%
- Commercial 25%
- Residential 21%
- Industrial 16%
- Solid Waste 2%

Climate Plan Elements. The Portland/Multnomah County climate plan has six focus areas for reducing carbon emissions:

1) Policy, Research, and Education;
2) Transportation, Telecommunications, and Access;
3) Energy Efficiency;
4) Renewable Resources;
5) Solid Waste Management; and
6) Forestry and Carbon Offsets.

Each of the six focus areas includes one or more objectives. Within each objective, the plans lists several specific activities intended to reduce carbon emissions – identified as either Government Actions or Community Initiatives. In total, the six focus areas include around 150 total initiatives.

Progress/Results. In June 2005, Portland and Multnomah County published a progress report updating the status of the climate plan.[42] Overall, the progress report indicates that greenhouse gas emissions decreased in the region. The progress report states that 2004 CO_2 emissions were nearly 400,000 tons lower than 2001 levels, a 4% decrease. The decreasing emissions put the County's 2004 emission levels nearly on par with 1990 levels.

Additionally, the progress report indicates that the emissions have decreased even when accounting for population. The progress report states that emissions levels decreased from 15.07 tons of CO_2 per capita in 2001 to 14.42 tons of CO_2 per capita in 2004.

[41] City of Portland and Multnomah County, *Local Action Plan on Global Warming*, April 2001.
[42] City of Portland and Multnomah County, *A Progress Report on the City of Portland and Multnomah County Local Action Plan on Global Warming*, June 2005.

The table below shows the change in CO_2 emissions levels by sector. The data show that of the nearly 400,000 tons of CO_2 reduced since 2001, 78% is attributed to decreases in the industrial sector. Transportation is the only sector that, despite reduction efforts, had higher CO_2 emissions levels in 2004 than in 2001.

Table 3-1. 2001 and 2004 Multnomah County Greenhouse Gas Emissions by Sector

Sector	2001 Tons of CO_2	2004 Tons of CO_2	Difference	
			Total	%
Transportation	3,691,624	3,731,390	39,766	1.1%
Commercial	2,499,812	2,485,205	-14,607	-0.6%
Residential	2,111,515	2,058,750	-52,765	-2.5%
Industrial	1,598,728	1,296,749	-301,797	-18.9%
Solid Waste	177,957	118,855	-59,102	-33.2%
Total	**10,079,636**	**9,690,949**	**-388,687**	**-3.9%**

Source: *A Progress Report on the City of Portland and Multnomah County Local Action Plan on Global Warming*, 2005

According to the progress report, over 50 of the 150 total initiatives had been implemented by 2005. The list below describes several of the initiatives highlighted by the progress report as successful in moving towards the CO_2 emissions goals. Some of the initiatives include usage or activity data, while other initiatives include data on either estimated or actual emission reductions.

- Portland has purchased and/or generated 11% of its energy usage (47.9 million kWh) for city facilities from renewable energy sources. Multnomah County purchases 3% of the power used by county facilities from renewable sources.

- Portland has converted more than 13,000 traffic signals to LED lights, saving 4.9 million kWh per year and 2,300 tons of CO_2 emissions annually.

- The Cool Portland Campaign organized citizen-led teams pledging to incorporate CO_2-reducing actions into daily activities, and was provided technical assistance and workspace by Portland. Over seven months in 2002, 92 participating households reduced their CO_2 emissions by 250 tons per year on average.

- Between 2001 and 2003, Portland reports weatherizing 261 residential homes and Multnomah County reports weatherizing 826 homes to help reduce energy consumption and optimize energy efficiency.

- Portland has facilitated the installation of energy-conservation measures – efficient thermostats, low-flow showerheads, improved insulation, and insulated windows – in over 10,000 apartment units.

- As of February 2003, a total of 3.4 million square feet of commercial space in Portland were in LEED-certified or registered buildings.

- As of 2004, 6% of residential and commercial customers in Portland purchased green power.

- Portland has purchased 30 new hybrid-electric vehicles since 2001. Multnomah County uses biodiesel for its fleet vehicles with diesel engines.

Program Costs and Sources of Funding. Portland/Multnomah County's climate action plan and progress report do not include any program cost data. However, the progress report lists the establishment of the Energy Trust of Oregon and its "consistent funding for energy-efficiency and renewable energy programs" as a factor in the successful implementation of action plan programs.

The Energy Trust of Oregon is a statewide organization that was established through Oregon legislation that restructured the state's electricity utilities. The Energy Trust began operating in March 2002, and administers energy efficiency and renewable energy programs to customers of Oregon's electricity utilities. The Energy Trust programs are funded through a 3% surcharge on electric bills.

While the Energy Trust breaks down program expenditures by utility service area instead of governmental jurisdictions, in 2006 it reports spending $45 million on energy efficiency programs and $2.6 million on renewable energy programs statewide.[43] The progress report states that between 2002 and 2004, Energy Trust programs provided energy-efficiency incentives to over 200 businesses and 14,000 households in Multnomah County.

MIAMI-DADE COUNTY, FLORIDA

In 1993, the Miami-Dade County Board of Commissioners approved a CO_2 reduction plan.[44] The goal of the plan was to reduce Miami-Dade's CO_2 emissions 20% below baseline 1988 levels. Miami-Dade's 1988 baseline inventory estimated that the region produced approximately 23.4 million tons of CO_2 annually, broken down by sector as detailed below:

- Electrical Usage 45%
- Transportation 45%
- Industrial 5%
- Commercial 4%
- Residential 1%

[43] Energy Trust of Oregon, *Leading Change: 2006 Annual Report*, pg. 14.
[44] Miami-Dade County, *A Long Term CO_2 Reduction Plan for Metropolitan Dade County*, November 1993.

Climate Plan Elements. Miami-Dade's emissions reduction plan included four categories with specific initiatives and CO_2 reduction targets. The plan estimated that the proposed measures could reduce over 11 million tons of CO_2 annually.

1) Transportation
- Mass transit & road improvements
- Traffic demand management
- Increase bicycle pedestrian modal split
- Increase fuel efficiency

2) Solid Waste
- Recycle 30-50% of Dade County's waste stream
- Recover and utilize landfill methane gas
- Reduce generated solid waste by up to 5%

3) Electrical Production/Use
- Increase efficiencies of Metro-Dade facilities/operations
- Decrease residential sector energy use
- Expand the use of alternative fuels
- Expand the use of landscaping and white surfaces
- Promote and expand participation in energy conservation

4) Land Use
- Reduce vehicle miles traveled by 5%

Progress/Results. In 2006, Miami-Dade County published a progress report updating the status of its CO_2 reduction plan.[45] A 2005 greenhouse gas inventory indicates that Miami-Dade's total CO_2 level has increased by 8.5 million tons (36%) over baseline 1988 levels. Accounting for population change over that same period, Miami-Dade's per capita emissions have increased by 8%, from 12.5 tons to 13.5 tons of CO2 per person per year.

Table 3-2: 1988 and 2005 Miami-Dade County Greenhouse Gas Emissions by Sector

Sector	1988 Tons of CO_2	2005 Tons of CO_2	Difference	
			Total	%
Electrical Usage	10,459,000	15,448,000	4,989,000	48%
Transportation	10,449,000	14,057,000	3,608,000	35%
Industrial	1,297,000	1,554,000	257,000	20%
Commercial	1,022,000	681,000	-341,000	-33%
Residential	196,000	227,000	31,000	16%
Total	**23,423,000**	**31,967,000**	**8,544,000**	**36%**

Source: *A Long-Term CO_2 Reduction Plan for Miami-Dade County, Florida: 1993-2006*, 2006

[45] Miami-Dade County, *A Long-Term CO_2 Reduction Plan for Miami-Dade County, Florida: 1993-2006*, December 2006.

Despite the overall increase in CO_2 emissions, the progress report provides data that show that some of the programs have successfully reduced CO_2 emissions. Miami-Dade reports that County efforts within the four climate plan categories have led to an annual average reduction of 2.5 million tons of CO_2, about 23% of the original goal of 11 million tons. As shown in the table below, 2.1 million tons (84%) of the CO_2 reduced comes from the solid waste category.

Table 3-3: Miami-Dade CO_2 Anticipated versus Actual CO_2 Reductions

Category	CO_2 Reduction	
	Anticipated (1993)	**Actual (2005)**
Transportation	8,927,000 tons	17,608 tons
Solid Waste	1,753,000 tons	2,091,821 tons
Land Use	172,000 tons	0 tons
Electrical Production/Use	492,610 tons	423,303 tons

Source: *A Long-Term CO_2 Reduction Plan for Miami-Dade County, Florida: 1993-2006,* 2006

Transportation. Miami-Dade's progress report indicates that 17,000 tons in quantifiable CO_2 reductions have primarily resulted from five programs, including:

- A 2.5 mile extension of its light-rail people mover system, completed in 1994 at a cost of $228 million, has led to an estimated annual CO_2 reduction of 1,939 tons.

- A Commuter Services Program initiated in 2002 that encourages alternatives to single occupancy vehicles has resulted in an estimated reduction of 49 million vehicle miles traveled from 2002-2005, and an annual CO_2 reduction of 7,532 tons.

- A Vanpool Program initiated in 1998 resulted in an estimated reduction of 38 million vehicle miles traveled from 1999-2005, and an annual CO_2 reduction of 3,752 tons.

The Miami-Dade progress report also states that the initial CO_2 reduction target from 1993 included over eight million tons saved annually through assumed increases in national fuel efficiency standards that never occurred. As a result, the Miami-Dade report states that, "It is advisable in future plans to avoid relying so heavily on a measure that is completely out of a jurisdiction's control."[46]

Solid Waste. Miami-Dade County began its community recycling program in 1990 for single-family residential, multi-family residential, and commercial sectors. As a result, the County reports an average annual CO_2 reduction of 1.6 million tons per year from recycling. Miami-Dade also initiated a program to recover and flare or use methane gas from its two landfills, leading to CO_2 emission reductions of 449,536 tons per year.

[46] Miami-Dade County, 2006, pg. 13-14.

Electrical Production/Use. The Miami-Dade indicates that progress in reducing CO_2 emissions from electricity use has been achieved in two areas: 1) increasing efficiencies in County facilities/operations; and 2) promoting and expanding participation in energy conservation. Specifically, the progress report states that:

- Implementation of energy performance contracts in County buildings beginning in 2000 has resulted in estimated CO_2 reductions of 5,887 tons per year.

- Converting 300 traffic signals to LED lights through 2003 reduced CO_2 emissions by 148 tons per year, or 0.5 tons per year per signal. Miami-Dade plans to convert all 76,000 of its traffic light signals to LED by the end of 2008, which would result in approximately 38,000 tons of CO_2 reductions annually.

- Florida Light & Power implemented a Demand Side Management Program in 1990 to help individual customers reduce their demand for electricity. This program is credited with helping reduce electricity demand by over 800 megawatts and reducing CO_2 emissions by 168,400 tons per year.

- Retrofitting over 1,000 bus shelters with solar panels to power the lighting needs of the shelters at night has led to CO_2 reductions of 1,794 tons per year.

- Between 1996-2000, 31 private companies participated in a County program funded by EPA's ClimateWise program to implement energy efficiency measures. While federal funding for this program ended in 2001, the report estimates that those companies that participated have achieved emissions reductions of 224,619 tons of CO_2 per year.

Land Use. The strategies in Miami-Dade County's CO_2 Reduction Plan to reduce emissions through the land use sector include encouraging the principles of transit and pedestrian oriented development, and other "smart growth" type planning principles. Miami-Dade was unable to quantify any emissions reductions that resulted from these efforts.

CITY OF ST. PAUL, MINNESOTA

In 1993, St. Paul adopted an Urban CO_2 Reduction Plan to reduce annual CO_2 emissions by nearly 2.5 million tons by 2005, a reduction of 20% from 1988 levels.

Plan Elements and Progress/Results. St. Paul's plan included six strategies to reduce emissions and CO_2 reduction targets for each strategy. A 2004 update to the plan described each strategy and documented CO_2 reductions.[47]

[47] *Summary of Saint Paul Urban CO_2 Emission Reduction Plan*, January 2004.

Table 3-4 compares St. Paul's 1993 anticipated CO_2 reductions with its actual reductions reported in 2004. Overall, St. Paul reports CO_2 reductions of about 950,000 tons per year, or 40% of its 1993 goal. The data show that the primary reductions have come through programs/initiatives in St. Paul's energy efficiency and energy supply strategies.

Table 3-4: City of St. Paul Anticipated and Actual CO_2 Reductions

Strategy	CO_2 Reductions (tons per year)	
	Anticipated (1993)	Actual (2004)
Energy Efficiency	1,354,400	242,800
Diversification of Traffic Sector	731,000	undetermined
Energy Supply	283,200	595,400
Municipal Action Plan	10,800	22,600
Recycling and Waste Prevention	10,800	89,900
Urban Reforestation	3,600	3,100
Total	**2,393,800**	**953,800**

Source: *Summary of Saint Paul Urban CO_2 Emission Reduction Plan*, 2004.

Energy Efficiency. This strategy aims to "reduce energy use through installation of cost-effective efficiency measures such as lighting, air-handling, and insulation in residential, commercial, and industrial sectors." Initiatives highlighted in the report include:

- Implementing a hot water district heating system in downtown Saint Paul, which has reduced CO_2 emissions by 183,100 tons annually; and
- Reducing natural gas usage within St. Paul residential, commercial, and industrial sectors; which has reduced CO_2 emissions by 60,224 tons annually.

Diversification of the Traffic Sector. This strategy would "reduce reliance on automobiles by increasing public transportation options and planning toward reducing the need for private transportation." While St. Paul reports it has implemented several initiatives in this area, any resulting CO_2 reduction is "undetermined."

Energy Supply. This strategy "promote[s] the use of alternative energy sources such as photovoltaic, wind, biomass and fuel cells." The CO_2 reductions in this area have primarily occurred from an initiative to use local wood waste to fuel a combined heat and power plant. St. Paul reports that this alternative energy program has displaced over 100,000 tons of coal and reduced CO_2 emissions by 283,000 tons per year.

Municipal Action Plan. The plan defines this strategy as "City government taking the lead by making equipment changes and being efficient in energy use in City-owned buildings and vehicles." Initiatives highlighted in the report include:

- Purchasing new, energy efficient equipment, which reduced CO_2 emissions by 8,400 tons annually; and
- Converting traffic signals to LED lights, which reduced CO_2 emissions by 1,600 tons annually.

CITY OF SEATTLE, WASHINGTON

In 2006, the City of Seattle published a formal climate action plan.[48] In addition, in 2007 Seattle published an emissions inventory update that compared 1990 and 2005 greenhouse gas emission levels by sector.[49]

Seattle's 2005 greenhouse gas emission inventory estimated that the region produced about 6.6 million tons of CO_2 annually, broken down by sector as detailed below:

- Transportation 61%
- Industrial 20%
- Commercial 12%
- Residential 9%
- Other 1%

Climate Plan Elements. Seattle's Action Plan aims to reduce 686,600 tons of greenhouse gas emissions by 2012 compared to 1990 levels in the following three areas:

1) Achieving more efficient and cleaner energy for homes and businesses (316,000 ton reduction goal);
2) Increasing fuel efficiency and use of biofuels (200,600 ton reduction goal); and
3) Reducing Seattle's dependence on cars (170,000 ton reduction goal).

Progress/Results. Seattle reports an overall reduction in CO_2 emissions of 8% in 2005 compared to 1990. This amounts to per capita emissions that were 11% lower than 1990 levels. The decrease primarily comes from the residential and industrial sectors, as shown in the table below. The transportation sector was the only sector where 2005 CO_2 emissions were higher than 1990 levels.

Table 3-5. City of Seattle County Greenhouse Gas Emissions by Sector, 1990 and 2005

Sector	1990 Tons of CO_2	2005 Tons of CO_2	Difference	
			Total	%
Transportation	3,889,000	4,010,000	121,000	3%
Industrial	1,541,000	1,319,000	-222,000	-14%
Commercial	875,000	816,000	-59,000	-7%
Residential	735,000	612,000	-123,000	-17%
Other	147,000	73,000	-74,000	-50%
Offsets Purchased	--	-216,000	--	--
Total	**7,187,000**	**6,614,000**	**-573,000**	**-8%**

Source: *Seattle's Community Carbon Footprint: an Update*, 2007

[48] City of Seattle, *Seattle, A Climate of Change: Meeting the Kyoto Challenge*, September 2006.
[49] City of Seattle, *Seattle's Community Carbon Footprint: an Update*, October 29, 2007.

Seattle attributes its reduction of CO_2 emissions to below 1990 levels to two main sources:

- The Seattle City Light utility has developed a zero net emissions policy for its electricity supply through investing in conservation, renewable energy sources, and purchasing carbon offsets. Seattle's 2005 CO_2 calculation includes the purchase of 216,000 tons of carbon offsets by the utility.[50]

- Between 1990 and 2005, many Seattle households and businesses converted their energy source from heating oil to natural gas. Natural gas is a less carbon intensive energy source than heating oil, meaning it emits comparatively less CO_2 per unit used.

Evaluation approach. Seattle's climate plan includes a three-tiered strategy for measuring progress in reducing emissions. The first tier measures progress via periodic greenhouse gas emissions inventories, as shown above.

The second tier uses a set of climate protection indicators that Seattle breaks down into three categories, as listed below:

1) ***Transportation Choices, Smart Growth***
   - Per capita vehicle miles traveled
   - Average weekday metro ridership
   - Annual Sound Transit Express ridership
   - Annual Sounder Ridership
   - Downtown bicycle commuters (one-day count)
   - Percentage of Seattle residents living in urban centers/villages

2) ***Clean Energy, Efficient Buildings***
   - Residential per capita electricity use and natural gas use
   - Non-residential per capita electricity use and natural gas use
   - Residential per capita natural gas use
   - Non-residential per capita natural gas use
   - Per capita water consumption
   - Per capita non-recycled waste
   - Percent of waste recycled

3) ***Clean Fuel, Clean Vehicles***
   - Number of biodiesel stations in Seattle

The third measurement tier offers program-specific output measures and/or goals associated with each of the Climate Plan's recommended actions.

[50] Carbon offset refers to reducing or displacing CO_2 in another place.

Program Costs and Sources of Funding. Seattle's adopted 2007-2008 budget included $1.7 million for climate investments in 2007 and $1.1 million in 2008. Seattle's 2007 budget included:

- $375,000 to purchase more climate friendly vehicles and landscaping equipment and to install a biodiesel tank;
- $530,000 to identify and implement energy efficiency measures in City facilities;
- $200,000 to initiate an extensive community awareness and action campaign;
- $100,000 to promote alternatives to single-occupant vehicle travel;
- $100,000 for technical and policy analyses for regional road-pricing systems; and
- $50,000 to increase fuel efficiency and use of biofuels by commercial fleet operators.

CITY OF BOULDER, COLORADO

In 2006, the City of Boulder published a climate action plan.[51] The plan included a 2004 greenhouse gas inventory that showed 1.81 million tons of CO_2 emissions from the city, contributed by the following sectors:

- Commercial 30%
- Transportation 28%
- Residential 17%
- Industrial 15%
- Univ. of Colorado 5%
- Solid Waste 4%
- Street Lighting 1%

Plan Elements. Boulder's plan lists multiple emissions reduction strategies and/or programs within four categories. The categories and their anticipated CO_2 reductions include:

1) Renewable energy and emissions offset strategies (203,778 tons);
2) Energy efficiency strategies to reduce emissions (76,222 tons);
3) Transportation (40,000 tons); and
4) Education and outreach (30,000 tons).

In total, Boulder's plan intends to reduce CO_2 emissions by 350,000 tons from 2004 levels.

Program Costs and Sources of Funding. Boulder residents approved a carbon tax in 2006 dedicated to funding Climate Action Plan programs and initiatives. The City assesses a tax on electricity consumption based on the amount of fossil fuel-based electricity used (e.g., customers purchasing wind power do not have to pay the tax).

[51] *City of Boulder Climate Action Plan*, June 2006.

Boulder estimates that the tax will generate about $1 million annually until 2013, when it is set to expire.[52] The carbon tax rates were designed for the residential, commercial, and industrial sectors to reflect planned program expenditures of 58% of funds to the residential sector, 39% to the commercial sector, and 3% to the industrial sector. As a result, Boulder reports that the average household will pay an additional $1.33 per month and an average business will pay an additional $3.80 per month due to the carbon tax.

To reduce CO_2 emissions to the desired level, Boulder estimates that it will cost approximately $5.6 million between 2007 and 2012. Boulder's Climate Action Plan includes a detailed annual budget for each of the four categories in the plan.

Table 3-6 shows the CO_2 reduction goal for each category, the cumulative 2007-2012 costs, and the corresponding planned cost per ton of CO_2 reduced. Overall, Boulder's Climate Action Plan activities would result in a cost to the City of $16 per ton of CO_2 reduced.

Table 3-6: City of Boulder Estimated Costs and CO_2 Reductions, 2007-2012

Category	Tons of CO_2 Reduced by 2012	Total City Costs, 2007-2012	City Cost per Ton CO_2 Reduced
Energy efficiency	76,222	$3,332,678	$43
Renewable energy	203,778	$539,357	$3
Transportation	40,000	$528,848	$13
Education/Outreach	30,000	$1,190,196	$40
Administration	--	$42,000	--
Total	**350,000**	**$5,633,080**	**$16**

Source: *City of Boulder Climate Action Plan*, 2006

In the Climate Action Plan, Boulder also includes calculations for total estimated private sector investment costs ($36 million), lifetime energy cost savings ($64 million), and utility rebate savings ($10 million) for each of the categories, as applicable. With these estimates factored in, the Action Plan reports that eventually the Boulder community would save $92 for every ton of CO_2 reduced.

Table 3-7: City of Boulder Estimated Community Cost per Ton CO2 Reduced, 2007-2012

Total Costs	Total Savings	Tons of CO_2 Reduced	Community Cost per Ton CO_2 Reduced
$42,161,655	($74,221,900)	350,000	($92)

Source: *City of Boulder Climate Action Plan*, 2006

[52] The City Council set the tax rate at $0.0022 per kWh for residential customers; $0.0004 per kWh for commercial customers; and $0.0002 per kWh for industrial customers. The Council has the authority to increase the rates as needed up to a maximum rate established in law.