A Bottom-up Approach to Setting a Greenhouse Gas Reduction Target for Charlotte, North Carolina

By Shannon Brewer, Emily Martin, Lisa Thompson

Dr. Prasad Kasibhatla, Advisor

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1. EXECUTIVE SUMMARY

In 2007, Charlotte’s City Council passed a resolution directing City staff to: (1) Inventory City Operations Greenhouse Gas (GHG) emissions; (2) Establish aggressive and realistic GHG emission reduction targets; (3) Create an action plan; (4) Prepare a cost-benefit analysis; and (5) Adopt a budget to meet the emission reduction targets. The objective of this Masters Project is to update the inventory of GHG emissions from City operations and recommend a GHG emissions target for the City’s operations, based on research into best practices as well as economic and technical feasibility.

Several considerations are important to the City in the selection of a GHG emission reduction target. First, many other cities have set ambitious emission reduction targets that appear unlikely to be met by their respective target dates. Charlotte does not want to set an unattainable target that fails to consider technical and economic feasibility. In addition, the City hopes to set an example for the community by setting an aggressive target and by making consistent and visible progress towards reducing emissions.

We completed the first part of our research over the summer of 2010. During that time, we interviewed a number of peer organizations, including other municipalities, universities and corporations. The purpose of this stage of our project was to investigate how comparable organizations set GHG emissions reduction targets and to document best practices for climate action planning. Our findings suggest that there is no accepted process for choosing a GHG emissions reduction target and many organizations set targets with little or no analysis into the economic or technical feasibility of achieving that target.

The remainder of our work focused on identifying potential GHG reduction projects for the City and determining alternate emissions reduction scenarios. We decided on a bottom-up approach (starting with individual business units before creating an organization-wide strategy) to fit with Charlotte’s unique decentralized structure. Potential greenhouse gas reduction projects were identified through collaboration with five of the City’s key business units. These projects were incorporated into different scenarios based on several key factors. Using these scenarios as a basis, we believe that the most likely GHG emissions reduction that the City can achieve under current financial, technical, and political constraints is approximately 1% per year.
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2. CITY OVERVIEW

2.1. CITY CONTEXT SUMMARY

Charlotte, North Carolina is the largest city in North Carolina, and the 18th largest city in the U.S. The City’s population according to the 2010 Census is 731,424. Charlotte’s economy is supported by numerous financial institutions, energy companies and motorsports operations. The City has become the second largest financial center in the U.S. after New York City and is also home to multiple Fortune 500 companies.

The City of Charlotte Government is composed of 14 decentralized key business units (KBUs) and operates under a council-manager form of government. The City uses a Balanced Scorecard approach to develop overarching focus areas and priorities. Each KBU is responsible for setting its own targets and metrics within each of the City's focus areas and annual budget constraints. An annual Strategic Operating Plan is created from the Balanced Scorecard and KBU sub-strategies. An overview of the City's strategic development cycle is illustrated at right.

The Strategic Operating Plan is composed of 5 Focus Area Plans: Housing and Neighborhood Development, Community Safety, Transportation and Planning, Economic Development, and Environment.

The City’s environmental projects and policies are incorporated into the City’s Environmental Focus Area Plan. This Plan encompasses a number of projects across multiple KBUs. In addition to the projects developed under the Environment Focus Area Plan, the City is currently undertaking numerous projects using funds from the Energy Efficiency and Conservation Block Grant (EECBG)
that the Department of Energy awarded to the City in 2009. The projects funded through the grant are managed by the City’s Energy and Sustainability Manager.

Finally, the City also addresses environmental issues through a number of policies and programs including the Transportation Action Plan, Sustainable Facilities Policy, Vehicle Policy and a growth framework to guide future development.

Although the City of Charlotte has already implemented many environmental projects, the potential greenhouse gas impact of these actions has not been quantified.

2.2. CITY INVENTORY OVERVIEW

The city of Charlotte’s greenhouse gas inventory reveals the current state of greenhouse gas emissions in the City and how emissions have grown since the last assessment in FY2006. Updating the City’s greenhouse gas inventory further allows us to disaggregate Charlotte’s emissions by KBU, which helped us to focus our efforts on the most greenhouse gas intensive KBUs.

We updated the data and calculations for the FY2009 inventory in compliance with the guidance of the Local Government Operations Protocol (LGOP),¹ which was developed to standardize local government GHG inventories.

2.2.1. EMISSION SCOPES

The LGOP separates GHG emissions into three categories, referred to as “operational boundaries” which allows for more effective GHG management and serves to minimize the potential double counting of emissions.² The categories, also called Scopes, include:

- Direct / Scope 1: Emissions associated with fuel consumption by stationary and mobile combustion sources, and fugitive emissions from refrigerant equipment and landfill sources, directly owned and operated by the City;
- Indirect / Scope 2: Emissions from purchased electricity or steam generated by utilities or service providers; and

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• Optional / Scope 3: Other indirect emissions, such as those from employee commuting and outsourced activities.²

Emissions are organized by Scopes to facilitate the assessment of responsibility associated with GHG emissions. Direct emissions under Scope 1 are those that are under the control of the City. Examples include city-owned or -operated vehicle fleets and closed landfills (see Figure 2.1). Indirect emissions in Scope 2 are the result of the City’s electricity consumption – the power generation is provided by external companies over which the City has no control or operational involvement. Optional emissions included in Scope 3 address all other sources of indirect and direct emissions of which the City has little to no direct operational control or ownership, such as employee commuting – while these emissions are caused by City employees, the vehicle is under the control of the employee and not the City.²
Figure 2.1  Direct and Indirect Emissions Sources\textsuperscript{3}

2.2.2. DATA CATEGORIZATION BY LGOP SECTOR AND KBU

We classified the FY2009 inventory by LGOP sector (e.g., buildings and facilities, streetlights and traffic signals, solid waste facilities) and by KBU.

The LGOP recommends including the following sectors for a standardized and accurate GHG inventory:4

<table>
<thead>
<tr>
<th>LGOP Recommended GHG Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings and Facilities</td>
</tr>
<tr>
<td>Streetlights &amp; Traffic Signals</td>
</tr>
<tr>
<td>Airport Facilities</td>
</tr>
<tr>
<td>Water Delivery Facilities</td>
</tr>
<tr>
<td>Wastewater Facilities</td>
</tr>
<tr>
<td>Solid Waste Facilities</td>
</tr>
<tr>
<td>Vehicle Fleet</td>
</tr>
<tr>
<td>Transit Fleet</td>
</tr>
<tr>
<td>Employee Commute</td>
</tr>
</tbody>
</table>

Further, the City of Charlotte's operations are divided amongst 14 KBUs:

<table>
<thead>
<tr>
<th>Charlotte's 14 Key Business Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
</tr>
<tr>
<td>Business Support Services (includes Fleet)</td>
</tr>
<tr>
<td>Budget &amp; Evaluation</td>
</tr>
<tr>
<td>Charlotte Area Transit System (CATS)</td>
</tr>
<tr>
<td>Department of Transportation</td>
</tr>
<tr>
<td>Police</td>
</tr>
<tr>
<td>Engineering &amp; Property Management</td>
</tr>
<tr>
<td>Finance</td>
</tr>
<tr>
<td>Fire</td>
</tr>
<tr>
<td>Human Resources</td>
</tr>
<tr>
<td>Neighborhood and Business Services</td>
</tr>
<tr>
<td>Planning</td>
</tr>
<tr>
<td>Solid Waste</td>
</tr>
<tr>
<td>Utilities</td>
</tr>
</tbody>
</table>

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We collected raw data for Charlotte’s GHG inventory directly from KBUs, as well as from invoices from Duke Energy and Piedmont Natural Gas. Appendix A describes in detail how the GHG inventory data was collected and how it was assigned to each LGOP and KBU category.

2.2.3. CITY INVENTORY RESULTS

The City of Charlotte’s total GHG emissions for City operations in FY2009 is approximately 310,000 metric tons of carbon dioxide equivalent emissions (CO2e), which is 1.8 percent higher than the emissions in FY2006. Figure 2.2 shows the breakdown of these emissions by the LGOP sectors. Figure 2.3 shows the breakdown of Charlotte’s emissions by KBU.

**Figure 2.2** FY2009 City Operations GHG Emissions by LGOP Sector (MTCO2e)
Figure 2.3  FY2009 City Operations GHG Emissions by KBU (MTCO2e)

*Includes employee commute emissions for City employees not incorporated into a KBU (e.g., city attorney’s office, city clerk’s office).

2.3. SETTING A TARGET

A target can serve many purposes in an organization, from being a source of accountability used to evaluate performance, to acting as a signal that focuses attention on a specific problem. The purpose of a target depends on the intended audience. In this case, the target has two audiences: an internal audience, City staff and City Council, and an external audience, the community. For the internal audience, the purpose of setting a GHG target is to motivate improvement and evaluate performance. However, the external audience will see the target as a signal demonstrating the City’s commitment to the environment. Both audiences should be considered when choosing a target, remembering that the City’s internal emissions are only 3% of the total community’s emissions.
We found several approaches to setting a greenhouse gas target. Some organizations, including Burt’s Bees and Duke University, selected a target based on scientific recommendations. According to the Intergovernmental Panel on Climate Change, a reduction of 80%-95% (below 1990 levels) by 2050 is required to avoid serious environmental impacts. We found only a few organizations with targets in line with these scientific recommendations. Targets this high are considered to be more aspirational than pragmatic and will be difficult to achieve. On the other hand, setting an ambitious target can be a powerful motivator.

Other organizations have chosen a target based on a membership organization’s requirements or other agreements. For example, the majority of member cities of the International Council for Local Environmental Initiatives (ICLEI), have committed to reducing emissions by 15% below baseline values over the next ten to fifteen years. The U.S. Conference of Mayors Agreement requires a 7% reduction from 1990 levels by 2012. Another possible benchmark is the Federal government. President Obama has committed the Federal Government to a 28% reduction from 2008 levels by 2020. Below is a summary of the annualized GHG reduction targets of the organizations mentioned above.

**Figure 2.4 Annualized GHG Targets of Benchmark Organizations**

![Bar chart showing GHG reduction targets]

**US Federal Government** - 2.3%
**Intergovernmental Panel on Climate Change** - 1.3%
**International Council for Local Environmental Initiatives** - 1.0%
**Cities for Climate Protection** - 0.3%
**US Conference of Mayors** - 0.3%

**Figure Notes:**
US Federal Government target is 28% reduction over 12 years.
Intergovernmental Panel on Climate Change target is 80% over 60 years.
ICLEI target (most commonly used target of member cities) is 15% over 15 years.
Cities for Climate Change target is 20% over 60 years.
US Conference of Mayors target is 7% over 22 years.

Finally, organizations may choose to set an emissions reduction target based on technical and economic feasibility. Our analysis is intended to demonstrate what might be possible for the City under various technical and economic scenarios.

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Over the summer of 2010, we interviewed fifteen government organizations, four academic institutions and seven corporations regarding their sustainability plans and greenhouse gas reduction targets. (See Appendix B). From our research and interviews, we discovered that the majority of organizations have chosen an emissions target based on either peer comparison or on the suggestions (or requirements) of a membership organization. We found no instances in our research of targets based on economic or technical feasibility. Instead, the common practice is to choose a target first, and build a strategy to achieve it afterwards.

The following figures show the reduction targets of the surveyed cities, counties, universities, and corporations. The annualized emissions reduction targets of these organizations average 2.3 percent, with a range from 0.3 percent to 7.1 percent. We found that targets ranged from very conservative to very aspirational, but it is too soon to tell if any of these targets will be achieved.

**Figure 2.5 Municipal Annualized Emissions Reduction Targets**

- Austin, TX: 6.7%
- New York, NY: 3.0%
- Oakland, CA: 2.4%
- Tallahassee, FL: 2.0%
- Durham, NC: 2.0%
- Mecklenburg County: 2.0%
- Asheville, NC: 1.6%
- San Jose, CA: 1.3%
- Nashville, TN: 1.3%
- Portland, OR: 1.0%
- Chicago, IL: 0.8%
- Denver, CO: 0.5%
- Boulder, CO: 0.3%

*See Appendix E for details on base and target years. In cases where an organization has more than one target, the most comparable target was used.*
In addition to choosing an appropriate level of GHG reduction, a reporting method must be defined. GHG emissions can be reported as total emissions, per capita emissions, or carbon intensity.\(^6\) Emissions can also be reported on a gross basis or a net basis. Gross emissions do not subtract for carbon absorption, while gross (or aggregate) emissions account for carbon capture and storage, as well as carbon absorbed from forests, tree coverage and agricultural soils. The figure below summarizes these alternative reporting methods. We strongly recommend using a gross total emissions target because it is credible and comparable to other cities. In addition, setting a total emissions target is essential to achieving real climate protection gains.

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\(^6\) Carbon intensity is defined as the amount of carbon by weight emitted per unit of energy consumed.
Figure 2.8   Technical GHG Target Considerations

**Total Emissions vs. Per Capita Emissions vs. Carbon Intensity**

- EPA Climate Leaders recommends that corporations use either an absolute or intensity target.
- Wachovia chose an absolute target after industry research led the company to believe that this measure was the most credible.
- All organizations interviewed with targets set absolute targets, but a few cities set additional per capita targets.
- “Total emissions goals are stronger than goals based on limits to carbon intensity or per capita limits.”*
- “Per capita goals or intensity goals leave room for total GHG emissions to increase”

**Gross Emissions vs. Net Emissions**

- Most US cities have gross emissions goals
- The IPCC reporting system, Kyoto Protocol and U.S. Mayors Climate Protection Agreement recognizes aggregate emissions (Aggregate emissions include carbon capture and storage, forests and tree coverage, and agricultural soils.)

**Time Horizon**

- A ten-year target was considered to be the minimum time frame for seeing meaningful results
- Many organizations set multi-year targets intended to balance both short-term and long-term projects
- EPA Climate Leaders recommends that corporations set a 5 to 10 year target.
- Wachovia’s local sustainability director recommends a 10-year horizon to allow sufficient time for culture change to occur.
- 35% of organizations surveyed used a 5-year horizon, 46% used 10 years and 35% had targets longer than 10 years.

3. KBU SUB STRATEGIES

3.1. DESCRIPTION OF DECENTRALIZED CITY OPERATIONS

Because Charlotte operates on a decentralized governance model, we decided to work with individual KBUs to analyze potential reductions, current projects, and potential targets. Furthermore, each KBU sets its budget independently within the Council policy framework and annual budget processes, so this approach is in line with the eventual budgeting and capital planning process that will accompany our GHG reduction recommendations. We chose to work with the following five KBUs, which represent over 75 percent of emissions from City activities:

1. Aviation
2. Business Support Services: Fleet
3. Charlotte Area Transit System (CATS)
4. Engineering and Property Management (EPM)
5. Utilities

We believe that these 5 KBUs are representative of the city as a whole, in terms of size, project type, budgeting process, and culture, and that recommendations for these KBUs can be scaled up to address the other 25% of city emissions not covered in our analysis.

3.2. KBU SUMMARIES

Although the City’s KBUs are decentralized and independent, they share a similar planning process. In each KBU, a leadership team chooses strategic initiatives and programs for the business unit. The KBU must get budget approval from city council annually to implement its selected projects. A description of the core business and strategic priorities for each KBU are provided below.

Once we identified the 5 KBUs with the highest potential impact to the City’s emissions, we scheduled a series of meetings to with each of the KBUs to determine what GHG reduction projects were already under way, and what other projects were being considered. From these conversations, we developed a “menu” of GHG reduction projects for each KBU. Projects were generated by 1) research by our team into best practices in GHG reduction, 2) studies already completed by KBUs, and 3) past experience and current projects. We only included projects from
Charlotte’s “Energy Road Map for Energy Efficiency and Conservation Block Grant (EECBG) Funds” when these projects were KBU-specific. Many of Charlotte’s EECBG projects are city-wide or community-wide, and thus don’t fit our bottom-up approach because they are not associated with a specific KBU or are focused on community, not City Operations, impacts.

### 3.2.1. ENGINEERING AND PROPERTY MANAGEMENT

Charlotte’s Engineering and Property Management (EPM) KBU manages the design, construction, and maintenance of city infrastructure. They also provide regulatory service support and building management services. EPM oversees a broad range of project activities, including:

**EPM Project Activities**

- Planning, contracting, surveying and other services related to new construction
- Environmental compliance services
- Management and maintenance of all public buildings
- Landscaping
- Permitting
- Maintenance of the City’s storm water system
- Roadway improvement

In FY2010-11, EPM’s appropriations were $995 million for active projects, with an additional $222 million anticipated in the next year.\(^7\)

EPM’s core values include:

- **Promote and Preserve Business Vitality.** Economic development drives Charlotte’s growth, and a vibrant business climate is development’s lifeblood. The quality of our regulatory processes, infrastructure projects, property transactions and contracting for goods and services can all have a positive impact on the City’s business environment.

- **Champion Sustainability.** To reinforce the long-term livability of this community, our decisions must protect and enhance our environment, provide transportation choices and conserve our resources.

- **Deliver Outstanding Citizen Service.** The linkage between our community and City Council’s Focus Areas is made stronger by comprehensive citizen service. How we serve citizens helps them better understand how to serve themselves and their neighbors. Every time we engage citizens, they see our people as the voice and face of the City organization.

\(^7\) EPM Strategic Plan, 2011
EPM GREENHOUSE GAS INVENTORY

The total emissions from Charlotte’s Engineering and Property Management Department were approximately 30,000 metric tons of CO2e in FY2009, which is about 10 percent of the total emissions from city operations.

As shown in Figure 3.1, city-owned and operated buildings are the main portion of EPM’s greenhouse gas emissions at 24 percent. Police stations account for 14 percent, and fire stations account for 11 percent of emissions. The Charlotte Mecklenburg Government Center also contributes 14 percent to EPM’s GHG emissions.

Figure 3.2 shows the EPM’s GHG emissions by fuel type. 85 percent of the EPM’s emissions are from electricity and 11 percent is from natural gas used to operate city buildings.

**Figure 3.1  2009 EPM GHG Emissions by Source**
GREENHOUSE GAS REDUCTION PROJECTS

EPM maintains a sustainable energy plan, which is updated yearly. Activities in the plan include:

- **CONTINUOUS RETUNING OF RUN TIMES, SCHEDULING, AND SETBACKS**
- **AT LEAST ONE RETROCOMMISSIONING PER YEAR**
- **RESEARCH INTO TWO NEW TECHNOLOGIES PER YEAR (E.G., VENDING MISERS, LEDS)**
- **AT LEAST ONE BUILDING ENVELOPE (E.G., INSULATION, AIR CURTAIN, NEW ROOF) PROJECT PER YEAR**

EPM also has a policy of conducting life cycle costing for projects over 20,000 square feet. Since 1998, EPM has saved 26,300 metric tons of CO2e and saved the City $7.8 million dollars through projects such as:

- **VARIABLE SPEED DRIVES**
- **WEB-BASED DDC CONTROLS SYSTEM AT 85 CITY FACILITIES**
- **HIGH EFFICIENCY CONDENSING HOT WATER BOILERS**
- **VENDING MISERS**
- **BUILDING ENVELOP INSULATION, WINDOWS, SEALING**

In addition to these already completed projects, we identified the GHG project opportunities shown in Table 3.1 through a series of meetings with City staff. The majority of EPM’s GHG emissions are due to City buildings, so we organized these projects by facility name.
<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Electricity Savings Potential (kWh)*</th>
<th>Annual Natural Gas Savings Potential (therms)*</th>
<th>Greenhouse Gas Reduction Potential (MTCO2e)**</th>
<th>Estimated Annual Cost Savings ($/year)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Hall, T12 to T8 2x4ft</td>
<td>62,700</td>
<td>32.9</td>
<td>$3,887</td>
<td></td>
</tr>
<tr>
<td>City Hall, T12 to T8</td>
<td>50,043</td>
<td>26.2</td>
<td>$3,103</td>
<td></td>
</tr>
<tr>
<td>City Hall, VFD to condenser water pumps</td>
<td>25,529</td>
<td>13.4</td>
<td>$1,583</td>
<td></td>
</tr>
<tr>
<td>City Hall, Ventilation fans for bathroom</td>
<td>1,071</td>
<td>2,101</td>
<td>11.7</td>
<td>$2,510</td>
</tr>
<tr>
<td>City Hall, OA reset for boiler</td>
<td>991</td>
<td>5.3</td>
<td>$1,153</td>
<td></td>
</tr>
<tr>
<td>City Hall, Energy misers</td>
<td>8,723</td>
<td>4.6</td>
<td>$541</td>
<td></td>
</tr>
<tr>
<td>City Hall, Low flow aerators</td>
<td>800</td>
<td>4.2</td>
<td>$930</td>
<td></td>
</tr>
<tr>
<td>CMPD Headquarters, Garage Ventilation</td>
<td>82,870</td>
<td>43.4</td>
<td>$5,138</td>
<td></td>
</tr>
<tr>
<td>CMPD Headquarters, Garage Lighting Control</td>
<td>63,072</td>
<td>33.0</td>
<td>$3,910</td>
<td></td>
</tr>
<tr>
<td>CMPD Headquarters, AHU MAT Control</td>
<td>11,447</td>
<td>151</td>
<td>6.8</td>
<td>$885</td>
</tr>
<tr>
<td>CMPD Westover Division, Hot water boiler upgrade</td>
<td>3,050</td>
<td>16.2</td>
<td>$3,547</td>
<td></td>
</tr>
<tr>
<td>CMPD Westover Division, VFDs for pumps</td>
<td>13,120</td>
<td>6.9</td>
<td>$813</td>
<td></td>
</tr>
<tr>
<td>Mint Museum, VFDs for CHW Pump</td>
<td>161,010</td>
<td>84.4</td>
<td>$9,983</td>
<td></td>
</tr>
<tr>
<td>Mint Museum, Lighting upgrade</td>
<td>82,986</td>
<td>43.5</td>
<td>$5,145</td>
<td></td>
</tr>
<tr>
<td>Mint Museum, Scheduling: AHU</td>
<td>46,427</td>
<td>24.3</td>
<td>$2,878</td>
<td></td>
</tr>
<tr>
<td>Police &amp; Fire Academy, Hot water heater upgrade</td>
<td>1,450</td>
<td>7.7</td>
<td>$1,686</td>
<td></td>
</tr>
<tr>
<td>Animal Control, T8 and centrifugal chiller (Lime Energy Report)</td>
<td>225,885</td>
<td>118.4</td>
<td>$14,005</td>
<td></td>
</tr>
<tr>
<td>Animal Control, BMS programmed for night setback</td>
<td>411</td>
<td>690</td>
<td>3.9</td>
<td>$828</td>
</tr>
<tr>
<td>CATS Bus Wash, Replace 400w metal halides with T5s in bus wash area</td>
<td>72,334</td>
<td>37.9</td>
<td>$4,485</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Programmable thermostats</td>
<td>36,632</td>
<td>1,113</td>
<td>25.1</td>
<td>$3,566</td>
</tr>
<tr>
<td>CATS Bus Wash, Replace Gas Furnace and HP</td>
<td>18,400</td>
<td>9.6</td>
<td>$1,141</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>RHB</td>
<td>SMH</td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----</td>
<td>-----</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Ceiling Fan to redirect heat in winter</td>
<td>1,600</td>
<td>8.5</td>
<td>$1,861</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Timers on roof fans</td>
<td>4,188</td>
<td>864</td>
<td>6.8</td>
<td>$1,264</td>
</tr>
<tr>
<td>CATS Bus Wash, T12 to T8</td>
<td>10,707</td>
<td>5.6</td>
<td>$664</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Timers for roof fan in tire service area</td>
<td>3,257</td>
<td>619</td>
<td>5.0</td>
<td>$922</td>
</tr>
<tr>
<td>CATS Bus Wash, Energy misers</td>
<td>8,723</td>
<td>4.6</td>
<td>$541</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Insulate garage doors</td>
<td>573</td>
<td>3.0</td>
<td>$666</td>
<td></td>
</tr>
<tr>
<td>CATS Bus Wash, Timers of roof fans for bathrooms</td>
<td>814</td>
<td>438</td>
<td>2.8</td>
<td>$560</td>
</tr>
<tr>
<td>CATS Bus Wash, Roof Fan timer for compressor room</td>
<td>2,443</td>
<td>1.3</td>
<td>$151</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Metal halide to T5 in high bays</td>
<td>106,378</td>
<td>55.7</td>
<td>$6,595</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, VAV Setback via BMS</td>
<td>70,340</td>
<td>2,778</td>
<td>51.6</td>
<td>$7,592</td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, OA reset for boiler</td>
<td>37,380</td>
<td>2,620</td>
<td>33.5</td>
<td>$5,365</td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Program VFDs for hot water pumps</td>
<td>61,941</td>
<td>32.5</td>
<td>$3,840</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Metal halide to T5 in maintenance shop</td>
<td>49,528</td>
<td>26.0</td>
<td>$3,071</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Timers for toiler exhaust fans</td>
<td>13,352</td>
<td>7.0</td>
<td>$828</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Reduce domestic HW setpoint</td>
<td>793</td>
<td>4.2</td>
<td>$922</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Turn off maintenance lights</td>
<td>5,694</td>
<td>3.0</td>
<td>$353</td>
<td></td>
</tr>
<tr>
<td>CATS Light Rail Maintenance Facility, Delamp restrooms</td>
<td>3,400</td>
<td>1.8</td>
<td>$211</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Metal Halide to induction in high bay</td>
<td>679,765</td>
<td>356.2</td>
<td>$42,145</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Delamp High Bays</td>
<td>383,100</td>
<td>200.7</td>
<td>$23,752</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Metal Halides to Induction for Pain Shop</td>
<td>322,331</td>
<td>168.9</td>
<td>$19,985</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Metal Halide to Induction for bus shelter</td>
<td>111,821</td>
<td>58.6</td>
<td>$6,933</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Delamp Metal</td>
<td>85,275</td>
<td>44.7</td>
<td>$5,287</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>CFM</td>
<td>Btu</td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>--------</td>
<td>-----</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Halides</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Admin offices, use bi level ballasts</td>
<td>33,133</td>
<td>17.4</td>
<td>$2,054</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Delamp Pain Shop</td>
<td>26,674</td>
<td>14.0</td>
<td>$1,654</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Energy Misers</td>
<td>23,760</td>
<td>12.4</td>
<td>$1,473</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Photosensors</td>
<td>12,883</td>
<td>6.8</td>
<td>$799</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Halogen to CFL</td>
<td>5,455</td>
<td>2.9</td>
<td>$338</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Motion Sensors</td>
<td>3,697</td>
<td>1.9</td>
<td>$229</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Motion Sensors Admin Building</td>
<td>2,962</td>
<td>1.6</td>
<td>$184</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Motion Sensors Paint Shop</td>
<td>2,062</td>
<td>1.1</td>
<td>$128</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Motion Sensors Rest Rooms</td>
<td>1,853</td>
<td>1.0</td>
<td>$115</td>
<td></td>
</tr>
<tr>
<td>CATS S Tryon, Delamp Main Building</td>
<td>1,389</td>
<td>0.7</td>
<td>$86</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, New chillers (water cooled) and VFDs on cooling tower and condenser water pumps</td>
<td>247,765</td>
<td>129.8</td>
<td>$15,361</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, T12 to T8 and magnetic ballasts and occupancy sensors</td>
<td>165,562</td>
<td>86.8</td>
<td>$10,265</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, New condensing boiler</td>
<td>2,371</td>
<td>12.6</td>
<td>$2,757</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, OA reset for boiler</td>
<td>810</td>
<td>4.3</td>
<td>$942</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, Restroom ventilation fans</td>
<td>7,782</td>
<td>4.1</td>
<td>$482</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, Energy Misers</td>
<td>4,374</td>
<td>2.3</td>
<td>$271</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, VFDs on chilled water pumps</td>
<td>3,282</td>
<td>1.7</td>
<td>$203</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, New elevator motor</td>
<td>1,080</td>
<td>0.6</td>
<td>$67</td>
<td></td>
</tr>
<tr>
<td>CMU Brookshire, New motor for chiller and boiler water pumps</td>
<td>842</td>
<td>0.4</td>
<td>$52</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Reducing AHU run times</td>
<td>72,533</td>
<td>38.0</td>
<td>$4,497</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Metal halide in warehouse to induction</td>
<td>15,380</td>
<td>8.1</td>
<td>$954</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Metal halide to induction for exterior</td>
<td>13,359</td>
<td>7.0</td>
<td>$828</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Motion sensors</td>
<td>9,137</td>
<td>4.8</td>
<td>$566</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, CFL swap</td>
<td>8,212</td>
<td>4.3</td>
<td>$509</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------</td>
<td>------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Delamping</td>
<td>5,486</td>
<td>2.9</td>
<td>$340</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, DHW setpoint reduction</td>
<td>5,220</td>
<td>2.7</td>
<td>$324</td>
<td></td>
</tr>
<tr>
<td>CMU General Commerce, Timers for restroom fans</td>
<td>4,172</td>
<td>2.2</td>
<td>$259</td>
<td></td>
</tr>
<tr>
<td>Spratt Street, Setbacks</td>
<td>1,340</td>
<td>2,260</td>
<td>12.7</td>
<td>$2,711</td>
</tr>
</tbody>
</table>

*Energy savings estimates were gathered from EPM staff. General efficiency projects were assumed to save 10% over baseline emissions.

**CO2 savings were calculated using 5.24x10^4 MTCO2e/kWh for electricity (in 2009, improving 1% annually), and 5.31x10^-3 MTCO2e/therm for natural gas.**

***Cost savings calculated based on average prices of $0.062/kWh (city operations average) and $1.163/therm (EIA data for North Carolina)^9.***

3.2.2. UTILITIES

Charlotte Mecklenburg Utilities (CMU) serves over 775,000 people in the City of Charlotte and surrounding areas. CMU operates three water treatment and five wastewater treatment facilities to provide safe access to drinking water for its customers. CMU was recently awarded EPA's Safe Drinking Water Act Excellence Award for providing consistently superior drinking water treatment and safe delivery to citizens.

Charlotte Mecklenburg Utilities facilities consist of:

**WATER TREATMENT PLANTS**

- Franklin - 181 million gallons per day (mgd) capacity
- Lee S. Dukes – 25 mgd capacity
- Vest – 36 mgd capacity

**WASTEWATER TREATMENT PLANTS**

- Irwin Creek – 15 mgd capacity
- Mallard Creek – 12 mgd capacity

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^10 http://charmecck.org/city/charlotte/Utilities/Pages/Home.aspx
- McAlpine Creek – 64 mgd capacity
- McDowell Creek – 12 mgd capacity
- Sugar Creek – 20 mgd capacity

**UTILITIES GREENHOUSE GAS INVENTORY**

The total emissions from Utilities were approximately 82,000 metric tons of CO2e in FY2009, which is about 26 percent of the total emissions from city operations.

As shown in Figure 3.3, the McAlpine Creek Wastewater Treatment Plant is responsible for the majority of Utilities’ GHG emissions at 34 percent. The rest of Utilities’ emissions are from other water and wastewater treatment plants, as well as the Industrial Catawba Pump Station.

Figure 3.4 shows Utilities' GHG emissions by fuel type. Almost all (96%) of GHG emissions from Utilities is from electricity used to power the water and wastewater treatment facilities.

**Figure 3.3** 2009 Utilities GHG Emissions by Source
GREENHOUSE GAS REDUCTION PROJECTS

CMU has recently initiated several energy savings projects that will reduce their greenhouse gas emissions as well as their operating costs. In 2010, CMU completed an HVAC treatment project at the Mallard Creek Wastewater Treatment Facility, which reduced annual electricity usage by 82,000 kWh and greenhouse gas emissions by 42.7 tons of CO2e. Table 3.2 shows additional projects CMU has initiated, and the associated energy and GHG savings.

Potential projects that CMU is considering are presented in Table 3.3. The most notable is the implementation of a combined heat and power system at the McAlpine Wastewater Treatment Facility. This system would collect biogas (a byproduct of the wastewater treatment process, which is around 50 percent methane) and use it to produce electricity to power the plant. Installing this system would reduce CMU’s electricity use by 17,500 MWh annually, and save over 9,000 tons of CO2e each year.
### Table 3.2. Current Greenhouse Gas Reduction Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Energy Savings Potential*</th>
<th>Greenhouse Gas Reduction Potential (MTCO2e)**</th>
<th>Estimated Annual Cost Savings ($/yr)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Upfit at Irwin Creek – completed in 2011</td>
<td>180,000 kWh/yr</td>
<td>94.0</td>
<td>$11,126</td>
</tr>
<tr>
<td>Hydro Power off Cascade at Irwin Creek, Sugar Creek, and Mallard Creek – completed in 2011</td>
<td>263,000 kWh/yr</td>
<td>137.7</td>
<td>$16,294</td>
</tr>
<tr>
<td>HVAC treatment at Mallard Creek – completed in 2010</td>
<td>82,000 kWh/yr</td>
<td>42.7</td>
<td>$5,056</td>
</tr>
<tr>
<td>Power Correction on Blowers at Mallard Creek – completed in 2011</td>
<td>81,000 kWh/yr</td>
<td>42.6</td>
<td>$5,039</td>
</tr>
<tr>
<td>Hydro Power off Cascade at McAlpine – completed in 2011</td>
<td>438,000 kWh/yr</td>
<td>229.5</td>
<td>$27,156</td>
</tr>
<tr>
<td>Solar Installation at McDowell – completed in 2011</td>
<td>1,400 MWH/yr</td>
<td>754.9</td>
<td>$89,317</td>
</tr>
</tbody>
</table>

*Energy savings estimates were gathered from Utilities staff.
**CO2 savings were calculated using 5.24x10^-4 MTCO2e/kWh for electricity\(^{11}\) (in 2009, improving 1% annually).
***Cost savings calculated based on average prices of $0.062/kWh (city operations average).

### Table 3.3. Potential Greenhouse Gas Reduction Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Energy Savings Potential*</th>
<th>Greenhouse Gas Reduction Potential (MTCO2e)**</th>
<th>Estimated Annual Cost Savings ($/yr)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC treatment at Irwin Creek, McAlpine, McDowell, and Sugar Creek</td>
<td>82,000 kWh/yr each</td>
<td>42.7 each</td>
<td>$5,056</td>
</tr>
<tr>
<td>Lighting Upfit at Mallard, McAlpine, McDowell, and Sugar Creek</td>
<td>180,000 kWh/yr each</td>
<td>94.0 each</td>
<td>$11,126</td>
</tr>
<tr>
<td>Combined Heat and Power System at McAlpine</td>
<td>17,500 MWH/yr</td>
<td>9,180</td>
<td>$1,086,000</td>
</tr>
</tbody>
</table>

*Energy savings estimates were gathered from Utilities staff; HVAC treatment and lighting projects were assumed to provide the same electricity reductions when implemented at each plant.
**CO2 savings were calculated using 5.24x10^-4 MTCO2e/kWh for electricity\(^{11}\) (in 2009, improving 1% annually).
***Cost savings calculated based on average prices of $0.062/kWh (city operations average).

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3.2.3. BUSINESS SUPPORT SERVICES: CITY FLEET MANAGEMENT

Business Support Services manages 3,423 City vehicles. The unit advises internal customers in the use and deployment of their fleet assets, handles vehicle acquisition/disposal (except CATS), tracks equipment specifications, provides preventative maintenance and equipment repair (all vehicles except transit trains and airport), and manages fleet information and usage analysis for the City fleet. The Fleet Management Advisory Team (FMAT) meets periodically with the KBUs to discuss fleet needs and issues.

The current fleet includes:

- 36 hybrid vehicles
- 337 flex fuel vehicles (doesn’t include transit vehicles)*
- 2 Compressed natural gas garbage trucks

* The City does not currently use flex fuel.

FLEET GREENHOUSE GAS INVENTORY

The total emissions from Fleet were approximately 39,000 metric tons of CO2e in FY2009, which is about 13 percent of the total emissions from city operations.

Figures 3.5 and 3.6 show Fleet’s GHG emissions by source and by fuel type, respectively. Sanitation vehicles include garbage trucks, street cleaners, and special services and contribute 22 percent of the Fleet’s GHG emissions. Light duty vehicles contribute 28 percent of the Fleet’s GHG emissions, and cars with severe usage (e.g., police cars) emit about 22 percent of the Fleet’s greenhouse gases. Gasoline and diesel contribute almost equally to the Fleet’s emissions.
Figure 3.5  2009 Fleet GHG Emissions by Source

Figure 3.6  2009 Fleet GHG Emissions by Fuel Type
GREENHOUSE GAS REDUCTION PROJECTS

Business Support Services purchases and maintains vehicles for the City’s other business units. Each business unit decides which vehicles get purchased, thus limiting the influence of BSS on the overall fleet characteristics.

One of the unit’s current strategic targets is to improve the efficiency of the overall City fleet by purchasing alternative fuel vehicles as funding allows and by seeking grant funding to outfit current vehicles with emissions reduction technology.

In addition to past and current projects, BSS has also looked into government contracting for flex-fuel vehicles, propane fuel and compressed natural gas. Table 3.4 lists potential projects for the City’s Fleet.

Table 3.4. Potential Fleet Greenhouse Gas Reduction Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Electricity Savings Potential (kWh)*</th>
<th>Annual Gas Savings Potential (gallons)*</th>
<th>Greenhouse Gas Reduction Potential (MTCO2e)**</th>
<th>Estimated Annual Cost Savings ($/yr)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Electric Fleet</td>
<td>(3,739,145)</td>
<td>695,655</td>
<td>4,232</td>
<td>$1,707,000</td>
</tr>
<tr>
<td>50% Hybrid Fleet</td>
<td></td>
<td>361,741</td>
<td>3,219</td>
<td>$1,008,000</td>
</tr>
<tr>
<td>20% Electric Fleet</td>
<td>(1,495,658)</td>
<td>278,262</td>
<td>1,693</td>
<td>$683,000</td>
</tr>
<tr>
<td>20% Hybrid Fleet</td>
<td></td>
<td>144,696</td>
<td>1,288</td>
<td>$403,000</td>
</tr>
<tr>
<td>10% Electric Fleet</td>
<td></td>
<td>139,131</td>
<td>846</td>
<td>$341,000</td>
</tr>
<tr>
<td>10% Hybrid Fleet</td>
<td></td>
<td>72,348</td>
<td>644</td>
<td>$202,000</td>
</tr>
</tbody>
</table>

*Hybrid savings were calculated using 52% gasoline savings, considering only passenger cars in the vehicle fleet. Electric fleet savings were calculated considering only passenger cars in the vehicle fleet with 100% gasoline savings, but an added electricity use of 0.25 kWh/mile (assuming an average of 21.5 mpg).

**CO2 savings were calculated using 5.24x10^-6 MTCO2e/kWh for electricity (in 2009, improving 1% annually), and 8.9x10^-3 MTCO2e/gallon of gasoline.13

***Cost savings based on average values of $0.062/kWh (city operations average), and $2.787/gallon gasoline (2010 EIA data)14.

3.2.4. CHARLOTTE AREA TRANSIT SYSTEM

The Charlotte Area Transit System (CATS) is the largest transit system between Atlanta, GA and Washington, DC with over 70 local, express and regional bus routes, a light rail line, services for the disabled, and vanpools serving more than 23,000,000 trips each year. Managed by the Public

Transit Department, a department within the City of Charlotte, CATS maintains a dual focus, managing and continually improving day-to-day operations of the region’s transit services within a six-county area while advancing planning for a regional rapid transit system integrated with land-use plans which includes light rail, commuter rail, bus rapid transit and expanded bus services. Since 1998, CATS ridership has grown 120% to 26M riders in 2009.\(^{15}\)

The current transit fleet includes:

- 323 Buses (includes 7 hybrid buses)
- 189 Para-transit and vanpool vans
- 20 Light Rail Vehicles

**CATS GREENHOUSE GAS INVENTORY**

The total emissions from CATS were approximately 40,000 metric tons of CO\(_2\)e in FY2009, which is about 13 percent of the total emissions from city operations.

Figure 3.7 and Figure 3.8 show CATS’ GHG emissions by source and by fuel type, respectively. The transit fleet is mostly diesel powered and contributes to 85 percent of CATS’ emissions. The electric light rail is responsible for 12 percent of CATS’ total emissions.

**Figure 3.7   CATS 2009 GHG Emissions by Source**

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\(^{15}\) Charmeck.org/city/charlotte/cats/about/Pages/default.aspx
GREENHOUSE GAS REDUCTION PROJECTS

CATS is enterprise run, governed by policies and procedures of the Metropolitan Transit Commission. CATS is currently working towards achieving 4.3 mpg average fuel efficiency across CATS bus operations fleet vehicles. This goal is being realized through acquisition of fuel-efficient and hybrid vehicles, maintaining idling practices, controlling governor settings, use of battery power for vehicle maintenance when feasible and use of ultra-low sulfur diesel fuel. CATS also recently retrofitted 35 percent of fixed route bus fleet (119 buses) with emissions reduction equipment and reduced idling on fixed route bus fleet from 35.15 percent to 30.30 percent. These practices resulted in 120,000 gallons of fuel savings in fiscal year 2009.

In addition to these past and current projects, CATS has looked into storing energy from rail brakes and into upgrading to all-electric vehicles. Table 3.5 lists potential GHG reduction projects for CATS.
### Table 3.5. Potential CATS Greenhouse Gas Reduction Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Electricity Savings Potential (kWh)</th>
<th>Annual Diesel Fuel Savings Potential (gals)</th>
<th>Greenhouse Gas Reduction Potential (MTCO2e)</th>
<th>Estimated Annual Cost Savings ($/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% Hybrid Buses</td>
<td>872,429</td>
<td>8,862.6</td>
<td>4,382.5</td>
<td>$2,577,000</td>
</tr>
<tr>
<td>50% Electric Buses</td>
<td>(20,132,988)</td>
<td>1,677,749</td>
<td>3,545</td>
<td>$3,708,000</td>
</tr>
<tr>
<td>20% Hybrid Buses</td>
<td>348,972</td>
<td>3,545</td>
<td>1,753</td>
<td>$1,031,000</td>
</tr>
<tr>
<td>20% Electric Buses</td>
<td>(8,053,195)</td>
<td>671,100</td>
<td>1,753</td>
<td>$515,000</td>
</tr>
<tr>
<td>10% Hybrid Buses</td>
<td>174,486</td>
<td>1,773</td>
<td>876</td>
<td>$1,483,000</td>
</tr>
<tr>
<td>10% Electric Buses</td>
<td>(4,026,598)</td>
<td>335,550</td>
<td>876</td>
<td>$354,000</td>
</tr>
<tr>
<td>Storing energy from rail brakes</td>
<td>961,159</td>
<td>504</td>
<td></td>
<td>$742,000</td>
</tr>
</tbody>
</table>

*Hybrid savings were calculated using 52% diesel savings for all CATS diesel buses. Electric bus savings were calculated with 100% diesel savings, but an added electricity use of 2 kWh/mile (assuming an average of 6 mpg). Storing energy from light rail brakes was estimated to save 10% from light rail electricity use.

**CO2 savings were calculated using 5.24x10^-2 MTCO2e/kWh for electricity (in 2009, improving 1% annually), and 1.02x10^-2 MTCO2e/gallon of diesel.**

*Cost savings based on average costs of $0.062/kWh (city operations average), and $2.954/gallon diesel (EIA data).**

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**Notes:**


3.2.5. CHARLOTTE DOUGLAS INTERNATIONAL AIRPORT

The Charlotte Douglas International Airport ranks as the 11th busiest airport in the United States, with 647 daily departures and nonstop service to 134 destinations. It is the largest hub for US Airways, and recently constructed a third parallel runway that allows three independent approaches for arrivals. This has the potential of increasing the airport’s capacity by 33 percent. The Charlotte Douglas International Airport is responsible for 100,000 direct and indirect jobs in the region, and generates 10 billion dollars of economic activity annually for Charlotte and the surrounding areas.

AIRPORT GREENHOUSE GAS INVENTORY

The total emissions from Charlotte Douglas International Airport were approximately 40,000 metric tons of CO2e in FY2009, which is about 13 percent of the total emissions from city operations.

The major contributor to the airport’s greenhouse gas emissions is the main terminal building. As shown in Figure 3.9, 81 percent of the airport’s emissions are from electricity powering the main terminal. Other buildings at the airport contribute to 8 percent of its emissions, and transit and the vehicle fleet contribute 6 and 2 percent, respectively.

Figure 3.10 shows the airport’s GHG emissions by fuel type. 81 percent of the airport’s emissions are from electricity and 8 percent are from natural gas to power buildings. Gasoline and diesel contribute 5 and 6 percent, respectively, to power transit buses and the airports vehicle fleet.
Figure 3.9  2009 Airport GHG Emissions by Source

- Main Terminal Building: 81%
- Vehicle Fleet: 2%
- Transit: 6%
- Other Buildings: 8%
- Employee Commute: 3%

Figure 3.10  Airport 2009 GHG Emissions by Fuel Type

- Electricity: 81%
- Gasoline: 5%
- Natural Gas: 8%
- Diesel: 6%

GREENHOUSE GAS REDUCTION PROJECTS

The airport has recently upgraded some of its lighting to reduce electricity usage and operating costs. These upgrades consist of replacing current light fixtures with fewer bulbs with lower wattage. Runway lighting projects involved replacing current lights with new LEDs, which use
one-third the electricity. Table 3.6 shows the current greenhouse gas projects completed by the airport.

Table 3.7 lists potential greenhouse gas reduction projects we evaluated for the airport. Airport staff also suggested additional lighting upgrades. We also reviewed existing literature on best practices in airport energy management\textsuperscript{18} and constructed additional project proposals. We assumed that general efficiency measures undertaken at the airport’s main terminal building could save 10 percent over baseline electricity usage. These projects could include setbacks, HVAC tune-ups, retrocommissioning, variable frequency drives, heat recovery systems, or controls upgrades.

**Table 3.6. Current Greenhouse Gas Reduction Projects**

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Energy Savings Potential*</th>
<th>Greenhouse Gas Reduction Potential (MTCO\textsubscript{2}e)**</th>
<th>Estimated Annual Cost Savings ($/yr)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Upgrades in the Engineering Building – completed in 2010</td>
<td>290,000 kWh/yr</td>
<td>152</td>
<td>$18,000</td>
</tr>
<tr>
<td>Lighting Upgrades in Parking Structure – completed in 2011</td>
<td>657 kWh/yr</td>
<td>0.3</td>
<td>$41</td>
</tr>
<tr>
<td>Lighting Upgrades to the Runways – completed in 2010</td>
<td>438 kWh/yr</td>
<td>0.2</td>
<td>$27</td>
</tr>
</tbody>
</table>

\*Energy savings estimates were gathered from Airport staff.

\**CO\textsubscript{2}e savings were calculated using 5.24x10\textsuperscript{4} MTCO\textsubscript{2}e/kWh for electricity\textsuperscript{19} (in 2009, improving 1% annually).

\***Cost savings calculated based on average prices of $0.062/kWh (city operations average).


## Table 3.7. Potential Greenhouse Gas Reduction Projects

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Lighting Upgrades in the B-Concourse</td>
<td>294,000 kWh/yr</td>
<td>154</td>
<td>$18,000</td>
</tr>
<tr>
<td>Lighting Upgrades in the Engineering Building Lunch Room</td>
<td>37,000 kWh/yr</td>
<td>19.5</td>
<td>$2,300</td>
</tr>
<tr>
<td>Additional Lighting Projects in the Main Terminal</td>
<td>150,000 kWh/yr</td>
<td>78.6</td>
<td>$9,300</td>
</tr>
<tr>
<td>Thermostat Adjustment in the Main Terminal</td>
<td>3,000,000 kWh/yr</td>
<td>1,572</td>
<td>$186,000</td>
</tr>
<tr>
<td>Conveyor Retrofits in the Main Terminal</td>
<td>840,000 kWh/yr</td>
<td>440</td>
<td>$52,000</td>
</tr>
<tr>
<td>Shutting Escalators down in off-hours</td>
<td>240,000 kWh/yr</td>
<td>126</td>
<td>$15,000</td>
</tr>
<tr>
<td>General Efficiency Measures in Main Terminal</td>
<td>5,600,000 kWh/yr</td>
<td>2,955</td>
<td>$350,000</td>
</tr>
</tbody>
</table>

*Energy savings estimates were gathered from Airport staff, and best practice research. General efficiency measures were estimated to save 10% from baseline electricity use.
**CO2 savings were calculated using 5.24x10^-4 MTCO2e/kWh for electricity (in 2009, improving 1% annually).
***Cost savings calculated based on average prices of $0.062/kWh (city operations average).

---

4. SCENARIO ANALYSIS

As a result of our interviews and research, we generated a database of over 250 potential GHG reduction projects. Doing a full cost estimate on each project was not feasible, since Charlotte has limited manpower and budget for cost analyses. If we had cost data, our team would have analyzed projects in terms of GHG reduction per $ invested and energy $ saved per $ invested. These measures of efficacy are best practices in setting GHG reduction goals and creating “GHG abatement curves.”\(^{21}\)

Since we could not obtain cost data, we decided to use a decision science tool called scenario analysis. Scenario analysis is appropriate when a decision must be made today that will have long-term implications. The goal of scenario analysis is to envision possible future scenarios by following these steps:

1. Identify driving forces that affect the decision
2. Organize these into future possible scenarios
3. Envision paths that would lead to these future conditions
4. Plan accordingly

This approach allowed our team and the City to examine range of possible scenarios, to maximize the usefulness of our work, and to allow the City to track key drivers that affect the GHG reduction decision.\(^{22}\)

4.1. SCENARIO DESCRIPTIONS

We identified the following driving forces affecting the City’s choice of a GHG reduction target:

- Preference to distribute effort equally by KBU or distribute effort unequally based on KBU reduction potential
- Preference for project type (demonstration projects that are visible but do not provide large GHG reductions versus high-impact projects that are less visible but more impactful in terms of energy and GHG reduction)
- City Council / City Management preference for one large capital project versus several smaller projects
- Long-term versus short-term outlook

We selected the first two variables to create our scenario matrix, because they are the greatest sources of uncertainty and thus the most important to track, when making recommendations for specific GHG reduction projects. These variables are also the most important when implementing a GHG reduction target, and thus the most important to examine at this planning stage. While we cannot predict the city’s preference on the third and fourth dimensions (one large versus several small projects; long-term versus short-term decision making horizon) these dimensions are trumped by the first two, which are more critical in setting a GHG reduction plan and choosing specific projects. Therefore, we did not examine the third and fourth dimensions.

**Figure 4.1  Greenhouse Gas Reduction Scenario Matrix**

<table>
<thead>
<tr>
<th>Effort Distribution</th>
<th>Scenario 1: City has a preference for demonstration projects, and expects each KBU to make equal effort</th>
<th>Scenario 2: City has a preference for high impact projects, and expects each KBU to make equal effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal by KBU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unequal by KBU</td>
<td>Scenario 3: City has a preference for demonstration projects, but distributes effort unevenly</td>
<td>Scenario 4: City has a preference for for high impact projects, but distributes effort unevenly</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Project Type**

- Demonstration
- Operational
We assigned projects to a scenario based on project type (operational versus high-impact) and also adjusted implementation dates (as early as 2011 or as late as 2019) depending on if we were in an “equal effort” or “unequal effort” scenario. For equal effort, we assigned roughly the same number of projects to each KBU per year. For unequal effort, we rank ordered projects from highest GHG reduction potential to lowest, and assigned them in order, regardless of which KBU the project was associated with. Furthermore, for each scenario, we analyzed a low, medium, and high case to indicate how aggressive the target is, both in terms of when projects are implemented and how many projects are conducted per year. This can be interpreted as a measure of investment (low, medium, high) and, in practice, means moving projects forwards in times or taking on additional projects every year. For details of projects included in each scenario, see Appendix H.

After we sorted projects into Scenarios according to project type, the following was observed:

- Scenarios 1 and 3 were mainly electric vehicles in the CATS system. These two scenarios were the least impactful, because most projects we examined were operational or not highly visible.
- Scenarios 2 and 4 emphasized building energy efficiencies, fleet upgrades, and CHP projects at the wastewater treatment plant.

### 4.2. SCENARIO RESULTS

We assumed a 0.6 percent organic growth in emissions per year based on the trend in the City’s emissions from 2006-2009. We also assumed a 1 percent per year reduction in GHG intensity of grid-connected electricity (MTCDE/kWh). In Scenarios 1 and 3, City emissions actually increase. Scenarios 2 and 4 yield around an 8 percent reduction by 2020, which is equivalent to approximately a 0.9 percent real reduction per year. Scenario 4’s low medium and high level of efforts yield very similar GHG reductions (7.8%, 7.9%, and 8.0% by 2020, respectively). This is because, since Scenario 4 favors high-impact projects without preference to which KBU they affect, we simply rank ordered projects by total GHG reduction and implemented them in order. Therefore, the low, medium and high cases are identical except for the incremental projects completed between low to medium and medium to high (about 4 projects). Scenario 2, by contrast, rank orders projects within KBUs and implements them in that order, with an equal number of projects per KBU. Therefore, projects included in low, medium and high level of efforts for Scenario 2 vary more, as do the ultimate GHG reductions.
Figure 4.2  Estimated Greenhouse Gas Reductions and Energy Savings by Scenario
Impact and energy savings calculated through 2020.
(Red shows increasing emission, green shows decreasing emissions)

<table>
<thead>
<tr>
<th>Impact on City Emissions by Scenario by 2020</th>
<th>Estimated Energy Savings ($mil) by 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCENARIO 1</strong></td>
<td></td>
</tr>
<tr>
<td>-5.9% Current</td>
<td>$5.9</td>
</tr>
<tr>
<td>-4.4% Low</td>
<td>$16.4</td>
</tr>
<tr>
<td>-2.8% Medium</td>
<td>$26.8</td>
</tr>
<tr>
<td>High</td>
<td>$58.3</td>
</tr>
<tr>
<td><strong>SCENARIO 2</strong></td>
<td></td>
</tr>
<tr>
<td>-0.1% Low</td>
<td>$22.1</td>
</tr>
<tr>
<td>Medium</td>
<td>$37.9</td>
</tr>
<tr>
<td>High</td>
<td>$74.1</td>
</tr>
<tr>
<td><strong>SCENARIO 3</strong></td>
<td></td>
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<tr>
<td>-4.4% Low</td>
<td>$16.4</td>
</tr>
<tr>
<td>-2.8% Medium</td>
<td>$26.8</td>
</tr>
<tr>
<td>High</td>
<td>$58.3</td>
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<tr>
<td><strong>SCENARIO 4</strong></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>$92.2</td>
</tr>
<tr>
<td>Medium</td>
<td>$93.7</td>
</tr>
<tr>
<td>High</td>
<td>$94.4</td>
</tr>
</tbody>
</table>

KBU reduction requirements vary by scenario, with most KBUs only generating reductions in Scenarios 2 and 4. CATS and Fleet have the largest reduction potential, due to the ability to switch to hybrid or electric vehicles. Utilities depends on one major project – the McAlpine combine heat and power installation – and so has moderate reduction potential at 7 percent. EPM and Aviation depend on incremental energy efficiency in buildings, and so have more moderate reduction potential around 5 percent.
### Figure 4.3 Reduction Potential by KBU (by 2020)

#### Aviation

<table>
<thead>
<tr>
<th>S1</th>
<th>S1</th>
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<th>S2</th>
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<td>LOW</td>
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<td>HIGH</td>
<td>LOW</td>
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<td>HIGH</td>
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<tr>
<td>6.5%</td>
<td>6.5%</td>
<td>6.5%</td>
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<td>-6.2%</td>
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#### Engineering & Property Management

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#### Fleet

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<td>2.9%</td>
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#### Utilities

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<tr>
<td>5.3%</td>
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<td>5.3%</td>
<td>-5.6%</td>
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#### CATS

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<tr>
<td>-4.9%</td>
<td>-13.1%</td>
<td>-4.9%</td>
<td>-14.3%</td>
<td>-4.9%</td>
<td>-13.1%</td>
<td>-37.8%</td>
<td>-38.6%</td>
<td>-38.6%</td>
<td>-37.8%</td>
</tr>
</tbody>
</table>
Notably, organic growth in emissions results in an upward trend, unless investment in GHG reduction projects is sustained.

Importantly, since 60% of the City’s GHG emissions are due to purchased electricity from Duke Energy, if Duke reduces the GHG intensity of electricity over the coming years, it would have impacts on the City’s GHG reduction trajectory. Duke Energy, if it retired coal plants and introduced less carbon-intense electric generation options like renewables, natural gas, or nuclear, could have a significant impact on Charlotte’s GHG emissions. The first effect would be to lower the City’s overall emissions, without any action on the City’s part. The second effect is to reduce the emissions impact of GHG reduction projects (because, for each kWh a project saves, fewer GHGs will be mitigated if electricity is becoming less carbon-intensive).

We conducted a sensitivity analysis to explore this dynamic. We examined annual GHG intensity reductions, by Duke, of 3%, 5%, and 10%. This study uses the 1% case for its results, since this is a realistic rate of reduction due to normal tune ups and plant improvements. In the best case of 10% GHG intensity reduction per year, the City’s emissions decrease by half. It is in the City’s interest to work with Duke Energy to encourage them to reduce the GHG intensity of their
electric fleet, since this is the largest single lever that can rapidly reduce Charlotte’s GHG emissions, more than any of our reduction scenarios combined.

**Figure 4.10 Impact of Duke Energy Carbon Intensity Improvements on Charlotte’s GHG Reduction Efforts**

![Graph showing the impact of Duke Energy carbon intensity improvements on Charlotte's GHG reduction scenarios]

4.3. **RECOMMENDATIONS AND NEXT STEPS**

We recommend that Charlotte commit to a gross GHG reduction target of 0.9% per year. This target is aggressive but achievable. The figure below shows how the four scenarios rank compared to peer organizations. Our recommended target is the highest possible of the four scenarios, yet is still lower than the majority of peer targets.

Our analysis shows that a reduction of 0.9% per year can be achieved under:

- Scenario 4 high
- Scenario 4 medium
• Scenario 4 low
• Scenario 2 high

The next step is for the City to determine the costs under each scenario.

In order to reach this target, Charlotte will need a centralized approach to setting priorities and allocating funding. While creation of suggested GHG targets was accomplished via a technical feasibility “bottom-up” approach, since KBUs vary in their GHG reduction potential and types of available GHG reduction projects, a centralized approach will be best when allocating funding and support. If projects were implemented via the typical decentralized divisions by KBU, the end results will not be the optimal allocation of projects across the City and will not be cost effective.
Figure 4.11 Ranking of Annualized GHG Emissions Reduction Targets including City’s Four Scenarios

The Environmental Focus Area Plan is a convenient platform for organizing future environmental projects. Our suggested approach could be expanded to other City KBUs by requiring GHG reduction potential calculations to be included for all environmental projects in the Focus Area Plan.
We believe that it is important for Charlotte to consider an aggressive goal in order to set an example for the community of Charlotte and to demonstrate the urgent need for change. However, the culture of the City dictates that an overly aspirational target would be inappropriate. The City prides itself on being a performance and results driven organization. As such, the primary role of an emissions target will be to guide investment decisions and to track performance towards a goal. While we recommend the most aggressive target, whatever greenhouse gas emissions goal is ultimately chosen, we recommend that the City hold a series of cross-KBU meetings to commit financial resources to the projects required for the chosen scenario. In these meetings, KBUs should be asked to generate cost projections for their “assigned” projects, to assess any changes in cost structures or anticipated savings. Any GHG reductions from the City’s Environmental Focus Area Initiatives, above what was considered in this study, should also be included during these meetings. An “all hands” meeting like this is critical to align the allocation of resources across the City and achieve the chosen GHG goal.

Moving forward, we recommend that all projects be required to calculate their GHG impacts (both increases and decreases) and that these calculations be reported to a central database. We also recommend a yearly GHG inventory, at minimum, to track progress towards the GHG goal. Finally, KBU executives and the City management may wish to use a dashboard reflecting key metrics, both financial and environmental. This is an excellent tool for monitoring results while also providing visibility to the community. Suggested metrics include:

- GHG growth / decrease in the current fiscal year
- Dollars saved as a result of GHG projects
- Tons of GHG saved as a result of GHG projects
- Funds expended
- $ / ton reduced
- Savings per $ invested

Finally, we hope that the City will consider moving beyond reducing GHG from City operations to focus on community-wide impacts. We feel that several of the City operations projects could have positive impacts, if extended to the broader Charlotte community, including:

- Extended CATS service, ridership campaigns, route improvement, and rider outreach
- EPM-sponsored weatherization programs, including bulk-discount priced energy efficiency equipment
- Programs, in partnership with community groups, to encourage carpooling to work
- An expansion of the current neighborhood energy competition pilot program, to encourage behaviors conducive to energy conservation.

We also hope that the City will continue to track City-wide emissions in their annual GHG inventory and eventually set a reduction goal for these emissions as well.
5. APPENDICES

Appendix A. City Greenhouse Gas Inventory Methodology
Appendix B. Summer Interviews
Appendix C. Summary and Comparison of Greenhouse Gas Inventory Protocols for Local Governments, Academic and Private Institutions
Appendix D. Alternative CATS GHG Accounting Method
Appendix E. GHG Targets for Select Local Governments, Academic and Private Institutions
Appendix F. Charlotte Sustainability Resources
Appendix G. Climate Action Planning Best Practices
Appendix H. Projects by Scenario
Appendix I. Economic Analysis of Selected GHG Reduction Projects
Appendix J. Current State of GHG Measurement and Reporting
Appendix A. City Greenhouse Gas Inventory Methodology

INTRODUCTION

We conducted an assessment and update of the City of Charlotte’s greenhouse gas (GHG) inventory of city government operations, buildings, vehicles, and facilities for FY2009 to assess the current state of greenhouse gas emissions in the City. The last greenhouse gas inventory was conducted by CDM for FY2006. This update reveals how Charlotte’s city operation emissions have grown over the past three years. This inventory also allowed us to disaggregate Charlotte’s emissions by KBU, which allowed us to focus our efforts on the most greenhouse gas intensive KBUs.

In 2008, the Climate Registry has published a comprehensive standard for conducting local government GHG inventories. The Climate Registry is a non-profit organization that was formed with the intent of improving the consistency and accuracy of GHG emissions reporting in North America. The Climate Registry is subscribed to by 41 U.S. states (including North Carolina), 11 Canadian provinces and 6 Mexican states, and currently provides the leading unifying GHG inventory guidance in North America. A partnership of The Climate Registry, the California Air Resources Board, the California Climate Action Registry, and ICLEI developed the sector-specific GHG protocol, Local Government Operations Protocol For Quantification and Reporting of Greenhouse Gas (GHG) Inventories, September 25, 2008.

We updated the data and calculations for the FY2009 inventory in compliance with the guidance of the Local Government Operations Protocol (LGOP). The LGOP is described below, followed by a discussion of the methodology and results of the updated and LGOP-compliant 2009 GHG emissions inventory for City of Charlotte operations.

METHODOLOGY

LOCAL GOVERNMENT OPERATIONS PROTOCOL

The LGOP was created to provide standardized methods and guidelines for local governments choosing to quantify and report GHG emissions from city operations. City operations are defined as buildings, facilities, vehicle fleets including transit vehicles, streetlights, airport facilities and emissions from employee commuting. The LGOP is based on guidelines and methodology used in the World Resources Institute and World Business Council for Sustainable Development Greenhouse Gas Protocol. Taking into account the unique structure of local governments as organizations, as compared with private companies, the LGOP provides general
guidance on how to determine what emissions sources to include in a GHG inventory and how to calculate those emissions. Using these methods, local governments may complete transparent and accurate GHG inventories that are based on the most up-to-date calculation methodologies and emissions factors. The ICLEI Clean Air and Climate Protection (CACP) 2009 Software was designed to be consistent with the LGOP. For example, the 2009 software is an update of the previous 2003 version, and includes new sectors such as airports, transit, refrigerants and modified methods for calculating waste and wastewater treatment.

**Figure 1** lists the six Kyoto Protocol GHGs, along with example emissions sources. These GHGs are: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). As shown in Figure 1, the primary sources of GHG emissions are: combustion of fossil fuels, releasing CO2 and N2O; releases of CH4 and N2O from biological processes; releases of HFCs, PFCs from refrigeration and fire suppression equipment; and releases of SF6 from high-voltage electrical equipment typically owned by utilities.

For the purposes of a city operations inventory, it is not practical to measure the GHG emission rate from every emissions source controlled by the City. The LGOP provides GHG emission factors for each source type, based on recent literature and research, and methods for calculating total annual GHG emission rates as a function of annual fuel usage, numbers of equipment or vehicles, and other activity data. Activity data for all emissions sources including electricity use, natural gas combustion, mobile sources and wastewater treatment were gathered with the help of employees from the City of Charlotte.

The ICLEI Clean Air and Climate Protection software contains the emission factors for each GHG, and calculates the resulting GHG emission rates based on activity data. It then converts the emission rates into carbon dioxide equivalents (CO2e) using emissions factors and global warming potentials (GWP). A GWP represents the ability of each GHG to trap heat in the atmosphere and is the ratio of the heat trapping ability normalized to that for CO2 (i.e., CO2 has a GWP of 1). GWP values from the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report were used, as shown in Table 1 below. These are the GWP factors that are currently used by the LGOP and other GHG accounting protocols.
Table 1. Global Warming Potential Factors

<table>
<thead>
<tr>
<th>GHG Pollutant</th>
<th>GWP Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>1</td>
</tr>
<tr>
<td>CH4</td>
<td>21</td>
</tr>
<tr>
<td>N2O</td>
<td>310</td>
</tr>
<tr>
<td>HFC – 134a</td>
<td>1,300</td>
</tr>
<tr>
<td>HFC – 143</td>
<td>300</td>
</tr>
</tbody>
</table>

EMISSION SCOPES

The LGOP separates GHG emissions into three categories, referred to as “operational boundaries” which allows for more effective GHG management and serves to minimize the potential double counting of emissions. The categories, also called Scopes, include:

- Direct / Scope 1 Emissions associated with fuel consumption by stationary and mobile combustion sources, and fugitive emissions from refrigerant equipment and landfill sources, directly owned and operated by the City;
- Indirect / Scope 2 Emissions from purchased electricity or steam generated by utilities or service providers; and
- Optional / Scope 3 Other indirect emissions, such as those from employee commuting and outsourced activities.

Emissions are organized by Scopes to facilitate the assessment of responsibility associated with GHG emissions. Direct emissions under Scope 1 are those that are under the control of the City. Examples include city- owned or -operated vehicle fleets and closed landfills (see Figure 1). Indirect emissions in Scope 2 are the result of the City’s electricity consumption – the power generation is provided by external companies over which the City has no control or operational involvement. Optional emissions included in Scope 3 address all other sources of indirect and direct emissions of which the City has little to no direct operational control or ownership, such as employee Commuting – while these emissions are caused by City employees, the vehicle is under the control of the employee and not the City.
Figure 1. Direct and Indirect Emissions Sources
DATA SOURCES

Raw data for Charlotte’s GHG inventory were collected directly from KBUs, as well as from invoices from Duke Energy and Piedmont Natural Gas. **Table 2** summarizes the data collection sources.

**Table 2. Data Sources**

<table>
<thead>
<tr>
<th>Data</th>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Use</td>
<td>Duke Energy</td>
<td>Invoices were collected from Duke Energy for all City owned addresses. Electricity data from each address was assigned to an LGOP category and to a KBU.</td>
</tr>
<tr>
<td>Natural Gas Use</td>
<td>Piedmont Natural Gas</td>
<td>Invoices were collected from Duke Energy for all City natural gas accounts. These data were already assigned to a KBU, and were matched to an LGOP category.</td>
</tr>
<tr>
<td>Aviation Vehicle Fuel Use</td>
<td>Aviation</td>
<td>Gasoline and diesel use records were collected for several vehicle types used at airport facilities.</td>
</tr>
<tr>
<td>CATS Fleet Fuel Use</td>
<td>CATS</td>
<td>Diesel use records were collected from CATS for all City transit buses.</td>
</tr>
<tr>
<td>Fire Vehicle Fuel Use</td>
<td>Fire</td>
<td>Gas and diesel use records were collected for all fire department vehicles.</td>
</tr>
<tr>
<td>City Fleet Fuel Use</td>
<td>Business Support Services</td>
<td>Gas and diesel use records were collected from the Business Support Services department for all city owned vehicles, including police cars and garbage trucks.</td>
</tr>
<tr>
<td>Employee Business Miles</td>
<td>City Records</td>
<td>Mileage reimbursement records were collected from the City and assigned to KBUs.</td>
</tr>
<tr>
<td>Employee Commute</td>
<td>City Records</td>
<td>Commute estimates were collected from the city based on employee zip code.</td>
</tr>
</tbody>
</table>
DATA CATEGORIZATION BY LGOP SECTOR AND KBU

The FY2009 inventory update was classified by LGOP sector (e.g., buildings and facilities, streetlights and traffic signals, solid waste facilities) and by KBU. This section describes how the greenhouse gas inventory data was assigned to LGOP category and to KBUs.

The LGOP recommends including the following sectors for a standardized and accurate GHG inventory:

- Buildings and Facilities
- Streetlights & Traffic Signals
- Airport Facilities
- Water Delivery Facilities
- Wastewater Facilities
- Solid Waste Facilities
- Vehicle Fleet
- Transit Fleet
- Employee Commute

Further, the City of Charlotte’s operations are divided amongst 14 KBUs:

- Aviation
- Business Support Services (includes Fleet)
- Budget & Evaluation
- Charlotte Area Transit System (CATS)
- Department of Transportation
- Police
- Engineering & Property Management
- Finance
- Fire
- Human Resources
- Neighborhood and Business Development
- Planning
- Solid Waste
- Utilities

Appendix A-6
The GHG inventory data we received from City of Charlotte employees was assignment to the above LGOP categories and KBUs as displayed in Table 3.

**Electricity Data:** Data from Duke Energy were classified by location of the utility meter. Based on these addresses, and discussions with Charlotte employees, the building type and operational activity for each address was determined. In addition to buildings, the Duke electricity data also included Streetlights and Traffic Signals, along with numerous meters for Water Utility Lift Stations and CATS light rail transit system. The buildings were labeled as Aviation Facilities, Buildings and Facilities, Solid Waste facilities, and Water and Wastewater Treatment Plants, according to the operational activity.

To further disaggregate by KBU, all Airport Facilities were assigned to the Aviation KBU, the majority of Building and Facilities were assigned to Engineering and Property Management, Solid Waste Facilities mapped directly onto the Solid Waste KBU, and all Water and Wastewater Facilities were assigned to the Utilities KBU. The CATS light rail transit system was assigned to CATS, and streetlights and traffic signals were assigned to the Department of Transportation.

**Natural Gas Data:** Similarly to electricity data, natural gas data was provided by address and assigned to the LGOP category based on the operational activity at each address. Piedmont Natural Gas also provided the KBU categorization with the natural gas use data.

**Aviation Vehicle Fuel Use:** Gasoline and diesel use by aviation vehicles and buses at the Charlotte Douglas International Airport. All fuel use by these vehicles was assigned to the Airport Facilities LGOP category and the Aviation KBU.

**CATS Fleet Fuel Use:** Diesel use by CATS transit buses was classified in the Transit Fleet category and the CATS KBU.

**Fire Vehicle Fuel Use:** Fuel use by Charlotte’s fire trucks and other fire vehicles was assigned to the Vehicle Fleet category and the Fire KBU.

**City Fleet Fuel Use:** Fuel used by city-owned vehicles was categorized in the Vehicle Fleet sector and Business Support Services KBU.

**Employee Business Miles:** Fuel used by Charlotte employees on city business was classified in the Vehicle Fleet category and was assumed to be in the Engineering and Property Management KBU.

**Employee Commute:** Employee Commute data was assigned directly to the Employee Commute LGOP category, and was divided amongst all KBUs according to the number of employees in each KBU.
### Table 3. LGOP and KBU Assignment

<table>
<thead>
<tr>
<th>Data</th>
<th>LGOP Category</th>
<th>KBU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity &amp; Natural Gas</td>
<td>Wastewater Facilities</td>
<td>Utilities</td>
</tr>
<tr>
<td></td>
<td>Water Delivery Facilities</td>
<td>Solid Waste</td>
</tr>
<tr>
<td></td>
<td>Solid Waste Facilities</td>
<td>Solid Waste Management</td>
</tr>
<tr>
<td></td>
<td>Buildings and Facilities</td>
<td>Engineering and Property Management</td>
</tr>
<tr>
<td>Aviation Vehicle Fuel Use</td>
<td>Airport Facilities</td>
<td>Aviation</td>
</tr>
<tr>
<td>CATS Fleet Fuel Use</td>
<td>Transit Fleet</td>
<td>CATS</td>
</tr>
<tr>
<td>Electricity</td>
<td>Streetlights &amp; Traffic Signals</td>
<td>Dept of Transportation</td>
</tr>
<tr>
<td>Fire Vehicle Fuel Use</td>
<td>Vehicle Fleet</td>
<td>Fire</td>
</tr>
<tr>
<td>City Fleet Fuel Use</td>
<td></td>
<td>Business Support Services</td>
</tr>
<tr>
<td>Employee Business Miles</td>
<td></td>
<td>Engineering and Property Management</td>
</tr>
<tr>
<td>Employee Commute</td>
<td>Employee Commute</td>
<td>Divided into all KBUs based on number of employees.</td>
</tr>
</tbody>
</table>
The 2009 version of the CACP software contains updated electricity emissions factors, which are now based on the U.S. Environmental Protection Agency’s (EPA) EGrid database, as recommended by the LGOP. These EGrid emissions factors are developed from actual emissions data from electricity generation nation-wide. These data are then aggregated by electric grid-region, to create regionally based electricity emission factors. The EGrid regions, shown in Figure 2, are smaller than those used in the previous ICLEI software and more accurately represent regional power pools. As shown in Figure 2, Charlotte’s electricity, and the associated GHG emissions, come from the SRVC EGrid region. In addition, electricity emission factors change every year based on the actual fuel mix (nuclear, coal, natural gas) used at power plants; EGrid data is a more recent reflection of GHG emissions than the previous version of the ICLEI software.

Figure 2. EPA EGrid Regions
VEHICLE EMISSIONS

The City provided annual gasoline and diesel fuel consumption data for city-owned and operated vehicles for the following sources: Aviation, Employee Business Miles, Business Support Services, and the Fire Department. The data contained fuel consumption for several different general vehicle types, but not specific model year information for each vehicle. While CO₂ emissions are based on fuel consumed, in order to calculate CH₄ and N₂O emissions specific make and model year data is required for each vehicle. In order to input vehicle fuel consumption into the 2009 CACP software, we used fuel data and the alternative method from the LGOP which recommends using a default emissions factor by vehicle type to calculate emissions in the absence of make and model year data.

We calculated GHG emissions from City employees commuting to work using total annual vehicle miles traveled (VMT). The VMT were calculated based on employee zip code data, and these data were added into the CACP software under the passenger car alternative method category.

We further calculated the CATS transit fleet GHG emissions using the same alternative method. This method is based on estimated average fuel efficiency for each vehicle type. For the transit bus fleet, emissions were calculated using the alternative method emissions factor for heavy duty vehicles.

WASTEWATER TREATMENT PLANTS

Methane and nitrous oxide emissions from wastewater treatment plants are two of the new emissions sources which were added to the city operations inventory based on the latest guidance in the LGOP. Biogas emissions data was not available for FY2009, so these emissions were assumed to have remained constant at 2006 levels.

AIRPORT FACILITIES

Emissions from Charlotte-Douglas International Airport (CDIA) buildings, facilities and vehicle fleet were included in the original 2006 inventory. In complying with the LGOP, these emissions are now separated as an individual sector in the city operations inventory, as opposed to being included in the Buildings and Facilities sector. CDIA emissions do not include emissions from aircraft because these emissions sources are typically considered to be Scope 3, or optional emissions sources, over which an airport has little to no financial or operational control.
The City of Charlotte’s total GHG emissions for City operations in FY2009 is approximately 311,000 metric tons of CO2e, which is two percent higher than the emissions in FY2006. Figure 1 shows the breakdown of these emissions by the LGOP sectors. Figure 2 shows the breakdown of Charlotte’s emissions by KBU.

Figure 1. FY2009 City Operations GHG Emissions by LGOP Sector
Tables 4 and 5 present Charlotte’s emissions by LGOP category and by KBU.

Table 4. FY2009 City Operations GHG Emissions by LGOP Sector

<table>
<thead>
<tr>
<th>LGOP Sector</th>
<th>MTCO2e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings and Facilities</td>
<td>33,772</td>
</tr>
<tr>
<td>Streetlights &amp; Traffic Signals</td>
<td>39,253</td>
</tr>
<tr>
<td>Airport Facilities</td>
<td>35,651</td>
</tr>
<tr>
<td>Water Delivery Facilities</td>
<td>30,149</td>
</tr>
<tr>
<td>Wastewater Facilities</td>
<td>49,729</td>
</tr>
<tr>
<td>Solid Waste Facilities</td>
<td>21,740</td>
</tr>
<tr>
<td>Vehicle Fleet</td>
<td>42,218</td>
</tr>
<tr>
<td>Transit Fleet</td>
<td>36,363</td>
</tr>
<tr>
<td>Employee Commute</td>
<td>21,606</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>310,480</strong></td>
</tr>
</tbody>
</table>
Table 5. FY2009 City Operations GHG Emissions by KBU

<table>
<thead>
<tr>
<th>KBU</th>
<th>MTCO2e</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>39,917</td>
</tr>
<tr>
<td>BSS</td>
<td>38,927</td>
</tr>
<tr>
<td>Budget &amp; Evaluation</td>
<td>42</td>
</tr>
<tr>
<td>CATS</td>
<td>40,213</td>
</tr>
<tr>
<td>CDOT</td>
<td>40,528</td>
</tr>
<tr>
<td>CMPD</td>
<td>7,270</td>
</tr>
<tr>
<td>EPM</td>
<td>30,569</td>
</tr>
<tr>
<td>Finance</td>
<td>311</td>
</tr>
<tr>
<td>Fire</td>
<td>6,360</td>
</tr>
<tr>
<td>Human Resources</td>
<td>131</td>
</tr>
<tr>
<td>Neighborhood and Business Development</td>
<td>490</td>
</tr>
<tr>
<td>Other*</td>
<td>820</td>
</tr>
<tr>
<td>Planning</td>
<td>170</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>22,653</td>
</tr>
<tr>
<td>Utilities</td>
<td>82,085</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>310,480</strong></td>
</tr>
</tbody>
</table>

*Includes employee commute emissions for City employees not incorporated into a KBU (e.g., city attorney’s office, city clerk’s office).

KBU RESULTS

This section presents the results of the GHG inventory for Charlotte’s major KBUs: Aviation, Vehicle Fleet, CATS, Engineering and Property Management, and Utilities. These KBUs account for 75 percent of Charlotte’s total operations emissions.
The total emissions from Charlotte Douglas International Airport was approximately 40,000 metric tons of CO2e in FY2009. Figure 3 shows aviation emissions by source, and Figure 4 shows the emissions broken down by fuel type. 81% of aviation emissions are from electricity powering the main airport terminal building.

Figure 3.  FY2009 Aviation Emissions by Source

Figure 4.  FY2009 Aviation Emissions by Fuel
The total emissions from Charlotte’s vehicle fleet was approximately 39,000 metric tons of CO2e in FY2009. Figure 5 shows fleet emissions by source, and Figure 6 shows the emissions broken down by fuel type. Fleet emissions are half from gasoline use and half from diesel use. 22% of the fleet emissions are from sanitation vehicles, 28% from light duty vehicles, and 22% from cars with severe usage, such as police cars.

Figure 5. FY2009 Fleet Emissions by Source

Figure 6. FY2009 Fleet Emissions by Fuel
The total emissions from Charlotte’s transit system was approximately 40,000 metric tons of CO2e in FY2009. Figure 7 shows CATS emissions by source, and Figure 8 shows the emissions broken down by fuel type. 85% of CATS emissions are from the diesel powered fleet, which includes City buses, and 12% of emissions are from the electric light rail system.

**Figure 7.** FY2009 CATS Emissions by Source

**Figure 8.** FY2009 CATS Emissions by Fuel
The total emissions from Charlotte’s Engineering and Property Management Department was approximately 30,000 metric tons of CO2e in FY2009. Figure 9 shows E&PM emissions by source, and Figure 10 shows the emissions broken down by fuel type. 14% of E&PM emissions are from the Charlotte Mecklenburg Government Center, 14% of emissions are from police stations, 11% are from fire stations, and 24% are from other City buildings. 85% of E&PM’s emissions are from building electricity use.

Figure 9. FY2009 E&PM Emissions by Source

Figure 10. FY2009 E&PM Emissions by Fuel
The total emissions from Charlotte’s utilities department was approximately 82,000 metric tons of CO2e in FY2009. Figure 11 shows fleet emissions by source, and Figure 12 shows the emissions broken down by fuel type. 34% of utilities emissions are from the McAlpine Creek Wastewater Treatment Plant, and 96% of utilities emissions are from electricity use.

Figure 11. FY2009 Utilities Emissions by Source

Figure 12. FY2009 Utilities Emissions by Fuel
References


Appendix B. Peer Organization Interviews

This appendix contains the full descriptions of the interviews conducted at peer organizations. We conducted interviews with:

15 cities and counties:
  - Asheville
  - Austin
  - Boulder
  - Cabarrus County
  - Chicago
  - Denver
  - Durham
  - Mecklenburg County
  - Nashville
  - New York
  - Oakland
  - Portland
  - Raleigh
  - San Jose
  - Tallahassee

4 colleges and universities:
  - Davidson College
  - Duke University
  - University of North Carolina, Chapel Hill
  - University of North Carolina, Charlotte

7 companies:
  - Bank of America
  - Burts Bees
  - Duke Energy
  - Medtronic
  - Lowes
  - Pacific Gas and Electric
  - Wachoiva
ASHEVILLE, NORTH CAROLINA

TARGET(S)

- Reduce city greenhouse gas emissions 80% from 2001 levels by 2050. Achieve a 2% annual reduction.

BACKGROUND

Asheville, North Carolina set an ambitious greenhouse gas emissions reduction target and developed 22 sustainability goals that are to be considered in decision making processes. These goals are ongoing, and action items are developed and completed to work towards these goals. They have seen a 2.5% annual reduction in greenhouse gas emissions since their climate action plan was implemented, exceeding their annual goal of 2%.

KEY INSIGHTS

1. MAKE SUSTAINABILITY A PRIORITY IN ALL DECISION MAKING
2. REINVEST ENERGY SAVINGS INTO A SUSTAINABILITY FUND
3. DEVELOP ONGOING SUSTAINABILITY GOALS

MAKE SUSTAINABILTIY A PRIORITY IN ALL DECISION MAKING

- Develop a culture of sustainability in all city departments
- A full-time leader is needed to manage sustainability projects, and to reinforce importance of sustainability in all decision-making.
- Bottom-up change is just as necessary as top-down change.

REINVEST ENERGY SAVINGS INTO A SUSTAINABILITY FUND

- Utility bill savings are reinvested in a sustainability fund, instead of going back into the general fund. This provides secure funding for future sustainability projects.
- Publicizing the cost savings of energy projects drives the importance home for many city and community leaders. People who aren’t on board with sustainability are still able to see the importance of cost savings.

DEVELOP ONGOING SUSTAINABILITY GOALS

- Asheville’s 22 sustainability goals cannot be achieved. Action items are developed and complete to work towards these goals. This supports the culture of ongoing sustainability within the city.
AUSTIN, TEXAS

TARGET(S)

- Austin-Energy: Reduce greenhouse gas emissions by 20% from 2005 levels by 2020.
- Community: Achieve carbon neutrality by 2050.

BACKGROUND

Austin owns and operates Austin-Energy, and this has enabled the City to achieve many of its greenhouse gas reduction goals. The City passed a Renewable Portfolio Standard which increases electricity generation from renewable sources to 35% by 2020. Austin has a very environmentally-focused community which has advocated for many environmental and sustainability efforts from the City.

KEY INSIGHTS

1. ENGAGE COMMUNITY EARLY
2. COORDINATE INTERDEPARTMENTAL EFFORTS

ENGAGE COMMUNITY EARLY

- Austin developed its plan for the community separately and after their plans for the utility and for the City’s operations.
- The community needs to be engaged early so support and collaboration can be gathered from the beginning.

COORDINATE INTERDEPARTMENTAL EFFORTS

- Projects developed across departments all contribute to a City’s sustainability efforts. Knowing what projects other departments are undertaking is critical so that crosscutting actions can be leveraged.
- Integrating projects and plans between departments ties together a climate action plan and makes it more cohesive.
BOULDER, COLORADO

TARGET(S)
Reduce greenhouse gas emissions by 7% from 1990 levels by 2012.

BACKGROUND
Boulder set its greenhouse gas reduction targets in 2002, and based its goal on the goals of the Kyoto Protocol. The City has been successful in reduction emissions, but need to reduce emissions an additional 26% to meet current goal. Boulder pass the country’s first carbon tax – a per kilowatt fee added to resident’s electricity bills which went to financing environmental projects.

KEY INSIGHTS
1. DEVELOP SECURE FUNDING SOURCE
2. PRIORITIZE PROJECTS ON MULTIPLE LEVELS
3. KEEP INVENTORY SIMPLE

DEVELOP SECURE FUNDING SOURCE
- Boulder was the first city to put a tax on carbon. The City charges an additional fee on electricity bills, which differs for residential, commercial, and industrial customers.
- This fee raises 1.6 million annually which is used to fund additional energy efficiency projects.
- This secure funding source guarantees the continuation of environmental efforts in the City.

PRIORITIZE PROJECTS ON MULTIPLE LEVELS
- Boulder prioritize projects not just on their greenhouse gas reduction potential and their cost effectiveness, but also considered the potential of projects to leverage external resources, the ease of measurement and evaluation, the proven effectiveness, project visibility, and community engagement potential.
- Highly visible project and projects that engage the community, even if they have less greenhouse gas reduction potential are valuable in their ability to gather community support and increase awareness of environmental efforts.

KEEP INVENTORY SIMPLE
- It is more important to conduct an inventory on a regular basis, even if it’s simpler and less encompassing of true city emissions, because progress towards environmental goals is made apparent. Spending too much time on getting an exact inventory is counterproductive, especially if many emissions sources can’t be directly impacted by the City.
CABARRUS COUNTY, NC

**TARGET(S)**

- No GHG specified, but have a goal of 5% annual reduction in energy use over the next 5 years

**BACKGROUND**

Cabarrus County is located North of Mecklenburg County and has a population of approximately 176,000. The county has a Renewable Energy Industrial Park, known as the “EcoComplex,” which converts waste and byproducts into energy. The county also provides sustainability workshops, operates the Elma C. Lomax Incubator Farm, which teaches local farmers organic and sustainable farming practices, and has formed a Local Food Policy Council.

**KEY INSIGHTS**

1. **FIND WAYS TO RAISE AWARENESS AND EDUCATE**

2. **BRAND SUSTAINABILITY INITIATIVES**

3. **INCORPORATE SUSTAINABILITY INTO PROJECTS ALREADY SCHEDULED**

**FIND WAYS TO RAISE AWARENESS AND EDUCATE**

- The county hosts regular sustainability workshop on a variety of topics such as green cleaning, local food and energy conservation
- The Elma C. Lomax Incubator Farm provides classroom and in the field training for local farmers
- Utility and water consumption are tracked and displayed
- Stickers on light switches remind employees to turn off lights

**BRAND SUSTAINABILITY INITIATIVES**

- Cabarrus County has designed its own sustainability logo to increase awareness

**INCORPORATE SUSTAINABILITY INTO PROJECTS ALREADY SCHEDULED**

- Cabarrus County Logo:
  3 circles represent the triple bottom line
**CHICAGO, IL**

**TARGET(S)**

Reduce Chicago’s (community) emissions 25% below 1990 levels by 2020

- Reduce Chicago’s (community) emissions 80% below 1990 levels by 2050

**BACKGROUND**

Chicago is a model city for sustainability, and has a highly visible and detailed strategy for addressing climate change. The Chicago Climate Action Plan focuses on 5 strategies; Energy Efficient Buildings, Clean and Renewable Energy Sources, Improved Transportation Options, Reduced Waste and Industrial Pollution, and Adaptation. In addition to the Climate Action Plan, the City released the “Chicago Greenhouse Gas Emissions and Mitigation Analysis” which details 33 strategies grouped into 9 categories. As a result of the City’s extensive experience in climate action planning, Chicago has even published a document guide for other cities titled “Lessons Learned: Creating the Chicago Action Plan.”

**KEY INSIGHTS (FROM “LESSONS LEARNED: CREATING THE CHICAGO ACTION PLAN”)**

1. **MITIGATION AND ADAPTATION SHOULD HAVE EQUAL WEIGHT AND HAVE MANY OVERLAPPING BENEFITS**

2. **SUPPORT FROM MAYOR, GOVERNMENT, CIVIC AND BUSINESS LEADERS CRITICAL**

3. **REQUIRES DEDICATED CITY STAFF**

4. **DEDICATED FUNDS ARE NEEDED TO SUPPORT RESEARCH, PLANNING AND IMPLEMENTATION**

5. **TASK FORCE OF LOCAL LEADERS VALUABLE**

6. **INVOLVE CITY COMMISSIONERS AND SISTER AGENCIES FROM THE BEGINNING**

7. **FREQUENT COMMUNICATION (CLIMATE SUMMITS) PROVIDE STAKEHOLDERS WITH UPDATES AND ARE AN OPPORTUNITY TO RECEIVE FEEDBACK**

8. **IT PAYS TO HAVE A RESEARCH TEAM TO TURN TO FOR ONGOING RESEARCH NEEDS**

9. **HAVE AN AlIGNED COMMUNITY STRATEGY (AFTER RESEARCH COMPLETED AND PRIORITIES CHOSEN)**

10. **LEVERAGE EXISTING INITIATIVES**

11. **ESTABLISH LONG-TERM PUBLIC-PRIVATE PARTNERSHIPS**

12. **TRACK PROGRESS AND CONTINUALLY REASSESS**

Appendix B-6
DENVER, COLORADO

TARGET(S)

- Reduce per capita greenhouse gas emissions by 10% from 1990 levels by 2012 (achieved).
- Reduce greenhouse gas emissions to 1990 levels by 2025.

BACKGROUND

Denver set its greenhouse gas emissions reduction goal by considering the guidelines of the Kyoto Protocol and with the advice and guidance of its GreenPrint Advisory Council. A per capita target was set because it allowed for population growth, and showed progress towards goal even if total greenhouse gas emissions continued to grow. Denver renews its goals every 5 years and updates its inventory every 2 years.

KEY INSIGHTS

1. APPLY LESSONS LEARNED FROM SIMILAR CITIES
2. PUBLICIZE PROGRESS
3. DEVELOP EXPERT ADVISORY COUNCIL

APPLY LESSONS LEARNED FROM SIMILAR CITIES

- Halfway through the development of its Climate Action Plan, Denver met with city leaders from Seattle, Portland, Chicago, Oakland, and Salt Lake City to discuss the political realities of developing and implementing sustainability policies. Over a 3 day period, these city leaders met with the Mayor, City Council, and City champions, and developed relationships that were valuable in answering questions and helping guide Denver through its Climate Action Plan development.

PUBLICIZE PROGRESS

- Denver chose a per capita metric because progress towards goal could be more easily publicized and understood.
- A per capita goal sounds significant to a larger audience, and more clearly depicts progress towards ultimate goal.

DEVELOP EXPERT ADVISORY COUNCIL

- Denver’s GreenPrint Advisory Council consists of 35 leaders from the community, academia, non-profits, corporations and helps guide the City’s direction for its environmental work.
- Balanced practical and aspirational goals to develop the City’s greenhouse gas emissions reduction target.
DURHAM, NORTH CAROLINA

TARGET(S)
- Reduce government (city, country, schools) greenhouse gas emissions by 50% from 2005 levels by 2030
- Reduce community greenhouse gas emissions by 30% from BAU projection by 2030.

BACKGROUND
Durham, North Carolina set a greenhouse gas emissions reduction target for the city, country and its school system. This goal is highly ambitious and the sustainability program is underfunded. Right now they are not on track to meet any of their goals.

KEY INSIGHTS

1. HAVE SUSTAINABILITY MANAGER IN PLACE WHILE CLIMATE ACTION PLAN IS DEVELOPED

2. KEEP INVENTORY SIMPLE AND ONLY INCLUDE WHAT CAN BE IMPACTED

HAVE SUSTAINABILITY MANAGER IN PLACE WHILE CLIMATE ACTION PLAN IS DEVELOPED
- Have a sustainability leader in place to help shape and develop a strong and manageable climate action plan and greenhouse gas reduction target.
- A sustainability manager would be able to shape target setting to account for city and county growth, while incorporating sustainability measures.

KEEP INVENTORY SIMPLE AND ONLY INCLUDE WHAT CAN BE IMPACTED
- Decide early what can be measured and what can be affected.
- Using models and regional estimate skews and muddles the data.
- Time is wasted on developing exact information on items the city has no control over.
- Perfect is the enemy of good.
MECKLENBURG COUNTY, NC

TARGET(S)

- Reduce greenhouse gas emissions 28% from 2006 levels by 2020

BACKGROUND

Mecklenburg County has developed an Environmental Leadership Policy Action Plan which details goals and objectives for emissions reduction, resource conservation, commitment, and stewardship enhancement. Progress is reported in an annual scorecard. Mecklenburg County and the City of Charlotte work together on many issues related to state and local policies. It is the role of Mecklenburg County to enforce state regulations, while the City of Charlotte maintains control over land use and the built environment. In addition, the City of Charlotte acts as a purchasing agent for the county because both are located in Charlotte.

KEY INSIGHTS

1. COMMUNITY EMISSIONS SHOULD BE THE #1 PRIORITY

2. COORDINATE WITH PEERS TO MAXIMIZE IMPACT

3. LEADERSHIP IS CRITICAL TO SUCCESS

COMMUNITY EMISSIONS SHOULD BE THE #1 PRIORITY

- County/City operations have marginal emissions compared to the emissions of the communities which they serve
- Community emissions are harder to influence, but could benefit from highly visible long-term goals
- Consider drafting goals for community feedback or the development of collaborative goals with segments of the community

COORDINATION WITH PEERS TO MAXIMIZE IMPACT

- Charlotte should consider its goals and strategy in the context of a larger county plan
- Standardization of some metrics across the region would facilitate comparisons and allow for measurement of collective results

LEADERSHIP IS CRITICAL TO SUCCESS

- Sustainability efforts need a clear vision
- A program champion with influence and accountability is needed to get things done
NASHVILLE, TENNESSEE

TARGET(S)

Reduce greenhouse gas emissions to 2005 levels by 2012. (gov’t only)
- Reduce greenhouse gas emissions by 20% below 2005 levels by 2020. (gov’t only)
- Reduce greenhouse gas emissions by 80% below 2005 levels by 2050. (gov’t only)

BACKGROUND

Nashville developed top-down aggressive greenhouse gas targets for the city and county government. They picked these targets and timelines to be consistent with common goals throughout the country. They have focused their efforts on educational campaigns throughout the city government, along with energy efficiency and green building retrofits funded through the Energy Efficiency and Conservation Block Grant funding.

KEY INSIGHTS

1. DEVELOP A SECURE FUNDING SOURCE FOR SUSTAINABILITY PROJECTS

2. USE ABSOLUTE TARGETS OVER INTENSITY TARGETS

DEVELOP A SECURE FUNDING SOURCE FOR SUSTAINABILITY PROJECTS

- Nashville developed secure funding sources for water projects by passing a new fee on resident’s water bills, to develop stormwater mitigation projects and to save wastewater treatment energy. A similar secure funding source needs to be developed to ensure the progress of sustainability projects.

USE ABSOLUTE TARGETS OVER INTENSITY PROJECTS

- While intensity targets show process towards a greenhouse gas reduction goal more quickly and allow for city growth, they downplay the ultimate need for reduction in total greenhouse gas emissions.
NEW YORK, NEW YORK

TARGET(S)

- Reduce greenhouse gas emissions by 30% from 2007 levels by 2017 (city)
- Reduce greenhouse gas emissions by 30% from 2007 levels by 2030 (community)

BACKGROUND

New York City developed PlaNYC to respond to land use, housing, and population concerns in the City. The plan addressed Land, Water, Transportation, Energy, Air, and Climate Change. This plan was developed through many rounds of meeting with the Sustainability Advisory Committee and endless public comment. New York releases an update on their progress annually.

KEY INSIGHTS

1. RIGOROUS ANALYSIS IN EVERY PART OF PLAN PROVIDES CREDIBILITY

2. ESTABLISH AN OUTSIDE ADVISORY BOARD TO SHAPE PLAN

3. STRONG MAYORAL LEADERSHIP GUIDES ALL ASPECTS OF PLAN

RIGOROUS ANALYSIS IN EVERY PART OF PLAN PROVIDES CREDIBILITY

- New York has a detailed and transparent inventory process, and provides rigorous analysis of every aspect of plan to give it credibility. Nothing was considered that wasn’t also thoroughly analyzed.

ESTABLISH AN OUTSIDE ADVISORY BOARD TO SHAPE PLAN

- New York established an outside advisory board consisting of 17 people from all sectors in city (environmental justice, green buildings, environmental policy, real estate, labor, etc.) to help guide Climate Action Plan. All members need to be dedicated and invested in project.

STRONG MAYORAL LEADERSHIP GUIDES ALL ASPECTS OF PLAN

- Mayoral support helped with publicity, and community reception of plan. Mayoral support had a trickle-down effect and inspired people who may not have originally been onboard with the plan.
OAKLAND, CALIFORNIA

TARGET(S)

- Reduce greenhouse gas emissions by 36% from 2005 levels by 2020.
- Reduce greenhouse gas emissions by 80% from 2005 levels by 2050
  - 20% reduction in vehicle miles traveled annually as residents, workers and visitors meet daily needs through walking, bicycling, and using transit
  - 24 million gallons of oil saved annually due to less driving and more fuel efficient vehicles on local roads
  - 32% decrease in electricity consumption through conservation and energy efficiency
  - 15% decrease in natural gas consumption through building retrofits and conservation
  - 63 million annual kWh of new renewable energy used to meet local electricity needs
  - 390,000 tons of waste diverted away from local landfills through waste reduction, reuse, recycling, and composting

BACKGROUND

Oakland set a top-down greenhouse gas target by considering the recommendations of the IPCC, which stated that industrialized nations need to reduce 25% below 1990 levels by 2020 to avoid the worst future climate impact scenarios. Oakland didn’t have 1990 data so they extrapolated forward to 2005, and increased the goal to 36%.

KEY INSIGHTS

1. WITHOUT SIGNIFICANT BEHAVIOR CHANGE, GOALS CANNOT BE ACHIEVED
2. PRIORITIZE PROJECTS AS FUNDED/UNFUNDED AND SHORT-TERM/LONG-TERM
3. GET INPUT ON OVERARCHING PLAN FIRST

WITHOUT SIGNIFICANT BEHAVIOR CHANGE, GOALS CANNOT BE ACHIEVED

- Oakland’s ambitious greenhouse gas goals cannot be achieved without significant behavior change from the City’s residents. Education and outreach programs are a critical part of Oakland’s Climate Action Plan.

PRIORITIZE PROJECTS AS FUNDED/UNFUNDED AND SHORT-TERM/LONG-TERM

- Oakland prioritizes its greenhouse gas projects as 3-year priority - funded, 3-year priority unfunded, and other. This allows the City to work on immediate projects that are funded, and get the resources needed for other priority projects. The plan is updated every 3 years, so new projects can be identified at each update.

GET INPUT ON OVERARCHING PLAN FIRST

- Oakland received a lot of community input on its goals, evaluation criteria, metrics used, and climate action plan. In the first round of comments, no numbers were provided so over-arching comments could be received before people began criticizing project evaluation numbers.

Appendix B-12
PORTLAND, OREGON

TARGET(S)
- Reduce greenhouse gas emissions by 40% from 1990 levels by 2030. (currently 1% below)
- Reduce greenhouse gas emissions by 80% from 1990 levels by 2050.

BACKGROUND
Portland set an aggressive greenhouse gas emissions reduction target of an 80% reduction from 1990 levels by 2050. They developed a thorough climate action plan, consisting of 2012 action items, 2030 objectives, and a 2050 goal in order to meet their ultimate greenhouse gas goal. They have reduced emissions to 1% below 1990 levels, but still have a long way to go. Most of their success has been achieved through land use and transportation planning policies preventing growth of the City outside an Urban Growth Boundary.

KEY INSIGHTS
1. EMPOWER STAFF TO DEVELOP SUSTAINABILITY POLICIES
2. CONSIDER GOALS, OBJECTIVES, AND ACTIONS
3. LAND USE PLANNING ACHIEVES TREMENDOUS SUCCESS

EMPOWER STAFF TO DEVELOP SUSTAINABILITY POLICIES
- Empowering staff from different departments to develop environmental and sustainability policies produces well-informed policies, and a staff which takes ownership of environmental efforts.
- Developing a city culture that promotes efficiency, transportation planning, renewables, etc. ensures that environmental efforts will be made a priority.

CONSIDER GOALS, OBJECTIVES, AND ACTIONS
- Develop overarching goal to be met, medium-term objectives that need to be met, and short-term action items that need to take place to meet goal.
- Shaping a short-term path to a long-term goal focuses environmental policy and project development.

LAND USE PLANNING ACHIEVES TREMENDOUS SUCCESS
- Focusing on density development, urban growth boundaries, alternative transportation, etc. shapes environmental efforts, but also gives identity to City within boundaries – infinite sprawl is not an option.
RALEIGH, NORTH CAROLINA

TARGET(S)

- Just starting target setting process.

BACKGROUND

Raleigh just completed a greenhouse gas inventory and presented to City Council last month. They are just starting the process of setting a greenhouse gas reduction target and developing a climate action plan.

KEY INSIGHTS

1. FOCUS ON POLICIES, NOT PROJECTS
2. BUILD POLITICAL INFRASTRUCTURE
3. IDENTIFY CHAMPIONS IN EACH DEPARTMENT

FOCUS ON POLICIES, NOT PROJECTS

- Projects are fleeting, but developing sustainability policies ensures that Raleigh’s climate goals will continually be worked towards.

BUILD POLITICAL INFRASTRUCTURE

- The biggest success Raleigh has had in getting sustainability addressed in their comprehensive plan. This ensures sustainability will remain a key issue for the City in years to come.
- Writing sustainability into the general plan and incorporating sustainability into the budgeting process defines its place in the City’s future.

IDENTIFY CHAMPIONS IN EACH DEPARTMENT

- Champions in each department are needed to identify sustainability projects, and to initiate department-specific sustainability efforts.
SAN JOSE, CALIFORNIA

<table>
<thead>
<tr>
<th>TARGET(S)</th>
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<tbody>
<tr>
<td>- Reduce greenhouse gas emissions by 15% from 2005 levels by 2015</td>
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<tr>
<td>- Reduce greenhouse gas emissions by 20% from 2005 levels by 2020</td>
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<tr>
<td>- Reduce greenhouse gas emissions by 35% from 2005 levels by 2030</td>
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<tr>
<td>- Reduce greenhouse gas emissions by 65% from 2005 levels by 2040</td>
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<tr>
<td>- Reduce greenhouse gas emissions by 85% from 2005 levels by 2050</td>
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<table>
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<tr>
<th>BACKGROUND</th>
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<tr>
<td>San Jose developed ten Green Vision Goals for 2020 encompassing energy, green buildings, sustainability, and job creation. San Jose projects that if they meet the energy-related goals, their greenhouse gas emissions reduction goals will also be met until at least 2020. Currently, San Jose is trying to integrate greenhouse gas reduction goals and projects with the City’s general plan.</td>
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<tr>
<th>KEY INSIGHTS</th>
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<tbody>
<tr>
<td>1. DEVELOP INSTITUTIONAL METHODOLOGY FOR DATA COLLECTION</td>
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<tr>
<td>2. GATHER SUPPORT FROM CITY LEADERS</td>
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<tr>
<td>3. COORDINATE INTERDEPARTMENTAL EFFORTS</td>
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DEVELOP INSTITUTIONAL METHODOLOGY FOR DATA COLLECTION

- San Jose has been impeded by lack of data for many of the city’s emissions-generating activities. Some data that was once recorded has been lost due to the paper-work reduction act.
- San Jose was able to develop an intuitional methodology for data collection, and is now able to track progress towards their greenhouse gas reduction goals.

GATHER SUPPORT FROM CITY LEADERS

- Clear direction and endorsement from city leaders is critical.
- Leadership is essential in developing city and community goals, prioritizing goals and targets, and deciding priority areas for city action.

COORDINATE INTERDEPARTMENTAL EFFORTS

- Many projects are cross-cutting across departments, so an interdepartmental team is key in coordinating efforts. Leaders from each department are able to better understand and communicate department’s strengths and priorities when developing and prioritizing projects.
TALLAHASSEE, FLORIDA

TARGET(S)


BACKGROUND

Tallahassee, Florida owns and operates its own utility. Switching this power plant from coal-fired to natural gas has already reduced the City’s greenhouse gas emission to 7% below 1990 levels in 2009 (meeting the requirements of the Kyoto Protocol). The utility contributes a significant percentage of the City’s emissions, so any other sustainability efforts aren’t seen in the City’s emissions data.

KEY INSIGHTS

1. CREATE A DEDICATED SUSTAINABILITY DEPARTMENT
2. DEVELOP ENVIRONMENTAL ADVISORY BOARD

CREATE A DEDICATED SUSTAINABILITY DEPARTMENT

- Tallahassee developed a Sustainability Department comprised of 10 dedicated individuals working on environmental compliance and environmental sustainability. This is an autonomous department that reports directly to the city manager.

DEVELOP ENVIRONMENTAL ADVISORY BOARD

Develop an Environmental Advisory Board comprised of leaders in the private sector, non-profits, county government, etc. This group guided the City in its sustainability efforts and recommended what projects the City should focus on.
DAVIDSON COLLEGE

TARGET(S)

- 10% reduction from 2008 levels by 2020
- 15% reduction from 2008 levels by 2030
- Carbon neutral by 2050

BACKGROUND

Davidson hired a New College President in 2007, who declared a "Year of Sustainability," helping to create urgency for the school’s sustainability efforts. The school’s Climate Action Plan is guided by the American College and University Presidents’ Climate Commitment (ACUPCC). Davidson has especially focused on alternative energy solutions.

KEY INSIGHTS

1. CLEAR LEADERSHIP IS CRITICAL
2. DEFINE INCENTIVES TO CELEBRATE AND REWARD
3. LEVERAGE COMPETITION

CLEAR LEADERSHIP IS CRITICAL

- A program champion will increase engagement and urgency
- Identify supporters in the organization and leverage them

DEFINE INCENTIVES TO CELEBRATE AND REWARD

- Define incentives not just on a organizational level but also for departments and individuals
- Energy savings dollars could be funneled into a pool for sustainability performance bonuses

LEVERAGE COMPETITION

- Leverage the competitive mindset to engage employees
DUKE UNIVERSITY

TARGET(S)

Achieve carbon neutrality by 2024. Emissions that aren’t reduced will be offset by with local, high-quality, verifiable offsets.

BACKGROUND

Duke University is a signatory of the American College and University Presidents Climate Commitment. Duke set the date to reach carbon neutrality as 2024 because it is the 100th anniversary of the indenture of Duke Trust. Duke has already achieved a 7% reduction in greenhouse gases from 2007.

KEY INSIGHTS

1. INCORPORATE ALL STAKEHOLDERS EARLY

2. SECTOR-SPECIFIC SUBCOMMITTEES ARE BETTER ABLE TO DEVELOP AND PRIORITIZE OWN PROJECTS

3. DON’T UNDERESTIMATE OUTREACH ABOUT BEHAVIORAL CHANGE

INCORPORATE ALL STAKEHOLDERS EARLY

- Involving all stakeholders, including staff, professors, and students early in the development of the Climate Action Plan is key. Stakeholders can voice their opinion about the plan, and take ownership of their role in helping reduce greenhouse gas emissions.

SECTOR-SPECIFIC SUBCOMMITTEES ARE BETTER ABLE TO DEVELOP AND PRIORITIZE OWN PROJECTS

- Each subcommittee included members from departments which would implement projects in that sector and each subcommittee developed and ranked own projects.

DON’T UNDERESTIMATE OUTREACH ABOUT BEHAVIORAL CHANGE

- Education about climate goals to all students, faculty and staff is critical in reducing greenhouse gas emissions.
- As people are made aware of their impact to Duke’s climate footprint, and made aware of easy steps to reduce their impact, they become proud of the university’s goal.
- Sustainability challenges have been very successful at Duke. Challenging people to drive less, use less water, etc., and comparing their usage to rival schools (UNC), has made a huge impact on individual climate impacts.

Appendix B-18
TARGET(S)
- Achieve carbon neutrality by 2050.

BACKGROUND
The University of North Carolina is a signatory of the American College and University’s Climate Commitment. Because UNC is state-funded, offsets are not an option to meet this goal. 2050 seemed like a reasonable timeframe.

KEY INSIGHTS
1. PROMOTE FINANCIAL SAVINGS IN ADDITION TO CARBON SAVINGS
2. DEVELOP PROJECT TEAMS FOR EACH MAJOR SECTOR OF EMISSIONS
3. STANDARDIZE FRAMEWORK FOR DEVELOPING PROJECT IDEAS

PROMOTE FINANCIAL SAVINGS IN ADDITION TO CARBON SAVINGS
- Focus first on low cost efficiency measures.
- Inspire groups to take on projects by promoting financial savings – not everyone is driven by carbon.

DEVELOP PROJECT TEAMS FOR EACH MAJOR SECTOR OF EMISSIONS
- Each project team developed and prioritized sustainability projects.
- Picked projects with the highest impact and greatest financial viability.

STANDARDIZE FRAMEWORK FOR DEVELOPING PROJECT IDEAS
- Held workshops for each working group to brainstorm sustainability project ideas
- Process-based workshops were most successful. Get all departments involved to look at a single process and how to make it more efficient and have less of a climate impact. Identify problems and brainstorm solutions as a group
UNC CHARLOTTE

TARGET(S)

- In progress

BACKGROUND

UNCC currently has a sustainability plan and GHG inventory, and is currently in the process of deciding on a reduction target. The school’s sustainability plan is organized around four core functions; Curriculum and Research, Culture and Community, Outreach and Partnership, and Business Operations. As a state agency, the school has mandatory reduction requirements. UNCC is a member of the President’s Climate Commitment.

KEY INSIGHTS

1. INTEGRATE SUSTAINABILITY MEASURES INTO EXISTING STRATEGY AND IMPLEMENTATION

2. MAKE SUSTAINABILITY A CORE VALUE

INTEGRATE SUSTAINABILITY MEASURES INTO EXISTING STRATEGY AND IMPLEMENTATION

- UNCC organizes its sustainability plan around core functions, with short and long term vision, goals, actions and metrics for each function.
- One of UNCC’s goals is for sustainability to become a core element of the University Strategic Plan

MAKE SUSTAINABILITY A CORE VALUE

- UNCC plans to “promote sustainability so that it becomes a core value”
- The university plans to measure success in this area by; percentage of employees who have environmental requirements in job descriptions, percentage of employees/students receiving sustainability training at orientation, number of grass roots clean up and recycling initiatives sponsored or self implemented, and number of sustainability speaker events on campus
BANK OF AMERICA

TARGET(S)

- Reduce greenhouse gas emissions by 9% from 2004 levels by 2009. (Achieved 17.7%)
- Currently working on setting a new target.

BACKGROUND

Bank of America set an initial target in 2004 based on the EPA Climate Leader framework. The company had to restate the baseline emissions inventory for multiple acquisitions between 2004 and 2009 but was able to achieve a reduction of 17.7%. The bank is in the process of setting a new target. Bank of America also announced a $20 billion commitment to addressing global climate change over the next 10 years. Business lines are responsible for creating their own initiatives and strategy to meet the $20 billion goal.

KEY INSIGHTS

1. INCORPORATE MEASURES TO INFLUENCE CORPORATE CULTURE AND BEHAVIOR

2. ADDRESS WHY PEOPLE SHOULD CARE

3. INTRODUCE SUSTAINABLE ELEMENTS INTO EXISTING PROJECTS

INCORPORATE MEASURES TO INFLUENCE CORPORATE CULTURE AND BEHAVIOR

- Bank of America recently hired a Sustainability Engagement Manager to address corporate culture and employee behavior
- The bank also created the “My Environmental Program “and “Sustainability Ambassador Program” to influence behavior at the company.

ADDRESS WHY PEOPLE SHOULD CARE

- Many employees will not see a connection between their core responsibilities and sustainability
- Consider what motivates employees and what incentives can be used

INTRODUCE SUSTAINABLE ELEMENTS INTO EXISTING PROJECTS

- Adding sustainable elements to existing projects is easier than getting support for completely new projects
BURTS BEES

TARGET(S)

- Carbon free by 2020. (set in 2006)
- 35% reduction in emissions per sales dollar from 2006-2012 (scope 1 and 2)

BACKGROUND

Burts Bees, which is owned by Clorox, has one of the most aggressive corporate sustainability plans today. The company's goals are the most aspirational of all the organizations surveyed. In addition, the firm's CEO is a vocal champion and the company has an established culture of environmental responsibility. The company is currently carbon neutral via offsets, but seeks to be carbon free by 2020. Burts Bees has additional goals of zero waste by 2020, 100% employee engagement in sustainability and 100% natural formulas. The company also ties a portion of employee performance bonuses to sustainability goals.

KEY INSIGHTS

1. INTEGRATE SUSTAINABILITY INTO THE PLANNING AND FORECASTING PROCESS

2. USE COMPETITION TO ENCOURAGE DESIRABLE BEHAVIOR

3. CREATE A FORMAL INCENTIVE STRUCTURE

INTEGRATE SUSTAINABILITY INTO THE PLANNING AND FORECASTING PROCESS

- At Burts Bees, sustainability initiatives and projects are evaluated in the same way as other strategic plans and are included in the corporate goal setting process
- Sustainability strategy at Burts is organized around specific goals
- Performance is managed via Business Action Teams and a Sustainability Steering Committee (reports to the Executive Leadership Team)

USE COMPETITION TO ENCOURAGE DESIRABLE BEHAVIOR

- Burts Bees’ “Green Derby” competition judges departments using waste-bin audits to determine how well waste is being disposed of in the correct container
- Dial displays online show the relative performance towards goals

CREATE A FORMAL INCENTIVE STRUCTURE

- At Burts Bees, a portion of employee performance bonuses are tied directly to sustainability goals
- In order to achieve their goal of 100% employee engagement, the company requires employees to complete sustainability training modules in order to be eligible for bonuses

Appendix B-22
DUKE ENERGY

**TARGET(S)**

Reduce customer energy consumption by 2,500 gigawatt-hours and peak demand by 2,100 megawatts (MW) by 2013

- Reduce or offset carbon dioxide emissions from the U.S. generation fleet 17 percent from 2005 by 2020 (i.e., go from 105 million tons in 2005 to 87 million tons in 2020)
- Reduce the carbon intensity of the total generation fleet from 0.63 tons of CO2 per megawatt-hour in 2005 to 0.50 tons of CO2 per megawatt-hours

**BACKGROUND**

Duke Energy is a regulated utility operator serving over 4 million customers in 5 states and is also the 3rd largest carbon emitter in the U.S. The company’s CEO, Jim Roger, issued an “aspirational” target of reducing the company’s emissions 50% by 2030. In addition to this target, the company has set a number of more attainable sustainability goals and targets that were developed in collaboration with the firm’s business groups.

**KEY INSIGHTS**

1. COLLABORATE WITH BUSINESS GROUPS TO SET GOALS AND TARGETS

2. USE MARKET SEGMENTATION TO INFLUENCE BEHAVIOR IN A VARIETY OF GROUPS

3. MINIMIZE RESISTANCE BY INCLUDING SUSTAINABLE CHANGES THAT WILL STEM FROM PROJECTS THAT HAVE TO BE DONE ANYWAY

**COLLABORATE WITH BUSINESS GROUPS TO SET GOALS AND TARGETS**

- Duke set corporate targets thru negotiation with business groups
- Executives are responsible for setting their own annual goals which must align with the company’s long-term targets
- Performance is managed thru on-going communication with the sustainability staff and via on-going goal visibility

**USE MARKET SEGMENTATION TO INFLUENCE BEHAVIOR IN A VARIETY OF GROUPS**

- Duke segments their customers by context and needs to determine the most effective strategies for influencing their behavior (energy conservation)
- The company analyzes the intersection of departments and services with customer needs to identify entry points where they can influence customer behavior
- A similar approach could be used by the City to drive change in the community

**MINIMIZE RESISTANCE BY INCLUDING SUSTAINABLE CHANGES THAT WILL STEM FROM PROJECTS THAT HAVE TO BE DONE ANYWAY**
LOWES

TARGET(S)

- Targets related to climate change have not been established, sustainability action plan in development

BACKGROUND

Lowe’s is a home improvement store which sells to residential and commercial customers. Lowe’s sells Energy Star products and has a focused on several key environmental issues as detailed in the company’s 2009 Corporate Social Responsibility Report. These issues are product application, product transportation, efficient store operation, and responsible wood sourcing. The firm also partners with The Nature Conservancy to minimize their environmental impact.

KEY INSIGHTS

1. DECEIDE METRICS IN COLLABORATION WITH THOSE WHO ARE ACCOUNTABLE FOR THEM

2. DELEGATE PROJECTS BY DETERMINING WHAT DRIVES THE OUTCOME

3. GET SUPPORT FROM THE TOP

DECEIDE METRICS IN COLLABORATION WITH THOSE WHO ARE ACCOUNTABLE FOR THEM

- Whoever has control over the data being measured should ultimately be held responsible for performance against decided metrics
- Involving data owners in metric setting increases buy-in
- Data owners have a better understanding of the data and appropriate metrics

DELEGATE PROJECTS BY DETERMINING WHAT DRIVES THE OUTCOME

- Lowe’s structured their analysis of environmental impacts by looking at inputs, processes and outputs
- Different segments or business units may have different drivers and require different metrics

GET SUPPORT FROM THE TOP

- Leadership needs to come from the top (CEO at Lowe’s, City Manager at the City)
- A leader’s personality and buy-in can strongly influence performance of the rest of the organization
Medtronic is an international medical device company based in Minneapolis, Minnesota. The company’s sustainability measures have come primarily from bottom-up initiatives, especially through buildings and facilities management.

**KEY INSIGHTS**

1. **FOCUS ON RAISING AWARENESS**
2. **USE A HOLISTIC APPROACH TO ENERGY MANAGEMENT**
3. **USE COMPETITION TO INFLUENCE BEHAVIOR**

**FOCUS ON RAISING AWARENESS**

- One challenge Medtronic faced in energy efficiency was a general lack of awareness of energy efficiency problems and solutions
- Medtronic created the “Go Green for Life” awareness program to influence employee behavior
- Headlining energy efficiency creates an understandable and identifiable objective for employees to support

**USE A HOLISTIC APPROACH TO ENERGY MANAGEMENT**

- Employees at Medtronic were willing to make one-off actions but often failed to incorporate energy-saving behavior into their everyday habits, which was limiting their impact
- Medtronic uses technology (automated building controls), policy (thermostat and energy star policies) and competition between buildings to manage energy use

**USE COMPETITION TO INFLUENCE BEHAVIOR**

- Medtronic used competition between buildings to improve energy savings
- Remember to compare performance in percentages not absolute values

Appendix B-25
PG&E

TARGET(S)

- Not known

BACKGROUND

PG&E provides electricity and natural gas to over 15 million customers in California. The company began a GHG inventory and voluntary GHG reporting in 2002 and has been an active advocate for more regulation in the industry. The company also participates in the EPA’s SF Emission Reduction Partnership and the EPA’s Natural Gas STAR Partnership. PG&E was the first in its sector to measure the carbon footprint of its supply chain.

KEY INSIGHTS

1. RAISE AWARENESS AMONG EMPLOYEES

2. TARGET YOUR MARKET USING SEGMENTATION

3. CREATE INCENTIVES

4. BRAND YOUR SUSTAINABILITY EFFORTS FOR VISIBILITY AND CONSISTENCY

RAISE AWARENESS AMONG EMPLOYEES

- PG&E trains all employees on the company’s environmental policies
- Employees attend group discussions on sustainability issues
- The company also has an intranet site for employees to share ideas or stories related to energy saving

TARGET YOUR MARKET USING SEGMENTATION

- PG&E targets community energy efficiency by segmenting customers and creating strategies around each segment
- The company uses a range of rebates, financial incentives, training, marketing and education to reach different customer segments

CREATE INCENTIVES

- PG&E links compensation to environmental goals via the employee bonus pool
- Consider using competition to engage employees
- Recognize employees for positive behavior

Appendix B-26
WACHOVIA – A WELLS FARGO COMPANY

**TARGET(S)**

- Reduce greenhouse gas emissions by 20% from 2008 levels by 2018*

**BACKGROUND**

Wells Fargo is a public financial services company that is based in San Francisco, California and operates in 40 states. The company acquired the Charlotte-based bank, Wachovia, in 2008. Wells Fargo and Wachovia took different approaches to designing a climate action strategy. Wachovia chose to set its goal and look for opportunities mostly within its electricity use and building management. Wells Fargo chose a multi-stakeholder approach in which key stakeholders and subject matter experts across the company contributed initiatives and respective reduction targets. These targets were then rolled up into a corporate target. Wells Fargo also analyzed peer organizations to confirm the reasonableness of their selected target.

**KEY INSIGHTS**

1. **SET A 10 YEAR TIME HORIZON FOR ACHIEVING GHG GOALS**
2. **EMPLOY A COLLABORATIVE PROCESS OF GOAL SETTING TO DETERMINE TARGET**
3. **FOCUS ON RAISING AWARENESS OF SUSTAINABILITY ISSUES AND METRICS**

**A 10 YEAR TIME HORIZON IS RECOMMENDED FOR ACHIEVING GHG GOALS**

- Legacy Wachovia set a GHG target for only 5 years which the company did not find to be an adequate time horizon for affecting significant change in the organization
- A 10-year goal prevents actions from being overly focused on short-term results

**EMPLOY A COLLABORATIVE PROCESS OF GOAL SETTING TO DETERMINE TARGET**

- A cross functional approach to setting a GHG target creates a more accurate picture of what is achievable by the organization
- Collaborative goal setting increases buy-in and accountability
- A collaborative process allows departments to integrate GHG goals into their business strategy and roll up the recommendations for executive approval

**FOCUS ON RAISING AWARENESS OF SUSTAINABILITY ISSUES AND METRICS**

- Integrating sustainability into organizational strategy requires new language and metrics
- Raising awareness is the first step towards influencing behavior

*Wachovia’s initial reduction goal was 10% over 5 years.*
Appendix C. Summary and Comparison of Greenhouse Gas Inventory Protocols for Local Governments, Academic and Private Institutions

INTRODUCTION

Several greenhouse gas protocols have been developed in recent years to provide a standardized set of guidelines for greenhouse gas accounting and reporting. This report reviews the prevalent protocols used in local governments, academic institutions, and the private sector: The Local Government Operations Protocol, The Cool Campus! How to Guide for College and University Climate Action Planning, and GHG Protocol Corporate Accounting and Reporting Standard, respectively.

Local Government: The Local Government Operations Protocol was developed through the partnership of The California Air Resources Board, The California Climate Action Registry, ICLEI – Local Governments for Sustainability, and The Climate Registry. The purpose of the Local Government Operations Protocol is to:

- Enable local governments to develop emissions inventories following internationally recognized GHG accounting and reporting principles defined below with attention to the unique context of local government operations;
- Advance the consistent, comparable and relevant quantification of emissions and appropriate, transparent, and policy-relevant reporting of emissions;
- Enable measurement towards climate goals;
- Promote understanding of the role of local government operations in combating climate change;
- Help to create harmonization between GHG inventories developed and reported to multiple programs.

The Local Government Operations Protocol is a tool for accounting and reporting GHG emissions across a local government’s operations. Reductions in emissions are calculated by comparing changes in a local government’s emissions over time. By tracking emissions over time, local governments should be able to measure the GHG reduction benefits from policies and programs put in place to reduce emissions within their operations.

Academic Institutions: The Cool Campus! How to Guide for College and University Climate Action Planning was developed through the partnership of Clean Air Cool Planet, National Wildlife Federation: Campus Ecology, and the Rocky Mountain Institute, and supported by the American College and University Presidents Climate Commitment. The purpose of Cool Campus! How to Guide for College and University Climate Action Planning: Determining Your Carbon Footprint and Emissions Trajectory is to raise awareness of greenhouse gas emissions. It allows green campus advocates to equate energy-wasting activities to the problem of climate change by showing their consequences in terms of GHG emissions.

Corporate: The GHG Protocol Corporate Accounting and Reporting Standard was developed through the partnership of the World Business Council for Sustainable Development and the World Resources Institute. The purpose of the GHG Protocol Corporate Accounting and Reporting Standard is:

- To help companies prepare a GHG inventory that represents a true and fair account of their emissions, through the use of standardized approaches and principles
- To simplify and reduce the costs of compiling a GHG inventory
• To provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions
• To provide information that facilitates participation in voluntary and mandatory GHG programs
• To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs.

The following benefits of completing a greenhouse gas inventory are addressed in each protocol:

• **Risk Management.** Voluntarily reporting GHG emissions may help local governments manage climate risk by documenting early actions to reduce GHG emissions. Such information may be accepted by future state, federal or international regulatory GHG programs.
• **Addressing Inefficiencies.** Accounting for emissions has helped many organizations gain better insights into the relationship between improving efficiency (reducing factor inputs and waste) and reducing emissions. As a result, organizations have redesigned business operations and processes, implemented technological innovations, improved products and services, and ultimately saved money and resources.
• **Readiness for a Carbon Constrained Future.** Identifying emissions sources to develop a GHG profile and management strategies may help local governments prepare for and respond to the potential impact of new regulations.
• **Recognition as an Environmental Leader.** Voluntarily reporting GHG emissions provides local governments with a pathway to recognize, publicize, and promote their environmental stewardship.
• **Stakeholder Education.** Assembling an annual GHG emissions inventory can help inform management, constituents, employees, and the public about a local government’s GHG emissions profile.

The protocols also detail the following five overarching accounting and reporting principles necessary for a greenhouse gas inventory. These principals are intended to guide the inventory and reporting of emissions.

• **Relevance.** The greenhouse gas inventory should appropriately reflect the greenhouse gas emissions of the local government and should be organized to reflect the areas over which local governments exert control and hold responsibility in order to serve the decision-making needs of users.
• **Completeness.** All greenhouse gas emission sources and emissions-causing activities within the chosen inventory boundary should be accounted for. Any specific exclusion should be justified and disclosed.
• **Consistency.** Consistent methodologies should be used in the identification of boundaries, analysis of data and quantification of emissions to enable meaningful trend analysis over time, demonstration of reductions, and comparisons of emissions. Any changes to the data, inventory boundary, methods, or any relevant factors in subsequent inventories should be disclosed.
• **Transparency.** All relevant issues should be addressed and documented in a factual and coherent manner to provide a trail for future review and replication. All relevant data sources and assumptions should be disclosed, along with specific descriptions of methodologies and data sources used.
• **Accuracy.** The quantification of greenhouse gas emissions should not be systematically over or under the actual emissions. Accuracy should be sufficient to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

### INVENTORY GUIDELINES

*Greenhouse Gas Definition:* Each protocol defines the greenhouse gases which should be assessed in a greenhouse gas inventory as the six chemicals regulated under the Kyoto Protocol: Carbon dioxide (CO2); Methane (CH4); Nitrous oxide (N2O); Hydrofluorocarbons (HFCs); Perfluorocarbons (PFCs); and Sulfur hexafluoride (SF6). The emissions of each gas should be assessed individually, then aggregated using internationally recognized Global Warming Potential factors (Annex).

*Base Year and Recalculation Procedures:* Each protocol outlines the process for picking a base year for to compare later emissions to. A base year is also required when setting an emissions reduction target. The base year for the
UNFCCC and subsequent Kyoto Protocol is calendar year 1990. However, required data from 1990 is often prohibitively difficult or impossible to collect. The protocols further state that it is more important that the base year be chosen so that accurate data is available so that it can serve as a basis for local action planning.

A base year must also be likely to be representative of the general level of emissions over the surrounding period. Energy use in a year that was particularly hot or particularly cold would usually differ to energy use in an average year, due to the greater level of use of air conditioning or heating respectively. Similarly, local governments that have an electricity supply comprising a high proportion of hydroelectricity should avoid abnormally dry years during which the amount of hydroelectricity generation is lower than usual.

The base year also determines the emissions level against which changes in emissions are measured. Therefore, any emission reduction activities put in place before the base year are considered to be part of the status quo and will not be seen as a reduction against an emission reduction target that may be adopted.

Each protocol outlines the process for recalculating base year emissions. For example, in local governments, there may be changes over time that affect a local government’s emissions, such as annexing previously unincorporated areas, outsourcing activities that generated GHG emissions (e.g. waste hauling), or improvement in the accuracy of emission factors. These changes will be reflected in the current greenhouse gas inventories, but should also be reflected in the base year inventory, in order to compare emissions across time. Because of this, base year emissions should be retroactively recalculated to reflect changes in the local government that would otherwise compromise consistency and relevance of the reported emissions.

The Cool Campus Guide and the GHG Protocol Corporate Accounting and Reporting Standard state that base year emissions should be recalculated if:

- Structural changes in the reporting organization that have a significant impact on the company’s base year emissions. A structural change involves the transfer of ownership or control of emissions-generating activities or operations from one company to another. While a single structural change might not have a significant impact on the base year emissions, the cumulative effect of a number of minor structural changes can result in a significant impact. Structural changes include: mergers, acquisitions, and divestments and outsourcing and insourcing of emitting activities
- Changes in calculation methodology or improvements in the accuracy of emission factors or activity data that result in a significant impact on the base year emissions data
- Discovery of significant errors, or a number of cumulative errors, that are collectively significant.

The protocols for each sector also stress the importance of inventorying emissions on a regular basis. The Local Government Operations Protocol and the GHG Protocol Corporate Accounting and Reporting Standard recommend the standard practice for entity-level GHG accounting is inventorying emissions on an annual basis. The Cool Campus! How to Guide for College and University Climate Action Planning recommends updating emissions inventories every other year.

**Organizational Boundaries**

The protocols all state that the next step in conducting a robust greenhouse gas inventory is to determine the organizational boundaries. Two approaches are recommended for this: an operational approach, or a financial approach.

*Operational Approach:* Using the operational approach methodology, an entity will account for all of the emissions from operations over which it has control. An entity would not account for GHG emissions from
operations in which it owns an interest but has no control. For local governments, this means that the local government has the full authority to introduce and implement its operating policies at the operation.

Financial Approach: Using the financial approach methodology, an entity will account for all of the emissions from operations according to its financial stake in the operation. The Local Government Operations Protocol describes the following conditions which establish financial control:

- Wholly owning an operation, facility, or source;
- Considering an operation to be, for the purposes of financial accounting, a group company or subsidiary, and consolidating its financial accounts in your organization’s financial statements;
- Governing the financial policies of a joint venture under a statute, agreement or contract; or
- Retaining the rights to the majority of the economic benefits and/or financial risks from an operation or facility that is part of a joint venture or partnership (incorporated or unincorporated), however these rights are conveyed. These rights may be evident through the traditional conveyance of equity interest or working/participating interest or through nontraditional arrangements. The latter could include your organization casting the majority of votes at a meeting of the board of directors or having the right to appoint/remove a majority of the members of the board in the case of an incorporated joint venture.

Table 1 summarizes the differences in GHG reporting based on financial control and operational control.

**Table 1. Comparison of Reporting based on Financial Control and Operational Control**

<table>
<thead>
<tr>
<th>Level of Control of Facility</th>
<th>% of Emissions to Report Under Financial Control</th>
<th>% of Emissions to Report Under Operational Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholly owned</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Partially owned with financial and operational control</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Partially owned with financial control; no operational control</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Partially owned with operational control; no financial control</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Joint financial control with operational control</td>
<td>Based on % ownership</td>
<td>100%</td>
</tr>
<tr>
<td>Joint financial control; no operational control</td>
<td>Based on % ownership</td>
<td>0%</td>
</tr>
<tr>
<td>Associated entity (not consolidated in financial accounts) with operational control</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>Associated entity (not consolidated in financial accounts); no operational control</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Fixed asset investments</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Not owned but have a capital or financial lease</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Not owned but have an operating lease</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The Local Government Operations Protocol strongly recommends that local governments use the operational approach, because this approach most accurately represents the emission sources that local governments can influence. The Cool Campus Guide and the GHG Protocol Corporate Accounting and Reporting Standard do not state a preference.

**OPERATIONAL BOUNDARIES**

Setting operational boundaries involves identifying emissions associated with an entity’s operations, and determining if emissions are direct or indirect. Direct GHG emissions are emissions from sources that are owned or controlled by the company, while indirect GHG emissions are emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company.
Emission Scopes: Direct and indirect emissions can be categorized by using the following standard scopes:

Scope 1: All direct GHG emissions from sources within the local government’s organizational boundaries (with the exception of direct CO2 emissions from biogenic sources). These emissions should be further subdivided into emissions from four separate types of sources:

- Stationary combustion to produce electricity, steam, heat or power using equipment in a fixed location (found in most local government sectors);
- Mobile combustion of fuels in fleet transportation sources (e.g., cars, trucks, marine vessels and planes) and emissions from off-road equipment such as in construction, agriculture and forestry;
- Process emissions from physical or chemical processing, other than fuel combustion (e.g., from the manufacturing of cement, aluminum, ammonia, etc.); and
- Fugitive emissions that are not physically controlled but result from intentional or unintentional releases, commonly arising from the production, processing, transmission, storage, and use of fuels and other substances, often through joints, seals, packing, gaskets, etc. (e.g., HFCs from refrigeration leaks, SF6 from electrical power distributors, and CH4 fromsolid waste landfills).

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling. Indirect GHG emissions are emissions that are a consequence of activities that take place within the organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity. Scope 2 emissions physically occur at the facility where electricity is generated. For example, emissions that occur at a power plant as a result of electricity used by a local government’s administrative buildings represent the local government’s indirect emissions.

Scope 2 emissions typically represent one of the largest sources of emissions for local governments; therefore, they embody a significant opportunity for GHG management and reduction. Local governments can reduce their use of electricity by investing in energy efficient technologies and energy conservation. A local government could also install an efficient on-site co-generation plant, particularly if it replaces the purchase of more GHG intensive electricity from the grid or electricity supplier. Reporting of Scope 2 emissions enables transparent accounting and reporting of emissions and reductions associated with such opportunities.

Scope 3: All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), outsourced activities, waste disposal, etc. Scope 3 emissions are considered optional emissions. Local governments are encouraged to identify and measure all Scope 3 emission sources to the extent possible. While reporting of Scope 3 emissions is considered optional, doing so provides an opportunity for innovation in GHG management. Local governments may want to focus on accounting for and reporting those activities that are relevant to their GHG programs and goals, and for which they have reliable information. Scope 3 sources that are particularly relevant for local governments and that many local governments have been estimating to date include:

- Emissions from waste generated by government operations, but disposed of outside its organizational boundary;
- Emissions from employee commuting; and
- Emissions from employee business travel.

While data availability and reliability may influence which Scope 3 activities are included in the inventory, it is accepted that data accuracy for Scope 3 emissions may be lower than Scope 1 and Scope 2 data. It may be more important to understand the relative magnitude of and possible changes to Scope 3 activities. Emission estimates
are acceptable as long as there is transparency with regard to the estimation approach and the data used for the analysis are adequate to support the objectives of the inventory.

QUANTIFYING EMISSIONS

Each protocol outlines a similar calculation-based methodology for quantifying greenhouse gas emissions. Activity data (e.g., kWh used, gallons of gasoline consumed) are collected for each emissions scope and for each sector. The activity data is then translated into greenhouse gas emissions by using emissions factors. Each protocol states the need for transparency by disclosing the activity data used to calculate emissions, along with the standard emission factors.

REPORTING EMISSIONS

Each protocol discusses several required data points when reporting emissions. The entity should first be described, along with a transparent description of the organizational and operational boundaries chosen. The Local Government Operations Protocol further lists the following indicators that should be provided when reporting greenhouse gas emissions:

- Size (square miles) – total area within the local government’s jurisdictional boundaries.
- Population – number of year round residents of the jurisdiction.
- Annual Budget – Total budget under the control of the local government including all general funds, restricted funds and enterprise funds wherever operations included in the emissions inventory are paid for by these funds. Semi-autonomous agencies whose emissions are not included in the inventory should not have their budgets included in this indicator. Transient capital funding should also be excluded.
- Employees – The number of full time equivalent staff employed by the local government.
- Climate Zone – the U.S. Department of Energy climate zone that the local government is in. Climate zones can be determined at this website: http://www.energycodes.gov/implement/pdfs/climate_paper_review_draft_rev.pdf
- Heating and Cooling Degree Days – Annual heating and cooling degree days in the community. This is available at www7.ncdc.noaa.gov/CDO/COD/DivisionalSelect.jsp#. In communities with more than one weather station, the heating and cooling degree days reported should be for the weather station closest to the majority of government operations.

The report should then cover greenhouse gas inventory details. Emissions should be reported by emissions scope and by sector, separately for each GHG (CO2, CH4, N2O, HFCs, PFCs, SF6). Emissions should then be aggregated and reported as CO2e. The report should also include:

- Year chosen as base year, and an emissions profile over time that is consistent with and clarifies the chosen policy for making base year emissions recalculations.
- Appropriate context for any significant emissions changes that trigger base year emissions recalculation (acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries or calculation methodologies, etc.).
- Emissions data for direct CO2 emissions from biologically sequestered carbon (e.g., CO2 from burning biomass/biofuels), reported separately from the scopes.
- Methodologies used to calculate or measure emissions, providing a reference or link to any calculation tools used and disclosing all the activity data used and the associated emissions factors.
- Any specific exclusions of sources, facilities, and / or operations.

Appendix C-6
## ANNEX

<table>
<thead>
<tr>
<th>Greenhouse Gas</th>
<th>Formula</th>
<th>Global Warming Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide</td>
<td>CO2</td>
<td>1</td>
</tr>
<tr>
<td>Methane</td>
<td>CH4</td>
<td>21</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>N2O</td>
<td>310</td>
</tr>
<tr>
<td>Sulfur Hexafluoride</td>
<td>SF6</td>
<td>23,900</td>
</tr>
</tbody>
</table>
Appendix D. Alternative CATS GHG Accounting Method

Greenhouse gas reduction projects in the CATS KBU present a challenge, since an increase in ridership of the CATS public transportation fleet will result in an increase in GHG emissions from City operations but a decrease in overall City emissions. Since we are scoping our recommended GHG targets for City operations only, we recommend that the City use the following accounting method to cope with this challenge:

1. **Present GHG emissions in terms of MTCDE / commuted mile.**
   Use a weighted average of MTCDE emitted per mile commuted, using assumed gas mileage of personal vehicles and busses. This weighted average is the resulting MTCDE / commuted mile metric. It can be improved by either more public transit ridership or better vehicle gas efficiency or both.

2. **Present CATS-specific emissions as well as the reduction in commuting emissions.**

The following examples shows this methodology:
### Sample Alternative CATS Accounting

<table>
<thead>
<tr>
<th></th>
<th>Basecase</th>
<th>Expanded Ridership</th>
<th>Improved Bus Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTCDE/gal gasoline</td>
<td>0.00881</td>
<td>0.00881</td>
<td>0.00881</td>
</tr>
<tr>
<td>MTCDE/gal diesel</td>
<td>0.01015</td>
<td>0.01015</td>
<td>0.01015</td>
</tr>
<tr>
<td>Assumed mpg, passenger car</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Assumed mpg, bus</td>
<td>4</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Assumed passengers/car</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Assumed passengers/bus</td>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>% Personal Car</td>
<td>95%</td>
<td>70%</td>
<td>95%</td>
</tr>
<tr>
<td>% Bus</td>
<td>5%</td>
<td>30%</td>
<td>5%</td>
</tr>
<tr>
<td>% Light Rail</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Total Personal VMT</td>
<td>100000</td>
<td>98000</td>
<td>100000</td>
</tr>
<tr>
<td>Total CATS Bus VMT</td>
<td>10000</td>
<td>12000</td>
<td>10000</td>
</tr>
</tbody>
</table>

### MTCDE/Commuted Mile

**Basecase**
- Personal Car: 0.40 MTCDE/1000 person mile
- Bus: 0.17 MTCDE/1000 person mile
- Average: 0.39 MTCDE/1000 person mile

**Expanded Ridership: MTCDE/commuting mile**
- Personal Car: 0.40 MTCDE/1000 person mile
- Bus: 0.08 MTCDE/1000 person mile
- Average: 0.31 MTCDE/1000 person mile

**Improved Bus Mileage: MTCDE/commuting mile**
- Personal Car: 0.40 MTCDE/1000 person mile
- Bus: 0.05 MTCDE/1000 person mile
- Average: 0.38 MTCDE/1000 person mile

### CATS vs City Comparision

<table>
<thead>
<tr>
<th></th>
<th>CATS Total</th>
<th>Community Total</th>
<th>Charlotte Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25.38</td>
<td>44.05</td>
<td>69.43</td>
</tr>
<tr>
<td>Improved Bus Mileage</td>
<td>30.45</td>
<td>43.17</td>
<td>73.62</td>
</tr>
<tr>
<td></td>
<td>14.50</td>
<td>44.05</td>
<td>58.55</td>
</tr>
</tbody>
</table>
# Appendix E. GHG Targets for Select Local Governments, Academic and Private Institutions

## 1. MUNICIPAL REDUCTION TARGETS

<table>
<thead>
<tr>
<th>City</th>
<th>Base Year</th>
<th>Target Date</th>
<th>Reduction Goal</th>
<th>Annualized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catawba County</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Mecklenburg County</td>
<td>2006</td>
<td>2020</td>
<td>28%</td>
<td>2.0%</td>
</tr>
<tr>
<td>Chicago, IL 2020</td>
<td>1990</td>
<td>2020</td>
<td>25%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Chicago, IL 2050</td>
<td>1990</td>
<td>2050</td>
<td>80%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Austin, TX – Utility</td>
<td>2005</td>
<td>2020</td>
<td>20%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Austin, TX – City</td>
<td>2005</td>
<td>2020</td>
<td>100%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Austin, TX – Community</td>
<td>2005</td>
<td>2050</td>
<td>100%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>1990</td>
<td>2012</td>
<td>10%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Boulder, CO</td>
<td>1990</td>
<td>2012</td>
<td>7%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Raleigh, NC</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Portland, OR 2030</td>
<td>1990</td>
<td>2030</td>
<td>40%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Portland, OR 2050</td>
<td>1990</td>
<td>2050</td>
<td>80%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Nashville, TN 2020</td>
<td>2005</td>
<td>2020</td>
<td>20%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Nashville, TN 2050</td>
<td>2005</td>
<td>2050</td>
<td>80%</td>
<td>1.8%</td>
</tr>
<tr>
<td>San Jose, CA 2015</td>
<td>2005</td>
<td>2015</td>
<td>15%</td>
<td>1.5%</td>
</tr>
<tr>
<td>San Jose, CA 2020</td>
<td>2005</td>
<td>2020</td>
<td>20%</td>
<td>1.33%</td>
</tr>
<tr>
<td>San Jose, CA 2030</td>
<td>2005</td>
<td>2030</td>
<td>35%</td>
<td>1.4%</td>
</tr>
<tr>
<td>San Jose, CA 2040</td>
<td>2005</td>
<td>2040</td>
<td>65%</td>
<td>1.9%</td>
</tr>
<tr>
<td>San Jose, CA 2050</td>
<td>2005</td>
<td>2050</td>
<td>85%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Asheville, NC</td>
<td>2001</td>
<td>2050</td>
<td>80%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Durham, NC</td>
<td>2005</td>
<td>2030</td>
<td>50%</td>
<td>2.0%</td>
</tr>
<tr>
<td>New York, NY – City</td>
<td>2007</td>
<td>2017</td>
<td>30%</td>
<td>3.0%</td>
</tr>
<tr>
<td>New York, NY - Community</td>
<td>2007</td>
<td>2030</td>
<td>30%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Oakland, CA 2020</td>
<td>2005</td>
<td>2020</td>
<td>36%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Location</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Reduction Goal</td>
<td>Annualized Reduction</td>
</tr>
<tr>
<td>------------------</td>
<td>--------</td>
<td>--------</td>
<td>----------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Oakland, CA 2050</td>
<td>2005</td>
<td>2050</td>
<td>80%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Tallahassee, FL 2008</td>
<td>2007</td>
<td>2008</td>
<td>5%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Tallahassee, FL 2010</td>
<td>2009</td>
<td>2010</td>
<td>2%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

## 2. Corporate Reduction Targets

<table>
<thead>
<tr>
<th>Company</th>
<th>Base Year</th>
<th>Target Year</th>
<th>Reduction Goal</th>
<th>Annualized Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank of America</td>
<td>2004</td>
<td>2009</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>Burt’s Bees</td>
<td>2006</td>
<td>2020</td>
<td>100%</td>
<td>7%</td>
</tr>
<tr>
<td>Duke Energy</td>
<td>2005</td>
<td>2020</td>
<td>17%</td>
<td>1%</td>
</tr>
<tr>
<td>Lowe’s</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Medtronic</td>
<td>2007</td>
<td>2013</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>PG&amp;E</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Wachovia</td>
<td>2008</td>
<td>2018</td>
<td>20%</td>
<td>2%</td>
</tr>
</tbody>
</table>

## 3. Academic Reduction Targets

<table>
<thead>
<tr>
<th>Institution</th>
<th>Base Year</th>
<th>Target Year</th>
<th>Reduction Goal</th>
<th>Annualized Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davidson College 2020</td>
<td>2008</td>
<td>2020</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>Davidson College 2030</td>
<td>2008</td>
<td>2030</td>
<td>15%</td>
<td>1%</td>
</tr>
<tr>
<td>Davidson College 2050</td>
<td>2008</td>
<td>2050</td>
<td>100%</td>
<td>2%</td>
</tr>
<tr>
<td>Duke University</td>
<td>2007</td>
<td>2024</td>
<td>100%</td>
<td>6%</td>
</tr>
<tr>
<td>UNC Chapel Hill</td>
<td>2007</td>
<td>2050</td>
<td>100%</td>
<td>2%</td>
</tr>
<tr>
<td>UNC Charlotte</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Appendix F. Charlotte Sustainability Resources

<table>
<thead>
<tr>
<th>Name</th>
<th>Region</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reporting Frameworks &amp; Protocols</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The GHG Protocol Corporate Standard</td>
<td>National</td>
<td>Corporate</td>
<td>A corporate standard for GHG reporting developed by the World Resource Institute and World Business Council for Sustainable Development.</td>
</tr>
<tr>
<td>The Local Government Operations Protocol</td>
<td>National</td>
<td>Government</td>
<td>A program-neutral GHG protocol developed by a collaboration of organizations including the California Climate Action Registry (CCAR), the California Air Resources Board (CARB), ICLEI Local Governments for Sustainability (ICLEI), and The Climate Registry.</td>
</tr>
<tr>
<td>American College and University Presidents’ Climate Commitment</td>
<td>National</td>
<td>Academic</td>
<td>Coordinated network of American Colleges and Universities seeking to mitigate their climate impact. Members agree to an inventory, target, milestone, immediate mitigation steps and to integrating sustainability into the curriculum.</td>
</tr>
<tr>
<td>Carbon Disclosure Project</td>
<td>International</td>
<td>Corporate</td>
<td>A UK-based non profit organization which provides a framework for corporations to measure and report their climate action strategies and impacts. The framework is intended to serve as a platform for investors who wish to incorporate sustainability measures into their investment decisions.</td>
</tr>
<tr>
<td>International Organization for Standardization (ISO)</td>
<td>International</td>
<td>Any</td>
<td>An international NGO comprised of the national standards institutes of 163 countries. Develops and publishes international standards.</td>
</tr>
<tr>
<td><strong>Energy Star</strong></td>
<td>National</td>
<td>Any</td>
<td>A joint program of the US EPA and DOE which provides an energy performance rating for products and buildings.</td>
</tr>
<tr>
<td>LEED</td>
<td>National</td>
<td>Any</td>
<td>International green building certification system</td>
</tr>
<tr>
<td><strong>Rating Systems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Government and NGO Programs and Research</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charlotte Green Team</td>
<td>Local</td>
<td>Membership Association</td>
<td>A consortium of local organizations committed to sustainable events and business practices.</td>
</tr>
<tr>
<td>U.S. EPA Climate Leaders</td>
<td>National</td>
<td>Corporate</td>
<td>An EPA Industry-government partnership which guides corporations in their development of climate change strategies.</td>
</tr>
<tr>
<td>ICLEI (Local Governments for Sustainability)</td>
<td>International</td>
<td>Government</td>
<td>A membership organization of local governments which are committed to measuring and addressing GHG emissions. The organization provides resources and protocols for climate action planning and implementation.</td>
</tr>
<tr>
<td>NC State Energy Office</td>
<td>Regional</td>
<td>Government Agency</td>
<td>The State Energy Plan allocates state resources and investment of Federal Recovery Act Funds to promote energy efficiency in businesses, residential buildings, and government operations as well as to promote cleaner energy technologies and help create and provide training for green jobs in the state.</td>
</tr>
<tr>
<td>Southeast Energy Efficiency Alliance</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>A nonprofit organization which promotes energy-efficient policies and practices and facilitates cooperation from businesses, utilities, government, advocates, consumers and universities.</td>
</tr>
<tr>
<td>NC Environmental Stewardship Initiative</td>
<td>Regional</td>
<td>Government Program</td>
<td>Voluntary program which promotes high environmental performance standards among state regulated organizations. The program requires members to set environmental performance goals, implement a certified ISO 14001 system and report annually.</td>
</tr>
<tr>
<td>NC Project Green</td>
<td>Regional</td>
<td>Government Program</td>
<td>An Alliance of NC local governments and state agencies which facilitates knowledge-sharing among government employees across the state.</td>
</tr>
<tr>
<td>NC GreenPower</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Nonprofit organization approved by the NC Utilities Commission which supports initiatives &quot;to supplement the state's existing power supply with more green energy.&quot; The organization is supported by all NC utilities and is administered by Advanced Energy.</td>
</tr>
<tr>
<td>Southern Alliance for Clean Energy</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Regional nonprofit watchdog organization focused on &quot;developing clean energy solutions throughout the Southeast.&quot; The Alliance advocates for energy reform and is represented on state utility boards and energy committees.</td>
</tr>
<tr>
<td>Advanced Energy</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Independent member organization for NC utilities and the governor of NC. The organization does research on energy efficiency solutions for the energy industry.</td>
</tr>
<tr>
<td>Carolina Recycling Association</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Member organization committed to waste reduction and recycling.</td>
</tr>
<tr>
<td>Earth Share of North Carolina</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Association of NC environment non-profits which runs workplace employee giving campaigns.</td>
</tr>
<tr>
<td>Environmental Defense North Carolina</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Partners with large companies and industry leaders to design and implement innovative environmental solutions.</td>
</tr>
<tr>
<td>North Carolina Sustainable Energy Association NCSEA</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Membership organization which promotes sustainable energy and energy efficiency in NC through education, public policy, and economic development.</td>
</tr>
<tr>
<td>Southern Alliance for Clean Energy</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Focused on developing clean energy solutions in the Southeast.</td>
</tr>
<tr>
<td>Southern Environmental Law Center</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>Shapes, implements and enforces environmental laws and policies in the south.</td>
</tr>
<tr>
<td>Clean Air Carolina</td>
<td>Regional</td>
<td>Nonprofit</td>
<td>A Charlotte-based nonprofit organization focused on &quot;achieving the cleanest air possible&quot; using awareness-raising campaigns and partnerships.</td>
</tr>
</tbody>
</table>
Charlotte Ecosystem Map

Environmental Conditions
- Economic and Markets: Fixing energy costs, grant funding and incentives available for energy projects, home to many Fortune 500 companies
- Geography and Infrastructure: Leader in land use planning and transit-oriented growth. Also, the largest city in NC.
- Culture and Social Fabric: Slight democratic leaning among voters, home to several universities

Resource Providers:
- Financial
  - Federal Funds
  - ARRA Grants
  - State Funds
  - Energy Utilities
- Human
  - City Staff
  - Local Universities
  - Local Businesses
- Knowledge
  - Employees
  - Local experts
  - Business partners
- Networking
  - Energy Efficiency Partners
  - City website
- Technological
  - US Climate Change Technology Program
- Intermediaries
  - Energy Utilities

Competitors (friendly and less friendly):
- Other states and cities

City of Charlotte

Environment Focus Area Vision:
- to become a national leader in environmental initiatives to preserve our natural resources while balancing growth with sound fiscal policy

Beneficiaries/Customer:
- Citizens of Charlotte
- Local businesses
- Green workforce

Complementary Org/Allies:
- Bank of America
- Central Piedmont Community College
- Charlotte Chamber of Commerce
- Clean Air Coalition
- Duke Energy
- Mecklenburg County
- Piedmont Natural Gas
- Sierra Club
- UNCC
- Wachovia/Wells Fargo

Impact
- Improve energy efficiency in buildings, facilities, and homes;
- Reduce energy and fossil fuel use in transportation throughout the City;
- Improve air quality and reduce GHG emissions;
- Enhance the energy economy of Charlotte through job creation and workforce development in the Energy Sector;
- Increase energy resilience through diversifying the energy supply

Appendix F-2
Appendix G. Climate Action Planning Best Practices

In addition to investigating emissions reduction target setting, we also researched best practices for climate action planning. The results are summarized below.

**Keep Inventory Simple**

- Keep inventory simple and only include what can be impacted. (Boulder and Durham)

**Need for Strong Leadership**

- Get support from the top. (Lowe’s)
- Gather support from city leaders. (San Jose)
- Strong mayoral leadership guides all aspects of plan. (New York)
- Support from mayor, government, civic and business leaders critical. (Chicago)
- Leadership is critical to success. (Davidson College and Mecklenburg County)

**Need for Dedicated Staff**

- Requires dedicated city staff. (Chicago)
- Create a dedicated sustainability department. (Tallahassee)

**Need for Expert Advisory Group**

- Develop environmental advisory board. (Denver and Tallahassee)
- Establish an Outside Advisory Board to shape plan. (New York)

**Involve Community Leaders Early**

- Task force of local leaders valuable. (Chicago)
- Frequent communication gives stakeholders opportunity to provide feedback. (Chicago)
- Incorporate all stakeholders early. (Austin and Duke University)

**Need for Secure Funding Source**

- Dedicated funds are needed to support research, planning and implementation. (Chicago)
- Reinvest energy savings into a sustainability fund. (Asheville)
- Develop a secure funding source for sustainability projects. (Boulder and Nashville)

**Incorporate Sustainability into all decision making**

- Introduce sustainable elements into existing projects. (Bank of America)
Integrate sustainability into the planning and forecasting process. (Burt’s Bees)
Make sustainability a core value. (UNC Charlotte)
Make sustainability a priority in all decision making. (Asheville)

Interdepartmental Coordination

Employ a collaborative process of goal setting to determine target. (Wachovia)
Collaborate with business groups to set goals and targets. (Duke Energy)
Coordinate interdepartmental efforts. (Austin and San Jose)

Need for Incentives

Create a formal incentive structure to celebrate and reward. (Burt’s Bees, PG&E, and Davidson College)

Leverage Existing Initiatives and Projects

Minimize resistance by including sustainable changes that will stem from scheduled projects. (Duke Energy)
Integrate sustainability measures into existing strategy and implementation. (UNC Charlotte)
Incorporate sustainability into projects already scheduled. (Catawba county)
Leverage existing initiatives. (Chicago)

Raise Awareness & Brand Sustainability Efforts

Focus on raising awareness of sustainability issues and metrics. (Medtronic and Wachovia)
Raise awareness among employees. (PG&E)
Find ways to raise awareness and educate. (Catawba County)
Brand your sustainability efforts for visibility and consistency. (Catawba County and PG&E)
Appendix H. Projects by Scenario

Current Projects

**Airport**
- Lighting upgrades (engineering bldg, parking structure, runway)

**CATS**
- Idling Policy
- 7 Hybrid Buses

**Utilities**
- Lighting (Irwin)
- Hydro Power off Cascade (Irwin, Sugar, Mallard, McAlpine)
- HVAC treatment (Mallard)
- Power Correction on Blowers (Mallard)
- Solar Installation (McDowell)
## Scenario One

**Highly Visible, Evenly Distributed by KBU**

<table>
<thead>
<tr>
<th>KBU</th>
<th>Scenario One – Low</th>
<th>Scenario One – Medium</th>
<th>Scenario One - High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATS</td>
<td>10% Hybrid Buses (2012)</td>
<td>20% Hybrid Buses (2012)</td>
<td>50% Hybrid Buses (2012)</td>
</tr>
</tbody>
</table>

Appendix H-2
## Scenario Two

### Non-Demonstrational, Equal Level of Effort

<table>
<thead>
<tr>
<th>KBU</th>
<th>Scenario Two – Low</th>
<th>Scenario Two – Medium</th>
<th>Scenario Two - High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATS</td>
<td>10% Hybrid Buses (2012)</td>
<td>20% Hybrid Buses (2012)</td>
<td>50% Hybrid Buses (2012)</td>
</tr>
<tr>
<td>Year</td>
<td>Projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 2012 | General EE – Government Center  
General EE – CATS Maintenance  
General EE – Discovery Place  
General EE – Government Center |
| 2013 | General EE – Discovery Place  
General EE – CATS Maintenance  
CATS S Tryon retrofit  
General EE – Government Center |
| 2014 | CATS S Tryon retrofit  
Chiller, Lighting – Animal Control  
General EE – CDOT Maintenance  
General EE – Belmont Center  
CMU Brookshire retrofit  
General EE – Equipment Management Siegle |
| 2015 | General EE – Equipment Management Siegle |
| 2016 | Lighting, Pumps, Scheduling – Mint Museum  
General EE – TMOC Maintenance  
General EE – I85 Service Road Bldg  
General EE – TMOC Administration |
| 2017 | General EE – Building Maintenance  
General EE – Polk Park  
CATS light rail maintenance facility retrofit |
| 2018 | General EE – City Hall  
General EE – Polk Park |
<table>
<thead>
<tr>
<th>Year</th>
<th>Project Descriptions</th>
</tr>
</thead>
</table>
| 2019 | CATS Bus Wash Retrofit  
|      | CMU General Commerce  |
|      | General EE – CMPD Freedom Division  
|      | General EE – Fire Station 10  
|      | General EE – Northpointe Industrial Park  |
| 2018 | General EE – CDOT Street Maintenance  
|      | General EE – CDOT Operations  
|      | General EE – CMPD North Tryon Division  
|      | General EE – Fire Station 1  |
| 2019 | General EE – CMPD Hickory Grove Division  
|      | General EE – Equipment Management – Louise  
|      | General EE – Equipment Management  
|      | General EE – Fire General Offices  |
Scenario Three
Highly Visible, Evenly Distributed by KBU

<table>
<thead>
<tr>
<th>KBU</th>
<th>Scenario Three – Low</th>
<th>Scenario Three – Medium</th>
<th>Scenario Three - High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATS</td>
<td>10% Hybrid Buses (2012)</td>
<td>20% Hybrid Buses (2012)</td>
<td>50% Hybrid Buses (2012)</td>
</tr>
</tbody>
</table>

Scenario Four
Non-Demonstrational, Best Projects

<table>
<thead>
<tr>
<th>KBU</th>
<th>Scenario Four – Low</th>
<th>Scenario Four – Medium</th>
<th>Scenario Four - High</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATS</td>
<td>50% Hybrid Buses (2012)</td>
<td>50% Hybrid Buses (2012)</td>
<td>50% Hybrid Buses (2012)</td>
</tr>
<tr>
<td>Fleet</td>
<td>50% Hybrid (2012)</td>
<td>50% Hybrid (2012)</td>
<td>50% Hybrid (2012)</td>
</tr>
<tr>
<td></td>
<td>Lighting retrofit –</td>
<td>Lighting retrofit –</td>
<td>Lighting retrofit –</td>
</tr>
</tbody>
</table>

Appendix H-6
<table>
<thead>
<tr>
<th>Year</th>
<th>Projects</th>
</tr>
</thead>
</table>
| 2014 | CATS S Tryon retrofit  
General EE – CATS Maintenance  
General EE – Government Center |
| 2015 | CMU Brookshire retrofit  
General EE – Discovery Place |
| 2016 | Chiller, Lighting – Animal Control  
General EE – TMOC Maintenance |
| 2017 | CMU General Commerce  
Lighting, Pumps, Scheduling – Mint Museum |
| 2018 | CATS light rail maintenance facility retrofit  
General EE – Building Maintenance  
General EE – CMPD Headquarters |
| 2013 | General EE – Government Center  
CMU Brookshire retrofit  
General EE – CATS Maintenance  
General EE – Discovery Place  
CATS S Tryon retrofit |
| 2014 | Chiller, Lighting – Animal Control  
General EE – TMOC Maintenance |
| 2015 | Lighting, Pumps, Scheduling – Mint Museum  
CATS light rail maintenance facility retrofit |
| 2016 | General EE – CMPD Headquarters  
General EE – Building Maintenance |
| 2017 | CMU General Commerce  
CATS Bus Wash Retrofit  
General EE – Northpointe Industrial Park  
General EE – CMPD Freedom Division |
| 2013 | Lighting retrofit – McAlpine (2015)  
HVAC retrofit – McDowell (2016)  
HVAC retrofit – Sugar (2016)  
HVAC retrofit – McAlpine (2017)  
HVAC retrofit – Irwin (2017) |
| 2014 | Lighting retrofit – McAlpine (2016)  
HVAC retrofit – McDowell (2017)  
HVAC retrofit – Sugar (2017)  
HVAC retrofit – McAlpine (2018)  
HVAC retrofit – Irwin (2018) |
<table>
<thead>
<tr>
<th>2019</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>- General EE – CMPD Freedom Division</td>
<td>- General EE – Equipment Management Louise</td>
</tr>
<tr>
<td></td>
<td>- General EE – City Hall</td>
</tr>
<tr>
<td></td>
<td>- General EE – CDOT Maintenance</td>
</tr>
<tr>
<td></td>
<td>- General EE – Fire Station 1</td>
</tr>
<tr>
<td></td>
<td>- General EE – Equipment Management Louise</td>
</tr>
<tr>
<td></td>
<td>- General EE – Northpointe Industrial Park</td>
</tr>
<tr>
<td></td>
<td>- General EE – Equipment Management Seigle</td>
</tr>
<tr>
<td></td>
<td>- General EE – Fire Station 1</td>
</tr>
<tr>
<td></td>
<td>- General EE – Equipment Management</td>
</tr>
<tr>
<td></td>
<td>- General EE – CDOT Maintenance</td>
</tr>
<tr>
<td></td>
<td>- General EE – City Hall</td>
</tr>
<tr>
<td></td>
<td>- General EE – I85 Service Road</td>
</tr>
<tr>
<td></td>
<td>- General EE – TMOC Administration</td>
</tr>
<tr>
<td></td>
<td>- General EE – Fire Station 4</td>
</tr>
<tr>
<td></td>
<td>- General EE – CMPD Westover Division</td>
</tr>
<tr>
<td></td>
<td>- General EE – Belmont Center</td>
</tr>
</tbody>
</table>
Appendix I. Economic Analysis of Selected Projects

This appendix shows the potential economic performance of selected GHG reduction projects. These costs are based on the City’s estimates. Cost savings are based on an electric rate of $0.62/kWh, a natural gas rate of 1.163/therm, gasoline rate of $2.787/gallon, and diesel rate of $2.954/gallon. NPV is performed over a 5 year horizon with a 7% discount rate.

**BUILDING ENERGY EFFICIENCY UPGRADES**

<table>
<thead>
<tr>
<th>Project</th>
<th>Upfront Cost</th>
<th>Anticipated Annual Savings</th>
<th>Simple Payback (Years)</th>
<th>5-year NPV (7% discount rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brookshire Upgrades</td>
<td>$539,582*</td>
<td>$30,402</td>
<td>18</td>
<td>($387,783)</td>
</tr>
<tr>
<td>Old City Hall Upgrades</td>
<td>$378,525*</td>
<td>$13,706</td>
<td>28</td>
<td>($301,241)</td>
</tr>
<tr>
<td>CMU Animal Control Upgrades</td>
<td>$83,770*</td>
<td>$14,833</td>
<td>6</td>
<td>($21,450)</td>
</tr>
<tr>
<td>VMF Light Rail Facility Upgrades</td>
<td>$66,751*</td>
<td>$28,777</td>
<td>2</td>
<td>$47,888</td>
</tr>
<tr>
<td>CMPD West Upgrades</td>
<td>$47,138*</td>
<td>$4,361</td>
<td>11</td>
<td>($27,343)</td>
</tr>
<tr>
<td>CMU General Commerce Upgrades</td>
<td>$446,790*</td>
<td>$8,277</td>
<td>54</td>
<td>($385,844)</td>
</tr>
<tr>
<td>CATS S Tryon Upgrades</td>
<td>$541,518*</td>
<td>$105,162</td>
<td>5</td>
<td>($103,115)</td>
</tr>
<tr>
<td>CATS TMOC Bus Wash Upgrades</td>
<td>$31,912*</td>
<td>$15,821</td>
<td>2</td>
<td>$30,801</td>
</tr>
<tr>
<td>Project</td>
<td>Upfront Cost</td>
<td>Anticipated Annual Savings</td>
<td>Simple Payback</td>
<td>5-year NPV (7% discount rate)</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Police and Fire Academy: Hot Water System Upgrade</td>
<td>$24,258*</td>
<td>$1,686</td>
<td>14</td>
<td>($16,210)</td>
</tr>
<tr>
<td>Spratt Street Upgrades</td>
<td>$38,850*</td>
<td>$2,711</td>
<td>14</td>
<td>($25,920)</td>
</tr>
</tbody>
</table>

* After utility incentives

**WASTEWATER TREATMENT PLANT UPGRADES**

<table>
<thead>
<tr>
<th>Project</th>
<th>Upfront Cost</th>
<th>Anticipated Annual Savings</th>
<th>Simple Payback</th>
<th>5-year NPV (7% discount rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McAlpine Combined Heat and Power</td>
<td>$10M</td>
<td>$1,086,240</td>
<td>9</td>
<td>($5,183,365)</td>
</tr>
</tbody>
</table>

**CATS PROJECTS**

<table>
<thead>
<tr>
<th>Project</th>
<th>Upfront Cost</th>
<th>Anticipated Annual Savings</th>
<th>Simple Payback</th>
<th>5-year NPV (7% discount rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid Bus Replacement</td>
<td>$602,000</td>
<td>$6,026</td>
<td>100</td>
<td>($539,548)</td>
</tr>
</tbody>
</table>
Appendix J. Current State of GHG Measurement and Reporting

**Organizations**

- Neutral
  - ISO
  - The Climate Registry

- Government
  - ICLEI

- Corporate
  - GRI
  - The GHG Protocol Corporate Standard
  - EPA Inventory & Goal Tracking Forms
  - Investor CDP

- Academic
  - ACUPCC Reporting System

**Protocols**

- Neutral
  - ISO 14064
  - The General Reporting Protocol
  - Local Government Operations Protocol

- Government
  - ICLEI

- Corporate
  - GRI
  - The GHG Protocol Corporate Standard

- Academic
  - ACUPCC Reporting System