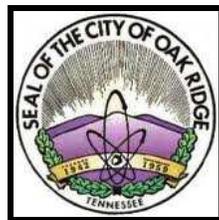


**Climate Action Plan**  
For  
**Oak Ridge, Tennessee**



**Prepared by:**

**The Oak Ridge  
Environmental Quality Advisory Board**

**September 21, 2010**

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**Climate Action Plan  
for  
Oak Ridge, Tennessee**

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## **ACKNOWLEDGEMENTS**

The Environmental Quality Advisory Board would like to thank Oak Ridge City Council for having the foresight to see energy efficiency and climate change as matters of concern to the City of Oak Ridge and its citizens. We also thank Council for tasking us to work on this difficult issue and for providing resources to support our efforts. This task has educated us about the complicated processes controlling the Municipal and Community sectors of the City, and enriched our own lives in the process.

We especially thank Councilperson Ellen Smith for serving as an informal liaison between City Council and EQAB. She has provided us with great insight and advice about the inner workings of City government and provided much help with comments and suggestions as our work on the Plan progressed. She has sacrificed much of her personal time to attend our various meetings and work sessions.

EQAB would also like to thank former City Manager James O'Connor for formally tasking us with the responsibilities associated with development of a Climate Action Plan for Oak Ridge and the challenge of investigating the various issues related to the overall sustainability of the City. We are also thankful to former Acting City Manager Gary Cinder for providing us with resources and staff to accomplish our goals. We also thank City Manager Mark S. Watson for continuing to support the efforts started prior to his tenure as City Manager. We look forward to working with him to implement the measures outlined in the Plan.

EQAB also wishes to thank City Staff for all the help they provided by supplying the raw data needed to calculate the baseline greenhouse gas emissions for the City and for staff's willingness to review various versions of the Plan and provide constructive comments and suggestions to improve it. We are especially grateful to the Community Development Department for their cooperation and support extended through Athanasia Senecal's work with EQAB throughout this task.

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## ACRONYMS

CACP	Clean Air and Climate Protection
CAP	Climate Action Plan
CCP	Cities for Climate Protection
CPTED	Crime Prevention Through Environmental Design
DCS	digital control systems
DOE	U. S. Department of Energy
EPA	U. S. Environmental Protection Agency
EQAB	Environmental Quality Advisory Board (Oak Ridge)
ESCO	energy services company
GHG	greenhouse gas
GPS	Green Power Switch
ICLEI	ICLEI-Local Governments for Sustainability (formerly the International Council for Local Environmental Initiatives)
IDA	International Dark-Sky Association
IDB	Industrial Development Board (Oak Ridge)
LED	Light-emitting diode
OFM	U. S. Office of Financial Management
ORUD	Oak Ridge Utility District
PILOT	Payment in Lieu Of Taxes
PV	photovoltaic
TPO	(Knoxville Regional) Transportation Planning Organization
TVA	Tennessee Valley Authority



## EXECUTIVE SUMMARY

In June 2008, the City of Oak Ridge joined ICLEI—Local Governments for Sustainability (ICLEI), an international association of local governments, as well as national and regional government organizations who have made a commitment to sustainable development. ICLEI members receive a plethora of resources, which include software applications, as well as resource guides, technical consulting, training, and a large network of peers, all committed to making their communities more sustainable.

Shortly after the City joined ICLEI in July 2008, the City Manager, at the urging of the City Council, directed the Environmental Quality Advisory Board (EQAB) to develop the City's sustainability initiative by following ICLEI's Five Milestone process. Ultimately, EQAB developed this Climate Action Plan (CAP) following these milestones.

ICLEI Five Milestones:<sup>1</sup>

- Milestone 1.** Conduct a baseline emissions inventory and forecast.
- Milestone 2.** Adopt an emissions reduction target for the forecast year(s).
- Milestone 3.** Develop a Local Action Plan.
- Milestone 4.** Implement policies and measures.
- Milestone 5.** Monitor and verify results

So what is sustainability? According to the U. S. Environmental Protection Agency (EPA) home page for sustainability, the traditional definition of sustainability calls for policies and strategies that meet society's present needs without compromising the ability of future generations to meet their own needs.<sup>2</sup> In particular, sustainability incorporates plans, policies, and practices that ensure limited resources are not exhausted, but rather, managed in such a manner as to ensure that the natural resources and environmental quality on which life depends can be enjoyed by future generations. From a municipal standpoint, the goal of sustainability is to increase long-term value and desirability of our community, while reducing negative impacts on the environment.

During the planning process, this plan has been referred to as both a sustainability plan and a CAP. Since sustainability encompasses social equity, economic viability, and environmental quality, it is a broader topic than the scope of this plan. While this plan includes measures that will help the City become more sustainable, the primary focus is on identifying measures that have the potential to increase energy efficiency, thereby mitigating the impacts of climate change. This CAP accomplishes this objective by first defining baseline greenhouse gas emissions (GHG) in Oak Ridge, then defining achievable targeted reductions in these emissions. The recommendations included in this CAP are the result of GHG inventories that



were conducted for government operations and the community sector using software tools provided by ICLEI and consultations with professionals in the fields of environmental science and energy utilization.

In addition to recommendations from ICLEI resources, throughout the development of the CAP, EQAB also sought and obtained input from the public, City staff and City Council in order to ensure that existing, planned, and proposed GHG reduction measures were included in order to highlight their contributions toward meeting future municipal and community GHG reduction targets. Based on a review of existing, planned, and proposed measures, EQAB recommended, and City Council adopted by resolution in 2009, the following emissions reductions targets:

<b>Municipal Reductions</b>	<b>Community Reductions</b>
10% by 2015	5% by 2015
50% by 2030	30% by 2030
80% by 2050	50% by 2050

While this plan includes recommended reduction measures that range from short-term (0 to 2 years), medium-term (2 to 5 years), to long-term (5 to 10 years), it is meant to be a "living" document which should be updated during the life cycle of these various projects. EQAB recognizes that even during the finalization of this document, the City of Oak Ridge has been continuing to implement energy reduction measures that because of publication and presentation deadlines are not included in this document. In addition, EQAB recognizes that the successful implementation of this CAP will require development of effective community outreach and education programs that encourage citizens to adopt sustainability principles and other emission reduction initiatives and goals.

As noted previously, this CAP does not fully and completely address sustainability as it relates to Oak Ridge. However, recommendations made at the January, 2009 forum that relate to making the City more sustainable that are not included in the CAP will be considered at a later time as appropriate and consistent with the city's sustainability initiative.

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<sup>1</sup> ICLEI - Local Governments for Sustainability, <http://www.iclie.org>

<sup>2</sup> The Environmental Protection Agency, <http://www.epa.gov/sustainability/basicinfo.htm>



## SECTION 1: INTRODUCTION

This Climate Action Plan (CAP) plan has been developed by the City of Oak Ridge, Tennessee's Environmental Quality Advisory Board (EQAB) over the course of two years. This plan is one component of a comprehensive initiative to make Oak Ridge more sustainable, attract and retain new residents and businesses, and reduce the City's greenhouse gas (GHG) emissions.

### 1.1: Directive from the City Manager

The citizens and community leaders of Oak Ridge have a long history of environmental activism. For more than four decades, EQAB, a 12-member volunteer body with varying backgrounds, has advised the Oak Ridge City Council on environment-related matters. City Council began discussing sustainability in early 2008 and by mid-June 2008, the City joined Local Governments for Sustainability (ICLEI). ICLEI is a membership association that consists of more than 1,048 local, regional, and national governments committed to climate protection and sustainability. Membership benefits include access to online toolkits, case studies, software, technical consulting, and access to peers within the ICLEI network. ICLEI's Cities for Climate Protection (CCP) campaign uses the following five milestones to help municipalities calculate and reduce greenhouse gas emissions within their jurisdiction(s):

- Milestone 1.** Conduct a baseline emissions inventory and forecast.
- Milestone 2.** Adopt an emissions reduction target for the forecast year(s).
- Milestone 3.** Develop a Local Action Plan.
- Milestone 4.** Implement policies and measures.
- Milestone 5.** Monitor and verify results

In July 2008, then City Manager Jim O'Connor issued a directive to EQAB to develop the City's sustainability initiative using the ICLEI Five Milestone process. EQAB took full advantage of ICLEI resources during development of this CAP and based its approach on the five milestones. The City Manager's directive to EQAB can be found in **Appendix A** of this report.

### 1.2: Community Input and Participation

EQAB spent a substantial amount of time obtaining community input in order to increase support for this initiative. EQAB actively sought public input and participation throughout the development of this CAP in order to ensure the plan was not developed in isolation but rather would emphasize issues of primary concern to the citizens of Oak Ridge. In January 2009, EQAB held a public forum to receive citizen input on actions the City could take to



become more sustainable. The *Greening Oak Ridge* forum included a keynote speaker, breakout sessions, and a summarization and capture of citizen comments. Keynote speaker Jim Frierson, from Chattanooga's Green Committee, was asked to speak with Oak Ridge residents about Chattanooga's sustainability initiatives, since at the time, Chattanooga was close to completing its own CAP. Mr. Frierson provided some helpful tips and lessons learned from their planning process. More than 100 residents attended the *Greening Oak Ridge* forum and in the process generated approximately 475 suggested actions. Suggestions were sought and provided in the following six primary components of sustainability:

1. Built Environment (land use, smart growth, zoning, building codes, urban forests, and brownfields);
2. Air Quality and Transportation;
3. Water Quality and Resources;
4. Business Opportunities (potential roles for businesses, green collar jobs, impact of other ideas on businesses);
5. Natural Environment (open space and biodiversity); and
6. Government Purchasing and Policies.

Citizen feedback was also solicited during Earth Day 2010. EQAB set up a booth at this event and received comments from the public on additional ways the City could become more sustainable.

Oak Ridge City Council also provided feedback during the development of this CAP in two work sessions with EQAB. At the first work session, which took place on April 23, 2009, EQAB presented a summary of the highest-ranking ideas generated at the *Greening Oak Ridge Forum*. Among these ideas were the following:

- Promoting and installing renewable energy;
- Encouraging the creation of green neighborhoods;
- Creating efficient local and regional public transportation;
- Revising ordinances and policies to incentivize green construction and renovation;
- Conserving water-energy resources with demand management and retrofits;
- Increasing the localization and velocity of money (the rate at which money changes hands within an economy), and
- Protecting our urban forest.

The second work session, on November 19, 2009, was held to receive feedback on a preliminary working draft of the CAP. Revisions were made based on the feedback provided during this session.



Additional input was provided by graduate students from the University of Tennessee Knoxville during the fall 2009 semester. Under the tutelage of Professor Bruce Tonn, an Environmental Planning class prepared an academic paper based on the sustainability initiative being developed in Oak Ridge. These graduate students, whose majors are in diverse fields including architecture, planning, public administration and forestry, were all involved in research related to sustainability. The students also explored education and outreach options for advancing sustainability initiatives, principles of New Urbanism, local economic development, transportation planning, water conservation, municipal codes, seeking grants, and future perspectives. This collaborative effort resulted in an informative paper that compliments this CAP. Further, the ideas and suggestions presented in this paper are intended to serve as a resource for future sustainability planning. A summary of comments can also be found in **Appendix B** of this report, and an abstract of The University of Tennessee paper is included in **Appendix C**.

### 1.3: Mission Statement

EQAB developed and adopted a mission statement for the sustainability initiative during a work session on February 12, 2009. The mission statement was developed primarily as a basis for evaluating and ranking ideas and input provided by citizens at the *Greening Oak Ridge* forum. EQAB's sustainability mission statement is to: *"Create a sustainable community by reducing greenhouse gas emissions and consumption of resources while delivering critical public services, enhancing our quality of life and encouraging economic opportunities for residents and businesses."* A detailed discussion of the derivation and use of the mission statement is described in **Appendix D** of this CAP.

### 1.4: Climate Action Plan Objectives

The primary objective of this CAP is to identify and describe a series of measures EQAB believes the City could potentially implement to reduce GHG emissions from local government and community activities and operations. The first part of this plan provides a brief overview of the City's baseline GHG emissions, which were established using software and guidelines established by ICLEI. This was an important component of the development process because it provided the baseline for the City's emissions as well as insights regarding which of the many categories within the energy consumption spectrum were the largest components of Oak Ridge's "carbon footprint." The latter portion of this plan provides an overview of each measure recommended by EQAB to reduce GHG emissions. It is not the intent of this plan to present final "shovel-ready" projects for the City to implement but rather to provide rationale and criteria for evaluating suggestions and to identify additional areas to investigate further to optimize the City's resources to accomplish these objectives.



## SECTION 2: GREENHOUSE GAS REDUCTION GOALS

### 2.1: Determining the Oak Ridge Baseline

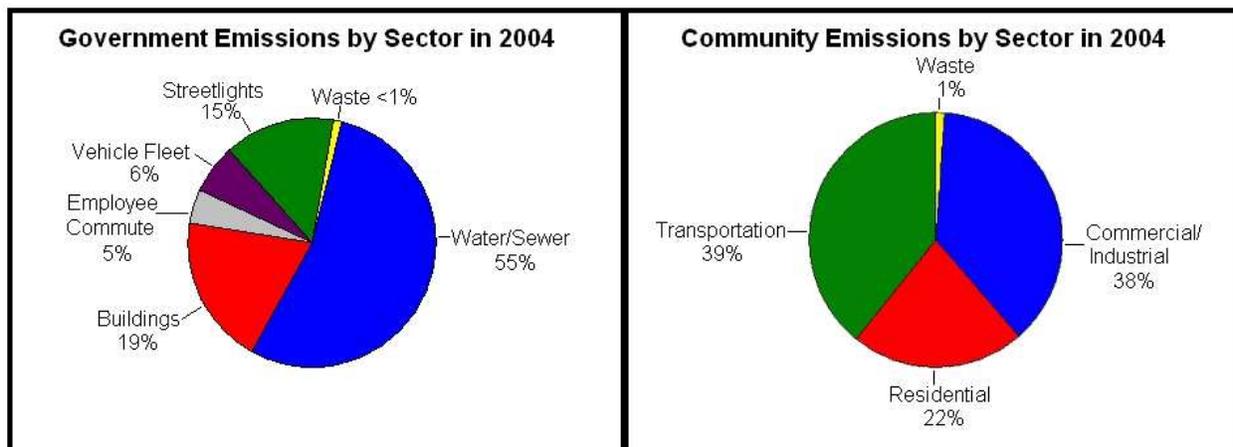
#### Why determine a baseline?

Because it is good to know where the bulk of emissions are coming from, so we can target projects and programs that reduce GHG emissions and then determine their effect by comparison to the baseline value.

The Clean Air and Climate Protection (CACP) software, version 1.1, provided by ICLEI, was used to conduct a baseline inventory of GHG emissions associated with both government and community operations in Oak Ridge. Using a baseline year of 2004, raw data were entered into the program and converted into tons of carbon dioxide [equivalent carbon dioxide (eCO<sub>2</sub>) units]<sup>3</sup>. The guidance provided by ICLEI for developing a baseline year suggests that it is best to select a base year by finding the earliest year for which there is complete, comprehensive and reliable data. The year 2004 was chosen as the baseline year for Oak Ridge

because the greatest quantity of verifiable data (much of it in the form of electronic records) was available for this year.

The eCO<sub>2</sub> unit is a universally accepted standard of measure used for normalizing and evaluating GHG emissions such as carbon dioxide, methane, nitrous oxide, halocarbons, and sulfur hexafluoride.<sup>4</sup> The input data used to perform the baseline inventory was collected from a variety of sources including the City of Oak Ridge Finance Department, the Oak Ridge Utility District (ORUD), the City's municipal waste contractor (Waste Connections), and the Knoxville Regional Transportation Planning Organization (TPO). The pie charts below illustrate the percentage of eCO<sub>2</sub> in Oak Ridge by each of the primary sectors evaluated using the CACP software.





The details and summary findings of the baseline inventory can be found in **Appendix E** of this report.

## 2.2: Reduction Goals

The GHG emission target schedule for Municipal Government was developed by first taking then candidate Barack Obama's announced national goal of 80 percent reduction by mid-century as a given and working backwards from that goal to develop the roadmap and milestones to achieving that goal in Oak Ridge.<sup>5</sup> Because large complex systems generally tend to respond to change slowly, EQAB understood that the actual progress to the ultimate goal of 80 percent reduction over the next 40 years would most probably be along an S-curve, not a straight line. These trajectories are shown by the solid blue S-curve, and dashed blue line, respectively, in Exhibit 2-3 below. Progress is likely to initially be slow, and then accelerate and improve. On the other hand, initial measures and reductions are generally easier to implement and achieve than later ones. EQAB did not deem it feasible to specify particular interim goals for each and every year between now and 2050.

EQAB determined that setting two interim goals, in the years 2015 and 2030, would be sufficient to define progress and constrain the path toward the ultimate goal. Because Oak Ridge's Municipal Government is already making significant progress with existing measures, the first interim goal of 10% GHG reduction by 2015 (rather than 5% as the S-curve suggests) was recommended by EQAB. The second interim goal of 50% reduction by 2030 is approximately on track with the progress one would see in a real system.

Setting the GHG reduction targets for the Community followed the same process, except that EQAB recommended more conservative goals for the Community than Municipal Government. This is because the Community's GHG emissions are roughly 30 times more massive than the Municipal Government emissions, and also because the Community GHG emissions are less amenable to direct control by Municipal Government. Again, the interim goals of 5% reduction by 2015 and 30% reduction by 2030 are within 5% of the green S-curve shown in Exhibit 2-4.

Developing GHG emissions reduction targets is significant because they quantify specific emission reduction goals a community strives to achieve. Using 2004 as the baseline year, EQAB considered several factors before selecting specific reduction targets, such as: jurisdiction's ability to attain the emissions reduction targets; availability of resources (staff time and cost); and possible dates for implementation.

### 2.2.1: Municipal versus Community Goals

EQAB selected different GHG emissions reduction targets for government operations than for community operations due to the assumption that the City is able to implement measures



more quickly than the community. Furthermore, the City's ambitious goals illustrate a commitment toward leading the way for the community in emissions reduction practices.

### 2.3: Adopted Goals

In September 2009, Oak Ridge City Council adopted (by resolution) the following emissions reductions goals:

<b>Municipal Reductions</b>	<b>Community Reductions</b>
10% by 2015	5% by 2015
50% by 2030	30% by 2030
80% by 2050	50% by 2050

**Exhibits 2-1 and 2-2** show the GHG emissions that would result from both the municipal and community reduction goals being met.

**EXHIBIT 2-1.** Municipal GHG Emission Reductions

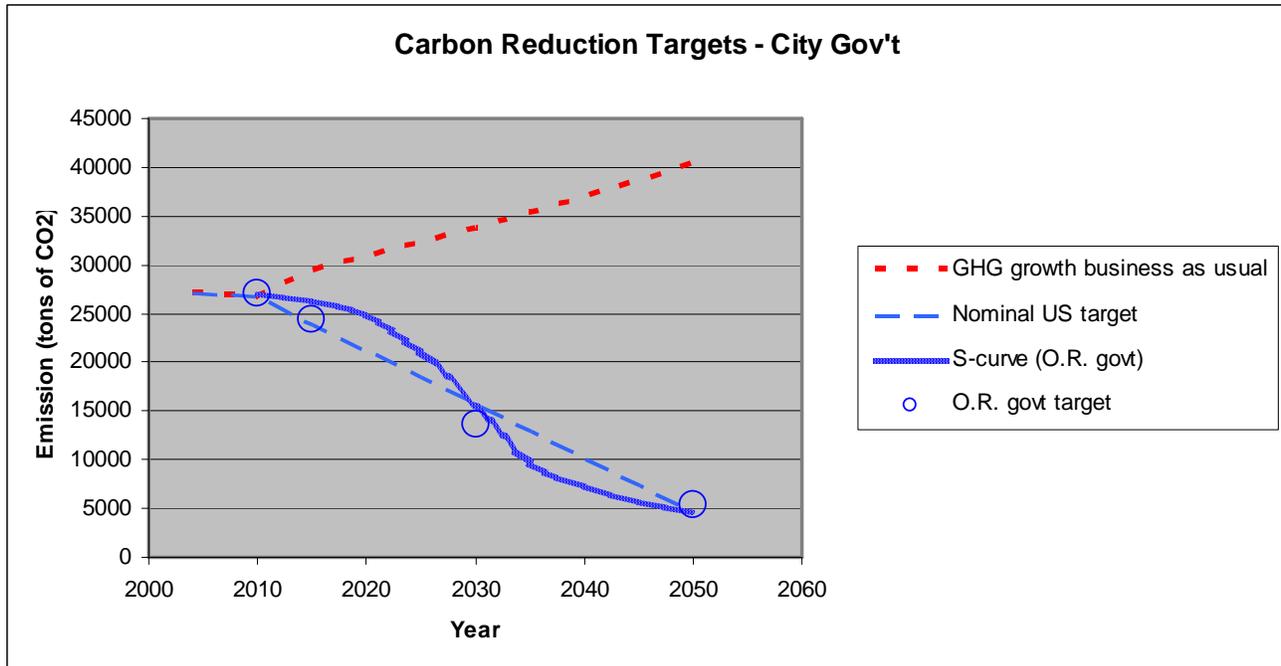
Municipal GHG Emissions in 2004 (tons eCO <sub>2</sub> )	Municipal GHG Emissions with 10% Reduction Goal for 2015 (tons eCO <sub>2</sub> )	Municipal GHG Emissions with 50% Reduction Goal for 2030 (tons eCO <sub>2</sub> )	Municipal GHG Emissions with 80% Reduction Goal for 2050 (tons eCO <sub>2</sub> )
27,101	24,391	13,551	5,420

**EXHIBIT 2-2.** Community GHG Emission Reductions

Community Greenhouse Gas Emissions in 2004 (tons eCO <sub>2</sub> )	Community GHG Emissions with 5% Reduction Goal for 2015 (tons eCO <sub>2</sub> )	Community GHG Emissions with 30% Reduction Goal for 2030 (tons eCO <sub>2</sub> )	Community GHG Emissions with 70% Reduction Goal for 2050 (tons eCO <sub>2</sub> )
693,248	623,923	346,624	138,650



## 2.4: Forecasts based on Business-as-Usual scenario



**EXHIBIT 2-3.** Forecast of Carbon Reduction Targets for City Government

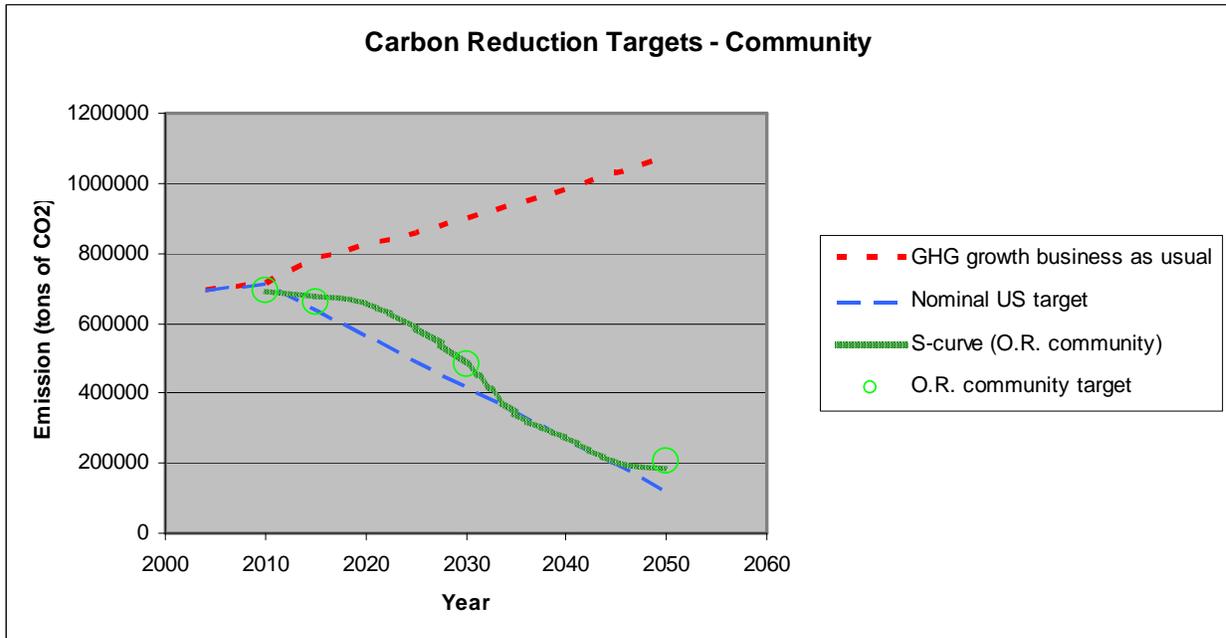
In the forecast of government emissions, the first curve (dotted red line) shows the 2004 baseline figure, which is 27,101 regular tons; an estimate of 26,694 tons for 2010; and the projected growth through 2050 under a business-as-usual case. The second curve (dashed blue line) shows the 2004 baseline figure of 27,101 tons; an estimate of 26,694 tons for 2010; and the projected emissions falling through 2050 if the City's progress is consistent with the President's goals for the country.

The third curve (solid dark blue line) shows an S-curve starting with the 2004 baseline of 27,101 regular tons in 2010; then the estimated emissions falling through 2050 of the City government's progress follows an S-curve.

The fourth curve (the four open circles) shows the targets that City Council adopted, beginning with the 2004 baseline of 27,101 regular tons in 2010; then three more targets at the years 2015, 2030, and 2050.



**EXHIBIT 2-4.** Forecast of Carbon Reduction Targets for the Community



In the emissions for the community sector, the first curve (dotted red line) shows the 2004 baseline figure, which is 693,248 regular tons (approximately the same as estimated for 2010); and the projected growth through 2050 under a business-as-usual case. The second curve (dashed blue line) shows the 2004 baseline figure of 693,248 regular tons, an estimate of 710,615 tons for 2010; and the projected emissions falling through 2050 if the community's progress is consistent with the President's goal for the country.

The third curve (solid green line) shows an S-curve starting with the 2004 baseline of 693,248 regular tons in 2010; then, the estimated emissions falling through 2050 if the progress of people of Oak Ridge follows an S-curve. Note that the profile over 40 years is less aggressive than the City government's profile. This is because it is assumed to take longer for 30,000 people to implement changes than it will for 300 City employees. The fourth curve (four open circles) shows the targets incumbent upon the citizens, which City Council adopted, beginning with the 2004 baseline of 693,248 regular tons in 2010; then, three more targets at years 2015, 2030, and 2050. Again, these adopted targets for the citizens are not as aggressive as the President's goals for the country, nor as aggressive as the City Government goals.

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The City of Oak Ridge



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<sup>3</sup> The carbon dioxide equivalent is a metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential. CO<sub>2</sub> equivalents are commonly expressed as “million metric tons of carbon dioxide equivalents (MMTCO<sub>2</sub>Eq)”. More information can be found at <http://www.epa.gov/climatechange/glossary.html>.

<sup>4</sup> Environmental Protection Agency, Office of Transportation and Air Quality. *Metrics for Expressing Greenhouse Gas Emissions: Carbon equivalents and Carbon Dioxide Equivalents*. EPA20-F-05-002. February 2005. <http://www.epa.gov/otag/climate/420f05002.htm>.

<sup>5</sup> <http://www.examiner.com/x-325-Global-Warming-Examiner~y2008m8d1-Barack-Obamas-80-carbon-reduction-goal>



## SECTION 3: MITIGATION PLAN

### 3.1: Existing Municipal Measures

Each of the recommendations in this mitigation plan will improve energy efficiency, while at the same time combating climate change. The City has already taken measures to improve energy efficiency without labeling them as sustainability initiatives. In an effort to meet the adopted emissions reduction targets, existing, planned, and proposed measures that mitigate climate change are included in this report. EQAB has given much consideration to the proposed recommendations, accounting for actions that are already underway as well as actions that need to be taken. The percentage of GHG emissions per sector, based on the Oak Ridge baseline year inventories, were also a factor when making recommendations. **Appendix F** provides an example of an implementation plan for one of the recommended measures presented in this section.

Included in the mitigation plan are existing, proposed, and planned measures in both government and community sectors, which reflect a list of priority actions from public feedback as well as feedback from the Oak Ridge City Council. Short- (0 to 2 years), medium- (2 to 5 years) and long- (5 to 10 years) term actions are also included in the list of recommendations that follow. Financing options will be discussed in the next section. This plan is meant to be a “living” document and will continue to evolve as the City develops sustainable practices over the next several years.

#### 1. Increase energy efficiency in City-owned facilities (Municipal Building)

*Measure:* Install digital control systems (DCS)

*Measure status:* Existing

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> savings:* 32.6 tons per year

*Estimated Annual Cost Savings:* \$9,287

*Implementation Schedule:* Short (0 to 2 years)

Effective March 2010, the City received an energy grant to install a digital control system at the Central Services Complex, the largest City-owned facility in Oak Ridge both in terms of size and energy consumption. In 2004, the baseline year selected for the GHG emissions inventory, 1,737 units of eCO<sub>2</sub> were consumed at the complex in electricity, which cost the City \$141,786.

The Department of Energy (DOE) provides a variety of energy saving tips on its website. Digital control systems are estimated to reduce annual energy bills by approximately



10 percent. The savings are achieved by adjusting thermostat settings 10 to 15 degrees over an 8-hour period of the day.<sup>6</sup> Assuming that installing a digital control system at the Central Services Complex will result in a 10 percent energy reduction and a reduction of 32.6 tons of eCO<sub>2</sub> annually, the City should expect to save about \$9,287 annually through implementation of this measure.

### **Data used for calculating financial benefits**

Based on the City's 2004 Retail Rate Schedule, the Central Services Complex consumed more than 15,000 kilowatt hours (kWh), and the demand was more than 1,000 KW. The Central Services Complex falls into the commercial category, which is Class 50. Commercial customers pay a rate of \$.039 per kWh for energy exceeding 15,000 kWh; in 2004 the City paid \$.073 for the first 15,000 kWh used.

## **2. Reduce the amount of waste sent to the landfill (Municipal Solid Waste)**

*Measure:* Office Recycling Program

*Measure Status:* Existing

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> Savings:* 150 – 300 tons per year

*Estimated Annual Cost Savings:* \$7,500 - \$150,000 per year<sup>7</sup>

*Implementation Schedule:* Short (0 to 2 years)

In 2004, 158 tons of waste were generated from municipal operations and sent to the Chestnut Ridge Landfill. In an effort to reduce waste generated by municipal operations, the City piloted a single stream office recycling program at the Central Services Complex in September 2009. The program is expanding to include other government-owned facilities. Effective May 2010, the Central Services Complex, the Municipal Building, the Waste Water Treatment Plant, Fire Stations 1-3, Recreation and Parks, and the Public Library began participating in the single stream office recycling program. The City is in the process of expanding this program across government operations and hopes to implement the program at all City facilities within 2 years.

One pound of recycled material collected from households in Oak Ridge is estimated to save approximately 8000 British Thermal Units (Btu) in energy associated with mining and processing of virgin materials, and production of products. The eCO<sub>2</sub> signature of that avoided energy is approximately equal to three times the recycled material's weight. Office waste generally contains a higher proportion of recyclable material than typical household trash, and the sources are more concentrated thus it is easier to collect. Therefore City government can at minimum expect the same diversion (i.e., approximately 33 percent) from the landfill as is now generated by the successful single-stream recycling program for residences. Furthermore, although it does not currently do so, the City eventually might be



able to capture in some manner the economic benefit in that recycling stream, which is presently worth 2.5 to 25 cents per pound.

**3. Increase energy efficiency of traffic lights at every intersection (Municipal Energy)**

*Measure:* Replace existing traffic lights with LED technology

*Measure Status:* Existing

*Responsible Department:* Electric Department

*Estimated Equivalent CO<sub>2</sub> savings:* 23 tons per year

*Estimated Annual Cost Savings:* To be determined

*Implementation Schedule:* Short (0 to 2 years)

Light-emitting diode (LED) technology is more energy efficient than traditional incandescent lights and LED lights typically last longer. The City began upgrading its traffic signals with LED technology in 2006; the majority of upgrades occurred in 2007 and 2008. As of April 2010, 23 of the City's 43 lights have been replaced with LED technology. Pre- and post-energy consumption for lights that existed in 2004 has been compared. Both metered and unmetered lights are included in the estimated CO<sub>2</sub> savings. Metered traffic signal lights accounted for 85 tons of eCO<sub>2</sub> in 2004, while unmetered traffic signal lights account for 274 tons of eCO<sub>2</sub> in 2004. Over the next year, the City plans to replace all of the traffic signals with LEDs at the remaining intersections. A breakdown of energy usage before and after LED technology upgrades is shown in **Exhibit 3-1** below.

**EXHIBIT 3-1.** Completed LED Upgrades on Existing Traffic Signals in the Baseline Year

Intersection	Average Monthly kWh (2004)	Average Monthly kWh (2009)	Reduction from 2004 to 2009 (%)
Arkansas Ave/OR Turnpike	921	324	65
S. Illinois Ave/Lafayette Dr.	2,324	385	83
N. Illinois Ave/Outer Dr.	1,182	120	90
Manhattan Ave/OR Turnpike	1,948	71	96
S. Illinois Ave/Tulane Ave	1,815	189	90
S. Illinois Ave/Robertsville Rd.	1,250	130	90
S. Illinois Ave/E. Tulsa Rd.	1,619	489	70
<b>Total</b>	<b>11,059</b>	<b>1,708</b>	<b>85</b>



Since 2004, the City has added and re-categorized some of these lights. In addition, the Oak Ridge Electric Department is in the process of replacing the lights in the city's holiday lighting fixtures with LED lights. In addition to the seven intersections listed in Exhibit 3-1, there are also 17 unmetred traffic signals within Oak Ridge, some of which have been upgraded to LEDs since 2004. In 2004 these unmetred traffic signals were estimated to use 31,200 kWh per month (based on the rate of \$.05362 per kWh the city pays for traffic signals and a delivery point charge of \$2.50 per month) and 23,400 kWh per month in 2009, an estimated reduction of approximately 25 percent.

### 3.2: Planned Municipal Measures

#### 1. Increase Energy Efficiency in the Municipal Building (Municipal Energy)

*Measure:* Install a new roof on the Municipal Building

*Measure Status:* Planned

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> Savings:* 4.4 tons per year

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Short (0 to 2 years)

The City is currently replacing the roof of the Municipal Building. In 2004, 647,000 kWh of electricity were consumed at this facility. Assuming that installation of a new roof will reduce energy by 5 percent, the City will save 32,360 kWh, which is equivalent to 4.4 tons of eCO<sub>2</sub> annually. The City added "green" contract language to the bid package for this project, which means that preference will be given to installers that meet specified criteria.

#### 2. Develop a Bicycle and Pedestrian Plan (Municipal Transportation)

*Measure:* Develop an integrated, City-wide bicycle and pedestrian plan

*Measure:* Planned

*Responsible Department:* Community Development

*Estimated Equivalent CO<sub>2</sub> savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Medium (2 to 5 years)

The City is currently developing a bicycle and pedestrian plan with the Knoxville Regional Transportation Planning Organization. The main goal of the plan is expected to fill in "critical gaps" between existing bicycle and pedestrian corridors so that bicyclists and pedestrians who choose to commute via alternative modes have greater capacity to do so. During the



preparation of this plan, priorities, policies, and programs that will make it easier and safer for people to walk and bike to work and school were emphasized.

Since there is an unusually high percentage of people that commute to work in Oak Ridge, integrating a transportation system could have numerous environmental benefits and improve the health of our citizens. When the plan is in place, it is assumed that the number of trips by vehicle will decrease.

This bicycle and pedestrian plan is important for establishing a local transportation network from which to build; this plan is being designed to be integrated into future regional plans, as they are developed.

### 3.3: Proposed Municipal Measures

#### 1. Increase energy efficiency in City-owned facilities (Municipal Energy)

*Measure:* Conduct a comprehensive energy audit of all City-owned facilities and implement recommendations.

*Measure status:* Proposed

*Responsible Department:* Electric Department

*Estimated Equivalent CO<sub>2</sub> savings:* 827 tons per year

*Estimated Annual Cost Savings:* \$70,336

*Payback:* 15 years

*Implementation Schedule:* Short (0 to 2 years)

EQAB recommends that the City execute a performance-based contract with an energy services company (ESCO) to conduct a comprehensive audit, also known as a master audit. Unlike standard energy audits, which consist of a walk-through inspection of facilities that identify areas for further evaluation, a comprehensive audit includes computer modeling to determine actual year-round energy savings as well as a detailed preliminary analysis of financing of the recommended mitigations. The firm chosen to perform the energy audit would be compensated by a percentage of the City's energy saved. A comprehensive energy audit would also include information on code compliance, maintenance schedules, and equipment inventories.

In 2004 the U. S. Office of Financial Management (OFM) released a report (prepared by FCS, a consulting firm), entitled *Best Practices and Trends in Performance Based Contracting* that summarized best practices and trends in performance-based contracting. The report describes the performance-based contract acquisition process and is available to assist federal, state and local governments with information about the performance based



contract processes and the steps involved along the way.”<sup>8</sup> Performance-based contracts provide an excellent way to make energy efficiency improvements and pay for them over time. In fact, “OFM believes as agencies work to contract for results instead of merely buying services, performance based contracting will become an important tool to assure that the State’s taxpayers are receiving the best value for the services purchased.”<sup>9</sup>

In 2004, the consumption of electricity at City-owned facilities was 5,992,134 kWh, which cost the City \$378,152. Assuming that implementation of the energy audit recommendations will reduce energy use by nearly 20 percent, this would result in a reduction of approximately two million kWh per year and a potential savings of over \$75,000 annually (based on current year dollars). As previously mentioned, the fee for a performance-based contract with an ESCO is based on a percentage of the City’s savings. Therefore, if the City paid an ESCO 7 percent of the energy saved, the City would still save \$70,336.27 per year. EQAB recommends a phased-in approach that calls for audit recommendations to be implemented in the year 2012. EQAB also recommends a 15-year pay schedule so that upgrades can be paid for incrementally.

**Exhibit 3-2** provides a breakdown of the energy savings for each of the ten City-owned facilities.

**Exhibit 3-2.** Projected Energy and eCO<sub>2</sub> Savings

Facility	Baseline Year (kWh/yr)	20 % Energy Savings (kWh/yr)	20 % Reduction (tons eCO <sub>2</sub> /yr)
Central Services Complex	2,360,000	472,000	108
Civic Center	1,512,000	302,400	70
Library	964,700	192,940	44
Fire Station 1	66,760	13,352	9
Fire Station 2	77,170	15,434	4
Fire Station 3 <sup>1</sup>	144,160	28,832	7
Municipal Building	647,200	129,440	30
Police Operations	17,700	3,540	1
Scarboro Center	137,409	27,481	6
Animal Shelter	65,035	13,007	3
<b>Totals</b>	<b>5,992,134</b>	<b>1,198,426</b>	<b>282</b>

Source: The eCO<sub>2</sub> emissions savings were calculated in the CACP software provided by ICLEI.

<sup>1</sup> First Station 4 (located at the East Tennessee Technology Park) is not included in this analysis because this station was not transferred to the City from the Department of Energy until 2008, i.e., four years after the base year.



## 2. Revitalize the Built Environment (Municipal Planning)

*Measure:* Retrofit Existing Buildings and Develop Brownfield and Greyfield Properties

*Measure Status:* Proposed

*Responsible Department:* Community Development

*Estimated Equivalent CO<sub>2</sub> Savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Long (5 to 10 years)

As defined by U. S. Environmental Protection Agency (EPA) and the *Small Business Liability Relief and Brownfields Revitalization Act* signed into law January 11, 2002, a *brownfield* site is a parcel of property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. By comparison, the Congress for the New Urbanism defines a *greyfield* as a real estate property that without necessary maintenance, renovations, and other capital expenditures may depreciated in value due to functional obsolescence (e.g., a mall or shopping center).<sup>10</sup> These are typically properties that because of prior development have infrastructure in place but the property's current use is outdated or prevents a better or more efficient use of the property. Such property includes vacant, blighted, obsolete, or otherwise underutilized property.

EQAB recommends that the City of Oak Ridge develop a long-term strategic plan to revitalize the built environment by improving the condition of previously abandoned residential and commercial buildings and sites throughout the City, particularly those that are City-owned. By incorporating mixed-use zoning principles where applicable, the City can attract new businesses and provide more housing choices for residents. Additionally, the new construction provides an opportunity for developers to use green building standards, which helps reduce the size of the City's carbon footprint.

EQAB also recommends that the City begin revitalizing the built environment by improving the condition of local brownfield and greyfield parcels, thus preparing them for non-residential development. The Oak Ridge Industrial Development Board (IDB) currently provides incentives for developing brownfield and greyfield sites using a Payment in Lieu Of Taxes (PILOT) Evaluation Matrix to determine the return amount developers receive for developing on brown and greyfields. EQAB recommends the IDB continue providing incentives to encourage development on these properties.



### **3. Establish an Efficient Vehicle Purchasing Policy (Municipal Fleet)**

*Measure:* Establish a vehicle purchasing policy for a phased-replacement of administrative City vehicles with high-efficiency vehicles (e.g., hybrid, electric, etc.)

*Measure Status:* Proposed

*Responsible Department:* Finance, Department Directors

*Estimated Equivalent CO<sub>2</sub> savings:* 3 tons per vehicle per year

*Estimated Cost Savings:* \$537 per vehicle per year

*Implementation Schedule:* Long (5 to 10 years)

Energy efficient vehicles have a lasting impact on the environment; therefore, creating a vehicle purchasing policy that establishes minimum fuel economy standards has the potential to save the City money on fuel while reducing carbon dioxide emissions from burning gasoline and diesel. Reduced vehicle emissions also could help reduce the concentrations of air pollutants that have caused the multi-county Knoxville region, including all of Anderson County, to be included in a designated non-attainment area for certain EPA National Ambient Air Quality Standards.

The City's fleet contributed to 6 percent of the City's greenhouse gas emissions in 2004. EQAB recommends that the City establish a phased-replacement policy for the replacement of City-owned and operated vehicles based on available and emerging green vehicle standards such as the EPA's *Green Vehicle Guide* which compares vehicles, based on the vehicle tailpipe emissions that contribute to local and regional pollution. This guide provides EPA vehicles ratings (on a scale between 1 and 10 with the cleanest vehicles being given the highest scores).<sup>11</sup> The City initiated the purchase of hybrid vehicles in 2005, and currently has four hybrids in the municipal fleet.

#### **Data used to calculate cost savings**

Using fuel economy standards of 45 percent highway and 55 percent city driving, an assumption was made that 15,000 miles are driven annually and that fuel costs are \$2.50 per gallon (fuelconomy.gov site). Using these values, an assuming a 2000 Chevrolet Malibu (4-cylinder) gets 19 miles to the gallon (mpg) in the City and 28 mpg on the highway, the 15,000 miles driven annually (with fuel costs \$2.50 a gallon), the City will spend about \$1688.21 a year (combined cost for city and highway). If one of these vehicles is replaced with a 2010 hybrid Ford Escape<sup>12</sup> (or comparable vehicle) that gets 34 mpg (city) and 31 mpg (highway), for the same number of miles driven, the City would spend approximately \$1150.97 a year (o fuel for this vehicle (this is a savings of over 30 percent)).



#### 4. Increase Carbon Sequestration (Municipal Energy)

*Measure:* Establish a tree planting and conservation program

*Measure Status:* Proposed

*Responsible Department:* Recreation and Parks

*Estimated Equivalent CO<sub>2</sub> Savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Medium (2-5 years)

Urban forests provide numerous environmental benefits and are essential to mitigating the impacts of climate change. Environmental benefits of trees include improved air quality, reduced stormwater runoff, reduced heat island effect and reduced energy usage. Through photosynthesis trees reduce the levels of carbon dioxide in the atmosphere by breathing in carbon dioxide and returning oxygen. Terrestrial carbon sequestration is the process through which CO<sub>2</sub> from the atmosphere is absorbed by trees, plants and crops through photosynthesis, and stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. The term "sinks" is also used to refer to forests, croplands, and grazing lands, and their ability to sequester carbon. Agriculture and forestry activities can also release CO<sub>2</sub> to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over some time period. Carbon is sequestered in the structure of the tree during its lifetime.<sup>13</sup>

Maintaining a balance between planting new trees and preserving existing trees is critical to ensuring that carbon storage is not outweighed by carbon released by decomposing trees or deforestation. The impacts of decomposition and deforestation are devastating because approximately 80 percent of the carbon stored within the biomass of a tree is released back into the atmosphere within one year of the tree's demise.

EQAB recommends the City of Oak Ridge establish a proactive tree-planting and conservation program, which would help protect the City's urban forest while promoting retention of existing trees by reducing clear cutting. If 50 mixed hardwood trees are planted each year, based on the mixture of trees listed in the table below, approximately 475 pounds of CO<sub>2</sub> will be sequestered annually. The table details the benefits that individual street-side trees provide, when planting trees 1.5 inches in diameter in the southeastern climate. The output is based on planting trees in parks and/or vacant spaces; the overall annual benefits do not include long-term care of the trees. **Exhibit 3-3** below includes estimates were obtained by using the National Tree Benefit Calculator developed by Casey Trees and Davey Tree Expert Co.<sup>14</sup>



**Exhibit 3-3.** Estimated Carbon Reduction from Trees

Tree Species	Stormwater Runoff Intercepted (gallons/year)	Energy Conservation (kWh/yr)	eCO <sub>2</sub> Reduction (pounds/yr)
Willow Oak	55	3	11
River Birch	75	4	9
Eastern Hemlock	36	2	3
American Elm	45	2	9
Ginko	75	4	9
Yellowwood	75	4	9
Eastern Redbud	105	7	12
Sugar Maple	45	2	9
Pin Oak	45	2	9
Silver Maple	53	2	15
Slippery Elm	53	4	9
Red Maple	31	1	40
Black Oak	45	2	9
Tulip Tree	45	2	9
Sweetgum	65	4	7
<b>Total</b>	<b>848</b>	<b>45</b>	<b>169</b>

**5. Improve efficiency of water conveyance throughout the City (Municipal Energy)**

*Measure:* Replace water and sewer infrastructure with more efficient technologies

*Measure Status:* proposed

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> Savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Ongoing

In 2004, the electricity used to treat and transport water and sewer operations throughout Oak Ridge accounted for more than half of the City government's carbon footprint. This large energy use is explained by the layout and terrain of the area, as well as the losses and inefficiencies due to the age of the system (much of the infrastructure in central Oak Ridge is over 65 years old). Newer efficient equipment should both mitigate risks of costly infrastructure failure and significantly reduce overall cost. EQAB recognizes that the City currently budgets approximately \$1 million per year on maintenance of this infrastructure and



recommends establishing a program to replace the equipment on a gradual basis, with the oldest equipment being replaced first.

Due to the high cost of replacing such infrastructure, EQAB recommends establishing an energy fund to offset the expenses. Once established, an energy fund could be replenished with savings from the infrastructure upgrade. Additional water/sewer infrastructure repairs could be paid for out of the savings in the energy fund (and replenished through energy savings).

## **6. Reduce Light Pollution from City-Owned Properties (Municipal Energy)**

*Measure:* Revise lighting specifications and replace existing lighting to reduce light pollution at city-owned properties and right-of-ways

*Measure Status:* Proposed

*Responsible Department:* Electrical Development

*Estimated Equivalent CO<sub>2</sub> savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Medium (2 to 5 years)

Light Pollution is misdirected or misused light which generally results from an inappropriate application of exterior lighting products.<sup>15</sup> There are many benefits of decreasing light pollution. Directing lights downward will lower electricity bills by lighting only the intended area. Further, it decreases glare on the road and restores the sky's natural beauty. In 2007, Blount County passed a new light conservation ordinance. In 2008, Roane County adopted new light regulations for new construction. In 2010, Oak Ridge amended its lighting ordinance for new commercial development to require that all lighting should comply with the International Dark-Sky Association (IDA) standards to prevent light pollution. EQAB recommends that the City develop and adopt new lighting specifications for the purchase of new and replacement lighting at city-owned properties based on the IDA standards and begin the systematic replacement of current lighting not meeting these requirements on all city-owned properties and along public right-of-ways.

EQAB recognizes that there is a widespread perception that dark sky lighting reduces safety. Therefore, EQAB recommends that before lighting reduction projects are undertaken, a threat risk assessment should be performed in order to ensure that safety and security is not compromised by the anticipated reductions. There is, however, ample research indicating that light for the sake of light does not equal a more secure built environment. Bright, glaring lights may actually decrease security by creating a sharp contrast between light and darkness, making the places outside the area of illumination nearly impossible to see. Bad lighting of this type can even attract criminals by creating areas with deep shadows that offer concealment opportunities. Moderate levels of illumination in alleys, staircases, parking lots, and other pedestrian areas helps people find their way and distinguish details of their



surroundings. Lights left on from dusk to dawn provide no alert activity. Installing a motion sensor, or turning off lights and forcing a trespasser to use a flashlight attract more attention, which is emerging as a more effective way to prohibit property damage.

Effective, well directed light is a key component of Crime Prevention Through Environmental Design (CPTED), a multidisciplinary crime prevention approach originally credited to criminologist C. Ray Jeffery in 1971. Since then, renowned architects, criminologists, psychologists, planners, and law enforcement have utilized CPTED ideas, incorporating biology and psychology, to create a cohesive crime prevention strategy."<sup>16</sup> Reducing light pollution contributes to a reduction in GHG emissions by reducing the number and intensity of lighting fixtures while providing better directed lighting in the built environment.

### 3.4: Existing Community Measures

#### 1. Reduce the amount of waste sent to the landfill (Community Solid Waste)

*Measure:* Single Stream Recycling Rewards Program

*Measure Status:* Existing

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> Savings:* 13,000 tons per year

*Estimated Cost Savings:* \$120,000 - \$360,000 per year

*Implementation Schedule:* Short (0 to 2 years)

Undoubtedly, prevention is the best way to reduce waste; however, this is not always possible. When waste cannot be avoided, recycling is the best option. In 2004, approximately 11,000 tons of residential waste was sent to the Chestnut Ridge landfill, which equates to approximately 546 eCO<sub>2</sub>. At that time, curbside service was available to pick up recycled newspapers, glass, and plastics and residents could take their mixed paper to a local recycling facility.

In March 2009, the City adopted a rewards-based single stream residential recycling program that has been highly successful, resulting in approximately 16 tons per day (4400 per year) being sent to the recycle center. The eCO<sub>2</sub> signature of the recyclable material is approximately three times the recycled material's weight, or over 13,000 tons per year of eCO<sub>2</sub>.



### 3.5: Proposed Community Measures

#### 1. Increase energy efficiency in Oak Ridge Schools (Community Energy)

*Measure:* Conduct a comprehensive energy audit of the Oak Ridge Schools facilities and implement recommendations.

*Measure Status:* Proposed

*Responsible Department:* School Administrators

*Estimated Equivalent CO<sub>2</sub> Savings:* 450 tons per year

*Estimated Cost Savings:* To be determined

*Payback:* 15 years

*Implementation Schedule:* Medium (2 to 5 years)

EQAB also recommends that a comprehensive energy audit be conducted of the Oak Ridge Schools, such as the one proposed for City-owned facilities, to determine maximum energy savings. The use of a performance-based energy services contract would allow the schools to make infrastructure upgrades and pay for them over an extended period of time.

In 2004 12,991,007 kWh of electricity was used by the Oak Ridge Schools. If implementation of the energy audit recommendations account for a 15 percent reduction, the schools would use 11,042,356 kWh of electricity, which is equivalent to 8,126 tons eCO<sub>2</sub>. EQAB recommends that the Oak Ridge School Board investigate turning off the majority of the interior lights after normal school hours. It is also recommended that individual motion detection light controls placed in each room for all schools (recognizing that the renovated High School already includes these improvements). Additionally, it is recommended that the lighting of football practice/track lights and Blankenship field be examined to determine a more effective means for reducing the hours these lights are operated. These savings are based on implementation of this measure in 2012.

#### 2. Increase Use of Renewable Energy (Community Energy)

*Measure:* Encourage residents to make the Green Power Switch

*Measure Status:* Proposed

*Responsible Department:* Electric Department

*Estimated Equivalent CO<sub>2</sub> Savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Long (5 to 10 years)

The Green Power Switch program enables the Tennessee Valley Authority (TVA) to produce renewable energy sources or purchase credits from renewable energy generators in other



parts of the country to diversify its power mix. 150-kilowatt-hour blocks of green power can be purchased for a minimal monthly fee. For as little as \$4.00 a month, green power can be purchased by residential and commercial customers and there is not a monthly cap on the amount of green power that can be purchased.

In 2004, residents purchased 2,280 blocks of green power and commercial businesses purchased 451. If it is assumed that an effective education and outreach program results in a 25 percent increase in the number of green power blocks purchased, then the total number of blocks purchased will increase by 682, resulting in the overall purchase of 3,413 green blocks of power.

### **3. Promote Renewable Energy**

*Measure:* Encourage residents to enroll in the TVA Generation Partners Program

*Measure Status:* Proposed

*Responsible Department:* Electric; Finance; Community Development

*Estimated Equivalent CO<sub>2</sub> Savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Long (5-10 years)

Generation Partners provides technical support and incentives for the installation of renewable generation systems. The program makes more green power available for Green Power Switch subscribers, and it creates a market for green power generation by homeowners and businesses.

Program participants support the environment by helping keep the Tennessee Valley clean and green. They also benefit by defraying the costs of their renewable system installation and lowering their monthly energy bills through the revenue they receive from the sale of the green power. The following describes the basic steps for converting to the program:

A renewable generation system is installed by a residential, commercial, or industrial power customer served by a participating power company of TVA power. Eligible resources include solar, wind, low impact hydro, and biomass.

Under the current program structure, TVA will purchase all of the green energy output at a rate of 12 cents per kilowatt-hour for solar and 3 cents per kilowatt-hour for other renewable generation as a premium payment above the retail rate and any fuel cost adjustments. For example, if you paid TVA 10 cents per kWh for the electricity you use to power your home each month, TVA would pay you 22 cents (10 cents plus a 12-cent guaranteed premium) per kWh for 100 percent of the green energy generated from your solar photovoltaic (PV)



system. Moreover, a 2 kW solar PV installation in the Tennessee Valley averages 200 kWh per month or roughly \$44 per month Generation Credit [200kWh X \$0.22/kWh (average retail rate of \$0.10 + solar premium \$0.12) = \$44]. At present, all new Generation Partners participants will receive a \$1,000 incentive to help offset start-up costs. The participating power company will provide monthly statements showing the energy used and any credit due. Power bills will be reconciled either monthly or annually at the discretion of the participating power company. Energy consumed at the home or business, whether it is generated at the site or delivered over the local power distribution system, is billed at the standard rate.

The customer is guaranteed payments for 10 years from the start of the agreement with the local power company. Customers should contact their local power company (in Oak Ridge, this is the City Electric Department) to apply for participation in the program prior to purchasing a renewable generation system. Generation Partners support the environment by using renewable energy sources, and they reduce their monthly energy bills through the revenue they receive from the sale of the green power. Participants do not have to subscribe to the Green Power Switch (GPS) Program to participate in GPS Generation Partners, nor does the power distributor have to be a participant in Green Power Switch.<sup>17</sup>

#### **4. Stimulate Local Economy**

*Measure:* Increase the localization and velocity of money (Community Economy)

*Measure Status:* Proposed

*Responsible Department:* Community Development, Chamber of Commerce

*Estimated Equivalent CO<sub>2</sub> savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Long (5 to 10 years)

Since every community depends on its tax base to support the local economy, it is critical to increase the "localization and velocity" of money being circulated (i.e., purchasing locally). One of the best things residents can do to reduce greenhouse gas emissions is to shop locally, thereby eliminating emissions associated with vehicular travel.

In an effort to educate the public on the benefits of purchasing locally, EQAB recommends that the City partner with the Chamber of Commerce to establish an education and outreach campaign that addresses the primary goals of: 1) working with existing businesses to provide incentives to those who live in Oak Ridge; 2) developing and implementing a marketing campaign that encourages people to live where they work; and 3) developing and implementing a marketing campaign to attract new businesses. Since there has been little change in the Oak Ridge population for several years, one could assume that an increased effort toward changing the current situation might have a positive impact.



In addition, EQAB recommends that the City continue working with private and nonprofit organizations and residents dedicated to preserving historic Oak Ridge, as these partnerships will help the City expand its capacity to receive grant funding.

### **5. Measure: Establish Community Garden (Community Economy)**

*Measure:* Proposed

*Responsible Department:* Community Development

*Estimated Equivalent CO<sub>2</sub> Savings:* to be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Medium (2 to 5 years)<sup>18</sup>

Community gardens are beneficial because they indirectly improve the environment by reducing vehicle miles travelled associated with obtaining food. In addition, these gardens often incorporate composting as a means of enhancing the soil, which provides an alternative to traditional disposal of biomass waste such as burning or land fill disposal. So called "victory gardens" are springing up all over the country and are increasing in popularity for a variety of reasons. A few of the benefits are described below:

- Filtering rainwater and helping to keep lakes, rivers, and groundwater clean ("Plants and the micro-organisms with which they symbiotically co-exist help to clean and filter water as it percolates through the soil.")
- Reducing soil erosion and runoff, which lessens flooding and saves the City money (Bremer et al, 2003, p. 50, 56; Sherer, 2006; tpl, 2004).
- Restoring oxygen to the air and helping reduce air pollution (Chicago, 2003, p.14; Sherer, 2006), through the gas exchange systems of leaves and soils.
- Reducing the "heat island" effect, which lessens the need for air conditioning and lowers electric bills (Bremer et al, 2003, p. 50).
- Providing access to traditional produce or nutritionally rich foods that may otherwise be unavailable to low-income families and individuals.
- Allowing families and individuals without land of their own the opportunity to produce food. Oftentimes gardeners take advantage of the experiential knowledge of elders to produce a significant amount of food for the household.
- Urban agriculture is 3 to 5 times more productive per acre than traditional large-scale farming;
- Local agriculture conserves resources by shortening the commodity chain, saving on fuel-demanding transportation and packaging (Bremer et al, 2003, p.23)
- Developing and maintaining garden space is less expensive than parkland area, in part because gardens require little land and 80% of their cost is in labor (Saylor, 2005);
- Composting saves on landfill space, which saves the City and taxpayers money



- Community gardens provide a place to retreat from the noise and commotion of urban environments; they attract people (including the 'creative class' of the new economy and small businesses).

In order to be effective, a source of topsoil, particularly needed for gardens placed over brownfields or previously paved areas, would have to be identified. It would also be potentially beneficial to provide containers and establish a program for restaurants to segregate food waste (vegetable only – not animal waste) to generate large volumes of compost for enriching to gardens' soils. It is recommended that this initiative be coordinated through non-profits (e.g., Keep Anderson County Beautiful, Habitat for Humanity). This initiative could potentially also support the Oak Ridge Farmers' Market.

#### **6. Adopt Light Pollution Ordinance for New Residential Development (Community Energy)**

*Measure:* Adopt an ordinance to reduce light pollution for new residential developments

*Measure Status:* Proposed

*Responsible Department:* Community Development

*Estimated Equivalent CO<sub>2</sub> savings:* To be determined

*Estimated Cost Savings:* To be determined

*Implementation Schedule:* Short (0-2 years)

As previously noted in section 3.3 (measure number 6), in 2010, Oak Ridge amended its lighting ordinance for new commercial development to require that all lighting should comply with the IDA standards to prevent light pollution. EQAB recommends the City amend its ordinance to include residential development.

#### **7. Reduce the amount of Community Solid Waste sent to the landfill**

*Measure:* Expand Single Stream Recycling Rewards Program to Apartments

*Measure Status:* Existing

*Responsible Department:* Public Works

*Estimated Equivalent CO<sub>2</sub> Savings:* 600 tons per year

*Estimated Annual Cost Savings:* \$5,000 - \$17,000 per year

*Implementation Schedule:* Short (0 to 2 years)

Commercial businesses and most apartment complexes within Oak Ridge are not currently served by the RecycleBank Program. This is because businesses tend to have individual contracts with different solid waste contractors, which would complicate a collection program too much, and apartments are thought to have insufficient room for the rolling bins, as well as too transient a population for adequately reward tracking. In addition, because a



typical apartment has a smaller physical footprint than a detached single-family home, and tends to have fewer occupants per dwelling unit, it will generate a smaller waste stream. EQAB estimates half, or 3 pounds per day (i.e., 21 pounds per week). However, as shown in **Exhibit 3-4** below, this value could vary significantly based on the number of occupants per each of the 1060 units within Oak Ridge.

**Exhibit 3-4.** Estimate Tons of Diverted Recyclables from Oak Ridge Apartments

Pounds of Recycling Per Week	Total Apartments	Pounds Per Week (all apartments)	Pounds Per Year (all apartments)	Tons Per Year Diverted
25	1,060	26,500	1,378,000	689
50	1,060	53,000	2,756,000	1,378
75	1,060	79,500	4,134,000	2,067
100	1,060	106,000	5,512,000	2,756

EQAB recommends that the City encourage the non-participating apartment complexes, comprising approximately 1060 dwelling units, to enroll in the program. As shown in Exhibit 3-4 above, by assuming that each apartment generates an average of 25 pounds of recyclable waste per week, this would increase the diversion of waste from the landfill by approximately 700 tons per year.

<sup>6</sup> Department of Energy, Energy Efficiency and Renewable Energy Homepage. [http://www.energysavers.gov/your\\_home/space\\_heating\\_cooling/index.cfm/my\\_topic=12720](http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/my_topic=12720)

<sup>7</sup> Estimates for eCO<sub>2</sub> and cost are based on average daily recycle tonnage received at the RockTenn recycling facility and commonly used "rules of thumb".

<sup>8</sup> FCS Group, (consulting firm that prepared the *Best Practices in Performance Contracts* document for the Office of Financial Management. <http://www.fcsgroup.com/services/management/index.html>.

<sup>9</sup> The Office of Financial Management, State of Washington. *Best Practices and Trends in Performance Based Contracting*. <http://www.ofm.wa.gov/contracts>.

<sup>10</sup> Congress for the New Urbanism, *Greyfields Regional Mall Study*, January 2001. <http://www.cnu.org/node/349>

<sup>11</sup> EPA Green Vehicle Guide (online tool used to calculate vehicle emissions by make, model, and year). <http://www.epa.gov/greenvehicles/index.do?>

<sup>12</sup> The 2010 hybrid Ford Escape receives a score of 9/10 for the amount of greenhouse gas emissions that it emits. ([www.epa.gov/greenvehicles/](http://www.epa.gov/greenvehicles/))

<sup>13</sup> EPA, *Carbon Sequestration in Agriculture and Forestry*. <http://www.epa.gov/sequestration/faq.html>.



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<sup>14</sup> National Tree Benefit Calculator developed by Casey Trees and Davey Tree Expert Company (online tool used to quantify benefits of trees).

<sup>15</sup> <http://www.starrynightlights.com/lpIndex.html>

<sup>16</sup> International CPTED Association Web site at [www.cpted.net](http://www.cpted.net). Information on Dark Skies is available at [www.darksky.org](http://www.darksky.org)

<sup>17</sup> Tennessee Valley Authority. <http://www.tva.gov/greenpowerswitch/partners/index.htm>.

<sup>18</sup> The Green Institute, *The Multiple Benefits of Community Gardening*. [http://communitygarden.org/docs/learn/articles/multiple\\_benefits.pdf](http://communitygarden.org/docs/learn/articles/multiple_benefits.pdf)



## SECTION 4: IMPLEMENTATION PLAN

There are a number of grants and technical assistance opportunities available for sustainability-related projects and the recommendations outlined in this report could be implemented with only modest investment. Priority has been given to the inclusion of proposed actions which provide definable and achievable payback within a reasonable timeframe, or that can be facilitated through available finance options. EQAB suggests the City use performance-based contracts, grants and technical assistance opportunities, and revolving energy funds to pay for the proposed actions.

Performance-based contracts are used by many municipalities because they provide local governments an opportunity to implement energy efficiency upgrades and pay for them later; however, not all energy service contracts are the same. EQAB recommends the City contract with an ESCO that is not selling a particular product; this ensures that the company will be more focused on providing a service. Further, a highly regarded ESCO will guarantee savings, realizing that it will not be paid until savings are achieved. Both Knox County and the City of Knoxville have achieved good results through their performance contracts.

A revolving energy fund is another method used for financing sustainability initiatives. An energy fund is similar to a bank account, established to pay for up-front project costs and is replenished with a percentage of the cost savings on the energy efficiency improvement(s). Energy funds can be set aside from budgeted money and/or grants. Cities such as Ann Arbor, Michigan have successfully been using revolving loan funds to pay for sustainability measures since its fund was established in 1988.

There are also a number of grants and technical assistance opportunities available in addition to performance-based contracts. Relevant to the recommendations in this plan, federal agencies offer grants and/or technical assistance opportunities for revitalizing the built environment, education and outreach programs, dark skies initiatives, tree planting programs and clean fuel conversions. EQAB recommends the City explore a variety of these funding options to pay for the proposed initiatives. A summary of available grant programs can be found in **Exhibit 4-1**.



**Exhibit 4-1.** Sample of Existing Grants and Assistance Programs

Funding Agency	Title of Program	Brief Program Description
EPA	Smart Growth Technical Assistance	Technical assistance is provided in one of two areas: 1) policy analysis (e.g., reviewing state and local codes, school location guidelines, transportation policies, etc.); or 2) public participatory processes (e.g., visioning, design workshops, alternative analysis, build-out analysis, etc.).
EPA	National Vacant Properties Campaign	Technical assistance is provided to support vacant property revitalization efforts.
EPA	Brownfield Assessment Grants	Four different types of grants are available: 1) Assessment grants provide funding for brownfield inventories, planning, environmental assessments and community outreach; 2) Revolving Loan Fund grants provide funding to capitalize a revolving loan fund that provides sub-grants to carry out assessment and/or cleanup activities at brownfields; 3) Cleanup grants provide direct funding for cleanup activities at specific sites; and (4) Job training grants provide environmental training for residents of brownfield communities.
EDA	Global Climate Change Mitigation Incentive Fund	The U.S. Department of Commerce's Economic Adjustment Assistance program, EDA has allocated \$14.7 million to the Global Climate Change Mitigation Incentive Fund, which supports projects that foster economic competitiveness while enhancing environmental quality.
State of Tennessee	State Revolving Loan Program	Clean Water State Revolving Fund (CWSRF) loans are available for the Planning, Design, and Construction Phases of wastewater facilities. The funds may be used for all three phases in any combination. Eligible projects include new construction or the upgrading/expansion of existing facilities and may encompass wastewater treatment plants, pump stations, force mains, collector sewers, interceptors, elimination of combined sewer overflows, and/or nonpoint source pollution remedies. Funding is available annually.



## APPENDIX A: DIRECTIVE TO EQAB

### ADMINISTRATIVE MEMORANDUM 08-18

DATE: July 25, 2008  
TO: Athanasia Senecal, EQAB Intern  
FROM: James R. O'Connor, City Manager  
SUBJECT: DIRECTIVE TO EQAB

As we have discussed, the following items are the deliverables being requested from EQAB for establishing a green policy for the City of Oak Ridge:

1. Conduct a baseline emissions inventory and forecast. Based on energy and waste data, the City calculates greenhouse gas emissions for a base year (e.g., 2000) and for a forecast year (e.g., 2015). The inventory and the forecast capture emissions from all municipal operations (e.g., City-owned and/or operated buildings, streetlights, transit systems, wastewater treatment facilities) and from all community-related activities (e.g., residential and commercial buildings, motor vehicles, waste streams, industry). The inventory and forecast provide a benchmark against which the City can measure progress.
2. Adopt an emissions reduction target for the forecast year and make a recommendation to City Council.
3. Develop a Local Action Plan (James O'Connor). This plan should include a timeline, description of financing mechanism, and assignment of responsibilities to implement the plan. Public input should be used and description of the community consensus should be included in the final plan document.
4. In addition, EQAB is being asked to offer additional recommendations that help "green" the City of Oak Ridge.

If you have any further questions, please let me know.

  
James R. O'Connor



**APPENDIX B: SUMMARY OF COMMENTS**

**Note:** All comments receive during the Greening Oak Ridge Forum are posted at [GreenOakRidge.net](http://GreenOakRidge.net)

<b>EXHIBIT B-1. Summary of Comments from the Greening Oak Ridge Forum by Category</b>	
<b>Category</b>	<b>Comment</b>
Built Environment	Rehabilitate older buildings to be energy efficient & offer incentives
	Change zoning to prevent clear cutting
	Require new buildings to be sustainable
	Adopt a certified local government system for historic districts
	Land bank property for re-use
	Adopt a dark sky ordinance for lighting
	Continue to expand greenways program
	Redevelop abandoned properties
	Restore brownfields to green fields with visual-plant grass
	Prioritize development within land use plans
	Build up, not out (infill vs. sprawl)
	Recycle concrete and asphalt
	Install city-wide broadband access
	Revitalize Jackson Square
	Introduce more efficient technology in buildings
	Encourage use of clothes lines
	Encourage the use of solar panels, but don't cut down trees
	Encourage gray water input to engineered wetlands
	Encourage residences and businesses to perform energy audits
	Streamline permitting for green building & renovations
Encourage development of diverse types of new housing	
Remove/renovate blighted residential properties	



**EXHIBIT B-1. Summary of Comments from the Greening Oak Ridge Forum by Category**

Green Environment	Promote landscapes with native species
	Plant demonstration gardens using native species
	Encourage businesses to provide for rental bikes, skates, canoes, and kayaks along the water front
	Use principles of landscape architecture to connect residential, commercial and municipal areas
	Provide opportunities for hosting art shows and specialty events at the waterfront park
	Establish best practices, and draft (or emulate) model codes for rainwater utilization.
	Create tree inventory baseline
	Plant trees
	Preserve trees
Business Opportunities	Identify opportunities and challenges with current business start-up/relocation processes
	Encourage people to live where they work
	Partner with ORNL to develop local green business opportunities
	Promote start-ups, innovation and technology transfer with emphasis on businesses that produce green services & products
	Explore opportunities to bring additional consumer dollars from outside the community
	Incentivize citizens and businesses to shop locally
	Encourage businesses to use compostable/renewable/recyclable materials
	Create and manage revolving loan fund to support sustainable objectives



<b>EXHIBIT B-1. Summary of Comments from the Greening Oak Ridge Forum by Category</b>	
Air Quality & Transportation	Develop master transportation plan
	Adopt a "Complete streets strategy"
	Add bike lanes and boxes
	Add a pedestrian bridge over the turnpike
	Add roundabouts
	Add pedestrian friendly commercial zones
Air Quality & Transportation	Add plug in charging meters for electric cars
	Implement flex time schedules to reduce idling
	Develop green parking lots
	Add more sidewalks
	Reduce vehicle idling at traffic lights, school pick-ups, government vehicles, drive-throughs
	Encourage car pooling, vans
	Develop a traffic calming plan
	Install/increase smart traffic controls to reduce idling
	Reduce emissions from burning
	Reduce air pollution from residential & commercial burning of vegetation
Government Purchasing	Maximize recyclable content of all city procured goods and services
	Establish a green purchasing policy
	Give priority to purchasing hybrid electric cars
	Provide tax incentives for energy generation & brownfield development
	Provide rebates to those who have already retrofitted



<b>EXHIBIT B-1. Summary of Comments from the Greening Oak Ridge Forum by Category</b>	
Government Purchasing (cont.)	Strengthen codes to prevent erosion
	Scale the money used for abatements-trade offs
	Maintain trees, permits to cut large trees, legacy tree program
	Support in town cultural organizations and events to encourage staying in town
	Encourage formation of community/neighborhood groups to address neighborhood-specific issues & give leaders a point of contact with the city
Water Quality & Quantity	Mitigate storm water run-off
	Establish engineered Blueways
	Implement practices and validated incentives for hybrid Blueways-Engineered Wetlands city-wide
Water Quality & Quantity	Conserve water usage
	Permit gray water use
	Minimize infiltration



<b>EXHIBIT B-2. Summary of Comments from the University of Tennessee's Environmental Planning Class</b>	
<b>Category</b>	<b>Comment</b>
Education & Outreach	Reach out to various types of organizations & work toward sustainability together:
	Partner with engineering organizations for technical assistance
	Partner with agricultural and gardening organizations to promote buying locally grown food
	Partner with local artists to promote themed public art that is attractive & delivers a message
	Partner with civic youth organizations to acquire volunteers for community-wide projects
	Partner with educational associations to customize education programs
	Partner with economic development organizations that can promote new urbanism principles such as mixed-use development and walkable neighborhoods
New Urbanism	Embrace the principles of New Urbanism & shift focus to what's possible
	Use mixed-use development where applicable
	Create walkable neighborhoods that branch out from mixed-use development
	At the edge of the community, add sidewalks, bikeways, trails and paths that connect with existing neighborhoods
	Ramp up cultural events that bring people together (concerts & art shows)
Local Economic Development	Increase public awareness of strategies that are being used to attract new businesses & be open to new strategies
	Research best practices and case studies that illustrate local economic development success
	Expand economic partnerships across sectors to include both private and nonprofit economic development organizations
Transportation	Analyze current transportation needs
	Offer alternative modes of transportation
	Develop car share & car pool programs
	Offer bike commuter services
	Use pervious parking surfaces when possible



<b>EXHIBIT B-2. Summary of Comments from the University of Tennessee's Environmental Planning Class</b>	
Water Conservation	Establish sustainable water saving practices that can be used by industrial & commercial businesses as well as residents
	Use a tiered rate structure and provide incentives to those who use less water
	Update storm water system to prevent further deterioration
Codes & Ordinances	Develop sustainable city codes like the following:
	Require stormwater management for building and parking lots
	Develop native, drought-resistant landscaping guidelines and update Water Shortage Response Plan to reduce potable water irrigation use by 50%
	Add an Energy Use section to the city's code to encourage energy-saving building practices
Grant Funding	Set aside an appropriate amount of time to research funding sources
Preparing for Oak Ridge in 2050	Provide developers and citizens with opportunities to invest and participate in revitalizing the center of Oak Ridge
	Mitigate transit oriented development as it relates to fuel consumption; use alternative methods of transportation
	Consider light rail, modern trolley or streetcar in future transportation planning
	Focus on both job creation and retention to balance the local economy
	Use renewable energy when possible & conserve natural resources
	Continue to focus on biotechnology & innovation



## **APPENDIX C: ENVIRONMENTAL PLANNING DOCUMENT**

### **ENVIRONMENTAL PLANNING FOR THE CITY OF OAK RIDGE**

This report was prepared by Angela Danovi, Beth Hawkins, Athanasia Senecal, Christina Haddad, Nathan Oliver, Ann Opachik, Em Chitty, and Tom Herbert at the University of Tennessee during the fall of 2009 in the graduate-level Environmental Planning course. The entire paper is available at [www.greenoakridge.net](http://www.greenoakridge.net).

#### **Introduction**

During the fall semester of 2009 the Environmental Planning class prepared an academic report on sustainability for the City of Oak Ridge. The report explores a multitude of ways in which the City of Oak Ridge can become more sustainable. The topics covered in this paper are education and outreach, new urbanism, local economic development, transportation planning, water conservation, codes, grants and future perspectives. This collaborative effort compliments the Climate Action Plan that the City's Environmental Quality Advisory Board (EQAB) is currently preparing with city staff. The ideas and suggestions outlined in this report are intended to serve as a resource for sustainability planning in Oak Ridge.

The first section of the report discusses community outreach and education. A vast list of resources, are included and there is a strong emphasis placed on the importance of public involvement. Further, stakeholder involvement is highly encouraged.

Section two of the report discusses new urbanism and illustrates the significance of incorporating new urbanism principles in planning. Mixed-use practices and getting people to live where they work are two important elements of new urbanism. This section of the report discusses other new urbanism principles as well.

Section three of the report discusses local economic development with an emphasis on attracting new businesses and retaining ones that have already been established. Local economic development strategies are also explored in detail.

Section four discusses the role that transportation plays in Oak Ridge. An overview of vehicular traffic, bicycle use and pedestrian use is provided and alternative modes of transportation are discussed. The concept of planning around people rather than cars is suggested as the ideal situation.



Section five explains the importance of water as a resource and offers several recommendations for water conservation. This section summarizes water quality reports from prior years and discusses the relevance of conserving water even when surpluses are available. An emphasis on stormwater management practices are explored as a method of reducing water consumption.

Section six discusses codes and the importance of sustainable design. Building, electrical, plumbing, and energy codes can be sustainable. Recommendations for incorporating sustainability into municipal codes and ordinances are provided. Model codes are also described.

Section seven explores a grant proposal for a project at the Oak Ridge public library. The proposal includes the major sections of a grant application as well as an extensive list of additional resources.

Section eight explores the future of Oak Ridge in 2050. Under certain assumptions with respect to education, technology, waste reduction and renewable energy, a unique perspective of Oak Ridge is offered.



## APPENDIX D: INPUT DATA COLLECTION AND EVALUATION

### D.1: Public Input

On Saturday, January 17, 2009, from the Oak Ridge Civic Center from 9 a.m. to 1 p.m., EQAB hosted a public forum to gather and discuss suggestions of Oak Ridge residents and businesses about what to do to make the City a green and sustainable community for current and future generations. Over 100 citizens attended.

Jim Frierson, Vice-chair of the Chattanooga Green Team, was the keynote speaker. Other speakers were members of EQAB, James P. Groton and Pat Imperato; and City Council members, Mayor Tom Beehan and Councilwoman Ellen Smith. Athanasia Senecal presented the results of the energy survey and described the ICLEI model.

Attendees broke into six roundtables with a facilitator and scribe. They included:

- **The Built Environment** – Linda Kimmel and Linda Hundt
- **Air Quality and Transportation** – Matt Shafer-Powell and Fred Stephens
- **Water Quantity and Quality** – Vickie Reddick and Robert Kennedy
- **Business Opportunities** – Ruby Miller and Chuck Agle
- **Green Environment** – Karen Bridgeman and Joan Nelson
- **Government Policies** – Leslie England and Pat Fain

From these roundtable discussions, over 400 ideas were recorded. After duplicates and very similar suggestions were combined, there were 293 discrete items for EQAB to use in developing a Local CAP. All of the original recommendations follow.

### D.2: Pair-wise Comparison

After all of the data had been collected and compiled, EQAB began the task of evaluating each idea based on its relevance to, and support of, the sustainability initiative. It was quickly realized that given the amount and complexity of information received, it would be necessary to apply a non-biased process to evaluate and prioritize the information so that each idea was evaluated fairly based on its merits and relevance to the sustainability initiative, and not on its emotional appeal or a special interest group's criteria or agenda. The method selected to perform this assessment was the pair-wise comparison technique.



Pair-wise comparison generally refers to any process for comparing entities in pairs to judge which element of each pair is preferred, or has a greater amount of some property or benefit. Pair-wise comparison is often used in the scientific study of preferences, attitudes, voting systems, social choice, and public choice. In addition, the United States government has applied this technique for years to evaluate numerous elements from threats and targets to engineered systems. One important application of the pair-wise comparison technique is in the management decision making process because it enables decision makers to take appropriate actions to deal with complex issues that may involve both tangible and intangible considerations and outcomes.

The objective of the pair-wise comparison task undertaken by EQAB was to determine the highest priority strategies (developed during the data compilation and reduction exercise) for creating a more sustainable community. The pair-wise comparison technique was used to determine the priority of the suggestions and input received from the public, EQAB members, and city staff based on the sustainability task assigned to EQAB.

The first step in the strategic prioritization process therefore was to develop the ranking criteria that would be used as the basis for the pair-wise comparison and ultimately the prioritization of the individual strategies. In order to identify the ranking criteria, EQAB developed a sustainability mission statement and adopted it as the basis for evaluating the mission objectives and for defining the criteria for performing the pair-wise comparison (i.e., prioritization). The mission statement, developed to be consistent with the direction provided to the Board for this initiative by the city manager (see Appendix A for memo from Jim Conner, dated July 25, 2008), is as follows:

*“Create a sustainable community by reducing greenhouse gas emissions and consumption of resources while delivering critical public services, enhancing our quality of life, and encouraging economic opportunities for our residents and businesses.”*

This mission statement was then used to develop specific criteria that could be used to rank the relative importance of the strategies developed in each sustainability subject area or discipline. EQAB developed the following list of ranking criteria from the mission statement:

**Criteria #1 - Critical Public Services.** This criterion was defined as the city's ability to provide fire, law enforcement, public health services, reliable electricity, emergency management, public utilities (electric, water, sewer, telecom, etc.), and transportation (roadways) related services.

**Criteria #2 – Sustainability.** This criterion was defined to include conserving resources, encouraging locally grown foods, reducing greenhouse gases, ensuring energy and



water security (i.e., reliable quantities and quality), and increasing public awareness of sustainability issues.

**Criteria #3 - Quality of Life.** This criterion was developed to include improved water quality, improved air quality, high-quality recreation, community, and cultural activities, maintaining safe and desirable neighborhoods, providing interconnected bicycle and pedestrian thoroughfares, focusing on human scale planning, and maintaining high-quality education and schools.

**Criteria #4 - Economic Opportunities for Residents.** For this exercise, this criterion was defined to include increased opportunities for trades and crafts, reducing transportation costs, lowering utility bills, increasing opportunities for professional and technical jobs, increasing the diversity of employers, increasing the diversity (i.e., costs) of available housing, increasing transportation options, and decreasing the tax burden for residents.

**Criteria #5 - Economic Opportunities for Businesses.** This criterion was defined for Oak Ridge as including opportunities for enterprises to "green" the antiquated housing stock, have access to preferential local and regional financing, build green infrastructure, provide comprehensive retail, plan and develop mixed use neighborhoods and buildings. In addition, this criterion would include an optimization of available public funds, implementation of more attractive zoning, increased tax base, opportunities for technology transfer with ORNL, and access to a diverse work force.

Because not all criteria are of equal importance, the criteria were ranked relative to each other before the strategies (developed from public input) were ranked using the criteria. By prioritizing the individual ranking criteria to determine their relative importance (via the calculation of weighting factors based on their relative rankings derived from a pair-wise comparison), EQAB was then able to use a pair-wise comparison to prioritize the strategies within each sustainability topic area (i.e., discipline) based on the five weighted criteria. The weighting factors for the evaluation criteria are included in the table below.



**Criteria Weighting Factors**

Criteria-specific Weighting Factors	Weighting Factors
Criteria 1. Critical Public Services	1.3167
Criteria 2. Sustainability	1.2167
Criteria 3. Quality of Life	1.1917
Criteria 4. Economic Opportunities for Residents	1.1583
Criteria 5. Economic Opportunities for Businesses	1.1167

EQAB, in concert with City staff and visiting members of the public, then prioritized the strategies in a series of open work sessions using the criteria in a structured way, resulting in a relative ranking of the strategies. This is the most critical part of the prioritization process because it determines which strategies should be considered first for increased efficiency and long term sustainability. It is important to note that some improvements can most likely be undertaken at all of the City's facilities and operations, so following a prioritized process does not mean that lower consequence strategies will or should be ignored.

Water Quality and Quantity Strategies	Total Pair-wise Scores	Ranking
CONSERVE water-energy (nexus) resources with demand management, full-cost pricing, taxes, demand charges, incentives, code changes, retrofits, right-sized infrastructure.	98.6	1
Promote RAINWATER for irrigation and other uses by: setting standards and best practices; promulgate, educate, encourage, and execute particularly within city facilities and new commercial facility construction (e.g., green roofs, etc.).	74.2	2
Establish engineered BLUEWAYS and WETLANDS for health, beauty, buffer, recreation, reduced sewer load, runoff filtration, etc.	68.2	3
Mitigate RUNOFF effect on water quality with permeable surfaces, design, code changes, education, incentives, and waste management. Set new RESERVOIR policies and regulations to improve water quality.	67.1	4
Revise building codes to legalize GRAYWATER for irrigation and establish standards and best management practices to promulgate, educate, encourage, and execute within city facilities, parks, etc.	51.9	5



Opportunities for Business	Total Pair-wise Scores	Ranking
Increase the localization and velocity of money.	60.8	1
Nurture and promote businesses that produce green services or products.	56.8	2
Support business operations and make city more "Small Business Friendly".	53.4	3
Promote start ups, innovation and technology transfer.	45.3	4

Green Environment	Total Pair-wise Scores	Ranking
Protect and maintain trees and our mixed hardwood forest (e.g., Greenbelts, etc.).	62.2	1
Manage, increase, and improve common spaces and parks.	51.9	2
Design improvements of the waterfront that maintain its natural integrity.	49.5	3
Promote natural landscape for beneficial environmental and human impact.	49.5	4

Built Environment Strategies	Total Pair-wise Scores	Ranking
Revitalize existing buildings and brownfields.	61.4	1
Promote and install renewable energy.	54.9	2
Incorporate comprehensive green building standards.	52.7	3
Use land in future development efficiently.	47.1	4



Air Quality and Transportation	Total Pair-wise Scores	Ranking
Encourage creation of "Green Neighborhoods".	118.8	1
Create efficient local and regional public transportation	96.4	2
Create human-powered movement infrastructure.	95.2	3
Promote city and community vehicles that are less reliant on fossil fuels.	88.7	4
Reduce vehicle emissions.	84.4	5
Reduce other "combustion" emissions.	56.7	6

Government Policy and Purchasing	Total Pair-wise Scores	Ranking
Revise ordinances and policies to encourage and incentivize green construction and renovation techniques.	86.1	1
Develop master plan to create decentralized mixed use commercial and residential areas from underutilized former commercial areas.	76.9	2
Establish tax incentives, abatements, and low interest loans for homeowners to renovate and/or retrofit MED/AEC-era homes with energy saving features and technologies.	71.7	3
Encourage residences and businesses to perform energy audits through public service education and advertising campaign.	69.3	4
Establish partnership for innovation with ORNL and/or innovative green technology enterprise to develop green pilot projects in Oak Ridge.	56.1	5



**APPENDIX E: ICLEI BASELINE MODELING RESULTS**

**City Government GHG Inventory for 2004**

<b>Buildings</b>		
<b>Building</b>	<b>Energy Use (kWh)</b>	<b>Natural Gas (thousand cubic feet)</b>
Animal Shelter	65,035	2,173
Central Service Complex (includes the fuel station)	2,412,552	4,550
Civic Center	1,512,000	2,655
Fire Station 1	66,760	351
Fire Station 2	77,171	346
Fire Station 3	144,160	470
Library	964,700	944
Municipal Building	647,200	717
Police Dept	17,700	85
Scarboro Center	137,409	842
<b>Total</b>	<b>6,044,687</b>	<b>13,133</b>

<b>Streetlights/Traffic Lights/Park Lights</b>		
<b>Name of Intersection</b>	<b>Energy Use (kWh)</b>	<b>Cost \$</b>
Un-metered Street Lights	4,228,060	\$195,481.00
Un-metered Traffic Signals	372,240	\$17,265.00
Arkansas/OR Turnpike	11,061	\$541.00
Bethel/Scarboro	10,884	\$533.00
Bus Terminal/Emory Valley	7,384	\$371.00
Bus Terminal/Liberty	12,025	\$586.00
Emory Valley	15,876	\$764.00
Hendrix/Lafayette	12,873	\$625.00
S. Illinois/East Tulsa	19,432	\$928.00
S. Illinois/Robertsville	15,002	\$723.00

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S. Illinois/Tulane	21,789	\$1,037.00
Streetlights/Traffic Lights/Park Lights		
Name	Energy use (kWh)	Cost \$
Jefferson/OR Turnpike	8,418	\$419.00
Lafayette/Emory Valley	13,599	\$659.00
Lafayette/Laboratory	9,835	\$485.00
Lafayette/South Illinois	27,888	\$1,319.00
Louisiana/OR Turnpike	9,675	\$477.00
Manhattan PL/OR Turnpike	7,107	\$358.00
Melton Lake/Edgemore	0	\$30.00
Melton Lake/OR Turnpike	0	\$30.00
Montana/OR Turnpike	8,021	\$401.00
Nebraska/OR Turnpike	0	\$30.00
Outer Drive/North Illinois	14,191	\$686.00
Rutgers Avenue	8,005	\$400.00
Rutgers/South Illinois	23,387	\$1,111.00
Scarboro/Bear Creek	13,215	\$641.00
Tyler & Tennessee	9,037	\$448.00
Union Valley/HWY62	35,934	\$1,678.00
Schools Outdoor Lighting	12,307	\$966.00
Sewer Outdoor lighting	0	\$30.00
Wilberforce Ball Park	3,976	\$289.00
Big Turtle Park	739	\$421.00
Bissell Park	61,994	\$2,895.00
Briar Cliff Park	1,399	\$95.00
Carl Yearwood Park	9,774	\$512.00
Cedar Hill Park	1,519	\$326.00
Centennial Golf Course	4,216	\$490.00
Elm Grove Park	3,816	\$372.00
Civic Center Event	45,208	\$187.00
Highland View Park	1,272	\$124.00
Jackson Square Park	10,786	\$992.00
Melton Lake Park	178	\$197.00
Oakwood Ball Park	1,593	\$337.00
Ridgeview Ball Park	0	\$30.00
Scarboro Park	78,476	\$5,568.00

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Solway Park	6,360	\$607.00
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Streetlights/Traffic Lights/Park Lights		
Name	Energy use (kWh)	Cost \$
LaSalle Park	7,592	\$543.00
Municipal Pool	253,050	\$18,817.00
<b>Total</b>	<b>5,419,193</b>	<b>\$261,824.00</b>

Employee Commute		
Number of employees	Completed surveys	Vehicle miles travelled weekly
Approximately 400	115	41,130

City Fleet		
Fuel Type	Gasoline (gallons)	Diesel (gallons)
Gasoline	125,752	0
Diesel	0	33,021
<b>Total</b>	<b>125,752</b>	<b>33,021</b>

Water/Wastewater Treatment for 2004			
Location	Equipment	kWh	Annual Cost
Arcadia Lane/Castlewood	Castlewood Lift Station	2,370	\$354.16
Coe Road	Emory Heights Lift Station	8,935	830.45
Emory Valley Road	Emory Valley Lift Station	241,920	24,275.31
Fairbanks Road	Fairbanks Road Lift Station	536	\$222.64
Graceland	Graceland Lift Station	10,434	\$936.89
Melton Lake Drive	Gregory's Lift Station	3,867	\$462.11
Gum Hollow Lift Station	Gum Hollow Lift Station	14,637	\$1,240.82
Laboratory Road	Home Depot Lift Station	543	\$223.10
Melton Lake Drive	Marina Lift Station	24,326	\$1,943.91
Oak Ridge Turnpike # 2	Oak Hills Lift Station	31,370	\$2,451.33



Water/Wastewater Treatment for 2004			
Location	Equipment	kWh	Annual Cost
Cairo Rd	East Plant Lift Station	335,840	\$26,888.47
Palisades Parkway	Palisades Lift Station # 1	399	\$212.78
Palisades Parkway	Palisades Lift Station # 2	1,596	\$300.25
Palisades Parkway	Palisades Lift Station # 3	1,647	\$302.76
Palisades Parkway	Palisades Lift Station # 4	1,108	\$263.86
Edgemoor Road	Park Meade Lift Station	215,398	\$13,073.67
Wedgewood Road # 2	Peach Orchard Lift Station	1,569	\$297.11
Scarboro Road	Pumphouse Road Lift Station	31,680	\$1,345.60
Radisson Cove	Radisson Cove Lift Station	6,354	\$642.15
Rivers Run Blvd at Melton Lake Dr.	Rivers Run Lift Station	11,312	\$1,000.50
Marywater Lane	Marywater Lift Station	1,154	\$267.68
Rolling Links	Rolling Links Lift Station	1,341	\$280.89
Rockbridge Greens	Royal Troon Lift Station	1,807	\$314.42
Scarboro Road	Scarboro Road Lift Station	21,440	\$1,734.49
E. Southwood Lane	Southwood Lane Lift Station	1,120	\$264.84
S. Illinois Avenue	Summit Ridge Lift Station	12,657	\$1,097.58
Warehouse Road	Warehouse Road Lift Station	809	\$218.35
Eastburn Lane	WATO Lift Station	660	\$231.63
Miramar Cir	Miramar Lift Station	61	\$188.33
Westview	West Outer Lift Station	15,739	\$1,319.17
Whippoorwill Lane	Westview Lane Lift Station	8,117	\$4,998.10
Whippoorwill Lane	Whippoorwill Lift Station	14,462	\$1,225.89
Pumphouse Road	Pumphouse Lift Station	154	\$195.06
Edgemoor Rd	Edgemoor Lift Station	14,000	\$1,195.29
Edgemoor Rd	Edgemoor Lift Station	48,450	\$3,677.38
West Outer Drive	Outer Drive Lift Station	97	\$190.95
William Lane	William Lane Lift Station	5,850	\$606.02
Golden Gate	Golden Gate Booster Station	3,743	\$454.32
West Outer Drive	Louisiana Reservoir & Booster	53,883	\$4,253.53
Union Valley Road	Scarboro Road Booster Station	8,352	\$769.08
South Walker Lane Booster Station	South Walker Lane Booster Station	13,633	\$4,167.00



Water/Wastewater Treatment for 2004			
Location	Equipment	kWh	Annual Cost
Whippoorwill Dr	Whippoorwill Booster Station	13,328	\$1,144.99
Wisconsin Ave to tank	Wisconsin Booster Station	121,300	\$10,824.75
Greenbriar Lane	Greenbriar Booster Station	14,400	\$1,222.36
A Pennsylvania Ave	Pennsylvania Booster Station	192,300	\$21,516.32
East Bear Creek Rd	Meter for water tank	866,600	\$54,809.43
West Bear Creek Rd	Meter for water tank	723,720	\$51,191.17
A.Orchard Lane at tank	Orchard Lane Water Tank	1,783	\$312.68
Delaware ETK at tank	Delaware Pump Station & Water Tank	1,424	\$286.91
Scarboro Rd/Commerce Rd	Scarboro Road Station	55,450	\$4,187.66
A. Scarboro Rd	Scarboro Booster Station	4,382,000	\$251,962.95
B. Scarboro Rd	Scarboro Booster Station	39,200	\$3,011.67
Orchard Lane	Orchard Lane Booster Station	63,504	\$4,888.14
Outer Drive Delaware tank	Outer Drive Booster Station	157,008	\$13,629.12
Pumphouse Rd West	Water Intake Station	0	\$184.00
Pumphouse Rd East	Water Intake Station	7,232,400	\$435,288.55
Bull Bluff Road	Gate	3,637	\$446.44
Bear Creek Road	Small Sewage Treatment Plant	22,563	\$1,810.38
Illinois Avenue	Robertsville Booster Station	313,400	\$29,184.42
Oak Ridge Turnpike	Waste Water Treatment Plant	4,751,600	\$283,758.76
	<b>Total</b>	<b>20,128,987</b>	<b>\$1,274,578.57</b>

Solid Waste		
Type	Tons	Hauling/Tipping Fee
Front load	103	\$3,709.44
Roll off	55	\$1,962.72
Total	158	\$5,672.16



**Community GHG Inventory for 2004**

<b>Oak Ridge Schools</b>			
<b>Name of School</b>	<b>kWh</b>	<b>Natural Gas (CCF)</b>	<b>Electricity Cost \$</b>
Glenwood Elementary	1,182,436	36,501	\$81,188.45
Jefferson Middle	1,335,054	18,908	\$96,415.57
Linden Elementary	2,525,566	5,143	\$150,906.75
Oak Ridge High	4,032,042	66,216	\$262,831.76
Robertsville Middle	1,673,718	21,339	\$118,791.98
Willow Brook Elementary	697,500	24,340	\$53,421.95
Woodland Elementary	768,599	18,776	\$57,701.96
Blankenship Field	114,132	0	\$7,717.95
School Administration Building	661,960	33,090	\$52,274.43
<b>Total</b>	<b>12,991,007</b>	<b>224,313</b>	<b>\$881,250.80</b>

<b>Community Inventory</b>		
<b>Sector</b>	<b>kWh</b>	<b>Natural Gas (CCF)</b>
Residential	162,463,702	559,568
Commercial/Industrial	267,511,050	882,813

<b>Transportation</b>	
<b>Vehicle Type</b>	<b>Vehicle miles travelled</b>
Average Size Vehicle	451,362,285

<b>Waste</b>	<b>Tons</b>
Residential	Approx. 11,000



## APPENDIX F: SAMPLE IMPLEMENTATION DIAGRAMS

### F.1: Gantt Chart

EQAB has prepared a sample work plan that illustrates several of the steps involved in revitalizing the built environment. The following example implementation diagram is intended to be a resource for staff and is not in any way meant to replace work already being done.

Task Name	Duration	Start	Finish	Project Manager
<b>Revitalize the Built Environment</b>				
Rehabilitate existing houses when possible	5-10 years	2010	2020	Community Development
Remove blighted residential/commercial properties	0-10 years			
Retrofit municipal buildings to green building standards	2-10 years			
Implement mixed-use principles where applicable	2-5 years			
Provide additional incentives to developers that use sustainable building practices	1 year			
Maximize green building standards for renovation and construction	10 years			
<b>Revitalize Existing Brown and Gray Fields</b>				
Update inventory of brown and gray fields				
Increase incentives to develop on brown and gray fields				

### F.2: Monitoring Results

One of the many ways of measuring results is to use a program logic model. A program logic model describes the logical flow from project inputs to the short-term and long-term outcomes. Managers can monitor each step along the way to ensure that a project is on track. Such models increase efficiency, thus maximizing time and use of money. The project logic model on the following page accompanies the Gantt chart above, illustrating the steps to revitalize the built environment. This example takes into account various stakeholders and steps that ensure the success of the recommended revitalization project. Needs to include adequately defined planning standards and trained staff and volunteers to encourage strong working partnerships. In order to avoid potential problems, accountability is mandatory, and partners have to buy into the program message. It is also critical that the appropriate stakeholders are informed of the current condition and work together toward a common goal.

