City of Phoenix

Climate Action Plan
for
Government Operations

October, 2009

ICLEI Local Governments for Sustainability USA

Credits and Acknowledgments

This report was a collaborative process with the City of Phoenix and ICLEI-Local Governments for Sustainability

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Acronyms

CACP	Clean Air and Climate Protection Software (2009)
CARB	California Air Resources Board (2008)
CCAR	California Climate Action Registry
CH_4	Methane
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent Emissions
EAS	Engineering and Architectural Services Department
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
JPA	Joint Powers Authority
LandGEM	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LGOP	Local Government Operations Protocol
LNG	Liquid Natural Gas
LPG	Liquefied Petroleum Gas
N_2O	Nitrous Oxide

Figures

Tables

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EXECUTIVE SUMMARY

Phoenix has been recognized as a leader in environmental stewardship and sustainability and has a long history of implementing pollution control and natural resource conservation programs. These efforts are summarized in the city's sustainability web site Phoenix.gov/sustainability. Most of the sustainability programs have also helped reduce GHG emissions in city operations and the community.

In 2008, the city expanded these efforts to include a focus on reducing greenhouse gas (GHG) emissions from city operations. In December 2008, the City Council adopted a goal to:

Reduce emissions from city operations to
5 percent below the 2005 levels by 2015

The emissions inventory found that municipal operations produced approximately 618,682 metric tons CO_2e in 2005. The relative contribution from each of the major sectors is listed below.

61%	Electricity and natural gas used in buildings and facilities
20%	Fleet vehicles
12%	Landfills
4%	Employee commute
3%	Wastewater treatment

The emissions inventory also estimates that GHG emissions will increase to 706,416 metric tons CO_2e in 2015 under a No Action scenario. As a result, the city would need to reduce emissions by 19 percent from the 2015 forecast levels to overcome this 14 percent growth in GHG and achieve an additional 5 percent reduction below the base year of 2005.

The city has identified ten broad measures that are expected to reduce emissions by an estimated 120,428 metric tons CO2e – achieving the goal. The measures include renewable energy, energy efficiency, alternative fuels, the automated train at Sky Harbor International Airport, landfill methane collection efficiency, and other programs. At the time this plan was being finalized, new federal funding became available for renewable energy, energy efficiency, and other programs to reduce GHG emissions while stimulating economic growth. The city has applied for a number of federal grants which could achieve additional GHG reductions. The impact from any successful applications will be addressed in future updates to this plan.

1. BACKGROUND

Climate Change: Scientific evidence has shown that since the beginning of the industrial revolution, human activities have been adding measurably to natural background levels of greenhouse gases (GHG). This conclusion is detailed in the Fourth Assessment Report[1] by the Intergovernmental Panel on Climate Change (IPCC), the preeminent global scientific authority on climate change. During the 20th century, the Earth's average temperature increased at rates unparalleled in the geologic record. Climatologists at the NASA Goddard Institute for Space Studies reported in 2008 that the eight warmest years have all occurred since 1998, and the 14 warmest years have all occurred since 1990.[2]

The 2006 Arizona Climate Action Plan reports that significant global warming impacts are expected throughout the state. The Arizona plan reports that in western North America, the climate has warmed on average by 1.4 degrees Fahrenheit over the past 50 years. Higher temperatures and increased evaporation can lower water levels in reservoirs, lakes and streams, resulting in water supply and quality issues. Conservative estimates of climate change predict significant impacts on the Colorado River by the end of this century. The Arizona plan also reports that those impacts include up to a 15 percent reduction in annual runoff, a 40 percent decrease in water basin storage, and a decline in hydroelectric power of 45 to 56 percent compared to the historical average. Climate change could also reduce Arizona's forested areas by 15 to 30 percent, exacerbate wildfires and air pollution, and reduce Arizona's crop production.[3]

There are six greenhouse gases recognized in the 1997 Kyoto Protocol, an international agreement linked to the United Nations Framework Convention on Climate Change. These include: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Most of these gases are emitted by the burning of fossil fuels by power plants, vehicles, and other combustion engines. The heat-trapping properties of these gases contribute to increases in global temperatures and changes in precipitation, rising sea levels, and adverse effects on many ecological systems.

The Role of Local Governments: The City of Phoenix has recognized that climate change is a reality, with potentially disruptive effects on Phoenix's residents, businesses, and natural resources. The City of Phoenix also recognizes that the federal government has the primary authority to affect global warming through national

[1] http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf
[2] http://www.nasa.gov/centers/goddard/news/topstory/2008/earth_temp.html
[3] http://www.azclimatechange.gov

regulation and international policies. However, local governments can also impact greenhouse gas emissions through changes in operations and policies.

Phoenix can reduce the emissions from city operations by increasing energy efficiency in buildings and vehicles, expanding alternative fuels, utilizing renewable energy sources, waste reduction, and promoting alternative modes of transportation for employees. The co-benefits of these measures may include lower energy bills, improved air quality, and more efficient government operations. This Climate Action Plan represents another effort by the City of Phoenix to lead by example through the GHG reduction measures outlined in this report.

AZ Climate Change Project: Prior to the development of this Action Plan for city operations, the City of Phoenix participated in the development of the AZ Climate Action Plan. In 2005, Governor Janet Napolitano established the Climate Change Advisory Group to study potential climate change impacts in Arizona, conduct an emissions inventory and GHG forecast, and develop recommendations for action. The emissions inventory for statewide GHG emissions in AZ found that the two largest sources of GHG emissions were transportation/mobile sources (39 percent) and electricity production (38 percent). Other sources include electricity use in residential and commercial uses (5 percent), industrial processes and fuel use (11 percent), waste management (2 percent), and agriculture/deforestation (5 percent).

The AZ Climate Change Action Plan estimates that Arizona's GHG emissions will increase from 59.3 million metric tons of carbon dioxide equivalent (CO_2e) in 1990 to an estimated 147 million metric tons CO_2e in 2020, a 148 percent increase.

The AZ Climate Change Advisory Group identified 49 actions that could reduce GHG emissions from energy production, energy use, mobile sources, waste management, agriculture, forestry, and other sources. Several examples from the City of Phoenix were included in the proposed actions for state-wide implementation including in-fill development incentives, transit/light rail services, energy conservation codes, and other programs.

Based on recommendations in the AZ Climate Change Action Plan, Governor Napolitano established a goal to reduce statewide GHG emissions to the 2000 levels by the year 2020, and 50 percent below the 2000 levels by 2040.[4]

[4] Executive Order 2006-13

2. CITY OF PHOENIX SUSTAINABILITY PROGRAMS

Phoenix has consistently demonstrated its commitment to environmental stewardship and sustainability through numerous pollution control and natural resource conservation programs. Those efforts have also helped reduce GHG emissions in city operations and the community. A full report of more than 80 sustainability programs is available at the city's sustainability web site Phoenix.gov/sustainability. The measures included in this Action Plan support the sustainability programs. Because this plan focuses on city operations, the city's wide range of community-based sustainability programs are not included. Examples are provided below.

- Adoption of Energy Conservation standards in the Building Codes
- Residential recycling program with curbside collection of plastic, glass, paper, cardboard, and metal
- Pedestrian-friendly development Zoning Code standards
- Zoning Overlay Districts to protect sensitive areas
- New light rail service with 20 miles of service opening in December 2008 and 37 miles of planned expansions
- A Heat Island Task Force to study options for reducing urban temperatures
- Innovative research on Downtown Urban Form development scenarios
- Water conservation, wetlands habitat restoration, and aquifer re-charge projects
- Open space preservation of more than 30,000 acres through bond funding
- Urban Forestry program to increase trees and promote community action
- Recycled asphalt overlay program for noise reduction and street maintenance
- District cooling projects that chill water at night for daytime cooling of buildings

3. EMISSIONS INVENTORY AND FORECAST

In January 2008, the city began the Climate Action Plan project with ICLEI – Local Governments for Sustainability USA (ICLEI) as the consultant. The first step in the process was to conduct a comprehensive inventory of GHG emissions from municipal operations. The *City of Phoenix 2005 GHG Emissions Inventory for Government Operations* is summarized in this section. The full report is available as the companion document to this Action Plan.

The emissions inventory required collection and review of extensive records on energy use, methane emission data from landfills and wastewater treatment (WWT) plants, vehicle fuel consumption, and other sources of GHG in municipal operations. City staff provided data used to create an emissions inventory, and assisted with the analysis of the data.

The city's preliminary emissions inventory was first reported to the City Council in December 2008. The final inventory reflects minor changes that did not impact the adopted GHG reduction goal.

GHG Reporting Format: In this plan, GHG emissions are reported as carbon dioxide equivalent (CO_2e) metric tons to be consistent with the established international standard for comparison of the global warming potential (GWP) of different GHG relative to CO_2. For example, the Intergovernmental Panel on Climate Change (IPCC) indicates that methane (CH_4) is 21 times more potent than CO_2 and nitrous oxide (N_20) is 310 times more potent in heat trapping potential. Based on these GWP equivalents, one metric ton of CH_4 is reported as 21 metric tons CO_2e and one metric ton of N_20 is reported as 310 metric tons CO_2e.

Baseline Year Emissions: The city selected 2005 as the baseline year to serve as the reference point for predicting growth and measuring progress in the future. The year of 2005 was selected because city records for that year offer the most reliable data to accurately compare progress in reducing emissions in future years. The emissions inventory organizes GHG emission sources into five sectors, consistent with the standard Local Government Operational Protocol:

- Energy Use in Buildings and Facilities
- Vehicles
- Solid Waste (landfills)
- Wastewater Treatment (WWT)
- Employee Commute

The emissions inventory found city operations generated approximately 618,682 metric tons CO_2e in 2005. The GHG contribution from each sector is shown in Figure 1. Approximately 61 percent of the CO_2e emissions came from energy use in buildings

and other facilities, 20 percent from the municipal fleet vehicles, 12 percent from solid waste, 4 percent from employee commute, and 3 percent from the N_20 and CH_4 gasses emitted in the WWT process.

Figure 1. Greenhouse Gas Emissions by Sector

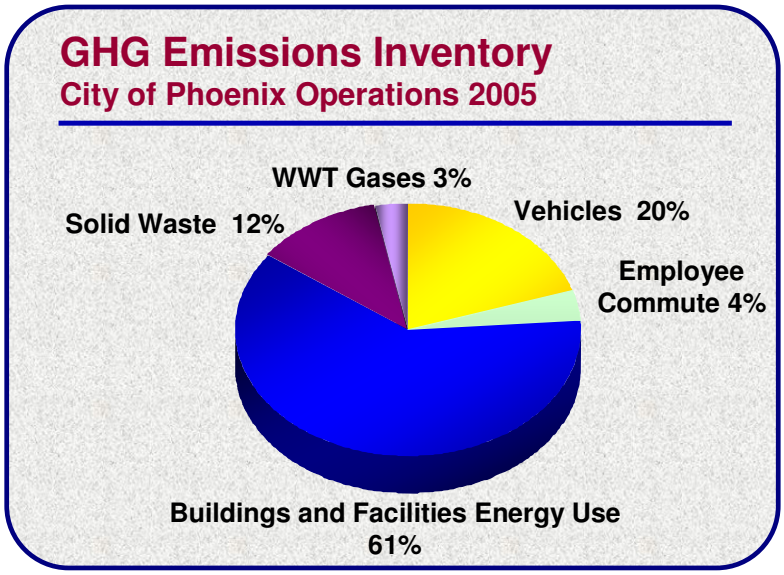
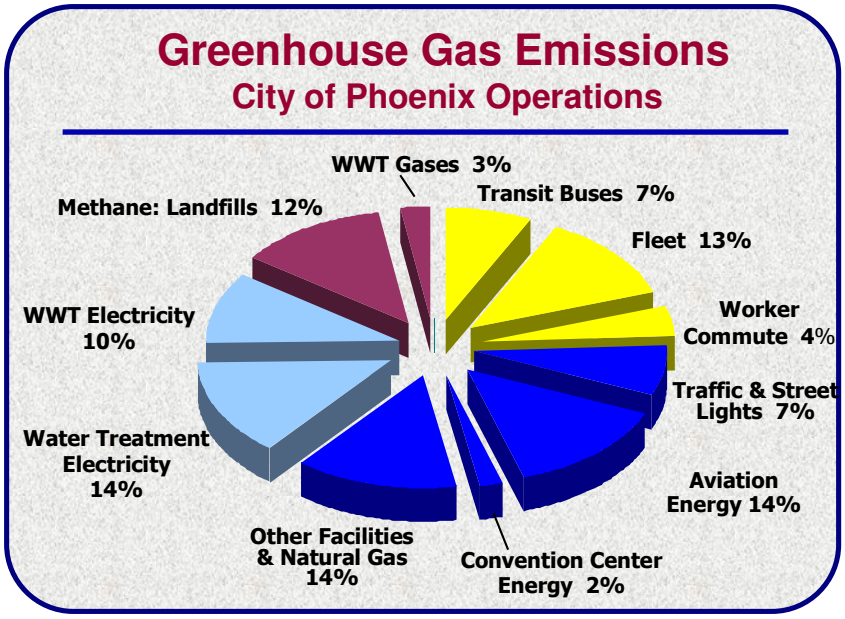


Figure 2 provides more detail on the emissions from energy use and fleet vehicles. Electricity used in the treatment of drinking water and wastewater combined contributes approximately 24 percent of the total emissions while energy use in all other buildings and facilities contributes 37 percent. Transit buses contribute 7 percent compared to all other vehicles in the fleet which contribute 13 percent.

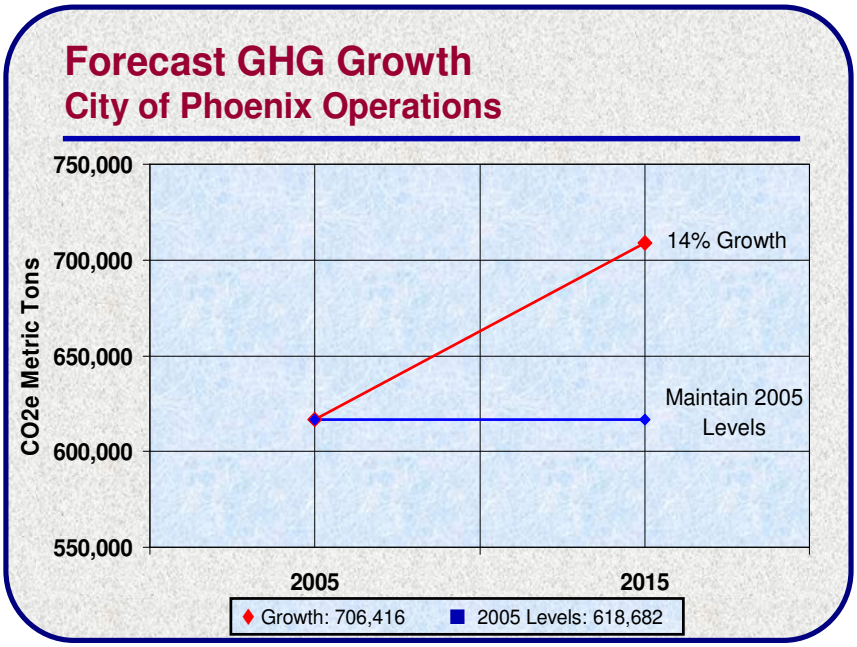
Figure 2. Detailed GHG Emission Sources



GHG Emissions Growth Forecast for 2005 - 2015: The GHG forecast is used to predict future emissions based on a No Action scenario which assumes the city would not implement new or expanded programs. GHG emissions were forecast for 2015 because this year allows adequate time to estimate probable growth trends. Estimates of energy needs, population growth, and other key factors beyond 2015 were considered to be overly speculative.

Under the No Action scenario, the GHG emissions from city operations are expected to increase from 618,682 metric tons CO_2e in 2005 to 706,416 metric tons CO_2e in 2015 (Figure 3). This is an increase of 87,734 metric tons CO_2e or approximately 14 percent.

Figure 3. Forecast GHG Emissions



It is important to note that this GHG emissions forecast is highly dependent upon estimates of future growth. For example, the forecast assumes a core energy use growth rate of 1.5 percent per year for WWT and water processing. If the actual average growth rate were 2.0 percent per year through 2015, the total GHG emissions for city operations would increase to more than 715,000 metric tons CO_2e.

4. GHG REDUCTION GOAL

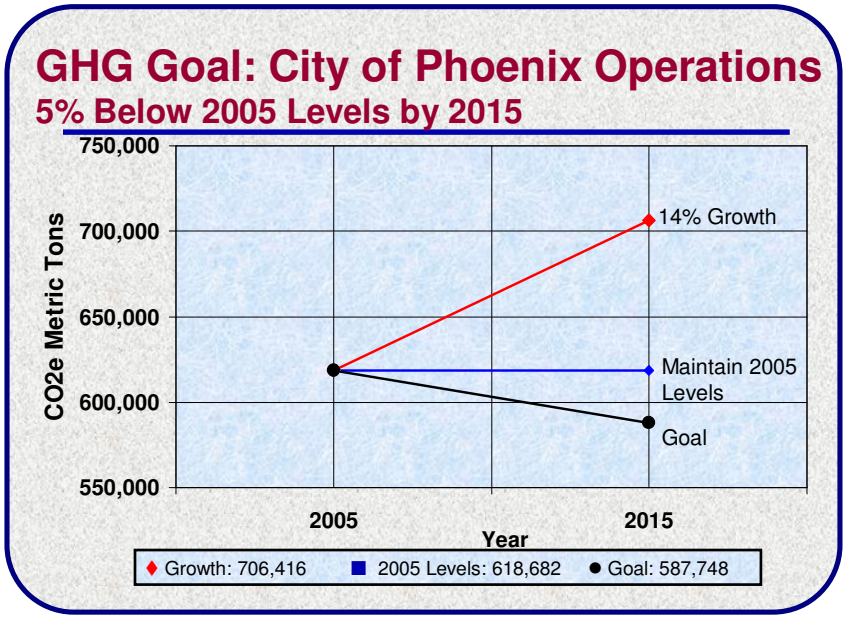
The selection of a GHG emission reduction goal can be a complex issue for any organization. Because the City of Phoenix is one of the fastest growing areas in the nation, the goal must recognize the challenges of providing services for an increasing population. Some cities have selected a longer term aspirational goal as the first step in the process, followed by an emissions inventory and identification of measures necessary to meet the goal. Others choose to start with the emissions inventory and review of feasible measures before selecting a reduction goal.

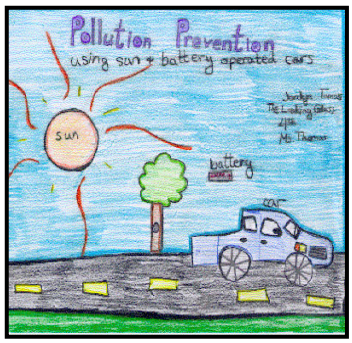
After consideration of several approaches, the Phoenix City Council approved funding to conduct a comprehensive emissions inventory and develop an Action Plan with a goal that is based on realistic but challenging GHG reduction measures. In December 2008, the Phoenix City Council adopted Resolution Number 20759, which states the city's goal to:

Reduce GHG emissions from city operations to 5 percent below the 2005 levels by 2015.

Because the GHG emissions were expected to increase by 14 percent from 2005 to 2015, the city will actually need to reduce emissions by 19 percent from the 2015 levels to first overcome the GHG growth and then achieve an additional 5 percent below the base year of 2005.

Figure 4. City of Phoenix Operations: GHG Reduction Goal





5. GHG REDUCTION MEASURES OVERVIEW

The GHG reduction measures presented in this Action Plan were developed from a review of the city's sustainability programs, options for new or enhanced programs, measures used by other cities, and discussions with key department staff and management. These GHG reduction measures were selected based upon their ability to provide cost effective and measurable GHG reductions over time.

The preliminary list of measures was originally reported to the City Council in December 2008. Although this Action Plan includes minor changes and reorganization of the measures, the final list of measures provide adequate GHG reduction to meet the adopted GHG reduction goal.

This Action Plan is being prepared at a time of great fluctuation in the national and local economy. The GHG reduction measures included in this plan were finalized after the city budget cuts of $156 million were implemented early in 2009. Additional budget cuts may be necessary in fiscal year 2009/10. Conversely, new federal funding has become available for a wide range of transportation and energy programs and the city is actively developing proposals to compete for those funds. If funded, these projects may achieve additional GHG emission reductions. The impact from those projects will be included in future updates to this plan.

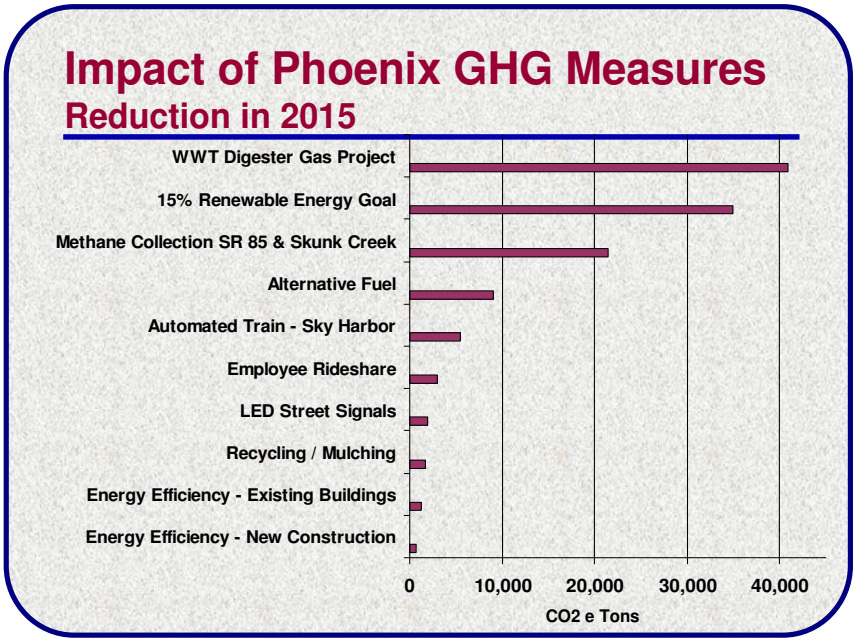
Climate Action Plan Measures and GHG Reduction Estimates: The city identified ten GHG reduction measures that will be implemented to reach the adopted goal. These measures are grouped into three sectors that reflect the major sources of GHG emissions identified in the emissions inventory: energy use, transportation, and solid waste. The measures under each sector are listed below. The sectors have been consolidated from the five sectors in the emissions inventory.

Table 1. Summary of Measures

• **Energy Efficiency & Renewable Energy (EN)**	**GHG Reduction CO_2e metric tons**
EN-1: WWT Digester Gas Projects (91st and 23rd Avenue plants)	40,916
EN-2: Renewable Energy Goal (15% renewable by 2025)	35,000
EN-3: Energy Efficient Traffic Signals	1,885
EN-4: Energy Efficiency: Existing Buildings	1,215
EN-5 Energy Efficiency: New Construction	697
• **Transportation (TR)**	
TR-1: Alternative Fuels: Bio-diesel & Ethanol	9,028
TR-2 Automated Train at Sky Harbor Airport: Phase I	5,519
TR-3 Employee Rideshare Program	3,019
• **Solid Waste (SW)**	
SW-1: Methane Collection at Landfills (SR-85 & Skunk Creek)	21,432
SW-2 Green Waste Mulching & Recycling	1,717
Total GHG Reduction	**120,428**

The measures in this plan are expected to reduce GHG emissions by 120,428 metric tons CO_2e achieving an estimated 5.3 percent reduction from the 2005 levels. The relative GHG reduction for each measure is shown in Figure 5. The top three projects will be responsible for reducing GHG emissions by 97,347 metric tons CO_2e, or 81percent of the total GHG reductions in the Action Plan. These include the WWT digester gas projects, the renewable energy goal, and the enhanced methane collection systems at the Skunk Creek and 27th Avenue landfills. Future updates to this plan may also include renewable energy projects for SR-85 Landfill and additional solar projects.

Figure 5: Impact of Phoenix GHG Measures



The GHG reduction measures are described in the following sections of this report. As discussed previously, the measures represent only a portion of the city's wide range of GHG reduction/sustainability programs. These measures will be used to evaluate progress toward achieving the adopted GHG reduction goal.

6. ENERGY EFFICIENCY & RENEWABLE ENERGY (EN)

This section describes the energy efficiency and renewable energy measures to reduce (or off-set) the GHG emissions associated with electricity and natural gas used to operate city buildings and facilities. The estimated 79,713 CO_2e ton reduction from these measures represents 66 percent of the total reductions in this Action Plan.

EN-1. Wastewater Treatment (WWT) Digester Gas Projects: The 91st Avenue and 23rd Avenue WWT plants currently capture methane generated in the treatment process. The methane is combusted in flares at these facilities. In 2008, the city issued a request for qualifications (RFQ) to solicit projects that could use this methane to produce electricity or substitute for natural gas. The GHG reduction from this measure comes from displacing the electricity or natural gas used elsewhere with the methane generated fuel from WWT process.

- ***Cost Information:*** Cost information is pending and will be available after the bid process is complete. This measure may not require specific city funding to construct and operate the system, but additional staff may be necessary for project management.

- ***Greenhouse Gas Reduction Potential by 2015:*** 40,916 metric tons CO_2e.

- ***Assumptions:*** This measure assumes the implementation of successful projects to use an estimated 3.2 million cubic feet per day of methane from the WWT plants to produce electricity or to replace natural gas. This is equal to the amount of methane flared at the 91st Avenue and 23rd Avenue WWT plants in 2007.

  Note: An additional 0.31 million cubic feet per day of the methane generated in the WWT process at the 91st Avenue WWT plant was used on site to operate the boilers for heating the digesters. This methane is not included in this measure because the system has been in operation before the 2005 baseline year.

EN-2. Renewable Energy Goal: In 2008, the City Council approved a Renewable Energy Goal that 15 percent of the total energy-use in municipal operations would be generated from renewable sources by 2025. This includes gas-to-energy projects at 27th and Skunk Creek landfills and undefined solar projects. In these renewable energy projects, the city may be the owner, a partner, or a sponsor.

The city is also pursuing additional renewable energy projects that were not considered during the adoption of the Renewable Energy Goal. If these projects are successful, they will be addressed in future updates to this Action Plan.

- ***Cost Information:*** The landfill gas-to-energy projects are not expected to require additional funding. By 2015, the annual costs are currently estimated to be $15,300 for solar agreements, based on a $0.03/kWh premium for solar.

- ***Greenhouse Gas Reduction Potential by 2015*****:** 35,000 metric tons CO_2e.

- ***Assumptions:*** This measure assumes displacing approximately 61,295,474 kWh of electricity with renewable energy. The specific combination of projects may vary in the future, but this measure assumes a landfill gas-to-energy project at Skunk Creek and 27th Avenue landfills and a variety of solar projects.

EN-3. Energy Efficient Traffic Signals: The use of energy efficient traffic signals can reduce energy consumption and associated GHG emissions. Traffic signals include traffic and pedestrian control signals at street intersections.

The city has been implementing a phased program to replace incandescent traffic signals with more efficient Light Emitting Diode (LED) technology. The city also requires the use of LED signals for new intersections or when an existing intersection is modified. Based on current funding levels, the complete replacement of all incandescent traffic signals is expected to be completed by 2025 - ten years beyond the scope of this Action Plan. This measure evaluates the GHG reduction from the portion of the project that will be completed by 2015.

The Street Transportation Department is currently evaluating options for additional energy savings through the use of induction and LED street lighting (street lights and signs). Future updates to this Action Plan will address these programs as the testing of more efficient street lighting evolves past the pilot phase.

- ***Cost Information:*** The LED traffic signals cost between $10,100 and $11,300 per intersection (parts & labor including pedestrian walk/don't walk signals). Funding for the equipment is currently available through the Public Works - Energy Conservation Fund with a portion of the funding for pedestrian traffic signals comes from the 2006 municipal bond program. This measure assumes that funding and staff resources are maintained at current levels.

- ***Greenhouse Gas Reduction Potential by 2015:*** 1,885 metric tons CO_2e.

  Assumptions: This measure assumes that the traffic and pedestrian signals at approximately 40 percent of the street intersections will be converted to LED traffic signals between 2005 and the 2015 goal year and that the electricity use at each of these intersections will be 54 percent less than the electricity use by the same signals in 2005.

EN-4. Energy Efficiency in Existing Buildings and Facilities: Since the early 1970's, the City of Phoenix has implemented a wide range of projects to improve energy efficiency and conservation in buildings, city parks, drinking water treatment and WWT systems, and other facilities. The city's unique Energy Savings Reinvestment Fund (Energy Conservation Fund) provides funding for energy efficiency retrofit projects including heating, ventilation and air conditioning, lighting retrofits, energy efficient pumps for the water distribution systems and public pools, and LED traffic signals. The fund is managed by Public Works Department and projects are conducted with the General Fund departments, the Water Services Department, and the Phoenix Convention Center.

Improved energy efficiency is also achieved through the Environmentally Preferable Products program which adds contract bid specifications to require environmentally sustainable equipment that has been certified by Energy Star, Electronic Product Environmental Assessment Tool or other certification program. Examples include computers, monitors, copiers, and other general appliances used in city operations. Products continue to be added to the list. The GHG reductions from this program are not included in the emission reduction calculations for this measure because accurate data is not currently available. Future updates to this Action Plan may address these programs.

The Aviation Department has implemented a wide range of energy efficiency and conservation measures including upgraded air conditioning units, lighting and other energy improvements. In addition, the department has created a Sustainability Fund that is currently used to support an energy audit of Terminal 4 at Sky Harbor airport to document current operational systems and identify initial energy conservation opportunities. The fund will support other projects in the future.

- ***Cost Information:*** This measure includes annual funding of approximately $150,000 in the Aviation Department Sustainability Fund and $1.5M from the Energy Conservation Fund which is supported by the General Fund, Water Services Department and the Convention Center.

- ***Greenhouse Gas Reduction Potential by 2015:*** 1,215 metric tons CO_2e.

- ***Assumptions:*** This measure assumes that a reduction of 1.5 percent of 2005 electricity use can be achieved in approximately 60 percent of the buildings managed by the Public Works Department. (A list of these buildings can be found in the emissions inventory supporting documents). Implementation of this measure also assumes that Aviation will achieve a 1.0 percent reduction in energy use compared to 2005, based upon ongoing equipment replacements and projects.

EN-5. Energy Efficiency for New Construction: Energy efficiency is an important consideration in the design of new buildings and facilities. In the city of Phoenix, new construction is managed by three departments. Engineering and Architectural Services Department (EAS) manages the construction of building projects funded by the General Fund and municipal bonds. The Aviation and Water Services departments are fee-supported "Enterprise" departments that manage their own construction projects.

The GHG reduction estimates of this measure include only the expected impact from EAS-managed projects because that program is more clearly defined. The Aviation and Water Services programs are discussed briefly below but the impact from those programs will be calculated in future updates to this plan.

The construction projects managed by the EAS Department are constructed in compliance with the EAS Building Standards Manual which includes a goal that buildings meet the basic Leadership in Energy and Environmental Design (LEED) certification standard. Updates to the manual in 2006 added a requirement for new buildings to achieve at least two LEED points for energy performance. This is expected to result in an energy savings of approximately 14 percent when compared to national building code standards (ASHRAE/IESNA Standard 90.1-2004).

The Aviation Department has included energy efficiency features in new construction at the airport terminals and other facilities. The automated train stations for the airport are being designed to (LEED) standards. The department will also consider the feasibility of using the energy standards in the EAS Building Standards Manual for design of future building construction.

The Water Services Department evaluates energy efficiencies and energy use avoidance as part of designing, constructing, and operating new facilities. Motors and pumps are carefully sized to minimize energy use. Where a large spectrum of service is needed, variable frequency drives are used to operate the equipment in the most efficient manner. The department also adapts operations to take advantage of time-of-day electrical rates to minimize the impact on the electric utility service and reduce cost. The Water Services Department has also created a Green Team that will consider energy conservation options in new WWT and water treatment processes and buildings. The department will also consider the feasibility of using the EAS Building Standards Manual standards in design of new administrative and other buildings. The water energy efficiency projects are not included in this plan because adequate data is not available to calculate the GHG reduction impact. New water treatment and WWT energy efficiency projects may be included in future updates to the plan.

- ***Cost Information:*** New construction projects managed by the EAS department are supported by the 2006 municipal bond program. The budget estimates for these projects included an additional 2 percent for the cost of meeting the enhanced LEED standards. This small cost premium has been shown to reduce the operating costs of facilities over time. Based on this success, this premium is likely to be included for buildings constructed under future bond programs.

- ***Greenhouse Gas Reduction Potential by 2015*:** 697 metric tons CO_2e.

- ***Assumptions:*** The emissions inventory estimates that energy use in buildings and facilities will increase by 1 percent per year. This measure assumes that approximately half of that growth will come from the energy used in new buildings constructed under the 2006 municipal bond program. This measure assumes that these buildings will achieve 14 percent better energy efficiency – consistent with the intent of the LEED energy standards in the EAS Buildings Standards Manual.

7. TRANSPORTATION (TR)

The transportation measures in this section includes alternative fuels, the automated train at Sky Harbor airport, and an employee rideshare program. These measures are expected to reduce GHG emissions by 17,566 metric tons CO_2e by 2015, representing a 15 percent of the total reductions in the Action Plan.

TR-1. Alternative Fuels: The city operates one of the largest alternative fuel fleets in the nation with approximately 2,900 vehicles using CNG, LNG, ethanol flex-fuel, or electric hybrid technology. The alternative fuel measures below focus on the transition to biodiesel and the expansion of the ethanol because those fuels are expected to experience the greatest increase during the 2005-2015 timeframe.

TR-1.a. Biodiesel: In November 2007, after a successful pilot program, the city started using a blend of 80 percent diesel and 20 percent biodiesel (B-20) in the non-transit vehicle fleets and diesel equipment.

Because biodiesel is produced from plants that absorb CO_2 during their life, the use of biodiesel does not add new carbon to the atmosphere - therefore reducing GHG emissions compared to fossil fuels. It is important to consider the source of the biodiesel because some fuel crops can have significant environmental and social impacts. Therefore, city staff carefully selects the bio-diesel supplier to ensure the fuels meet stringent state quality standards and minimize energy used in production and other adverse impacts.

- ***Cost Information:*** The biodiesel program costs approximately $100,000/year - based on costs of $0.01 to $0.02 per gallon more than diesel fuel.

- ***Greenhouse Gas Reduction Potential by 2015:*** 5,752 metric tons CO_2e. The emissions from N_2O and CH_4 were not included because they are dependent on vehicle type, and are minimal compared to CO_2.

- ***Assumptions:*** The energy savings and emissions reduction are calculated based on the use of B-20 in non-transit diesel vehicles and equipment. The emission calculation includes a 2 percent reduction in fuel energy density for the biodiesel.

TR-1.b. Ethanol (E-85): The city currently owns flex-fuel vehicles that are capable of using a blend of 85 percent ethanol (E-85). However, the vehicles are currently operated on gasoline because of the limited access to the fuel and the lack of E-85 compatible fuel tanks. This measure includes the continued purchase of flex-fuel vehicles and the construction of four E-85 compatible fuel tanks to fuel approximately 500 vehicles by 2015.

- ***Cost Information:*** This measure assumes that there is no incremental cost difference for flex-fuel vehicles.

  E-85 Fuel Cost: Although E-85 fuel costs have been lower than gasoline, ethanol has approximately 28 percent lower energy density. As a result, more fuel is required to travel the same distance. Therefore, the Public Works Department has planned for an additional cost of approximately $115,000/year.

  E-85 Fuel Tanks: Public Works plans to install approximately three new E-85 fuel storage tanks and Aviation plans to upgrade one fueling site to handle E-85 fuel. This measure assumes that the average cost of the new tank installation will be approximately $175,000 each by 2015.

- ***Greenhouse Gas Reduction Potential by 2015:*** 3,276 metric tons CO_2e. The emissions calculation accounts for the 28 percent decrease in energy density noted above. The emissions from N_2O and CH_4 were not included because they are dependent on vehicle type, and are minimal compared to CO_2.

- ***Assumptions:*** 500 vehicles operating on E-85 fuel by 2015.

TR-2. Automated Train at Sky Harbor Airport: This measure assumes that Phase I of the automated train at Sky Harbor airport will be completed to provide service from the Light Rail to Terminal 4 by the goal year of 2015. The GHG reductions are based upon the elimination of 29 CNG buses currently providing service to the long-term and employee parking lots. Because Phase II of the automated train (service to Terminals 2 and 3 as well as the consolidated rental car facility) is currently scheduled for completion in 2020, the emission reductions are not included in this Action Plan.

- ***Cost Information:*** This measure is currently funded.

- ***Greenhouse Gas Reduction Potential by 2015:*** 5,519 metric tons CO_2e.

- ***Assumptions:*** The GHG emissions reduction associated with this measure is based on eliminating 29 CNG-fueled buses from the 36 buses in the Aviation fleet. These calculations also assume that the electricity for the automated train energy is included within the one percent electricity growth rate predicted for the Aviation buildings.

TR-3. Employee Rideshare Program: The city's travel reduction program includes carpool parking subsidies, free bus/light rail passes for employees, emergency ride home cab vouchers, telecommuting, bicycle facilities, and other incentives.

- ***Cost Information:*** This measure assumes current funding is maintained for bus/light rail passes, and other program costs. Increased funding may be needed in the future but has not been assumed in this measure.

- ***Greenhouse Gas Reduction Potential by 2015:*** 3,019 metric tons CO_2e.

- ***Assumptions***: This measure assumes that the city will increase the participation in the travel reduction program from approximately 30 percent in 2005 to 40 percent in 2015. The calculation is based on the number of city staff who work at sites with 50 or more employees; consistent with the regional rideshare program.

8. SOLID WASTE (SW)

The solid waste measures discussed below will achieve an estimated 23,149 CO_2e metric ton reduction in GHG by 2015. This represents 19 percent of the total reductions in this Action Plan.

Renewable energy projects which use the emissions from landfills are discussed in the Renewable Energy Goal measure (EN-2).

SW-1. Methane Capture at Landfills: This measure includes enhanced methane collection systems at two landfills: Skunk Creek and SR-85. The GHG impact from this measure is based on the incremental improvement for the methane collection efficiency which goes beyond the industry standard.

Skunk Creek Landfill was closed in December 2005. In 2006, the final cap was installed and the methane collection system was expanded – resulting in increased methane collection efficiency from a baseline of 50 percent in 2005 to 85 percent. This exceeds the 75 percent methane collection rate that is used as the industry standard default value from EPA models. This incremental increase from 75 to 85 percent efficiency in the landfill methane system provides the basis for the GHG reduction achieved by this measure. The improved efficiency from 50 percent to 75 percent is included in the 2015 Forecast for the No Action scenario.

The SR-85 Landfill opened in January 2006 as the Skunk Creek Landfill closed. The methane collection system is designed to achieve an estimated 90 percent methane capture rate. This exceeds the 75 percent methane capture rate that is used as the industry standard default value in EPA models. This incremental increase from 75 to 90 percent efficiency provides the basis for the GHG reduction achieved by this measure.

- ***Cost Information:*** Assumes no incremental cost for the continued installation and operation of the methane collection system at the SR-85 landfill and operation of the expanded system at the Skunk Creek Landfill.

- ***Greenhouse Gas Reduction Potential by 2015:*** 21,432 metric tons CO_2e.

- ***Assumption:*** The GHG reduction from this measure includes the improved methane recovery at two landfills:

  Skunk Creek: Emissions reductions are based on improved methane collection efficiency from the industry standard of 75 percent to the 85 percent achieved by improvements to the system completed in 2006, as discussed above.

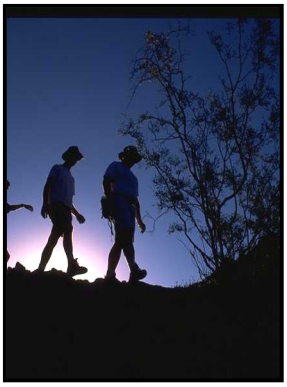
SR-85: Emissions reductions are based on the incremental improvement in the methane collection efficiency from the industry standard of 75 percent to the 90 percent achieved by the system at this new landfill, as discussed above.

SW-2. Green-Waste Mulching & Recycling: Mulching and recycling programs divert waste from landfills and reduce the volume of organic materials that generate methane emissions. The city provides green waste mulching services through a contractor at the 27th Avenue Transfer Station where 15,616 U.S. tons of green waste were mulched in 2005. The mulching services contract includes funding for up to 25,000 U.S. tons annually and this level is expected to be reached in 2009 and continue through 2015.

The city also provides citywide residential curbside recycling services for the collection of glass, metal, plastic, cardboard, and paper. This program was initiated in the early 1990s. The program is not included as a GHG reduction measure because the curbside recycling collection rates are expected to remain generally consistent through 2015.

- ***Greenhouse Gas Reduction Potential by 2015:*** 1,717 metric tons CO_2e.

- ***Assumptions:*** This measure assumes that green waste mulching will increase from 15,616 U.S. tons in 2005 to 25,000 U.S. tons in 2009 and continue at that level through 2015 (an increase of 9,384 tons per year).



9. CONCLUSION

Climate change is an issue of growing concern for communities across the United States and around the world. The City of Phoenix has displayed leadership and foresight in choosing to confront this issue now. By reducing the amount of greenhouse gases emitted in city operations, Phoenix joins other cities around the world taking early action to address global warming and the associated risks, such as increasingly severe weather events, disrupted water and agricultural systems, and rising sea levels.

The measures in this Action Plan are expected to reduce GHG emissions in Phoenix's government operations by 120,428 metric tons CO_2e in 2015, which will achieve the GHG reduction goal of 5 percent below 2005 levels by 2015.

As this plan was being finalized, the city was actively seeking new federal funds to support additional renewable energy projects, expanded energy efficiency projects, and support for alternative fuels. These new programs may provide additional GHG reductions.

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