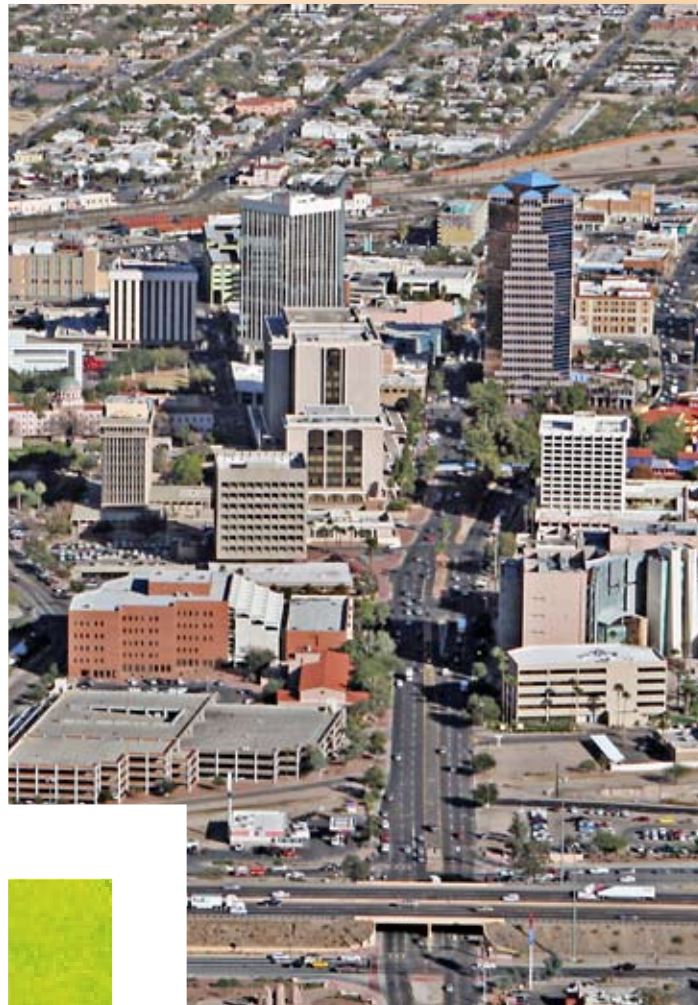




ACTION for a Better Future

CLIMATE MITIGATION REPORT – RECOMMENDATIONS



City of Tucson Office of
**CONSERVATION AND
SUSTAINABLE DEVELOPMENT**

December 2011

Table of Contents

Acknowledgements	II
Executive Summary	1
Section 1: Greenhouse Gas Emissions in Tucson	6
Section 2: Climate Vulnerability in Tucson	7
Section 3: Previous and Current Efforts to Reduce Greenhouse Gas Emissions	9
Section 4: Developing the Phase One Recommendations	14
Section 5: Phase One Recommendations	
Core Phase One Strategies	17
Carbon Reducing Land Use and Transportation Strategies	25
City Leadership and Increasing Efficiency	28
Attachment A: Draft Tucson Water climate vulnerabilities	
Attachment B: Draft Resolution Supporting the Establishment and Efforts of the Western Regional Climate Adaptation Planning Alliance	

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EXECUTIVE SUMMARY

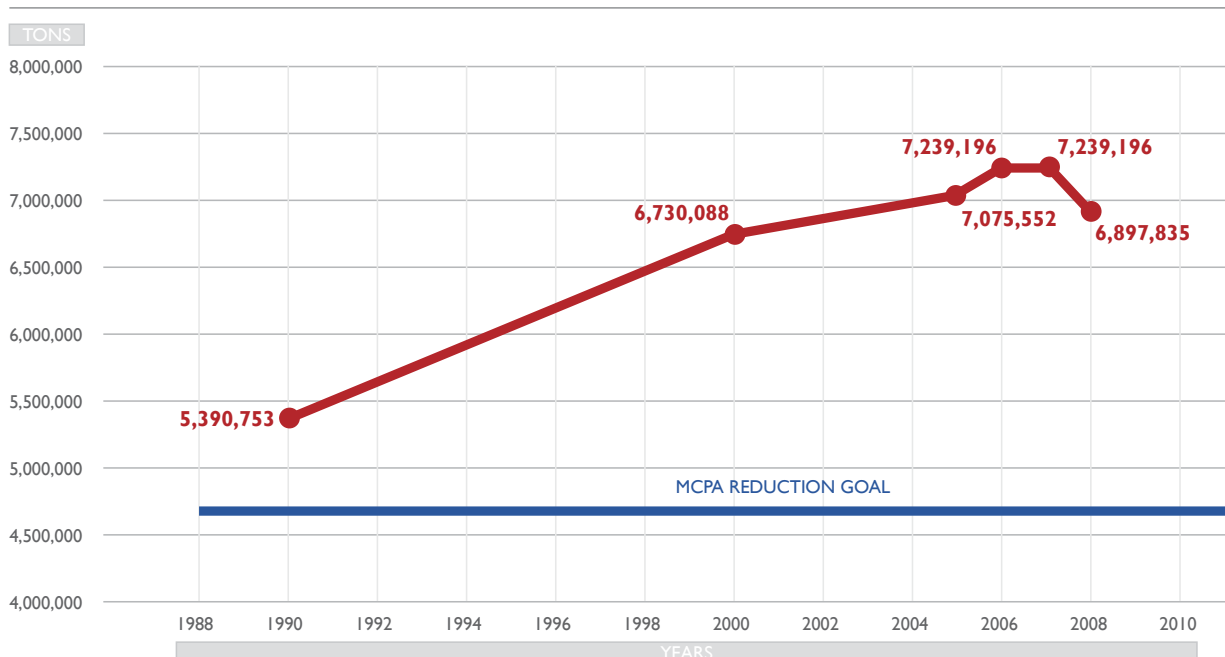
Introduction

The Mayors' Climate Protection Agreement (MCPA) was adopted by Mayor and Council in 2006 and re-affirmed in 2008 (Resolutions 20443 and 21012). In 2008, Mayor and Council also created a Climate Change Committee (CCC) to advise staff on implementation of the MCPA. Following more than two years of research and analysis, the CCC is submitting a set of Phase One recommendations for implementation beginning in 2012. These Phase One recommendations represent a small percentage of the action that is needed to achieve the MCPA goal and will be followed with additional phases of recommendations.

Greenhouse Gas Emissions in Tucson

The MCPA calls for a reduction in City and community-wide greenhouse gas emissions to 7% below 1990 levels. From 1990 to 2008, the greenhouse gas emissions in Tucson have risen from about 5.4 million tons to almost 6.9 million tons (see Figure 1). This 28% increase in Tucson greenhouse gas emissions compares to a 47% increase in emissions within Pima County as a whole and 14% nationally.

FIGURE 1: Tons of Greenhouse Gases Emitted in Tucson



Climate Vulnerability in Tucson

When the Mayor and Council re-adopted the MCPA in 2008, they also decided that the City should undertake climate adaptation planning. While mitigation planning focuses on reducing community greenhouse gas emissions, adaptation planning centers around an assessment of the vulnerability of people, the built environment, and natural systems to future climate changes that are projected based on past levels of emissions.



Tucson, situated in the hot and arid Desert Southwest, is particularly vulnerable to climate change. People, plants and wildlife already exist close to their physiological limits with respect to heat and dryness. Reducing the community's climate vulnerability is essential to protecting the health and safety of our residents, preserving the integrity of City infrastructure, maintaining the efficiency of building stock, and taking advantage of economic opportunities associated with a changing climate. Reducing climate vulnerability also requires increased access to resources so that residents have the capacity to adapt to (i.e., prepare for and respond to) future climate changes and, as a result, is strongly aligned with economic development strategies that decrease unemployment and increase wages.

Previous and Current Efforts to Reduce Greenhouse Gas Emissions

Between 2000 and 2008, overall City government emissions dropped by 6 percent, showing substantial reductions in building energy use (32 percent), employee commuting (29 percent) and fleet emissions (28 percent). This reflects the City's commitment to resource efficiency in facilities and operations. The City is not alone in their efforts to address energy and climate issues, however. The University of Arizona has adopted a carbon-neutral policy and is undertaking climate mitigation planning. Local businesses, such as Raytheon, and the Davis-Monthan Air Force Base have made significant strides in reducing their carbon footprint. Climate action planning is also a priority for other Arizona cities such as Flagstaff and Phoenix.

Developing the Phase One Recommendations

The Climate Change Committee (CCC) created in 2008 was charged to “develop a Climate Change Mitigation and Adaptation Plan including recommendations to achieve the City's greenhouse gas reduction commitments along with strategies and steps needed to prepare for the direct and indirect effects of climate change on the City's infrastructure and operations, as well as its ecological, economic and social capital.”

The CCC, with assistance from a University of Arizona climate change study and Westmoreland Associates consultants, reviewed over 150 potential mitigation measures and analyzed the more than 60 of those measures that seemed applicable to Tucson. The Westmoreland analysis resulted in 36 greenhouse gas reduction strategies. One of those strategies has been dropped from consideration because of its infeasibility. Another, pertaining to funding the climate program, has been tabled for discussion until after this report was submitted to Mayor and Council.

The 34 recommendations in this report are a first step toward improving the efficiency of our community, reducing energy and water use, lowering utility costs, improving air quality, and reducing our contribution to levels of atmospheric greenhouse gases. During preliminary outreach, some stakeholders expressed concerns about additional regulations. These recommendations reflect that concern, but in turn, rely on the community and businesses to take real action on their expressed commitment to making these improvements in our community.

Phase One Recommendations

The recommendations in this report include: (1) core Phase One strategies, (2) voluntary goals for community action, (3) voluntary improvements to new construction, (4) carbon-reducing land use and transportation policies, and (5) goals for increased City leadership and efficiency. Core Phase One strategies are largely outreach and education programs, so they are proposed here as the primary mechanism for encouraging achievement of the voluntary community (#2) and new construction actions (#3).

Core Phase One Strategies: (9% of MCPA Goal)

These strategies are being recommended for implementation by the City of Tucson.

- Climate Challenge for Business Program
- Community Climate Challenge Program
- 2012 International Energy Conservation Code (IEEC)
- Vehicle Maintenance and Driver Behavior Education Program

The four core Phase One mitigation strategies recommended in this report are expected to achieve 9% of the MCPA emissions reduction goal (see Figure 2).

Voluntary Goals for Community Action: (31% of MCPA Goal)

Specific goals for voluntary community action have been identified as important elements in meeting the MCPA emission reduction goal. These goals relate to community investment in existing homes and businesses in:

- Commercial Photovoltaic (PV)
- Smart Meters in existing Commercial Buildings
- Improved Residential Energy Efficiency
- Residential PV
- Residential Solar Thermal
- Energy Star Air Conditioners
- Residential Smart Meters
- Travel Carbon Offsets
- Energy Efficiency Improvements in Rental Housing
- Time-of-Sale Residential Energy Efficiency Retrofits



If these community goals are met, an additional 31.3% of the MCPA emission reduction goal is expected to be achieved.

Voluntary Improvements to New Construction: (10% of MCPA Goal)

Cost-effective improvements in energy efficiency of new construction were identified. Although these strategies can be implemented as regulatory mandates, based on stakeholder input, the Phase One recommendation is for the voluntary installation, in new construction, of:

- Cool/Energy Star Roofing – Residential and Commercial
- Smart Meters in Commercial Buildings
- Commercial Solar Thermal
- Energy Star Air Conditioners in Residential
- Residential Solar Thermal

If there is voluntary compliance, these energy improvements to new construction would contribute another 9.5% toward reaching the MCPA emission reduction goal.

In making this initial phase of climate mitigation recommendations, these first three categories are bundled together. Under the umbrella of the 3 education programs (Climate Challenge for Business, Community Climate Challenge, and Vehicle Maintenance and Driver Behavior Education), the voluntary community action and voluntary improvements to new construction are presented as goals for assessing implementation of the education programs.

Carbon-Reducing Land Use and Transportation Policies: (4% of MCPA Goal)

City policies to promote sustainable land use and transportation can have a significant role in the long-term energy efficiency of the community through their impact on:

- Transit Oriented Development and Urban Infill
- Increased Bike Lane Usage
- Bike-Share Programs
- Car-Share Programs
- Incentives for Zero Emission Vehicles and Plug-In Hybrid Vehicles
- Reduced Vehicle Idling

Although only 4.0% of the MCPA emission reduction goal is expected to result from the policies analyzed in the Westmoreland report relating to promoting bike ridership, sustainable land use, and supporting alternative transportation options in the short-term, the long-term benefit to the community of sustainable land use and transportation policies can be very significant in terms of reduced air pollution, lower fuel costs, increased walkability, more efficient development, reduced greenhouse gas emissions, and other factors.

City Leadership and Increased Efficiency: (1% of MCPA Goal)

The City can both be a positive role model for sustainable operations and demonstrate responsible use of revenues by increasingly improving the efficiency of government facilities and operations through investment in:

- Solar Thermal
- PV
- Energy and Water Efficiency Building Retrofits
- Improved Fuel Efficiency of the Vehicle Fleet
- Efficient Street Lighting

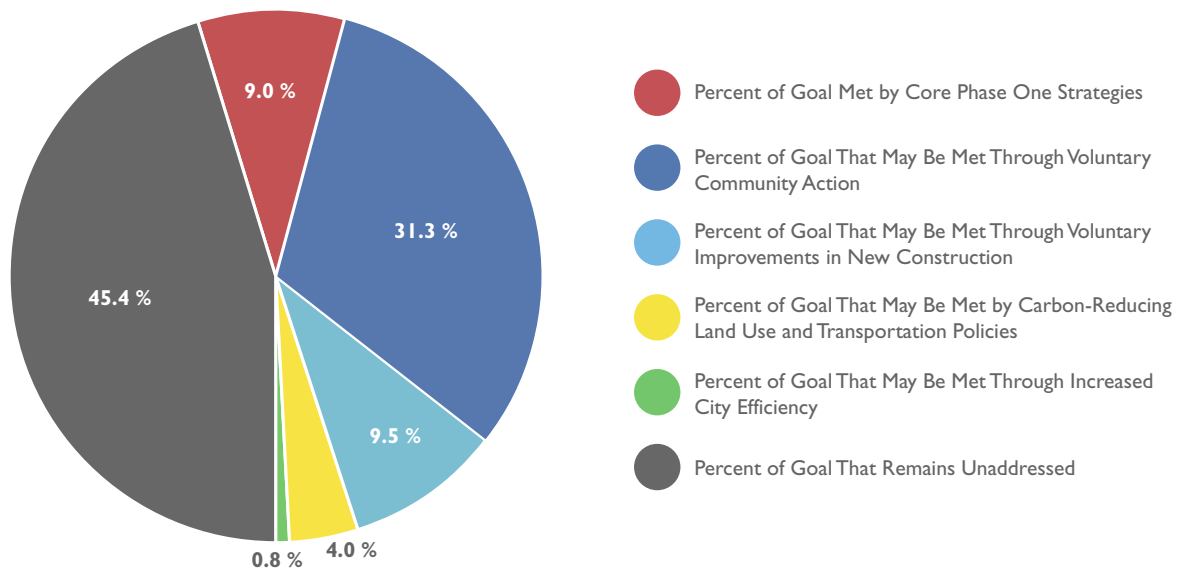
Increased efficiencies in City facilities and operations could meet nearly 1% of the MCPA emission reduction goal. This is a solid contribution considering that the City's emissions make up less than 5% of community-wide greenhouse gas emissions.



RECOMMENDATIONS DELIVER 50% OF THE GOAL:

All of the above strategies combined account for just over half of the MCPA reduction goal. The CCC will continue to work on identifying additional opportunities for efficiency and reduced resource use within the Tucson community.

FIGURE 2: Percentage of MCPA Goal Met by the Recommended Mitigation Strategies



CCC CLIMATE MITIGATION REPORT AND RECOMMENDATIONS

Section 1: Greenhouse Gas Emissions in Tucson

City Energy Use and Greenhouse Gas Emissions

Over the past couple of decades, the amount of energy that was required to operate City facilities, including the City water system, has increased significantly. The cost associated with this energy use has risen dramatically as well. Between 1997 and 2007, energy use in City facilities rose 86%. The corresponding increase in cost was more than 90% and amounted to more than \$5 million. Energy use for water treatment and distribution rose 120% between 1990 and 2007. The cost increase over that time has been more than \$10 million.

City fleet fuel use has only risen slightly between 2000 and 2007; increasing less than 7%. (Data is not available for 1990.) In addition, the City has increasingly shifted from traditional gasoline and diesel to less carbon-intensive fuels such as biodiesel and E-85. City fleet consumption of gasoline and diesel dropped from 2.7 million gallons in 2000 to 1.7 million gallons in 2007. This drop in traditional fuel use was offset by consumption of nearly 1.2 million gallons of alternative fuels. So although City fleet fuel use rose slightly, the greenhouse gas emissions associated with that fuel consumption has dropped by 37%.

Greenhouse gas emissions associated with waste produced during City operations has risen by about 28% between 2000 and 2007; from 2,437 metric tons of carbon equivalents to 3,128 metric tons. (Data is not available for 1990.)

Between 2000 and 2008, overall City government emissions dropped by 6 percent, showing substantial reductions in building energy use (32 percent), employee commuting (29 percent) and fleet emissions (28 percent). The MCPA goal, however, is based on reducing greenhouse gas emissions below 1990 levels. Between 1990 and 2007, greenhouse gas emissions from City electricity and natural gas use rose 53%. The City's emission inventory in 1990, which did not account for fleet, solid waste, employee commuting, or street/traffic lights, showed that the City was responsible for emitting 115,106 metric tons of greenhouse gases. In 2000, the first year for which we have complete data, the City's greenhouse gas emissions totaled nearly 240,000 metric tons. Full emissions in 1990 would have probably been on the order of 180,000 metric tons. A 7% reduction in greenhouse gas emissions below 1990 levels would then be on the order of 12,600 tons. In 2008, the City total greenhouse gas emissions was 221,810 tons. To reach a goal of approximately 167,400 tons (7% below 1990), the City would have to reduce current emissions by 54,410 tons (24.5%).

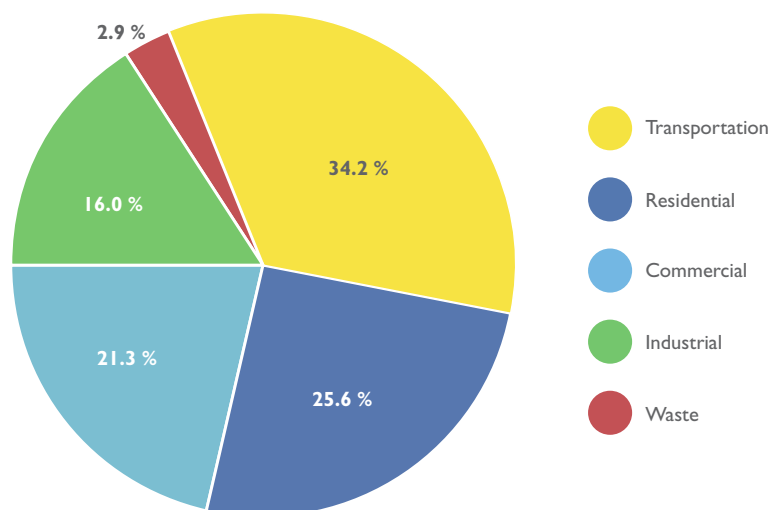
Community Greenhouse Gas Emissions

Between 1990 and 2008, community-wide greenhouse gas emissions have risen 28%, from approximately 5.4 million metric tons to over 6.9 million metric tons. This increase was largely driven by a 40% increase in greenhouse gas emissions associated with vehicle miles traveled (VMT) by private and commercial vehicles, a 39% increase in residential electricity use, and a 58% increase in commercial electricity use. Waste, which is a relatively minor contributor to greenhouse gas emissions in Tucson, did show an increase in associated greenhouse gas emissions of 15%.

These increases were somewhat offset by reductions in residential natural gas use (26%), commercial natural gas use (21%), and reductions in industrial natural gas use (26%). Overall, greenhouse gas emissions in the residential sector have increased by 28%, in the commercial sector by 44%, and in the industrial sector by 2%. Community greenhouse gases, while still rising, did drop from 2007 to 2008, probably at least part due to the economic recession. Greenhouse gas emissions decreased by more than 6% during that period.

Overall, more than a third of all community greenhouse gas emissions are associated with transportation, about a quarter come from the residential sector, almost 40% come from the commercial and industrial sector, and a small amount comes from waste (Figure 3).

FIGURE 3: Tucson Greenhouse Gas Emissions – Percentage by Sector



Section 2: Climate Vulnerability in Tucson

Our region is witnessing some of the most pronounced changes in climate seen in the United States. Between 1976 and 2005, Arizona experienced an increase in average annual temperature of 2.5 degrees F. This increase is more than twice the global average over the same time period and among the highest increases observed in the lower 48 states. The desert southwest is expected to experience a further increase in temperature of 5 to 8 degrees F by the end of the century, given no reductions in global greenhouse gas emissions. Shifts in temperatures are expected to be greater in the summer than in the winter. This increase may be exacerbated by urban heat island effect and can lead to more extreme heat events and more severe droughts. Because of large year-to-year variations, there has been no detectable trend in average annual precipitation during the past three decades. However, given no reduction in global greenhouse gas emissions, southern Arizona is expected to see up to a 10% decrease in annual average precipitation by the end of the century, as compared to the 1970-2000 period.

Climate impacts expected in the southwest will affect key economic drivers and issues of public health and safety. These include impacts to our water resources (increased variability in precipitation, earlier snow melt, and degraded water quality), decreased crop and livestock production (upward pressure on food

prices), increases in flood intensity (infrastructure and ecosystem impacts), wildfires (reduction in air quality and soil stability), and extreme heat events and energy disruptions (impacts on electricity cost and availability). Many of these impacts also have a direct bearing on public health and safety (extreme heat, decreased air quality, flash floods, disease vectors), and our regional economy (water-dependent industries and tourism).

The CCC strongly supports Tucson Water's initiative to address climate impacts to the community's water resources in the Drought and Climate Variability Response and Preparedness Plan. The charter for this project states:

Climate change is already happening and climate scientists have concluded with confidence that past climate patterns and the statistics of climate averages and extremes will no longer serve as valid guidance for future planning. Scientific consensus based on rigorous analysis of observed and projected hydroclimatic factors suggests that climate change within the Colorado River watershed could include but may not be limited to an increase in average surface temperature, spatial changes in annual and seasonal precipitation both in magnitude and intensity, more frequent earlier melting of spring snow packs, increased evaporation, and reduced surface water flows in the Colorado River. The Central Arizona Project (CAP) is currently projecting that a shortage on the Colorado River may occur within the next five years; this would mean that lower priority CAP water users will be curtailed as needed. The Central Arizona Project also predicts that high-priority CAP allocations (Municipal & Industrial [M&I] and Indian) may be reduced beginning in the mid-2020s. In subsequent years, the annual probability of an M&I shortage could increase.

Planners at Tucson Water have been aware of the climate-variability issue for many years. More recently, Tucson Water staff has identified a range of potential future impacts on Utility-related activities. A preliminary list of potential impacts is summarized in Attachment A. Tucson Water has already implemented a number of adaptive actions which will increase its resilience to long-term drought and to reductions in CAP deliveries due to shortages on the Colorado River. These actions as well as future initiatives will provide the Utility with even greater flexibility and adaptive capacity to respond to climate change and its associated uncertainties. Climate scientists are constantly refining predictions and assessments of future climate-related risk. Similarly, governmental agencies on multiple levels have begun developing strategies to minimize the anthropogenic causes of climate variability and to adapt to impacts that may occur over time. Effective action will require greater cooperation and coordination among all sectors.

This long-sighted and proactive approach will be necessary in other areas of City planning and decision-making in order to protect the health and safety of our residents, preserve the integrity of City infrastructure, maintain the efficiency of building stock, and take advantage of economic opportunities associated with a changing climate. It is essential that the City take steps to mitigate and adapt to the anticipated future changes and to those already underway.

The City has existing mechanisms and programs through which sound adaptation planning can occur. One example is the City's Emergency Operations Plan, which is currently being updated. As part of that update, projected climate vulnerabilities and strategies for responding to those vulnerabilities should be taken into consideration and integrated where appropriate. Similarly, climate vulnerability assessments and adaptation strategies should be an integral part of the updated General Plan.

To help create a road map and framework for integrating the consideration of climate change impacts into existing planning mechanisms such as the Emergency Operations Plan, the General Plan, and others, the City's ongoing climate adaptation planning is attempting to "mainstream" climate adaptation factors into City operations and planning. This work, led by a consultant group that assisted with the City of Seattle's adaptation planning, is being conducted in close collaboration with the CCC, researchers at the University of Arizona, and other city and county stakeholders to ensure the issues addressed are those of highest relevance and importance to the community.

This work has just started and is initially focusing on reaching out and gathering input from the above mentioned stakeholders. This input will be used to guide the assessment of the community's vulnerabilities (i.e., those affecting Tucson's citizens and infrastructure). Next, candidate adaptation strategies will be developed that increase the City's resilience to the impacts mentioned above (e.g., extreme temperature events, flooding). These will be evaluated and prioritized based on their effectiveness, both in terms of cost and in reducing risk. Particular emphasis is being placed on addressing climate impacts to disadvantaged segments of the community.

Section 3: Previous and Current Efforts to Reduce Greenhouse Gas Emissions

City of Tucson

Between 2000 and 2008, overall City government emissions dropped by 6 percent, showing substantial reductions in building energy use (32 percent), employee commuting (29 percent) and fleet emissions (28 percent). This reflects the City's commitment to resource efficiency in facilities and operations. Among the initiatives that have resulted in these reductions are the following:

1. In 2006, the City of Tucson adopted a Resolution that all new City facilities, and additions or renovations over 5,000 square feet, would be built to a minimum standard of LEED Silver. In addition, City Design and Construction Standards for City facilities call for 5% of total annual lighting, mechanical system and domestic water heating energy consumption to be offset by the use of solar energy; motion & light sensors and day lighting; waterless urinals and dual flush toilets; Cool or Energy Star roofs; carpeting with recycled content; solar water heating; energy efficient doors, lighting, and cooling towers; and use of permeable concrete where possible. To date, the City has built 9 LEED facilities, 2 of which are rated Gold and another one rated Platinum. The LEED facilities show significant energy efficiency improvements over conventional buildings. The City's LEED facilities are all at least 17% more efficient than baseline and several of the buildings are close to 50% more efficient than baseline.



2. Tucson is one of 25 cities designated as a Solar America City by the U.S. Department of Energy. Clean Renewable Energy Bonds (CREBs) have been used by the City to finance new solar installations. There are currently around 2.2 Megawatts (MW) of photovoltaic (PV) systems at several City of Tucson buildings, and another 2 MW in PV systems are currently under construction. In fiscal year 2011, the City's PV systems produced over 2.5 million kilowatt-hours (kWh) which amounts to an annual savings of nearly \$220,000 and a greenhouse gas emissions reduction of nearly 500,000 tons. The City also has a solar farm in Avra Valley to support the recharge facilities there. The system started commercial operation at the end of February, 2011. To date, it has produced 1,875 kWh. The system is designed to produce about 2,250 kWh in the first year, an amount that it appears the system will actually exceed. Although this project is cost neutral, i.e. the cost of the solar energy is the same as electricity would have been, this project will offset over 4,500 tons of greenhouse gas emissions annually.
3. The City invested a portion of its Energy Efficiency and Conservation Block Grant (EECBG) into several energy efficiency projects. Over \$2 million was allocated to energy and water audits of City facilities and energy efficiency retrofits to streetlights, parking lot lights, the City's data center and servers, water booster pumps, and other facilities. These improvements are expected to save nearly 4 million kWh of electricity every year. Based on an electricity cost of 8.5 cents per kWh, this equates to more than \$330,000 in savings annually.
4. By 2010, almost 30% of City fleet vehicles used alternative fuels (e.g., biodiesel, E-85, CNG, and electricity). City fleet fuel use has increased by just 7% between 2000 and 2007. The City has also increasingly shifted from traditional gasoline and diesel to less carbon-intensive fuels such as biodiesel and E-85. City fleet consumption of gasoline and diesel dropped from 2.7 million gallons in 2000 to 1.7 million gallons in 2007. This drop in traditional fuel use was offset by consumption of nearly 1.2 million gallons of alternative fuels. So, although City fleet fuel use rose slightly, the greenhouse gas emissions associated with that fuel consumption has dropped by 37%.
5. The Sun Tran fleet is completely comprised of buses that run on alternative fuels. The same is true for the Sun Van fleet. Sun Tran also takes advantage of living in sunny Tucson by utilizing solar energy to provide lighting at many bus shelters throughout the community. These shelters reduce the amount of energy needed to provide safe and well lit shelters for passengers.
6. The City adopted a Resource Efficient and Procurement Utilization Policy in 2006 that gives a price preference of 10% for recycled paper, and calls for requiring and enforcing 2-sided copying when feasible, purchasing duplex-capable copy machines when replacing existing machines, printing pamphlets and other materials double-sided on recycled paper, and when purchasing paper, tires, building insulation, plastic products, auto parts, compost material, aggregates, solvents, and rubber products to buy recycled options when feasible.
7. By Administrative Directive, it is City policy that all City offices and facilities recycle those materials which are accepted in the City's recycling program. All City Departments are required to appoint a recycling liaison to coordinate with Environmental Services.



The City will continue to work toward more efficient resource use. The City currently has 3 internal “green teams” working on plans to reduce City energy and water use and improve the resource efficiency of procurement practices. Significant utility and fuel savings can be achieved through behavior modification brought about by employee education. The first education program associated with this effort is an energy efficiency workshop. This workshop can help employees reduce their energy use at work and at home. Workshops for Housing staff and residents of City public housing were held in late November and early December 2011. Additional workshops will be available to all City staff.

There is a backlog of unfunded facilities equipment replacements throughout the City. Replacing equipment with new, more efficient equipment reduces costs and frees that money to be leveraged for further equipment replacement. The General Services Department will be implementing an Internal Performance Contracting program, with seed money from the General Services Internal Fund, to provide an opportunity to capture cost savings and carry a replacement fund across fiscal years. It is estimated that a \$29.5 million investment over 10 years will result in an estimated energy savings of approximately \$42 million in savings over a 22 year period, which equates to \$12.5 million in net savings.

Tucson was selected to be part of the 22-member Climate Resilient Communities Steering Committee to assist ICLEI¹ with the development of a climate adaptation planning framework and tools to guide other municipalities in their adaptation planning. That framework and the first set of tools was piloted in late 2010, with Tucson being one of 8 communities selected for the pilot. Tucson is also part of a ten-city Western Regional Climate Adaptation Planning Alliance, the first multi-state climate adaptation network in the country.



Arizona Town Hall

The climate mitigation actions outlined in this report benefit more than just the Tucson community. Many of the strategies discussed in this report were identified in the 2011 Arizona Town Hall on Arizona’s Energy Future as essential elements to ensuring a safe, reliable, and affordable energy system that is an economic development asset for the State.

The Arizona Town Hall is an independent, non-profit organization that identifies critical issues facing Arizona, creates a forum for education and exploration of the topic and fosters leadership development. By drawing upon Arizona’s diversity of citizens, the Town Hall process promotes public consideration of these issues, builds consensus and supports implementation of the resulting recommendations. Approximately 100 energy policy experts attended the 99th Arizona Town Hall on Arizona’s Energy Future in 2011. These experts included utility representatives, attorneys, construction industry representatives, Arizona universities and colleges, staff from local and State government, and non-profit organizations.

The 99th Arizona Town Hall Report on Arizona’s Energy Future outlines several areas in which local governments could have a role in helping the state transition to a stronger energy future. Community education on the true costs of energy such as associated greenhouse gas emissions, energy conservation, and the importance of renewable energy figured predominately in the Report. Another significant theme is the need to promote energy efficiency in business and residences through

¹ ICLEI is an international association of local governments as well as national and regional local government organizations that have made a commitment to sustainable development.

improved building and appliance standards, energy efficiency retrofits, and increased alternative transportation options. Not surprisingly, the Report also emphasizes the need to increase our use of renewable energy in the State.

Finally, the Report calls for the development of a State energy plan to “create a diverse, sustainable portfolio of energy generation with as close to zero carbon emissions as feasible by mid-century.” The City’s efforts to reduce community greenhouse gas emissions are aligned with and are an important part in moving toward this goal of zero carbon emissions.

University of Arizona

In 2007 The University of Arizona (UA) became a signatory to the American College & University Presidents Climate Commitment and began a planning process to put the UA on a path to carbon neutrality, which complements its excellence in climate science and research. The 2009 update to the UA Comprehensive Campus Plan further reinforces the University’s commitment to environmental sustainability by identifying carbon neutrality as a major campus planning theme. Several UA units are working together to develop a formal plan to reach carbon neutrality by 2050.

Like the City, the UA has adopted LEED silver as a minimum standard for all new buildings and has since earned a LEED platinum rating for the expansion of its Student Recreation Center. Two residence halls completed in 2011 are in the process of being awarded at least a LEED silver.

The UA also has over 820 kW of installed solar PV capacity and is in the process of installing an additional 300 kW. The UA Tech Park partnered with Tucson Electric Power on 3.6 MW of installed capacity, which is planned to grow by an additional 15 MW in the near future.

The University of Arizona established the UA Green Fund in 2010 to fund student- and employee-led sustainability projects, including efforts to reduce the University’s carbon footprint. Funded projects include retrofitting the 2nd Street parking garage with LED lighting that uses 60% less energy and installing 40 kW of donated PV panels at Biosphere 2. The UA is also establishing a revolving fund to invest in larger energy efficiency projects that reduce utility costs.

Other Arizona Cities

Although in June 2006, Tucson became the first Arizona city to sign on to the MCPA, many more are now signatories including Apache Junction, Bisbee, Buckeye, Bullhead City, Flagstaff, Gilbert, Goodyear, Mesa, Oro Valley, Peoria, Phoenix, and Winslow.

In January 2008, Phoenix began a comprehensive effort to develop a Climate Action Plan to reduce greenhouse gas emissions from city operations. In December 2008, the City Council approved a resolution adopting a goal to reduce greenhouse gas emissions from city operations to 5 percent below the 2005 levels by 2015.



Flagstaff has completed a greenhouse gas emissions inventory. Like Tucson, Flagstaff is part of the Climate Resilient Communities Steering Committee, one of the 8 communities selected for the ICLEI adaptation pilot, and is a member of the Western Regional Climate Adaptation Planning Alliance.

In August 2008, the Pima County Board of Supervisors unanimously adopted a Sustainable Action Plan for County Operations. Key elements of this Plan include:

- Develop an anti-idling policy
- Right-size the County fleet (number and size of vehicles; purchase vehicles no larger than necessary to optimize gas mileage)
- Create a Green Bike Program (for localized work trips)
- Purchase hybrid replacement vehicles (vehicles powered by both gas and electricity)
- Expand Driver Energy Conservation Awareness Training (DECAT)
- Expand Trip Reduction Program including exploring all of the following: expanding flex time, installing bicycle racks at all County facilities allowing modification of work locations based on employees' resident location where possible, and adopting a flex parking space program (i.e., reduce the cost of parking passes for those that ride bikes or take the bus most days but occasionally have to drive)
- Develop a comprehensive outfitting guideline and administration procedure for County offices, with the goal of enhancing employee comfort and health, and reducing CO2 emissions
- Sponsor a "Living Building Challenge" competition to achieve a building with net zero energy and water consumption (which exceeds maximum LEED certification levels)
- Create an Energy Conservation & Information Program for Employees that includes: "Energy Champions" for each Department, posting of signage for behavioral reminders ("Turn off lights," etc.), dimmable personal climate devices at work stations, an administrative policy on energy conservation, an energy training program for new and existing staff, and an employee recognition program
- Create an Energy Conservation Program for County Facilities and Programs that includes: a policy of using life-cycle analysis in the procurement and prioritization of energy projects; appointment/ hiring of an energy manager; an Energy Conservation Program for county-funded affordable housing, home replacement, and home repair & weatherization projects; conducting a County wide energy audit, considering the use of performance-based energy management consultants, and exploring the feasibility of HVAC automated telephone dial-in system for employees working evenings and weekends.
- Increase use of Renewable Energy by: emphasizing on-site renewable energy credits in County LEED buildings, soliciting proposals for Renewable Energy Power Purchase Agreements (PPAs), exploring the development of cooperative RFPs with large energy users to take advantage of economies of scale in the purchase of renewable energy, establishing a renewable energy task force to review emerging technologies and assess their value toward meeting the 15% renewable energy goal, evaluating potential methane gas capture projects at Pima County landfills to generate electricity and reduce greenhouse gas emissions.

Most relevant to the City's climate mitigation planning is the County's commitment to complete a greenhouse gas emissions inventory for County operations, establish success indicators and measurable targets for reducing greenhouse gas emissions, update the greenhouse gas emissions inventory on an annual or bi-annual basis, and amend or modify the Sustainable Action Plan, as needed, to achieve the success indicators and target. The County also committed to offering support and assistance to the City of Tucson Climate Change Committee, and evaluating the Committee's future recommendations for possible adoption and action by Pima County.

Section 4: Process of Developing the Phase One Recommendations

The Climate Change Committee (CCC) was charged to “develop a Climate Change Mitigation and Adaptation Plan including recommendations to achieve the City’s greenhouse gas reduction commitments along with strategies and steps needed to prepare for the direct and indirect effects of climate change on the City’s infrastructure and operations, as well as its ecological, economic and social capital.”

The CCC started with an initial list of more than 150 potential mitigation strategies. The committee reviewed this list of strategies and removed those that they felt were not applicable to or were otherwise infeasible for Tucson. The remaining 61 strategies were analyzed as part of a University of Arizona climate study. The University students researched the strategies and developed reports for each measure that discussed where these measures had already been implemented and the results, as well as estimating greenhouse gas emission reduction potential and, where possible, implementation costs.

The CCC reviewed the reports and removed strategies from further consideration if it appeared that the strategies had not been effective in other communities or they did not result in meaningful emissions reductions. During these discussions, a couple of additional strategies were



also added to the list for future evaluation. The resulting set of 54 mitigation strategies was further analyzed by Westmoreland Associates. The Westmoreland Report (http://cms3.tucsonaz.gov/files/ocsd/CMS1_037899.pdf) evaluated each of the strategies and provided more refined calculations of emissions reduction potential, implementation costs, and net savings to the community. The report also discussed where the strategies have previously been implemented and the results, the City’s role in implementation, co-benefits, and possible unintended consequences. Westmoreland combined a number of strategies that were very similar and also eliminated some that had negligible emissions reduction potential; reducing the total number of strategies to 35, plus one additional strategy for funding implementation of a climate mitigation program.

The Westmoreland report used relatively conservative estimates in order to not overstate the effectiveness of the strategies analyzed. For those measures that had been the subject of earlier analysis by the University of Arizona students, Westmoreland validated the assumptions and findings for each. In every instance where confidence was lacking in any assumption, data source, calculation, or implementation scenario they undertook a new analysis of the proposed policy measure.

For new measures submitted for analysis, Westmoreland researched the previous use of these strategies in other communities and then created a scenario under which such a measure might be implemented in Tucson. For all mitigation measures examined, Westmoreland ensured that there were valid and reproducible greenhouse gas savings at the unit level. For example, a technology change such as implementation of a direct load control device, e.g., a smart meter, is expected to result in an average reduction in electricity use and associated greenhouse gas emissions based on empirical findings from other communities where the measure is already in place. From the unit level (one home installing one device) the expected energy and emissions reductions could then be scaled to the level of the implementation scenario chosen for the analysis (i.e. 40% of all homes by 2020).

A time frame for likely implementation of each measure had to be identified. The MCPA calls for the greenhouse emissions reduction goal (7% below 1990 levels) to be met by 2012. Due to the time needed for the deliberative process to take place and conclude in a decision to implement, energy savings, emissions reductions, cost savings, etc. would not even begin to accrue until sometime in 2012. As a result, it was decided to establish a secondary goal, specifically emissions reductions possible in 2020, for purposes of evaluating the mid- to long-term potential of the measures.

The greenhouse gas emissions reduction amount used in the analysis was based on the April 2011 update to Regional Greenhouse Gas Inventory prepared for the City by the Pima Association of Governments (PAG). According to the PAG Inventory, a 7% reduction in GHG emissions below the City's 1990 level (5,390,753 tons) equates to 5,013,400 tons. This became the reduction target for emissions in 2012 in order to meet the MCPA goal. The PAG Inventory was based on data from 2008, so in order to have a more current baseline, Westmoreland forecast the City's emissions in 2012 (estimated to be about 7 million tons). So the amount of emissions reductions sought was the difference between the projected 2012 level and the 7% below 1990 level – or 1,986,600 tons.

Extending the 2012 MCPA goal to 2020, and estimating GHG reductions in 2020, allowed Westmoreland to calculate implementation costs and net economic benefits through 2020. The analysis presented the greenhouse gas savings in 2020 (tons) and economic attributes (US\$/ton of emissions reduction over the life of the analyzed program) of each measure separately.

Westmoreland obtained and used energy, price, and other relevant data that were as locally-specific to Tucson as possible. In some cases, state, national or global data sources were used to inform or validate conclusions reached. However,



whenever possible, regional or national data was customized to the specific circumstances of the City's population, housing stock, commercial and residential construction patterns, land use plans, economic development, and energy prices.

Energy prices were forecast to 2020 using a mix of international, national and local variables, rather than simply extending national price forecasts to Tucson without consideration of historically unique variations in energy costs in the City. For greenhouse gas emissions calculations, the analysis is based on the carbon dioxide equivalent (CO₂e) measure that was initially used in the PAG Inventory. The carbon dioxide equivalent takes into account the emission of greenhouse gases other than carbon dioxide, such as methane, but translates them into equivalents of carbon dioxide based on the extent of their climate warming potential relative to that of carbon dioxide. For example, methane has a warming potential 72 times greater than that of carbon dioxide, so one ton of methane emissions is equivalent to 72 tons of carbon dioxide emissions.

All of the economic analyses were conducted in today's dollars. An economic multiplier of 1.5 was applied when measuring net economic benefits of a particular measure. For each measure analyzed, incidental co-benefits were identified. These non-energy benefits are not normally quantified in an economic analysis of energy technologies or policy measures.

Non-energy benefits accrue to the utility, society at large, and to the individual or business that has invested in the energy efficiency improvement or renewable

energy system (the participant). Utility benefits include a decrease in the number of bad debt accounts that are written off, fewer delinquency notices, reduced customer calls, fewer shutoffs and reconnections for delinquency, reduced collection costs, rate subsidies avoided, and transmission and distribution savings.

Societal benefits include improved health and safety, reduced environmental impacts, and avoided water and wastewater treatment. The participants' benefits, in addition to direct energy savings, include fewer service terminations and cost to restart, increased house/building value, and increased comfort. The importance of recognizing these non-energy benefits is that, even though the value of them is not included in the Westmoreland analysis, studies have shown that they do represent a significant additional value associated with energy efficiency improvements and that value can be substantially greater than the direct energy savings resulting from these improvements. All of the measures analyzed in the report show a net savings to the community, i.e., the amount of money saved is greater than the cost of implementing the measure, however, if the full benefit of these measures was taken into account, the net benefit would be even greater.

In January and February 2011, the CCC participated in several workshops to discuss the results of the Westmoreland analysis and identify those strategies that they felt were appropriate for the City to consider. One strategy was eliminated during this discussion due to its infeasibility, and the topic of funding the climate mitigation program was tabled until early 2012 after an initial set of recommendations had been made to Mayor and Council. Based on the Westmoreland analysis, the 34 remaining measures, if implemented, would collectively contribute 54.6% toward meeting the MCPA greenhouse gas emissions reduction goal.

CCC members and staff then met with a variety of stakeholders to discuss the remaining 34 mitigation measures. Numerous presentations were also given to interest groups and other organizations. These discussions were intended to help refine the measures and to help prioritize them with respect to which should be implemented first. Some of the measures will require additional work to refine the method of implementation. Other measures will require the development of partnerships with other agencies and the identification of funding mechanisms before they can be implemented. The CCC felt it was critical, however, for the City to move forward with those measures that were implementable in the short term.

The recommendations in this report are a first step toward improving the efficiency of our community, reducing energy and water use, lowering utility costs, improving air quality, and reducing our contribution to levels of atmospheric greenhouse gases. During preliminary outreach, some stakeholders expressed concerns about additional regulations. These recommendations reflect that request, but in turn, rely on the community and businesses to take real action on their expressed commitment to making these improvements in our community.

Section 5: Recommendations

Core Phase One Strategies with Voluntary Action Goals

The CCC makes the following four Core Phase One Strategy recommendations to Mayor and Council. The three Core Strategies that consist of outreach and education programs (Recommendations 1,2, and 4) also reflect recommended goals for voluntary community action and voluntary improvements to new construction.

Recommendation 1: Climate Challenge for Business Program

Core Strategy: We recommend that the City expand the voluntary Green Business Certification (GBC) program. This program does not require any specific performance levels for improved water or energy efficiency from participating businesses, so we recommend that the City also create a voluntary Climate Challenge program for businesses, as a second tier in the GBC program, which recognizes businesses for the amount of improved efficiency that they achieve. Staff should identify potential partners and work with them to craft a program in 2012, with the goal of implementing the program in January 2013.



Supporting Efforts: Work with partners to pursue State property-assessed clean energy (PACE) financing legislation and explore other options for private financing mechanisms for investment in energy efficiency and renewable energy projects. PACE and other mechanisms can provide the up-front capital to businesses to allow them to invest in these improvement and realize energy cost savings. Pursuing PACE financing is a recommendation in the 2011 Arizona Town Hall on Arizona's Energy Future.

Goals for voluntary action by the business community:

- A.** Through the Climate Challenge program pursue by 2020 –
 - I. New installed photovoltaic (PV) capacity of 525 MW on existing facilities,
 - II. 10% of existing facilities with smart meters installed,
 - III. Business support for new commercial and industrial buildings to have improved energy efficiency through cool roofs, smart meters, and solar thermal.
- B.** Work with builders and other stakeholders to identify ways to ensure that new commercial and industrial buildings have –
 - I. Cool/Energy Star roofs
 - II. Smart meters
 - III. Solar thermal



The basic Challenge program is anticipated to reduce Greenhouse Gas emissions by about 14,000 tons per year. If existing businesses meet the voluntary action goals it is expected to reduce emissions by almost 103,000 additional tons per year. If all new commercial and industrial construction had the above three features, nearly 32,000 tons of greenhouse gas emissions would be saved each year.

Supporting Arizona's Energy Future

Recommendations from the Arizona Town Hall on Arizona's Energy Future that are supported by this strategy include:

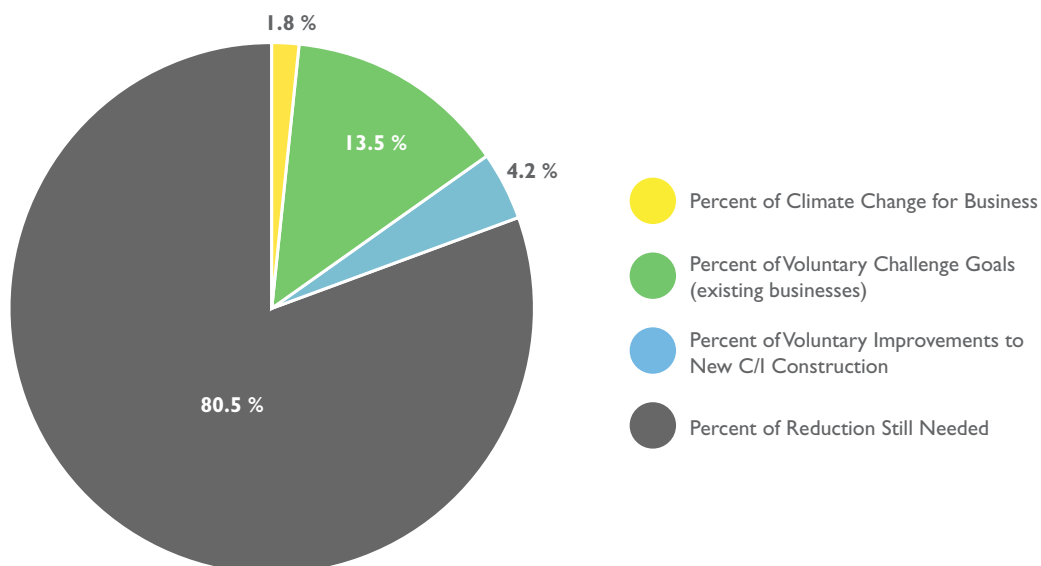
- Reducing risks to Arizona's energy reliability and security include encouraging more distributed energy production, such as rooftop solar collectors;
- Educating the public and changing consumer behavior towards greater energy efficiency. Both government and the private sector need to play a role in promoting energy efficiency and changing individual consumption habits;
- Comprehensive energy efficiency policies must consider uniform building and appliance efficiency standards on local, county, and state levels while allowing municipalities to establish higher standards;
- Policy makers should also consider, and where appropriate, adopt tax policy and other incentives to promote desired outcomes such as energy conservation and investments in renewable energy.

Greenhouse Gas Emission Reduction Potential of Recommendation One

For the commercial and industrial sector to meet the MCPA reduction goal (7% below 1990 levels) it would require a reduction in the greenhouse gas emissions from this sector, currently at more than 2.5 million tons per year, of approximately 760,000 tons per year. Combined, all of the measures within this recommendation, if fully implemented, would achieve just under 20% of the needed reduction in commercial and industrial sector emissions (See Figure 4).

With respect to the overall MCPA emissions reduction goal, the Climate Challenge for Business Program meets 0.7% of the goal. The two voluntary elements, voluntary goals for existing businesses and voluntary goals for new construction, would achieve 5.2% and 1.6%, respectively, of the MCPA goal.

FIGURE 4: Percent Reduction in Commercial/Industrial Greenhouse Gas Emissions for Each Element in Recommendation One



Cost and Savings Estimates for Voluntary Retrofits in Existing Businesses

There are a number of financing options for photovoltaic systems, and the up front costs, net savings, and payback period will vary depending on the option chosen. The proliferation of solar leasing firms, power purchase agreements, and direct purchase of solar systems shows that investment in solar can pay for itself within the useful life of the system. As technology improves, and as electricity costs rise, investment in solar will become increasingly cost effective.

Commercial smart meters provide businesses with real-time information on their energy usage. This information allows businesses to see the impact of energy-consuming activities and encourages energy conservation. In markets where smart meters are rapidly coming into use, energy savings are estimated to be as much as 10-12%. Smart meters cost between \$240 and \$300. Even assuming some additional associated expense beyond that, smart meters pay for themselves almost immediately. Taking into consideration future increases in electricity costs, smart meters have the potential to save Tucson businesses millions of dollars. If just 10% of Tucson businesses installed smart meters, the energy savings by 2020 is estimated to exceed \$50 million. Over the lifetime of those meters, those businesses could save more than \$350 million.

From: *Community Economic Security and Climate Action Analysis* by Westmoreland Associates, Feb. 2011.

Cost and Savings Estimates for Voluntary Improvements in New Construction

Cool roof is a generic term for roofing materials, including Energy Star products, which reduce the amount of the sun's heat that is transferred into the building interior. There are now a variety of materials and colors that are commercially available. The cost increase of cool roofs over traditional materials is about \$0.05/square foot. A case study by the City of Tucson found that in the case of the 23,400 square foot Thomas O. Price Service Center, installation of a cool roof saved approximately 50% of the cooling costs for the building. These savings, about \$4,000 annually, paid back the cost of installation within 6 years.

Businesses can use solar thermal as a way to provide hot water for use in the building. Installed costs range from \$4,000 to \$7,000 depending on the type of systems, not including rebates and tax credits. A commercial office building with 3 sets of bathrooms and a use of 330 gallons per day would save \$270 per year, recouping their investment in less than 10 years.

From: *Community Economic Security and Climate Action Analysis* by Westmoreland Associates, Feb. 2011.

Recommendation 2: Community Climate Challenge

Core Strategy: We recommend that the City, in partnership with Tucson Electric Power (TEP) and the Metropolitan Energy Commission (MEC), expand the community-wide Energy Efficiency Education (EEE program). This educational workshop does not ask for any specific action on the part of homeowners, so we recommend that the City also create a voluntary Community Climate Challenge to recognize the most significant community-based efforts to improve neighborhood energy and water efficiency. Staff should work with partners to craft a program in 2012, with the goal of implementing the program in January 2013.

Supporting Efforts: Staff should also work with property owners, property managers, and tenants of multi-housing to identify ways to increase energy efficiency of the units and increase energy conservation by the tenants.

Staff should work with realtors and other stakeholders to identify ways to encourage those buying or selling homes to invest in energy efficiency upgrades in those homes. Based on results from the City of Berkeley's mandated time-of-sale retrofit program, an investment of up to \$2,000 improves energy efficiency of a home by an average of 14%. The mandatory retrofit program in San Francisco has shown reductions in energy use of 15%. This would result in energy savings of approximately 3,500 kWh per year for a retrofitted home and a cost savings to the buyer of nearly \$300 per year at current electricity prices. At a minimum, consider adopting, as recommended in the 2011 Arizona Town Hall on Arizona's Energy Future, a requirement that residential energy use be disclosed at time of sale.

Staff should work with partners to pursue State property-assessed clean energy (PACE) financing legislation and explore other options for private financing mechanisms for investment in energy efficiency and renewable energy projects. PACE and other mechanism can provide the up-front capital to homeowners to allow them to invest in these improvement and realize energy cost savings.

Goals for voluntary action by current homeowners:

- A.** Through the Community Climate Challenge program work to achieve by 2020 –
 - I. A \$400-\$1,200 investment in energy efficiency retrofits in 15,000 residences,
 - II. PV systems installed in 400 additional residences,
 - III. Solar thermal installed in 400 additional residences,
 - IV. More efficient air conditioning units installed in 10,000 residences,
 - V. Smart meters in all homes, and
 - VI. Homeowner support for new residential construction to have improved energy efficiency through cool roofs, smart meters, Energy Star air conditioners, and solar thermal.
- B.** Work with home builders and other stakeholders to identify ways to increase the proportion of new residential construction that has –
 - I. Cool/Energy Star roofs
 - II. Smart meters
 - III. Solar thermal
 - IV. Energy Star air conditioners

The basic Challenge program is anticipated to reduce greenhouse gas emissions by almost 8,000 tons per year. If homeowners meet the voluntary



action goals it is expected to reduce emissions by nearly 250,000 additional tons per year. If all new residential construction had the above three features, approximately 129,000 tons of greenhouse gas emissions would be saved each year. In addition, almost 16,000 tons of greenhouse gas emissions per year would be avoided if all multi-family buildings received energy efficiency upgrades at time of sale.

Supporting Arizona's Energy Future

Recommendations from the Arizona Town Hall on Arizona's Energy Future that are supported by this strategy include:



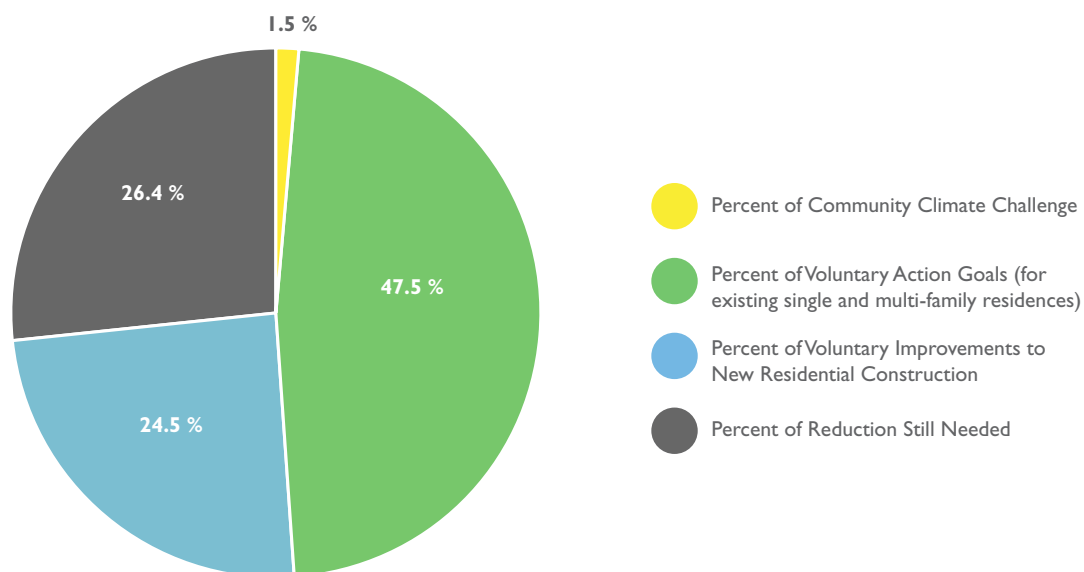
- Comprehensive energy efficiency policies must consider encouraging home energy efficiency upgrades and conservation, developing model energy disclosure ordinances, providing up-front capital and financing programs (such as PACE) for homeowners to improve residential energy efficiency, and developing programs to help low income and vulnerable populations adopt energy efficiency measures.

Greenhouse Gas Emission Reduction Potential of Recommendation Two

For the residential sector to meet the MCPA reduction goal (7% below 1990 levels) it would require a reduction in the greenhouse gas emissions from this sector, currently at just under 1.8 million tons per year, of approximately 524,000 tons per year. Combined, all of the measures within this recommendation, if fully implemented, would achieve just over 73% of the needed reduction in residential sector emissions (See Figure 5).

With respect to the overall MCPA emissions reduction goal, the Community Climate Challenge Program meets 0.4% of the goal. The two voluntary elements, voluntary goals for homeowners and voluntary goals for residential new construction, would achieve 12.5% and 6.5%, respectively, of the MCPA goal.

FIGURE 5: Percent Reduction in Residential Greenhouse Gas Emissions for Each Element in Recommendation Two



Cost and Savings Estimates for Voluntary Retrofits in Existing Homes

Arizona's Weatherization Program, which provides low-cost energy efficiency upgrades to homes, estimates it has saved homeowners over \$2.6 million since the first ARRA home retrofit was completed in September 2009. To date, 4,293 home energy retrofits have been completed, which has cut electricity usage in Arizona by over 23 million kilowatt-hours and reduced emissions by the equivalent of almost 43 million miles not driven on Arizona roads.¹

Homeowners can use solar thermal as a way to provide hot water for use in their homes. After rebates, the cost of a solar thermal system is about \$2,150. For a home with an electric water heater, the homeowners would save approximately \$270 per year. The Solar Store estimates that these systems can actually pay for themselves within 3 to 7 years.

From: *Community Economic Security and Climate Action Analysis* by Westmoreland Associates, Feb. 2011.

¹ Stats taken from the Arizona Commerce Authority website.

Cost and Savings Estimates for Voluntary Improvements in New Construction

Cool roof is a generic term for roofing materials, including Energy Star products, which reduce the amount of the sun's heat that is transferred into the building interior. There are now a variety of materials and colors that are commercially available. The cost increase of cool roofs over traditional materials is about \$0.05/square foot. Cool roofs can reduce electricity needs by 40% over conventional roofing materials, for an average savings of about \$216 per year. For a 2,000 square foot house, the payback for the cool roof would be 6 months.

An Energy Star air conditioning unit costs about \$550 dollars (17%) more than a convention AC and uses about 25% less energy. This energy savings, at current electricity prices, result in an annual savings of about \$134 per year and a payback period of just over 4 years.

From: *Community Economic Security and Climate Action Analysis* by Westmoreland Associates, Feb. 2011.

Recommendation 3: 2012 International Energy Efficiency Code (IEEC)

Core Strategy: We recommend that the City, through a public process managed by the Planning and Development Services Department, update the City's IEEC from the 2006 to the 2012 version with an effective date of January 1, 2013. We recommend that the City include the Net-Zero Energy Building Model Code, which was developed through the Energy Efficiency and Conservation Block Grant program, as a voluntary compliance path. This will allow builders who wish to build net-zero energy homes and commercial buildings a streamlined and clear approach to doing so in compliance with the IEEC. An updated IEEC is expected to result in an emissions reduction of approximately 114,000 tons per year, which achieves 5.7% of the MCPA reduction goal.

Supporting Arizona's Energy Future

Recommendations from the Arizona Town Hall on Arizona's Energy Future that are supported by this strategy include:

- Comprehensive energy efficiency policies must consider uniform building and appliance efficiency standards on local, county, and state levels while allowing municipalities to establish higher standards.

Recommendation 4: Vehicle Maintenance and Driver Behavior Education Program

Core Strategy: We recommend that the City develop, in coordination with Pima Association of Governments (PAG), Pima County Department of Environmental Quality (PDEQ), and other parties, a vehicle maintenance and driver behavior education program. Staff should identify potential partners and work with them to craft a program in 2012, with the goal of implementing the program in January 2013.

Supporting Efforts: Transportation-associated emissions comprise the largest component of greenhouse gas emissions in Tucson (34%). One way to address those emissions is through purchase of carbon offsets. As a

result, this education program should also encourage the purchase of carbon offsets by drivers. Carbon offset programs sell

carbon credits and invest these voluntary purchases in projects that reduce greenhouse gas emissions. These offset programs can provide direct benefits to the community through tree-planting and investment in solar hot water heaters. Staff should also work to explore options for local carbon offset projects so there are more opportunities for offset providers to invest in local greenhouse gas emissions reduction projects.



Staff should also evaluate options for anti-idling restrictions, such as those in place in Maricopa County.

Goals for voluntary action by drivers:

- A.** Through the Vehicle Maintenance and Driver Behavior Education program work to achieve by 2020 –
- I. 10% of drivers mitigate their travel related greenhouse gas emissions with carbon offsets, and
 - II. Driver understanding and support for how land use and transportation policies, such as transit-oriented development and investment in alternative transportation can reduce greenhouse gas emissions and increase community livability (see next section for more detail).

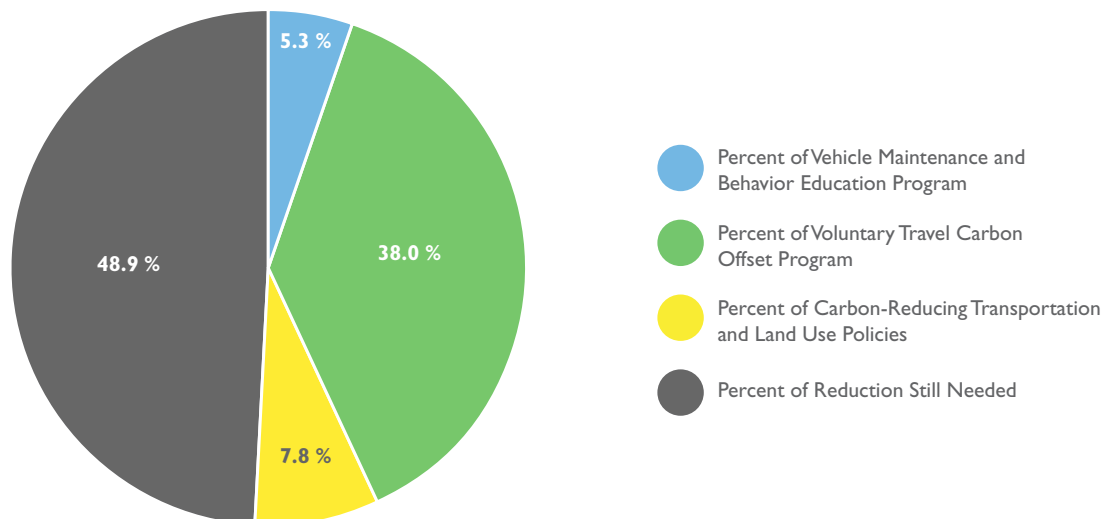
The basic driver education program is anticipated to reduce greenhouse gas emissions by almost 42,000 tons per year. An effective voluntary travel carbon offset program could reduce emissions by about 300,000 tons per year. The sustainable land use and transportation policies analyzed in the Westmoreland report could reduce community greenhouse gas emissions by about 61,000 a year. This estimate is based on a very limited set of policies and a conservative analysis, however. The long-term impact of an overall sustainable land use and transportation approach would be much greater.

Greenhouse Gas Emission Reduction Potential of Recommendation Four

For the transportation sector to meet the MCPA reduction goal (7% below 1990 levels) it would require a reduction in the greenhouse gas emissions from this sector, currently at almost 2.4 million tons per year, of more than 780,000 tons per year. Combined, all of the measures within this recommendation, if fully implemented, would achieve just over 51% of the needed reduction in transportation sector emissions (See Figure 6).

With respect to the overall MCPA emissions reduction goal, the Driver Education Program meets 2.1% of the goal. The voluntary carbon offset would achieve 15% of the MCPA goal and the limited set of carbon-reducing land use and transportation policies that were analyzed could meet, conservatively, 3.1% of the goal.

FIGURE 6: Percent Contribution of Recommendation Four and Carbon-Reducing Transportation and Land Use Policies



Savings Estimates for Improved Vehicle Maintenance and Driver Behavior

The Environmental Protection Agency has estimated that the average U.S. vehicle has tires that are underinflated by 10-11 pounds per square inch. Vehicles with tires underinflated by this amount lose approximately 3% in fuel efficiency. Incorrect motor oil weight can reduce fuel efficiency by 1-2%, poorly tuned engines cause on average a 4% drop in fuel efficiency, and faulty oxygen sensors can result in a 40% decrease in fuel efficiency. If, through driver education, the fuel efficiency can be improved by 5% for about one-third of the miles driven by gasoline-powered vehicles, the net fuel savings would amount to more than \$150 million.

From: *Community Economic Security and Climate Action Analysis* by Westmoreland Associates, Feb. 2011.

¹ Stats taken from the Arizona Commerce Authority website.

Carbon-Reducing Land Use and Transportation Policies

The City's land use and transportation policies can have a significant impact on community greenhouse gas emissions. The City already has strong bicycle and transit programs, is currently working also to improve how the Land Use Code supports sustainable development, and has a wide range of General Plan policies that encourage sustainable development (also referred to as Smart Growth). In addition, PAG has a Travel Demand Reduction program, a Clean Cities program, and long-term goals for alternative transportation improvements as identified in the 2040 Regional Transportation Plan. Imagine Greater Tucson is working with the community to identify desired future growth patterns and urban form which, although they are not influenced by a greenhouse gas reduction goal, are clearly, based on preliminary analysis of community feedback, more energy efficient than current growth patterns and traditional urban form.

The Arizona Town Hall on Arizona's Energy Future also includes a number of recommendations regarding land use and transportation such as creating local incentives to encourage use of public transportation, use of bicycles, more fuel-efficient vehicles, and telecommuting; developing incentives for use of alternative, more energy efficient forms of transportation; and developing a long-term, comprehensive energy plan that includes transportation planning, including increased availability and use of more energy efficient public transportation between and within cities, efforts to reduce commuting distances and encourage telecommuting, and promotion of alternative transportation fuels; developing alternative transportation infrastructure such as clean-burning fueling stations; and incentivizing the conversion of vehicle fleets to alternative fuels.

In support of these efforts, the CCC recommends that the following carbon-reducing policies be adopted by the City:²

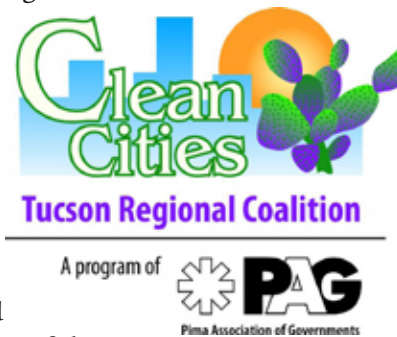
1. Continue to implement the sustainable land use code project. This project is focused on several areas related to sustainable development such as removing infill barriers by promoting transit-oriented development and encouraging energy and water conservation. This project is developing flexible zoning options to address heat island mitigation, greater use of urban agriculture, promoting rainwater harvesting, reducing barriers to solar access, and encouraging parking areas with pervious surfaces and greater solar reflectivity.

² Policies without greenhouse gas emissions reduction estimates were not included in the Westmoreland analysis and were included to support existing efforts by the City, PAG, and other entities.

2. Continue to pursue a Platinum Bike Friendly designation for Tucson. Continue to invest in bicycle infrastructure that offers people alternative forms of transportation attractive to all levels of cyclists, such as bicycle boulevards, cycle tracks, bicycle lanes and multi-use paths, buffered bicycle lanes, greenways, and other such facilities that enhance



- the comfort and safety of current and potential bicycle commuters. Ensure that bicycle facilities are one part of an integrated system-wide multi-modal transportation plan that offers residents a choice of transportation modes for their daily needs, with additional elements such as better bus stops, safe crossing lights near bus stops, and more and safer pedestrian facilities. Support programmatic elements such as Cyclovia, smart trips, guaranteed ride home programs, bicycle stations, bicycle parking, promotional events and bicycle safety classes that have proven effective in increasing the number of people using alternate transportation modes. Doubling bike ridership would reduce community emissions by more than 16,000 tons per year.
3. Work with PAG, UA, and other partners to identify opportunities for encouraging the use of alternative transportation, like carpooling, vanpooling, biking, walking, and mass transit. Expand current travel demand management (TDM) programs to include outreach to small and medium size businesses, as well as community and social service organizations. Encourage commercial property owners to accommodate alternative mode users by providing bike storage facilities, preferential parking for carpoolers and vanpoolers and green space with benches and shade for pedestrians. Identify best opportunities for establishing, implementing, and promoting bike share and car share programs. Consider opportunities for bike share and car share stations to be located on City property, including City garages. Implement transit oriented planning policies to encourage dense clustered development that facilitates shared vehicle and transit demand. A bike share and a car share program could reduce emissions by 6,000 tons per year.
 4. Work with PAG's Clean Cities Program to expand clean fuel infrastructure such as biodiesel, compressed natural gas (CNG), electric vehicle (EV) infrastructure, and propane, to assist in the deployment of alternative fueled vehicles throughout our region. These fuels help reduce greenhouse gas emissions, and help reduce America's dependence on fossil fuels. Also work to promote the installation of electric vehicle charging infrastructure and the future extension of the modern streetcar system. As part of the ongoing assessment of the Land Use Code, ensure that it does not present a barrier to installation of electric vehicle infrastructure.
 5. Continue to expand the Sun Tran regional fixed-route bus system to encourage more trips by transit. The 20-year RTA plan includes expansion of some major routes and increased frequencies on core Tucson corridors such as Grant, Speedway, Broadway, 22nd Street, Stone, 1st Avenue, and Campbell. The current regional mode split for transit use is 3%. Our goal should be to increase the transit mode split to 10% for central Tucson and 5% for less populated areas, thus reducing single-occupant vehicle trips.



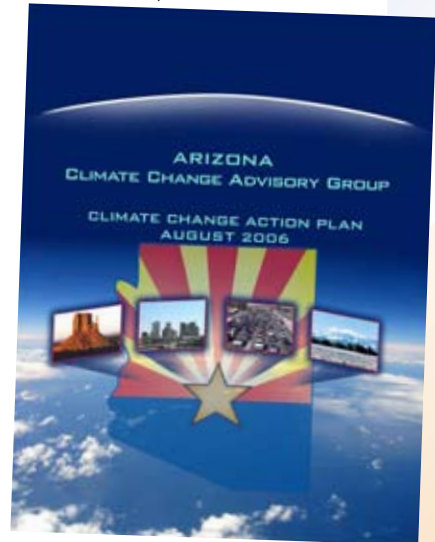
6. Encourage Transit-Oriented Development (TOD) along major fixed-route transit corridors (e.g., bus and streetcar). Establish cost incentives to entice investors to build compact mixed-use housing and retail projects that reduce vehicle trips and increase transit trips. Develop a TOD overlay zone that is very specific to select transit corridors and utilize form-based codes and incentives that are easy for investors to understand.
7. Construct the 3 roundabouts proposed as part of the Silverbell Road improvement project. In the future, consider the feasibility of roundabouts in all roadway improvement projects. Each roundabout is anticipated to save over 300 tons of emissions per year due to less delay at these intersections.
8. Promote the 2040 Regional Transportation Authority (RTA) Plan goals of “A balanced network of expanding alternative mobility choices to meet rail, highway, transit, roadway, bicycle and pedestrian mobility needs” and “Vibrant, sustainable communities that link transportation and land use” by supporting implementation strategies such as:
 - Adopt a regional “Complete Streets Policy” so jurisdictions consider all modes of transportation when they design or re-design a street. Complete Streets is not a uniform design prescription that requires sidewalks, bike lanes and transit accommodations on every corridor. Instead, complete street designs consider the context of the road and appropriate accommodations for all users of the transportation system, including pedestrians, bicyclists and transit users as well as children, older individuals, and individuals with disabilities.
 - Retain the quality of the current public transit system, expand access and services, and implement high capacity transit options that both meet the needs of transit-dependent populations and attract new riders.
 - Develop incentives to promote non-vehicular trips, and disincentives to discourage vehicular trips.
 - Create visible multi-modal stations where users of bus, streetcar, and bicycle and pedestrian facilities can conveniently transfer modes. The stations should have excellent bike and pedestrian access and transit amenities and could be public-private partnerships.
 - Commit to future development patterns that provide safe, easy and convenient access to alternative mode transportation options and support high-capacity transit investment.
 - Promote TOD by building higher-intensity mixed-use communities near transit centers and locating new transit facilities along major corridors.
 - Promote a mixture of land uses and creation of walkable neighborhoods so that housing, work, and shopping destinations are in close proximity to each other and residents have alternatives to driving such as walking or biking.
9. Support the Imagine Greater Tucson visioning process, which is seeking to define shared values to encourage regional cooperation and guide planning among local jurisdictions.



City Leadership

City leadership in reducing community greenhouse gas emissions is a critical element of climate mitigation. Although the City's contribution to community greenhouse gas emissions is relatively small (3%), the City can lead by example and encourage others to take similar action. Improving resource efficiency also sends a strong message of fiscal responsibility to the community. The CCC recommends the following actions:

1. Continue to update the Tucson greenhouse gas inventory every two years to determine trends in City and community emissions. Also, identify critical climate vulnerability indicators and track these on an annual basis. Climate vulnerability indicators relate to exposure (i.e., actual trends in temperature and precipitation), climate sensitivity (e.g., more susceptible populations such as the elderly, people with respiratory illness, and people who work outside), and adaptive capacity (e.g., people with limited resources to adapt to climate changes such as low-income, unemployed, disabled, and people with limited access to transportation).
2. Direct staff to report back to Mayor and Council twice a year on: (1) progress on implementation of approved climate mitigation strategies, (2) progress on identifying additional strategies to meet the MCPA goal, (3) trends in critical climate vulnerability indicators, and (4) emerging regional climate science.
3. Direct staff to identify potential funding sources to support implementation of the approved climate mitigation measures, including through partnerships with other agencies and organizations such as TEP, PAG, Pima County Department of Environmental Quality, Arizona Department of Environmental Quality, and Environmental Protection Agency. A recommendation on potential funding mechanisms should come back to Mayor and Council within 6 months. The CCC applauds the City's commitment to aggressively reducing per capita water consumption by investing in programs funded by a water conservation fee. The CCC feels that a similar investment in helping homeowners and business reduce their energy use, and as a result their electricity, gas, and fuel costs, is essential.
4. Incorporate the carbon-reducing policies in this report, as well as other sustainable land use and transportation policies, into the update of the General Plan. Review the Arizona Town Hall Report on Arizona's Energy Future and incorporate those recommendations into future energy, climate, land use, and transportation planning.
5. Continue to support the work of the 3 internal "green teams", implement their recommendations for increased efficiency of City operations and facilities, and facilitate the on-going education of City employees. The CCC identified a set of strategies that would reduce the City's greenhouse gas emissions by 35,000 tons per year (15% reduction from current levels). These strategies have been forwarded to the internal teams. The CCC recognizes that, with limited knowledge of City facilities and operations, these may not be the optimal measures to implement, but recommends that the City establish a goal for the teams to identify measures that would result in an equivalent greenhouse gas emissions reduction (35,000 tons).



The City has already achieved a 6% reduction below 2000 levels. Achieving 35,000 tons of emissions reduction would bring the City's emissions to 21% below 2000 levels. Approximately 23,000 tons of additional reduction is needed to reach the MCPA goal (7% below 1990 levels) and should be the longer-term goal for the green teams.



6. The internal green teams are not currently addressing community recycling and waste reduction and no specific waste reduction or recycling strategies were recommended in previous sections of the report. But, it is important that the City continue and expand efforts to increase residential and commercial recycling and recycling of construction and demolition materials. Increased commercial recycling and complete recycling of construction and demolition materials would save more than 20,000 tons of emissions per year.
7. Commit to a Regional Climate Adaptation Planning Alliance. This Alliance currently includes Tucson, Flagstaff, Phoenix, Las Vegas, Salt Lake City, Park City UT, Denver, Boulder County, Fort Collins, and Aspen. Continued involvement in this Alliance will improve the City's position for future adaptation efforts. In addition to information-sharing and enhanced access to scientific expertise, Alliance members will be better position to utilize emerging methodologies for adaptation planning. Members will also remain informed of opportunities and challenges encountered by other regional communities. A draft Resolution can be found in Attachment B.
8. Review the Arizona Town Hall Report on Arizona's Energy Future and incorporate those recommendations into future energy, climate, land use, and transportation planning.

Attachment A:

Draft Tucson Water Climate Vulnerabilities

ATTACHMENT A

POTENTIAL CLIMATE-VARIABILITY ISSUES & CHALLENGES

City of Tucson Water Department
August 6, 2010

Future Colorado River Water Supply Shortages

- What impact will climate change have on the extensive watershed which feeds the Colorado River? What are the plausible ranges of future possibility with regard to statistical changes in temperature, precipitation, and runoff in the Colorado River watershed and their relationship to water-level elevation in Lake Mead?
- How much could both climate and non-climate-related changes impact Arizona's annual access to its Colorado River surface-water right allocation and CAP's portion of that allocation?
- What is the credible range of future possibility regarding the magnitude, duration, and frequency of CAP shortages that could be experienced by the City of Tucson/Tucson Water over time?

Challenges and Considerations in Mitigating Future CAP Shortages

- To what degree will the Seven Basin States engage in high-stakes conflict OR creative cooperation to mitigate future impacts of climate change on Colorado River water availability? Will the "interim" shortage sharing agreement among the Seven Basin States be extended in some form beyond 2025? Will Mexico participate in taking a shortage thus mitigating to some degree the impact on the Seven Basin States' and Arizona's Colorado River surface-water allocation?
- To mitigate climate variability/change impacts, what mutually beneficial win-win relationships might be developed among various interests within the Central Arizona Project's Three-County Service Area to minimize climate-related vulnerabilities?
- To what degree will the Arizona Water Banking Authority (AWBA) be able to firm the City's CAP allocation with wet-water supplies and for how long? What adjustments to the AWBA's current plan may have to be considered given that climate variability/change was not contemplated when it was developed?
- To what degree will the Central Arizona Project's ADD Water Program be able to buttress/reinforce the City's CAP allocation in times of shortage? How much additional, highly reliable supply should the City order through ADD Water to sufficiently reinforce its CAP allocation? To what degree would such additional supplies be less vulnerable to shortage?
- What financial mechanism should the Utility/City use to have sufficient funds on hand to make that investment and when should it be prepared to expend those funds?
- In addition to acquiring additional supplies to augment the Utility's water-resource portfolio, what role will the City's Effluent Entitlement have in helping to increase the reliability of the Utility's available potable supplies in times of CAP shortage? Could climate-change projections facilitate the public's acceptance of Indirect Potable Reuse?
- What other local demands for water could potentially compete with the City's need to buttress its CAP allocation to ensure potable supply reliability in future years? Under

ATTACHMENT A

POTENTIAL CLIMATE-VARIABILITY ISSUES & CHALLENGES

what conditions could other types of demand take priority over potable supply reliability for the City?

Potential Seasonal & Long-Term Impacts on Water Demand

- What are the plausible ranges of future possibility with regard to annual and seasonal changes in temperature and precipitation in south-central Arizona over time?
- How might climate variability/change impact the onset of the monsoon in the Tucson region given that potable water demand is highly sensitive to its onset? Will the monsoon season become statistically dryer or wetter over time and how might such change impact water demand? How might future climate change impact the onset of peak demand season and/or its duration?
- How will climate change impact long-term water use trends? Will there be higher use to compensate for higher average temperatures (day and/or night) or lower use in response to real or perceived water scarcity? If night-time temperatures rise more than daytime temperatures, how might that affect water demand and system capacity? Might increases in average temperature (day or night) cause greater evapotranspiration and a corresponding increase in soil temperature? If so, how might such factors affect future water demand and system capacity? What other factors would have to be considered?
- Would there be supply challenges associated with such climate-based changes in seasonal and/or long-term demand? Do Tucson Water's potable and reclaimed water recharge facilities provide sufficient supply flexibility and adaptive capacity to address future climatic uncertainties?
- Besides the response measure already in place in the *City of Tucson Water Department's Drought Preparedness and Response Plan*, what other mitigation strategies could be employed to address marked changes in seasonal demand within a given year and/or in the longer-term?

Cost of Energy and Water

- How might potential climate change regulations (such as mandated reductions in greenhouse gas emissions using cap & trade, emission taxes, and/or other means) impact the cost of operating water utilities in the Southwest?
- How might such regulatory changes affect the Central Arizona Project who imports Colorado River water and potentially other source water approximately 330 miles to Tucson (with a vertical lift of about 2,800 feet much of which occurs in its southern leg to Tucson)? How might such impacts affect Tucson Water/City of Tucson in the future? Can Tucson Water extend its "postage stamp" subsidy to non-CAP water supplies (such as ADD Water supplies) which will likely be delivered to Tucson through the CAP infrastructure?
- How might such regulations affect the availability and cost of power for Tucson Water who pumps/boosts, treats, and distributes water within its service area?
- What considerations should Tucson Water entertain when planning to mitigate potential increases in power cost due to future federal/state regulations to decrease greenhouse gas emissions at power plants? To what degree can non-fossil based

ATTACHMENT A

POTENTIAL CLIMATE-VARIABILITY ISSUES & CHALLENGES

power sources economically off-set uncertainties associated with fossil-fuel sources? Is hydroelectric power generation within Tucson Water's system infrastructure technically and economically feasible and if so, can it be usefully harnessed? To what degree can solar-power generation or other sustainable sources of energy provide for some portion of the Utility's projected power needs?

- What incentives will be available for water and power utilities to make greater use of renewable energy resources which can help off-set potential vulnerabilities of more conventional/traditional sources of energy supply?

Potential Environmental/Habitat Concerns

- What impact will progressive climate change (such as general warming and drying, intensification of weather patterns, and so on) have on the diversity and survivability of locally endangered and threatened species and the long-term viability of their associated habitats? How might such changes impact Tucson Water's compliance/maintenance of its proposed habitat conservation plan in Avra Valley? What might it mean more generally for Pima County's Sonoran Desert Conservation Plan and associated regional land-use planning efforts?
- How might a progressive change in climate impact efforts to artificially develop, restore, and/or enhance habitats using supplemental water supplies? Could such enhanced environments be self supporting in a dynamic climatic regime most likely shifting toward warmer and dryer?
- Will there be a gradual northward march of biozones if the climate becomes warmer and dryer in future decades? If so, could that cause vector control issues such as an increase in the incidence of mosquito-borne diseases more commonly seen further to the south?

Potential Water-Quality Changes

- With generally warmer and dryer climatic conditions projected for the Colorado Plateau and the Southwest in the longer term, what impact might such change have on evapotranspiration in the Colorado River watershed, on in-stream Colorado River flows, and on the quality of Colorado River water conveyed through the CAP Canal?
- Could there be an increase in the salinity of Colorado River water and therefore CAP water delivered to Tucson? Could there be more frequent spikes in turbidity due to a higher incidence of large tributary flood flows discharging into the Colorado River? What might be the water quality impacts of other potential constituents of potential concern if there is less surface water to dilute those concentrations?
- Could increasing summer temperatures in the Tucson area impact chlorine demand in the potable and reclaimed water distribution systems?

Intensification of Weather: Floods and Water Infrastructure

- What impact might higher intensity local storms and associated floods have on in-channel and off-channel water-supply facilities given the potential for more frequent higher magnitude floods? What might this mean in terms of in-channel scour depths, lateral channel bank erosion, and changes in sediment transport?
- To what degree could an intensification of weather impact pipelines which are located

ATTACHMENT A

POTENTIAL CLIMATE-VARIABILITY ISSUES & CHALLENGES

under or immediately adjacent to stream channels, recharge facilities sited within flood plains, and so on?

Impact on Already Increasing Urban Heat Island Effect

- What impact would climate change have on the already observed increasing heat island effect in the Tucson Metro Area? If climate change results in increasing warming in the Tucson area, what effect could it have in further increasing the heat island effect?
- How might this impact local water demand both annually and seasonally?
- How might steps to mitigate this effect redirect water resources from aquifer augmentation to meet future water supply needs?

Near-Term Conservation Goals & Long-Term Adaptability/Resilience

- What role might climate change projections have on Tucson Water's customers' willingness to conserve more to increase supply reliability? How much more would customers be willing to conserve? To what degree can conservation reduce or mitigate future water supply costs?
- How might the potential "hardening" of water demand through more aggressive conservation programming in the near to mid terms impact the Utility's ability to adapt and respond to longer term supply-demand challenges associated with climate variability and climate change?
- Strategically, what would be the most prudent course of action in the near to mid terms to maximize resource flexibility and adaptability in the future?

Revenue/Water-Use Trends

- In recent years, there has been a marked decrease in both per capita consumption and a general flattening of total potable water use. The factors affecting this observed change are not completely known. What will be customer water use patterns in the longer term and how will they impact the Utility's revenue stream?
- How will this impact future investment in both Utility infrastructure and in acquiring additional water resources?

Human Migration to the Southwest

- Could increasing climate change create positive green-house emission offsets caused by "in-migration" to the Southwest? Is total heating/cooling energy use in the Southwest less than in the more northerly and easterly climatic zones within the United States? How might this change over time?
- What could be its longer-term implications in terms of development?

Attachment B:

**Draft Resolution Supporting the Establishment
and Efforts of the Western Regional Climate
Adaptation Planning Alliance**

Exhibit A - Resolution Supporting a Regional Climate Adaptation Planning Alliance

Resolution No. ##-11

RESOLUTION SUPPORTING THE ESTABLISHMENT AND EFFORTS OF REGIONAL CLIMATE ADPATATION PLANNING ALLIANCE

WHEREAS, the governments of Fort Collins, Las Vegas, Flagstaff, Denver, Boulder, Park City, Salt Lake City, Tucson, and Boulder County (the Partners) joined together in a collaborative process to explore climate change adaptation planning; and

WHEREAS, the Urban Sustainability Directors Network provided funding to the Partners to enable them to come together and share and explore planning frameworks, creative ideas, and knowledge about climate adaptation planning; and

WHEREAS, the Partners held two meetings in 2011, the first in Las Vegas and the second in Park City, as well as several conference calls; and

WHEREAS, the Partners have benefited greatly from these meetings and the associated dialogue about climate change and planning for the future of a changing climate; and

WHEREAS, the Partners have published the following document: "Report on Climate Change and Planning Frameworks for the Intermountain West," and

WHEREAS, the Partners acknowledge that climate change is already having a significant impact on western and southwestern states, and that local communities have a critical role, and indeed an obligation to their citizens, to anticipate, plan, and prepare for impacts associated with climate change; and

WHEREAS, the Partners acknowledge that some of the impacts of climate change are regional in nature and will require regional cooperation and planning to effectively prepare our local communities for future conditions; and

WHEREAS, given the success of the Partners to date, they agree that the establishment of an ongoing Regional Climate Adaptation Planning Alliance (the Alliance) would of great value to our local communities and to the region as a whole; and

WHEREAS, such an Alliance would enable continued learning, knowledge transfer, and regional collaboration; and

WHEREAS, the Alliance plans to continue to communicate on a regular basis with telephone meetings and through other methods in order to assist each other, to share progress, and to discuss climate change-related topics and associated adaptation strategies with respect to:

- Economic Health and Resilience
- Climate Change Science
- Municipal Water Supply Planning
- Forest Management
- Emergency Management

- Transportation Planning
- Human Health and Related Services
- Agricultural Impacts and Food Security
- Energy Generation, Supply, and Security

And any other area of cooperation that the parties may agree upon; and

WHEREAS, the Alliance wishes to affirm the partnership and the desire for future collaboration, knowledge transfer, and dialogue; and

WHEREAS, any commitment of financial or human resources is voluntary and not obligatory and none of the parties are expected to collaborate on matters where internal prohibitions exist; and

NOW, THEREFORE, BE IT RESOLVED by the City Council of Park City, Utah that the City Council hereby declares its support for the establishment of a Regional Climate Adaptation Planning Alliance and the membership of Park City in said Alliance.

PASSED AND ADOPTED this 27 day of October, 2011.

PARK CITY MUNICIPAL CORPORATION

Mayor Dana Williams

Attest:

Janet M. Scott, City Recorder

Approved as to form:

Mark D. Harrington, City Attorney