Metro Tucson Climate Change Starter Plan

Cool Cities Committee Report
Sierra Club Rincon Group

April 2009

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Climate Change Starter Plan

Introduction

Climate change is now a major public concern since awareness has significantly increased and climate science produced more certain findings during the past three years. The emerging warning is "climate change is a worse and more urgent problem than we thought." Measurements of the Artic sea ice melt in Fall 2007 show faster change than current models have predicted. The chairman of the U.N. Intergovernmental Panel on Climate Change, Rajendra K. Pachauri recently stated, "What we do in the next two to three years will determine our future."

Indeed, climate change effects everyone and climate stabilization, mitigation, and adaptation is everyone's problem. We in Arizona may be particularly hard hit. In November 2007, a panel of scientists at the Arizona State University Climate Change Conference agreed that Arizona is "ground zero" for the most severe heating and precipitation-loss impacts in the U.S..

Yet, scientists advise that with every community doing their part, the build-up of greenhouses gases in the atmosphere can be stabilized and reversed. Motivating every community to take action now is the priority of a growing group of U.S. Cities. Tucson's Mayor and City Council signed on to the U.S. Mayors' Climate Protection Agreement on September 6, 2006. This agreement includes a commitment to achieve the Kyoto Protocol which requires a reduction of CO2 emissions 7% below 1990 levels by 2012.

Current Planning Context

Rapidly evolving events in the U.S. economy and major anticipated changes coming from the Obama Administration and Congress are combining with new scientific climate findings to suggest that major changes in related policies will be forthcoming at all levels of governance.

The first shoe of the sustainability crisis has fallen, namely the current financial meltdown and subsequent shrinking of industries and public organizations. The present situation is much worse than a typical recession as many economists point out. We are experiencing a massive revaluing downward of our whole economy and socializing of large, national business risks. The scope and scale of this mess is unprecedented and will likely take many years to work out. Meanwhile, will the next two sustainability shoes to fall be resource shortages and critical tipping points in global warming?

The context for planning metro Tucson's future is rapidly changing as a consequence both of the economic meltdown and the recent election. On the one hand, economic growth is significantly slowing almost everywhere and on the other, a new policy priority is emerging which calls for massive investments in green infrastructure projects and technology development to put people back to work. The question remains what projects would best accomplish the goals of building a sustainable economy, protecting our environment, and still be affordable under emerging fiscal constraints.

So what is the sustainable path forward?

First let's start by looking at what the City and the County already endorse in their respective sustainability plans -- the most often- adopted definition: "Sustainability is meeting the needs of the present without compromising the ability of future generations to meet their own needs." What is important about this definition is that we have to consider the needs of the future. What is also productive is that considering this definition leads people to the logical conclusion that almost everything we do is fundamentally unsustainable because everyday we are depleting non-renewable resources at irreplaceable rates and loading the atmosphere with climate-changing, carbon-based greenhouse gases. While this definition may be effective in raising awareness about unsustainability, it provides no guidance or tools to move forward.

At its base, sustainability is the capacity to continue a desired condition or process either social, ecological or both. Resiliency is the ability of a system to adjust its configuration and function under disturbance. Both concepts are important as we seek to reduce greenhouse gas emissions (GHG), build a sustainable economy, and implement efficient public infrastructures which can function under changing conditions. Every level of our community is important in the effort to mitigate and adapt to climate change – household, neighborhood, small business, education, social service agencies, government, non-profits, and industry.

The purpose of the Cool Cities Climate Change Starter Plan is to put a sense of scale on this problem and define the main strategies where significant reductions in GHG emissions, primarily CO2, could be pursued. By raising the bar on what ultimately the community must accomplish, we are providing an important starting point for the larger community including our main institutions and local jurisdictions to develop systemic community policies and to fill in the details of how we are actually going to accomplish the first goal of meeting the Kyoto Protocol goal by 2012 and other goals to come. California has recently adopted the State goal to reach 1990 levels by 2020 and 80% below 1990 levels by 2050. An emerging consensus of climate scientists recommends that 80% to 100% of all greenhouse gas emissions be eliminated by 2050. For details, see: http://www.sierraclub.org/carbon/

While the Kyoto goal may seem overly aggressive given our current level of emissions, the new findings suggest it may be insufficient to stabilize global climate change. In December 2009, parties to the international climate change conference will meet in Copenhagen to develop a new global GHG emissions plan to succeed the Kyoto Protocol when it expires in 2012.

Recent Trends and Events

Climate science findings released since the last IPCC consensus report in 2007 are showing faster then previously estimated global changes including most dramatically, the now anticipated complete summer melting of the artic ice sheet within approximately 6 years compared to end of century as predicted in the 2007 report. The following link is a news story from the UK which describes the debate at the top: http://www.sustainabletucson.org/2008/12/09/too-late-why-scientists-say-we-should-expect-the-worst/ An important new report from the Public Interest Research Centre in UK is designed to help citizens and activists raise awareness and increase their effectiveness in mitigating and adapting to climate change: http://www.climatesafety.org/downloads/climatesafety.pdf

Scientists at the University of Arizona are also stepping up their public speaking. As climate professor and Nobel Laureate, Jonathon Overpeck stated in December 2008, " We need to anticipate, plan, and adapt."

Activism is picking up among advocacy groups like the Sierra Club. This is motivated by traditional environmental goals of reversing damage to ecosystems and creating green jobs which ensures both economic and environmental health. In Europe alone, 350,000 jobs have already been created in the wind and solar energy industries during the past decade.

Even labor groups are now joining environmentalists because they see the advantages of going green. Most visibly, the Blue-Green Alliance was formed by United Steelworkers and the Sierra Club in 2006 to deliver the message that you can protect the environment and preserve jobs at the same time. Increasingly, unions see jobs in the renewable energy sector as a way to create a new wave of well-paid jobs that will replace the nearly 5 million manufacturing jobs that have disappeared over the past decade.

The Sierra Club is also pursuing a public campaign to "Move Beyond Coal." Coal plants are a leading cause of respiratory illness, they account for over 40% of our nation's carbon dioxide emissions, and, because of impending carbon pricing, are rapidly becoming more expensive. Yet there are still plans to build more than 100 coal-fired power plants across the U.S. Coal-fired power plants are one of our nation's largest and dirtiest sources of energy. There are readily available alternatives to coal that can meet our energy needs and save consumers money, boost the economy, create jobs, improve public health, and combat global warming.

The Sierra Club's Move Beyond Coal Campaign described at: http://www.sierraclub.org/coal/ aims to eliminate one-third of the nation's global warming emissions, by:

- Challenging new coal plants across the country.
- Increasing efforts to retire the dirtiest old power plants.
- Addressing the entire coal cycle, including mountaintop removal mining and its devastating impact on communities.
- Educating investors and conducting shareholder advocacy to drive investment away from coal and into clean energy alternatives.
- Stepping up efforts to support clean energy solutions.
- Strengthening relationships with the public and a variety of coalitions to address coal as it relates to the environment, public health and the economy.

A Climate Action Plan for Tucson

In 2008, local governments working with the Pima Association of Governments (PAG) finalized an inventory of local greenhouse gas (GHG) emissions. In early 2009, the City of Tucson's Office of Conservation and Sustainable Development began directing a City initiative to develop a climate action plan as the next step following the GHG inventory. The Sierra Club's Cool Cities Campaign which began in 2007, is designed to support local efforts and encourage everyone to reduce our GHG impacts and adapt to climate change. The Rincon Group's Cool Cities committee chose to develop a preliminary inventory and plan in accordance with the Kyoto Protocol GHG goals for 2012 which the City of Tucson has endorsed. The intent of this Cool Cities Plan is to provide a first cut at assessing the scale of

GHG impacts and four broad strategies to close the gap between "business as usual" and where we need to go in order to achieve climate stabilization.

The Rincon Group's Cool Cities Plan

Build-up of GHGs (mostly CO2) in the atmosphere is mainly the result of combusting fossil fuels -- coal, oil-based fuels, and natural gas. Energy consumption data gathered in 1992 and 1998 by University of Arizona energy economist Dr. Helmut J. Frank shows the breakdown of Tucson metro energy consumption by sector: **transportation 50%, residential 15%, commercial/institutional 10%, and industrial 25%.** Moreover, the trend shown by his studies shows that per capita energy consumption is decreasing for buildings and increasing for transportation. By comparison, U.S. energy consumption data reported by the U.S. Greenbuilding Council shows **transportation 33%, buildings 38%, and industry 29%.**

As the basis for its analysis, the committee used the UA energy consumption data, the Department of Energy CO2 coefficients for natural gas and petroleum fuels, and Tucson Electric Power's average CO2 emissions factor for coal-generated electricity – 1915 lbs. CO2 per end-use megawatt hour consumed. CO2 coefficients are numbers which enable the calculations of CO2 emissions for different energy sources.

Using this data, (See Appendix A) the committee calculated the corresponding CO2 emissions for each metro Tucson sector for different years. The breakdown for 2006 was: transportation 36%, residential buildings 20%, commercial buildings 12%, and industry 32%. Tucson's carbon footprint is somewhat higher for transportation and industry and less for residential and commercial buildings. See figure 1.

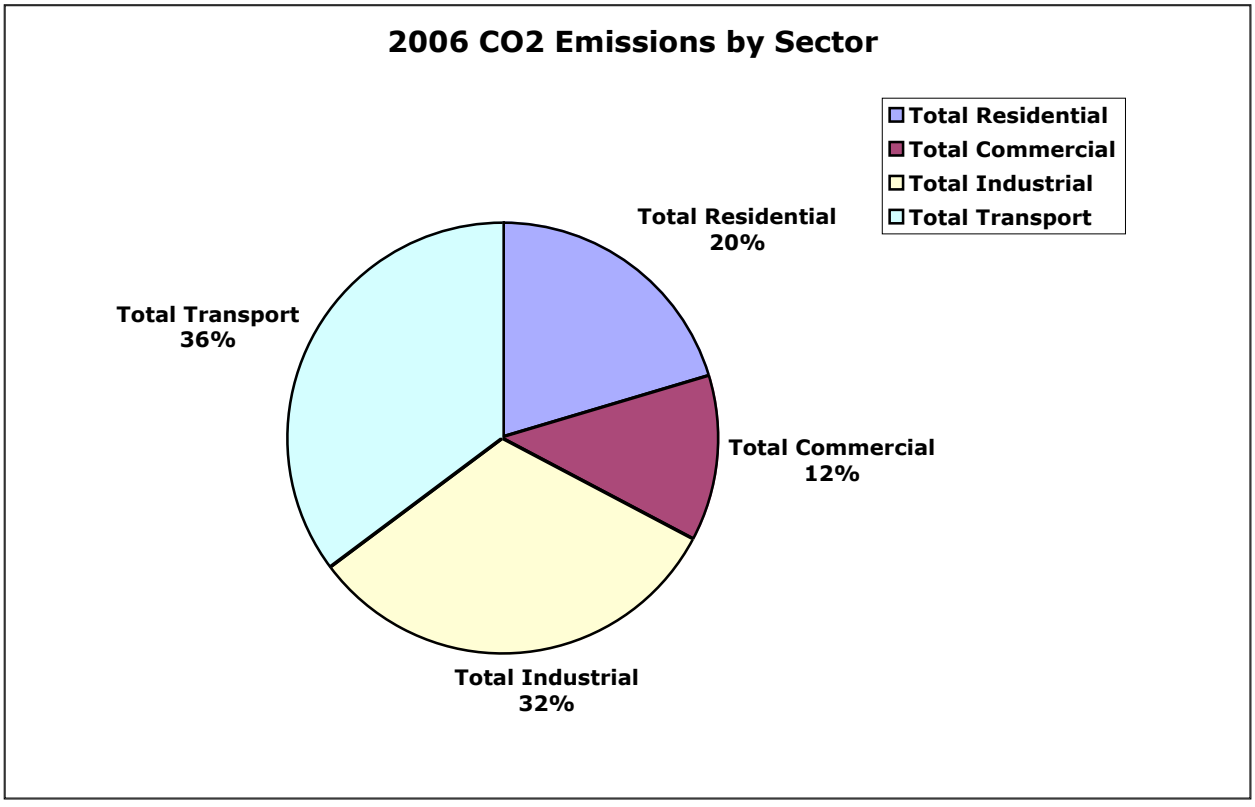

Figure 1. 2006 CO2 Emissions by Sector

The committee estimated that the 2006 level of GHG emissions in Greater Tucson was 15.9 million metric tons CO2 or approximately 15.9 metric tons per person. The U.S. average annual per person carbon footprint is higher than Tucson at 20 metric tons.

The 2012 Kyoto goal for Tucson is approximately 11.2 million metric tons CO2. (The Kyoto goal is 7% below the 1990 level.) **This means that we will have to eliminate all new additional emissions in the next four years and reduce overall emissions by 30% over 2006 levels. Total required annual emissions reductions is 4.7 million metric tons of CO2 for the entire metro area or approximately 4.7 metric tons per person.** This is a challenge indeed, but scientists say that it can be accomplished at a cost much less than mitigating and adapting to the consequences of destabilizing the climate.

Metro Tucson's Kyoto Reduction Goals

To close the gap between "Business as Usual" and meeting the Kyoto Reduction Goals by 2012 (See Figure 2 & 3), metro Tucson will have to accomplish the following greenhouse gas emissions reductions:

Transportation – 1,680,000 metric tons CO2.
Residential buildings – 975,000 metric tons CO2
Commercial buildings – 485,000 metric tons CO2
Industry (mining, construction, aerospace, defense, agriculture) – 1,535,000 metric tons CO2

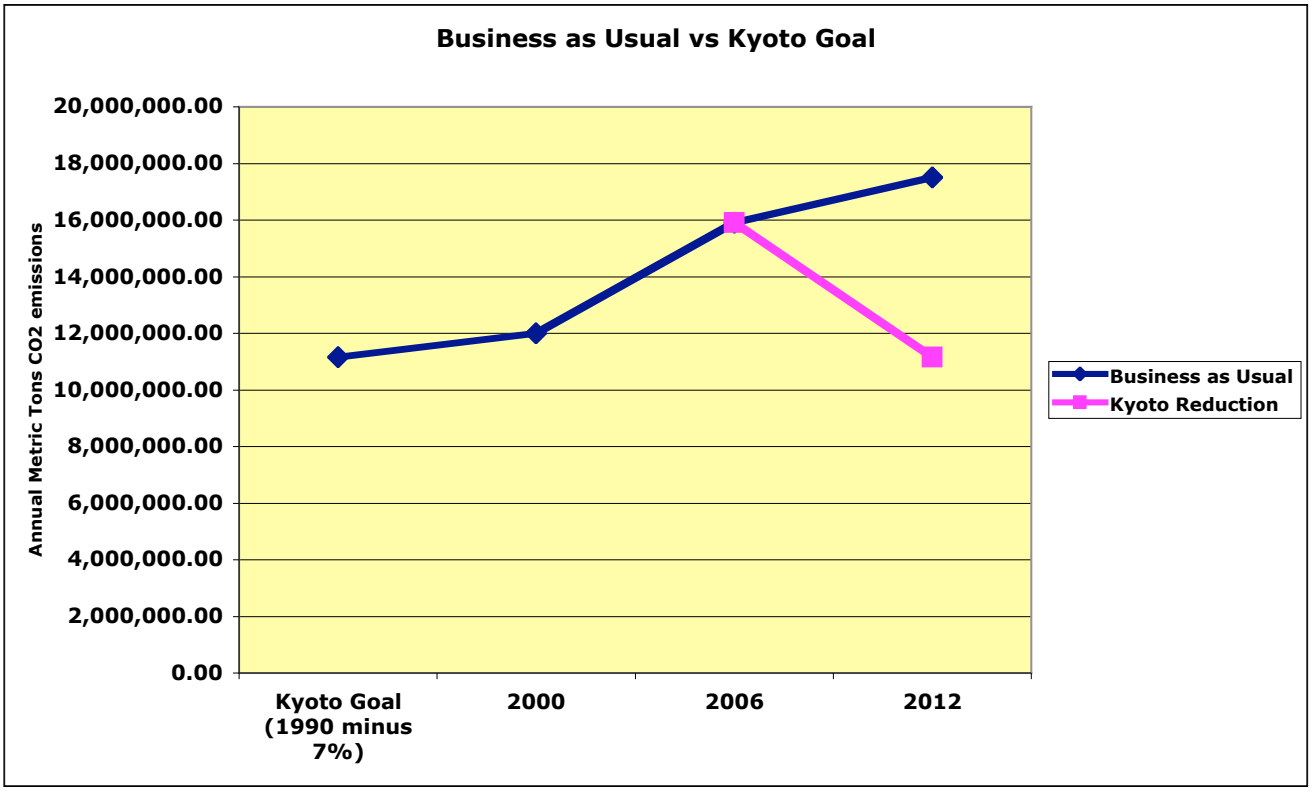

Figure 2. Business as Usual vs. Kyoto Goal for 2012

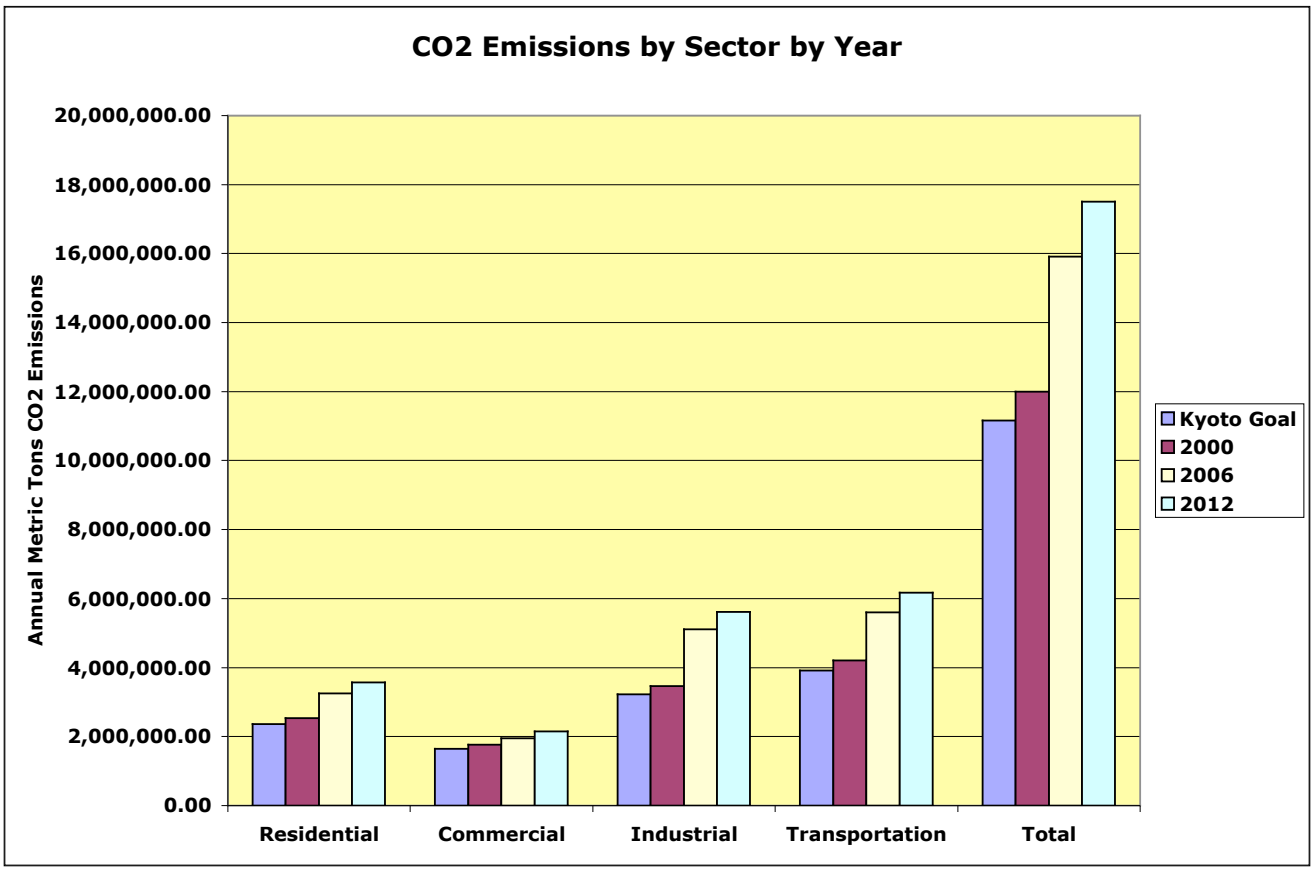

Figure 3. CO2 Emissions by Sector by Year

Cool Cities Goals

The Rincon Group Cool Cities Committee recommends four major strategies to close the gap which a metro Climate Action Plan will need to accomplish. These include **1) Diversification and electrification of transportation and urban village land-use redevelopment; 2) Energy and water-efficient retrofitting of existing housing and commercial buildings; 3) New green buildings, fixtures, appliances, and equipment; and 4) Rapid expansion of the solar industry and beneficial uses of solar.** The four strategies are uniquely suited to metro Tucson which has many regional opportunities for diversifying and electrifying metro transportation and has a large stock of existing buildings that are energy and water-inefficient.

The approximate reduction goals proposed by the Cool Cities Committee are:

1) Transportation-related CO2 reduction – 35%
2) Retrofitting existing housing and buildings – 25%
3) Green buildings, appliances, and machines – 15%
4) Rapid expansion of solar energy installations – 25%

1. Diversification and Electrification of Transportation and Urban Village Redevelopment

The large carbon footprint produced by transportation can be efficiently and effectively reduced by at least 35% in the next five years by reducing the percentage of single-passenger vehicle trips, creating additional infrastructure for safe walking and biking, electrifying more of our transportation system, and supporting the transformation of our urban form by facilitating the redevelopment of neighborhood-scaled "urban villages' whereby mobility requires fewer vehicle trips.

Electrifying our transportation system entails significantly increased use of electric transit (including light rail, modern streetcars, trolley buses), plug-in hybrid electric vehicles, and electric bicycles. In particular, we recommend that:

1) Electric rail transit be implemented on Broadway and South Sixth Avenues, Tucson's two most traveled transit corridors;
2) The downtown modern streetcar system be extended on Campbell north to River Road and south to Tucson International Airport and the industrial zone;
3) The two traffic lanes to be added in the Regional Transportation Authority's Grant Road Improvement Project be provided with a rapid transit mode such as electric trolley buses, electric rail, or Bus Rapid Transit.

Electrifying our transportation system has two immediate benefits for climate stabilization. The first is that the CO2 emissions generated by producing electricity is much less costly to capture and sequester at a central plant than hundreds of thousands of tailpipes. Because coal-generated electricity is very high in carbon emissions, further use of coal-based electricity must also employ carbon capture and sequestration technologies. The second is that the top three renewable energy sources – solar, wind, and geothermal – produce electricity with virtually no emissions. Thus combining electrification of transportation with rapid renewable energy development results in clean energy-powered mobility. The Sierra Club's Green Transportation Initiative supports massive investment in this area. For details, see http://www.sierraclub.org/transportation/

Tucson is an "inconvenient" city that has been getting more congested every year until the recent economic slowdown. "Severe congestion" is projected to increase from 6% of all trips to nearly 30% in the next 25 years if past driving patterns continue. The average distance between wherever we are and whatever we want to get to is 6 miles today, and we are building roads to accommodate a doubling of driving, caused by an expected increase in average trip length to almost 8 miles per trip.

Significant GHG reductions from transportation will be difficult in the next few decades from only relying on the new technologies mentioned above. If fleet average fuel economy doubles by 2030, we will be no better off than we are today if the Pima Association of Government's estimates of increases from 7.5 billion miles per year to about 14 billion are correct. We must limit travel to limit total GHG.

Tucson can remodel itself into a network of 60-80 urban villages where their commercial cores (Village Centers) are within 1-2 miles of everyone. If that can be achieved with safe, walkable neighborhoods and good bus services, there are currently enough commercial services so that everyone can live close to 1-2 grocery stores, a day care center, a pet care center, 6+ restaurants, a clinic, drug store, and a dozen doctors and dentists, lots of office space, 2-3 banks, a bunch of car & tire repair shops, and much more.

By making Tucson increasingly convenient, accessible, and affordable, we can limit the driving we force on people, and allow improving technologies to reduce our energy use and greenhouse gas production.

2. Retrofit Existing Housing and Buildings

We can achieve dramatic and long-lasting improvements in energy and water efficiency for most of metro Tucson's 200,000 existing homes built before energy efficiency standards were required. For these poorly insulated homes that have standard A/C units, the reductions could reach 40% to 50% of heating and cooling bills, at no net cost. Much more may be justified by cost alone, if an integrated approach is taken and timed with equipment replacement.

These improvements include insulating the building shell, sealing ducts, adding passive solar heating, solar water heating and sun control cooling, and replacing obsolescent, energy in-efficient appliances, as well as replacing failing household infrastructures and removing accessibility barriers. This will require the retraining and training of thousands of Tucsonans for well-paying jobs that serve the needs of our desert home.

If Tucson invested in retrofitting at the current national rate, our repair and remodeling industry would be nearly $1 billion per year. The key to meeting Tucson's needs will be a variety of low-cost, long-term financing options from utilities, banks, local governments, and peer-to-peer lending. Changes in ACC regulations can make a massive conservation program acceptable and profitable to utilities.

Tucson should create a major green redevelopment industry employing thousands of well-paid local people in order to attack climate change and peak oil. We can create a $1-$3 billion per year industry to remodel old buildings and current urban form. It will be paid for by removing the inefficiencies we currently pay in high utility bills, taxes, car costs, and insurance. It will retrofit and remodel our built environment with the most energy and water-efficient systems of the 21st century, and preserve our aging homes for our aging people.

Tucson could benefit from studying other areas which are now working on comprehensive green retrofitting of existing homes. Great Britain has recently announced ambitious plans to green retrofit 25% of all UK homes by 2020 and 100% of all homes by 2030.

3. Green Buildings, Appliances, and Machines

When it comes to construction of new homes, improving energy efficiency and reducing greenhouse gases go hand in hand. The same goes for other types of buildings as well. Setting the course for energy consumption and greenhouse gas emissions starts with construction. It is very important to start out in the right way – build that home or business right to begin with.

Electricity use for buildings accounts for 48% of our nation's total consumption. Source: http://www.architecture2030.org/current_situation/building_sector.html

When a new building is built, if the construction includes proper attention to insulation, appliance efficiencies and other construction factors, the reduction of energy compared to an inefficiently designed home is enormous.

Here in the Tucson Area, a major contributor to greenhouse gases are buildings and the appliances associated with them. We all know that new homes and businesses in the Tucson Area will continue to spring up. We need to make sure that these buildings are built in a sound way to reduce our total greenhouse gas production and to reduce energy consumption.

Improving energy efficiency in an existing building, while also important, costs much more than incorporating the costs into the construction process. Energy efficiency investment is a great rate of return on your investment in a new home or business.

The Sierra Club Rincon Group recommends that all jurisdictions in the metro area incorporate LEED standards or equivalents in all of its municipal buildings. It is also important to incorporate Leadership in Energy and Environmental Design standards (or equivalents) into the building codes for residential and business construction. (See http://www.usgbc.org/)

The use of energy efficient design combined solar energy technologies should lead to zero or near zero energy use for heating and cooling and could cover much of the normal electricity use in buildings. The American Institute of Architects has established this goal for 2030.
(http://news.thomasnet.com/companystory/519830)

We should be gearing up to make a reality of net-zero homes and businesses much sooner.

4. Rapid Expansion of the Solar Industry and Beneficial Uses of Solar

Tucson has excellent solar energy potential and needs to develop this as a key component in attacking our carbon footprint. Substitution of fossil fuels – coal, oil, and natural gas – with clean renewable energy sources is absolutely essential to significantly reduce GHG emissions. By 2050, our entire economy should be largely powered by clean renewables if we are to avert global climate disaster. For more details, see: http://www.sierraclub.org/energy/ .The Cool Cities Committee proposes a number of solar initiatives to tap this source. These include:

1) developing large scale solar thermal projects outside of town, such as in the Avra Valley; develop large scale photovoltaic (PV) projects on city and county owned buildings; attract solar industries;
2) require strip malls and big box stores that seek rezoning to install PV as a condition of rezoning; pursue city or county bonding to make financing solar easier for homeowners and small businesses;
3) require proper orientation of all new buildings for passive solar design;
4) require all new buildings either have PV and solar hot water heating installed or at least be equipped for easy installation later;
5) integrate solar requirements with new green building codes;
6) support unlimited scale net metering at the ACC along with the new REST standards;
7) support training of solar technicians at local community colleges; and
8) encourage plug-in hybrid vehicles (cars, bicycles, and trucks) with free or low cost solar powered plug-in stations in public places.

This is a long list, but many of these initiatives can be accomplished and would help Tucsonans contribute to a reduced carbon footprint.

Solar Tax Credits and Rebates

Many incentives already exist to motivate increased investment in solar energy. There is a federal tax credit of 30 percent, with a cap of $1,500 for the combined tax years 2009 and 2010 for:
• Roofs: "Energy Star" qualified metal and asphalt roofs
• Appliances: Biomass stoves and high-efficiency air conditioners, heat pumps, furnaces and boilers using a variety of energy sources. High-efficiency water heaters.
• Windows and Doors: Skylights and exterior doors and windows with low-energy transfer properties.
• Insulation: Most insulation qualifies.

There is a 30 percent tax credit with no cap until 2016 for:
• Photovoltaic systems for generating a home's electricity.
• Solar hot water heaters, except those for pools and hot tubs.
• Small wind generators for home use.
• "Energy Star" geothermal pumps.
• Residential fuel cell and microthermal systems.

Tucson Electric Power is offering significant rebates to purchasers of PV systems which are connected to the common grid. These rebates are offered by TEP to comply with Arizona's Renewable Energy Portfolio Standard which mandates that 15% of electric power be generated by renewables by 2025.

To finance a major ramp-up of solar installations, the Committee has been following the Berkeley solar finance plan. This is a plan to get city (or county or even state) governments to partner with financial institutions (be it banks or credit unions, in the Berkeley case a bank) to finance a solar purchase and then to have the payback included with real estate tax payments.

Solar financing may be better than solar tax incentives for a number of reasons including these three:
1) Financing does not discriminate against those that don't pay enough taxes to take the write-offs;
It in fact allows those very people to buy into a system that they could not previously participate in;

2) Financing does not cost as much to the City/County/State governments, so they can afford to spread the program to many more homes/businesses, thus more effectively promoting solar energy.

3) When people have to take a loan, they are more likely to scrutinize their investment, and make a wise investment, than if they simply receive a credit on their tax returns.

Several questions do remain regarding the plan such as: Will we be able to get cities/counties to adopt the program? Is there the political will to remove legal roadblocks and enable this method of financing?

Differences Between the MEC and PAG Energy and CO2 Inventories

This starter plan is intended to contribute to the wider community effort to develop Climate Action and Sustainability Plans in the region. Local jurisdictions working under PAG recently completed and released the PAG Regional Greenhouse Gas Inventory. The Cool Cities CO2 data and inventory reports somewhat higher emissions and differs in other respects with the results of the PAG report although both

can be considered adequate starting points for local planning. A good emissions inventory is a necessary first step to building a good climate action plan.

The Cool Cities data is based on two actual energy consumption time series counts in 1992 and 1998 done by the nationally-recognized UA energy economist, Dr. Helmut J. Frank commissioned by the Metropolitan Energy Commission (MEC). The PAG data for transportation was based on computer modeling estimates which calculates CO2 emissions based on vehicle miles traveled (VMT), population growth, and national indexes of driving types and fuel mixes.

One area of considerable difference is the way the two studies account for diesel. The MEC study shows that use of diesel is increasing at twice the rate of overall annual energy consumption (3% vs 1.5%.) One assumption the PAG inventory makes is that the ratio of gasoline use to diesel fuel use is 15:1 . Dr. Frank's study shows the ratio is less than 4:1 indicating much higher diesel usage in the two time periods he measured. Diesel combustion produces somewhat more CO2 emissions than gasoline. In addition, the PAG inventory excludes all of the non-road uses of diesel in industry.

The differences are most striking in the conclusions of the two approaches: The MEC work shows that transportation and industry (including construction, mining, agriculture) constitutes more that 68% of all regional GHG emissions and growing. PAG's study shows that transportation is emitting only 34% of the total with residential, commercial, and industrial contributing 64% and growing the fastest. These differences are significant and lead to differing policy priorities. MEC's conclusion in 2001 was that energy-efficiency in buildings was improving significantly while energy-use in transportation was getting worse, effectively canceling all the gains made in buildings. If the PAG conclusions are not modified, buildings will continue to get most of the attention while transportation increasingly becomes our Achilles Heel.

Even though the PAG group was provided the MEC data, it was ignored and not used. The PAG Inventory states that it is a preliminary study to be adjusted as new information becomes available. In fact, the software that was used allows actual data to be used in place of modeling. According to the report, this substitution was done in the case of using actual SunTran data for fueling buses . The Cool Cities Committee continues to request that PAG use Dr. Frank's data, especially the transportation fuels data, in future iterations of the inventory. Dr. Frank did state in 2001 that future community energy assessments would be more problematic because of the increasing difficulty in obtaining fuel sales data. However, the two data sets Dr. Frank gathered in the 1990s are consistent and constitute the only known comprehensive energy assessment of the region using actual counts.

Other Issues

Finally, there are other remaining issues which climate change planning needs to address. First, the status of "clean coal" technology has been unclear until recent reports which suggest that the costs of carbon capture and sequestration (CCS) may likely be higher than simply investing in clean renewable energy sources. Second, because of new, more troubling scientific findings, the debate over "safe" ultimate levels of greenhouse gases in the atmosphere is not over. Different determinations of "safe" levels leads to different climate action plan goals. Third, most climate scientists now concede that preventing ongoing climate change by mitigation is no longer possible. There is already too much "change in the pipeline." Mitigation now must be balanced with climate change adaptation strategies. The question remains how much of each will be necessary to ensure a livable bioregion?

Climate Action Steps Everyone Can Take

Living sustainably and helping solve the climate crisis go hand in hand. Here are some general actions everyone can take to reduce our community's carbon footprint and ensure that the worst impacts of climate change can be prevented. This following list was developed by Sustainable Tucson's planning initiative.

Food

Buy local natural foods.
Eat at restaurants that serve local natural foods.
Cultivate a backyard kitchen garden.
Make nutrient-rich soil by composting organic waste.
Cook with solar ovens.

Water

Harvest rainwater.
Irrigate landscape with greywater.
Use native landscape plants.
Use low-flow toilet.
Use front loading washing machine.
Use low-flow faucets and shower heads.

Transportation

Share rides with others.
Use public transit.
Walk more.
Bicycle more.
Use electric cars, scooters, and bicycles.
Use bio-diesel made from local feedstock.
Lobby for expanded sidewalks, bike paths, and transit.

Buildings

Add wall and roof insulation.
Upgrade to insulated windows and doors.
Caulk air leaks.
Use high efficiency air conditioning or coolers.
Install solar-electric panels.
Install solar hot-water system.
Use natural light and low-wattage light bulbs.
Shade buildings with trees and shrubs.
Dry clothes using the sun.

Use local materials.
Recycle solid waste material locally for future uses.

Social

Talk with your neighbors.
Teach children.
Join groups doing sustainability work.
Help people who need help.
Introduce sustainability into your work and social groups.
Share work projects with others.
Buy Locally. Employ locally.
Spend leisure time in Tucson.
Celebrate community.

Cool Cities Committee

The Cool Cities Committee working group includes: Committee Chair Bob Cook, Tres English, Russell Lowes, Bruce Plenk, Linda Rothchild, and Carol Tepper.

APPENDIX A

Metro Tucson Energy Consumption and CO2 Emissions 1990 - 2006

		DOE CO2 coefficient (Lbs CO2 /million BTU)	Energy Consumption Annual % Change '92-'98 = 1.5% except	1990 minus 7% Trillion BTUs	1990 minus 7% Metric Tons CO2	1990 Trillion BTUs	1990 Metric tons CO2 (1TBTU = 254,570.326 MT CO2)	1992 Trillion BTUs	1998 Trillion BTUs	2000 Trillion BTUs	2000 Metric Tons CO2	2005 Trillion BTUs	2005 Metric Tons CO2	2006 Trillion BTUs	2006 Metric Tons CO2
Residential	**Coal electricity**	1915 lbs CO2/MWh		6.95	1,768,288.76	7.47	1,901,385.76	7.70	9.70	9.99	2,543,412.13	10.79	2,746,885.10	10.95	2,788,088.37
	Natural gas	117.00	-2.00	10.45	554,359.24	11.23	596,085.21	10.80	9.10	8.74	463,621.83	7.86	417,259.64	7.71	408,914.45
	other	139.10		0.63	39,842.38	0.68	42,841.27	0.70	0.70	0.72	45,491.24	0.78	49,130.54	0.79	49,867.50
Commercial	**Coal electricity**	1915 lbs CO2/MWh		4.78	1,217,133.82	5.14	1,308,746.05	5.30	5.60	5.77	1,468,361.64	6.23	1,585,830.57	6.32	1,609,618.03
	Natural gas	117.00	-2.00	7.25	384,971.70	7.80	413,948.06	7.50	6.30	6.05	320,968.96	5.44	288,872.06	5.33	283,094.62
	gasoline	156.40		0.27	19,198.98	0.29	20,644.06	0.30					0.00		0.00
	diesel	161.40		0.27	19,812.75	0.29	21,304.04	0.30	0.60	0.62	45,243.62	0.67	48,863.11	0.68	49,596.06
	other	139.10		0.09	5,691.77	0.10	6,120.18	0.10	0.10	0.10	6,498.75	0.11	7,018.65	0.11	7,123.93
Industrial	**Coal electricity**	1915 lbs CO2/MWh		8.75	2,227,584.54	9.41	2,395,252.20	9.70	11.80	12.15	3,094,047.74	13.13	3,341,571.56	13.32	3,391,695.14
	Natural gas	117.00		5.32	282,460.64	5.72	303,721.12	5.90	8.70	8.96	475,562.64	9.68	513,607.65	9.82	521,311.76
	coal	215.00		1.44	140,759.76	1.55	151,354.58	1.60	3.40	3.50	341,523.02	3.78	368,844.87	3.84	374,377.54
	gasoline	156.40		0.27	19,198.98	0.29	20,644.06	0.30	0.50	0.52	36,535.02	0.56	39,457.82	0.56	40,049.69
	diesel	161.40		3.34	244,357.30	3.59	262,749.79	3.70	4.70	4.84	354,408.39	5.23	382,761.07	5.31	388,502.48
	other	139.10		4.96	313,047.25	5.34	336,609.94	5.50	5.50	5.67	357,431.18	6.12	386,025.67	6.21	391,816.06
Transportation	**gasoline**	156.40		36.63	2,598,261.46	39.38	2,793,829.53	40.60	44.30	45.63	3,237,002.88	49.28	3,495,963.11	50.02	3,548,402.56
	diesel	161.40	3.00	11.45	838,399.51	12.31	901,504.85	13.10	16.90	17.91	1,311,479.44	20.78	1,521,316.15	21.40	1,566,955.63
	Jet fuel	156.30		6.31	447,689.68	6.79	481,386.76	7.00	5.50	5.67	401,628.27	6.12	433,758.54	6.21	440,264.91
	other	139.10		0.54	34,150.61	0.58	36,721.08	0.60	0.70	0.72	45,491.24	0.78	49,130.54	0.79	49,867.50
	Total Coal electricity			20.39	5,213,007.13	21.92	5,605,384.01	22.70	27.10	28.03	7,105,821.51	30.64	7,674,287.23	31.17	7,789,401.54
	Total Nat gas	117.00		22.86	1,221,791.58	24.58	1,313,754.39	24.20	24.10	24.01	1,260,153.42	24.00	1,219,739.35	24.06	1,213,320.83
	Total coal	215.00		1.44	140,759.76	1.55	151,354.58	1.60	3.40	3.50	341,523.02	3.78	368,844.87	3.84	374,377.54
	Total gasoline	156.40		37.17	2,636,659.41	39.96	2,835,117.65	41.20	44.80	46.14	3,273,537.90	49.84	3,535,420.93	50.58	3,588,452.25
	Total diesel	161.40		15.06	1,102,569.57	16.19	1,185,558.67	17.10	22.20	22.87	1,711,131.46	26.68	1,952,940.33	27.39	2,005,054.18
	Total Jet fuel	156.30		6.31	447,689.68	6.79	481,386.76	7.00	5.50	5.67	401,628.27	6.12	433,758.54	6.21	440,264.91
	Total other			6.22	392,732.00	6.69	422,292.47	6.90	7.00	7.21	454,912.41	7.79	491,305.40	7.90	498,674.98
TOTAL				109.45	11,155,209.13	117.69	11,994,848.52	120.70	134.10	137.93	14,548,707.99	148.84	15,676,296.65	151.15	15,909,546.23
	Total Residential			18.02	2,362,490.38	19.38	2,540,312.24	19.20	19.50	19.45	3,052,525.19	19.43	3,213,275.28	19.45	3,246,870.32
	Total Commercial			12.67	1,646,809.02	13.62	1,770,762.38	13.50	12.60	12.54	1,841,072.97	12.45	1,930,584.40	12.45	1,949,432.64
	Total Industrial			23.83	3,227,408.47	25.63	3,470,331.69	26.70	34.60	36.02	4,659,507.99	40.00	5,032,268.63	40.83	5,107,752.66
	Total Transport			54.93	3,918,501.26	59.07	4,213,442.21	61.30	67.40	69.93	4,995,601.84	76.96	5,500,168.34	78.42	5,605,490.60
TOTAL				109.45	11,155,209.13	117.69	11,994,848.52	120.70	134.10	137.93	14,548,707.99	148.84	15,676,296.65	151.15	15,909,546.23

Original data from:

1. “Community Energy Assessment for the Tucson-Pima Metropolitan Area”, Dr. Helmut J. Frank, Tucson-Pima Metropolitan Energy Commission, 1994.
2. “Tucson-Pima Energy Assessment Update”, Dr. Helmut J. Frank, Tucson-Pima Metropolitan Energy Commission, 2000.
3. U.S. Department Of Energy, Energy Information Administration, CO2 Coefficient Tables. http://www.eia.doe.gov/oiaf/1605/coefficients.html
4. Tucson Electric Power, Telephone interview. 2009