City of Ann Arbor

2012

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CITY OF ANN ARBOR
CLIMATE ACTION PLAN
EXECUTIVE SUMMARY

The City of Ann Arbor Climate Action Plan

Climate change is not a future problem: it is happening now. Unprecedented disruptions are happening locally and globally, and immediate, impactful action is needed to mitigate emissions of greenhouse gases (GHGs) contributing to this global challenge.

This Climate Action Plan is community focused, meaning it is not limited to addressing municipal government emissions, which in Ann Arbor make up less than two percent of the entire community's emissions inventory. The actions found in the Plan may not all be feasible immediately; some may never be possible. There also may be emerging or unexplored ideas not discussed in these pages that will be identified in the future. As with any large-scale project or endeavor, actions that the municipality ultimately implements that require upfront investments will be brought before decision makers for consideration.

Underlying this Plan is the belief that the consequences to society and natural systems from continued inaction far outweigh the costs and challenges associated with the implementation of the proposed actions.

The Climate Action Plan recognizes the substantial scientific evidence that predicts a changing climate and the real role of cities in evaluating and managing the risks threatening city residents and municipal systems.

This executive summary provides an overview of:

- The likely effects of climate change to Ann Arbor and the Great Lakes Region;
- The inventory of City GHG emissions in 2000 and 2010 and the relative contributions from the Commercial, Residential, Transportation, Waste Management, and University of Michigan sectors; and
- Recommended GHG targets and categories of actions to mitigate and adapt to a changing climate.

This Climate Action Plan also recognizes the important role of the University of Michigan (UM) as not only a large generator of community GHG emissions, but also a leader in developing a GHG reduction plan that is underway and making progress. Opportunities for collaboration between the City and University are ongoing on several fronts and should continue in the years ahead.

Climate change, as discussed in this report, refers to the rapid climate shifts observed in recent years attributed to persistent anthropogenic (human-caused) changes in the composition of the atmosphere. Man- made GHGs in the Earth's atmosphere are changing the heat balance of the planet causing overall global temperature increases, which, in turn, threaten global public health, economies, and food and water supplies.

The City of Ann Arbor is actively working with local universities and their research centers, such as the Great Lakes Integrated Sciences and Assessments Center (GLISA), to assemble the best available scientific forecasts on the effects of climate change.

The predicted effects of accelerating warming in the Great Lakes region include:

- Decreased winter ice cover;
- Increased extreme weather events;
- Changing rainfall patterns disruptive to crop productivity;
- Shifts in distribution and composition of animal, insect, and floral species which may radically disrupt existing ecosystems; and
- Risk of new diseases in the region traditionally found in warmer climates.

The Likely Effects of Climate Change

The Inventory — Comparing GHGs 2000 to 2010

Total GHG emissions across the Ann Arbor community in 2010, with UM included, were over 2.2 million metric tons of CO_2e. This is up slightly from 2.19 million metric tons in 2000. Ann Arbor is largely built out to its geographic boundary, but a decline in commercial/industrial emissions during this time and a concurrent uptick in activity and emissions at UM nearly leveled off the appearance of a significant change in emissions. The GHG inventory attempts to only track emissions within the city limits.

The Residential Sector

The Residential sector created **approximately 22 percent** of total community emissions. The Residential sector experienced a modest increase of 3.4 percent between 2000 and 2010.

Climate change contributes to overall warmer temperatures and increased high-heat intensity days in the summer. This means there will likely be an increase in electricity-related emissions (e.g., to power air conditioners) and a reduction in natural gas emissions (e.g., to provide home heating in winter). Without substantial increases in the amount of renewably generated electricity in the DTE grid, the Residential sector will remain a major source of GHG emissions as the grid is currently dominated by coal-fired power.

The Commercial/Industrial Sector

The Commercial/Industrial sector made up **approximately 25 percent** of 2010 community emissions. While this was the largest sector in 2000, after an estimated 23 percent decrease in 2010, it became the second-largest sector. Approximately 25 percent of the decline since 2000 in Commercial/Industrial emissions is explained by UM purchasing the 2 million-square-foot former Pfizer world headquarters campus that was re-opened as the North Campus Research Complex in 2010, thereby transfering emissions from this property to the UM sector. Remaining emissions reductions are possibly attributable to economic factors less easily pinpointed and spread out across a number of properties and businesses. While there was a decline in the total emissions in this sector, as more businesses reactivate underutilized building space in the future, Commercial/Industrial emissions could climb again. Price fluctuations for fuels, natural gas in particular, are also anticipated to impact this sector's emissions. Measures such as those identified in this Plan will need to be taken to mitigate consumption or improve building energy efficiency.

The Transportation Sector

The Transportation sector emissions made up **approximately 22 percent** of total 2010 emissions. This sector experienced a slight decrease in 2010 from 2000 levels. While total vehicle miles traveled have increased over this period, improvements in fuel efficiency are the likely reason emissions from this sector have decreased.

As in the building sectors, there are and will be technological advances that improve the "greenness" of the community's fleet of vehicles. Many residents are already taking it upon themselves to drive hybrid and more fuel-efficient cars. Even with these advances, continually improving options for walking, biking, busing, and better integrating land uses to reduce travel distances are essential to reducing GHG emissions in this sector.

An important limitation to this inventory is the lack of information on emissions resulting from the production of items we purchase, use, and discard. A few communities are beginning to factor these emissions into their inventories, and future City GHG inventories and Plan updates would likely find that materials consumption in the community is a major source of GHG emissions that are caused by city consumption but occur outside of the City. This is similar to the use of electricity that is consumed locally, but produced by fossil fuels like coal outside city limits.

The Waste Sector

The Waste sector decreased more than 25 percent from 2000 to 2010 because of increased recycling rates and a decrease in waste collection volumes throughout the City.

While the Waste sector includes annual solid waste collection and the embedded future emissions from landfilling, annual methane released from the closed Ann Arbor landfill, and annual process emissions from wastewater treatment, total emissions still make up **less than 1 percent** of total community GHG emissions.

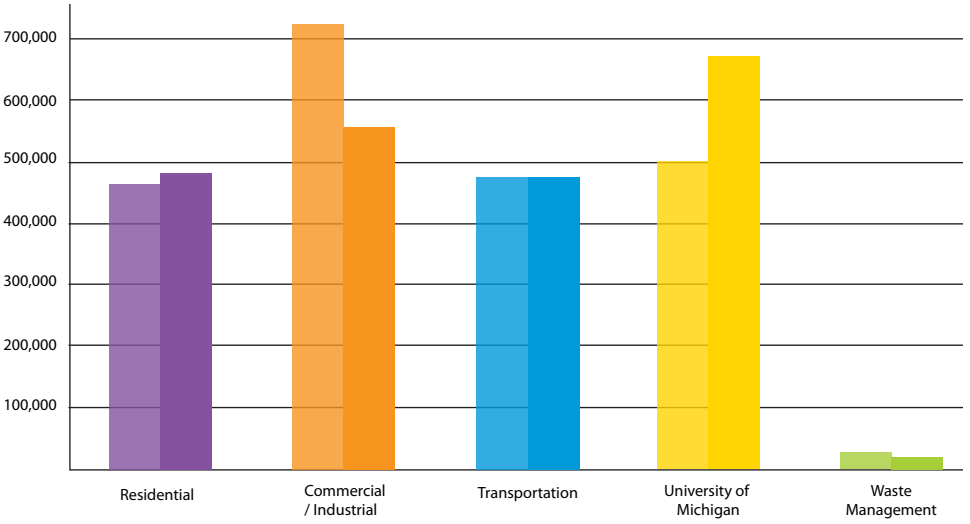

Figure 1: Total 2000 GHG emissions (left) compared to total 2010 GHG emissions (right)

Since implementing single-stream recycling in 2010, trash tonnages have decreased by 10 percent and recycling rates have increased by 24 percent. The City should continue to look for ways to reduce waste and increase the amount of material that is recycled or reused.

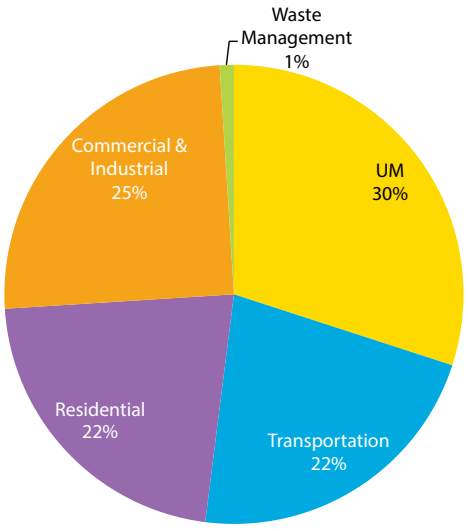

Figure 2: 2010 GHG inventory

The University of Michigan

UM is treated as its own sector given that its own GHG reduction plan is underway and detailed emissions data are available.[1] **Approximately 30 percent** of community emissions in 2010 derive from UM. Ann Arbor's Climate Action Plan represents a continued partnership with UM and its facilities staff, and the Plan incorporates UM's commitments as a vital part of reducing future GHG emissions.

Between 2000 and 2010, UM activities and building square footage grew significantly. As stated in the Planet Blue Sustainability 2011 Annual Report: "[UM] is currently in the midst of an unprecedented period of growth." While emissions have increased at UM since 2000, the energy intensity (as measured by BTUs/person/square foot) has dropped annually in recent years as a result of energy efficiency improvements and emissions reductions strategies.

Recommended Targets and Actions

The Climate Action Task Force has identified the discontinuation of the use of fossil fuels as critical to the successful reduction of GHGs. By taking strong action, Ann Arbor would be able to not only move the City to zero use of fossil fuels by 2050 but also provide the leadership and a path for other communities to follow.

Ann Arbor would not be alone in calling for major reductions by mid-century, and a major shift in energy sources, over the coming decades. In fact, Ann Arbor would be aligning its goals with the best available climate science and would be joining the ranks of other leading governmental entities. For instance, the State of Maryland Climate Action Plan calls for a 90 percent reduction by 2050 (from 2006 levels), and other city climate action plans from across the country aspire to an 80 percent or more reduction by 2050 (e.g., Michigan's Climate Action Plan). Of course, for this to happen, larger moves toward renewable energy will be essential over the next 30 to 40 years. These changes will affect more than just Ann Arbor and will require structural shifts that are more fundamental and widespread than the actions or ideas laid out in this Plan. Whether by state or national regulations, such as a stronger renewable energy portfolio standard, or by other economic forces and societal will, the 2050 GHG reductions targeted here are only possible through a massive rethinking of the country's electricity, heating, and transportation fuel source system and supporting infrastructure.

The Climate Action Plan recommends three targets for community-wide GHG emissions reductions, all of which are relative to the year 2000 baseline.

- Short-term target (2011 Energy Challenge, City Council resolution R-11-142, April 19, 2011):

  Reduce CO_2e emissions 8 percent by 2015

- Mid-term target (aligns with University of Michigan 2025 target):

  Reduce CO_2e emissions 25 percent by 2025

- Long-term target: (meet optimal climate scenario[2,3]):

  Reduce CO_2e emissions 90 percent by 2050

For purposes of presentation in the report, and to align with the City of Ann Arbor's Sustainability Framework that will direct future City plans, goals, and priorities, actions detailed in this Plan have been grouped into four main categories: Energy and Buildings, Land Use and Access, Resource Management, and Community and Health.

Energy and Buildings

Resource Management

Land Use and Access

Community and Health

Table 1 breaks down the climate action categories and subcategories, number of recommended actions, and cumulative GHG reduction estimates outlined in this report. Not every action identified could be modeled for its GHG emission impact, so emission reductions shown by category, if all actions are implemented, would have a larger impact than is reflected in the estimates shown.

Many recommended actions depend not only on City Council approval but also participation from members of the community and local businesses or other entities. Thus, future collaboration among residents, businesses, local organizations, city government, UM, and other stakeholders is essential to design and implement solutions that achieve the recommended GHG reductions.

While this plan recommends many specific actions, the implementation details will be developed separately. Each of the recommended actions with any significant financial costs to the municipality will be brought before City Council for discussion, public comment, and decisions.

Action Categories	**Action Subcategories**	**# of Actions**	**Estimated GHG Emissions Reduction ($MTCO_2e$)**
Energy and Buildings	Higher Performing Buildings Energy Source Renewable Energy	25	381,607
Land Use and Access	Integrated Land Use Transportation Options Sustainable Systems	21	44,102
Resource Management	Responsible Resource Use Local Food Healthy Ecosystems	25	35,522
Community and Health	Engaged Community Safe Community	13	18,577

Table 1: Climate action categories and subcategories

In order to reach the 2025 GHG reduction target of 25 percent below year 2000 levels, almost all of the actions proposed in the Plan would need to be implemented. Figure 2a shows the predicted effects from the four action categories proposed in the Plan. If fully implemented, assuming no large increase in incremental consumption over 15 years, community emissions would be gradually reduced to 28 percent of 2000 levels by 2025.

Some actions will have an immediate impact when implemented, while others will take a decade or more to see full effect. Since UM has begun its own effort to reduce emissions 25 percent by 2025, the projection curve omits UM emissions, and assumes they are on pace with planned reductions.

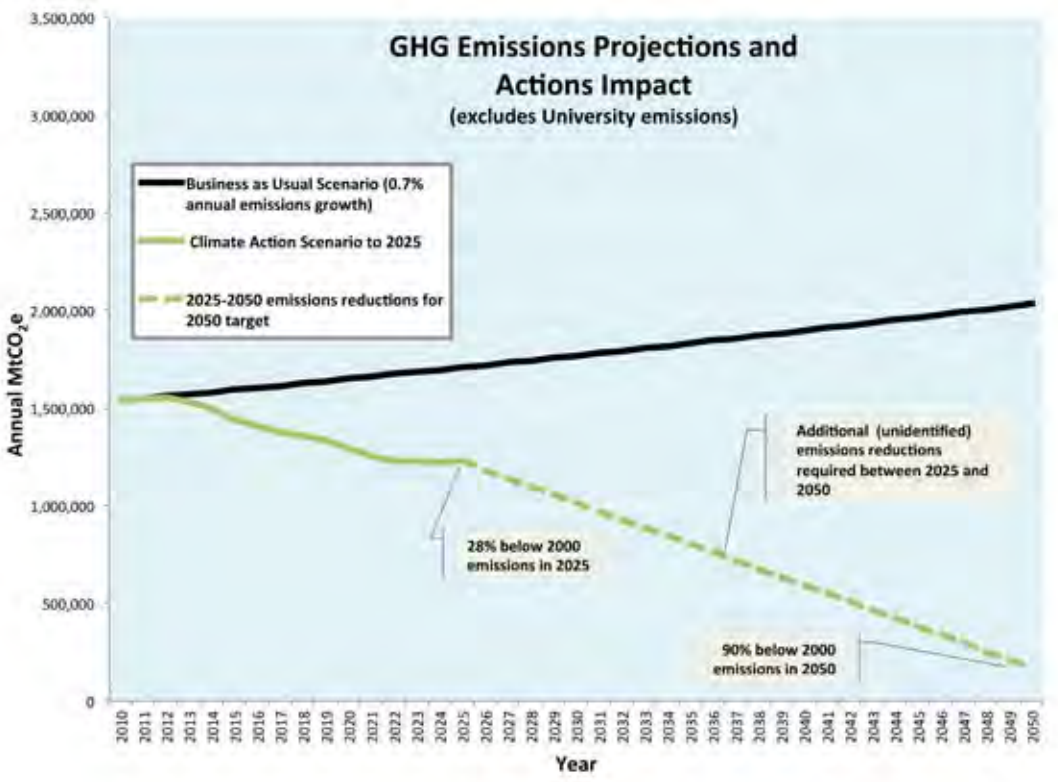

Figure 3: GHG Emissions Projections and Actions Impact

To achieve the long-term target, a 90 percent GHG reduction by 2050, major shifts in energy sources must occur — changes that most likely eliminate reliance on fossil fuels by the building and transportation sectors. This Plan cannot predict what actions should occur during that distant timeframe, but it will likely require a significant shift from fossil fuels to a broad set of renewable energy sources. Implementing the identified actions from now to 2025 will better position Ann Arbor to enact policies or influence decisions affecting the source and course of fuel and energy supplies in the longer 38-year horizon, out to 2050.

Ann Arbor must also begin to plan for and attempt to adapt to the effects of climate change across the community and within municipal systems. Adaptation and mitigation efforts combined will produce the greatest results and should be treated as a set of actions, not as alternatives to each other. Even the best mitigation efforts cannot eliminate the expected impacts of climate change over the first half of the century and beyond. This Plan recommends five specific strategies that the City of Ann Arbor and its residents can use to react effectively and efficiently to climate-related challenges:

- Implement "no regrets" adaptation actions now
- Ensure an integrated systems planning approach to the building and natural infrastructure for all climate change planning scenarios
- Protect citizens from health and safety hazards
- Integrate climate projections into all City planning across all systems
- Update and maintain technology and plans to support emergency management responses to extreme climate events

These strategies are intended to build resilience, prepare for extreme events, and prevent future negative outcomes. However, since this Plan predominantly focuses on detailing climate mitigation strategies, the City should pursue additional ways to outline a more detailed, thorough, and specific climate adaptation strategy that encompasses the over-arching strategies above. As more research and policy tools emerge to help cities understand the impending and current local impacts of climate change, Ann Arbor will be positioned to effectively respond to one of the most pressing issues we face.

Adaptation

For a copy of the full Climate Action Plan, visit www.a2energy.org/climate

Executive Summary Endnotes:
1 http://www.ocs.umich.edu/greenhouse.html
2 http://www.planning.org/pas/memo/open/jan2009/
3 http://pubs.giss.nasa.gov/docs/2008/2008_Hansen_etal.pdf

Acknowledgements

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Abbreviations

ADA: American with Disabilities Act

AFV: alternative-fueled vehicle

ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

CAP: Climate Action Plan, the Plan

CFL: compact fluorescent lamp

CH_4: methane

CHP: combined heat and power

CIP: capital Improvements Program

CO_2: carbon dioxide

DSM: Demand Side Management

DTE: Detroit Edison

GHG: greenhouse gas

ICLEI: International Council for Local Environmental Initiatives

IECC: International Energy Conservation Code

IPCC: Intergovernmental Panel on Climate Change

kWh: kilowatt hour

LED: light-emitting diode

LEED: Leadership in Energy and Environmental Design, a third-party certification program for the design, construction and operation of high performance green buildings.

MDNRE: Michigan Department of Natural Resources and Environment

MDOT: Michigan Department of Transportation

$MTCO_2e$: metric tons of carbon dioxide equivalent

NAAQS: National Ambient Air Quality Standards

NOAA: National Oceanic and Atmospheric Administration

NOx: nitrogen oxides

PACE: Property Assessed Clean Energy

PPA: power purchase agreement

SEMCOG: Southeast Michigan Council of Governments

TIF: tax increment financing

UM: University of Michigan

VMT: vehicle miles traveled

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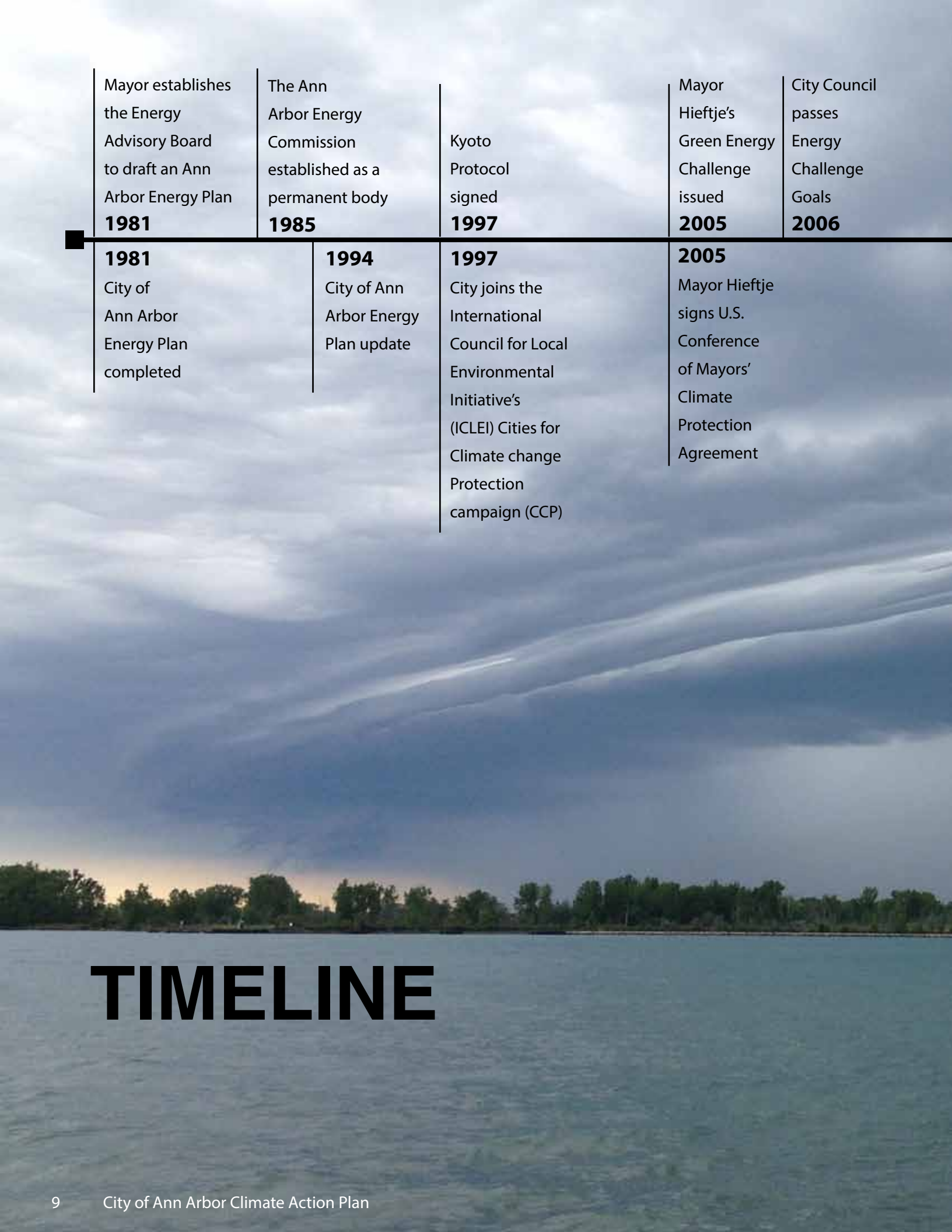


TIMELINE

Mayor establishes the Energy Advisory Board to draft an Ann Arbor Energy Plan
1981

The Ann Arbor Energy Commission established as a permanent body
1985

Kyoto Protocol signed
1997

Mayor Hieftje's Green Energy Challenge issued
2005

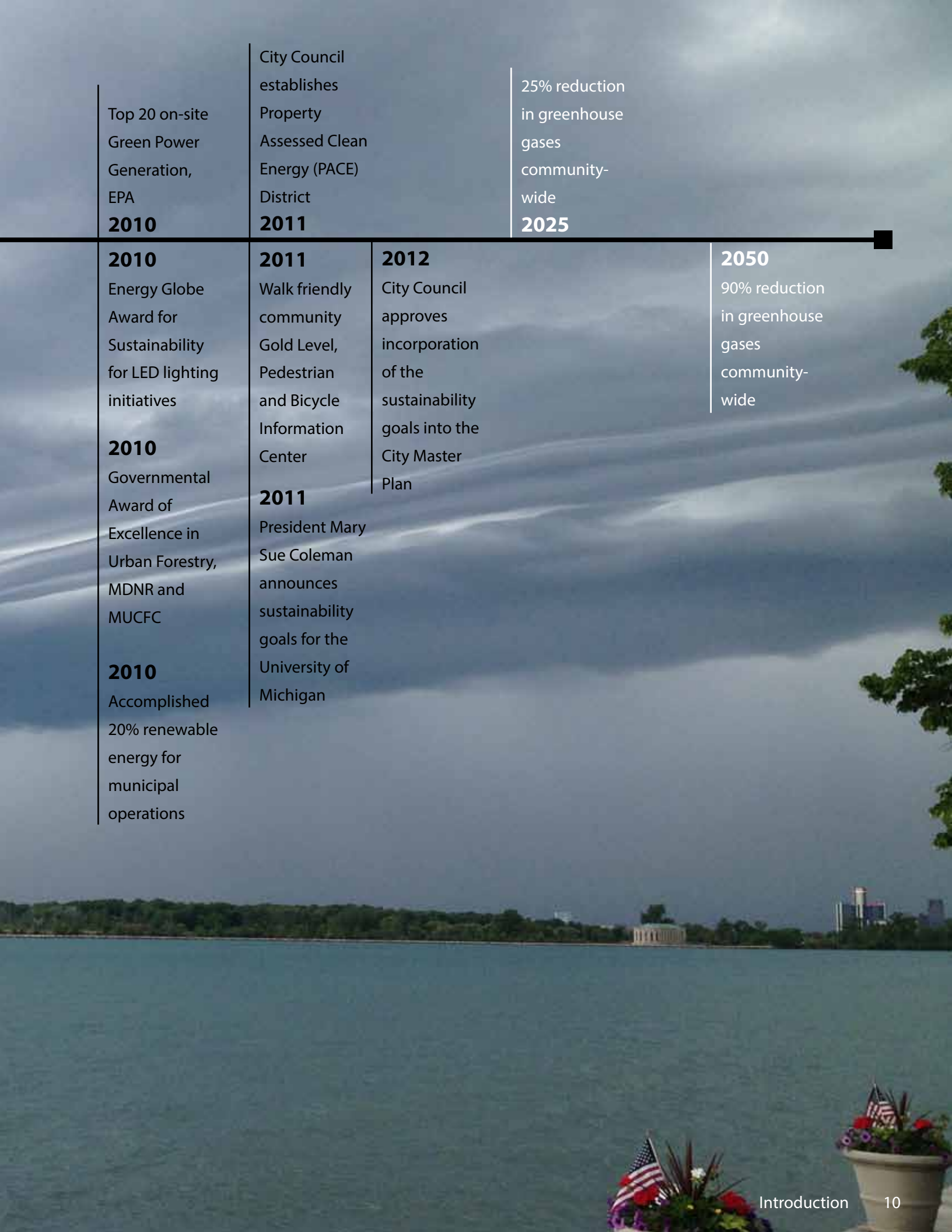
City Council passes Energy Challenge Goals
2006

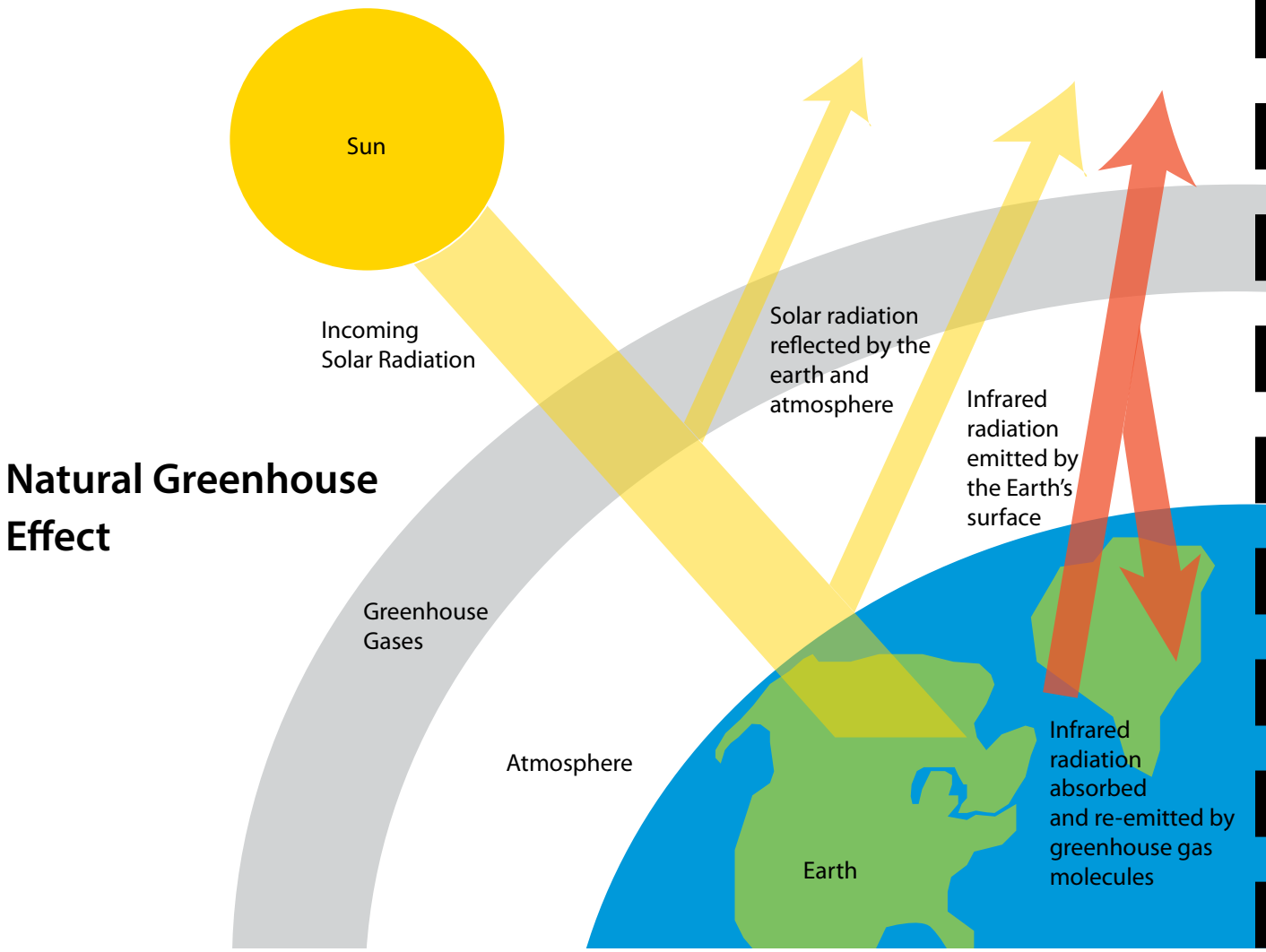
1981
City of Ann Arbor Energy Plan completed

1994
City of Ann Arbor Energy Plan update

1997
City joins the International Council for Local Environmental Initiative's (ICLEI) Cities for Climate change Protection campaign (CCP)

2005
Mayor Hieftje signs U.S. Conference of Mayors' Climate Protection Agreement

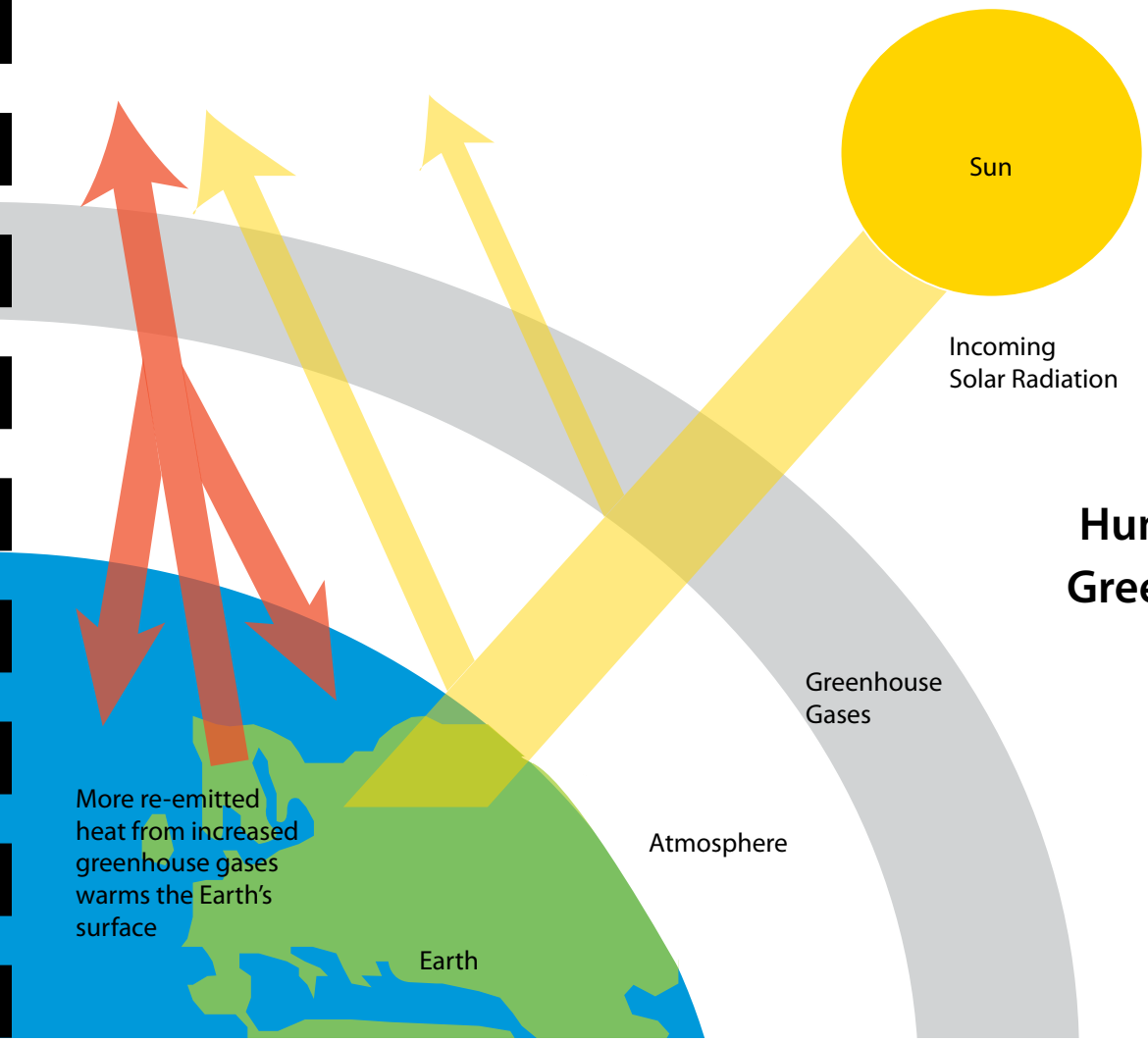

Top 20 on-site Green Power Generation, EPA
2010
City Council establishes Property Assessed Clean Energy (PACE) District
2011
25% reduction in greenhouse gases community-wide
2025
2010
Energy Globe Award for Sustainability for LED lighting initiatives
2010
Governmental Award of Excellence in Urban Forestry, MDNR and MUCFC
2010
Accomplished 20% renewable energy for municipal operations
2011
Walk friendly community Gold Level, Pedestrian and Bicycle Information Center
2011
President Mary Sue Coleman announces sustainability goals for the University of Michigan
2012
City Council approves incorporation of the sustainability goals into the City Master Plan
2050
90% reduction in greenhouse gases community-wide



CLIMATE

Climate change is a shift in global climate patterns beginning in the mid to late 20th century that, by strong scientific consensus, is attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.[1] These changes alter the composition of the global atmosphere and are in addition to natural climate variability observed over comparable time periods.[2] Climate change has resulted in a pronounced difference in average weather conditions, as well as shifts in the distribution of events (e.g., more or fewer extreme weather events), which are measured in terms of precipitation, temperature, humidity, and wind.

While Earth's climate has changed naturally over long periods of time, as demonstrated by ice ages and other events in the fossil record, climate change as discussed in this report refers to the rapid climate shifts observed in recent years attributed to persistent anthropogenic (human-caused) changes in the composition of the atmosphere.



CHANGE

There is a high level of scientific consensus that changes currently underway are heavily driven by human emissions of carbon dioxide, methane, and other heat-trapping gases, known as greenhouse gases (GHGs).[3] Since the Industrial Revolution in the late 19th century, concentrations of manmade GHG emissions have been increasing in the atmosphere. During the last 50 years alone, levels of carbon dioxide in the atmosphere have increased 30 percent and methane concentrations have doubled.[4]

These rapidly increasing concentrations of GHGs are caused by the burning of fossil fuels — coal, oil, and natural gas — that power the growing global economy, as well as changes in land use patterns, including deforestation, industrialized agriculture, and land clearing. Increased emissions from manmade GHGs in the Earth's atmosphere are changing the heat balance of the planet causing the overall global temperature to increase.

Observed and Projected Impacts

Rising Temperatures

"Average temperatures increased by 2.3 degrees F (1.3 degrees C) from 1968 to 2002 in the Great Lakes region."

Extreme Weather Events

"The frequency and intensity of severe storms has increased, and current models suggest that this trend will continue as the effects of climate change become more pronounced."

Precipitation

"Warmer temperatures will lead to less precipitation falling as snow, and more falling as rain."

In 2007, scientists from the Intergovernmental Panel on Climate Change (IPCC) reported that "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations," and called the warming of the planet "unequivocal."[5] A wealth of evidence points to human activities as the main cause of global warming over the past 50 years.[6]

Average global temperatures have increased nearly 1.8 degrees Fahrenheit (one degree Celsius) since 1955. According to the National Oceanic and Atmospheric Administration (NOAA), the Earth's average temperature is warming at a rate of 0.29 degrees Fahrenheit per decade.[7] Continued increases of GHG emissions are predicted to lead to an average additional temperature increase of 1.8 to 5.4 degrees Fahrenheit by 2050.[8] Temperature increases will likely lead to increased frequency and intensity of precipitation events, increased evaporation, loss of soil moisture, and a rise in sea level. With these profound changes in the Earth's climate will come changes in extreme weather events and alterations in crop productivity. With increasing urgency, climate scientists continue to research the complexities of the planet's reaction to greater concentrations of GHGs, including the level of emissions reductions needed to stabilize the climate, speed at which the planet is reacting to climate change, and likely consequences to human civilization and biodiversity.

Source: GLISA, 2012. *Climate Change in the Great Lakes Region.*
http://www.glisa.msu.edu/docs/fact_sheets/GLISA_climate_change_summary.pdf

Increased extreme weather events

Soil erosion from persistent rainfall

Poor air quality

Mitigation

Mitigation refers to efforts to reduce the sources of GHGs or enhance the Earth's ability to sequester them. In an effort to set GHG stabilization targets that would prevent catastrophic, irreversible climate change, climate scientists worldwide have suggested limiting temperature increase to a global average of 2 degrees Celsius.[9]

Due to the long lifetime of GHGs in the atmosphere, it is necessary to think in terms of cumulative emissions that started with the Industrial Revolution. Even if all GHG emission-producing activities were to cease immediately, there is a certain amount of aditional climate change (and anticipated temperature increase) that will still occur.

A Word About Adaptation

While mitigation eliminates or reduces the hazards and risks associated with climate change by reducing GHG emissions, adaptation refers to taking measures to prepare for unavoidable climate change. These approaches overlap and the benefits of taking action in one area often affect the other. The City has many adaptive strategies underway, most of which were not designed in response to climate change, but still fall under the realm of climate adaptation. For example, building rain gardens and harvesting rainwater on-site is an adaptation technique that facilitates a reduction in flooding during storm events. This action also saves energy by reducing the need to pump water, which is a long-term mitigation technique. Short-term investments made to adapt to climate changes often have long-term mitigation benefits. Adaptation and mitigation efforts combined will produce the greatest results and should be treated as a set of actions, not as alternatives to each other.

Habitat loss

Increased average temperatures

Risk of contamination and disease

GLOBAL CLIMATE EFFORTS

Climate change is a worldwide challenge and will require far-reaching efforts. The global community has been trying to develop an international response to climate change since 1997, with the adoption of the Kyoto Protocol that became effective in 2005. The countries that ratified the Kyoto Protocol commitments set emission reduction targets for 2012.

At the time, the protocol was widely seen as a vital first step in global cooperation to achieve emissions reductions. While the United States did not ratify the Kyoto Protocol at the federal level, several individual states recognized the risks that climate change will bring to infrastructure and the wellbeing of citizens, and therefore established climate change strategies of their own. To date, 30 states have completed climate action plans (see map below). These plans are in various stages of implementation; however, in a few instances some plans have been shelved when elections brought in new leadership with a different set of priorities.

Copenhagen Accord

In 2009, the U.S., along with 113 other nations, singed on to the Copenhagen Accord, thereby formally recognizing the threat of climate change. While the declaration acknowledges that "actions should be taken to keep any temperature increases to below 2 degrees C", no internationally agreed upon GHG reduction targets were established.

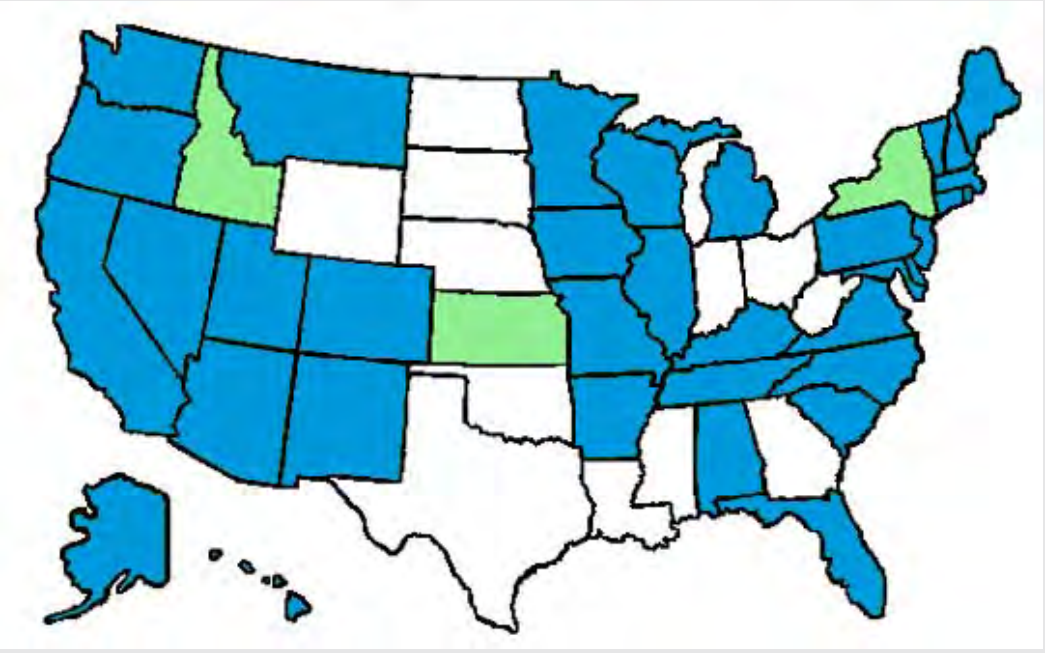


Figure 4:
U.S. States with Climate Action Plans July, 2012

Source: Pew Center on Global Climate Change

State of Michigan

The U.S. Environmental Protection Agency forecasts that the biggest threats climate change presents in the State of Michigan will likely be seen in the form of droughts, increased intensity and frequency of precipitation events, and increased frequency of heat waves during the summer months.[10]

On November 14, 2007, Governor Jennifer M. Granholm issued Executive Order No. 2007-42 establishing the Michigan Climate Action Council. The Council comprised members representing academia, industry, utilities, state and local government, and environmental interest groups. The Council was tasked with the following:

- Produce an inventory and forecast of GHG sources and emissions from 1990-2020.
- Consider potential state and multi-state actions to mitigate and adapt to climate change in various sectors including energy supply, energy efficiency and conservation, industrial process and waste management, transportation and land use, and agriculture and forestry.
- Develop a comprehensive Climate Action Plan with specific recommendations for reducing GHGs in Michigan by business, government, and the general public.
- Advise state and local government on measures to address climate change.

The resulting state Climate Action Plan, finalized in March of 2009, contains a detailed GHG inventory for Michigan, a platform of positions, emission reduction goals from this plan, and recommendations supported by cost modeling. While cities are not given directives, it is clear local governments should initiate local actions to address climate change. With the election of a new governor in 2010, the future of implementation of the State plan is unclear.

The Role of Cities

Mitigating climate change depends on reducing activities that cause GHG emissions. While global targets and state-level policies are important, there continues to be limited action from federal and international agencies. At the local level, collaboration among municipalities is essential to create the innovation necessary to effectively reduce GHG emissions. Mitigating GHG emissions will require reducing energy use, shifting electricity generation from high-emission fuels (such as coal) to low- or no-carbon renewable energy sources, and re-envisioning land use and agricultural activities.

In 2005, the U.S. Conference of Mayors recognized the need to play a key leadership role in the area of climate protection. Mayors pledging to achieve the goals of the Kyoto Protocol in their own cities signed the organization's Climate Protection Agreement. As of early 2012, more than 1,000 mayors from all over the world have signed the agreement, representing nearly 89 million citizens.

According to a March 2010 UN and World Bank report, "With the majority of the world's population now urbanized, cities will be at the forefront of efforts to reduce GHG emissions."[11] With this call to action in mind, and with the leadership of the Michigan Climate Action Plan as guidance, the City of Ann Arbor is now joining the global effort on a local level by developing this Climate Action Plan.

Cities are responsible for two-thirds of global energy use and more than 70 percent of heat-trapping emissions.

ICLEI

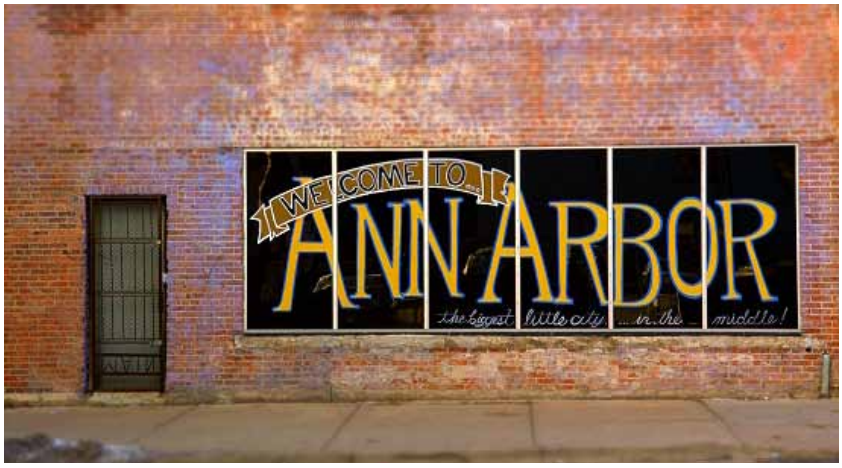
Founded in 1990 as the International Council for Local Environmental Initiatives, ICLEI – Local Governments for Sustainability is an international association made up of more than 1,220 municipalities committed to sustainability.[10] In the United States, more than 500 local communities have joined ICLEI and made a commitment to sustainable development and climate protection. ICLEI provides assistance to local and regional governments by helping to integrate sustainability and climate mitigation techniques into decision making. The program provides cities with climate-related technical and policy assistance, software training, and information services. To learn more about ICLEI's work in the U.S., please visit www.icleiusa.org.

Snapshot of Ann Arbor

Ann Arbor is located in Washtenaw County, an area of southeast Michigan approximately 40 miles west of Detroit. Founded in 1824, the City grew steadily after the University of Michigan (UM) relocated here from Detroit in 1837. Over time it received the nickname of "Tree Town" due to its densely forested residential areas, parks, and urban corridors. Today, around 114,000 residents live within the City's 28 square miles. Ann Arbor's affiliation with five colleges and universities makes it a hub for excellence in education. UM plays a large role in Ann Arbor's economy and employs nearly 30,000 people in health services, education, high-tech research, and biotechnology.

The City of Ann Arbor's leadership recognizes the serious threats that climate change poses to the local environment, economy, and livelihoods. Research from organizations such as the Great Lakes Integrated Sciences and Assessments Center (GLISA) predicts that as a result of rapid climate change, the Great Lakes region in particular will experience temperature increases, increases in extreme weather events, changes to rainfall patterns, and lake temperature changes.

The impact of these changes will likely include decreased winter ice cover, increased need for stormwater management, shifts in agricultural productivity, changes in vegetation, as well as in the distribution and composition of animal and insect species, and risk of diseases that traditionally have been found in warmer climates.



Projected Population Growth:

Southeast Michigan Council of Governments (SEMCOG) estimates that by 2040, Washtenaw County will have nearly 40,000 more residents — a 12 percent increase in population. Projections show that the majority of the increase will be people age 55 and older, while the younger population will decrease. Although SEMCOG predicts Washtenaw County will have a 12 percent increase, it estimates that Ann Arbor's population will grow by a mere 0.4 percent. Expected growth in the surrounding townships will have a significant impact on the City's transportation sector, as a large number of employment opportunities will continue to reside within city limits.

Projected Climate Impacts in Ann Arbor:

- Warmer winter and evening temperatures
- Loss of snow cover
- Increased frequency and intensity of extreme weather events
- Increased precipitation throughout winter and spring
    - More high water events
    - More groundwater recharge
    - Soil loss due to erosion
    - Degredation of plants and animals in wetland areas due to river disruptions from flooding events or droughts

Background of City Action

The City has had a longstanding commitment to energy conservation, having formed a citizen-advisory Energy Commission in 1981 that crafted Ann Arbor's first Energy Plan, and has gone on to develop innovative recommendations for advancing renewable energy and improving energy efficiency in Ann Arbor. The Ann Arbor Energy Office now staffs this commission, in addition to seeing to the operational energy needs of the City and pursuing new opportunities for reducing the municipal carbon footprint while encouraging residents and businesses to do the same.

In 2005, Ann Arbor Mayor John Hieftje joined other signees of the U.S. Mayors Climate Protection Agreement by pledging to meet the Kyoto Protocol emissions reduction targets at the local level through community-level action. In addition, the agreement urges federal and state governments to endorse policies and programs aimed at reducing GHG levels, and encourages Congress to pass GHG reduction legislation.

In a speech to City Council on September 19, 2005, Mayor Hieftje issued the Ann Arbor Energy Challenge, calling for Ann Arbor municipal operations to use 20 percent renewable energy by 2010 and for the whole community to use 5 percent by 2015. After the Energy Commission reported to Council that the City could surpass the 20 percent renewable energy target for municipal operations thanks to the development of wind energy projects in Michigan, Mayor Hieftje raised the goal to 30 percent by 2010. On May 1, 2006, City Council unanimously passed a resolution to formally adopt these goals. The City reached its original 20 percent renewable energy goal for municipal operations in 2010 primarily based on municipal generation of electricity from hydropower and landfill gas. A re-evaluation of the Energy Challenge Goals by the Energy Commission and Energy Office in early 2011, utilizing available data and forecasting future scenarios, resulted in new City Council-approved municipal operations and community goals for 2015 (see box below).

In 2010, the Energy Office received a Pollution Prevention grant from the Michigan Department of Natural Resources and Environment (now the Michigan Department of Environmental Quality) enabling the City to assemble a task force of diverse experts to draft this community Climate Action Plan (Plan). The Plan uses existing data on city-wide emissions to identify reduction opportunities in the short- and long-term and outlines mitigation strategies.

2015 Energy Challenge Goals

For municipal operations:

- Reducing greenhouse gas emissions 50 percent from 2000 levels;
- 30 percent renewable energy

For the entire community:

- Reducing greenhouse gas emissions 8 percent from 2000 levels;
- 5 percent renewable energy

The Climate Action Task Force

The City of Ann Arbor Climate Action Task Force is made up of 13 individuals offering varied perspectives and expertise, representing 12 different organizations that are actively engaged on issues affected by climate change. The City of Ann Arbor Energy Commission, by resolution, assembled the Task Force in August 2011 to develop mid- and long-term GHG reduction goals and identify actions necessary to accomplish these goals, through a Climate Action Plan. Starting in September 2011, the Task Force met approximately monthly for a total of six full-group meetings and many sub-committee meetings over the course of nine months. This group identified the actions comprising the heart of the Plan.

Task Force Members

Terry Alexander - Executive Director, Office of Campus Sustainability, University of Michigan

Wayne Appleyard - Chair, Ann Arbor Energy Commission

Bonnie Bona - Ann Arbor City Planning Commission

Richard Fleece - Public Health Director, Washtenaw County

Mike Garfield - Director, Ecology Center

Charles Hookham - Ann Arbor Energy Commission

Joseph Malcoun - DTE Energy Resources

Steve Manville - Washtenaw County Public Health, Citizen Representative

Laura Rubin - Executive Director, Huron River Watershed Council

Nancy Shore - Director, getDowntown

Mike Shriberg - Education Director, Graham Environmental Sustainability Institute, University of Michigan, Ann Arbor Energy Commission

Valerie Strassberg - Ann Arbor Environmental Commission

Chris White - Manager of Service Development, Ann Arbor Transit Authority

Purpose

This Climate Action Plan identifies mid- and long-term GHG reduction targets and a list of actions to achieve those targets. The Plan is intended to guide Ann Arbor decision makers in taking action to meaningfully reduce GHG emissions. The Plan also outlines the City's short-term goals and accomplishments to date.

The Climate Actions section of the Plan is organized around four overarching themes that align with the City of Ann Arbor's Sustainability Framework, which helps direct local actions with overarching sustainability goals that were extracted from more than 20 years of local planning. For more information on the Sustainability Framework, see page 23. Many recommended actions depend on more than City Council approval and would require participation from members of the community and local businesses or other entities. Thus, future collaboration among residents, businesses, local organizations, city government, UM, and other stakeholders is essential to design and implement solutions that achieve the recommended GHG reductions.

While this Plan is a standalone document, it aligns with other state and regional plans in the major target areas examined for carbon reductions.

Defining the Plan Boundaries

Although GHGs are pervious to geographical boundaries, the actions needed to reduce emissions often depend on political, jurisdictional, or financial constraints. While understanding that many of the activities that occur within the City of Ann Arbor have upstream and downstream inputs and impacts outside our boundaries, City jurisdictional boundaries are considered the limits of Plan recommendations as well as the extent for inventorying known emissions.

UM is independent from many City actions or control. For purposes of telling a complete story of community emissions, UM emissions are included in the inventory as a distinct sector. UM is actively working on climate action (see page 27), so while certain recommended actions may impact UM, this Plan is meant to complement UM's internal climate plan.

Climate Action Plan Process

The first step, as identified in ICLEI's milestone process detailed on page 22, is to establish a baseline inventory of GHG emissions. As will be explained in detail in the Greenhouse Gas Emissions Inventory section, emissions from 2000 serve as the baseline year to measure the City's progress.

A community-wide emissions inventory was also completed for the 2010 calendar year. Results from 2010 were compared to the 2000 baseline to assess trends of emissions growth or decline. Using the results of the inventory comparison process, the Task Force was able to assess the sectors that contributed the most to community GHG emissions, which helped inform discussions on where to focus and begin action.

Members of the Task Force initially set reduction targets and then divided into working groups along the lines of the Sustainability Framework, or action categories. With guidance from the Steering Committee (described on page 23), these working groups drafted lists of actions that were then presented to the entire group for discussion and revision.

The Steering Committee then used established modeling tools, including ICLEI's Climate and Air Pollution Planning Assistant (CAPPA), and internal modeling spreadsheets to project the emissions reduction potential and life-cycle cost of the proposed actions, where possible. Some actions in the Plan could not be fully modeled but remain included in the Plan.

Climate and Air Pollution Planning Assistant (CAPPA):

CAPPA is an ICLEI tool utilized by the City to create a comprehensive emissions reduction dataset. CAPPA provides a database of emission reduction strategies within five categories: energy efficiency/conservation, energy generation, transportation, waste, and other. CAPPA version 1.5 was used by the City to calculate emissions reduction potential of actions in the Plan. Those actions not built into the CAPPA software were modeled separately.

ICLEI Milestones:

ICLEI provides local governments with the framework and methodology to calculate greenhouse gas emissions, establish targets to lower emissions, and monitor performance of reduction measures. As an ICLEI member the City of Ann Arbor utilized the milestone process in its Climate Action Plan process.

Milestone 1: Conduct a baseline emissions inventory and forecast.

Milestone 2: Adopt an emissions reduction target for the forecast year.

Milestone 3: Develop a local action plan for achieving the emissions reduction target.

Milestone 4: Implement the action plan.

Milestone 5: Monitor and report on progress.

Figure 5: ICLEI milestone process

Internal Meetings

The Climate Action Plan Steering Committee included staff from the City of Ann Arbor Energy Office, City of Ann Arbor Environmental Coordination, the Ann Arbor Energy Commission, and nonprofit partner Clean Energy Coalition. This internal advisory committee met three to four times per month from August 2011 through June 2012 to conduct background research, work with the broader Task Force, compile climate data, model recommended actions, and draft the Plan itself.

Public Outreach

The City of Ann Arbor has attempted to engage the public and incorporate feedback along the process of developing the Plan. The Climate and Energy outreach meeting took place on March 8, 2012, at the Ann Arbor District Library as part of the City of Ann Arbor Sustainability Forum series. A panel of six speakers provided members of the community with an overview of the Plan, local climate impacts, renewable and alternative energy, and energy efficiency. The 112 community members in attendance were able to ask questions and provide feedback.

Beginning in March of 2012, the Climate Action Plan was also brought to public meetings of the City's Energy, Environmental, and Planning Commissions, as well as other targeted events like the 2012 Mission Zero Festival. A presentation and feedback opportunity for City Council took place on June 11, 2012. The public will continue to be engaged as Plan recommendations are brought forward to City Council and other decision makers.

Ann Arbor Sustainability Framework

In 2011, the City of Ann Arbor received a grant from the Home Depot Foundation Sustainable Cities Institute to develop the following:

1) A sustainability framework that reorganized existing city plan goals into an overarching set of sustainability goals for Ann Arbor.

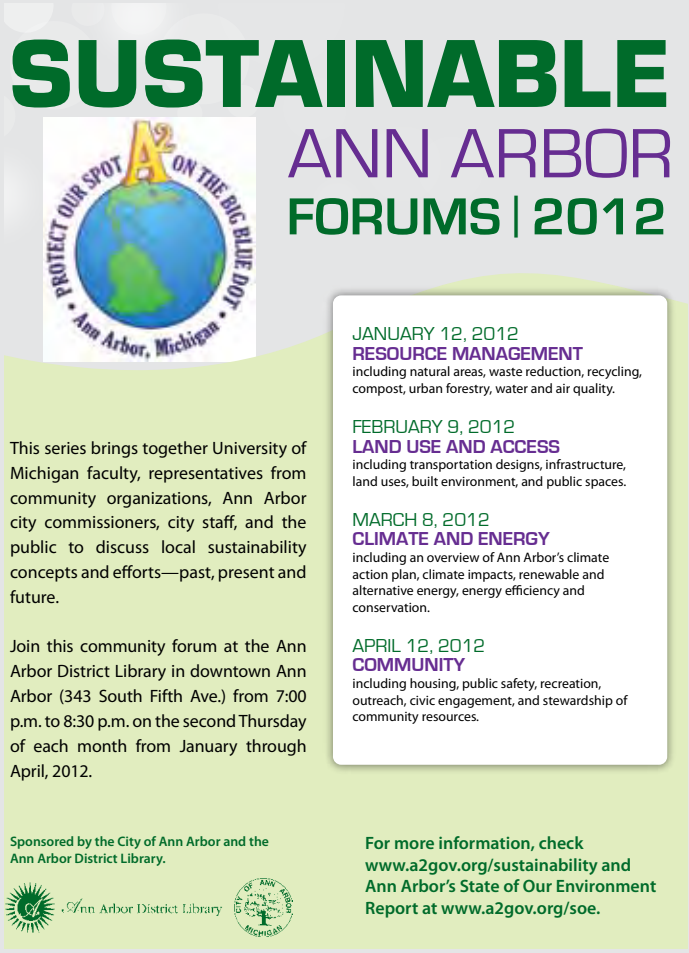
2) A sustainability action plan that organized established quantifiable targets and actions into one integrated plan to track progress.

This Climate Action Plan is the first of the City's plans to utilize the outcomes of the Sustainability Framework and align its goals with sustainability goals, based on the three key aspects of sustainability — environment, economy, and equity. Ann Arbor's sustainability goals are organized into four theme areas: 1) climate and energy, 2) community, 3) land use and access, 4) resource management. These theme areas helped set the categories and subcategories for the Climate Action Plan to ensure further alignment. Definitions and goals from the framework were thoroughly vetted through many city staff and a separate advisory group to ensure consistency with the City's vision, as defined in many Council Approved local plans.

While the City of Ann Arbor's Climate Action Plan is a standalone document developed with the powers and limitations placed on the City and the sensitivities of its citizenship, it aligns with other state and regional plans in the major target areas examined for carbon reductions. One area in which the Ann Arbor plan differs from the Michigan CAP is that high-level federal policy recommendations are largely excluded.

Climate & Energy Sustainability Forum

In early 2012, the City of Ann Arbor collaborated with the Ann Arbor District Library to host a "Sustainable Ann Arbor" discussion series. This series brought together UM faculty, representatives from community organizations, city commissioners, city staff, and the public to discuss local sustainability concepts and efforts — past, present and future. The series was organized around four theme areas: resource management, land use and access, climate and energy, and community. Each forum included a series of short presentations followed by a question and answer session, and were intended to help guide the City's sustainability framework planning efforts.



Challenges

Ann Arbor cannot take action to reduce local GHG emissions without considering the broader context in which it operates. This includes certain limitations — jurisdictional and financial — that act as short-term constraints. Some actions in this plan aim to address these constraints, while others seek to work within them.

Jurisdictional Challenges

The State of Michigan defines the powers of local governments, subject to federal law. While Michigan is a "home rule" state where broad authority is given to local governments, the state has reserved certain authorities for itself. For instance, Michigan's Uniform Energy Code sets a statewide standard for energy efficiency in new construction and major renovations and does not allow local governments to deviate from this standard. The Uniform Energy Code, as it stands today, prevents the City from passing a more stringent local energy code than the state code. This might be addressed by modifying the state law to allow more local authority or by modifying when the code is enforced at the local level, for instance, by requiring buildings to be brought up to the current code when they are sold.

UM's relationship with the City is unique. Although UM receives state funding, it is in fact older than the state of Michigan and is governed by its own elected board of regents. While the City provides a wide range of services to the University — including fire protection and water, sewer, and storm water utilities — UM generally functions as an independent entity that operates in parallel with the City. Fortunately, UM has been proactive in looking for ways to reduce its energy use and other environmental impacts, including having a GHG emissions reduction target in line with targets set in this Plan.

Financial Challenges

Most of the actions recommended in this Plan require some upfront cost, either in the form of capital investment or staff time. Many of the low-cost behavioral actions typically require an educational or promotional effort. While it is worth stating that many of these actions, especially the conservation and efficiency measures, make good investments with solid financial paybacks, at a time of shrinking budgets, additional expenditures may be hard, but still necessary.

Local government officials, residents, and business owners must consider the significant costs of not investing in energy efficiency, renewable energy, and GHG emissions reductions when contemplating initial investments. This Plan assumes that local government will consider the significant set of additional benefits associated with each action beyond the estimated GHG reductions. Global climate change has the potential to be staggeringly expensive if cities and communities do nothing to mitigate emissions now. Some actions outlined in the Plan are self-funding or even help to fund other actions, whereas others would require a source of funding to be identified.

The Cost of Inaction

Every dollar not spent on mitigation before 2020 results in the need to spend $4.30 after 2020 to reduce emissions enough to limit the global average temperature increase to 2 degrees Celsius.[12] The International Energy Agency's World Energy Outlook for 2011 notes that the long lifetime of energy infrastructure means that cumulative GHG emissions are already "locked-in," so delaying mitigation action is not only more expensive but over time becomes less practicable.

Figure 6: Trends in Average Temperature Changes 1970-2011

Figure 7: Trends in Average Temperature Changes 1912-2011

The Global Warming Price Tag in Four Impact Areas, 2025 through 2100

In billions of 2006 dollars

	2025	2050	2075	2100
Hurricane damages	$10	$43	$142	$422
Real estate losses	$34	$80	$173	$360
Energy sector costs	$28	$47	$82	$141
Water costs	$200	$336	$565	$950
SUBTOTAL IMPACT	**$271**	**$506**	**$961**	**$1,873**

Source: NRDC, 2008. *The Cost of Climate Change.* http://www.nrdc.org/globalwarming/cost/contents.asp

Table 1a: Global Warming Price Tag in Four Impact Areas

University of Michigan

In 2012, President Mary Sue Coleman announced the sustainability goals for the UM. The Office of Campus Sustainability, in partnership with the Graham Environmental Sustainability Institute and the Environmental Sustainability Executive Council, completed a Campus Sustainability Integrated Assessment (IA) in 2011. Results of this assessment led to the development of a set of long-term environmental sustainability goals centered around four themes: Climate Action, Waste Prevention, Healthy Environments, and Community Awareness. Each theme was established in conjunction with a guiding principle and includes five measurable reduction targets to be met by 2025.

Climate Action

The university's Climate Action theme relates to energy use, energy conservation and renewable energy technologies. Over 60 percent of the university's GHG emissions are directly linked to the purchase of electricity and 35 percent from energy produced by its central power plant. The remaining 5 percent is generated from the transportation sector. From 2010 to 2011 the university saw a 7.5 percent increase in GHG emissions which is attributed to an increase in population size and building area. As UM continues to grow in students, building space, and research/medical care expenditures, so does the demand for energy. Although the university has already incorporated energy conservation

measures such as mandatory LEED Silver certification and ASHRAE 90.1 2007 plus 30 percent for all new construction projects exceeding $10 million in value, there are many additional measures being studied or implemented that may greatly reduce emissions. The university outlined a guiding principle used to help establish emission reduction goals in buildings and transportation.

Guiding Principle: *The university will pursue energy efficiency and fiscally-responsible energy sourcing strategies to reduce greenhouse gas emissions toward long-term carbon neutrality.*

Climate Action Goals (related to a FY2006 baseline):

- *Reduce scope 1 and 2 GHG emissions by 25 percent.*
- *Decrease carbon intensity of passenger trips on UM transportation options by 30 percent.*

Waste Prevention

Through the IA, the university has highlighted education as a best practice to help reduce waste. In collaboration with student groups, the university has used special events and athletic events to spread the word about recycling, waste reduction, and product reuse. Programs such as single stream recycling, student move-in and move-out programs, zero-waste basketball games, and the university's annual "Earthfest: party for the planet" provide staff, faculty and students with visual reminders of best waste-related practices. Waste generation decreased by 2.7 percent over 2010. Currently the university recycling rate is around 30 percent and efforts are being made to increase that number significantly. Additionally, the university has adopted programs and practices to support sustainable purchasing to reduce waste upstream and pilot post consumer composting programs in 2012.

Guiding Principle: *The university will pursue purchasing, reuse, recycling, and composting strategies toward long-term waste eradication.*

Waste Reduction Goal (related to an FY2006 baseline):

- *Reduce waste tonnage diverted to disposal facilities by 40 percent.*

Healthy Environments

Healthy Environments is a commitment by the university to provide access to natural areas while making an effort to preserve and restore those spaces. Through this theme, the university commits to measures that save water, protect the water resource, reduce runoff, reduce chemical application, preserve natural spaces, and source food from local resources. The university used over 1.3 billion gallons of water in 2011, which is a 6.2 percent increase over 2010. Advanced irrigation technology, water saving fixtures, and central chiller plants are amongst the methods the university is investing in to help reduce water consumption. Additional measures such as installation of detention basins where land is available and porous pavement parking lots where the pilot test areas indicate they stand up to Michigan winters are among the methods being used to control storm water.

The university also increased its commitment to purchase fair trade, local and organic food. Currently, there are 84 food establishments on campus which purchase nearly 85 percent of all their food from Sysco. The university is working with Sysco to purchase more food locally and strive for organic options. The university is also promoting student-supported programs such as "Go Blue, Eat Local" which promotes purchasing food from regional family farms.

Guiding Principle: *The university will pursue land and water management, built environment, and product sourcing strategies toward improving the health.*

Goals (related to an FY2006 baseline):

- *Purchase 20 percent of the university's food in accordance with the university's Sustainable Food Purchasing Guidelines.*
- *Protect Huron River water quality by reducing runoff from impervious surfaces and reducing the volume of land management chemicals used on campus by 40 percent.*

Community Awareness

The University of Michigan has committed to engaging and educating their community through various outreach programs. The Plant Blue Ambassador Program is a two credit course aimed at connecting students and staff around issues related to sustainability. It uses social-based community marketing and peer-to-peer education to encourage a culture of sustainability throughout the university. The university also supports environmentally focused opportunities such as its annual EarthFest, the Sustainability Without Borders program, and has over 600 classes focused on or relating to the environment and sustainability. Most recently the university has started a campus-wide study through the Institute of Social Research (ISR) to measure attitudes and environmental literacy amongst students, faculty and staff. The Sustainability Cultural Indicators Project started in early 2012. So far the program has conducted focus groups and will launch a campus-wide comprehensive survey in Fall 2012.

Guiding Principle: *The university will pursue stakeholder engagement, education, and evaluation strategies toward a campus-wide ethic of sustainability.*

Goal: No formal goal adopted, but the university will invest in programs to educate our community, track behavior, and report progress over time.

The Office of Campus Sustainability is working on an implementation plan that will help guide the project evaluation, selection, and management of the metrics as the program moves forward. The IA is the first integration phase of this process and will eventually lead to a final report outlining all strategies and actions intended to reach these goals by 2025.

COMMUNITY GREENHOUSE

Ann Arbor's GHG emissions inventory uses estimates for the year 2000 as the baseline against which future reductions are compared. This baseline year was first established by a 2003 Master's project from the UM School of Natural Resources and Environment.[13]

For purposes of comparison with the baseline year, and as the basis for this plan, a community-wide GHG emissions inventory was also performed for 2010, representing the most recent data available.

	Residential	Commercial/ Industrial	Transportation	Waste	University of Michigan	Total
2000 (Baseline)						
CO_2e (metric tons)	463,763	726,416	477,163	26,696	496,831	2,190,869
% of Total CO_2e 2000	21%	33%	22%	1%	23%	100%
2010 (Current)						
CO_2e (metric tons)	479,728	560,944	476,772	20,188	671,605	2,209,237
% of Total CO_2e 2010	22%	25%	22%	1%	30%	100%

Table 2: Ann Arbor Community Emissions by Sector

Comparing Current Emissions to Baseline

As depicted in Table 2, Ann Arbor emitted 2.2 million metric tons of CO_2e in 2010, which amounted to a 0.8 percent growth in emissions compared to 2000. The Residential sector experienced a modest increase of 3.4 percent between 2000 and 2010. While Commercial/Industrial emissions were the largest sector in 2000, after a 23 percent decrease in 2010, they became the second-largest sector. Around 25 percent of the decline in Commercial/Industrial emissions is explained by UM purchasing the 2 million-square-foot former Pfizer world headquarters campus, which was re-opened as the North Campus Research Complex in 2010, thereby transfering emissions from this property to the UM sector. (UM electricity purchased from DTE is extracted so that it is not double-counted in the Commercial/Industrial sector.) The remaining emissions reductions are attributable to additional economic factors less easily pinpointed and spread out across a number of properties and businesses.

The Transportation sector experienced a slight decrease in 2010 from 2000 levels; while total vehicle miles traveled are believed to have increased over this period, improvements in overall fuel efficiency appear to have reduced emissions from this sector. The Waste sector decreased more than 25 percent from 2000 to 2010, which reflects increased recycling rates and a decrease in waste collected throughout the city.

GAS EMISSIONS

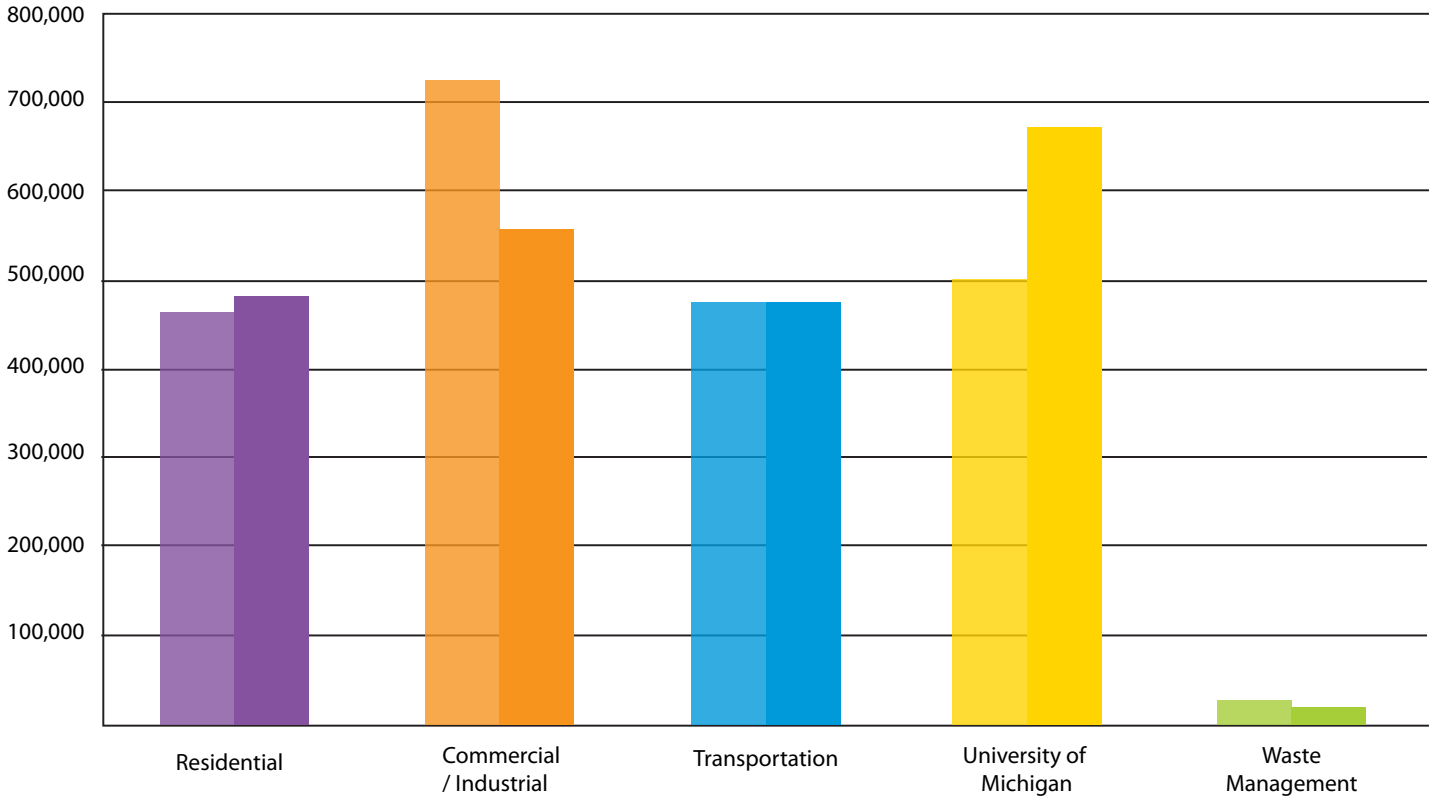


Figure 8: Total 2000 GHG emissions compared to total 2010 GHG emissions

University of Michigan Emissions

The Climate Action Plan Task Force chose to separate UM as its own sector given the availability of detailed emissions data for 2010, its separate GHG reduction plan underway, and ability to provide additional detail to the inventory. It should be noted that UM's 2000 emissions are back-casted estimates from year 2004 data, UM's baseline year for internal climate action planning.

Between 2000 and 2010, UM activities and building square footage grew significantly. As stated in the Planet Blue Sustainability 2011 Annual Report, "The [university] is currently in the midst of an unprecedented period of growth." While emissions have increased at the university since 2000, the energy intensity, or BTUs/person/square foot, has dropped annually, in recent years. This highlights the energy efficiency improvements and emissions reductions strategies coming out of the Campus Sustainability Integrated Assessment and the Planet Blue Operations Team.[14] As both the Ann Arbor community and UM look to mitigate GHG emissions in the long-run, cooperation will be essential. This Climate Action Plan acknowledges UM's role as the largest sector of community emissions, and praises the initiation of its own GHG reduction plans that are already underway. The Ann Arbor Climate Action Plan and UM target for mid-range reduction recommendations align by calling for25 percent reduction in GHGs by 2025.[15]

Factors Impacting Emissions

Residential Sector

As climate change contributes to overall warmer temperatures and an increased number of high-heat intensity days in the summer, there will likely be an increase in electricity-related emissions (from powering air conditioners) and a reduction in natural gas emissions (from home heating). This means community energy use is shifting from a lower-emitting fuel source (natural gas) to a higher-emitting fuel source (coal, which is used to supply more than half of the electricity generated in Michigan). This will persist until regional electricity providers shift from using coal to renewable sources.

Currently, state regulations require electric utilities to supply only 10 percent of the electric grid with renewable energy by 2015.[16] As of early 2012, around 5 percent of the Detroit Edison (DTE) electricity serving Ann Arbor comes from renewable sources, primarily wind turbines. Without substantial increases in the amount of renewably generated electricity in DTE's fuel-source mix, the Residential sector will remain a major source of GHG emissions.

Commercial/Industrial Sector

While the economic downturn of the late 2000s likely contributed to a decline in emissions within this sector, as more businesses rebound and perhaps reactivate underutilized building space in the future, Commercial/Industrial emissions could again rise. Price fluctuations for fuels, natural gas in particular, are also anticipated to impact this sector's emissions. Measures will need to be taken to mitigate consumption and improve building energy efficiency.

Transportation Sector

As in the building sector, there are and will continue to be technological advances that improve the "greenness" of the community's vehicles; many residents are already taking it upon themselves to drive hybrid, alternative fuel, and more fuel-efficient cars. Even with these advances, continually improving options for walking, biking, and busing, in addition to better integrating land uses to reduce travel distances, are essential in reducing GHG emissions in this sector.

Waste Sector

Total emissions from this sector make up less than 1 percent of total community GHG emissions, despite it including annual solid waste collection, embedded future emissions from landfilling, annual methane released from the closed Ann Arbor landfill, and annual process emissions from wastewater treatment. Any action taken to reduce emissions from the waste sector is unlikely to have a significant impact on total community emissions.

It is important to consider that currently the GHG inventory does not include emissions that result from upstream processing of materials that end up as waste. A few communities are just beginning to factor these full "life-cycle" emissions into their profiles, and future city inventories and Plan updates will likely find that materials consumption in the community is a major source of GHG emissions outside of the city's boundaries.

Climate Action Planning Emissions Reduction Targets

This Climate Action Plan recommends three targets for community-wide GHG emissions reductions, all of which are relative to the 2000 baseline GHG inventory.

Short-term target (2011 Energy Challenge, City Council resolution R-11-142, April 19, 2011):

- **Reduce CO_2e emissions 8 percent by 2015**

Mid-term target (aligning with the UM 2025 target):

- **Reduce CO_2e emissions 25 percent by 2025**

Long-term target (aligning with current science at time of report):

- **Reduce CO_2e emissions 90 percent by 2050**

The Climate Action Task Force agreed that the long-term reduction target should be linked to the recommendations of climate scientists and should be adjusted over time as new scientific evidence is available. The target of 90 percent reductions from 2000 levels by 2050 represents the most common recommendations of climate scientists as published at the time this report was written.

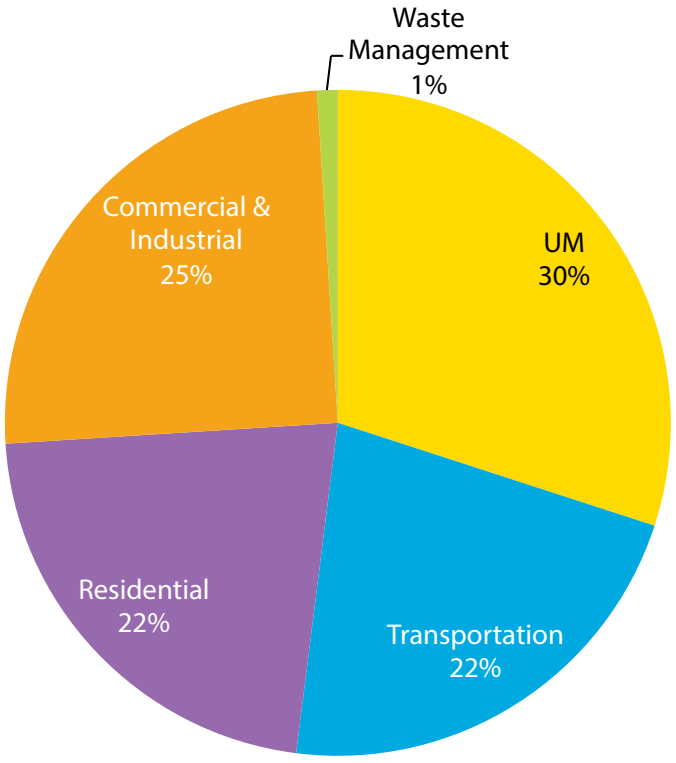


Figure 9: 2010 Greenhouse Gas Inventory

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3 More about greenhouse gases: Nearly half of the solar radiation from the sun is absorbed by the earth, while the rest is reflected back towards space. This absorbed solar radiation heats the planet. Historically, naturally occurring gases — primarily carbon dioxide and methane — have trapped a portion of the heat that is reflected by the Earth's surface. This "greenhouse effect" causes the planet to heat to a stable and habitable temperature that supports life in a way that would not be possible from incoming solar radiation alone. For their role in creating this greenhouse effect, carbon dioxide and methane, as well as nitrous oxide, have become known as "greenhouse gases" (GHGs).

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14 University of Michigan, 2011. *Planet Blue Sustainability 2011 Annual Report.*
http://sustainability.umich.edu/system/files/pubs/pdf/sustainability-report_2011.pdf

15 The community Climate Action Plan uses the baseline year of calendar year 2000; the University of Michigan's baseline is fiscal year 2004.

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CLIMATE

The following section summarizes all of the actions identified in this Climate Action Plan to assist the City of Ann Arbor with meeting its mid- and long-term GHG reduction targets. These actions are grouped into the following four main categories to align with the City's Sustainability Framework:

- Energy and Buildings
- Land Use and Access
- Resource Management
- Community and Health

ACTIONS

The following information is provided in this action summary:

- A listing of actions by subcategory
- A brief description of each action
- The estimated annual reduction in metric tons of carbon dioxide equivalents ($MTCO_2e$) once the action reaches full implementation. Staff did not estimate reduction for some actions (listed as not estimated) due to unavailable data or to avoid double counting.
- The estimated cost of an action per ton of CO_2 reduced over an action's life cycle (the length of time that the action is anticipated to exist)
- The anticipated impact of each action (low, medium, high; in terms of $MTCO_2e$ reduced), including actions for which specific GHG reduction estimates were not estimated
- The organizations that would need to lead implementation of each action
- The estimated timeframe to reach each action's full impact (short, medium, long)

Matrix Key

Implementation Leads

AAPS – Ann Arbor Public Schools
AATA – Ann Arbor Transit Authority
CC – City Council
BC – Business Community
CD – Community Development
HC – Housing Commission
DDA – Downtown Development Authority
FS – Field Services
GDT – Get Downtown
NGO – Non-Governmental Organization
PDS – Planning and Development
PMU – Project Management Unit
PU – Public Utility
PRU – Parks and Recreation Unit
RES – Residents

	Action ID	Energy and Buildings Actions
 Higher Performing Buildings	EB-1	Weatherize existing housing stock
	EB-2	Build or renovate energy efficient affordable housing units
	EB-3	Offer incentives for energy audits and implementation of identified energy conservation measures
	EB-4	Promote use of efficient lighting technologies for both outdoor and indoor applications
	EB-5	Provide incentives to commercial building owners to install motion-sensing light switches and automated thermostats
	EB-6	Promote conversion to green roofs for commercial and industrial buildings
	EB-7	Promote the use of reflective roofs in the commercial and industrial sectors
	EB-8	Provide incentives to builders to exceed state energy codes in their renovations and new construction
	EB-9	Use Property Assessed Clean Energy (PACE) to finance commercial building energy improvements
	EB-10	Expand and Enforce current ordinance, Chapter 105 Section 8:524 that requires landlords to provide energy budgets to tenants
	EB-11	Strengthen housing code energy standards for rental properties
	EB-12	Implement a Residential Energy Conservation Ordinance with required upgrades
	EB-13	Strengthen energy code for new and renovated buildings at the state or local level
 Energy Source	EB-14	Increase use of combined heat and power units
	EB-15	Create a downtown geothermal heating and cooling district
	EB-16	Implement a downtown combined heat and power district system
	EB-17	Create a geothermal utility to implement ground source heat pumps for residential heating and cooling
	EB-18	Ensure availability of utility-level solar incentives
	EB-19	Utilize digestion of waste water treatment plant material, or post consumer organics, to generate useful biogas

Recommended Actions

SPU – Systems Planning Unit
UM – University of Michigan
WTP – Water Treament Plant
WWTP – Wastewater Plant

Impact (Annual $MTCO_2$ Reduction)
* – Low (0-5,000)
** – Medium (5,001-20,000)
*** – High (20,001+)

Impact Timeframe
S – short (1-5 years)
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L – long (20+ years)

	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	14,197	-$56	**	SPU, CD, WC	M
	1,030	-$46	*	HC, CD, BC	S
	Not Estimated	Not Estimated	**	SPU, PU, NGO, DDA	S
	8,034	-$155	**	SPU, PMU, PU	S
	13,781	-$136	**	SPU, PU	S
	2,004	$232	*	SPU, PU, DDA	S
	2,691	-$143	*	SPU, PU, DDA	L
	542	-$102	*	SPU, PDS	M
	14,846	-$87	**	SPU, NGO	M
	7,971	-$92	**	SPU, PDS	L
	2,781	$1	*	SPU, PDS	L
	7,103	-$98	*	SPU, PDS	S
	2,791	-$59	*	SPU, PDS	M
	35,134	-$126	***	SPU, PDS	L
	12,482	-$63	**	SPU, PDS, DDA, PMU	S
	17,567	-$126	**	SPU, PDS, DDA, PMU	L
	26,387	-$23	***	SPU, PMU	M
	3,952	$188	*	SPU, PU	S
	2,080	-$160	*	SPU, WWTP	S

Matrix Key

Implementation Leads

AAPS – Ann Arbor Public Schools	HC – Housing Commission	PDS – Planning and Development
AATA – Ann Arbor Transit Authority	DDA – Downtown Development Authority	PMU – Project Management Unit
CC – City Council	FS – Field Services	PU – Public Utility
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	Action ID	Energy and Buildings Actions Continued
Renewable Energy	EB-20	Increase the renewable portfolio standard
	EB-21	Maximize purchase of Michigan renewable energy
	EB-22	Implement an agreement with DTE Energy to create more stringent renewable energy requirements and fund other energy efficiency and renewable energy programs
	EB-23	Work with Michigan Public Service Commission and DTE Energy to allow direct purchase of renewable energy by residential electricity customers
	EB-24	Implement community renewable energy projects
	EB-25	Work to achieve the "5000 Solar Roofs" target (domestic hot water)

	Action ID	Land Use and Access Actions
Integrated Land Use	LU-1	Actively support regional approaches to land use planning to reduce origin and destination distances
	LU-2	Create a program that provides incentives to employees and residents who choose to live within two miles of their job
	LU-3	Encourage coordinated zoning and redevelopment at higher densities, using land use, development regulations, and market forces
	LU-4	Maximize incentives for mixed use and transit-oriented development
	LU-5	Support future funding for greenbelt land purchases around Ann Arbor
	LU-6	Revise the local Parking Ordinance to allow for flexibility with parking provisions
Transportation Options	LU-7	Create a Travel Demand Management program that uses social and targeted marketing to encourage more residents to walk, bike, and bus to their destinations
	LU-8	Implement a community-University bikesharing program
	LU-9	Actively engage and support the study and delivery of commuter rail along high demand corridors
	LU-10	Provide incentives for use of public transit
	LU-11	Create a citywide go!pass program that combines bus use incentives with biking and walking incentives
	LU-12	Enhance transit service, including more weekend and evening service

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	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	98,764	$29	***	SPU, NGO, RES	M
	99,706	$27	***	SPU, PU	M
	44,188	$109	***	SPU, PU	S
	64,572	-$12	***	SPU, PU	M
	1,099	$106	*	SPU	S
	3,243	$308	*	SPU	M

	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	Not Estimated	Not Estimated	**	PDS, SPU	M
	Not Estimated	Not Estimated	*	SPU, BC, GDT, DDA	S
	Not Estimated	Not Estimated	**	PDS, SPU, CD	M
	3,352	-$372	*	PDS	L
	Not Estimated	Not Estimated	**	PDS, NGO, CC	M
	Not Estimated	Not Estimated	***	PDS, DDA	L
	9,962	-$335	**	PDS, SPU, DDA, GDT	M
	143	$249	*	SPU, UM, NGO, GDT	S
	1,077	$2,798	*	PDS, SPU, NGO, AATA	S
	Not Estimated	Not Estimated	*	SPU, GDT, AATA, AAPS, UM	S
	621	Not Estimated	*	SPU, AATA, UM, GDT	S
	125	Not Estimated	*	AATA, UM	S

Matrix Key

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	Action ID	Land Use and Access Actions Continued
 Transportation Options	LU-13	Encourage market-based and incentive-based parking strategies and rates
	LU-14	Create an innovative ride-sharing system
	LU-15	Encourage business and building owners to reduce in-bound vehicle traffic
	LU-16	Increase events and activities that raise awareness of commuting benefits
 Sustainable Systems	LU-17	Ensure that sidewalk/bike/transit service exist within ¼ mile of every Ann Arbor household
	LU-18	Establish requirements or guidance for electric vehicle and hydrogen-fueled vehicle parking infrastructure for projects and increase city-wide infrastructure for electric vehicle charging and hydrogen refueling
	LU-19	Make all possible signal and intersection pedestrian improvements
	LU-20	Evaluate project life cycle and upstream CO_2e emissions as criteria for City's Capital Improvements Plan scoring prioritization system
	LU-21	Evaluate public infrastructure to prepare for redevelopment readiness and densification in the downtown and major corridors

	Action ID	Resource Management Actions
 Responsible Resource Use	RM-1	Increase residential and commercial rainwater capture and reuse
	RM-2	Increase residential and commercial grey water reuse
	RM-3	Review water and wastewater water rate structures
	RM-4	Adopt a water conservation ordinance
	RM-5	Increase pipe replacement to avoid the loss of treated water
	RM-6	Reduce Ann Arbor's consumption/total waste stream
	RM-7	Advocate for county, state, regional, and federal product stewardship policies
	RM-8	Re-evaluate "pay as you throw" system for residential solid waste
	RM-9	Reduce residential solid waste pick-up schedule to bi-weekly
	RM-10	Encourage residents to place garbage, recycling, and compost carts out for collection only when full
	RM-11	Implement a single-use bag ban or fee
	RM-12	Facilitate more material reuse opportunities throughout the community
	RM-13	Reduce packaging waste

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	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	13,350	Not Estimated	**	SPU, DDA, GDT	S
	8,253	$4,615	**	NGO, AATA, UM, GDT	S
	Not Estimated	Not Estimated	*	SPU, AATA, GDT, UM, BC	S
	847	$99	*	SPU, NGO, GDT	S
	4,752	$550	*	SPU, PMU, GDT, AATA, UM	S
	1,602	-$294	*	SPU, PDS, PMU, DDA, UM	M
	18	Not Estimated	*	PMU, SPU, PDS	S
	Not Estimated	Not Estimated	*	SPU, PMU	S
	Not Estimated	Not Estimated	**	SPU, PDS, PMU	L

	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	944	-$2,783	*	SPU, NGO	M
	122	-$899	*	WTP, SPU, NGO, RES	M
	662	-$588	*	SPU, WTP, WWTP	S
	3,432	-$850	*	SPU, WTP	S
	Not Estimated	Not Estimated	*	SPU, PMU, WTP, FS	M
	2,726	-$73	*	SPU, BC	M
	Not Estimated	Not Estimated	*	SPU, NGO	S
	731	$0	*	SPU, NGO	S
	197	-$1,186	*	SPU	S
	79	-$1,080	*	SPU, NGO	S
	2,599	$146	*	SPU	S
	16	Not Estimated	*	SPU, PDS, UM	S
	Not Estimated	Not Estimated	*	SPU, NGO	S

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	Action ID	Resource Management Actions Continued
 Responsible Resource Use	RM-14	Implement a compostable/recyclable to-go packaging ordinance
	RM-15	Utilize zoning incentives to encourage reuse of existing buildings, structures, and recycled building materials
	RM-16	Promote "climate impact" labeling for restaurants as well as other businesses
	RM-17	Develop a comprehensive green business certification program to include solid waste, pollution prevention, green purchasing, water reduction, and energy efficiency
	RM-18	Require any city-sponsored (or city-located) outdoor event to be zero-waste
	RM-19	Increase residential and commercial recycling participation and tonnages
	RM-20	Implement a construction and demolition debris recycling ordinance
	RM-21	Improve recycling opportunities at the city's drop off station
	RM-22	Increase incentives and collection of residential and commercial organic waste (including food and soiled paper products)
	RM-23	Implement a home composting education and outreach program, including providing incentives to increase participation in home composting programs
 Local Food	RM-24	Increase local food production and consumption
 Healthy Ecosystems	RM-25	Increase forest canopy across public and private property

	Action ID	Community and Health Actions
 Engaged Community	CH-1	Create, design, and implement a sustainable community energy efficiency program
	CH-2	Provide a centralized energy resource that empowers citizens with information, tools, and opportunities to take action on their energy use
	CH-3	Create neighborhood "green teams" or "sweeps" to promote climate mitigation strategies
	CH-4	Implement a community net-zero home building/renovation contest

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	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	Not Estimated	Not Estimated	*	SPU, NGO, BC, UM	S
	Not Estimated	Not Estimated	*	SPU, UM, PDS	M
	Not Estimated	Not Estimated	*	SPU, BC, NGO	S
	7,620	-$160	**	SPU, NGO, BC	M
	4	$2,218	*	SPU, NGO	S
	3,710	-$354	*	SPU, NGO	M
	Not Estimated	Not Estimated	*	SPU, NGO	S
	Not Estimated	Not Estimated	*	SPU, NGO	S
	66	Not Estimated	*	SPU, NGO, BC, UM	S
	258	-$198	*	SPU, NGO, UM	S
	Not Estimated	Not Estimated	**	SPU, PRU, PDS, NGO	M
	12,356	$58	**	SPU, PRU, UM, NGO	L

	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	Not Estimated	Not Estimated	**	SPU, NGO, PU, UM	S
	Not Estimated	Not Estimated	*	SPU, NGO	S
	17,973	Not Estimated	**	SPU, PDS, NGO, UM	S
	47	$133	*	SPU, NGO, PU, PDS	S

Matrix Key

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	Action ID	Community and Health Actions Continued
 Engaged Community	CH-5	Expand existing environmental education curriculum in coordination with Ann Arbor Public Schools and local private schools
	CH-6	Motivate residents and business owners to alter behavior to facilitate emissions reductions
	CH-7	Develop and deliver training and education programs for building code officials, homebuilders, construction contractors, and all trade professionals in green building, renewable energy, energy efficiency, and water efficiency.
 Safe Community	CH-8	Design and implement urban stormwater infrastructure that enhances ecological functioning
	CH-9	Integrate mitigation and adaptation planning into park design and improvements
	CH-10	Develop a policy that requires private and municipal projects to plant shade trees and vegetation that help lower the heat island effect within the city
	CH-11	Implement an idling reduction ordinance
	CH-12	Generate better local air quality data
	CH-13	Reduce non-GHG emissions from vehicles and buildings

Adaptation Strategies

Implement "no regrets" adaptation actions now

Ensure an integrated systems planning approach to built and natural infrastructure for all climate change planning scenarios

Protect our citizens from health and safety hazards

Update and maintain technology and plans to support emergency management response to extreme climate events

Integrate climate projections into all City planning across all systems

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	Annual $MTCO_2e$ Reduced	$/tCO_2e$	Impact	Implementation Leads	Impact Timeframe
	Not Estimated	Not Estimated	*	AAPS, SPU, UM	S
	Not Estimated	Not Estimated	*	SPU, RES, BC, UM, NGO, DDA	M
	Not Estimated	Not Estimated	*	SPU, PDS, NGO	S
	Not Estimated	Not Estimated	*	SPU, PMU, PDS, NGO, UM, PRU	L
	Not Estimated	Not Estimated	*	PRU, SPU, PMU	M
	Not Estimated	Not Estimated	*	SPU, PDS, PMU, UM	S
	557	Not Estimated	*	AAPS, SPU, AATA, UM, NGO	S
	Not Estimated	Not Estimated	*	SPU, UM	M
	Not Estimated	Not Estimated	*	SPU, UM, PDS	M

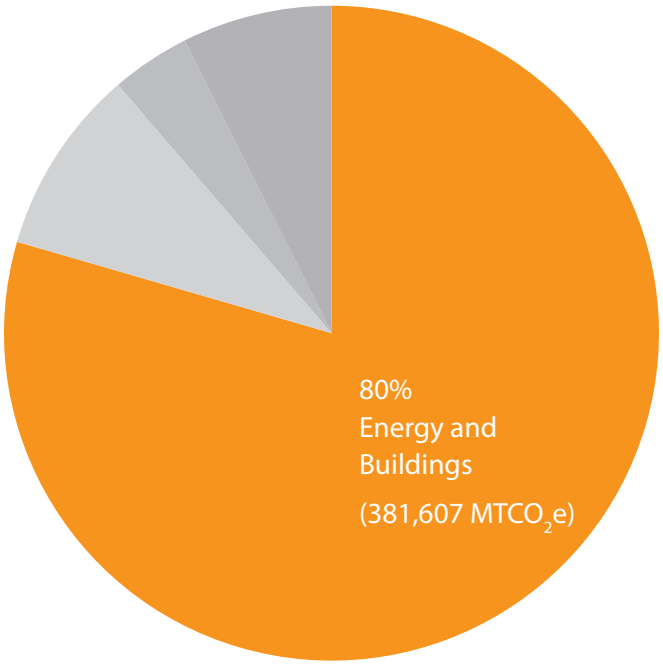
Buildings accounted for 41 percent of the primary energy consumption in the United States (22 percent from residential buildings and 19 percent from commercial buildings) in 2010.[1] The energy used in buildings contributes significantly to GHG emissions in the City of Ann Arbor and makes up 77 percent of the City's total emissions. In order to reach the goal of 25 percent reduction by 2025 or substantial reductions in the future, the City of Ann Arbor and its residents need to reduce energy use in buildings through energy efficiency, and the use of renewable and low-carbon energy sources must increase dramatically. The efficiency of new buildings will need to be addressed through design guidelines and standards.

This section is broken up into three subcategories:

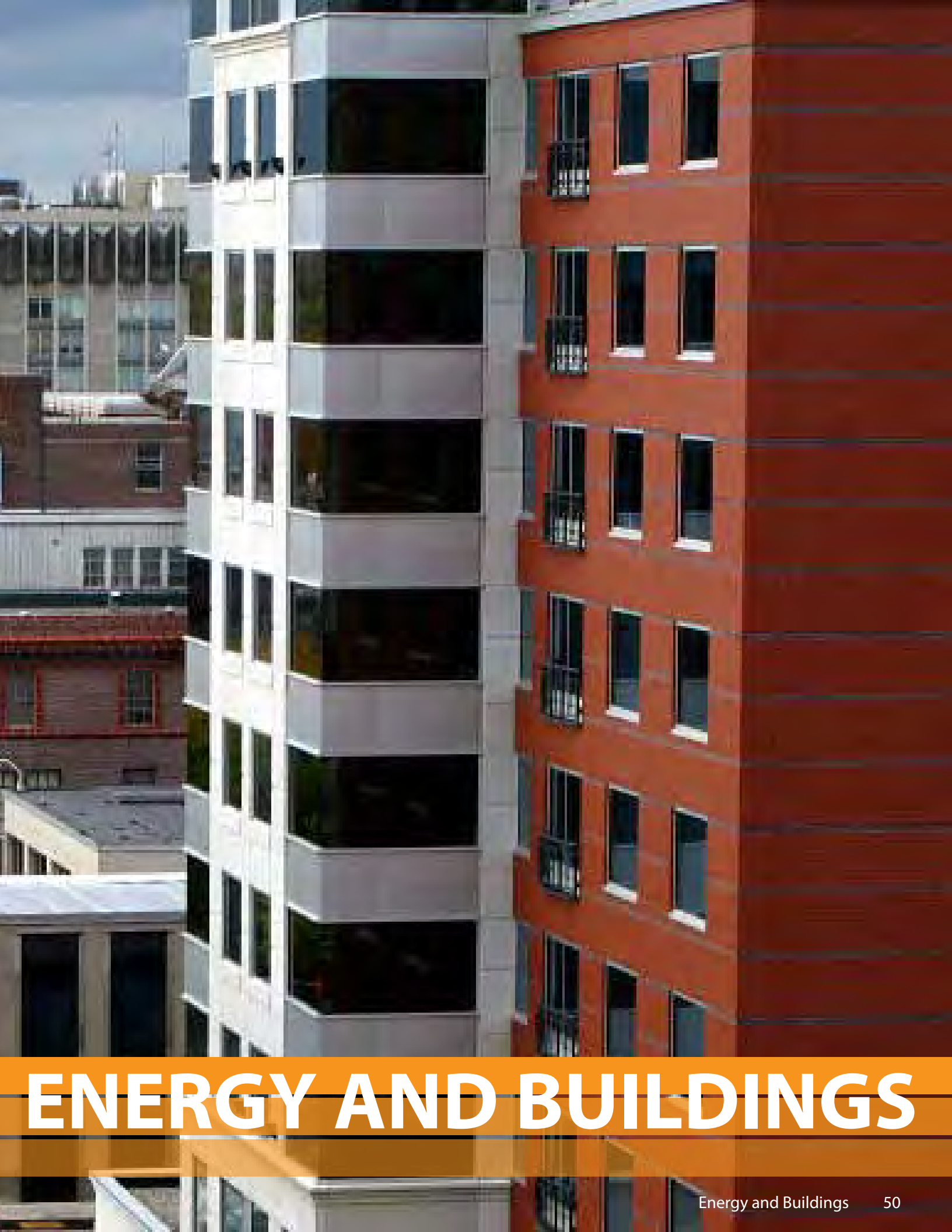
Higher Performing Buildings refers to actions that will increase efficiency in new and existing buildings within our community.

Energy Source refers to the transition from centralized high carbon energy sources to low or no carbon technologies.

Renewable Energy is obtained from resources that cannot be depleted; such as wind, tidal, hydro and solar, photovoltaic and thermal.



Actions identified in this section amount to 80 percent of the total emissions reduced by implementing actions in this Plan



ENERGY AND BUILDINGS

ENERGY AND BUILDINGS:

HIGHER PERFORMING BUILDINGS

Higher Performing Buildings refers to actions that will increase efficiency in new and existing buildings within our community. Energy used in buildings is determined by a variety of factors including insulation level, building type and age, window age and size, air sealing, appliance and equipment efficiency, and heating and cooling systems.

Number of Higher Performing Buildings Actions: 13

Eighty percent of Ann Arbor's buildings were built before 1976. Since older buildings are typically less energy efficient, the City must focus its efforts to reduce GHGs by implementing strategies that drive retrofits and improvements into these buildings.

Higher Performing Buildings

Historically, air pollution reduction efforts have focused on transportation and stationary emission sources such as manufacturing and power generation, however, the built environment plays a significant role in generating GHG emissions. In the U.S., buildings account for nearly 50 percent of the country's total GHG emissions (and also happen to represent 40 percent of the nation's total energy use, 70 percent of electricity used, 60 percent of raw materials, and 12 percent of potable water used).

Building energy use is also a considerable economic expense for both residential and commercial building owners and renters. Citywide, Ann Arbor (excluding UM) spends approximately $140 million annually on natural gas and electricity. Because most of Ann Arbor's energy is not generated locally, this expense represents money that leaves the community. Basic energy efficiency investments could save 10 percent and keep $14 million per year circulating in the local economy. For example, households in Ann Arbor spend roughly $1,600 each year for home energy needs; a 10 percent reduction would put an additional $160 per household into the local economy.

Ann Arbor currently has more than 31 million square feet of commercial, industrial, and institutional buildings not including buildings owned by the UM; residential buildings contribute an additional 36 million square feet. Actions presented within the Higher Performing Buildings section help address emissions across this nearly 70 million square feet in two implementation categories:

1. Energy Efficient Retrofits
2. Ordinances and Codes

City Commitment to Renewables

In addition to the Energy Challenge Goals that support this Climate Action Plan, the City's Environmental Commission worked to develop other broad environmental goals for Ann Arbor that were approved by City Council in 2007. Included is the goal to "use 100 percent renewable energy," which remains an important long-term vision for the City.

Ann Arbor PACE

a2 energy PACE PROGRAM FOR COMMERCIAL OWNERS

The Ann Arbor City Council established a Property Assessed Clean Energy (PACE) district in 2011 to encourage commercial property owners to invest in energy-saving technologies. PACE allows property owners to make energy-related upgrades to buildings using a special property assessment. This financing has several potential benefits to commercial property owners over traditional loan products. Traditional financing programs are typically limited by short repayment periods, high or variable interest rates, and stringent credit requirements that do not account for savings from energy efficiency improvements. PACE special assessments offer low fixed rates, eligibility determined by property value, and longer repayment terms.

Most of the actions listed in this Plan rely on the owner or occupant to make improvements, typically with the help of incentives, but six actions identify implementation mechanisms that require changes to existing policies, new ordinances, or new codes.

All recommended actions include increased outreach to, collaboration with, and participation by community members. In spite of the significant savings that energy efficiency improvements can produce in both commercial and residential buildings, achieving those savings requires a multi-pronged programmatic approach using education, engagement, collaboration among multiple parties, and regulatory approaches.

Energy Efficient Retrofits

EB-1: Weatherize existing housing stock

Weatherization helps protect buildings from impacts from the elements, while ensuring a comfortable and energy efficient interior space for occupation. The City can work more closely with partners like Washtenaw County, DTE Energy, and local non-profits that already work to weatherize the existing housing stock. Additionally, an ordinance that requires weatherization investments when buildings are remodeled, re-roofed, marketed, or sold may help the City realize a more efficient and maintained building stock.

EB-2: Build or renovate energy-efficient affordable housing

Reducing energy costs is an effective way to make housing more affordable for many families. This Plan recommends that the City create policies and programs that govern the construction and renovation of affordable housing units. These policies and programs should incorporate the six principal energy efficiency measures outlined as essential by the U.S. EPA for new homes: effective insulation, high-performance windows, tight construction and ducts, energy-efficient heating and cooling equipment, energy-efficient products, and third-party verification. Such programs should be complementary to existing weatherization projects undertaken by Washtenaw County. The local Housing Trust Fund should be utilized to assist with this action.

EB-3: Offer incentives for energy audits and implementation of identified energy conservation measures

Energy audits provide building owners with an assessment of building energy use, determine opportunities to reduce energy loss, and prioritize energy efficiency investments. Audits along with associated investments help save the building owner money and reduce GHG emissions by reducing the building's energy demand. The City should develop incentives for residential and commercial energy audits, but must first work with local partners to identify funding sources.

EB-4: Promote the use of efficient lighting technologies for both outdoor and indoor applications

The City should rely on its existing a2energy program to educate and motivate building owners to update lighting fixtures and/or bulbs to advanced technologies such as compact fluorescent lamps (CFLs), light emitting diodes (LEDs), induction lighting, and other emerging technologies. Continuing to install efficient lighting technologies in municipally-owned buildings will help the City of Ann Arbor lead by example.

Ann Arbor LED streetlight conversion for over 1,800 downtown streetlights

Ann Arbor converted over 1,800 streetlights to high-efficiency LEDs. Savings on avoided maintenance by City crews, as well as the typical 50 percent or better energy savings of LEDs, mean the City avoids $170,000 in annual costs. Indoor LED applications are becoming more common as well, as costs drop and the technology continues to improve. Ann Arbor's LEDs reduce municipal expenses and the amount of GHG emissions and pollution associated with electricity generation for lighting.

EB-5: Provide incentives to commerical building owners to install motion-sensing light switches and automated thermostats

This Plan recommends that the City collaborate with local businesses and organizations to develop incentives for building owners to install lighting control motion sensors and programmable thermostats. These two actions are the most easily implemented "low-hanging fruit" and can often result in measurable energy reduction in buildings.

EB-6: Promote conversion to green roofs for commerical and industrial buildings

A green roof is a rooftop that is partially or completely covered by vegetation. Green roofs help absorb rainwater, lower air temperatures by reducing the heat island effect, better insulate buildings, provide a space for wildlife, and also provide attractive outdoor space for building occupants. This Plan recommends that the City encourage conversion to green roofs through an education and outreach program aimed at commercial and industrial building owners, while continuing to install green roofs on municipal buildings. The program should focus on motivating building owners to install green roofs at the time of roof replacement. Green roofs typically have a longer life than normal roofs, and by improving insulation, can reduce energy costs to businesses.

The newly remodeled Larcom City Hall building features a 10,318-square-foot green roof over the original flat roof of the first floor. The green roof features a variety of plants that help to insulate the building year-round and also reduce stormwater runoff. In addition, the green roof is estimated to extend the life of the roof by up to 200 percent. The roof area is publicly accessible and features an outdoor seating area.

The Leadership in Energy and Environmental Design (LEED) standard was developed by the U.S. Green Building Council in 2000 to promote and recognize leadership within the green building industry. The LEED certification process is an independent, third-party verification that the design and construction of a building protects environmental quality and human health. The standard assesses buildings in key areas of sustainability such as site development, energy efficiency, materials selection, and indoor air quality. In addition, the standard also encourages economic and social sustainability by awarding points for infill development and access to public transportation.

EB-7: Promote the use of reflective roofs in the commercial and industrial sectors

These roofs absorb less heat, reduce the energy needed to maintain a comfortable temperature inside the building, and can also assist with sunlight reflectivity if a building owner installs a rooftop photovoltaic system. Reflective roofs are also cost-effective to install; ICLEI software used in modeling this Plan indicates they are only $0.25 per square foot more than the standard black roof.[2] This Plan recommends that the City require reflective roofs at the time of roof repair or replacement for commercial and industrial buildings.

EB-8: Provide incentives to builders to exceed state energy codes in their renovations and new construction

Currently, the state of Michigan energy code standards follow the 2009 International Energy Conservation Code (2009 IECC) for residential buildings and ASHRAE 90.1-2007 for commercial buildings. The City can develop incentives to encourage builders to exceed state energy codes, through achieving certifications and aggressive standards such as like ENERGYSTAR for new homes, LEED (see box above), Passive House Standard, and/or other consensus standards that exceed existing Michigan codes. Since the City of Ann Arbor cannot impose stricter building requirements than the State, a robust incentive program could offer an alternative to regulatory approaches.

EB-9: Use Property Assessed Clean Energy (PACE) to finance commercial building energy improvements

In December of 2010, Michigan passed legislation (Public Act 270) which authorizes local governments to create Property Assessed Clean Energy (PACE) districts to finance efficiency improvements and renewable energy systems to commercial and industrial properties through voluntary special assessments. In October of 2011, Ann Arbor City Council established the Ann Arbor PACE district. This program provides access to attractive financing with longer-terms and fixed interest rates that are not currently available through traditional financing. The development and implementation of PACE was initially funded through a grant from the Ann Arbor Area Community Foundation and American Recovery and Reinvestment Act (ARRA) stimulus funds. This Plan recommends that the City continue to market and support PACE with administrative resources until it can become self-supporting from application fees, interest, payments, or other sustainable funding sources.

Ordinances and Codes

EB-10: Expand and enforce current city ordinance that requires landlords to provide energy budgets to tenants

Chapter 105 Section 8:524 of the Ann Arbor Code of Ordinances requires landlords to provide heating budget information to tenants, prior to lease signing. This allows tenants to make fully informed decisions about the full costs of housing – rent and utilities. Requiring landlords to disclose natural gas, electricity, and water use costs, when applicable, could further strengthen this existing policy that is not heavily promoted or enforced at this time. Expanded public awareness and increased enforcement of this code section combined with the City's new Green Rental Housing Partnership (HUD grant 2012-2015) will create demand for more energy efficient units and drive investments in rental housing units.

Chapter 105 Housing Code

No owner of rental property shall lease the property without furnishing to the tenant, before the time of entering into the lease, a budget plan. As used in this section, "budget plan" means a projection of monthly utility costs for primary heating fuel prepared by the public utility company. This section shall apply to the rental of all dwelling units for which budget plan information is available from the utility company without charge and in which the tenant is required to pay the owner or the utility company a utility charge for heating fuel in addition to rent. The budget plan statement shall be in writing, included as part of the leasing agreement, but may be prepared by the owner based on information verbally supplied by the utility company. (Ord. No. 66-87, § 1, 12-21-87)

EB-11: Strengthen housing code energy standards for rental properties

Rental properties are currently governed under Chapter 105 of the City Code, which regulates housing by establishing basic requirements for inspections, heating, light, and weatherization of rental units. This Plan recommends enforcing the current standards and expanding the housing code energy standards for rental properties. Because the rental inspection cycle of every 30 months is firmly established, Ann Arbor already has the enforcement and compliance assistance structure in place to implement this change. More rigorous enforcement of the current code will greatly benefit both the condition and energy efficiency of the rental housing stock.

EB-12: Implement a Residential Energy Conservation Ordinance with required upgrades

A Residential Energy Conservation Ordinance (RECO) requires energy improvement upgrades to a specified level when a home is sold or transfers ownership. Several local and international governments have developed successful programs, including Berkeley, CA; Austin, TX; and Great Britain. Many local governments in Michigan already have requirements that a house be inspected at transfer and repaired or brought to current code (examples include installation of ground fault interrupters, back flow prevention devices, and handrails). RECOs implemented in the U.S. have placed a cap on the amount of money required to be spent on energy efficiency at the time of transfer. This plan recommends establishing a RECO across Ann Arbor.

EB-13: Strengthen energy code for new and renovated buildings at the state or local level

Effective March 9, 2011, Michigan codified the use of the International Energy Conservation Code 2009 as the standard for new or renovated homes and ASHRAE 90.1-2007 for commercial properties. This Plan recommends that the City advocate for more stringent State energy codes as they are released and/or pressure the State to adopt leading-edge building codes. Alternately, the City may explore use of home rule to promote stronger building codes within city boundaries.

ENERGY AND BUILDINGS:

ENERGY SOURCE

Energy Source refers to the transition from centralized high-carbon energy sources to low or no carbon technologies. While relying exclusively on 100 percent renewable sources of energy is a goal for Ann Arbor, certain transitional sources and technology should be utilized to help bridge the gap. Currently, the City relies almost exclusively on centrally

Number of Energy Source Actions: 6

controlled electricity generation/distribution and natural gas. Some Energy Source actions deal with innovative approaches like district heating, or combined heat and power (CHP), while others allow for a more gradual shift to renewable energy sources.

Energy Source

Addressing emissions from energy depends heavily on addressing the source of the energy. In assessing statewide GHG emissions, the Michigan Climate Action Plan looked specifically at the energy supply sector, which includes the production, processing, generation, transmission, and storage of electricity and fossil fuels. In 2005, emissions from the energy supply sector represented 45 percent of Michigan's total consumption-based emissions. Within this sector, electricity generation represented 93 percent of total emissions, the remainder coming from the production, processing, transmission, and distribution of natural gas.[3]

Due in part to the State's relatively large population (8th most populous state), northern climate, and extensive industrial sector, Michigan's total energy consumption is fairly high. Michigan is limited in most energy resources and imports 97 percent of its petroleum needs, 82 percent of its natural gas, and 100 percent of coal and nuclear fuel from other states and nations. These imports account for about 72 cents of every dollar spent on energy by Michigan's citizens and business owners, a cost that continues to increase. In 1999, $20 billion was spent on energy in Michigan; by 2009, that number had grown to $31.3 billion. While petroleum costs in this period nearly doubled, natural gas costs increased 81 percent and electricity costs grew 24 percent.[4]

Historically, Michigan's electrical generation has depended heavily on fossil fuels. While it remains so today, the intersection of changes in regulations, fuel type availability and pricing, and customer expectations are changing the makeup of the generation source of Michigan's electricity.

Fig. 10a. Michigan Gross Generation by Fuel Type

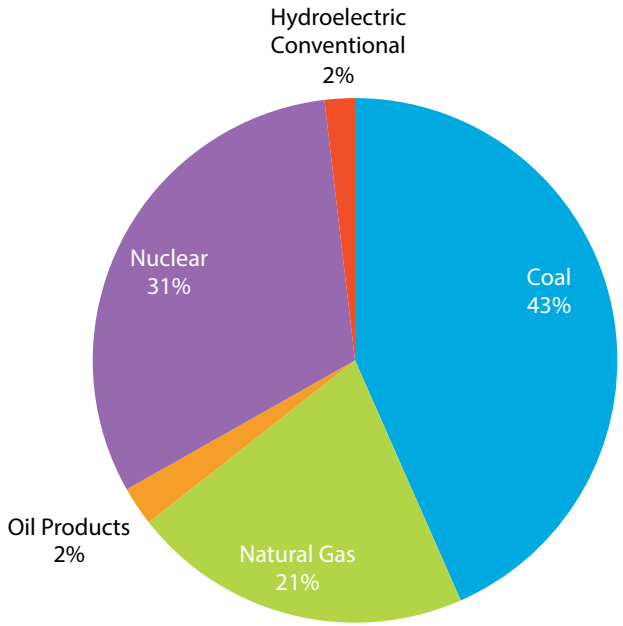


Fig. 10b. Michigan Gross Emissions by Fuel Type

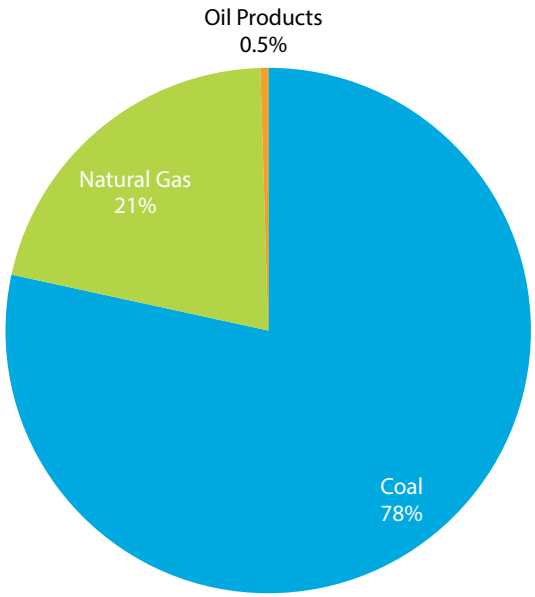


Figure 10: Breakdown of Michigan Electricity Generation and CO2 Emissions, March 2011 - March 2012[5]

Fig. 11a. DTE Gross Generation by Fuel Type

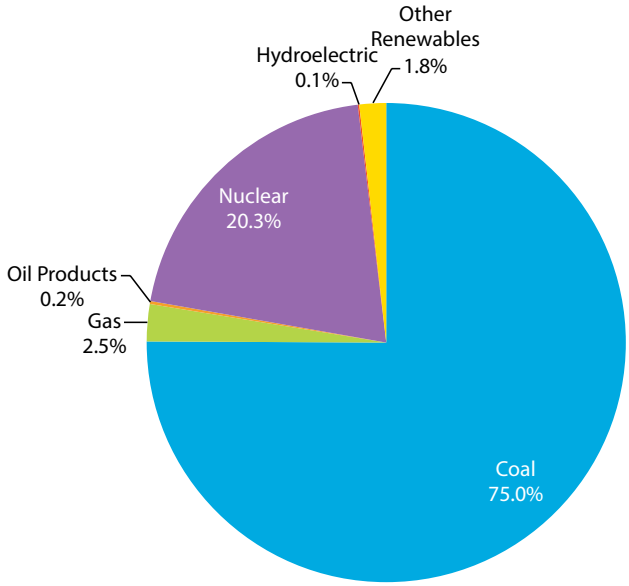


Fig. 11b. DTE Gross Emissions by Fuel Type

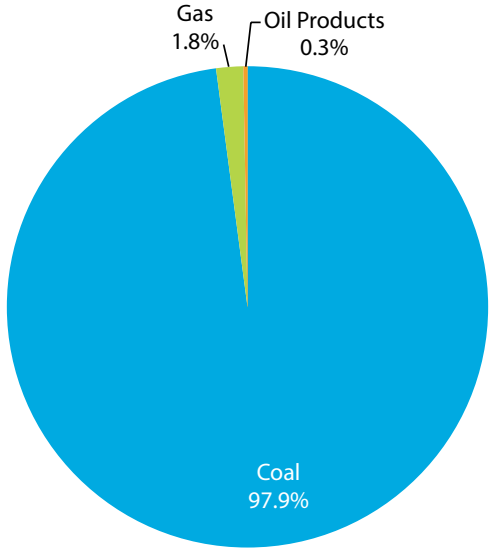


Figure 11: Breakdown of DTE Energy's Electricity Generation and CO_2 Emissions, 2011[6]

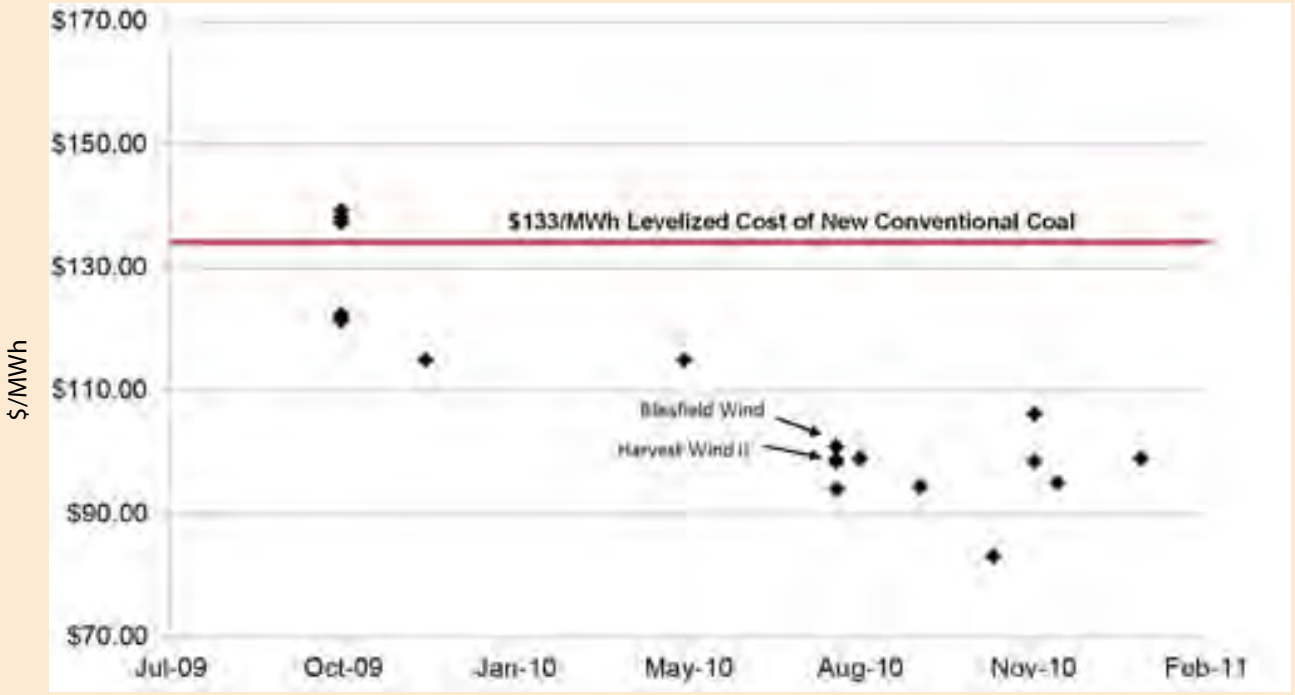
As depicted in Figure 10a, from March 2011 to March 2012, Michigan generated 43 percent of its electricity from coal and 21 percent from natural gas. Nuclear comprised 31 percent, and while nuclear is zero carbon while operating, it entails new construction costs and poses long-term risks to the environment. These figures represent significant changes from 2005, when coal comprised 73 percent of electricity generation, natural gas only 4 percent, and nuclear 18 percent.[7] Similar changes in the ratios of electricity generated from coal and natural gas have been observed nationwide. Even with this reduced reliance on coal for electricity generation, emissions from coal still represent 78 percent of Michigan's total GHG emissions, as indicated in Figure 10b.

The story for Ann Arbor is more drastic. DTE Energy is the sole electricity and natural gas provider for the entire community, so generation and emissions by fuel type for Ann Arbor can be calculated based on DTE's reported information (instead of a combination of all statewide energy providers). As detailed in Figure 11a, in 2011, 75 percent of Ann Arbor electricity was generated from coal, 20 percent from nuclear, 2.5 percent from natural gas and less than 2 percent from renewables. This means that coal represents 98 percent of emissions from electricity that is generated to serve Ann Arbor, as depicted in Figure 11b.

In Michigan and other Midwest states, the electricity source remains the biggest area of opportunity for the reduction of GHGs. Recent generation data illustrates that Michigan had additional gas-fired capacity, which was being reserved for peak loads and power quality support due to the higher cost of natural gas in past years, which is now being used for generation. As Michigan modernizes its centralized generating capacity and the capabilities of the grid are improved, further use of natural gas will likely occur – as long as prices remain attractive. Additionally, as the nuclear facilities age they will eventually be de-commissioned; due to the extremely high cost of construction it is unlikely that nuclear capacity will be replaced. These ongoing and forthcoming changes in electrical generation create a window of opportunity to move toward lower-carbon and zero-carbon electricity generation.

"In terms of cost, renewable energy in Michigan has been cheaper than new conventional coal in recent years. With the exception of three contracts established shortly after the signing of PA 295, new renewable generation costs have been significantly lower than anticipated by the utility companies and show a downward sloping pricing trend. This is evident with new wind farm contracts such as Blissfield Wind and Harvest II, which came in at costs significantly less than estimated in Consumers Energy's Renewable Energy Plan."[8] *Michigan Energy Overview, October 2011*

The Costs of New Generation: Renewable Energy vs. Coal



Each point on the graph represents a renewable energy contract submitted to the MPSC as part of PA 295.

The phasing out of fossil fuels is critical to meaningful reductions of community GHG emissions. Some intermediate actions can act as a bridge in the coming decades to reducing and ultimately eliminating fossil fuel reliance. Moving Ann Arbor from its current dependence on centrally controlled sources of electricity and natural gas to a system that provides electricity and heat from renewable sources is essential. None of the specific actions identified in this section rely on the continued or increased use of coal-fired generated electricity and, as such, they begin Ann Arbor's transition to renewably generated electricity.

EB-14: Increase use of combined heat and power units

Combined heat and power (CHP) is a system that increases the utilization of fuel by converting the energy from combustion into both electrical generation and heat. The electricity and heat are typically used on a campus or within a building while the electricity can also be net metered to the grid. The U.S. has historically lagged behind Europe and the rest of the world in the use of CHP technology. While the U.S. has underutilized CHP, the technology has been changing in recent years, moving from large systems to smaller units that can be installed in large commercial buildings and even residences.[9] The potential market capacity for CHP in Michigan is estimated to be up to 7,500 MW in the industrial and commercial sector and an additional 18,000 installations in the multi-family residential sector. This potential may only be realized if the regulatory and policy issues become more supportive of CHP installations.[10] Ann Arbor should promote the increased use of CHP units in a variety of applications through the reach of the a2energy program and the availability of PACE or other financing mechanisms. This plan also recommends that the City consider partnering with an established CHP expert for assistance with increasing the number of CHP installations.

EB-15: Create a downtown geothermal heating and cooling district

This Plan recommends that Ann Arbor investigate and potentially implement a downtown geothermal loop that would run in the City's right-of-ways to provide a geothermal connection to closely spaced downtown buildings. In order for this action to be successful, the City of Ann Arbor will need to develop a regulatory and/or administrative structure that will maximize connection of the individual downtown buildings to the geothermal loop. Each downtown building on the route serviced by the loop would need to install a ground source heat pump-driven heating and cooling system for that building's systems.

EB-16: Implement a downtown CHP district system

The feasibility of installing a downtown heat and power district would be evaluated in conjunction with EB-15 and EB-17. The feasibility study will estimate the economics and outline a path to implementation for EB-15, EB-16, and/or EB-17. A downtown CHP district will supply a heat source to downtown buildings year round and will generate electricity that can be used locally or supplied to the DTE grid. The regulatory structure (merchant plant, City utility) under which a CHP district is installed will need to be carefully defined before proceeding with detailed engineering. Ann Arbor may need to work with the MPSC to develop enabling legislation or policy. This action could act as a bridge to zero fossil fuels. In the time between installing a CHP district system and needing to replace it, the choice and cost of zero carbon technologies available will be more attractive than options available immediately.

EB-17: Create a geothermal utility to implement ground source heat pumps for residential heating and cooling

Implementing this action will make geothermal loops available to single-family homes. This plan recommends that the City of Ann Arbor investigate creating a geothermal utility that will make residential geothermal units attractive to homeowners. Since the high initial cost for the loop is converted into a monthly usage fee, homeowners are more likely to invest in geothermal units. The City could model the creation of a geothermal utility after the City of Wyandotte's, which is currently being piloted. The geothermal units in homes would eventually receive the needed electricity from centralized renewable energy or distributed generation. To implement this, Ann Arbor would need to expand one of its current utilities or create a new utility, both of which would require negotiations with the MPSC.

City of Wyandotte's Geothermal Utility

The City of Wyandotte, MI, with the help of a federal grant, created a geothermal utility to provide low-carbon energy to residents. Geothermal energy systems take advantage of the earth's constant core temperature by utilizing fluid filled tubes to exchange heat between buildings and the ground. The city had long established municipal electric and water utilities and made the decision to add geothermal service in order to reduce summer electric loads and the city's carbon footprint. The project also helps low-income residents reduce their energy bills. Residents can have a system installed by the city, or a third party, and rates can be arranged to finance the cost of creating the geothermal well.

EB-18: Ensure availability of utility-level solar incentives

In recent years, DTE Energy began a customer-owned pilot program called Solar Currents, which was one of the top utility-level solar incentives programs in the country. Solar Currents provided financial incentives for business and home owners interested in solar PV installations. The program provided rebates of $2.40 per watt of installed solar PV power and per kilowatt payments for every kilowatt hour produced. DTE discontinued the program as of May 2011 after 64 homes and businesses in Ann Arbor successfully enrolled. The City of Ann Arbor and the Ann Arbor Energy Commission should investigate a variety of options that would ensure a return of incentives promoting installation of both PV and thermal solar systems.

Rated at the time to be one of the better solar PV incentives in the country, DTE's SolarCurrents program was phenomenally successful in its two-year lifespan. About 500 installations resulted from the program, which altogether produces 5 MW of electricity.

EB-19: Utilize digestion of waste water treatment plant material, or post consumer organics, to generate useful biogas

The City of Ann Arbor's wastewater treatment plant currently does not digest its primary and waste activated sludges for energy recovery prior to land application or landfilling (seasonally dependent). In order to utilize digestion of wastewater sludges for biogas, the City utility would begin by fully evaluating the options for utilizing the energy content of this sludge before disposal. Once a method is chosen, the City utility could work with a partner to implement this process and generate useful biogas.

ENERGY AND BUILDINGS:

RENEWABLE ENERGY

Renewable Energy is obtained from resources that cannot be depleted, such as wind, tidal, hydro, and solar. The State of Michigan Public Act 295 of 2008 requires Michigan electric providers to supply at least 10 percent of their electricity sales from renewable resources by 2015. Residents and businesses can also generate their own electricity using solar, wind, or

Number of Renewable Energy Actions: 6

geothermal systems on their own property, or they can participate by opting into DTE's Green Currents program. Major advancements in the utilization of renewable energy is essential to any plan seeking to mitigate greenhouse gases.

Renewable Energy

Utilizing renewable energy sources for energy generation helps reduce reliance on fossil fuels and significantly reduces GHG emissions. The State of Michigan Public Act 295 of 2008 requires Michigan electric providers to supply at least 10 percent of their electricity from renewable resources by 2015.[11] The City of Ann Arbor currently supplies renewable electricity from landfill gas and hydropower to the grid that, combined with other solar and fleet measures, is equivalent to the energy used by 20 percent of City operations. The City of Ann Arbor and its residents and business owners can go above and beyond state requirements and generate their own electricity using solar, or in some situations wind, or participate in DTE's Green Currents program which is a voluntary program that custumers can purchase into to supply their energy from renewable sources.

Many traditional energy sources have negative long-term environmental impacts. The health effects of the by-products of combustion have been understood for many years and regulations to reduce exposure to by-products continue. Additionally, the continued use of coal, oil, and natural gas to generate electricity have resulted in increased GHG concentrations in the atmosphere that affect the Earth's climate. As we deplete the fossil fuel resource supply, prices are expected to increase, as resources become scarcer and more expensive to extract from the earth. Recent studies indicate that wind power is now more cost effective that new coal generation.[12] Ann Arbor's reliance on coal and natural gas for electricity and heating make it particularly vulnerable to increased prices and disruptions in supply. In order to establish a more diverse energy portfolio and meet the Energy Challenge Goals, the City of Ann Arbor should pursue renewable energy opportunities for municipal, business and residential buildings.

In 2007, Ann Arbor was designated by the US Department of Energy (DOE) as a Solar America City. This program was initiated by the DOE to encourage the use of solar energy technologies, identify barriers to solar adoption, and develop strategies and partnerships to identify solutions to these barriers. This program has resulted in the installation several solar PV systems at public locations, as well as an online solar map to help residents determine the feasibility of a solar project at their home. In addition, the program served to educate local leaders and City staff about solar technology and change the perceptions that surround the feasibility of renewable energy projects.

EB-20: Increase the renewable portfolio standard

A Renewable Portfolio Standard (RPS) is a regulatory requirement for utilities to increase the quantity of electricity generated from renewable resources in an efficient and cost-effective manner. An RPS can decrease GHG emissions, increase the diversity of the energy supply, and improve both the economy and environment. Currently, Michigan has a RPS which requires all utilities to have 10 percent of retail sales come from renewable sources by 2015. This standard requires DTE to have 300 MW of new renewable generation by 2013 and 600 MW by 2015. The City of Ann Arbor should advocate both locally and at the state level to increase the RPS to maximize electricity generated from renewable sources.

EB-21: Maximize purchase of Michigan renewable energy (e.g., DTE Green Currents)

Presently, DTE's Green Currents program allows customers to support renewable energy through voluntary enrollment in the program. Program participants pay a $0.02 per kWh premium for 100 percent match of their use with renewables/ renewable energy certificates or can purchase blocks of 100 kWh of renewable energy for $2.50 per block per month. Enhanced and ongoing education would make citizens more aware of this program and the value of creating market demand for renewable energy.

EB-22: Implement an agreement with DTE Energy to create more stringent renewable energy requirements and fund other energy efficiency and renewable energy programs

The City of Ann Arbor could work with DTE to generate a new agreement that creates more stringent renewable energy requirements and funds energy efficiency and renewable energy projects and programs.

EB-23: Work with the Michigan Public Service Commission and DTE Energy to allow direct purchase of renewable energy by residential electricity customers

Allowing direct purchase of renewable energy would increase market choices by allowing businesses or homes to purchase renewable energy directly from a non-utility supplier, rather than purchasing renewable energy indirectly, such as through DTE's Green Currents program. Effective and efficient implementation of this action would require a State statute that allows Community Choice Aggregation (CCA). CCA is currently available in several states, including Ohio, Massachusetts, and California. CCA enables cities and counties to supply electricity to the customers within their borders. Unlike a municipal or privately held utility, a CCA does not own transmission and delivery systems. Instead, a CCA is responsible for providing the energy commodity (the electrons) to its constituents – which may or may not entail ownership of an electricity generating facility. CCAs gain buying power by the aggregation of customers. This is unlike Michigan's current choice law, which requires that each individual purchaser shop for his or her own power – which is very inefficient and does not leverage buying power. Additionally, Michigan's power suppliers providing the choice program only offer power to commercial and industrial customers.

There is evidence that CCA programs have been effective in driving the conversion to renewable energy sources. In order to be successful, the City of Ann Arbor will need to draft legislation and form a coalition to advance this action. This action will require a longer time to implement, but it has dramatic potential to drive the transition to renewable energy.

EB-24: Implement community renewable energy projects

The City should consider working with identified partners and energy providers to develop community renewable energy projects to accelerate the adoption of distributed generation. There are many successful models of community renewable energy projects being implemented in the U.S. Most focus on driving down the transaction costs of installing renewable energy systems on homes.

Cincinnati 100% Community Renewable Energy

Cincinnati has developed an ambitious plan to supply 100 percent of the community's energy from renewable sources without a significant increase in utility rates. This plan is possible through an Ohio community choice aggregation law that allows communities to bid for the best electricity deal. The city currently receives electricity that is generated primarily from coal, and this contributes to poor air quality in the region. In 2011, Cincinnati residents passed a ballot measure to allow the city to bargain on their behalf to find a new electricity provider. The City sent a request for proposals that asked energy suppliers to bid for the lowest price as well as commit to purchasing renewable energy credits. FirstEnergy Solutions won the bid and the City is presently working on the contract to allow the company to be the city's electricity provider.

Solar canopies at the Cinncinati Zoo generate 1.6 MW of energy

EB-25: Work to achieve the "5,000 Solar Roofs" target

In 2006, Ann Arbor City Council passed a resolution setting a goal of 5,000 solar roofs in Ann Arbor by 2015. The resolution focused on solar hot water heaters but efforts should be expanded to also include photovoltaics. Sun in southeast Michigan can provide a significant percentage of the community's energy needs. If every residential building in Ann Arbor had a one kilowatt solar electric system on its roof, the community could generate over 30 million kilowatt-hours of clean electricity each year. Nearly 10 percent of the residential demand.

Energy and Buildings Endnotes

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LAND USE AND ACCESS

Understanding the interaction between people's needs and desires to access destinations and how land uses are arranged is important in any attempt to reduce GHG emissions. Land use shapes and is shaped by development of the built environment. Historic dependence on the automobile and conventional zoning that often separated different land uses, like businesses from residences, still impacts how people access local destinations in Ann Arbor, as it does in many other urban areas in the U.S. Personal vehicle travel contributes significant GHG emissions, and while the car is likely to remain the dominant means of transportation for many people in the near future, maximizing public transportation opportunities, creating more bike lanes and better pedestrian infrastructure, supporting low and no emission vehicles, and encouraging more compact development within the downtown and along major transportation corridors will all contribute to reducing fuel consumption and decreasing emissions from travel.

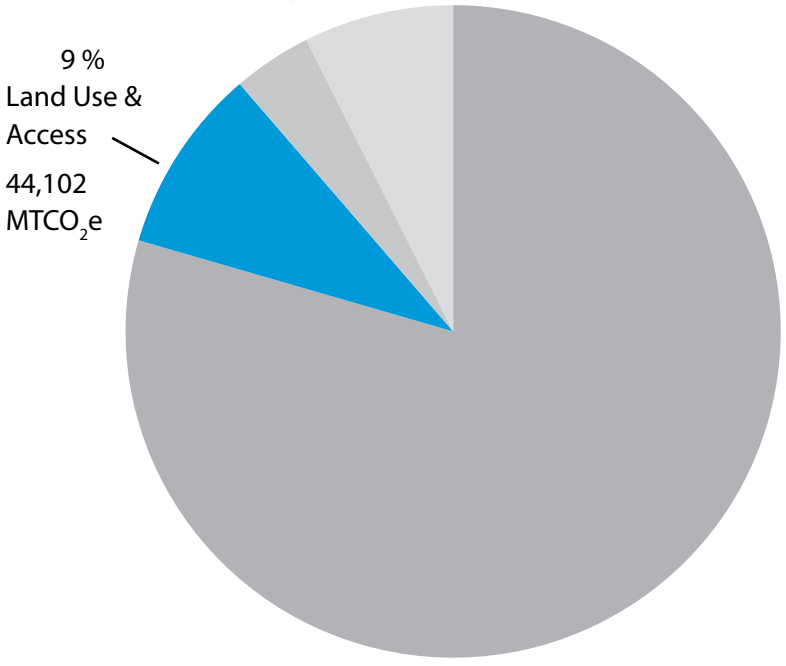
Ann Arbor is committed to reducing vehicle miles traveled (VMT) by increasing access to efficient and sustainable transportation options such as busing, bicycling, or walking, as well as through improving the ways land is developed or left as open and recreational space. The City can continue to encourage a pedestrian-friendly environment that depends less heavily on the automobile to access places of interest.

The actions discussed in this section are divided into three subcategories:

Integrated Land Use for Ann Arbor means encouraging a compact pattern of diverse development that maintains a unique sense of place, preserves natural systems, and strengthens neighborhoods, corridors, and downtown.

Transportation Options refers to establishing a physical and cultural environment that supports and encourages safe, comfortable, and efficient ways for pedestrians, bicyclists, and transit users to travel throughout the city and region.

Sustainable Systems focuses on planning for and managing constructed and natural infrastructure systems to meet the current and future needs of our community.

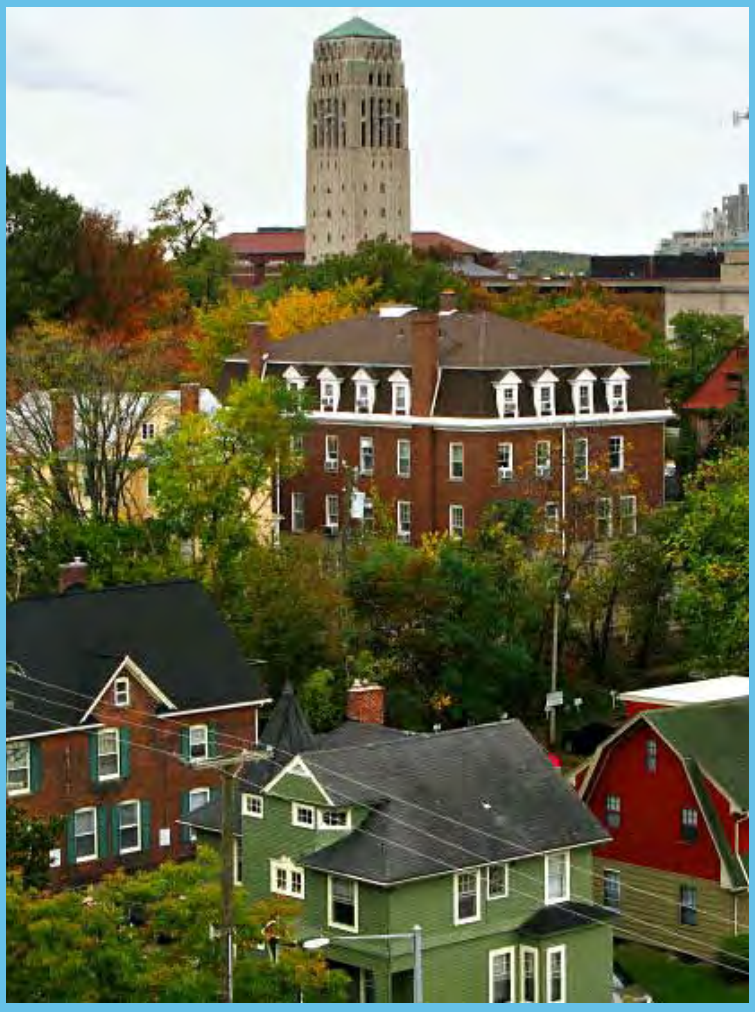


Actions identified in this section amount to 9 percent of the total emissions reduced by implementing actions in this Plan

LAND USE AND ACCESS:

INTEGRATED LAND USE

Integrated Land Use for Ann Arbor means encouraging a compact pattern of diverse development that maintains a unique sense of place, preserves natural systems, and strengthens neighborhoods, corridors, and downtown. Ann Arbor must remain vigilant over the kinds of land use decisions made today as these decisions affect how residents and visitors access destinations, goods, and services long into the future.



Number of Integrated Land Use Actions: 6

One of the key identifying features of Ann Arbor is the diverse use of land in and around the City, including multiple university campuses, employment corridors, active parks, schools, natural areas, retail and entertainment facilities, and unique and historic neighborhoods. Providing pedestrian-centered environments encourages residents to drive less, promotes local economic activity, and reduces transportation-related GHG emissions.

LU-1: Actively support regional approaches to land use planning to reduce origin and destination distances

Ann Arbor has strong partnerships with local organizations and regional and state government. The City should continue to facilitate these partnerships and prioritize a regional approach to sustainable land use and transportation planning. A regional approach allows multiple jurisdictions to outline a shared vision that will focus on environmentally, economically, and socially sustainable changes. This approach fosters collaborative efforts and provides a forum for representatives at all levels of government to share information, resources, and best practices that will help achieve long-term goals and targets. Working with UM, Washtenaw Area Transportation Study, SEMCOG, and adjoining jurisdictions, Ann Arbor can promote land use planning that reduces distances between origin and destination for Ann Arbor residents.

LU-2: Create a program that provides incentives to employees and residents that choose to live within two miles of their job

Though some people have flexible work arrangements, many must still commute five or more days a week to and from their workplace. Proximity to one's workplace can substantially reduce the collective transportation footprint. Ann Arbor can work with local businesses to entice employees to live and invest in a home within two miles of their workplace by establishing financial incentives for both renters and homeowners. Two nearby examples to draw from are Detroit's Live Downtown program and Eastern Michigan University's new mortgage incentives.

Local Example: Detroit's Live Downtown Program

Detroit's Live Downtown program uses financial incentives to encourage employees of specific companies to live where they work, creating a more dense and vibrant downtown environment. This program was modeled after a flourishing pilot program, Live Midtown. Five major companies, including DTE Energy, Compuware, Quicken Loans, BlueCross Blue Shield of Michigan, and Strategic Staffing Solutions, are offering cash incentives to buy or rent in the greater downtown area.

Since 2011, employees working in downtown Detroit are incentivized to live in the surrounding neighborhoods. Incentives include up to $20,000 in loan forgiveness, $2,500 for new renters towards the first year payments, $1,000 for renewing a current lease in the area, and matching fund opportunities for exterior home improvements. More than 15,000 employees are eligible for any incentive offered. Detroit's Live Downtown program is administered by Midtown Detroit, Inc.[1]

LU-3: Encourage coordinated zoning and redevelopment at transit-supportive densities, using land use, development regulations, and market forces

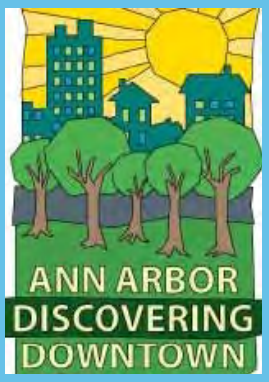
Planning for growth is a complex process that must incorporate high quality-of-life standards with economically strong and environmentally friendly goals. Sprawl-enabling zoning of the past, development and speculation of cheaper land away from town centers, historic market preferences, and the perceived endless availability of inexpensive gasoline, have all contributed to present land use arrays. Zoning and policies in Ann Arbor can be and are already being modified to allow for transit-supportive density, redevelopment, and infill development that help create a more vibrant city. Continuing to promote infill development, mixed housing types, multiple story buildings, and mixed-use transit nodes will maximize the City's investments in utility and transportation infrastructure, potentially help reduce travel-related GHG emissions, and create active and vital neighborhoods.

One way to encourage sustainable use of available land is to look beyond specific projects and guide development in terms of corridors within and across the City. Implementing the Washtenaw Avenue Corridor Study, a major corridor redevelopment project, as a pilot can reveal how other locations throughout and Ann Arbor can be re-envisioned for the better.

Another consideration is being more flexible with cottage housing options in single-family districts. This can restore density in areas where the household size has declined significantly from when the houses were first built, potentially supporting neighborhood schools while serving as a magnet for pedestrian-oriented neighborhoods.

Ann Arbor Discovering Downtown (A2D2)

A2D2 is a set of zoning amendments established by City Council to improve the downtown area. The A2D2 initiative achieved the following high priority projects:



- Created special overlay zoning for the downtown that identified areas of similar character
- Incorporated a set of essential design guidelines
- Streamlined the development proposal process
- Worked with the Historic District Commission to clarify criteria for development
- Pursued a comprehensive parking strategy for the downtown

LU-4: Maximize incentives for mixed-use and transit oriented development

The City can promote high-quality, mixed-use development through financial incentives such as brownfield redevelopment financing or purchase/transfer of development rights, regulatory relief from requirements like parking or setbacks, and outreach to developers and lenders, such as through the PACE program. Incentives help reduce development costs and increase return on overall investment. Regulatory relief could also promote greater flexibility in development by improving project codes or reducing the amount of time a project is under review.

LU-5: Support future funding for greenbelt land purchases around Ann Arbor

The Ann Arbor Greenbelt program began in 2003 when residents voted to create a 30-year, 0.5 mil tax levy in which a portion of the money is used to protect agricultural land and open space outside of City borders and a portion is used to purchase new City parkland. The purpose of this program is to protect land along the Huron River, working farmland, and natural areas. As of February 2012, funds have protected 27 working farms and three open-space parks, which collectively comprise more than 3,500 acres of land. Protecting open space through

the Greenbelt program will help reduce GHG emissions by improving air quality, utilizing trees to sequester carbon, and protecting local food sources. However, if not done strategically, this can contribute to sprawl by creating "leap-frog" rural and suburban residential development beyond the greenbelt. Another alternative that addresses the demand side of the equation is transfer of development rights, which would allow greater density in receiving zones in exchange for restricting development in the sending zone.

The Ann Arbor Greenbelt program has protected 27 working farms including the M Cook Barn located in Lodi Township

LU-6: Revise the local parking ordinance to allow for more flexibility with parking provisions

There are a variety of ways to revise local parking regulations, including decreasing or eliminating the number of required parking spaces for both commercial and residential developments, expanding the range of the residential parking program, adding parking maximum allowances, and allowing more shared parking in residential and commercial areas to reduce the number of parking spaces needed on individual properties. Ann Arbor has already been very active in implementing this action. The next phase of this action will require the City to focus on incentives for car-sharing, shared parking arrangements, charging stations for electric vehicles, and potential future technologies such as hydrogen powered vehicles. Transportation of people and supplies account for 22 percent of Ann Arbor's GHG emissions.

LAND USE AND ACCESS:

TRANSPORTATION OPTIONS

Transportation Options refers to establishing a physical and cultural environment that supports and encourages safe, comfortable, and efficient ways for pedestrians, bicyclists, and transit users to travel throughout the city and region. There are significant

Number of Integrated Land Use Actions: 10

community health and economic benefits to decreasing VMT and promoting walking, cycling, and use of public transit.

Transportation Options

This significant portion of community emissions could be reduced by continuing to promote a physical and cultural environment that supports and encourages safe, comfortable, and efficient ways for pedestrians, bicyclists, and transit users to travel throughout the City and region, as has been envisioned in the Ann Arbor Non-Motorized Transportation Plan and Ann Arbor Transportation Plan. This Climate Action Plan supports the rapid advancement of vehicle efficiency improvements while also emphasizing the need to reduce overall VMT, and supports recommendations in the existing Non-Motorized Transportation Plan. While technological advances, such as electric vehicles and vehicles that utilize lower-emission fuels, will be necessary in the effort to curb climate-changing emissions, a robust system for walking, biking, and mass-transportation is also essential in reducing community emissions.

In order to reduce emissions associated with our diverse land uses, it is important to direct new and retrofitted infrastructure and land use policies to support and prioritize low-carbon transportation options. The City of Ann Arbor has already begun to embrace policies and programs to broaden its transportation options and increase its reliance on sustainable forms of transportation. The City can continue to prioritize reducing the number of miles people and goods must travel by focusing on community-oriented design, reducing sprawl, and continuing to develop a connected network of sidewalks, pedestrian pathways, and bicycle lanes.

Non-Motorized Transportation Options

In 2007, Ann Arbor City Council adopted a comprehensive Non-Motorized Transportation Plan, which aims to create a physically active, accessible, and livable community by promoting pedestrian and bicycle facilities. Since 2008, the City has been working to expand on existing infrastructure by adding 25 miles of sidewalks, 38 miles of on-road bicycle lanes, and 129 mid-block crossings. Ann Arbor currently has 475 miles of sidewalks, 38 miles of on-road bike lanes, and 55 miles of shared-use paths. These expansion efforts support the large number of pedestrians and cyclists who already rely on non-motorized modes of travel and will encourage many others to switch to more carbon-friendly commuting behaviors. Residents who choose to use their bike or walk instead of using a car help reduce road congestion, improve air quality, improve their own health, and reduce GHG emissions.

The City will continue to enhance an integrated bicycle system by installing more bicycle parking, expanding cycling lanes, and incorporating more divided cycling lanes into the greater road system. In addition to providing a safe and comprehensive cycling system, the City will continue to work with local partners and programs to promote cycling.

Walk, Bike, Drive Campaign

To increase safety for all road users, Ann Arbor launched the Walk, Bike, Drive public outreach and education campaign. The campaign includes reminders and practical tips for all users to enhance overall safety. The campaign helped Ann Arbor obtain gold-level walk friendly community recognition and silver-level bicycle friendly designation in 2010.

Border-to-Border Trail

The Border-to-Border (B2B) Trail is a bicycle and pedestrian path along the Huron River that provides recreation and commuting opportunities to Ann Arbor residents. Portions of the trail have been completed and others are still under development. The completed trail will span 35 miles across Washtenaw County from the Livingston County border to the west to Wayne County to the east.

getDowntown

getDowntown provides information and assistance to businesses and employees on commuting options like biking, riding the bus, walking, carsharing, and carpooling. A partnership between the City of Ann Arbor, the Ann Arbor Downtown Development Authority, and the Ann Arbor Transportation Authority, the getDowntown program offers sustainable transportation programs and events throughout the year, including the Commuter Challenge.

LU-7: Create a Transportation Demand Management program that uses social and targeted marketing to encourage more residents to bike, walk, and bus to their destinations

Transportation Demand Management (TDM) programs utilize a variety of strategies to reduce reliance on single-passenger automobiles and promote transit alternatives such as carpooling, telecommuting, and public transportation. TDM programs provide incentives to residents to utilize transit alternatives and often couple these with disincentives for automobile travel such as increasing parking rates and reducing available parking. The City of Ann Arbor can create a TDM program that uses social and targeted marketing to motivate residents to bike, walk, and bus to and from their destinations. Local businesses can help promote the program and be encouraged to provide facilities that support alternative commuting.

The Commuter Challenge

The Commuter Challenge is a friendly competition between Ann Arbor organizations to see who can get the most employees to log an alternative commute — walking, biking, taking the bus, carpooling, telecommuting — each May. The Commuter Challenge, organized by getDowntown, offers prizes to encourage commuters to try new modes of transportation.

LU-8: Implement a community-University bike-sharing program

The City of Ann Arbor is currently working with student groups and UM's Parking and Transportation Services to create a bike-share program. A bike-share program will allow students to use their University ID cards to access rental bicycles at designated kiosks. Student groups started a petition in late 2011, and as of February 2012, have obtained more than 1,250 signatures in support of establishing a bike-share program. While an effective bike-share program would rely heavily on the City completing a more organized and robust system of bike lanes and paths, the City's non-motorized plan provides strategies that would assist in implementing this action.

Paris Velib Bikeshare

The City of Paris has one of the most successful bike share programs in the world. The Velib bike-sharing program was launched in 2007 with 20,000 bikes. As of 2009, over one-third of all bicycle trips in Paris were by Velib users. Paris has become a model for other programs around the world, including the Barclays Cycle Hire system in London.

Minneapolis Nice Ride

Minneapolis launched its seasonal bike-share program in June, 2010. The system includes 116 kiosks and 1,200 bicycles making it the second largest bike-share system in the U.S. The program was intitally funded by Blue Cross and Blue Shield of Minnesota, the City of Minneapolis, and a federal transportation grant from the Nonmotorized Transportation Pilot Program.

City of Madison B-cycle

The City of Madison B-cycle program began in May 2011. The city has 35 B-cycle stations with 350 bikes throughout downtown Madison. Users can purchase a membership online or at any B-station. The system is designed to encourage short trips throughout the city and reduce congestion, parking demand, and pollution. B-cycle programs exist in 13 cities throughout the country, including Denver, Des Moines, Charlotte, and Chicago.

Washington State University Green Bike

In 2009 Washington State University (WSU) launched its bike share system with the goal of decreasing traffic congestion, lowering carbon emissions, and encouraging health and physical exercise. The WSU fleet is made up of 120 bikes and five check-in/out locations. The program is currently sponsored by WSU Wellbeing. Over 100 colleges and universities across the country operate bike sharing or rental programs.

Bus and rail options

Bus

The Ann Arbor Transit Authority (AATA) operates the local public transit system for the greater Ann Arbor area. AATA currently operates 27 bus routes that serve Ann Arbor and portions of surrounding cities and townships. Over the last five years, overall ridership has increased by more than 40 percent.[2] The City of Ann Arbor has a strong partnership with the AATA and will continue to support efforts to expand AATA services, improve efficiency, encourage ridership, and also work with other bus service providers.

Expanded Partnership Between AATA and Michigan Flyer

In April 2012, AATA launched a partnership with Michigan Flyer to operate a new public transportation service with 12 daily roundtrips between Ann Arbor and the Detroit Metropolitan Airport. This new service offers a convenient, affordable, and reliable way for Ann Arbor residents to get to and from the airport without using a personal automobile. This new service adds to the array of long-distance bus options available to the Ann Arbor community that reduce the need to have and use personal vehicles.

Rail

Ann Arbor currently has one Amtrak station and three passenger service routes that connect residents to Detroit, Kalamazoo, Chicago, and other cities across the region. According to the Michigan Department of Transportation, rail ridership grew significantly in 2011, and Ann Arbor continues to be the busiest stop along the Detroit-to-Chicago corridor.[3]

In 2010, the State of Michigan received $150 million in federal funds to make high-speed rail improvements along the corridor. In 2011, legislators approved Senate Bill 237 which allows the State to use a portion of these federal funds for a new train station in Ann Arbor that can accommodate high-speed rail.[4]

LU-9: Actively engage and support the study and delivery of commuter rail along high-demand corridors

Commuter rail service refers to passenger trains that are actively used to transport riders to and from work in cities. Commuter rail service in Ann Arbor could ease traffic congestion, promote economic development, reduce gasoline consumption, and reduce GHG emissions. There are currently two proposed commuter rail lines that would serve Ann Arbor residents and commuters.

WALLY is a proposed commuter rail line that would run north/south between Ann Arbor and the City of Howell. This route would provide an efficient and cost-effective alternative for some commuters who work in Ann Arbor but live outside city limits. Currently, US-23 is one of the most congested routes leading into Ann Arbor. This Plan supports the continued support and promotion of the WALLY commuter rail project. For more information, see www.theride.org/wally.

MiTrain would operate between Ann Arbor and the City of Detroit. This east-west line starting in Ann Arbor would service Ypsilanti, the Detroit Metro Airport, Greenfield Village, and the City of Dearborn before arriving in Detroit. Southeast Michigan Council of Governments (SEMCOG) is leading development of this line along with partners from communities along the corridor, County representatives, local transit operators, and the Michigan Department of Transportation (MDOT). This Plan recommends Ann Arbor continue to support this project and work with SEMCOG to ensure its success. For more information, visit www.semcog.org/AADD.

Many developing countries are building bus-rapid-transit (BRT) systems. These are lanes and stops dedicated to moving buses as rapidly as possible, providing many of the benefits of commuter rail at a reduced (10-20 percent) cost.

LU-10: Provide incentives for use of intracity and intercity public transit

Increasing public transit use reduces air pollution, energy consumption, and congestion and saves money for residents. Finding ways to offer incentives for using public transportation can help increase ridership. These incentives should be continually sought after and increasingly offered. Encouraging organizations to purchase transit passes for their employees or providing in-house incentives for employees who switch from driving to using public transit is also necessary.

Washington Metropolitan Area Transit Authority SmartBenefits Program

Similar to other fringe benefits offered by employers, SmartBenefits is a program administered by the Washington Metropolitan Area Transit Authority in Washington, D.C. that allows employers to provide a pre-tax monthly commuting benefit to employees in the form of a "SmarTrip" card. The card encourages the use of public transportation by simplifying the process for employers to contribute to staff's sustainable commute. SmarTrip cards are accepted at most major transit providers, such as rail lines, commuter buses and vanpools, and can work in conjunction with a personally funded commuting account.

LU-11: Create a citywide go!pass program that combines bus use incentives with biking and walking incentives

The Ann Arbor Downtown Development Authority (DDA) currently provides discounted transit passes, known as the go!pass, to downtown employers who then offer them at little or no cost to employees. A go!pass allows unlimited bus usage and encourages employees to utilize public transportation when traveling to and from the downtown area. If this program was expanded outside DDA boundaries and included incentives for biking and walking, vehicle emissions could be further reduced throughout the City.

LU-12: Enhance transit service for the City of Ann Arbor, including offering more frequent routes and more weekend and evening service

AATA evaluates current routes and periodically increases service during evening hours and weekends. Currently, AATA operates from 6 a.m. to 11:30 p.m. Monday through Friday and 7:30 a.m. to 7:00 p.m. on Saturday and Sunday. Not all routes are operational during those hours. Expanding operating hours and improving service, frequency, and offerings for all members of the community will be an important component in the ongoing effort to address climate change.

Electric vehicles

The City of Ann Arbor, in collaboration with local non-profits, is committed to increasing infrastructure to support plug-in electric vehicle (PEV) use within the city. PEV charging stations are just starting to appear across town, and more are on the way. PEVs reduce tailpipe GHG emissions by reducing or eliminating dependency on gasoline or diesel as a fuel source. While GHG emissions are still generated through the production of electricity, as the electricity grid transitions to more renewable sources, PEV GHG emissions will be reduced.

Automobiles

While this Plan looks to help offset over-reliance on automobiles, cars and trucks will continue to be the primary mode of transportation for most citizens and travelers in Ann Arbor for the foreseeable future. In order to accommodate the needs of all residents, the City can work to improve existing streets and bridges while also focusing on development of a more cohesive network of "complete streets".

Complete Streets

Complete Streets are designed and operated so they are safe, comfortable, and convenient for all users—pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. These streets can differ depending on a particular community's needs, but some common features include:

- ADA-compliant transit stops and crosswalks
- Bike lanes that allow enough room for both automobiles and bicycles, or separate bike lanes from road traffic
- Sidewalks that are safe for all users
- Audible or tactile signals for blind pedestrians
- Crosswalks that are clearly marked and visible to motorists, and safe for pedestrians

LU-13: Encourage market-based and incentive-based parking strategies and rates

The City can work with the DDA to create a new parking fee structure that increases rates on the busiest blocks and during the busiest time of day. Best practices are available from cities such as Seattle and Washington, D.C., which have used market-based pricing to reduce parking demand.

LU-14: Create an innovative ride-sharing system

Ride-sharing is one strategy to help reduce the number of vehicles coming in and going out of the city on a daily basis. Promoting and supporting an innovative ride-sharing system will help reduce emissions and improve quality of life by reducing time spent in traffic. The City can work with local businesses and organizations to create an innovative ride-sharing system that meets the needs of all users and lowers the number of vehicles entering and exiting the city.

Michigan Rideshare

Michigan Rideshare is a free online service that helps commuters find carpool, vanpool, and bike partners. Ride sharing helps save money, reduce congestion, and lower emissions. Visit https://mirideshare.org/en-US/ for more information.

LU-15: Encourage business and building owners to reduce in-bound vehicle traffic

Creating awareness and encouraging incentive programs that reduce in-bound vehicle traffic will reduce air pollution, traffic congestion, and energy consumption, which will lead to lower GHG emissions. Employers can reduce the "carbon footprint" of their employees' travel by encouraging the following:

Telecommuting – Allowing employees to work from home or other remote locations one or more days a week

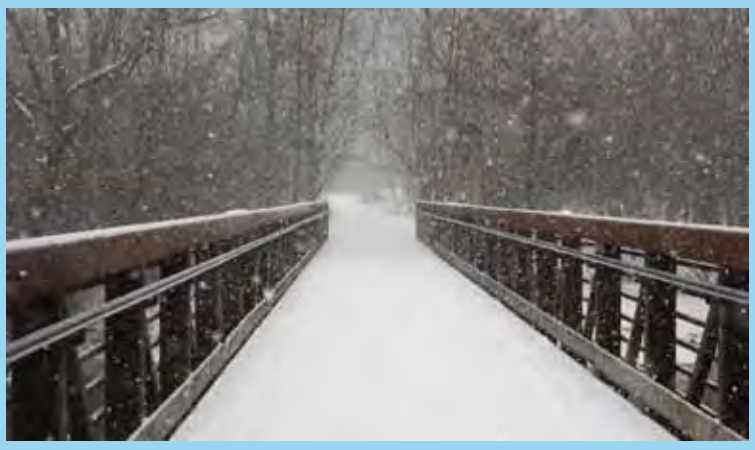
Alternative Work Schedules – Allowing employees flex time, compressed work week, staggering start and end times

Incentivize ridesharing – Coordinating carpooling or vanpooling programs or structuring the workday or office schedule to accommodate shared rides among employees internally or with other businesses

LU-16: Increase events and activities that raise awareness of commuting benefits

In Ann Arbor, nearly 18 percent of residents walk to work and 3 percent commute by bike. Although these numbers are higher than the national average, it is vital to continue to increase awareness of commuting benefits and encourage residents and employees to consider alternative transportation methods when commuting. Educational efforts raise awareness and reduce GHG emissions by promoting long-term commuting behavior changes.

In 2008, Ann Arbor was voted the third Best Walking City and was named a gold-level walk friendly community in 2010.[5,6]



LAND USE AND ACCESS:

SUSTAINABLE SYSTEMS

Sustainable Systems focuses on planning for and managing constructed and natural infrastructure systems to meet the current and future needs of our community. Sustainable systems utilize new technology and innovative approaches to infrastructure design and management that may

Number of Sustainable Systems Actions: 5

also use basic principles found in nature for guidance. Ann Arbor is committed to planning for and managing constructed and natural infrastructure systems to meet the current and future needs of the community.

Sustainable Systems

Ann Arbor is committed to planning for and managing constructed and natural infrastructure systems to meet the current and future needs of the community. These sustainable systems are designed and managed to serve the community in a more sustainable manner. This section focuses on infrastructure and technology that support sustainable growth and development.

LU-17: Ensure that sidewalk/bike/transit service opportunities exisit within 1/4 mile of every Ann Arbor household

In order for the City to promote and incentivize alternative transportation options, the infrastructure must be in place for all members of the community to utilize those options.

Sidewalks – Walking reduces overall GHG emissions, energy use, dependency on gasoline, and traffic congestion, while offering the social benefits of encouraging interaction with others and improving health. Ann Arbor has approximately 530 miles of sidewalks and shared-use paths throughout the city. Fifty-six percent of the primary roads have sidewalks on both sides of the road. The City is continuing to increase the number of sidewalks and maintain and upgrade existing sidewalks.

Bike Lanes – The number of people using bicycles to commute has been increasing steadily over the past decade. Riding a bicycle reduces GHG emissions, saves money, and reduces traffic congestion. The City is developing an integrated bicycle system that provides divided lanes wherever possible. The City is also improving existing bicycle infrastructure and working with local partners to promote cycling for commuting as well as other trips within the city.

Ann Arbor's Model for Mobility

In 2006, Mayor Hieftje introduced his transportation vision of the City of Ann Arbor. The vision focuses heavily on walking, and bicycling, but also aims to expand the City's bus, rail, and train system to support a more regional mode of mobility and reduce Ann Arbor's over-reliance on auto travel. The three key components of this vision are:

- An east-west regional transit route
- A north-south rail connection using existing railways
- A local street car west-east connector system

Transit Service – While AATA buses currently serve 5.6 million riders per year, there may be additional ways to encourage ridership and expand access to the service. The UM transit system also serves additional customers and routes. The City of Ann Arbor will work with the AATA and UM to identify ways to expand transit services to within 1/4 mile of every Ann Arbor household.

AATA is already serving 95 percent of Ann Arbor with service available within 1/4 mile of every household.[7] This action should be attainable in the very near future for area busing. Washtenaw County voters support a 1-mill property tax increase to pay for countywide service expansion.

LU-18: Establish requirements or guidance for electric vehicle and hydrogen-fueled vehicle parking infrastructure for projects and increase city-wide infrastructure for electric vehicle charging and hydrogen refueling

Providing electric vehicle (EV) charging infrastructure is necessary to accommodate the future influx of these vehicles as a mainstay in our community's fleet. The City can work with local partners and within local code to ensure adequate EV infrastructure is a part of new development projects and accommodated in existing structures and parking lots. Over the next few years, new fast-fueling hydrogen vehicles are also expected to be entering the market and these vehicles should similarly be accommodated for in new projects and planned infrastructure.

LU-19: Make all possible signal and intersection pedestrian improvements

Improving intersections will help reduce emissions by increasing efficiency and reducing idling time. Well designed intersections also help support an active urban form that encourages walking and bicycling. Many intersections within city limits have undergone a variety of improvements already, and are built to ensure pedestrian safety. Design strategies already in place and those that can be enhanced include: installing center medians, installing accessible pedestrian- and bicyclist-activated signal buttons, increasing signage, crosswalk striping, curb extensions, wheelchair ramps, incorporating midblock crossings, and installing roundabouts.

High intensity Activated crossWalK (HAWK)

A HAWK beacon is a traffic signal device that assists pedestrians to safely cross busy streets. By pushing a button, pedestrians activate the signal which goes through a series of yellow and red sequences requiring motorists to stop. MDOT is working with the City of Ann Arbor on its HAWK traffic control devices.

Ann Arbor City Council recently updated its pedestrian ordinances to require the driver of a vehicle to stop and yield the right-of-way to pedestrians in and approaching marked crosswalks when traffic-control signals are not in place or are not in operation.

LU-20: Evaluate project life cycle and upstream CO_2e emissions as criteria for the City's Capital Improvements Plan scoring prioritization system

A project's life cycle refers to the entire period from idea conception through development and implementation to completion. Along with upstream emissions (or embodied energy), which include material sourcing, fuel use, and production emissions, life cycle emissions are a more holistic way of measuring a project's impact. The City could evaluate the life cycle of a project, its material composition, and the upstream carbon emissions associated with that project when evaluating a project's prioritization in the Capital Improvements Plan (CIP).

Capital Improvements Plan

The CIP outlines a schedule of public expenditures for a six-year period. It provides for large, physical improvements that are permanent in nature that are needed for the functioning of the community, including transportation, parks, utilities, and municipal facilities improvements. The CIP provides a methodology for turning needs into projects by outlining anticipated funding sources, schedules for study, design and/or construction solutions, and staff resources.

LU-21: Evaluate public infrastructure to increase density through supporting redevelopment readiness in the downtown and major corridors

A comprehensive evaluation of underlying infrastructure is necessary to prepare for a future population increase focused closer to the heart of downtown Ann Arbor and already developed major corridors. Preparing now for new growth can help avoid over-burdening water, sewer, and utility systems. Providing more residents with the option to locate within the downtown and along growing corridors helps reduce daily VMT and travel emissions. Understanding how our underlying systems can handle such an influx is a vital next step.

"In 2010-2011 alone, Ann Arbor added over 9 miles of bicycle lanes to city streets, increasing the total to 36.2 miles of bike lanes."

Land Use and Access Endnotes

1 Midtown Detroit, Inc. *Detroit Live Downtown*. [Accessed June 2012]
www.detroitlivedowntown.org

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http://www.aata.org/pdf/AATA%20overview%20for%20web.pdf

3 Ann Arbor.com, 2011. *Train ridership on the rise: Ann Arbor remains busiest Amtrak stop between Detroit and Chicago.*
http://www.annarbor.com/news/train-ridership-on-the-rise-ann-arbor-remains-busiest-amtrak-stop-between-detroit-and-chicago

4 Michigan Senate Bill 0237, 2011.
http://www.legislature.mi.gov/(S(sg5ig3553t5p1melksjxoiuk))/mileg.aspx?page=getobject&objectname=2011-SB-0237

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http://icma.org/en/Article/11499/Ann_Arbor_MI_Ranked_as_Third_Best_Walking_City_in_America

6 Walk Friendly Communities. *Ann Arbor Profile*. [Accessed June 2012]
http://www.walkfriendly.org/communities/community.cfm?ID=10

7 Washtenaw County. *Commuting.* [Accessed June 2012]
www.ewashtenaw.org/government/departments/environmental_health/recycling_home_toxics/your_world/commuting.pdf

RESOURCE MANAGEMENT

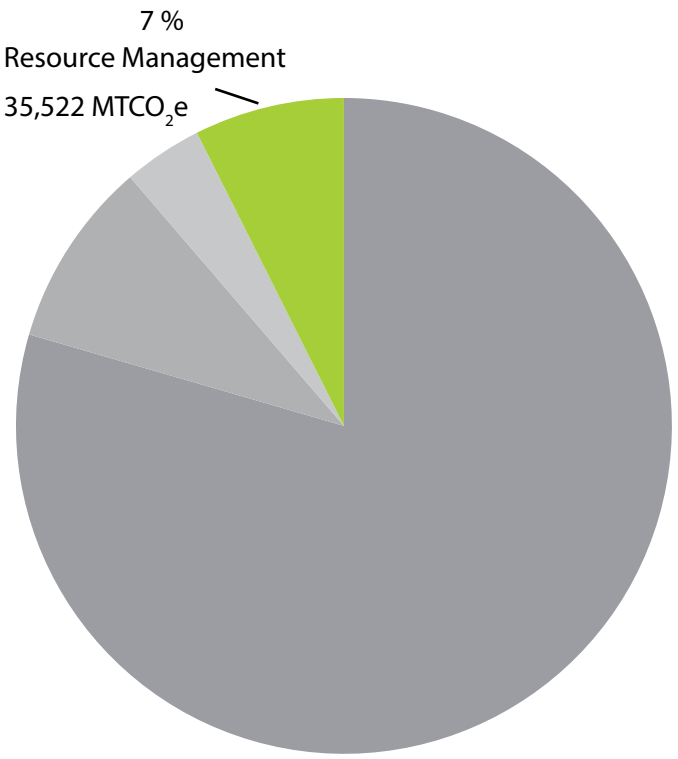
Effective management of our natural resources is essential to mitigate climate change effects and the risks posed to the community. An increase in the severity and frequency of climate-related weather hazards – heavy rain, flooding, ice storms – is the most significant effect predicted for Ann Arbor. In order to minimize the vulnerability of Ann Arbor's built and natural systems, this section of the Plan focuses on actions that protect our natural resources, enhance locally produced food, and expand and diversify the urban forest.

This section is divided into three goal areas:

Responsible Resource Use includes actions to effectively manage water resources, minimize water and wastewater treatment, curb consumption, and decrease the amount of landfilled material by increasing reuse, recycling and composting within the community by all sectors.

Local Food addresses the need to protect and enhance our local agriculture and aquaculture resources.

Healthy Ecosystems refers to the need to conserve, protect, enhance, and restore our aquatic and terrestrial ecosystems so they can serve as connections for plants and animals while providing valuable community space for humans.



Actions identified in this section amount to 7 percent of the total emissions reduced by implementing actions in this Plan

RESOURCE MANAGEMENT:

RESPONSIBLE RESOURCE USE

Responsible Resource Use includes actions to effectively manage water resources, minimize water and wastewater treatment, curb consumption, and decrease the amount of landfilled material by increasing reuse, recycling, and composting within

Number of Responsible Resource Use Actions: 23

the community by all sectors. Many of the stormwater related actions also provide ancillary benefits of reducing risk from anticipated flooding events.

Responsible Resource Use

The methods and strategies used to manage natural resources influences the amount of energy consumed and the associated GHGs emitted. For example, intensive energy processes are needed to pump and treat water and wastewater. Energy is also required to extract natural resources and to manufacture, transport, and dispose of products at the end of their useful life.

Actions presented within the Responsible Resource Use section encompass four categories:

- Water Conservation
- Material Resources
- Waste Reduction and Re-Use
- Recycling and Composting

In order to diminish the impacts of a warming planet on the region, Ann Arbor must use resources responsibly and maximize waste reduction efforts.

Water Conservation

GHGs are emitted from producing the electricity used to pump and treat water and wastewater; hence, efforts to reduce the amount of water pumped and/or processed, including water that currently leaks out of the system, will reduce GHG emissions.

Although the total GHG emissions related to water pumping and treatment are a small proportion of Ann Arbor's total emissions, reductions in this area may also provide ancillary benefits such as developing strategies to adapt to future drought episodes. For further details on Ann Arbor's water management practices, see Appendix.

Material Resources

Reducing the GHG emissions associated with consumption is an important part of any effective climate action plan. GHG emissions are produced at all stages throughout a product's lifecycle. Beginning with the extraction and processing of raw materials, and continuing in product manufacturing, transport, use, and disposal, all products have lifecycle emissions that are largely not transparent to consumers.

According to the U.S. EPA, "37 percent of U.S. total GHG emissions result from the provision and use of goods produced within the U.S."[1] Additionally, a recent report released by the Product Policy Institute estimates that products and packaging account for 44 percent of total U.S. GHG emissions when products made abroad and consumed in the U.S. are included in the analysis and those products that are exported are excluded.[2]

The upstream and global GHG reduction potential from waste reduction efforts, especially those related to reducing consumption and the need for material extraction and manufacturing, is large. While these GHG reductions are not necessarily measurable within city boundaries, this Plan recommends that the City pursue actions that reduce GHG emissions generated by products throughout their entire lifecycle. This Plan recommends that the City of Ann Arbor educate residents, businesses, and visitors about consumption choices to reduce upstream emissions.

The lifecycle of a product

City of Ann Arbor Resource Recovery Center & Materials Recovery Facility

The Resource Recovery Center (RRC), located on a 400-acre site, is responsible for the disposal, recovery, and processing of garbage, recyclables, and compost from Ann Arbor and some neighboring communities. The RRC site includes the Materials Recovery Facility (MRF), Compost Center, Drop-off Station and closed landfill. The MRF processes around 140 tons of recyclables per day. Waste that cannot be reused or recycled is compacted, loaded onto trucks, and sent to a private landfill.

Waste Reduction and Reuse

Reducing consumption is the most effective and economical method of handling waste; less consumption generates less waste. Waste reduction and reuse saves natural resources, eliminates the need to extract resources and manufacture products, minimizes waste management costs, and reduces the associated GHG emissions. The U.S. EPA recommends implementing the following waste management hierarchy:

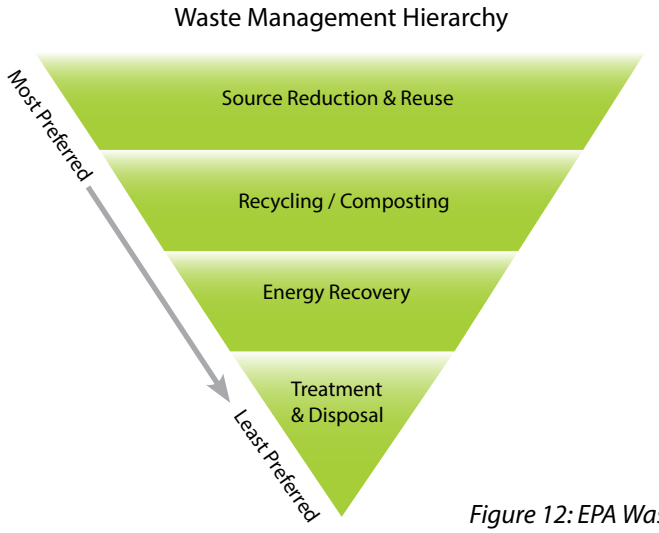


Figure 12: EPA Waste Management Hierarchy

In many ways, local, regional, and national policies can be an asset to curbing unnecessary waste before it is created. In addition, educating residents and businesses about consumption choices is an integral strategy to reduce waste by generating less. Expanding the City's efforts in this area can lead to significant reductions in waste generation.

Recycling and Composting

Recycling and composting are important indirect ways to mitigate climate change. Although the City of Ann Arbor has made significant progress towards diverting waste through recycling and composting programs, a new set of actions and strategies are necessary to become a zero waste community.

Wasting resources is inefficient. The vast majority of materials that end up in our landfills are either reusable or recyclable. Recycling products decreases GHG emissions by saving energy related to material extraction and product manufacturing. Additionally, decreasing the amount of material sent to landfills minimizes the methane generated from landfills.

Composting is a natural process that recycles organic materials back into the earth. Decomposition of food and other organic waste in landfills is an anaerobic process and produces methane, which is nearly 21 times more potent than carbon dioxide. Composting is an aerobic process and produces no methane and less carbon dioxide.

Compost collected from grocery stores, hotels, and restauramts

Compost turner. Turning the compost oxygenates the rows and speeds up the process

Recycling, reuse, deconstruction, and remanufacturing shift the value added in the economy from highly mechanized, environmentally harmful extraction industries, to labor-intensive, local industries.[3]

- U.S. EPA, 2009

RM-1: Encourage residential and commercial rainwater capture and reuse

Rainwater is a valuable resource and its proper management can help create a healthy Huron River watershed while reducing the GHG emissions associated with water pumping and treatment for irrigation. Rainwater can be captured on-site for reuse. Managing rainwater on-site reduces stormwater runoff and pollution, and helps mitigate climate change risks associated with the fresh water supply and flooding events.

Rainwater harvesting is the capture, storage, and reuse of rainwater from rooftops and other surfaces for uses typically outside a home or business. Rainwater harvesting systems can range in size, price and capacity. Systems range from a barrel placed at the bottom of a downspout, to installing multiple underground tanks with pumps, filters, and controls. Water stored in simple systems can be a great substitute for uses where a high level of purity is not necessary, such as garden care. Pricier systems can provide homeowners with multiple filters that make rainwater safe for all types of uses.

Cities can support rainwater harvesting by generating a list of appropriate uses, defining system requirements, and defining appropriate uses. Ann Arbor supports rainwater harvesting on private residential lots and offers residents credits on stormwater bills for installing a harvesting system. Local organizations, such as the Huron River Watershed Council (HRWC), provide resources and tips to residents interested in using a rain barrel or installing a rain harvesting system. The City also works closely with the Office of the Washtenaw County Water Resources Commissioner to provide residents with access to rain barrels for purchase and additional resources.

Rainwater can be used in a variety of ways:

Outdoor uses – Watering plants, watering garden, washing cars, and irrigating lawn

Indoor uses – Flushing toilets, laundry, cooling, and cleaning (subject to code requirements). Drinking, bathing, and cooking as long as proper filtration and sanitation systems are in place

Calculate your own rainwater harvesting potential

Collection area (ft^2) * Rainfall (in/yr) / 12 (in/ft) = Cubic feet of water per year

Cubic feet of water per year * 7.43 ($gallons/ft^3$) = Gallons per year

Average residential lot impervious surface 3,266 ft^2 * average annual precipitation 37.5 in/yr = 10,206.25 ft^3 = 75,832.44 gallons per year

Rainwater can also be managed on site to reduce stormwater runoff and associated pollution through the use of permeable surfaces, permeable pavers, and rain gardens on both residential and commercial properties. The City currently also offers residents a credit for the installation of a rain barrel, rain garden, cistern, or drywell. The City offers commercial stormwater credits to businesses that participate in the Community Partners for Clean Streams program or install approved stormwater controls.

The Plan recommends that the City support the following goals and actions in addition to developing and implementing effective community policies and outreach and education campaigns:

- Increase the use of rain barrels
- Increase the use of native plants
- Increase the prevalence of rain gardens
- Increase the use of permeable pavements
- Increase the use of parks for stormwater management and infiltration
- Train City staff to assist interested parties in capturing rainwater
- Provide public outreach for residents and businesses about rainwater capture, including offering home tours, showcasing demonstration projects, etc.
- Create an infiltration and performance standard for both stormwater runoff adjacent to streets and roads as part of new construction and street reconstruction, and for new additions to residential and commercial construction
- Revise codes and policies as necessary
- Enhance incentives

RM-2: Increase residential and commerical greywater use

Greywater is defined as untreated wastewater from washing machines, sinks, bathtubs, showers, or dishwashers. Essentially, greywater is any water that does not come into contact with human waste. Greywater reuse has the potential to significantly reduce water use in homes and businesses and decrease the amount of wastewater that must be treated; however, this is not a widely practiced or accepted means to reduce potable water demand. Although some residents use buckets to collect excess water from showers to water their plants, this is a minimal amount compared to the potential volume generated in both commercial and residential buildings. Any effort to reduce flows to the wastewater plant needs to be modeled to ensure that sufficient flows remain available to operate the collection system and treatment plant.

The most significant barrier to greywater reuse is cost. Capturing greywater requires installation of separate drain lines from appliances and fixtures. Additionally, storage containers are necessary to temporarily hold greywater until it is used. The cost of retrofitting an existing home with a greywater system typically ranges from $2,000 for a small system to $10,000 for a high-end, high tech system.[4] Commercial buildings are currently the most feasible option for greywater systems.

Significant barriers also exist in the form of health and safety codes and maintenance requirements. In addition, there may be ways to improve the City's internal review and approval processes to make it simpler for businesses and residents to install greywater systems.

Greywater Use at Home

This toilet utilizes waste water from a clothes washer for flushing instead of potable water. Greywater with partial filtration, or with no treatment at all, can be used from a variety of household appliances.

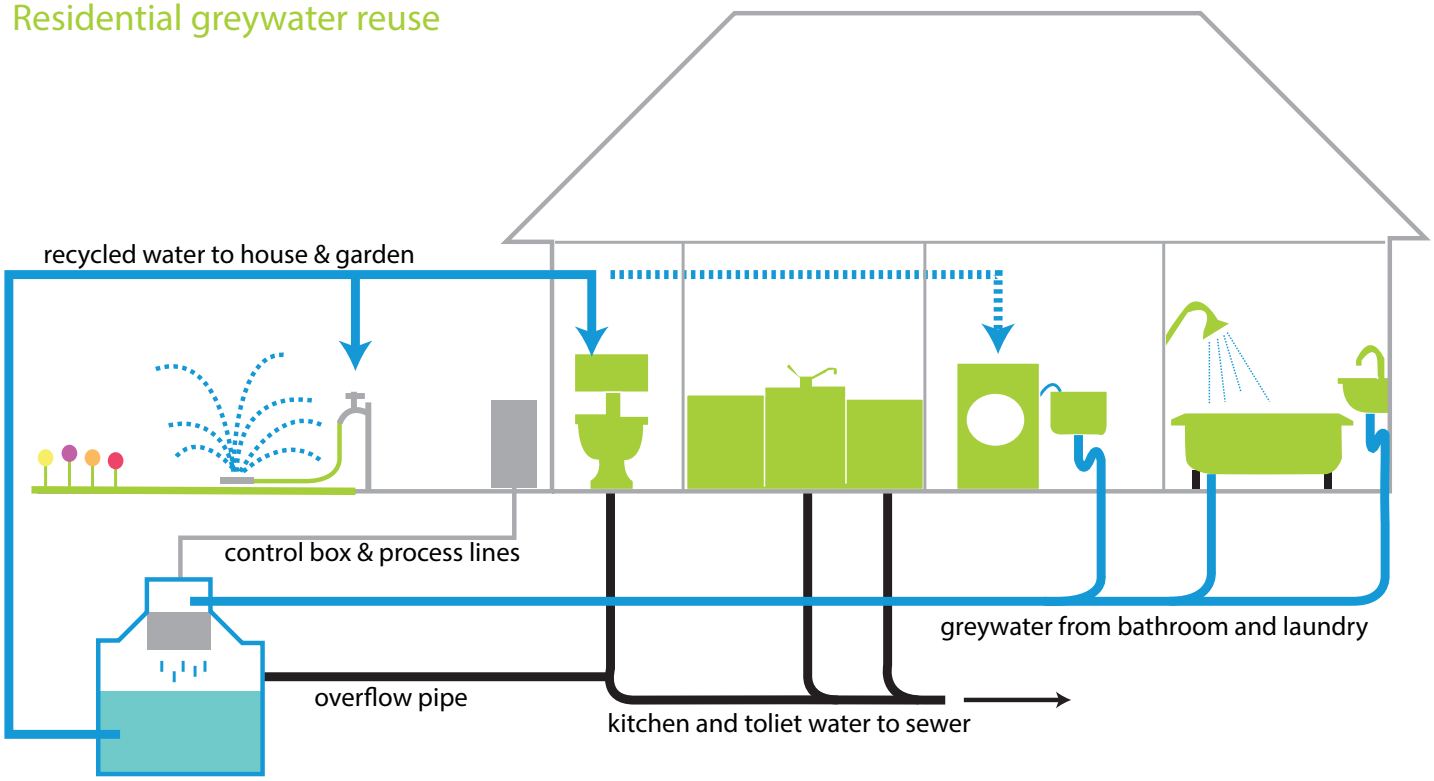


Figure 13: Residential greywater system

This Plan recommends that the City evaluate increasing greywater use throughout the community and undertake the following actions:

- Establish a definition of greywater and provide an approved list of systems that adhere to City health and safety codes
- Revise codes and policies where necessary
- Train City planning and inspection staff regarding greywater use and systems
- Encourage greywater system installation in all redevelopment and new development for commercial and residential properties
- Providing contractors with minimum materials, design and construction, and performance requirements to encourage the installation of greywater systems
- Provide public outreach for residents and businesses about greywater reuse

RM-3: Review water and wastewater rate structures

The average Ann Arbor household has three people and uses about 115 gallons of water per day per person. Water rate structures promote efficient water use and water conservation. Two basic types of water rate structures exist: service charge and consumption charge. Service charge is a fixed price paid by consumers each billing period, regardless of consumption amounts. Consumption charge calculates price of water based on each unit consumed. Although these two charges are the basis for most water rate structures, variations do exist.

Since 2004, the Ann Arbor water utility has used an inclining block rate structure to price water — as volume consumed increases, so does the price. The lowest water rate is calculated for the first seven water units (ccfs), with an increased charge for the next 8-28 units, a higher rate for 29-45 units, and the highest rate for over 46 units. This new rate structure is more equitable than a flat rate, since consumers pay more per unit used. Opportunities may exist to reevaluate the rate structure with the availability of new data from smart meters and evaluate peak pricing to reduce energy costs and associated GHG emissions.

RM-4: Adopt a water conservation ordinance

A water conservation ordinance is used to decrease water use. As part of the City's water management strategy, this Plan recommends developing an ordinance to support water conservation measures to ensure current and future water supply needs. Water conservation ordinances typically include permanent water waste prohibitions, water restrictions to be implemented during shortage conditions, and penalties for violations.

Water conservation ordinances often include the following:

- Enactment of water conservation days during peak usage periods
- Limits on watering hours for lawns, landscape or other vegetated area
- Limits on watering duration
- No excessive water flow or runoff
- No washing on hard or paved surfaces
- Mandatory obligation to fix leaks, breaks or malfunctions
- Re-circulating water required for decorative water fountains and decorative water features

RM-5: Increase pipe replacement to avoid the loss of treated water

The City of Ann Arbor's water distribution system has grown and evolved considerably over the last century and currently has 450 miles of water mains. Although the City has varying life expectancies for differing era pipes that have been installed over time, the vast majority of the City's distribution system was installed during a twenty-year period from 1960 to 1979.

Main Install Decade	Life Expectancy
1800s – 1910	120 years
1920 – 1940	100 years
1950 – present	75 years

Table 3: Ann Arbor's water distribution system life expectancy

In 2011, the City of Ann Arbor's water losses were approximately 230 million gallons, amounting to 4.5 percent of the total 5,150 million gallons processed for that year. The City's loss rate is considerably below the U.S. EPA's recommended goal of 10 percent annually. The national average for water systems breaks nationally is 0.25 to 0.35 breaks per mile. Using a five year average, the City has experienced approximately 0.26 breaks per mile. In general, Ann Arbor's water distribution system is meeting or exceeding recommended national standards. Opportunities do exist to further minimize water losses and reduce the associated GHG emissions generated from the processing and treatment of water. The City should continue to be aggressive in its practices to replace leaking pipes.

The City is currently planning and strategizing for needed pipe replacement projects, especially considering that a significant amount of piping will reach its useful lifespan between 2030 and 2035. Since there are GHGs emitted from the manufacture, transportation, and installation of piping, the City should incorporate GHG analysis directly into its capital improvement planning process. The City should maximize opportunities to complete necessary pipe replacements with other needed capital improvement projects in the same location to ensure efficiency and minimize climate impacts.

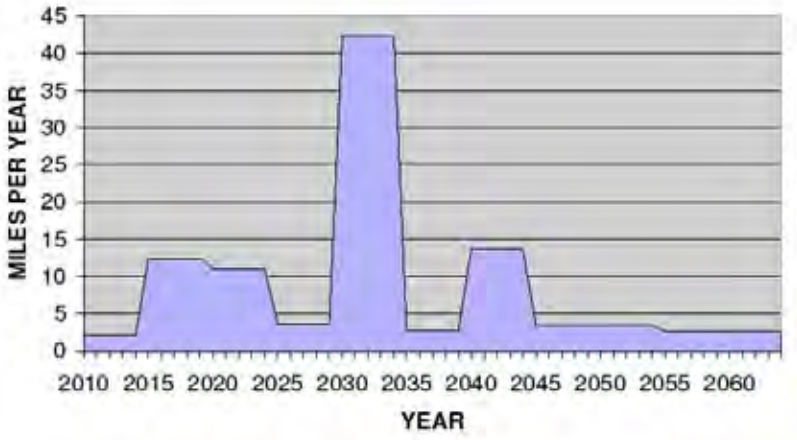


Figure 14: Watermain replacement projections (based on expected life of pipe)

RM-6: Reduce Ann Arbor's total waste stream

In the City of Ann Arbor's 2002-2007 Solid Waste Plan, the City established a goal of reducing overall community-wide material consumption by five percent by 2012. According to data gathered on waste generation since that date, the City has met this goal, likely aided by the decline in the economy.

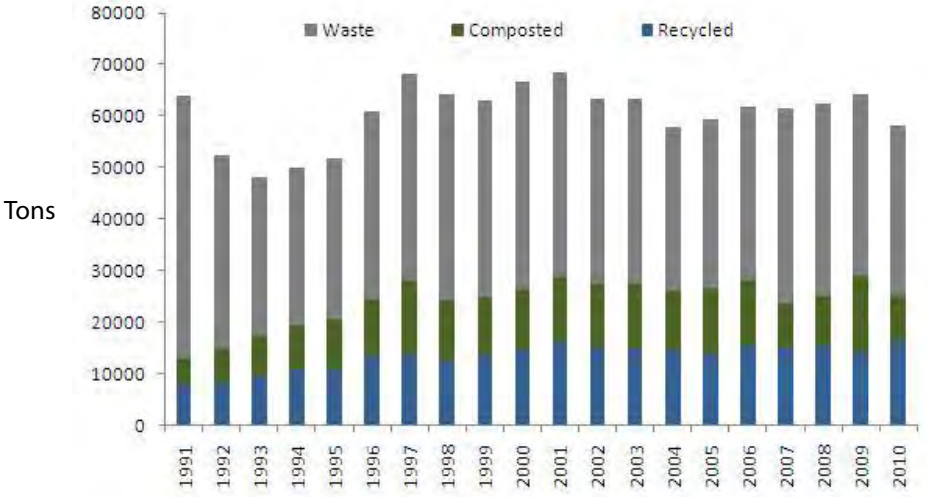


Figure 15: Ann Arbor compost, waste, and recycling

As stated previously, the most efficient waste management strategy is to avoid generating waste in the first place. This Plan recommends that the City educate residents and businesses on the benefits of reduced consumption and pursue the following actions and education and outreach campaigns:

- Establish a zero waste plan for the city
- Promote the U.S. EPA's waste management hierarchy in the following order of priorities from most to least preferred: 1) source reduction and reuse, 2) recycling/composting, energy recovery, 3) treatment & disposal
- Develop and promote a "buy less stuff" campaign
- Expand the promotion of junk mail reduction strategies to residents and businesses
- Educate residents and businesses on the lifecycle impacts of products and their consumer choices

RM-7: Advocate for county, state, regional, and federal product stewardship policies

Product stewardship is defined as "all parties who have a role in designing, producing, or selling a product or product components must take responsibility for the environmental impacts at every stage of that product's life."[5] Product stewardship promotes the concept of products being seen as resources rather than waste and minimizes health, safety, and environmental impacts of products through all lifecycle stages.

In order to advocate for product stewardship policies, the City will need specific product stewardship information that provides data regarding cost savings and environmental benefits. To obtain this data, the City must collaborate with partners to gather data and create recommendations that will help shape product stewardship policies. An option could be to join an organization that aids with this process, such as the Product Stewardship Institute.

RM-8: Evaluate an expanded "pay as you throw" system for residential solid waste

"Pay as you throw" (PAYT) is a system used to offer variable collection rates to residential and commercial customers based upon the amount of waste they throw away. PAYT systems are also referred to as volume-based or unit pricing systems. Essentially, ratepayers pay proportionately more for the additional waste they generate, similar to other utilities.

PAYT systems have a variety of benefits:

- The structure is more equitable; customers are charged for the amount of waste they produce
- Members of the community have an incentive to reduce waste, recycle, and compost in order to minimize costs
- PAYT helps inform members of the community of the true costs associated with waste disposal
- This system could generate more revenue for the City

Currently, the City of Ann Arbor has a PAYT system for businesses and a modified PAYT system for residents. In the modified PAYT residential system, residents can pay a small annual surcharge to upgrade to a larger garbage cart or an additional cart altogether. The City, however, covers much of the cost of residential garbage collection and disposal through property taxes and a solid waste millage. Under a PAYT system, the financing for trash collection would be directly paid by the consumer, while recycling, composting, and other waste services would continue to be covered at no extra charge.

The City has evaluated an expanded residential PAYT system previously and determined that it was not the right strategy to pursue. This Plan recommends all actions that reduce GHG emissions, including PAYT, be considered.

The City should evaluate offering three to four cart sizes to residents (20 gallon mini-can, 32 gallon, 64 gallon, 96 gallon) and establish rates proportional to the volume provided. Implementing an outreach campaign and hosting informational sessions will help the City provide community members with the opportunity to discuss the reasons for the change and the associated costs.

RM-9: Reduce residential solid waste pick-up schedule to bi-weekly

Currently, the City provides weekly residential trash pickup. A bi-weekly program switches households from weekly to bi-weekly pickup. Switching to a bi-weekly pickup system could save the City nearly $40,000 in annual fuel costs alone, reduce fuel related GHG emissions, and increase solid waste collection efficiency while encouraging further recycling and composting. The City would also accumulate additional cost savings through reduced vehicle maintenance and replacement costs and driver salaries.

Several cities in the U.S. have switched to bi-weekly pickup, including Portland, Oregon; Hamilton, Massachusetts; Miami Springs, Florida; among others. Internationally, Toronto Ontario and the majority of cities in Germany and Denmark offer bi-weekly garbage collection. Several of these cities found the bi-weekly process most successful if recycling and organic material pickup occurs weekly and trash pickup bi-weekly. Providing compost and recycling pickup more often increases participation in these efforts and leads to a decrease in volume of trash produced.

Various methods may help make bi-weekly trash pickup successful. First, the City can evaluate providing residents with countertop composting pails and large rolling compost bins free of charge. This provides residents with the resources necessary to make composting easier. The City can also evaluate programs to increase the collection of post-consumer organics including meat, dairy, and other organic waste that is currently restricted. This would include evaluating construction of a biodigester or some other regional facility to manage these materials. Additionally, the City would need to dedicate resources to educate residents about the benefits of bi-weekly trash collection, how to effectively manage trash for a two-week period, addressing common concerns to ensure a smooth transition.

RM-10: Encourage residents to place garbage, recycling, and compost carts out for collection only when full

Most residents place their garbage, recycling, and/or compost carts out each week for collection and many carts are not full. Putting out carts that are less than full reduces collection efficiency and leads to increased GHG emissions due to additional truck stops and starts and avoidable truck idling time to collect the cart. An education program that supports residents placing only full carts out for collection, while addressing likely concerns such as odor, would reduce GHG emissions and fuel costs due to increased collection efficiency.

RM-11: Implement a single-use bag ban or fee

This action is designed to reduce waste by minimizing the use of plastic and paper single-use shopping bags and requiring Ann Arbor residents to use reusable shopping bags. This action has significant benefit in reducing the upstream emissions associated with the manufacture and transport of single use bags.

According to the U.S. EPA, the annual U.S. per-capita use of disposable bags is 6-11 per week, resulting in 300 to 600 disposable bags per person annually. Based on this estimate, Ann Arbor residents use an estimated 35 to 65 million plastic shopping bags per year and 8 million paper shopping bags each year. Plastic bags are typically made of polyethylene that is derived from natural gas or petroleum and does not biodegrade in landfills. Paper bags are more energy intensive to produce than plastic bags, but are more often recycled by consumers. Paper bags in landfills decompose and produce methane.

The most effective and efficient method for eliminating waste is to reduce use and optimize reuse. Banning or charging a fee for single use bags will also lead to a cleaner environment by decreasing the number of plastic bags found in trees, streams, creeks, lakes and drainage systems. Additionally, a ban or fee will reduce litter along roadsides and protect threatened wildlife. This proposed action would impact grocery stores, pharmacies, big box stores, hardware stores, the farmers market, and retailers citywide.

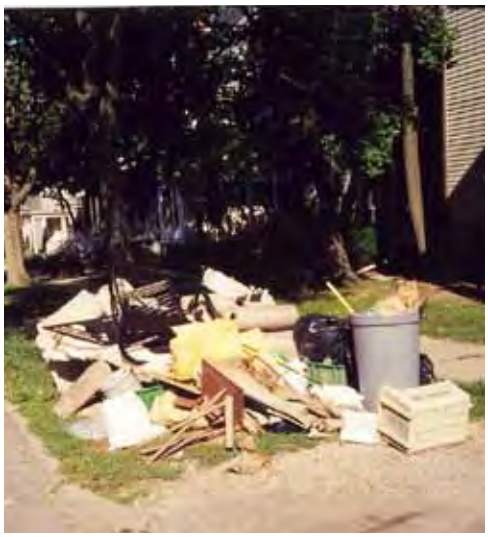
Many communities throughout the U.S. and the world have already committed to bag bans or reduction ordinances through fee requirements. These include but are not limited to the cities of Aspen, Colorado; Austin, Texas; Santa Monica, California; Seattle, Washington; San Jose, California; etc.

In 2009, the City of Ann Arbor conducted two separate disposable bag surveys: one consumer-based survey and the other of businesses within the community. Of the 774 consumer respondents, 58 percent were in favor of a ban on the use of plastic bags given at the point of sale. 43.4 percent were in favor of a fee being placed on all disposable bags, including both paper and plastic bags. 71.8 percent of respondents were in favor of a per-bag rebate provided to consumers who used their own reusable bags, which is a program currently offered by many local stores. Additionally, 43.8 percent of consumers felt that a fee of 25 cents per bag would be the most effective price to motivate consumers to bring their own shopping bags.

Responses from business owners and managers were surprisingly supportive as well. Of 59 business respondents, 57.6 percent were in favor of a ban on plastic bags at the point of sale. 56.7 percent were in favor of providing a rebate to consumers who used their own reusable bags. Additionally, 30.4 percent felt that a 25 cent bag cost would motivate consumers to bring their own bags.

In addition to a single-use bag ban or fee, there are multiple ways to promote and incentivize residents to use fewer disposable bags or bring their own bags. This Plan recommends that the City create an outreach program for residents to carry reusable bags.

RM-12: Facilitate more material reuse opportunities throughout the community



Ann Arbor's population is highly transient. Most incoming students purchase similar things such as dorm furniture, kitchenware, and ink-jet printers, and despite existing collection and reuse programs, many students discard items upon graduation. Creating a stronger infrastructure for reuse in the city would eliminate unnecessary waste by giving residents the option to buy used. This will also ensure a longer lifecycle for many items.

The City should evaluate a "free-cycle" sharing and exchange program for categories of items that are commonly needed temporarily, such as children's toys and moving boxes. This network could be strictly online with content added by the users (a hyper-local model similar to Craigslist or the existing Freecycle Ann Arbor), or a storefront alternative to Recycle Ann Arbor's ReUse Center or Habitat for Humanity's Restore that houses items available. The City should also consider incorporating an online list of yard and garage sales within the City to the exchange, similar to the one implemented in King County, Washington.[6]

RM-13: Reduce packaging waste

According to the U.S. EPA, packaging constitutes up to one-third of the non-industrial waste stream.[7] While many countries have longstanding legislation to encourage reduced packaging and increased packaging recyclability, the U.S. lags far behind in this area. In the absence of critical product stewardship policies that would help eliminate waste before it reaches the consumer, the City of Ann Arbor may benefit from encouraging residents to purchase products that can be bought in bulk or with reusable containers and totes.

RM-14: Implement a compostable/recyclable to-go packaging ordinance

This Plan recommends that the City develop an ordinance requiring local food establishments to use to-go foodware that can either be composted through the City's composting program, or that can be recycled through the City's recycling collection program. This action would effectively ban the use of expanded polystyrene (Styrofoam™) packaging containers and one-time-use containers that are not recyclable or compostable.

Many food providers in Ann Arbor currently provide to-go ware in expanded polystyrene containers. Expanded polystyrene is made from petroleum and is a product that does not biodegrade for hundreds of years. When it ends up as litter in streets, parks, and waterways, it breaks down into small pieces which are costly and difficult to clean up and are often ingested by wildlife. Although polystyrene is accepted at the City's Drop-off Station for recycling, most residents do not go out of their way to recycle this material. The vast majority of polystyrene used in the U.S. is currently not recycled due to the high costs associated with transportation and the specialized equipment required. Polystyrene recycling is not a closed-loop system, meaning that more resources must be used to create new products out of the recycled materials. This leads to increased pollution and inefficiency.

There are also significant human health concerns related to the use of polystyrene. Styrene, the precursor to polystyrene, is a hazardous substance that has been shown to leach from polystyrene containers into food and drink, in greater quantities when the food or drink are of high temperature or high fat content.

Many cities across the country have imposed food service packaging requirements, including Seattle, Washington; Portland, Oregon; and numerous California cities such as Los Angeles, Oakland, Berkeley, Malibu, Alameda, Emeryville, Fairfax, Richmond, Monterey, Santa Cruz, and Santa Monica.

Beyond establishing an ordinance, the City may benefit from assisting food vendors and consumers with the transition to recyclable and compostable to-go containers. This assistance would include developing and distributing a list of acceptable foodware, providing one-on-one consultations with food vendors to help them select appropriate to-go materials that meet their needs, creating a bulk purchasing network for vendors to help reduce the costs of alternate materials, and providing education to the community on the importance of this action and how consumers can recycle or compost the to-go containers in the City's collection system.

Americans discard over 2.5 billion Styrofoam cups each year

RM-15: Use zoning incentives to encourage reuse of existing building, structures, and recycled building materials

Demolishing buildings to build new buildings, may be time efficient, but is a resource and energy inefficient endeavor. The City loses the embodied energy (upstream energy needed to generate and transport the materials) of the building materials and creates the need to bring in newly manufactured materials for construction. This Plan recommends the City develop incentives to reuse existing building structures and deconstruct buildings that must be torn down for reuse.

The establishment of historic districts is one such mechanism Ann Arbor has successfully used to preserve the character of these communities and reduce the GHG emissions associated with tear downs and new buildings.

RM-16: Promote "climate impact" labeling for restaurants as well as other businesses

Climate impact labeling is intended to provide consumers with information regarding the climate-related impact of products. Labeling products provides consumers with better information regarding potential products to influence better purchasing habits. Labeling can also help boost demand for local and sustainable products.

Climate Certification of Food Pilot

Sweden embarked on a pilot to label carbon dioxide emissions on certain grocery items and restaurant menus.

The *Climate Certification of Food* is a system for both the production and distribution of food. "The regulations cover the farm, crop production, greenhouse cultivation, milk production, beef production, pig production, egg production, fisheries and transport." The sale of climate friendly items has already risen by 20 percent since emissions counts first appeared on menus in Sweden.

A single standard method is essential to implementing a climate labeling program, but climate labeling can be complex. Determining the impact of a product with multiple materials requires more multifaceted data than determining the impact of an individual material. Other factors to consider are a product's production, packaging, transportation, storage methods, and distribution. Lifecycle analysis may be required in order to collect the large amount of information necessary to accurately label based on climate impacts. A vast amount of information is available worldwide, but differences in methodology and parameters often make this information difficult to use.

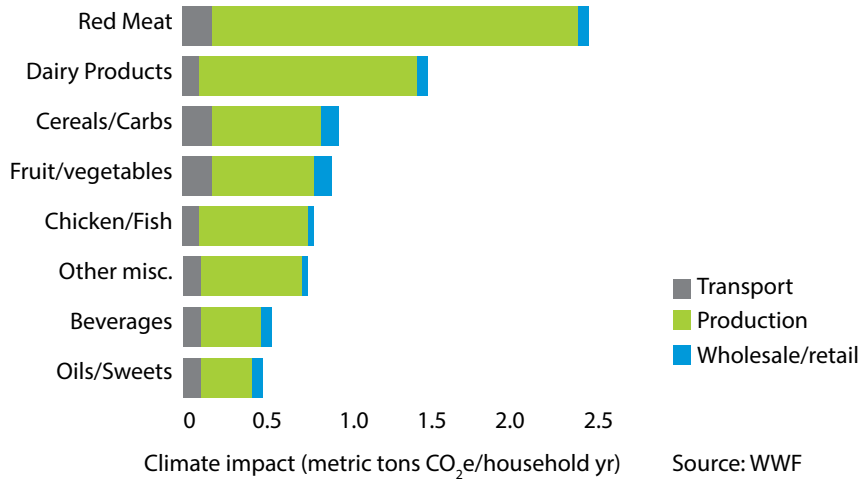


Figure 16: Total GHG emissions by supply chain tier associated with household food consumption in the US

The City of Ann Arbor could partner with researchers at the University of Michigan to develop a local labeling program and labeling standards. Labeling could include details about a product's origin, transport miles, and estimates of the amount of energy utilized to produce, transport, and deliver an item, if possible.

Based on studies conducted in northern Europe, simple stickers or labels tend to work best for labeling products. Labels should be straightforward and provide accurate information so customers can compare their carbon footprint as easily as they can compare nutritional information of a food product. The most effective labels tend to be color coded, have a score from 0-100, and incorporate easy-to-understand symbols such as an airplane or freight train.

RM-17: Develop a comprehensive green business certification program to include solid waste reduction, pollution prevention, green purchasing, water reduction, and energy efficiency

A green business certification program distinguishes and provides recognition to local businesses and organizations that take voluntary measures to reduce their impact on the environment and operate in a sustainable manner. The certification program could include a green business directory on the City's website and marketing materials for the business to promote its membership. The City should work with Washtenaw County on this effort and develop a strategy for expanding the County's existing Waste Knot Program. Washtenaw County initiated the Waste Knot Program more than a decade ago to incentivize and reward businesses for prioritizing and committing to waste reduction practices. The program has since grown in scope but could be expanded further to include requirements in each of the five sustainability areas (solid waste reduction, pollution prevention, green purchasing, water reduction, and energy efficiency). If the City and County provide consultations to businesses, guide them through the process, and track program results, this may increase the program's effectiveness.

RM-18: Require any city-sponsored (or city-located) outdoor event to be zero-waste

Special events are an often overlooked portion of a city's waste stream. Special events present an opportunity to capture the waste that might otherwise be landfilled and to educate residents about waste reduction. The City has begun implementing zero waste practices at a few city events such as Earth Day and Green Fair, but has not yet implemented a systematic approach to reducing waste at all events. The City could use several approaches to reduce this waste through policy adoption such as requiring only city-sponsored events to go zero-waste, requiring all events that take place within city limits to be zero waste, or requiring all events within city limits to have a waste and recycling plan in place and filed with the City. Requiring special events to submit a waste plan will allow the City to begin tracking the amount of waste produced at events and will improve the City's ability to achieve waste reduction targets.

RM-19: Increase residential and commerical recycling participation and tonnages

As of 2010, 43 percent of Ann Arbor's waste was either recycled or composted. While the diversion rate is relatively high compared to most American cities, Ann Arbor still lags behind cities with aggressive waste reduction goals in place. For instance, San Francisco has the highest diversion rate in the country (77 percent) and hopes to achieve zero waste by 2020. Many other cities in California have a diversion rate above 60 percent. California state law has required diversion rates of 25 and 50 percent of all municipalities.

In order to achieve increased tonnages in a recycling program, this Plan recommends that the City set an aggressive target and create a detailed plan to achieve the goal. Potential implementation tools and options to achieve this action include:

- Expanding outreach efforts to businesses including expanding free waste audit and consultation services. Often businesses can save money on their waste collection costs when they increase their recycling, which gives them incentive to take part in the program.
- Expanding outreach efforts to residents to encourage program participation
- Continually evaluate and implement opportunities to expand the list of acceptable recyclables both curbside and at the Drop-off Station (detailed more thoroughly in RM-21)
- Developing programs to get at the portions of the waste steam not currently targeted by existing programs. The City should sort both the residential and commercial waste streams to determine the current waste characterization and develop programs to target those materials. Examples of this could include adopting a construction and demolition debris recycling ordinance (which is detailed in RM-20) or expanding the list of acceptable materials for the composting program (detailed in RM-22).

RM-20: Implement a construction and demolition debris recycling ordinance

A construction and demolition (C&D) debris ordinance would require building and demolition contractors to divert a predetermined percentage of their debris from landfills through reuse and recycling. Nationwide, C&D accounts for 25 percent to 45 percent of the entire waste stream by weight. A tremendous opportunity exists to capture this material for reuse and recycling rather than landfilling. Typically, between 65 percent and 95 percent of C&D is either reusable or recyclable.

The City of Ann Arbor already has some groundwork in place to implement a comprehensive C&D recycling ordinance. Local nonprofit, Recycle Ann Arbor, operates a program (Calvert's Roll-Off Containers) that provides for collection, transportation, and processing of construction and demolition material for recycling. The service is aimed at commercial, industrial, and residential building projects and is the largest of its kind in the Washtenaw County area. The program provides for both the recycling and reuse of building materials through its ReUse Center location.

Implementing a C&D ordinance would not only prevent a significant amount of material from being landfilled each year, it would also create increased economic opportunity for the City and the region. A C&D ordinance could also drive the market for more recycled content building materials manufacturers to set up shop in Southeast Michigan.

A C&D ordinance should require contractors to submit a waste plan for each site that includes the location of the work site and proof that materials were accepted at a designated recycling facility. Often a C&D debris recycling ordinance is paired with a specific waste reduction goal, although currently, Ann Arbor does not track C&D material and the impact of diverting it from Ann Arbor's waste stream is unknown.

RM-21: Improve recycling opportunities at the City's Drop-off Station

This Plan recommends that the City evaluate improvements at the Drop-off Station to maximize accepted material types and to make it a more user-friendly place for residents who want to participate in the program. The City should consistently work with ReCommunity, which operates the materials recovery facility and markets the recyclable material, to increase the number of accepted materials in the program and find new market opportunities for the materials already accepted in the program. Additionally, the City should evaluate using several smaller satellite sites with containers for specific recyclable materials not accepted in the curbside program, instead of one larger site. This could minimize some of the operating costs associated with the Drop-off Station, and increase participation if residents do not need to travel far.

RM-22: Increase incentives and collection of residential and commerical organic waste (including food and soiled paper products)

According to the U.S. EPA, nearly 30 percent of the waste stream is made up of organics, yard trimmings, and food waste.[8] Currently, organic yard waste is collected weekly April through mid-December from Ann Arbor residents. Residents can use compost carts or can bag their yard organics in bags that can be purchased through local hardware stores. Currently, the City offers a 35-, 64-, or 96-gallon cart for purchase for a one-time $50 and the resident must collect the cart from City Hall. In 2010 and 2011 the City offered discounted compost carts and provided free delivery. Residents who have carts have the option of adding uncooked fruit and vegetable waste, coffee grounds, and uncoated paper plates, cups, and napkins to their organic waste for composting. However, more education can be undertaken so every resident knows this is an option.

Several program amendments may maximize composting potential in the City, including:

- Evaluate eliminating any charges for composting carts and provide delivery to single-family homes and duplexes. Converting more residents to a cart system instead of a bag system allows the City to maximize accepted materials and automated rather than manual collection, which will improve the efficiency of the collection routes and reduce GHGs.
- Evaluate offering compost collection at no additional cost to multi-family units and businesses.
- Add additional organics to the collection program, such as meat and dairy products, and compostable containers (detailed in RM-14) when appropriate post-consumer management facilities are developed.
- Evaluate implementing a commercial food waste collection program.

RM-23: Implement a home composting education and outreach program, including providing incentives to increase participation in home composting programs

Enhanced outreach and educational opportunities will help the City increase residential composting. Teaching residents how to compost at home reduces the City's need to run collection routes to collect compostable materials resulting in a correlated reduction in greenhouse gas emissions.

RESOURCE MANAGEMENT:

LOCAL FOOD

Local Food addresses the need to protect and enhance our local agriculture and aquaculture resources to reduce regional and global transportation related GHG emissions, strengthen the local economy, improve citizen health and

Number of Local Food Actions: 1

wellness by increasing access to healthy foods, and increase the City's long-term resiliency in the face of climate change.

Local Food

According to the United Nation's Food and Agricultural Organization (FAO), the food and agricultural sector is responsible for more than one third of global GHG emissions. In the U.S., our food system is largely centered on providing a variety of foods inexpensively and all year long, regardless of the growing season. Many elements contribute to feeding a community, such as the first steps of growing and harvesting food. Food also requires processing, packaging, transportation and distribution before it even reaches the consumer. All of these elements contribute to GHG emissions that are magnified as distance from one stage to the next increases. "The American meal travels on average 1,500 miles before it gets to the diner's plate."[9] Food imported from other states or countries typically requires more energy than locally grown food. In addition, soil is the largest carbon sink on the planet and its ability to sequester carbon and filter water makes it an important element in reducing GHG emissions.

Interestingly, as a result of a warming climate, Michigan may experience benefits from a longer growing season, however, changes in precipitation, increased occurrence of inclement weather, and other expected climate impacts could all negatively affect crop production. Due to an early start to spring and the warmest spring on record, Michigan, which normally generates a significant portion of the nation's tart cherries, had virtually no harvest in 2012. Regardless, efforts to establish a local and reliable food system that can be productive through all seasons will make Ann Arbor and Michigan more resilient in the face of expected climate change impacts.

Consumers and food establishments must have better access to locally grown food. While there has been a growing local foods movement both locally and nationally, this Plan recommends that the City enhance its policies, programs, and community partnerships to increase local food purchases to a minimum of 10 percent citywide.

Establishing a vibrant local foods movement provides a series of other ancillary benefits. Local foods are increasingly produced without the use of pesticides and herbicides. Therefore, increased local food purchases will reduce human exposure to chemicals, decrease the amount of chemicals released into the environment, and decrease the energy used to create chemical pesticides. Encouraging the use of local foods also increases the consumption of healthy fruits of vegetables, improves human health, and reduces ever-rising obesity rates. The supply and purchase of local foods can also boost the local economy.

Best practices from around the country:

In early 2012 Monterey County, California passed a resolution to ban the known carcinogen methyl iodide. Although the chemical is highly toxic, it is routinely used in strawberry production, which is big business in California. Banning the fumigant will reduce the risk to farm workers, groundwater, and communities in the rural county.

RM-24: Increase local food production and consumption

The City of Ann Arbor has made progress in increasing the availability and consumption of local foods. The City operates the Ann Arbor's Farmers' Market every Saturday of the year and on Wednesdays from May through December. The market, features locally grown produce, meats, grains, baked goods, and other items. The City also manages an innovative land preservation program: the Greenbelt Program, whose mission is to protect active agricultural and open land from development and to make local food production a larger priority. Over 3,000 acres of land have been protected as of spring 2012.

The City of Ann Arbor has passed several ordinances geared at supporting local food production. These include allowing up to four chickens at single-family dwellings and duplexes, up to two stands of beehives, and food production on city property between sidewalks and roads.

Many non-profits and community groups currently work on this issue in Ann Arbor and in the region. Project Grow is a local organization that provides Ann Arbor residents with over 300 community garden plots (over 4 acres of space) and the technical expertise to grow fresh, organic food and has been active since the 1970s. The Ann Arbor 350 initiative, is providing support to the Ann Arbor community to create a healthy homegrown food supply. On a regional level, the Food System and Economic Partnership (FSEP) is a Southeast Michigan initiative that develops partnerships between the local agricultural community and surrounding communities. The Selma Café, which operates in partnership with the FSEP, is a local-foods breakfast that occurs in Ann Arbor every Friday morning, offering a gathering place for community members to eat locally grown foods and support creating a vibrant regional food economy.

In order for the City of Ann Arbor to continue to increase local foods consumption throughout the community, this Plan recommends the following strategies:

- Expand partnerships with local organizations and non-profits already educating and engaging the community on local food issues
- Continue to promote and foster farmer's markets, local community supported agriculture (CSAs), and bulk purchasing opportunities
- Expand educational opportunities with residents, with a special focus on low-income and federally subsidized housing communities, to gain skills in organic gardening, fruit production, animal husbandry, food preservation and cooking, and affordable healthy eating
- Incorporate urban agriculture design into public spaces
- Encourage more community gardens on large local green spaces
- Promote the use of energy-efficient greenhouses to allow year-round food production

Food System Economic Partnership

Based in Ann Arbor, FSEP promotes a vibrant local food system by building partnerships between food producers, local food industry leaders, and community groups. FSEP is active in helping to start and develop small farms, getting local foods into schools and institutions, as well as advocating for policy changes to help area farmers. The organization is also part of the Fair Food Network, which is also an Ann Arbor based group, which works nationwide to build a more sustainable food system.

Selma Café and hoop houses

FSEP has also partnered with the Selma Café to help strengthen the local food system. The café serves a weekly breakfast that features local foods. The funds raised by the café are then used to help local farmers develop projects, such as hoop houses. Together, these organizations support human, economic, and environmental health in the region.

Best practices from other countries

Fairmount Waterfront Hotel in Vancouver, Canada grows herbs, vegetables, fruits and edible flowers for its restaurant, saving between $25,000 and $30,000 annually and more than offsetting the $16,000 annual maintenance cost.

RESOURCE MANAGEMENT:

HEALTHY ECOSYSTEMS

Healthy Ecosystems refers to the need to conserve, protect, enhance, and restore our aquatic and terrestrial ecosystems so they can serve as connections for plants and animals while providing valuable community space for humans. A primary characteristic of Ann Arbor is the extent, diversity and quality of its natural systems. The City strives to be a leader in environmental protection and

Number of Healthy Ecosystem Actions: 1

enhancement. Protecting our built and natural environments is a community goal and has long-term environmental, human health and economic benefits. This Sustainability goal incorporates clean air and water, protection of plant and animal species, open space management, water systems, and urban forestry.

Healthy Ecosystems

The City of Ann Arbor has a large number of creeks (7), streams, forests, and open spaces. These natural areas support a diverse range of wildlife that are vital to the City's landscape. Climate changes will significantly affect biodiversity and ecosystems in Ann Arbor. Degradation of our ecosystems will increase our GHG emissions, reduce adaptive capacity, and intensify the negative effects of climate change.

Wetlands, soil, forests, and bodies of water play an important role in absorbing and storing carbon. As human activity changes the climate, maintaining healthy ecosystems will become a challenge and will impact the carbon-storing abilities of these systems. Conserving and protecting Ann Arbor's existing ecosystems will allow them to continue serving as "carbon sinks," reduce vulnerability to climate change, and increase resilience in our community. In order to reach GHG emission reduction goals, protection and conservation of the City's natural resources is essential. Restoring wetlands, replanting forests, and managing ecosystems will play a crucial role in reducing emissions. Conserving natural spaces will also provide protection to residents as wetlands and forests act as natural buffers from storms and flooding.

Healthy ecosystems can resist and recover from extreme weather events quickly, thus preservation and management of these areas is essential to both adapt to and mitigate against the impacts of climate change. Maintaining an interconnected, diverse environment in the City of Ann Arbor will protect the community and improve its resiliency.

Ann Arbor Sustainability Framework

Supporting healthy ecosystems throughout Ann Arbor also contributes to promoting healthy citizens. The Active Living and Learning goal of the City's Sustainability Framework aims to improve residents' quality of life by providing diverse cultural, recreational, and educational opportunities for all members of the community.

The majority of the actions that would otherwise fall within this section are already housed in numerous other existing City plans, ranging from urban forestry to stormwater to parks and recreation. With the exception of one action detailed on the following pages. this Plan recommends supporting existing actions instead of generating any new actions for the explicit purpose of mitigation carbon emissions.

Urban Forestry

An urban forest includes all the woody vegetation growing in an urban area, including trees, shrubs, and vines found along city streets, public parks and private property. Ann Arbor's urban and community forest is a prominent feature of the City, made up of over 40,000 street trees and 6,600 park trees in mowed areas. Ann Arbor has over 3,600 acres of parkland maintained by the City of Ann Arbor, Ann Arbor Public Schools, and the University of Michigan. This valuable feature is a vital part of the City's green infrastructure system and provides immeasurable social, environmental and economic benefits.

Urban forests play a major role in reducing CO_2 through sequestration. Sequestration is the process in which CO_2 is absorbed by trees through photosynthesis, transformed into biomass, and stored as carbon. Trees act as a carbon sink by removing carbon dioxide from the atmosphere and storing the carbon in their roots, branches, trunk and leaves while simultaneously releasing oxygen into the air. One sugar maple tree reduces CO_2 levels by 502 pounds per year. Collectively, Ann Arbor estimates that its public tree resources reduces CO_2 by 7,851 tonnes per year.

Ann Arbor's urban forest provides a wide range of other environmental benefits to the community. Street and park trees minimize the urban heat island effect in downtown areas, therefore reducing GHG emissions by reducing the demand for cooling in urban buildings. The urban heat island effect is largely caused by heat being retained in building materials used in development (such as concrete), which create higher temperatures in urban areas. Trees also provide direct shade for homes and businesses thereby reducing the need for air conditioning in the summer months.

Urban forests improve air quality by absorbing pollutants through the pores in the surface of their leaves. Trees also reduce noise pollution, improve community aesthetics, and improve leisure and recreation opportunities for residents which contribute to greater community health. Urban forests also limit flooding by mitigating stormwater run-off and reduce topsoil erosion. Utilizing a wide variety of trees in planting efforts mitigate pest attacks, create lower fire-related risks, which will be key strategies for adapting to climate change.

RM-25: Increase forest canopy across public and private property

Since 2005, the City has planted nearly 5,000 trees along streets and in parks to replace both ash trees lost to the emerald ash borer and other street trees that died or were removed for other reasons. Ann Arbor currently estimates its urban tree canopy at 32.9 percent.

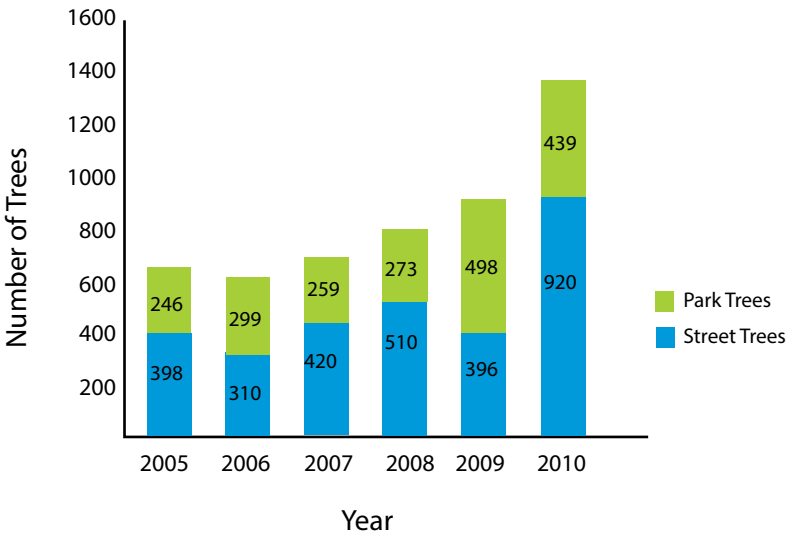


Figure 17: Number of trees planted by fiscal year (July 1-June 30)

The City is developing an urban and community forestry plan to establish goals, targets, and actions for the community forest. These goals range from protecting, maintaining and expanding Ann Arbor's tree canopy to promoting the amenity uses of an urban forest. The City's Climate Action and Urban and Community Forestry Plans support the role that the City's urban forests play in increasing carbon sequestration and adapting to expected climate change impacts.

In order to implement this action fully, the City of Ann Arbor will continue to support the role of parks and other city properties for canopy coverage and carbon sequestration. Preserving and maintaining the City's urban forests and plant hearty native trees with high carbon sequestration potential. The City will ensure species variety and plant trees that will be able to survive with changing temperatures. In addition, the City will evaluate the effectiveness of developing a carbon offset purchasing program, one where residents can purchase carbon offsets directly from the municipality and where the proceeds support further local sequestration opportunities.

Together, Ann Arbor's public trees intercept 65 million gallons of stormwater each year

Resource Managment Endnotes

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2 U.S. EPA, 2009. *Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices.*
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4 Greywater Action – For a Sustainable Water Culture. *How much does a greywater system cost?*
http://greywateraction.org/faqs/greywater-recycling#faq10

5 Minnesota Office of Environmental Assistance, 1999. *Product Stewardship Policy Initiative.*
http://www.pca.state.mn.us/index.php/view-document.html?gid=4910

6 King County, Washington Solid Waste Division. *Online Exchange.*
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http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2009-fs.pdf

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http://edition.cnn.com/2008/WORLD/asiapcf/03/16/eco.food.miles/

COMMUNITY AND HEALTH

Climate change is already affecting the lives of Ann Arbor residents in a variety of ways. Our energy sources, built environment, water resources, natural systems, and agricultural systems are vulnerable to a more variable climate - temperature shifts, precipitation changes, more severe weather, increased ground-level ozone, milder winters, and rising summer air temperatures. Human health and safety are particularly at risk when climate changes lead to extreme heat events, declining air quality, increased flooding, and new vector-borne diseases.

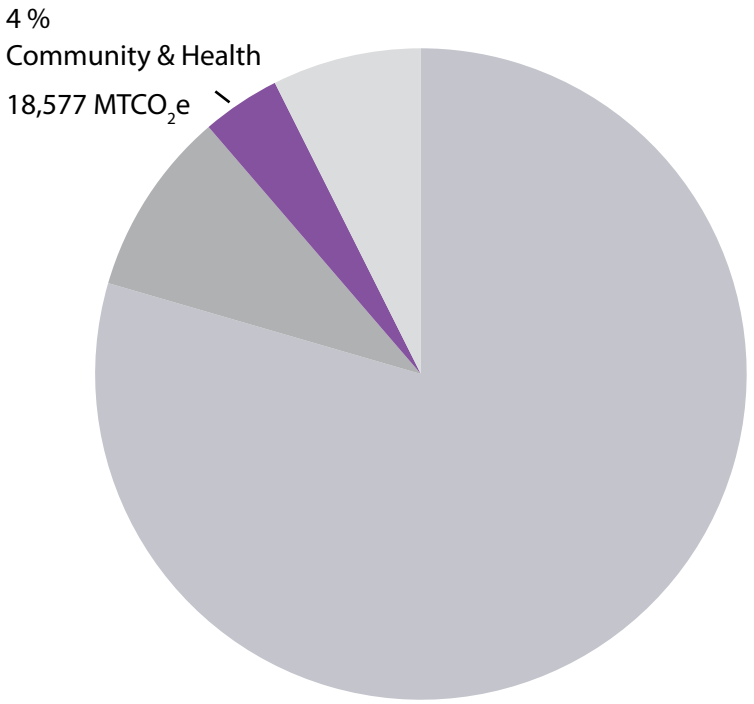
Threats to public health are likely to worsen as impacts from climate change increase. Projections indicate more frequent and intense heat waves, increased smog and particle pollution, and greater chance of waterborne diseases connected to heavy rainfall events. Given the rapid pace with which the climate is changing, these impacts will affect all man-made and natural systems and will only be addressed through a combination of adaption and mitigation actions. In addition, community understanding and action is essential to mitigate the local contributions to climate change, while beginning to adapt to the predicted effects.

This section is divided into three Sustainability goal areas:

Engaged Community focuses on creating an educated, aware, and active community to support Ann Arbor's climate mitigation and adaptation efforts.

Safe Community refers to minimizing the risks to public health and property from the hazards related to climate change.

Adaptation refers to the need to adapt or cope with the inevitable impacts of climate change, regardless of future GHG emission reductions.



Actions identified in this section amount to 4 percent of the total emissions reduced by implementing actions in this plan

COMMUNITY AND HEALTH:

ENGAGED COMMUNITY

Engaged Community focuses on creating an educated, aware, and active community to support Ann Arbor's climate mitigation and adaptation efforts. This Plan recommends that the City generate community-wide outreach campaigns aimed to educate and support community members and inspire them into action. In addition, the Plan recommends fostering partnerships with businesses, organizations, regional and state government, and

Number of Engaged Community Actions: 7

community members to implement each of the actions necessary to achieve the City's GHG reduction targets. At the local level, public outreach and education campaigns are essential to facilitate behavior changes, connect individuals with local organizations, and provide the tools and resources necessary to be successful. Engaged, empowered citizens are the key to success.

Engaged Community

Community commitment and participation are absolutely essential to successfully reducing GHG emissions and adapting to climate change. Business owners, residents, school officials, non-profit leaders, the faith communities, and members of large institutions and government must all work together to accomplish many of the actions listed in this report and the specific actions listed below. The City's task is to lead by example and provide residents and business owners with the education and supportive resources to enable the City to achieve its community-wide GHG reduction goals.

To engage the community, this Plan recommends that the City ensure all citizens have the information, support, and resources necessary to reduce their GHG emissions. Leadership, strong management, and community participation are the necessary ingredients to implement these ambitious actions and to reach reduction targets. This Plan also recommends that the City build upon existing outreach campaigns and partnerships. While by no means an exhaustive list, below are some community organizations that have recently played a central role in addressing climate change issues locally.

The Clean Energy Coalition strives to promote healthier, energy independent communities. The nonprofit has administered numerous successful programs that have positively impacted the Ann Arbor community, including Ann Arbor Clean Cities Coalition and a2energy.

The Ecology Center is a 42-year-old Ann Arbor-based environmental organization that spearheaded development of the city's recycling programs, park system, clean energy programs, sustainable transportation initiatives, Greenbelt land preservation program, and other projects at the county, regional, and state levels. The Ecology Center coordinates Ann Arbor 350, which is mobilizing Ann Arbor residents to reduce the community's carbon footprint.

As a network of UM schools, colleges, and units, the Graham Institute engages the UM campus community as well as external groupsto create adaptive partnerships in order to better define complex problems. Among its other initiatives regarding sustainability and climate, the Institute has taken the lead role in stuyding climate change adaptation in the Great Lakes region.

The Huron River Watershed Council seeks to protect human health of the Ann Arbor community by leading watershed management projects that support the environmental quality of the Huron River. In addition to working with municipalities, the organization is also heavily involved in community education and outreach in order to increase public awareness and enjoyment of the river.

CH-1: Create, design, and implement a sustainable community energy efficiency program

Ann Arbor is likely to see a decrease in community-wide energy use and GHG emissions if it implements a strategic Community Energy Efficiency Program (CEEP) that targets both residents and business owners. In order to have the largest impact and achieve the best results, this Plan recommends that the City hire, at a minimum, one full-time community energy coordinator to design, market, implement, and manage the program on an ongoing basis. The CEEP will incorporate and continue to promote the City's PACE program to promote energy upgrades for local businesses (as well as residential properties, as federal law allows) and will also be tasked with identifying additional sources of funding.

CH-2: Provide a centralized energy resource that empowers citizens with information, tools, and opportunities to take action on their energy use

In early 2012, the City of Ann Arbor launched "a2energy," a program to promote energy efficiency and renewable energy to homeowners, commercial property owners, landlords, and renters across the City. The City's Energy Office partnered with a local non-profit, to create program materials and outreach activities, along with the program website, www.a2energy.org. These tools focus on breaking down barriers, identifying actions people can take to reduce energy use, and connecting them with resources to get the work done and pay for it. a2energy is also the information hub for Michigan's first Property Assessed Clean Energy (PACE) program, available to Ann Arbor's commercial property owners.

A network of contractor partners assists with the marketing of energy efficiency to the community and website "e-peeps" offer firsthand accounts of locals saving energy and money while enhancing their properties. With an engaging graphical identity, a2energy has become the public face of the Energy Office and is gaining recognition throughout the Ann Arbor community.

This Plan recommends that the City work with local partners to expand the program and maintain a2energy.org as a resource for all residents. The program will also serve as a platform to develop a community-wide campaign to partner with local businesses, non-profits, community groups, public agencies, schools, and the University focused on carbon-reducing behavior change. This campaign will focus on extensive outreach that educates residents, business owners, organizations, members of the media, and religious leaders. As part of this outreach campaign, the City will also promote partnerships between local businesses and organizations that can help to implement carbon-reducing initiatives.

CH-3: Create neighborhood "green teams" or "sweeps" to promote climate mitigation strategies

Green teams are made up of groups and individuals that help promote and implement environmental strategies within a community using an approach that taps into existing local networks. These "green teams" should be organized to focus on promoting a variety of projects related to energy and water consumption, waste reduction and recycling, transportation, and local food initiatives. These strategies help foster community resource stewardship and can balance top-down regulatory approaches. As a part of this effort, the City should engage with local non-profits and existing community groups to find common ground that supports and enhances their own mission and interests. This Plan recommends that the City recruit community stakeholders and partner organizations, provide a platform for coordination and participation (likely via a2energy.org), and assist in the development of tools and best practices.

BETTER BUILDINGS FOR MICHIGAN

The BetterBuildings for Michigan program is focused on communities in Southeast Michigan and is aimed at improving energy efficiency through both residential and commercial community "sweeps" that help building owners identify energy saving opportunities. The program relies on marketing and outreach to motivate building owners to take action and invest in energy upgrades.

CH-4: Implement a community net-zero energy home building/renovation contest

Promoting an annual community net-zero home building/renovation contest is one small step in helping to achieve that goal. The contest will challenge the residential and design community to transform existing homes or build new homes that incorporate innovative energy, stormwater, and climate-relevant design to achieve net zero energy consumption and thus, zero carbon emissions.

Net-zero homes maximize energy efficiency and use a combination of solar, wind, geothermal, and advanced insulating and building technology to reduce structural energy use. According to the National Renewable Energy Laboratory, net-zero buildings "reduce energy load to the minimum practical level, then capture on-site the required amount of renewable energy to satisfy remaining needs."[1]

CH-5: Expand existing environmental education curriculum in coordination with Ann Arbor Public Schools and local private schools

This Plan recommends that the City work with local community groups and parents to ensure the development of an environmental curriculum that incorporates climate science and mitigation measures people can take in their own lives. This would focus on the basic science of climate, how climate change can impact our community, and what actions students and their parents can take at home and in their community to change their behaviors and reduce their GHG emissions.

CH-6: Motivate residents and business owners to alter behavior to facilitate emissions reductions

The City should utilize current community engagement campaigns to promote existing carbon-reduction efforts while also promoting new ideas, steps, partnerships, and opportunities. An action encouraging behavior change must have support, collaboration, and promotion from a wide range of stakeholders including the City, local organizations, schools, non-profits, and community groups. Outreach campaigns could provide tools that allow members of the community to track their energy use and compare their energy use to their neighbors. Outreach could include promoting friendly neighborhood competitions and behavior challenges such as the getDowntown commuter challenge.

The City's Green Energy Challenge

Mayor Hieftje established the Green Energy Challenge in 2005 with the goal that the city's operations would use 30 percent green energy by 2010. In 2011 City Council established a new goal that calls for the municipal operations to use 30 percent renewable energy by 2015. The challenge also established a goal of reducing the greenhouse gasses from municipal operations by 50 percent from 2000 levels. There are energy goals aimed at the entire community. The challenge calls for a community reduction in greenhouse gasses by 8 percent of 2000 levels and utilizing 5 percent renewable energy by 2015.

The business community can also help lead, inspire, and educate citizens through programs, campaigns, and sharing best practices. This Plan recommends that the City form strategic alliances with local business leaders, community organizations, and non-profits to help facilitate outreach and improve community awareness and participation. The City should encourage Ann Arbor business owners to make a voluntary commitment to take actions that reduce GHG emissions and should promote friendly competition between businesses to achieve the greatest GHG reductions or make permanent GHG reduction choices.

Local Business Best Practices

The People's Food Co-op in Kerrytown stocks its shelves with a variety of locally grown and processed foods. The Co-op makes an effort to highlight local goods, as well as those produced from within Michigan. This emphasis reduces the miles that food travels from producer to seller thereby reducing its carbon footprint. In addition, promoting local business supports the regional economy.

Steps for Business Owners

Business owners can reduce their carbon emissions by utilizing energy efficient lights and equipment. This could include compact florescent or LED bulbs, EnergyStar certified equipment, as well as smartstips or other energy monitoring devices. Additionally, when purchasing office supplies business owners should look for recycled paper, recycled packaging products and other earth friendly office materials. Place recycling receptacles in key locations so that less waste will be sent to the landfill. In the office kitchen area business owners should encourage employees to bring in reusable plates and utensils. The business owner and managers should model energy saving behavior by turning off lights and equipment when not in use. In addition, business owners could allow employees to work from home one day a week, which would reduce the carbon emissions caused by daily commutes.

Ann Arbor Sustainability Framework

The City's Sustainability Framework establishes the goal to develop a prosperous, resilient local economy that provides opportunity by creating jobs, retaining and attracting talent, supporting a diversity of business across all sectors, and rewarding investment in our community. An educated and engaged workforce will generate economic benefits for the community into the future.

CH-7: Develop and deliver training and education programs for building code officials, homebuilders, construction contractors, and all trade professionals in green building, renewable energy, energy efficiency, and water efficiency

A "Complete Contracting" training program would educate contractors on energy efficiency, building durability, air quality, efficient use of resources, and water efficiency. The program should provide contractors with the tools necessary to ensure all new and retrofitted buildings have green building materials, efficient HVAC systems, insulation, well-designed ventilation, and efficient water systems. Equally important is a training program for City staff, including building inspectors, electrical inspectors, housing inspectors, planners, and others, that promotes the latest research and innovation in energy practices and ensures a consistent commitment to energy efficiency across all City departments.

COMMUNITY AND HEALTH:

SAFE COMMUNITY

Safe Community refers to minimizing the risks to public health and property from the hazards related to climate change. There are health and safety considerations involved with nearly all of the actions previously mentioned in this Plan. It is important to consider the ways that reducing GHG emissions contributes to a safe, healthy, thriving community.

Number of Safe Community Actions: 6

The City of Ann Arbor will prioritize a safe, clean water supply suitable for all species and will protect the natural resources that are important community assets. Additionally, the City will take action to reduce air pollution and improve overall air quality.

The many assets that make up the Ann Arbor community, including its network of parks, watersheds to the Huron River, trees, and other living things all help define the living experience of the City's residents. The notion of a "safe" community refers not just to the safety of residents but also to the protection of the community and its ecosystems. While this Plan focuses on mitigating GHG emissions, many of the actions presented in this document have additional benefits that can directly improve public health and safety.

This section focuses on actions related to minimizing the risks to public health and property from man-made and natural hazards and includes three main areas that touch on public health and safety: water, trees, and air quality. This Plan recommends that the City take action to reduce air pollution and improve overall air quality while continuing to provide a safe, clean water supply suitable for all species and protect the natural resources that are critical community assets.

Water

CH-8: Design and implement urban stormwater infrastructure that enhances ecological functioning

Water runs off impervious surfaces such as rooftops, driveways, parking lots, and streets and picks up surface pollutants before it reaches storm sewers and eventually rivers. Green infrastructure and urban design can help restore and protect Ann Arbor's natural systems by integrating land use practices that work to naturally manage stormwater and connect habitats. Man-made infrastructure improvements such as green streets and green roofs can also contribute to this effort. This Plan recommends the City use green infrastructure, when possible, to manage the City's stormwater capacity and that the City implement green urban design that enhances ecological functioning within the City and its surrounding areas. While the emissions reduction benefits of these practices are discussed earlier in the Resource Management section, it is worth mentioning that reducing thestrain on storm and sanitary systems benefits community health through a reduction in pollutants in our local water supply. Other species that live and depend on the City's network of water resources also benefit from improved stormwater management.

Green Roof

Ann Arbor City Hall has 10,318 square feet devoted to sedum and alium plants. This type of green roof absorbs rain water to prevent flooding and helps insulate portions of the building, keeping it warmer in winter and cooler in the summer. Excess water from heavy precipitation flows into roof drains and then ground-level rain gardens and cisterns around the building.

Pervious Parking Lot

The Fifth and William Street parking lot has a porous paved surface that allows stormwater to infiltrate into the soil below. This lowers the amount of stormwater runoff and reduces pollutants in surrounding rivers and lakes.

Separate Sewer System

Ann Arbor's separate sewer system serves an area of 3800 acres. It is made up of two collection systems; one stormwater drainage system for collecting stormwater and one sanitary sewerage system for collecting domestic sewage.

CH-9: Integrate mitigation and adaptation planning into park design and improvements

Parkland and communal open space is a point of civic and community pride in Ann Arbor. Residents and visitors of all ages enjoy access to walking paths, playing fields, picnic areas, natural areas, and playgrounds. Parkland and natural open spaces can also infiltrate stormwater to decrease peak flows from storms and increase infiltration into the soil. This Plan recommends that the City continue to improve upon stormwater design standards that make stormwater infrastructure in parks as visually pleasing as possible, to maintain parks as places of community enjoyment while also achieving optimal infiltration. Areas of shade provide respite on high heat days and increased swimming opportunities along the river could provide additional adaptive benefits.

Parks across Ann Arbor help residents enjoy the outdoors while also supporting a healthy local ecosystem. In addition to these benefits, natural areas and trees help to filter and absorb stormwater which can reduce the risk of flooding in the community. The City is developing stormwater management plans that utilize park areas as "green" infrastructure that enhance natural drainage and remove pollution from runoff. The City is also looking for ways to expand green infrastructure through the implementation of a green streets policy that would help manage stormwater city-wide. Planting more trees and diverting water from the stormwater system will create a healthier environment.

Trees and Heat Islands

From the City's seal, which features an oak tree, to the nickname "Tree Town," Ann Arbor is known for its abundant urban forests. Beyond the visual appeal, however, shade trees and other well-managed vegetation can act as natural weather regulators, helping reduce the heat trapped in an area on a hot summer day or shaping wind patterns.

An urban heat island is an area two to ten degrees Fahrenheit warmer than the surrounding rural region.[2] Urban areas tend to exacerbate these heat differentials due to the amount of concrete, asphalt, and tar roofs that absorb solar radiation and heat the air. Heat islands allow heat to build up throughout the day which makes it more difficult for cities to cool down in the evening. This can lead to increased incidents of heat-related illnesses and deaths and can also increase air pollution from increased energy demand for air conditioning and water.

The City is in the early stages of exploring Health Impact Assessments as a means of examining the adaptive benefits of selective tree planting. By increasing the amount of shade in an urban area, the heat island effect can be minimized.

CH-10: Develop a policy that requires private and municipal projects to plant shade trees and vegetation that help lower the heat island effect within the City

This Plan recommends that the City revisit its landscape and design guidelines and policies to require shade tree and vegetation planting for both private and municipal projects in particular to reduce the heat island effect. This will increase the impact of shade trees as natural cooling mechanisms in urban areas and of trees along with other vegetation to help regulate wind patterns. This Plan also recommends that the City evaluate opportunities and incentives to increase shading of impervious surfaces for new construction and redevelopment projects that require stormwater upgrades.

A properly managed and diverse urban forest can also be resilient to invasive insects that carry diseases and impact the human population. By planting diverse tree species, the community benefits from increased shade and decreased heat island effects, while supporting biodiversity. Careful planting and management will both help the City mitigate and adapt to changing climate conditions.

Air Quality

Michigan currently ranks seventh in both occurrences of acute respiratory symptoms and health care costs by State. According to the U.S. EPA, Michigan is one of nine states most vulnerable to health-related impacts exacerbated by ground-level ozone.[3] Washtenaw County is currently designated as "out of attainment" for both ozone and particulate matter under the EPA National Ambient Air Quality Standards (NAAQS).

Ozone and particulate matter are both strongly linked to human health concerns. Even at low levels, ozone can cause a number of negative respiratory effects; the dangers of ozone are increased by higher temperatures. Particulate matter can reach unsafe levels at any point throughout the year, exacerbating pre-existing health conditions and respiratory disorders.

Transportation-related GHG emissions are also a major concern in Ann Arbor, where people are still very dependent on vehicles. Nearly 70,000 people commute into the City each day generating 440,000 trips per day. High levels of nitrogen oxides and volatile organic compound (VOC) emissions from vehicles increase respiratory risk for children, seniors, and other vulnerable residents.

Allergens, such as pollen, can also interact with pollution and cause public health issues. High levels of carbon dioxide can actually promote growth and reproduction in plants such as ragweed, which can exacerbate asthma or other respiratory infections.

CH-11: Implement an idling reduction ordinance

Vehicle idling produces unnecessary emissions, wastes fuel, contributes to poor air quality, and poses environmental health risks especially to young lungs. Idling occurs when a vehicle's main engine is running, but the vehicle is not "doing work". According to the U.S. EPA, it is more fuel efficient to turn off the engine and restart it if a vehicle will be idling for more than 30 seconds. Typically idling occurs out of habit rather than out of necessity.

The City of Ann Arbor is currently considering an idling ordinance to address the health, environmental, and economic impacts of idling.

The average American breathes 3,400 gallons of air a day

CH-12: Generate better local air quality data

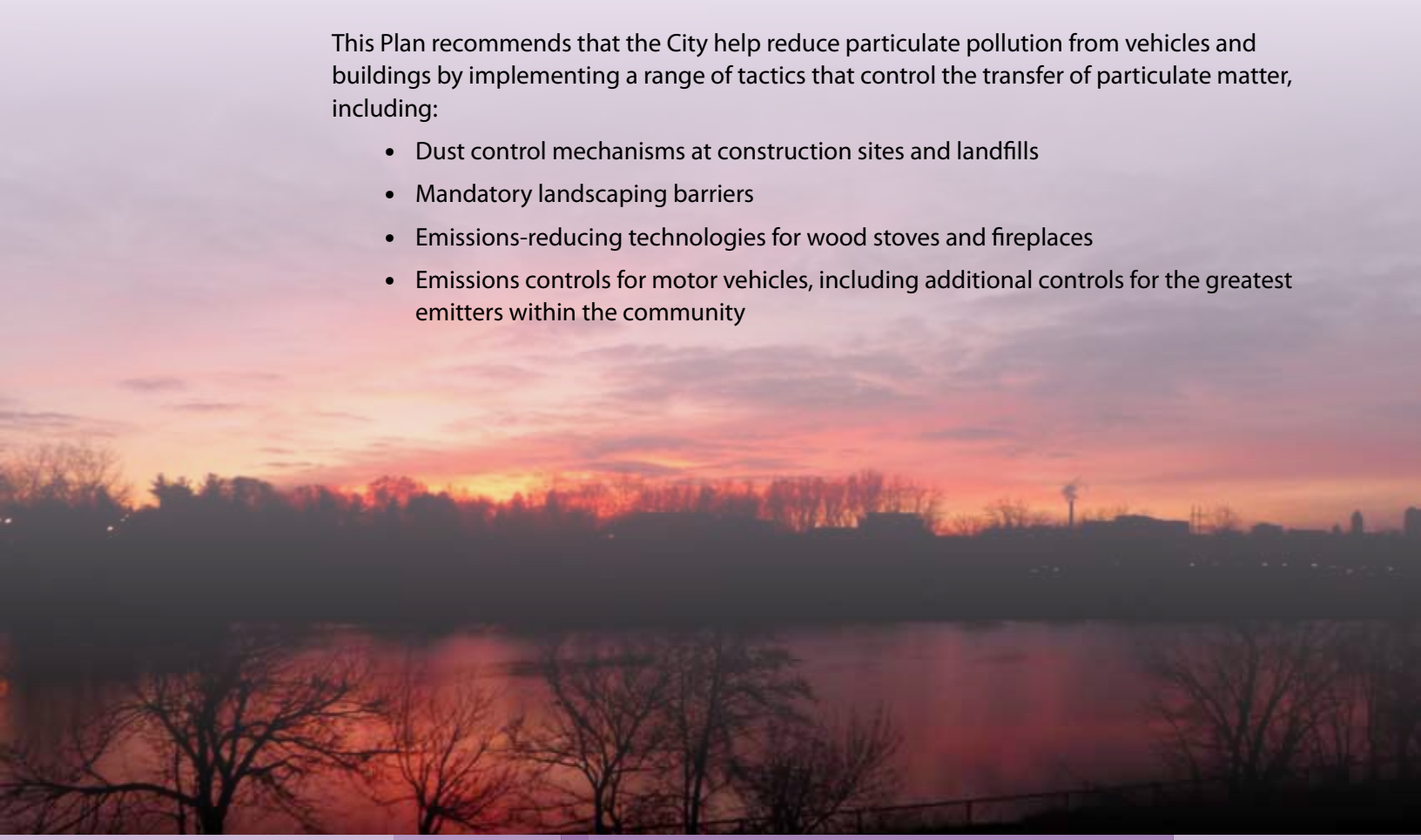
Although some air quality data is available from the U.S. EPA monitoring site located in Ypsilanti, Michigan, this information is not ideal to use for city-specific studies or planning. If more granular data were available, the City would have more specific information to share regarding local air quality. This Plan recommends that the City work with public and private partners to use available technology to generate better local air quality data and maps for residents and identify ways to publicize this information.

CH-13: Reduce non-GHG emissions from vehicles and buildings

While earlier sections of this report contain great detail on actions that aim to reduce GHG emissions from the building and transportation sectors, it is also important to consider the health impacts of non-GHG emissions from these sources. Particulate matter pollution is made up of tiny liquid and solid particles that stay suspended in the air. The small size of particulates makes them a major health concern; they are small enough to enter people's lungs where they can lead to sevdere asthma, bronchitis, or other lung diseases. Particulates come from motor vehicles, dust from construction sites and landfills, fireplaces, wildfires, and other sources.

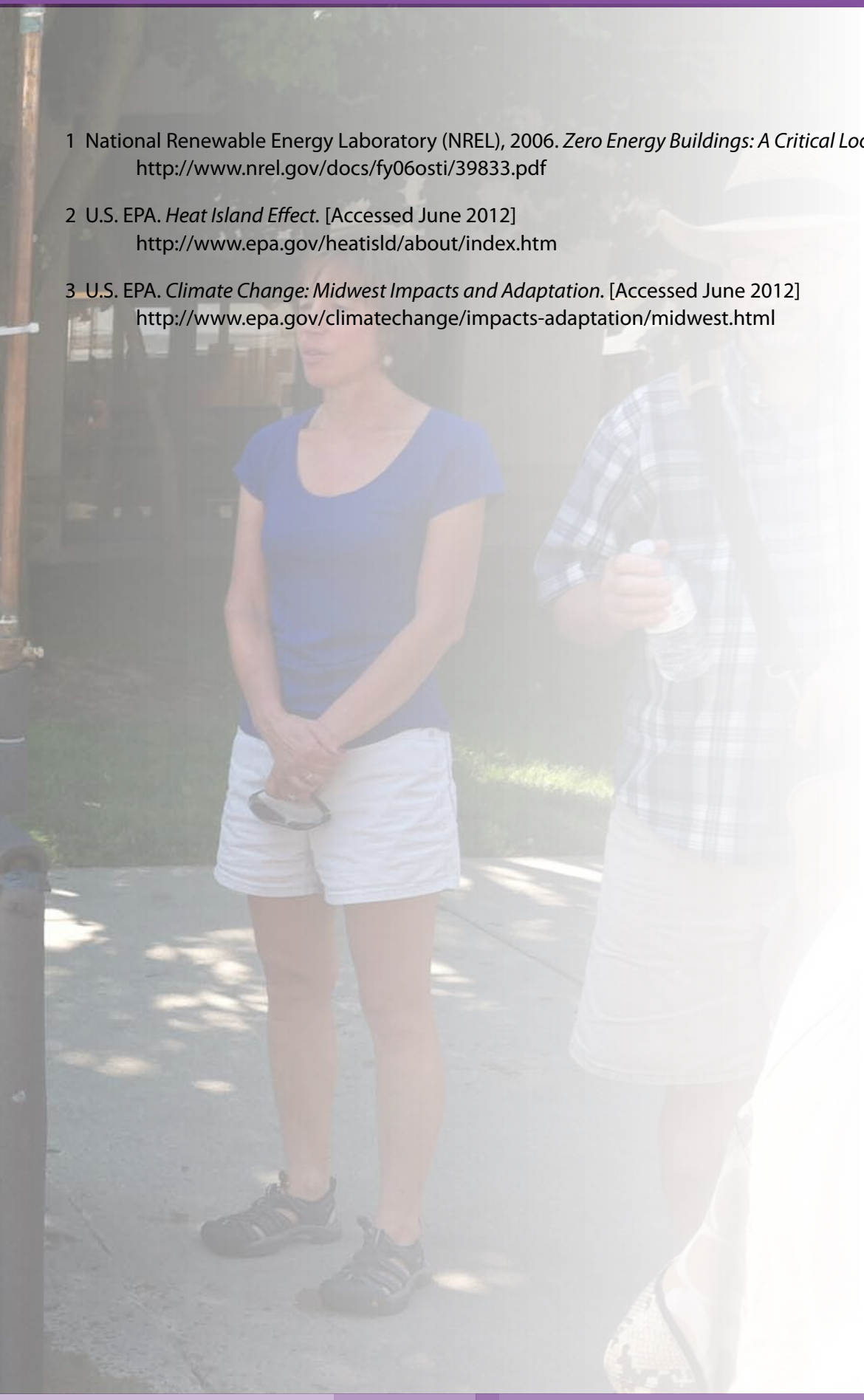
This Plan recommends that the City help reduce particulate pollution from vehicles and buildings by implementing a range of tactics that control the transfer of particulate matter, including:

- Dust control mechanisms at construction sites and landfills
- Mandatory landscaping barriers
- Emissions-reducing technologies for wood stoves and fireplaces
- Emissions controls for motor vehicles, including additional controls for the greatest emitters within the community




CITY OF ANN ARBOR
MICHIGAN
A²H₂O
Only Tap Water

Community and Health Endnotes



1 National Renewable Energy Laboratory (NREL), 2006. *Zero Energy Buildings: A Critical Look at the Definition.* http://www.nrel.gov/docs/fy06osti/39833.pdf

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GHG Emissions Projections and Impact of Actions

Figure 18 shows the cumulative impact of the over eighty actions outlined in the Plan compared with a business as usual (BAU) projection for Ann Arbor emissions.

In order to meet the mid-term 25 percent emission reduction from year 2000 levels by 2025, initial analysis performed for this Plan suggest that most to all of the previously discussed actions recommended would need to be implemented. Modeling results predict that an approximately 28 percent emissions reduction is possible by 2025. However, several of the actions do not have an associated GHG reduction tied to them due to the complexity and uncertainty of assumptions needed to accurately model impacts. Thus, the cumulative CO_2e reductions possible by taking all actions in the Plan, including those without estimates, would likely surpass a 28 percent drop in GHG emissions by 2025. Despite the inherent uncertainty of measuring impacts, there are certainly GHG reduction benefits to all of the actions presented in the Plan. Nearly all of the actions also have economic development benefits for Ann Arbor as well, since over 0.72 cents out of every dollar spent on energy in Michigan goes out of state, as the majority of our fuel supplies are imported.[1]

Some actions could have an immediate impact if implemented, while others would take a decade or more to reach their full potential. The "business as usual" (BAU) growth line in Figure 6 shows an assumed 0.7 annual growth rate in emissions (discussed further below), while an emissions projection line based on implementing Plan actions moves out toward reduction targets set forth in 2025 and 2050. Even as actions are implemented it is assumed that resulting emissions reductions are working against the potential growth rate in overall emissions. Therefore, if no further actions are taken after 2025, the projection line would begin to pull net emissions back upwards, away from the 2050 target level. The dashed line shown on the graph depicts unidentified actions needed to further cut emissions and reach a 90 percent reduction from year 2000 levels by 2050. After 2025, to reach a 90 percent reduction in 2050, major shifts in energy sources must occur, changes that essentially eliminate reliance on fossil fuels (e.g., 100 percent renewables) for both building energy use and transportation. As Ann Arbor does not currently have control over utility electricity and heating supply, and given the predominance of gasoline and diesel fuels in the automotive fleet, reaching the 2050 reduction target will not be simple or without upfront costs, but it is not impossible (see 2050: The Challenge, the Future, and the Journey). Necessary solutions exist today, but current market conditions do not favor some of the needed changes (e.g., coal is still priced cheaper per watt than solar photovoltaics to generate electricity).

Predicting a "business as usual" or "do nothing" growth rate for community emissions is difficult, and past trends do not accurately predict future realities, especially given the limited extent of the data snapshots used to estimate Ann Arbor's GHG emissions. Data from Ann Arbor's community greenhouse gas emissions inventory suggests a modest increase from 2000 to 2010 (0.8 percent). This number, if taken annually to be less than 0.1 percent growth in a decade, tracks lower than the national average annual GHG growth rate of 0.7 percent, from the Energy Information Administration's (EIA) accounting of annual increased observed since 1990.[2] Intervening years between 2000 and 2010 in Ann Arbor likely saw greater fluctuations, with available utility data from 2008 and 2009 suggesting higher Commercial/Industrial activity and associated emissions prior to the recent recession. The City of Ann Arbor's projected population growth (one predictor for emissions growth/decline) based on data from the regional planning council, is under one percent over the next twenty years, with outlying townships expected to receive more residents than the City proper. This trend follows past Census records that reveal a largely stable population size within the city limits of Ann Arbor. There is no perfect way to predict economic productivity (another predictor for emissions growth/decline) out to 2050, but if such activity increases substantially and consistently in future years, but without regard to sustainability practices, then

projected BAU emissions could be much higher and the impact of actions shown in Figure 18 would have a significantly diminished impact. Therefore, the less than one percent EIA growth rate used is a potentially conservative scenario for BAU emissions.

The Ann Arbor Energy Commission, City and other local partner staff, and other organizations and businesses in Ann Arbor, can utilize analysis performed during the drafting of the Plan to help prioritize implementation of the actions and strategies presented. Each action identified requires varying degrees of deeper evaluation before being fully undertaken. Most actions carry a cost with them, though many actions save money over their lifetime. However, failure to act on climate change, even on a local level, is likely to be a far more costly economic gamble than moving forward now on actions that reduce Ann Arbor's emissions footprint.[3]

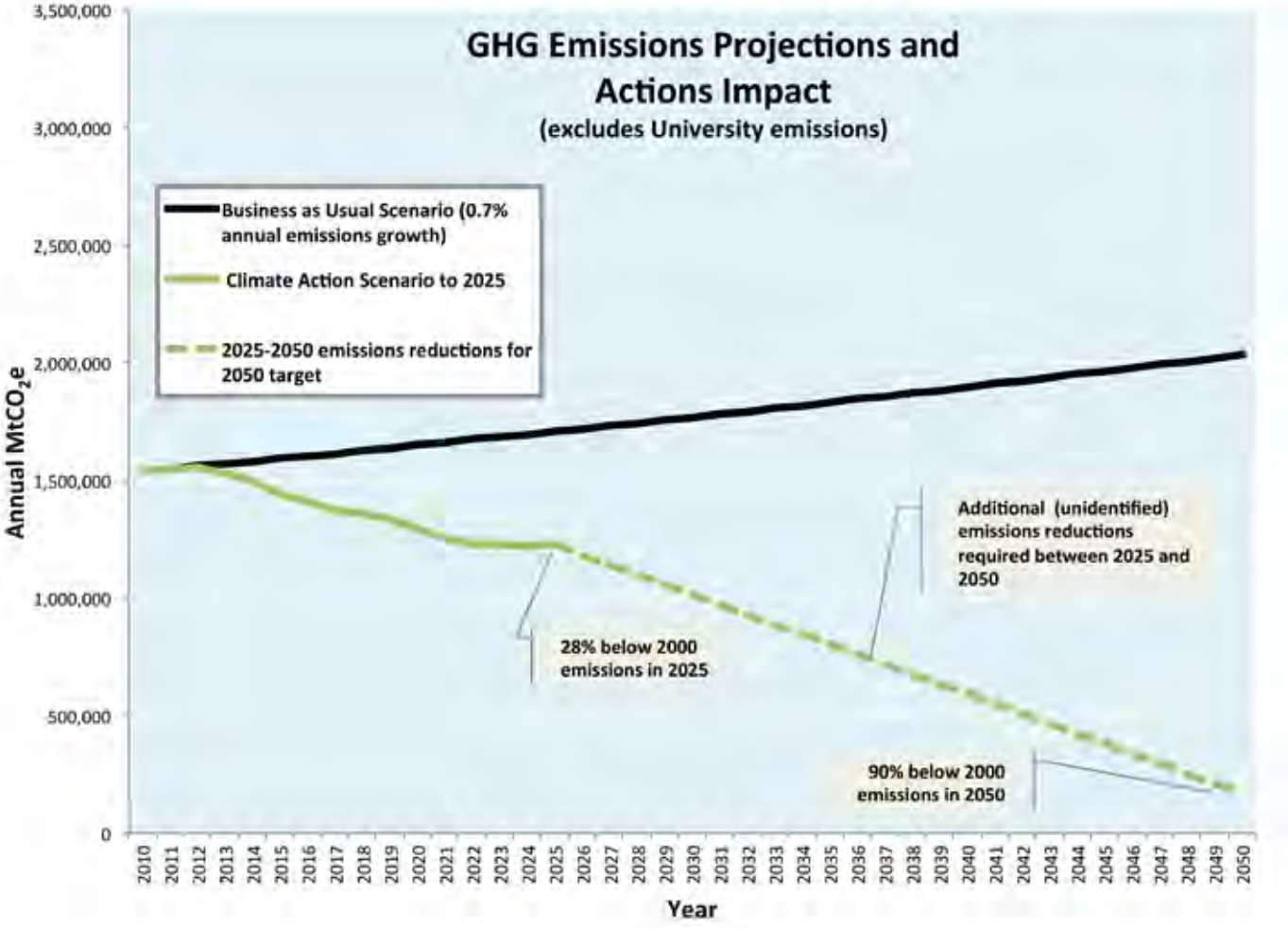


Figure 18: GHG Emissions Projections and Actions Impact

Endnotes for this section can be found on page 177.

ADAPTATION STRATEGIES

Adaptation refers to taking measures to prepare for unavoidable climate change. The City has many adaptive strategies underway, most of which were not designed in response to climate change but do fit into climate adaptation strategies. This Plan recommends integrating five adaptation strategies in collaboration with mitigation efforts in order to most effectively reduce GHG emissions and adapt to the impacts that are already occuring.

Implement "No Regrets" Adaptation Actions

Carefully manage collection, diversion and reuse of rainwater to maximize use and water quality

Adapt to and effectively manage current hazards and emerging threats

Evaluate risks and vulnerabilities that impact our natural and human systems

Assess and anticipate climate change impacts on natural and built environments

Adaptive capacity refers to the ability of a system or community to adapt to the impacts of climate change. It is the overall capability a city has to use an assortment of adaptation strategies. There are elements to adaptation that enhance adaptive capacity such as improving access to resources, reducing poverty, lowering inequities in resources and wealth, and improving education.

Vulnerability refers to how susceptible certain systems and specific socio-economic groups are to the impacts of climate change.

Risk Management is a process that helps categorize, prioritize, and understand the risks associated with climate change and determine the adaptation responses that will best reduce risk.

Adaptation

Climate experts agree that climate change is already occurring and the impacts are likely to increase in the future. Average surface temperatures in the Great Lakes Region rose by 2.3 degrees Fahrenheit from 1968 to 2002 and are predicted to increase by 3.6 to 11.2 degrees Fahrenheit in the next 75 years.[4] While the intention with this Plan is to reduce levels of GHG emissions to slow the rate of climate change, the City of Ann Arbor must also plan for the effects on municipal and private infrastructure from a climate that will continue to change.

The City must determine whether, and for how long, present asset management strategies will continue to be cost effective under different climate scenarios. This approach will help the city identify the largest threats to city systems and identify priority actions that are necessary to protect members of the community and the built and natural infrastructure. Although most traditional impact and vulnerability assessments look at predicted climate scenarios and develop strategies based on those scenarios, identifying how long present management strategies will be effective will provide more concrete information and a stronger guide for implementation.

Public health is likely to be significantly affected by increased air temperatures leading to summer high-heat events. High summer temperatures will lead to increased air pollutants such as smog and particulate matter. Increased incidence of flooding and drought are expected due to changes in extreme precipitation events. Some effects will affect all members of the community and others will disproportionately harm children, the elderly, low-income or other vulnerable populations. The City is just beginning to look at adaptive strategies that may benefit vulnerable populations.

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities".[5] Similarly, adaptation can be described as an understanding of how individuals, groups, and natural systems can prepare for and respond to changes in climate or their environment.[6] Adaptation strategies will naturally vary by region, just as climate impacts will vary, but in every case will inform and enhance mitigation efforts.

Mitigation attempts to permanently eliminate or reduce the hazards and risks associated with climate change whereas adaptation attempts to minimize the negative impacts of climate change. Adaptation and mitigation efforts combined will produce the greatest results and should be treated as a set of actions, not as alternatives to each other. Even the best mitigation efforts cannot eliminate the impacts of climate change over the next few decades.

This Plan recommends that the City undertake both mitigation and adaptation strategies in order to most effectively reduce GHG emissions and adapt to the impacts that are already occurring today.

While humans have been adapting to changes in the environment for centuries, the difference today is in the rate and scale of those changes. Extreme weather events can have disastrous outcomes when they affect vulnerable human and natural systems. This Plan recommends five specific strategies that the City of Ann Arbor and its residents can use to react effectively and efficiently to climate-related challenges. These strategies are intended to build resilience, prepare for extreme events, and prevent future negative outcomes.

Implement "no regrets" adaptation actions now

"No regrets" adaptation refers to actions that, when implemented, will have benefits both under current climate conditions and under potential future conditions. They are actions that provide benefit to the community regardless of whether the climate changes to the extent predicted by scientists. No regrets actions help increase resilience to hazards while also having economic, social, and environmental benefits.

Some of the hazards that can be anticipated as a result of climate change include flooding, heat waves and heat emergencies, air pollution, and infectious diseases. Recognition that these will be of key importance to the Ann Arbor community will help inform any adaptation planning.

Examples of no regrets actions are:

- Addressing flooding concerns by upgrading aging stormwater infrastructure, increasing capacity for wastewater collection and treatment, and promoting rainwater collection
- Anticipating the public health impact of extreme heat events as well as other weather changes, including increased storm events
- Protecting air quality and promoting actions that help remedy current air pollution problems while looking ahead to future threats from increased pollution and diseases due to warmer temperatures

Ensure an integrated systems planning approach to built and natural infrastructure for all climate change planning scenarios

- Use climate-resiliency practices in all city planning efforts
- Engage the public in comprehensive adaptation planning
- Require vulnerability assessments for climate-related environmental hazards

Protect our citizens from health and safety hazards

- Encourage all citizens to have emergency plans and emergency supplies in their homes
- Develop and implement preparedness and response plans for health threats such as heat waves, severe weather events, and infectious diseases

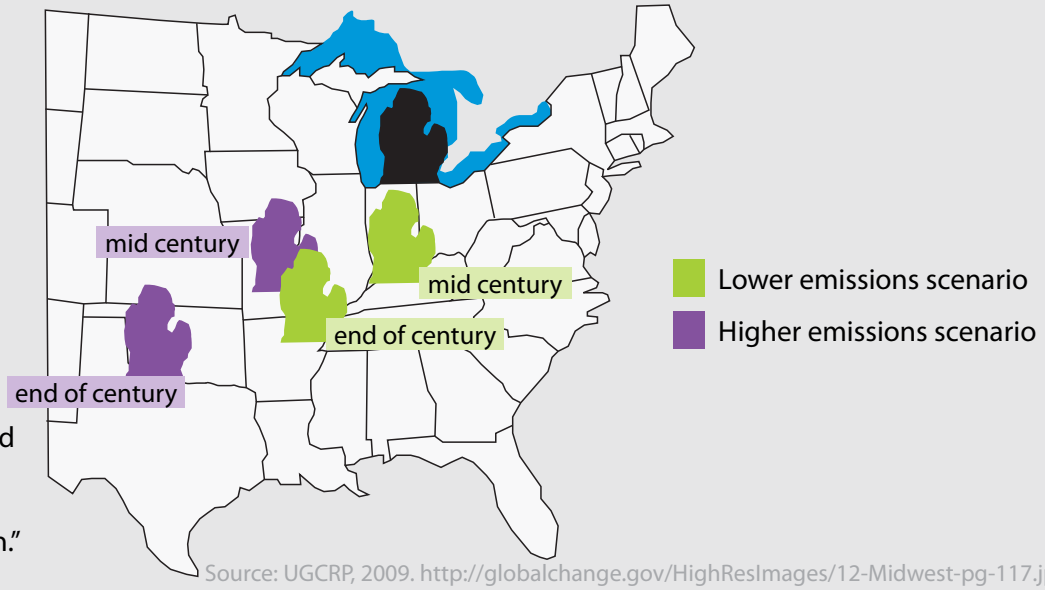
Update and maintain technology and plans to support emergency management response to extreme climate events

Integrate climate projections into all City planning across all systems

- Work with UM and other partners to stay informed of best available climate science
- Coordinate and integrate all land use planning and infrastructure
- Engage residents and businesses

Michigan Temperature and Precipitation Changes

"Model projections of summer average temperature and precipitation changes in Michigan for mid-century (2049-2059), and end-of-century (2080-2099), indicate that summers in Michigan are expected to feel progressively more like summers currently experienced in states south and west. Michigan is projected to get considerably warmer and have less summer precipitation."



Source: UGCRP, 2009. http://globalchange.gov/HighResImages/12-Midwest-pg-117.jpg

City of Ann Arbor current adaptation efforts

Stormwater

- Doyle park with an extended detention wetland to manage stormwater - collaboration between the county, the city, and the township
- Permeable pavement parking lot (5th and Williams) and permeable pavement road (Easy St. and Sylvan Ave.)
- West Park stormwater system - large swaths of native prairie and wetland plantings meant to cleanse rainwater runoff from North Seventh Street

Land Use

- Purchase new City parkland and protect agricultural and open space land outside of the City (the Greenbelt District)

Forestry

- Tree planting to manage stormwater and reduce energy needs

Heat

- Cooling centers (library and Delonis Center) with free transportation for elderly, individuals with heat-sensitive conditions and people with disabilities

Endnotes for this section can be found on page 178.

2050: The Challenge, the Future, and the Journey

The Challenge

As modeling performed for this Plan indicates, implementing the full range of actions identified would meet the City of Ann Arbor's mid-term goal of 25 percent reduction from 2000 levels by 2025. This is only the beginning, however; reaching the long-term target of 90 percent GHG reduction by 2050 will be another challenge altogether.

Quite simply, to prevent catastrophic climate change, the Earth's population must stop burning fossil fuels. Is such a goal possible? Is there a way to envision how it could happen? What decisions need to be made now to enable actions in 2025, 2050, and beyond that will help save the planet?

The Future

From 2012, 2050 — 38 years into the future — seems a long way off. Especially given the drastic changes that society has experienced in recent decades, it is difficult to make accurate predictions.

In 1974, 38 years ago, cloud storage, personal computers, cell phones, and the Internet did not exist. Engineers were experimenting with and rediscovering passive solar energy ideas, and photovoltaic cells were still the stuff of the space program. While some forward thinkers at the time had visions of what might come next, the world in 2012 is a very different place than it was in 1974.

There is every reason to believe that 2050 will have many more surprises than even today's leading technology experts can imagine. This is likely to be true in any number of areas of society, but in particular related to helping supply energy renewably and abundantly.

Part of the challenge of imagining the future is thinking beyond what is familiar today. In 2012, centralized electrical generation and the complex electrical distribution system needed to support it are part of the political, economic, and even geographic landscape. This makes the suggestion of any massive change, such as a drastic switch from fossil fuels to enable a 90 percent reduction in the emissions of GHGs, seem like an impossibility. But what if electricity in 2050 is provided in a completely different way than it is now? If the future landscape is unknown, future opportunities may also as of yet be unknown.

Even with current technology, however, there are ways to start moving toward a low-carbon future. Change is needed on a global scale, but the pathway can begin right here in Michigan.

The Journey

The journey begins by first eliminating wasted energy. As discussed earlier in this Plan, implementing energy efficiency and conservation measures could potentially reduce GHG emissions and energy demand by 20 percent or more. The remaining load would then be replaced over time with electricity from renewable sources. People today assume that fossil fuels are necessary for modern civilization, simply because that is all they have known. But clean, renewable energy from solar, wind, and biomass sources can in fact replace the nonrenewable polluting energy sources of the past.

Numerous studies have analyzed the current and projected future consumption of fossil fuels alongside energy requirements and have demonstrated that the proper mix of renewables can consistently and perhaps more dependably provide all of the needed energy.[7] The variable energy outputs of wind turbines and, solar photovoltaic arrays, when smartly interconnected with controllable biomass plants and a modest amount of pumped water and compressed air storage systems could provide the world with continuous power in a clean and sustainable way. As the available wind and solar power varies and demand fluctuates, biomass and pumped storage devices could be employed to make up the difference. When more power is available than needed the water and air are pumped back into their storage areas. Excess wind and solar energy might also be used to create hydrogen through electrolysis, which can then be used to make a relatively inexpensive source of zero-carbon hydrogen for fuel cell vehicles.

Michigan has utilized pumped storage since 1973 through the Ludington Pump Storage Plant on Lake Michigan, which has dependably generated and stored enough power to serve a community of 1.4 million people.[8] Additionally, the vast caverns of depleted natural gas fields in northern Michigan, where half of all of the natural gas sold by Consumers Energy and MichCon is currently stored for winter use, could be converted to store compressed air for running turbines in much the same way that the Ludington Pump Station stores energy from night to day. The end result could be a very efficient energy system generated from diverse and dispersed sources.

The Journey — a Step at a Time

Efficiency & Conservation

The first and most cost-effective measure to be employed immediately — and continuously revisited as technologies improve — is energy efficiency and conservation. With energy prices relatively low for so long, energy is used not wisely but wastefully. This wastefulness is occurring through transporting the energy, converting fuel to energy, storing energy, and in poorly designed buildings – not to mention human behavior. Reducing wasted energy means needing less at the start.

Buildings

One important place to start improving energy efficiency is by retrofitting the existing building stock and constructing new buildings to a standard that reduces their energy use by a high percentage. Once buildings are using less energy, adding renewable energy sources, specifically solar, to the buildings can make them net energy producers, all while creating jobs and reducing the dependency on oil, coal, and natural gas. Since a large percentage of existing buildings will still be in use in 2050, retrofitting is critical. Studies have shown that the solar energy falling on the roofs of buildings on an annual basis more than equals what a properly designed building needs to function.[9] Since not all buildings have adequate solar exposure due to shading by trees or other buildings, an interconnected grid that can manage demand leveling will continue to be important. Meanwhile, where it is feasible to install such a system, geothermal heat pumps might offer a renewable alternative to natural gas heating systems in buildings.

Transportation

America is in love with the automobile despite the fact that it is a major contributor to GHG emissions, but the good news is that the transition to fuel-efficient and alternatively powered vehicles is already underway. Electric vehicles are already much more efficient than their internal combustion predecessors. Synthetic fuels could also be used as a bridge to zero carbon transportation.

Given that two-thirds of the energy used in vehicles is simply to move the weight of the vehicle, technology advancements that reduce vehicle weight will also be crucial. Current technology suggests that vehicle weight could be reduced to a quarter of what it is currently; this would result in doubling the vehicle miles traveled per unit of energy. Although the auto industry seems deeply entrenched in present manufacturing technologies, it is important to note that train locomotives went entirely from steam to diesel in 12 short years driven purely by economics. Seat belts and catalytic convertors were instituted in shorter time periods by legislative action.

Changing transportation modes can also be an effective way to use energy more efficiently. Replacing trucks with trains for goods that travel more than 100 miles is one way to start. Reducing the need for transportation altogether by choosing locally produced goods and food will also reduce the amount of energy needed to maintain society.

Industry

Industry has or will need to adopt methods of production that are driven by electricity and gases from renewable resources. Additionally, industry will need to focus on more regional production and distribution systems. Inserting requirements for low-carbon emissions into the supplier chain will help drive this process.

Agriculture

Agriculture will have to face the tremendous dual challenge of feeding the increasing global population while reducing dependency on petroleum-powered equipment and petroleum-based fertilizers and pesticides. This will likely also require transitioning the current industrial agricultural system into a more regional food production system in order to reduce emissions from transporting food long distances.

Looking — and Stretching — to the Future

The discontinuation of the use of fossil fuels in all sectors — energy production, buildings, and transportation — is key to the successful reduction of GHGs in the long term. In the short term, this Plan identifies actions that will more rapidly reduce Ann Arbor's emissions, some of which serve as a "bridge" between fossil fuel dependency and renewable energy use. One example of a bridge action is installing CHP systems, which run on natural gas but help reduce reliance on coal while at the same time maximizing the value of the energy source.

All of the actions identified in this Plan will be important steps along the way, but they are certainly not final solutions. As explained in the "GHG Emissions Projections and Impact of Actions" chapter of this Plan, these actions only achieve the City's mid-term emissions reduction goal of 25 percent reduction by 2025. Meeting the challenge of 90 percent reductions by 2050 will require actions that will be even more expensive or politically challenging than the actions detailed throughout the Plan.

Ann Arbor will need to end its current reliance on centrally controlled sources of electricity and natural gas distribution and transition to a system that, while still heavily dependent upon centralized generation, will provide some alternative sources of electricity and heat while increasing the resilience of energy supplies. This is described in the literature as "distributed energy," which is the ability to generate electricity from smaller units and distribute it within a small locality rather than transporting it great distances across the grid.

Stretch Actions for Today

This section of the Plan suggests that Ann Arbor will need to take aggressive action to not only move to zero use of fossil fuels by 2050 but also to provide leadership and outline a pathway for other communities to follow. While not presented as formally recommended or modeled actions, as those detailed earlier in this Plan, the following are some ways the City might reach its longer-term targets:

1. Establish a statewide or local Renewable Portfolio Standard of 100 percent (consistent with City Council goal in resolution R-330-7-07)
2. Enter into a power purchase agreement that supplies most, if not all, of Ann Arbor's electricity needs with renewable energy
3. Lobby nationally for a carbon tax, feed-in-tariff, or appropriate system to place a price on carbon
4. Influence the State to enact regulations that permit and encourage Community Choice Aggregation
5. Explore the use of home rule to require new and existing buildings (commercial and residential, owner-occupied, and rental) to meet stringent energy codes such as those set by the Architecture 2030 "2030 Challenge"[10]

Conclusion

In a sobering article published as the final draft of this Plan was being assembled, longtime environmentalist and climate advocate Bill McKibben pointed to the problem with fossil fuels: "We have five times as much oil and coal and gas on the books as climate scientists think is safe to burn. We'd have to keep 80 percent of those reserves locked away underground to avoid that fate. Before we knew those numbers, our fate had been likely. Now, barring some massive intervention, it seems certain."[11]

Without a serious change in the way communities, cities, states, and nations generate and use power, transport goods and people from place to place, and build the structures in which residents live and work, the most severe predictions of climate scientists will come true. The City of Ann Arbor realizes how important it is to take action now to help mitigate future crises. This Plan recommends that the City consider adopting the actions included here as a first step on a long and challenging pathway while at the same time begin thinking of how to eliminate fossil fuel dependency altogether.

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7 A variety of sources address different aspects of current vs. future energy needs and how those could be met with a variety of different fuel sources. The following list, while far from exhaustive on this topic, represents most of sources consulted on this topic in the Plan:

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9 Architecture 2030. *Architecture 2030.* [Accessed June 2012]
http://architecture2030.org/files/2010_handout.pdf

10 The 2030 Challenge for the global architecture and building industry is part of the Architecture 2030 program.
http://architecture2030.org/2030_challenge/the_2030_challenge

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Glossary

Alternative Fuel – Any non-petroleum source fuel (i.e., vegetable oil, hydrogen, ethanol).

Best Management Practices (BMPs) – Innovative, dynamic and improved practices applied to a problem.

Biodegradable Waste – Type of waste, typically from plant or animal sources, which can be broken down by other living organisms.

Biodiesel – Diesel fuel made completely or in-part with animal fat or vegetable oil.

Biomass – Organic matter (living or recently dead) used to generate electricity or produce biofuel, including biodegradable wastes that can be burned as fuel. Industrial biomass can be grown from numerous plant types including switchgrass, hemp, corn, sugarcane, and some types of trees.

Bus Rapid Transit systems (BRT) –BRTs provide high-quality, fast, and cost-effective high-capacity transportation by creating dedicated lanes, set stations, and regular and frequent service, greatly improving mobility especially in dense urban settings.

Business As Usual (BAU) – Normal practices when no action is taken to cause change.

Clean Air Climate Protection (CACP) – Software developed by used to calculate, project and track CO_2 emissions for the community of Chattanooga in the Chattanooga Climate Action Plan.

Climate and Air Pollution Planning Assistant (CAPPA) – ICLEI software used to help municipalities explore, identify, and analyze potential climate and air pollution emissions reduction opportunities.

Carbon Credits – Credits voluntarily traded to offset carbon dioxide (CO_2)emissions.

Carbon Footprint – Measures (in units of carbon dioxide) the impact of human activities on the environment (greenhouse gases produced). A carbon footprint can be calculated in many ways (individual, household, business, event, city or county, government, community or country).

Clean Energy – Energy from constantly renewable sources (wind, solar, biomass, etc.).

Community choice aggregation (CCA) – Community choice aggregation is a state policy that enables local governments to aggregate electricity demand within their jurisdictions in order to procure alternative energy supplies while maintaining the existing electricity provider for transmission and distribution services.

CO_2 – Chemical formula for the carbon dioxide (greenhouse gas).

Combined Heat and Power (CHP) – Also known as cogeneration, CHP is the simultaneous production of electricity and heat from a single fuel source, such as: natural gas, biomass, biogas, coal, waste heat, or oil.

Compact Fluorescent Light Bulb (CFL) – An energy saving light bulb lasting 8 to 15 times longer than incandescent bulbs.

Conservation – Saving from loss or depletion (minimizing or eliminating waste).

Diversion of Waste – The process of preventing waste from entering the landfill through recycling and composting.

Energy Star – A joint program of the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE) that helps consumers save money and protect the environment through energy efficient products and services (more than 50 categories).

Ethanol (E85) – A fuel made from plants (mainly corn in the U.S.) consisting of 85% ethanol and 15% gasoline that can be used in vehicles with modified engines.

Floodplain – A strip of relatively flat (plain) and normally dry land alongside a stream, river or lake that is covered by water during a flood.

Floodway – Part of a floodplain otherwise leveed, reserved for emergency diversion of water during floods; channel of a river or other watercourse referred to as "regulatory floodway;" channel for an overflow of water caused by flooding.

Flood (100 year) – A statistical calculation indicating there is a 1-in-100 chance that a flood this size will happen during any year.

Fossil Fuels – Non-renewable sources of energy formed from plants and animals that lived many years ago (coal, oil and natural gas). Most of our energy demands are met by the burning of fossil fuels.

Geothermal – Renewable energy from within the earth used to heat buildings or generate electricity.

Greenhouse Effect (atmospheric) – Increased concentrations of the greenhouse gases in the atmosphere, causes heat to be trapped and reduces radiation loss.

Greenhouse Gases (GHGs) – Naturally occurring constituents of the atmosphere (including water vapor, carbon dioxide, methane and nitrous oxide) that can also be emitted by human activities. Although essential to maintaining the temperature of the Earth, the atmospheric carbon dioxide concentration is increasing, and a health concern at some levels.

Greening – The process of adding sustainability principles into the planning process of an event or operation.

Hydrogen – Zero-emission fuel which uses electrochemical cells, or combustion in internal engines, to power vehicles and electric devices.

ICLEI – Local Governments for Sustainability (formerly International Council on Local Environmental Initiatives) - an international association reporting to the global community founded in 1990 that provides technical consulting, training, information, and computer software to their members.

Intelligent Transportation System (ITS) – Efforts to add information and communications technology to transport infrastructure and vehicles in order to better manage factors that are at odds with each other (i.e., vehicles, routes) to improve safety, and reduce vehicle wear, travel times and fuel consumption. ITS's vary in technologies applied, from basics to advanced.

Landfill – A site for the disposal of waste materials by burial.

Light-Emitting Diodes (LED) – Bulbs that last many times longer than regular incandescent bulbs, do not become hot to touch, and use less energy. They are illuminated solely by the movement of electrons in a semiconductor material.

Leadership in Energy and Environmental Design (LEED) – Developed by the U.S. Green Building Council (USGBC), provides a suite of standards for environmentally sustainable development. Buildings may be rated (scored) by LEED as Certified, Silver, Gold, or Platinum, depending on points attained for different sectors of the building industry.

Leadership in Energy and Environmental Design-Neighborhood Development (LEED-ND) – rating system that integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design.

Low Impact Development (LID) – An approach to land development (or redevelopment) that works with nature, balancing growth with environmental integrity.

Methane Gas (CH_4) – Methane is a relatively potent greenhouse gas, but it also has a short atmospheric lifetime. It is emitted by human-influenced sources including landfills, natural gas and petroleum systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial process. Methane is over 21 times as heat-trapping as carbon dioxide.

Michigan Public Service Commission (MPSC) – The State of Michigan agency that regulates investor owned utilities, such as gas, electric, telephone, and rural cooperatives.

Native Plant Species – Plants that generally occur naturally in a certain growing zone rendering them to be more low maintenance and more easily sustainable.

Non-Toxic Cleaners – Do not contain harmful chemicals (chorine, ammonia, etc.).

PM2.5 – Particulate matter is the term for particles found in the air including dust, dirt, soot, smoke, and liquid droplets. Particles less than 2.5 micrometers in diameter (PM2.5) are referred to as "fine" particles and are believed to pose the greatest health risks.

PM10 – Particles less than 10 micrometers in diameter that pose a health concern because they can be inhaled into and accumulate in the respiratory system.

Photovoltaic (PV) – A clean source of energy, technology, and research related to the application of solar cells for energy by converting sunlight directly into electricity.

Post-consumer waste – Waste produced at the end of a material cycle (i.e., household waste).

Pre-consumer waste – Waste that comes from a manufacturing process (paper production trimmings, damaged cans, etc.) that goes back into the manufacturing process (bypassing waste or recycle).

Recycling – Turning material into a usable raw material at the end of its life, thus diverting it from the waste stream (landfill).

Renewable Energy (Clean Energy) – Family of energy sources (solar, hydro, biomass, geothermal, hydrogen, wind) derived from renewable sources (natural processes that are replenished constantly).

Repurpose – Converting an item from one form (or one use) to another, bypassing the waste stream.

Reuse – Objects or goods used multiple times (e.g., cloth shopping bags).

Solar Array – A panel of photovoltaic cells that generates electricity.

Solar Powered – Powered by solar (sun) energy harnessed from solar panels located nearby.

Stratum – Horizontal layers of similar material (i.e., rock).

Sustainability (Sustainable Development) – Making development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable Energy – An energy system that sustains human and ecological health (i.e., from clean energy sources).

Vehicle Miles Traveled (VMTs) – The number of miles that residential vehicles are driven. Along with other data, VMT are often used in estimating congestion, air quality, and potential gas-tax revenues, and can provide a general measure of the level of the nation's economic activity.

Volatile Organic Compound (VOC) paints – Low in VOCs, available as low-VOC and zero-VOC; often with Green Seal certification.

Waste Stream – The flow of all solid waste (homes, businesses, manufacturing and institutions) that is recycled, burned, or disposed of in landfills, residential waste stream or recyclable waste stream.

Wind Power – Electricity generated from wind turbines and producing no pollution. Producing only about 1% of the world's energy, it is the fastest growing form of renewable energy.

Xeriscape – A type of low-maintenance landscaping that does not require supplemental irrigation. Long used in desert areas, it is more widely used now to save water.