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Austin COMMUNITY CLIMATE PLAN

2015

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Letter from the Steering Committee

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Photo by Lydia Jarjoura

Dear Mayor and City Council,

In 2014, City Council had the vision to put Austin on a path to economic and environmental sustainability and to establish our city as a global leader in meeting the challenges posed by climate change. The continuing drought is a stark reminder that climate change is one of the biggest threats to our economy and way of life in Central Texas. Scientists stress that it is also one of the biggest challenges that our planet has ever faced–but it does not need to be. Through your leadership today, Austin will set an example to communities around the world and become a powerhouse in the new green economy.

We are honored to have been working with numerous stakeholders and City departments to answer Council's request for a revised and comprehensive climate protection plan. The Austin Community Climate Plan will establish a blueprint to achieve net-zero community-wide greenhouse gas emissions by 2050, or sooner, if feasible.

We know that meeting this target is not just about addressing the threats that climate change poses, but also about spurring creativity, rewarding ingenuity, and generating opportunities so that everyone in Austin can participate, benefit, and prosper. We also know that meeting this challenge will require change–change in how we generate and use energy, how we get around town, how businesses measure prosperity, and how we deal with waste. We are optimistic that we can meet the net-zero target in ways that will lower energy bills, make transportation more flexible, clean the air we breathe, conserve water, and create local jobs.

We also know that the risks of not tackling the challenges posed by climate change will come at a great social, economic, and environmental cost–in health impacts to our most vulnerable citizens, in loss of property from natural disasters, and in increased pollution and drought. We are already experiencing these impacts; in 2011, we faced terrible wildfires, the loss of trees and woodlands from both wildfires and drought, and rising utility bills to keep us cool during a record-breaking, hot summer. This is likely to become the new normal in Texas for our children and grandchildren unless we take action.

However, the benefits to be gained are vast. Some people support carbon-free energy with solar panels. Some companies have invested in fuel-efficient fleets and electric vehicles that lower overhead costs. We are already increasing the density of some neighborhoods and are continually adding more bike lanes. We are investing in clean

energy through Austin Energy with more and more of our energy coming from the wind and the sun. We believe the benefits that result from confronting the challenges of climate change are clear: a more secure future for our families, innovation that results in local jobs and stewardship of the natural resources that make Austin such a special and desirable place to live. If we are all willing to roll up our sleeves and confront the challenges together, everyone can enjoy the benefits.

This Austin Community Climate Plan sets the stage to achieve the goal established by Council because it is:

- **Achievable:** we recognize that all Austinites will have to take action, and we have identified actions that take into account technology limitations, funding constraints, and other barriers to behavior change.
- **Practical:** we have taken existing plans into account to highlight current efforts that will positively contribute to community-wide greenhouse gas reductions.
- **Effective:** we have identified a full list of strategies that are good for the environment. We will continue to analyze these strategies and identify the ones that are also good for our wallets: a carbon neutral Austin can and should be an affordable Austin as well.

We also realize that this is just the beginning of our journey. That is why this plan has several policy recommendations for periodic updates, as well as a call for a strong implementation process. But most importantly, it puts an assessment of climate change impacts on the City Council's management dashboard when major investments and plans are up for consideration.

Adopting this plan sets a strong commitment to a safe, healthy, and vibrant Austin for many years to come. We are committed to working with all parties concerned to make the next phase—developing an implementation plan—a success.

Steering Committee Co-Chairs

Al Armendariz

Francois Lévy

Joep Meijer

>> Adopting this plan << sets a strong commitment to a safe, healthy, vibrant Austin for many years to come.

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Executive Summary

Ultimately, the entire Austin community must be engaged in the effort to realize >> carbon neutrality. <<

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Photo by Michael Knox

In the past few years, changing climate has directly impacted the Austin region. From the Bastrop fires, to the Halloween Floods of Onion Creek, and to some of the hottest summers on record, Central Texas has seen first-hand how those events can cause major negative consequences for a community.

Building on the City of Austin's long history of sustainability leadership, the Austin Community Climate Plan offers a robust set of strategies and actions that will aim for net-zero community-wide greenhouse gas emissions by 2050, or sooner if feasible. Implementing this plan will help to create a vibrant, healthy, and safe Austin for future generations, as well as improve the quality of life for those who live here today.

The City of Austin must provide leadership by creating effective partnerships with private businesses and non-profit leaders to educate and inform individual choices in support of this plan. Identifying opportunities for incentives and targeted programs to support broader outcomes will be important to this plan's success.

Ultimately, the entire Austin community must be engaged in the effort to realize carbon neutrality. If we all work together, this goal is not only achievable but will also help to address many of the challenges that face Austin, such as affordability, traffic congestion, and disaster preparedness. This plan demonstrates that there are a multitude of benefits that individuals, families, and organizations can realize by making choices that will help us get to community-wide net-zero greenhouse gas emissions.

The chart on the following page demonstrates a straight-line target path to get to net-zero by 2050, including interim targets for 2020, 2030, and 2040, as well as allowing for up to 10% of carbon offsets.

Strategies and Actions

The actions identified in this plan will result in both immediate and cumulative reductions in emissions resulting from electricity and natural gas, transportation, materials management, and industrial process sources. (Detailed information about each sector that contributes to Austin's carbon footprint can be found in the Technical Appendices of this document.) Most of the identified actions can be accomplished through the full and continued implementation of many adopted City plans and other initiatives already underway. Other actions will require further research and development, and some actions may depend on advances in technology, or meeting economies of scale, in order to become viable. Despite the progress that will be made in mitigating emissions, the strength of the local economy and sustained population growth will continue to increase total emissions in Travis County if the community does not take strong actions now.

The six-month process that produced these strategies and actions also identified many synergies that exist across sectors. By choosing growth patterns that create a more compact and connected city, not only does energy use per capita decline, but vehicle miles traveled per person and transportation costs are also reduced. By continuing investment in renewable energy sources, the City can feel confident about promoting rapid growth in electric vehicles in order to meet our broader climate goals and protect local air quality. Going forward, careful consideration should be given to implementing actions that optimize these types of synergies to have a greater impact and ensure better outcomes for our community. In addition, efforts to balance costs with benefits such as affordability must be made.

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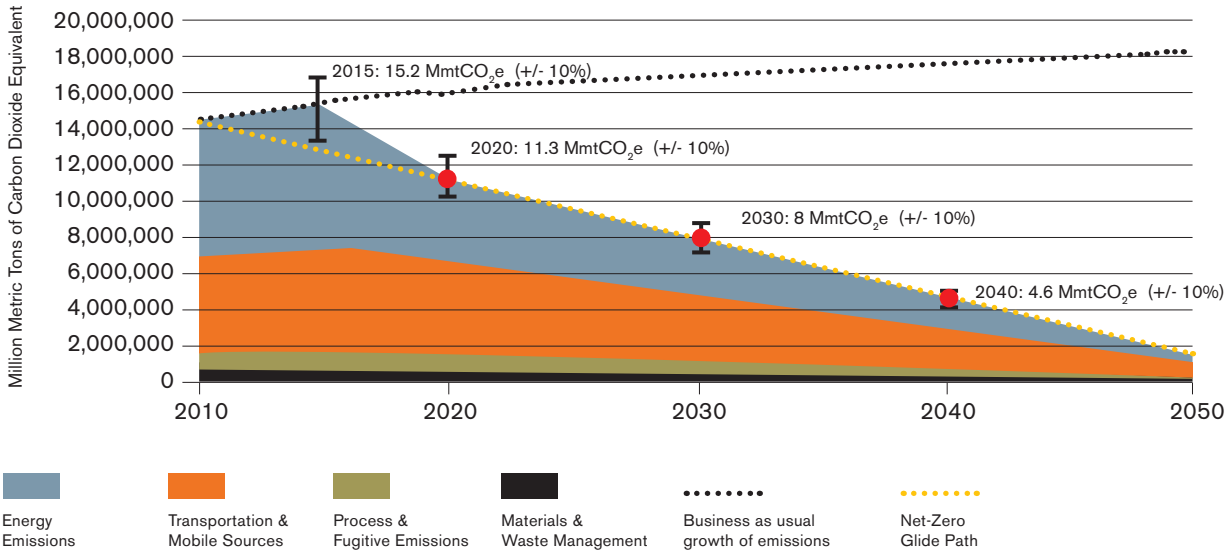
Climate Plan Target Path to Net-Zero by 2050



Recommendations

1. The City of Austin should continue to invest resources in implementing the adopted policies and plans identified in the City of Austin Climate Action Plan section of this report; many will reduce greenhouse gas emissions. In addition, the City should move forward with the following new actions within the next year:

Electricity and Natural Gas Sector Actions:

- Buildings and Integrated Efficiency: Explore financing mechanisms to enable energy efficiency, demand response, distributed generation, and energy storage. Possible financing mechanisms could enable large amounts of private sector retrofits including Property Assessed Clean Energy (PACE) and Warehouse for Energy Efficiency Loans (WHEEL), and privately financed on-bill repayment. (See Action BIE-1 in Appendix B)
- Behavior Change: Increase efforts to engage customers to drive energy efficiency and demand response; increase transparency of energy costs in multifamily and commercial buildings; evaluate feasibility of neighborhood-wide energy efficiency challenges. (See Action BC-1 in Appendix B)
- Resource Technologies: Begin a coordinated effort to prioritize strategic development and evolution of Smart Grid/Intelligent Energy Management Systems, within constraints of rate affordability goals, to further enable intermittent resources and use of electric vehicles for storage/demand shift. (See Action RT-1 in Appendix B)

Transportation and Land Use Sector Actions:

- Transportation Demand Management: Support efforts to work with large employers and academic institutions to implement and improve trip reduction programs that include a regular survey of how the workforce commutes, explanation of benefits to commuters, and includes promotion of transportation alternatives (e.g. carpool/vanpool, bus/rail, bike/walk, flex/compressed work schedules) to their employees; celebrate successful programs. (See Action TDM-1 in Appendix C)
- Transportation Demand Management: Support programs that help commuters make first and last mile transit connections including promotion of first/last mile modes, such as, free circulator buses, collective zoned vanpool service, flex route systems, and bikeshare. (See Action TDM-4 in Appendix C)
- Vehicles and Fuel Efficiency: Support programs and efforts that expand electric/alternative fuel infrastructure and consider incentives for the purchase of electric/alternative fuel vehicles by individuals and fleet owners; pursue code options to increase “charger ready” parking. (See Action VFE-1 in Appendix C)

Materials and Waste Management Sector Actions:

- Purchasing: City adopts procurement specifications for materials reuse, reduced packaging, products with low embodied energy, materials with recycled content, and locally manufactured products and the City encourages other agencies and enterprises to follow suit. (See Action PU-2 in Appendix D)
- Methane Management: Area landfill operators refine landfill gas capture and combustion system to destroy methane at their landfills. (See Action MM-2 in Appendix D).
- Recycling and Organics Diversion: Ensure that businesses and multifamily properties affected by the Universal Recycling Ordinance maximize diversion of organics and recyclable materials. (See Action OD-1 and RE-4 in Appendix D)

2. Develop an implementation plan for all remaining Phase 1 actions (see Technical Appendices). City departments should utilize cost benefit analyses to prioritize actions, determine budget requirements and identify roles and responsibilities. In addition, a public outreach and engagement plan should be created to encourage emission reduction behaviors by local businesses, organizations, and residents.

3. Determine the feasibility of a carbon impact statement that could be used to inform policy makers of the greenhouse gas emissions impacts of major City decisions. These decisions could include large expenditures, land development plans, capital improvement projects, and other major departmental planning efforts that have significant impacts. All future revisions to the building code and land development code, including the CodeNEXT process already underway, should take into consideration the reduction of carbon through compact and efficient development.

4. Determine the feasibility of a local carbon fee or trading and investment program. This could create a mechanism to fund high return on investment greenhouse gas reduction projects for low income communities.

5. Invest in further study of climate projections for Central Texas and researching the most up to date science on global climate change trends. Continue climate resilience planning efforts by conducting vulnerability assessments to identify the people and assets most at risk from the impacts of climate change, as well as strategies that will protect people, the local economy, City operations and assets, ecosystems, and community infrastructure.

Background Information

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There have been unprecedented increases in average >> global temperatures << over the past three decades.

Climate change is here for Central Texas. The Colorado River Basin is experiencing an unprecedented drought that could continue to strain water resources for years to come. Inflow of total water volume to Lakes Travis and Buchanan is a key measure of the drought's intensity and these have been dramatically low; the top five lowest annual inflows have occurred since 2006. Another key measure of the drought's intensity and duration is the combined storage volume in Lakes Travis and Buchanan, which dropped to 35% capacity in February 2015. Last summer, the combined storage dropped alarmingly close to the all-time minimum. The National Oceanic and Atmospheric Administration's seasonal drought outlook has designated the mid to western parts of the lower Colorado River basin with a classification of "drought persists or intensifies."

In order to better understand the local impacts of climate change, the Office of Sustainability hired ATMOS Research, led by climate scientist Dr. Katherine Hayhoe from Texas Tech University, to conduct climate modeling for Central Texas using the same methodology used in the 2014 National Climate Assessment. Her study projected climate changes through 2100 to include the following for the Austin area:

- Increases in annual and seasonal average temperatures, with more days over 100° F and more nights over 80° F.
- More frequent high temperature extremes of over 110° F.
- Little change in annual average precipitation, but more frequent extreme precipitation, with more days of 2 inches or more in rainfall and increased durations of extreme rainfall.
- A slight increase in the number of dry days per year.
- More frequent drought conditions in summer due to hotter weather.

The National Climate Assessment summarizes the impacts of climate change on the United States; in 2014 the Third and most recent National Climate Assessment was released. This Third Assessment was assembled by more than 300 experts and vetted by a Federal Advisory Committee as well as a panel from the National Academy of Sciences. Key messages from the National Climate Assessment include[1]:

- Global climate is changing, this change is apparent across a wide range of observations, and the climate is projected to continue to change over this century and beyond. The

[1] 2014: Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67.

Photo by Victor Ovalle

global warming of the past 50 years is primarily due to human activities.

- The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, and how sensitive the Earth's climate is to those emissions.
- U.S. average temperature has increased by 1.3°F to 1.9°F since record keeping began in 1895; most of this increase has occurred since about 1970. The most recent decade was the nation's warmest on record. Temperatures in the United States are expected to continue to rise. Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time.
- The length of the frost-free season, and the corresponding growing season, has been increasing nationally since the 1980s, with the largest increases occurring in the western United States; ecosystems and agriculture are affected.
- Average U.S. precipitation has increased since 1900, but some areas have had increases greater than the national average, and some areas have had decreases. More winter and spring precipitation is projected for the northern United States, and less for the Southwest, over this century.
- Heavy downpours are increasing nationally, especially over the last three to five decades. Increases in the frequency and intensity of extreme precipitation events are projected for all U.S. regions.
- There have been changes in some types of extreme weather events over the last several decades. Heat waves have become more frequent and intense, especially in the West. Cold waves have become less frequent and intense across the nation. There have been regional trends in floods and droughts. Droughts in the Southwest and heat waves everywhere are projected to become more intense, and cold waves less intense everywhere.
- The intensity, frequency, and duration of North Atlantic hurricanes, as well as the frequency of the strongest

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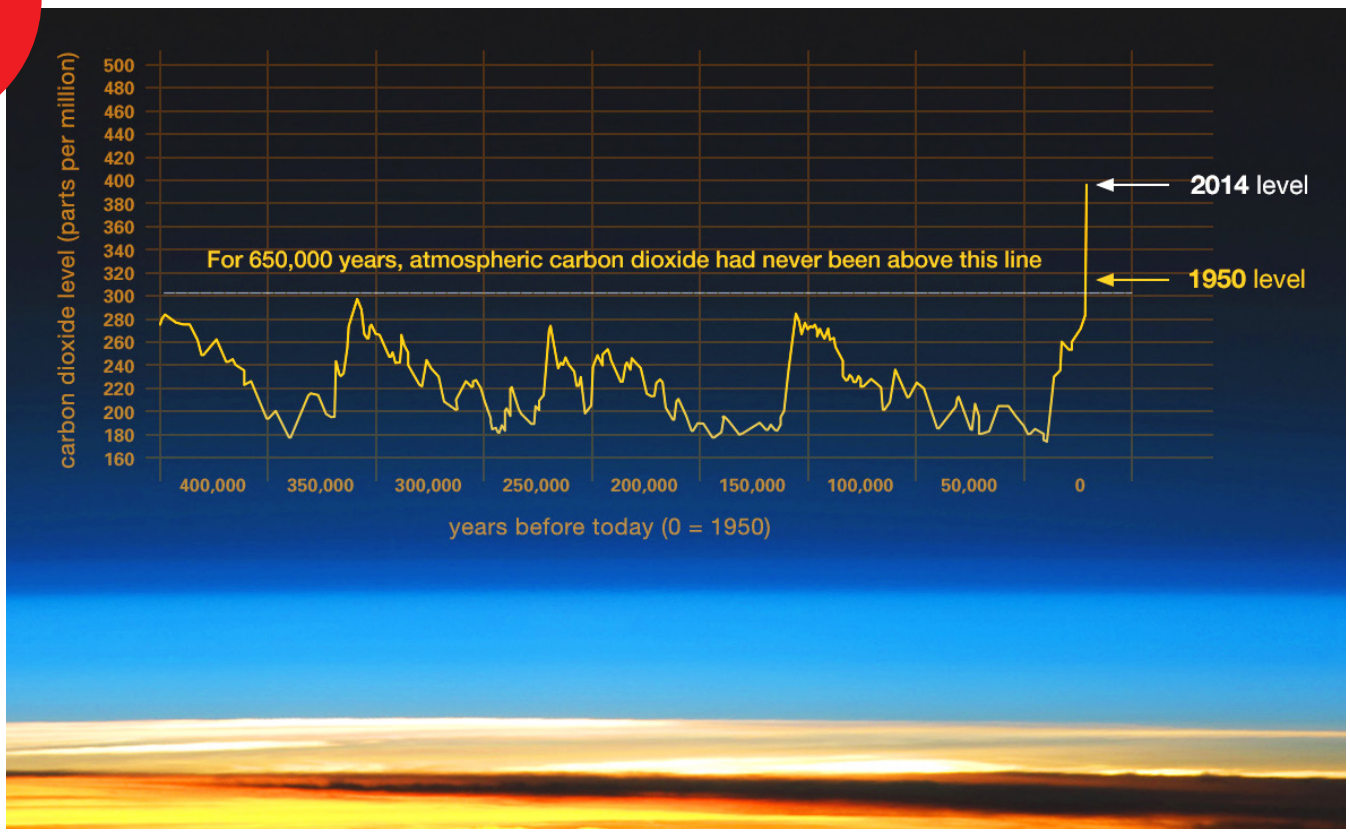
In order to avoid the worst impacts from climate change, greenhouse gas emissions must be reduced.

(Category 4 and 5) hurricanes, have all increased since the early 1980s. Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm.

- Winter storms have increased in frequency and intensity since the 1950s, and their tracks have shifted northward over the United States. Other trends in severe storms, including the intensity and frequency of tornadoes, hail, and damaging thunderstorm winds, are uncertain and are being studied intensively.
- Global sea level has risen by about 8 inches since reliable record keeping began in 1880. They are projected to rise another 1 to 4 feet by 2100.
- Rising temperatures are reducing ice volume and surface extent on land, lakes, and sea.
- The oceans are currently absorbing about a quarter of the carbon dioxide emitted to the atmosphere annually and are becoming more acidic as a result, leading to concerns about intensifying impacts on marine ecosystems.



This graph from NASA shows levels of atmospheric CO_2 increasing dramatically since the Industrial Revolution.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) stated that in order to avoid the worst impacts from climate change, greenhouse gas emissions must be reduced to 40% below 2005 levels by 2030 and 80% below 2005 levels by 2050. These actions may help in keeping the average global temperature from rising more than 3.5°F above pre-industrial levels.[2] This plan aims to put the Austin region on a path to reach and potentially exceed these important reduction goals.

Plan Development

In April 2014, Austin City Council passed Resolution 20140410-024 which established the goal of net-zero community-wide greenhouse gas emissions by 2050, or earlier if feasible. The Office of Sustainability convened a Community Climate Plan Steering Committee to lead and guide in the development of this plan. In addition, four Technical Advisory Groups (TAGs) were formed to create strategies and action plans for each of the major greenhouse gas emissions sectors in Travis County: Electricity and Natural Gas, Transportation, Materials and Waste Management, and Industrial Processes.

The Steering Committee set the following goals for development of the Austin Community Climate Plan:

This plan will be developed in a way that is open and transparent, balances the interests of the entire Austin community, is realistic within the constraints of currently available information, provides clear and compelling implementation pathways, and maintains Austin's position as a climate leader.

TAGs developed specific recommendations that were reviewed and evaluated by the Steering Committee and Office of Sustainability in terms of feasibility, barriers to implementation, the quantity of avoided emissions, and additional co-benefits that could be realized to prioritize actions that would reach the established net-zero goal.

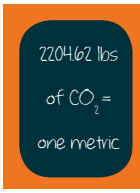
The public was invited to attend and provide comments at regularly scheduled Steering Committee meetings. Online tools were also used to gather input from the public on the plan's proposed strategies and actions. These included an online forum for people to submit their ideas for consideration, as well as a survey to collect information about individual behaviors related to energy use, transportation, and waste management. This information was used to develop a realistic and implementable plan, understand the barriers to taking action, and identify potential incentives or other motivating factors for reducing a person's carbon footprint.

What Does it Mean?

GHG: Greenhouse gas–a gas in the atmosphere that traps and re-directs heat back toward the earth's surface.

Global Warming Potential (GWP): A relative measure of how much heat a greenhouse gas traps in the atmosphere. GWP compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. GWP is calculated over a specific time interval and is expressed as a factor of carbon dioxide.

CO_2e: The unit of measurement used to standardize the impact of other GHGs to Carbon Dioxide based on GWP is carbon dioxide equivalent CO_2e).



$mtCO_2e$: The unit of measurement used as an international reporting standard for GHG. There are 2204.62 pounds of CO_2 in one metric ton.

Carbon Footprint: The total inventory of greenhouse gas emissions within a geographically bounded area, or connected to a specific activity or product.

Net-Zero: Balancing a measured amount of carbon emissions with an equivalent amount of permanently sequestered or offset emissions.

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[2]IPCC 2007 Climate Change Synthesis Report, http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html, accessed 11/12/14

Community Carbon Footprint

The Office of Sustainability completed the most recent community-wide greenhouse gas inventory in 2010 following the U.S. Community GHG Protocol developed by the International Council for Local Environmental Initiatives (ICLEI). By following this standard accounting protocol, the City of Austin can continue to directly compare our inventory to inventories of other cities, states, and international bodies. According to this protocol, the Office of Sustainability included the following direct emissions generating activities within Travis County:

1. Use of Electricity by the Community including emissions from power plants and energy used to treat and distribute potable water and collect and treat wastewater
2. Use of Fuel in Residential and Commercial air and water heating equipment
3. On-Road Passenger and Freight Motor Vehicle Travel
4. Emissions from landfills in the Community
5. Emissions from industrial facilities required to report to the EPA National Greenhouse Gas Reporting Program

The Office of Sustainability follows this protocol to capture all significant emissions sources that contribute to the community's total greenhouse gas emissions inventory, while establishing practical limits on the sources that are reported. A community-wide greenhouse-gas inventory based on 2013 data will be available later in 2015 and will be updated every three years going forward.

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Challenges with Reporting Protocols and Upstream Emissions

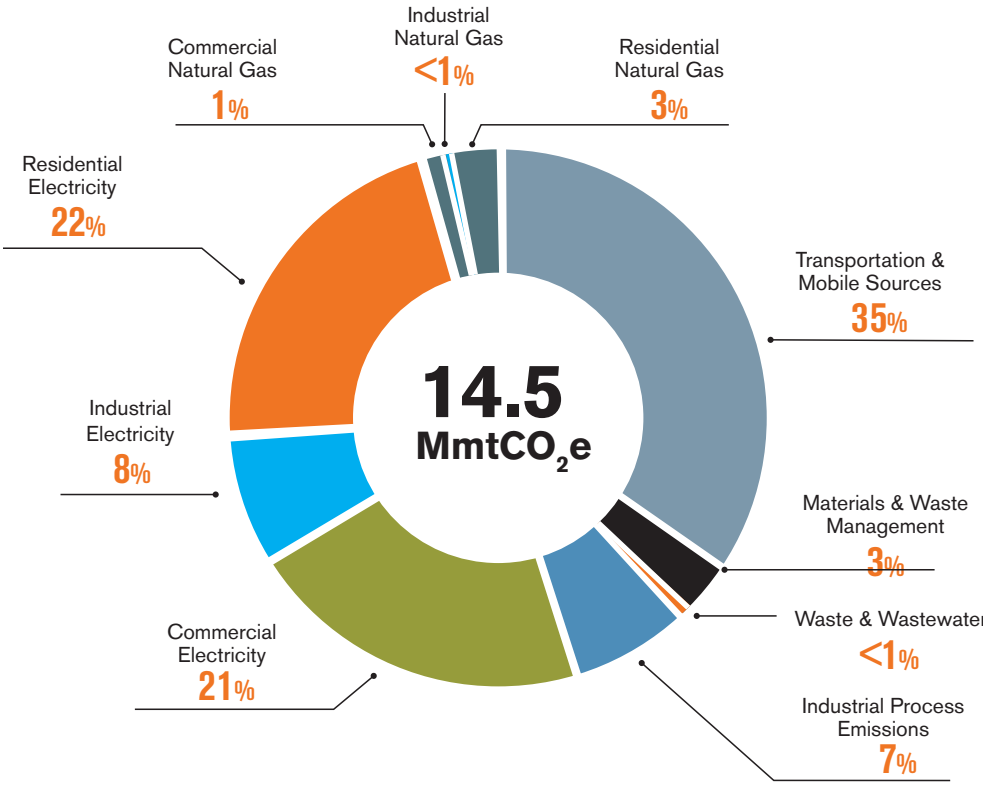
The City of Austin recognizes that current greenhouse gas emission quantification and reporting protocols do not fully capture every emission to the atmosphere. Some of the sources that are excluded from our community inventory are:

- Emissions produced from the energy consumed during extraction of raw materials, creation of food and goods, and transportation of those products to Austin
- Upstream emissions from the extraction and processing of fossil fuel
- Full accounting for emissions associated with air travel
- The carbon captured by trees and plants

While these emission sources and sinks are significant, the City's ability to accurately quantify them as well as influence their direct reduction is small. We acknowledge that by not including these sources and sinks, we are underestimating the full carbon footprint of our community. However, we have taken these emissions into account during our planning processes and are taking action that not only affects local direct emissions but also upstream emissions wherever possible.

Another area of variation in protocol methodology is the use of different global warming potentials of methane and other non-CO_2 greenhouse gases. The ICLEI protocol prescribes the use of a 100 year global warming potential for methane, while some other research states that a 20 year timeframe is more appropriate. If the current community-wide greenhouse gas inventory were to use the 20 year global warming potential and attempt to quantify upstream emissions with the extraction of natural gas while creating the community carbon footprint, it would increase the whole inventory by approximately 36%.

2010 Estimated Travis County GHG Inventory



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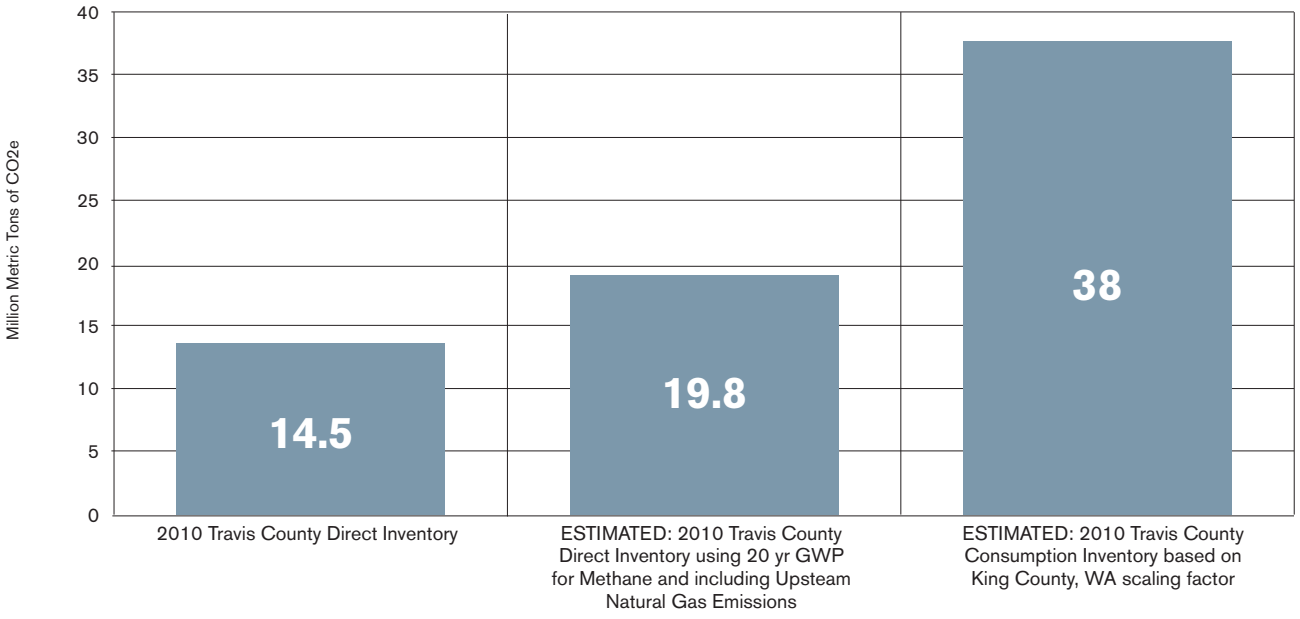
Comparing Inventory Approaches and Estimated Results



The chart above compares the relative magnitude of other approaches to completing a community-wide greenhouse gas inventory.

Community Climate Action Plan

Photo by Lydia Jarjoura

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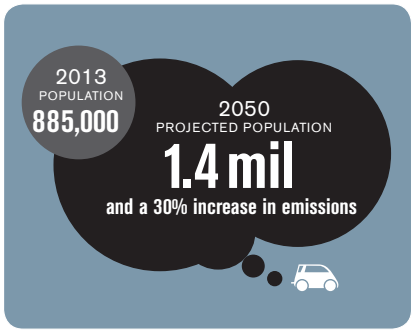
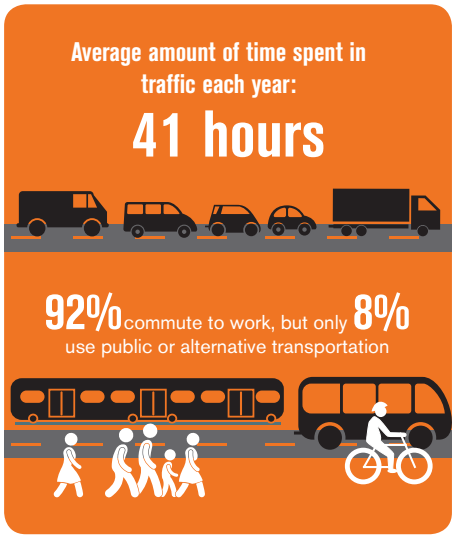
As one of the fastest growing cities in America for the last five years, Austin has prepared for and responded to a variety of physical, economic, and social impacts resulting from rapid population change. The projections for continued population growth also pose a challenge to meeting the goal of net-zero community-wide greenhouse gas emissions by 2050; it will take a concerted effort from the entire community to reach this ambitious goal.

Using relevant demographic data to understand who we are as a community helped to inform the development of the strategies and actions in this plan. Austin has a fast-growing Hispanic population. Although 56% of the population is under 35 years old, Austin is currently attracting more people in the 55+ age group than almost any other city. Analysts predict that the 65+ age group will make up as much as 20% of the population by 2050. However, Austin is also experiencing massive growth in the number of children between the ages of 5 and 14—a 49% increase from 2000 to 2013.

While this plan is focused on achieving net-zero greenhouse gas emissions community-wide, it is important to note that the strategies and actions proposed can also help address many other challenges facing Austin, including affordability and transportation issues. Individual choices and behaviors will have a strong influence on quality of life at the personal level, as well as for Austin as a whole.



Data source: City of Austin Demographer



Data source: INRIX traffic scorecard, www.inrix.com/scorecard

Data source: Location Affordability Portal, US HUD, www.locationaffordability.info/

NET-ZERO COMMUNITY CO-BENEFITS

Reduced energy costs

Improved energy security and reliability

Decreased risk of energy shortages or outages

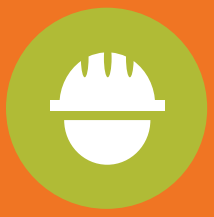
Greater affordability for all

Reduced pollution

Improved air quality

Improved public health

Thriving local economy



Expanded local jobs creation

Enhanced tra system

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Reduced traffic congestion

Safer streets

Improved disaster preparedness

Protected and enhanced ecosystems

Diminished water consumption by power plants

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How Do I FIT IN?

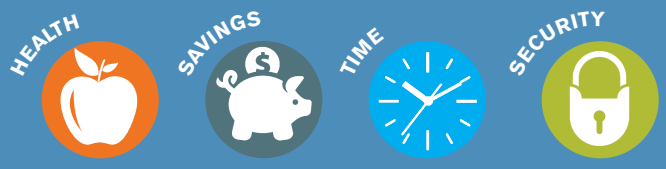
Community Overview

The average Austinite's carbon footprint comes from waste and wastewater treatment, transportation, and energy use, including heating, cooling and electricity for homes. While the actions of individual people contribute to the overall community-wide emissions total, reduction strategies cannot take a "one-size-fits-all" approach. Instead, individual challenges, constraints, and opportunities must be taken into account.

On the pages that follow, typical scenarios and behaviors are identified for representative groups within the Austin community. While this is not an all-inclusive listing of every demographic group in the city, it does provide a high-level overview of how the Austin Community Climate Plan will have an impact at the individual level.

In addition to protecting Austin from the effects of climate change, implementing the actions identified in this plan will provide multiple positive benefits to individual Austinites. Four have been highlighted here:

Health: increased physical activity and / or cleaner air
Savings: reduced energy bills and / or transportation costs
Time: additional time for family and personal enjoyment
Security: better preparedness for extreme weather



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How Do I
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College Students

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Co-Benefits:

HEALTH

SAVINGS

TIME

Roger is a student at the University of Texas at Austin. He lives in an apartment off campus with two roommates to help split the costs for rent, food, and utilities. The apartment is pretty basic and hasn't been upgraded in more than 10 years, so Roger and his friends are concerned about their energy bill and costs rising over time. Recycling is available but complicated, and composting is not yet offered at the complex. Roger regularly rides his bike or takes the bus to get to class, but depends on his car for going out with friends. When he's not studying or working at his part-time job, Roger enjoys the live music scene along Red River and on Rainey Street. Implementing strategies in the Austin Community Climate Plan will make it easier for Roger to take advantage of public transportation and ride his bike and walk more. He will also be encouraged to reduce his energy use through real-time updates on usage, as well as interactive neighborhood challenges using social media. College students like Roger will also receive information about where to find less expensive, used goods, instead of always having to buy new. In addition, students will have options for discarding lightly used goods for reuse and repurposing. This will keep more money in the local economy and more trash out of the landfill, as well as lower their monthly living expenses.

Refer to the Technical Appendices for more detail on Actions IS-1, IS-2, LU-1, LU-3, TDM-1, TDM-2, BC-1, BC-2, BC-3, BC-4, BIE-8, RR-1, RR-2, RR-3

How Do I
FIT IN?

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Central City Individuals and Families

Co-Benefits:

HEALTH

SAVINGS

TIME

Angel and Emali live with their daughter Sophia in an older apartment complex in the Hyde Park neighborhood. Even though it's a little small, they enjoy its quirky charm and the neighborhood character. Because they are renters, they are not able to make improvements to the apartment that would help lower their monthly utility bill; they are looking for other ways to reduce their energy use. Angel works downtown and his wife Emali works in the University district; both take public transportation to work occasionally, but often have to drive based on Sophia's active schedule. On the weekends, they enjoy biking to a neighborhood park, or going to a local farmer's market to shop for fresh food. For most of their weekend shopping errands they rely on their car, as most of the stops are a long way from where they live. Implementing the Austin Community Climate Plan will help central city families to lower their energy costs with a dynamic rate structure and advanced metering technology. They will also have increased access to public transportation and an expanded bike lane and sidewalk system. Central city families will also be able to purchase more items second-hand, which will help extend their budget and keep waste out of the landfill.

Refer to the Technical Appendices for more detail on Actions IS-1, IS-2, BC-1, BC-2, LU-1, LU-3, TDM-2, TDM-3, RR-1, RR-2, RR-3

How Do I
FIT IN?

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Suburban Individuals and Families

Co-Benefits:

This suburban family lives in a recently constructed, 2,500 square foot home. The home is energy efficient but it is large, so they are interested in exploring ways to lower their utility bill. However, their transportation budget is higher than average as both parents spend a considerable amount of time each day commuting to and from work. Lyn and her husband Daniel take separate cars so that one can drop off their daughters at school on the way to work, and the other can pick them up on the way home. For running errands and the occasional dinner out, the family opts to go to convenient shopping centers near their home. Implementing strategies in the Austin Community Climate Plan will make it easier for suburban families to use alternative transportation options to commute to work and enhance their ability to keep more household waste out of the landfill. It will also enable families like theirs to take advantage of solar photovoltaic and energy efficiency programs that will help in reducing their utility bill.

Refer to the Technical Appendices for more detail on Actions IS-1, IS-2, IS-3, TDM-1, TDM-4, TDM-8, VFE-1, BIE-1, BIE-2, BIE-4, BIE-5, RT-2, RE-1, RE-3, OD-2

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Retired, Fixed Income Individuals and Couples

Co-Benefits:

HEALTH

SAVINGS

SECURITY

Alonzo and Uralene have retired after working for nearly 50 years. The couple has built up a decent retirement nest egg, but they live on a flat, modest budget at this point in their life. They recently began volunteering with a local non-profit that is trying to spark the desire for education in future generations of kids; they firmly believe that their grandson should complete college and hope to help him achieve this. They own a circa-1945 home that they bought shortly after getting married. It could use some upgrades to be more energy efficient, but increasing property taxes and contributions toward their grandson's education fund keep their budget pretty tight. At this point, Uralene still drives, but she plans to stop in a couple of years, so both will depend on public transportation and a good sidewalk network to get around. Implementing the Austin Community Climate plan will help retired couples with enhanced public transportation options and better infrastructure to support biking and walking. New utility rate structures and solar rebate program offerings, as well as increased opportunities to purchase lower-cost, used goods, will enable them to stretch their budget further each month.

Refer to the Technical Appendices for more detail on Actions IS-1, IS-2, LU-1, LU-3, BC-1, BC-2, BC-3, BIE-1, BIE-2, RT-2, RR-1, RR-2, RR-3

How Do I
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Small Business Owners & Non-profit Leaders

Co-Benefits:

Paola opened her restaurant with her mom almost 10 years ago; they were inspired to bring traditional dishes from their home in Argentina to Austin. She has faced many challenges getting the business up and running–paying rent for a prime location, hiring employees, developing relationships with vendors, and building a loyal customer base. In the early days, she was barely able to break even, but now she consistently makes a modest profit and her family opened a second location last year. Paola spends a lot of time at the restaurant, and often spends an additional 45 minutes in traffic commuting to work each day. Paola knows that her employees struggle with transportation to and from work as well; there are not established bike routes to her restaurant, and many of her employees do not have bus stops within a 1/2 mile walking distance from their homes. In addition, Paola and other small business and non-profit leaders will find it easier to maximize their recycling and composting efforts to keep waste out of the landfill.

Refer to the Technical Appendices for more detail on Actions LU-1, LU-2, LU-3, PP-1, BIE-1, BIE-2, RE-4, OD-1, OD-4, RR-4

How Do I
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Large Companies and Employers

Co-Benefits:

Justin is the Vice President of Business Development for a large, multinational company with offices in three buildings on a corporate campus in North Austin. His job is to ensure that the company leads the competition in their industry, so he focuses on enhancing the company's reputation, attracting and retaining the best talent, and delivering a quality product that customers will demand. He is finding that the best employee candidates expect the company to provide transportation options to and from work. Customers are also asking Justin about what the company does to give back to the community and about its impact on the environment. Implementing strategies in the Austin Community Climate Plan will provide Justin and other large employers in Austin with trip reduction strategies and employee commuting programs that help reduce emissions and increase employee satisfaction and retention. The plan also will make it easier for Justin to access programs to help with efficiency upgrades to his company's offices, as well as maximize the amount of waste kept out of the landfill.

Refer to the Technical Appendices for more detail on Actions TDM-1, TDM-4, TDM-7, TDM-8, VFE-1, BIE-1, BIE-2, BIE-3, RE-4, OD-1, OD-4

How Do I
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Tourists

Co-Benefits:

HEALTH

SECURITY

TIME

Megan flies to Austin from Minneapolis for the Austin City Limits Music Festival each year and usually tacks on a few extra days to enjoy the city. She rents a room in a house near Zilker Park that offers short-term rentals during the festival. She walks to and from the festival each day, but rents a car to get around town on the days after. Megan seeks out the businesses, restaurants, and entertainment that are unique to Austin when she's here–she wants the full local experience. While Megan is here she struggles to make her normal sustainable lifestyle choices; she is eating food to-go that is heavily packaged and throws everything in the trash because she is not sure what can be recycled or composted. Implementing strategies in the Austin Community Climate Plan will help business travelers and tourists like Megan by providing additional alternative transportation options for getting around town, as well as resources and tools to understand recycling and composting options for Austin.

Refer to the Technical Appendices for more detail on Actions IS-1, IS-2, LU-3, TDM-2, TDM-5, RE-4, OD-1, OD-4

City of Austin Climate Action Plan

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Photo by Michael Knox

The City of Austin has a long history and strong track record of sustainability leadership through initiatives that support prosperity and jobs, conservation and the environment, and community health, equity, and cultural vitality. In 2007, the Austin City Council adopted a resolution to "make Austin the leading city in the nation in the effort to reduce the negative impacts of global warming," establishing a local goal aligned with the Intergovernmental Panel on Climate Change (IPCC) reduction targets.

Since adoption of the Climate Protection Resolution, the City of Austin has made significant progress in limiting emissions growth:

1. Municipal operations. The City has seen a 68% reduction of greenhouse gas emissions from our baseline, and all City-owned buildings are powered by 100% renewable energy.

2. Utility generation mix. Austin Energy is expected to reach the target of 35% renewables by 2020 ahead of schedule. In 2014, Council adopted a new Generation Plan that sets a goal of 55% renewables by 2025, 75% carbon-free energy by 2025, and will divest Austin of ownership of coal generation facilities.

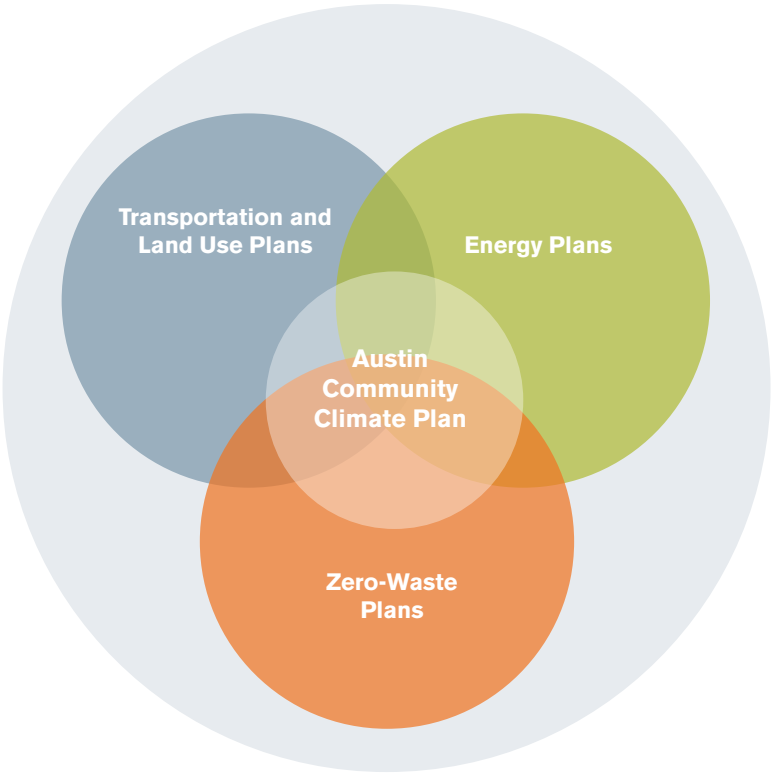
3. Homes and buildings. Austin Energy has achieved 440 of the new 900 megawatt demand side management target through energy efficiency programs and rebates, the Energy Conservation Audit & Disclosure Ordinance (ECAD), the Green Building Program, energy code updates, and research and early adoption of smart grid technologies.

4. Carbon Neutral Programs and Assistance. An online calculator is available for individuals to determine their carbon footprint, and a pilot program is underway to offset the emissions generated from large events and festivals.

In 2012, City Council adopted the Imagine Austin Comprehensive Plan, which set the vision for a sustainable future and provides a framework to begin to address the various challenges and opportunities ahead. This Austin Community Climate Plan aligns with a number of Imagine Austin goals and implementation strategies.

POLICIES AND PLANS THAT SUPPORT EMISSIONS REDUCTION

There are a number of other City plans that indirectly support the goal of community-wide emissions reduction:



Transportation and Land Use Plans

Imagine Austin

2014 Austin Strategic Mobility Plan

Austin Bicycle Master Plan

Urban Trails Master Plan

CAMPO 2035 Regional Transportation Plan

Zero-Waste Plans

Austin Resource Recovery Master Plan

Energy Plans

Austin Energy Resource, Generation, and Climate Protection Plan

In 2007, the Austin City Council adopted a resolution to "make Austin >> the leading city in the << nation in the effort to reduce the negative impacts of global warming."

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"Austin Energy is committed to the City of Austin's climate protection goals by ending our use of coal power by the end of 2022 and retiring inefficient natural gas units. We will replace these resources with a highly efficient gas plant and continued investments in local storage, demand response and renewable energy."

—Larry Weis, Austin Energy General Manager

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Photo by C. Jody Horton

Electricity & Natural Gas Sources of Emissions

(source of 55% of total community-wide emissions)

Because the City of Austin owns its electric utility and can guide generation planning decisions, City Council can set the direction to achieve significant emissions reductions. The following policies have been adopted by City Council:

Austin City Council Resolution 20140828-157

Adopted in August 2014, this resolution set the vision for reducing $C0_2$ emissions from all city-controlled generation resources to zero by 2030, increasing the amount of renewable generation resources from existing goals, advancing the local solar market, and encouraging further deployment of storage technologies (all goals subject to the previously-adopted and reaffirmed affordability goals).

Austin Energy Resource, Generation, and Climate Protection Plan: An Update of the 2020 Plan

Adopted on December 11, 2014, the 2025 Generation Plan supports an increase in the amount of renewable energy to 55% of customer demand, as well as investments in local storage and demand response. The following items are included in the new Generation Plan:

- Potential replacement of the Decker steam units with a nominal 500 megawatt highly efficient combined cycle plant, contingent on an independent review and Council approval.
- Supporting creation of a cash reserve fund for Fayette Power Project retirement beginning in 2022.
- Issuing a Request for Proposal for up to 600 megawatts of utility scale solar.
- Achieving a total of at least 900 megawatts of demand side management (DSM) by 2025.
- Developing an implementation plan for distribution connected local storage of at least 10 megawatts, complemented by as much as 20 megawatts of thermal storage.

Contingent upon further study, technological development, progress toward goals, and rate adjustments or restructuring, the Generation Plan also recommends the following:

- An additional 100 megawatts of demand response or energy efficiency to increase the demand side management achieved to 1000 megawatts by 2025.
- An additional 100 megawatts of local solar for a local solar portfolio of 200 megawatts contingent upon a rate structure that maintains equity among customers.
- Issuing a Request For Information for 170 megawatts of large scale storage, such as Compressed Air Energy Storage.

Transportation and Land-Use Sources of Emissions

(source of 35% of total community-wide emissions)

The City directs general land use policy and works with multiple partners on strategic transportation investments that will help reduce community-wide emissions:

Imagine Austin Comprehensive Plan

Provides a set of defined goals, principles, policies, and actions for the city's future growth. While there are numerous priority programs and goals laid out in Imagine Austin, some of the concepts related to transportation and land use are:

- A more compact and connected city that provides housing and businesses with activity centers.
- An integrated, expanded, and affordable transportation system that supports a variety of transportation choices, while reducing sprawl, congestion, and travel times.
- Safe bicycle and pedestrian facilities with well-designed routes that provide connectivity throughout Austin.

Austin Bicycle Master Plan

Aims to significantly increase bicycle use and improve safety throughout Austin by creating an all ages and abilities network, which is expected to significantly reduce automobile congestion in key travel corridors.

Urban Trails Master Plan

At full implementation, this plan will provide a cohesive recreational and transportation network of non-motorized, multi-use pathways to safely travel long distances across all of Austin.

Photo by Michael Knox

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"Over the past decade, our region has made strides in leveraging partnerships and implementing measures toward the reduction of traffic congestion and the improvement of air quality. As our city continues to grow, the Austin Community Climate Plan provides a unique opportunity to continue to build on the successes of existing partnerships to provide additional benefits to the community as a whole, while reaching toward the goal of net-zero greenhouse gas emissions by 2050."

—Rob Spillar, P.E., Director of Austin Transportation Department

"Austin's Zero Waste initiatives are proactive steps to protect Austin's quality of life now and for future generations. This new perspective treats the collected material as a resource that is recovered for a second life, rather than a waste stream destined for a landfill. Our collective efforts will reduce greenhouse gases from landfills and provide green job opportunities while adding economic value to our discards."

—Bob Gedert, Director, Austin Resource Recovery

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Materials and Waste Management Sources of Emissions

(source of 3% of total community-wide emissions)

The City only controls approximately 25% of the amount of annual waste generated, so there is a heavy reliance on working with private sector partners to achieve these goals.

Austin Resource Recovery Master Plan
Sets the goal of reaching 90% diversion (i.e. solid waste and materials that are not disposed of in a landfill or incinerator) by 2040, along with strategies for how to accomplish that goal.

Natural Systems

Green Infrastructure: Imagine Austin refers to "green infrastructure" as "parks, the urban forest, urban trails, greenways, rivers, creeks, lakes, gardens, green buildings, green streets, urban agriculture, open spaces, and wildlife habitat." As such, green infrastructure is a strategic element in addressing Austin's increasingly hot city, and its carbon footprint. Imagine Austin has a stated goal to integrate green infrastructure elements into the city's urban design.

Trees and the Urban Forest: A highly visible, and integral, aspect of green infrastructure is the role of trees in our environment, which can provide some direct carbon sequestration benefits. One federal research paper estimates that trees can sequester between 1-9 metric tons of CO_2 per acre per year, depending on the application.[1] In March 2014, City Council adopted the Urban Forest Plan, which provides the framework to manage Austin's public urban forest resources. A March 2015 study demonstrated the multitude of benefits that the city's urban forest provides; Austin's urban forest, "helps improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power plants." Specifically related to carbon dioxide benefits, Austin urban trees are already removing an estimated 38,400 metric tons of carbon per year, the equivalent of removing the annual greenhouse gas emissions associated with over 8,000 vehicles.[2]

[1] http://fas.org/sgp/crs/misc/R40562.pdf
[2] i-Tree Ecosystem Analysis, "Urban Forest Effects and Values," March 2015.

Photo by Betsy Woldman

Urban Heat Island: The Urban Heat Island effect occurs as pavement and buildings radiate absorbed solar energy, creating increased heat, increased demand for air conditioning, and decreased air quality. Research has shown that urban heat islands add 3% to 8% to the energy consumption of US cities.[3] The City of Austin has taken a multi-pronged approach to addressing urban heat islands through rooftop solar programs, the Austin Energy Green Building Program, efforts to encourage green roofs, tree plantings and other green infrastructure within rights-of-way, and adopting more efficient building codes to ensure maximum adoption of reflective roofs.

Austin Water

As the City of Austin's water utility, Austin Water has the responsibility to ensure that the citizens of Austin have an adequate and safe water supply–which includes making every effort to conserve that water supply. Lakes Travis and Buchanan are the region's main drinking water reservoirs and they are managed by the Lower Colorado River Authority. The Austin area, and particularly the region upstream of Austin that flows into the Highland Lakes, has been in the grip of an epic drought generally considered to have begun in March 2008. As of January 2015, lake storage was thought to be approximately 34% of full capacity, approaching historical low levels.

There is a distinct possibility that this drought is a consequence of climate change and that the region is shifting permanently to a drier climate or at least one with less water availability. While it is too early to know that for certain, and Texas has experienced many severe droughts over the centuries, Austin Water takes the possibility of a shift to a drier climate due to climate change very seriously. With the likelihood of less precipitation and higher temperatures (which would likely translate into drier ground, less runoff, and more evaporation in the lakes), water conservation efforts become even more critical moving forward. Efforts toward developing an Integrated Water Management Plan are already underway.

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[3]Kamal-Chaoui, Lamia and Alexis Robert (eds.) (2009), "Competitive Cities and Climate Change", OECD, Regional Development Working Papers N° 2, 2009, OECD publishing, ©OECD

Another aspect to the water discussion is the relationship between water and energy. There is significant water used in the production of energy, depending on the type of generation, and water utilities consume large amounts of energy to pump raw and treated water, as well as to collect and treat wastewater. While Austin Water Utility is already purchasing 100% carbon-free energy, any increases in efficiency of treating and delivering water will still provide benefits to the utility and its customers. By focusing efforts to ensure our generation resources are cleaner and require less water, both locally and in the extraction of fuels needed for certain types of generation, Austin can continue to be a leading city for protection of natural resources.[4]

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[4] Austin Water Utility, "Understanding the Drought," February 2015

Photo by Victor Orvalle

Climate Resilience Planning

Climate impacts everything in the natural and built environments. As the climate in Texas continues to change it has contributed to various environmental impacts, which have required tens of millions of dollars to address recovery efforts statewide.

- During the summer of 2011, Austin had 90 days with temperatures of at least 100° F.
- Multiple wildfires destroyed over 1,500 homes and 32,000 acres of forest surrounding Bastrop in 2011.
- The Halloween flood of 2013 resulted in loss of life, caused extensive damage to homes and businesses around Onion Creek, and displaced many people from their homes. In addition, the loss of vegetation from intense precipitation combined with prolonged drought conditions may increase flooding severity in the future.
- The entire region is in the midst of a hydrologically unprecedented drought that has severely depleted our sources of water, stressed vegetation and ecosystems, and negatively impacted water quality.

These and other changes are consistent with trends across the United States and around the world that have been attributed to human-induced climate change–the result of carbon dioxide and other heat-trapping gases released during fossil fuel combustion, deforestation, agriculture, and other activities. These emissions that have accumulated in the atmosphere will continue to change the climate for years to come. Bearing this in mind, it is not enough to create plans for mitigating future emissions; the City must also become resilient to climate change.

On November 21, 2013, City Council passed a resolution that resulted in the Office of Sustainability working with nine departments to determine how planning efforts integrate future impacts of climate change, and to identify a process for performing departmental vulnerability assessments. The resolution requested that the following be included in the scope of the assessment: transportation, electric utility, water utility, and drainage infrastructure; community health and wellness efforts; and disaster preparedness and emergency response management.

Photo by City of Austin

"The Watershed Protection Department stands at the nexus of extreme weather events, nature, and people. Whether it is saving lives from floods; managing our stream ecosystems to maintain or improve water quality; or protecting and preserving our endangered species, all cost-effective efforts must be made to creatively reduce our emissions and make our community more climate resilient."

–Victoria Li, Director,
Watershed Protection Department

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Austin can expect more extreme weather in the future

high temperatures

extended periods of drought

increasing risk of wildfires

intense rainfall events

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To proactively take steps to become more resilient to climate change, the City must manage the risk of impacts to both new and existing capital investments. This may involve infrastructure design and material decisions that ensure adequate service despite climate change projections. It will also mean ensuring high levels of service to residents and the ability to effectively protect human life during extreme weather events.

The City of Austin has begun preparing for the future by purchasing over 500 of the most flood prone homes in the Onion Creek area, with plans and funding to purchase another 355 homes. The total expenditure is expected to be approximately $160 million dollars and will address the greatest contiguous flood hazard region in Austin. In addition, frequent evaluations of changes in flood intensity and duration will be conducted using the most up-to-date information available.

It is also important to understand that some issues are out of the City's direct control such as grid-wide energy capacity, basin-wide water availability, regional food supply, and regional evacuees. In addition, some regional entities may not acknowledge climate change or recognize its risks. Climate variability also makes strategic planning a complex and ongoing process; there is a high degree of uncertainty in predicting the occurrence of when, where, and how strong extreme weather events will be. Although planning for uncertain weather may seem daunting, the City can act to ensure that departments and community members are resilient to the impacts of climate change.

Next Steps

With a 35-year timeline, changes in technology, economic trends, and actual population and demographic patterns over the long term will impact the feasibility of various strategies to achieve net-zero community-wide greenhouse gas emissions by 2050, or sooner if feasible. Taking these issues into account, the following reporting cycle is proposed following adoption of the Austin Community Climate Plan:

Building on the Recommendations proposed in the Executive Summary of this report, many of the strategies and actions identified in the Technical Appendices require further study, analysis, and planning before implementation. By Summer 2016, a full implementation plan would be developed that prioritizes the complete list of strategies and actions contained in the technical appendicies based on feasibility, impact, and cost for potential inclusion in the 2017 budget cycle.

Annual Progress Reports (shown in orange) will offer updates on the implementation status of actions and strategies, quantified emissions reductions from projects in the community, and success stories.

Progress Reports in 2019 and 2023, will offer updated community-wide greenhouse gas inventories, with emissions identified by sector to measure progress in all plan areas. These Reports will offer a more detailed analysis of implementation successes and challenges, as well as the lessons learned that will influence efforts in the future.

In 2020 and 2024, a complete qualitative and quantitative review of all actions identified in the 2015 Implementation Plan will be conducted, as well as an assessment of new opportunities, resulting in a full Plan revision. This effort will involve convening a new Steering Committee, new Technical Advisory Groups, and gathering community input on Plan revisions.

Reporting cycles beyond 2026 will be identified as part of the 2026 Annual Progress Report.

All of the reports will be completed by Office of Sustainability staff in collaboration with City Departments and community stakeholders. Each will be presented to Council by the end of the calendar year identified. To address the community action needed to acheive the goal, an outreach strategy for working with the general public, other governmental agencies, as well as private and nonprofit partners will be developed as a part of the Implementation Plan.

Climate impacts
everything in the
>> natural and <<
built environments.

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Photo by Michael Knox

Appendices

Appendix A: Methodology for Calculations

Protocol

The Office of Sustainability follows the *U.S. Community Greenhouse Gas Protocol* developed by the International Council for Environmental Initiatives (ICLEI). According to this protocol, five basic emissions generating activities must be included:

1. Use of Electricity by the Community
2. Use of Fuel in Residential and Commercial Stationary Combustion Equipment
3. On-Road Passenger and Freight Motor Vehicle Travel
4. Use of Energy in Potable Water and Wastewater Treatment and Distribution
5. Generation of Solid Waste by the Community

The intent of this protocol is to include all significant emissions sources that contribute to the community's total greenhouse gas emissions inventory, while establishing practical limits on the extent of insignificant sources that are be reported. By following this standard, the community inventory process is relevant, accurate, complete, measurable consistent, comparable, and transparent. The community-wide greenhouse gas inventory included in this report was based on 2010 data. An inventory based on 2013 data will be available later in 2015 and will be updated every three years going forward.

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Boundary

The community greenhouse gas emissions inventory used in this document is based on emissions that originate from sources located within Travis County, or that directly serve the needs of the area.

Greenhouse Gases Included

General source categories that have been included in the community greenhouse gas inventory are consistent with the *U.S. Community Greenhouse Gas Protocol's* accounting guidelines. The greenhouse gas constituents included are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N20), hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The Office of Sustainability currently adheres to the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report for reporting global warming potentials and converts amounts of individual greenhouse gas emissions to CO_2 equivalents (CO_2e).

Data Sources

This plan used primary data and information from sources including:

- Austin Energy
- Austin Transportation Department
- Austin Water Utility
- Austin Resource Recovery
- Texas A&M Transportation Institute
- Texas Gas Service
- EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT)
- Pedernales Electric Cooperative
- Bluebonnet Electric Cooperative

Appendix B: Electricity and Natural Gas Sector Findings

Introduction

The Electricity and Natural Gas sector comprised 55% of total community greenhouse gas emissions in 2010, the majority of which are indirect emissions associated with electricity use. Electricity in Austin is provided via an interconnected network of wires (the grid) that covers most of the state and is overseen by the Electric Reliability Council of Texas (ERCOT) . All electricity users are connected to this grid which includes meters, distribution lines, utility poles, substations, and transmission wires. All power plants connected to the grid supply energy to maintain the right frequency on the grid, which ensures electricity is available to the end user when needed. ERCOT balances the frequency by continuously forecasting and monitoring electricity demand and then dispatching power plants as needed. Although the locations of power plants relative to load centers are important, it is not possible to say that one end use is being served directly by a certain power plant; all electricity at any given time is made possible by all of the power plants generating into the grid at that time. Emissions associated with electricity use in a community can be estimated using the average emissions intensity from all power plants on the grid.

Approximately 8% of Electricity and Natural Gas sector emissions are direct emissions associated with natural gas distribution and consumption for heating, cooking, and other uses. Figure 1 shows the relative breakdown of greenhouse gas emissions by use for the sector in 2010.

A key consideration for the Electricity and Natural Gas Technical Advisory Group (TAG) was how to properly account for emissions associated with electricity use across the entire Austin community. The TAG used electricity sales multiplied by a grid-average emissions factor, adjusted by any owned resources or resources with which local utilities have a long-term power purchase agreement and for which the location of the resource is known. By using this approach, the community's greenhouse gas footprint accounts

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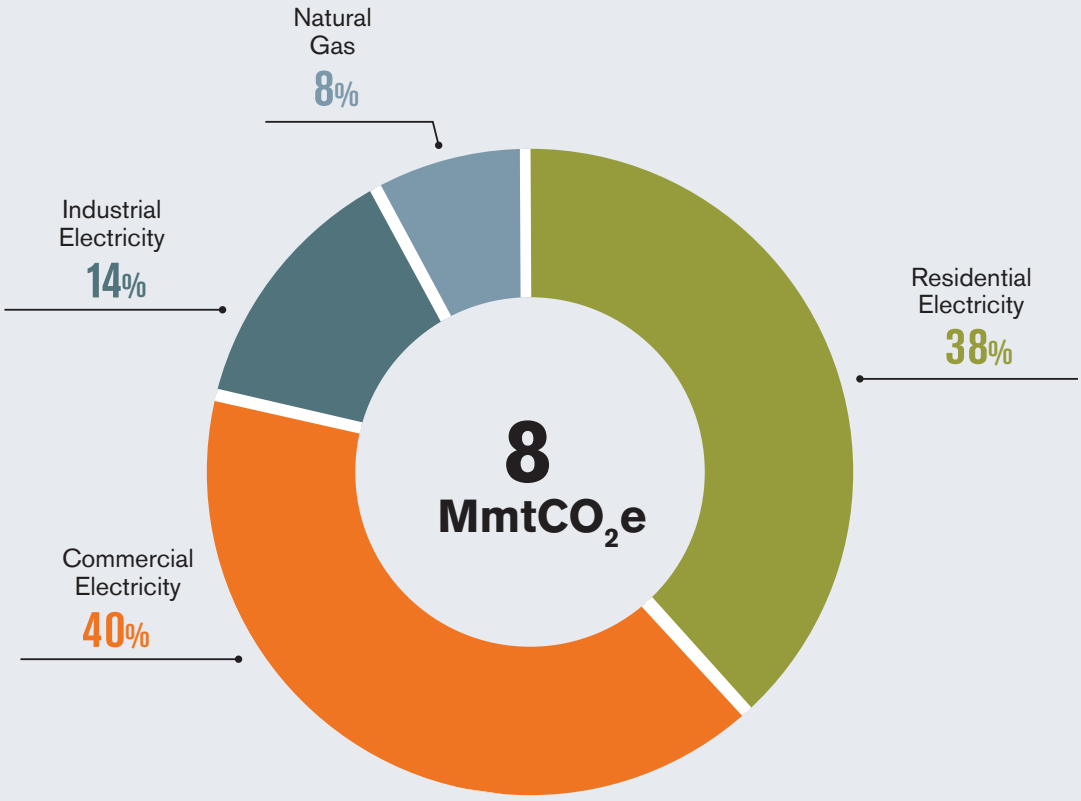

Figure 1: Breakdown of Greenhouse Gas Emissions for Electricity and Natural Gas.

for electricity generated or contracted by the local utility and also that which is supplied by the ERCOT grid. The City of Austin currently uses this method to account for Austin Energy's generation emissions inventories, and to the extent other local utilities either own their generation resources or have long-term agreements with specific resources, they can calculate their emissions in this way. Otherwise, emissions would be calculated based on a grid-average emissions factor and local decisions about generation resources would have a negligible impact on total community greenhouse gas emissions.

This plan uses Travis County as the geographic boundary for emissions. Electricity use in areas served by Bluebonnet Electric Cooperative, Pedernales Electric Cooperative, and the University of Texas at Austin is included when calculating and projecting greenhouse gas emissions. This definition provides an opportunity for the City to collaborate with other electricity providers in the County to share ideas and strategies for emissions reductions beyond Austin city limits, or Austin Energy service areas. Representatives from Texas Gas Service participated as part of the TAG since they provide natural gas to residents in the community and they will be an important stakeholder in helping the community achieve the long-term goal of net-zero community-wide emissions.

The Electricity and Natural Gas TAG worked with the Office of Sustainability to develop estimated emissions reductions for the proposed strategies and actions in this plan. Figure 2 shows 2010 emissions for this sector, estimated emissions in 2050 using a Business As Usual (BAU) trend line, and the approximate reductions impact of various strategy areas.

Most of the emissions in this sector are associated with electricity provided by Austin Energy. Austin Energy's recently approved Generation Plan proposes aggressive energy efficiency and renewable goals for the community by 2025 and no greenhouse gas producing resources by 2050. The third bar (#1)

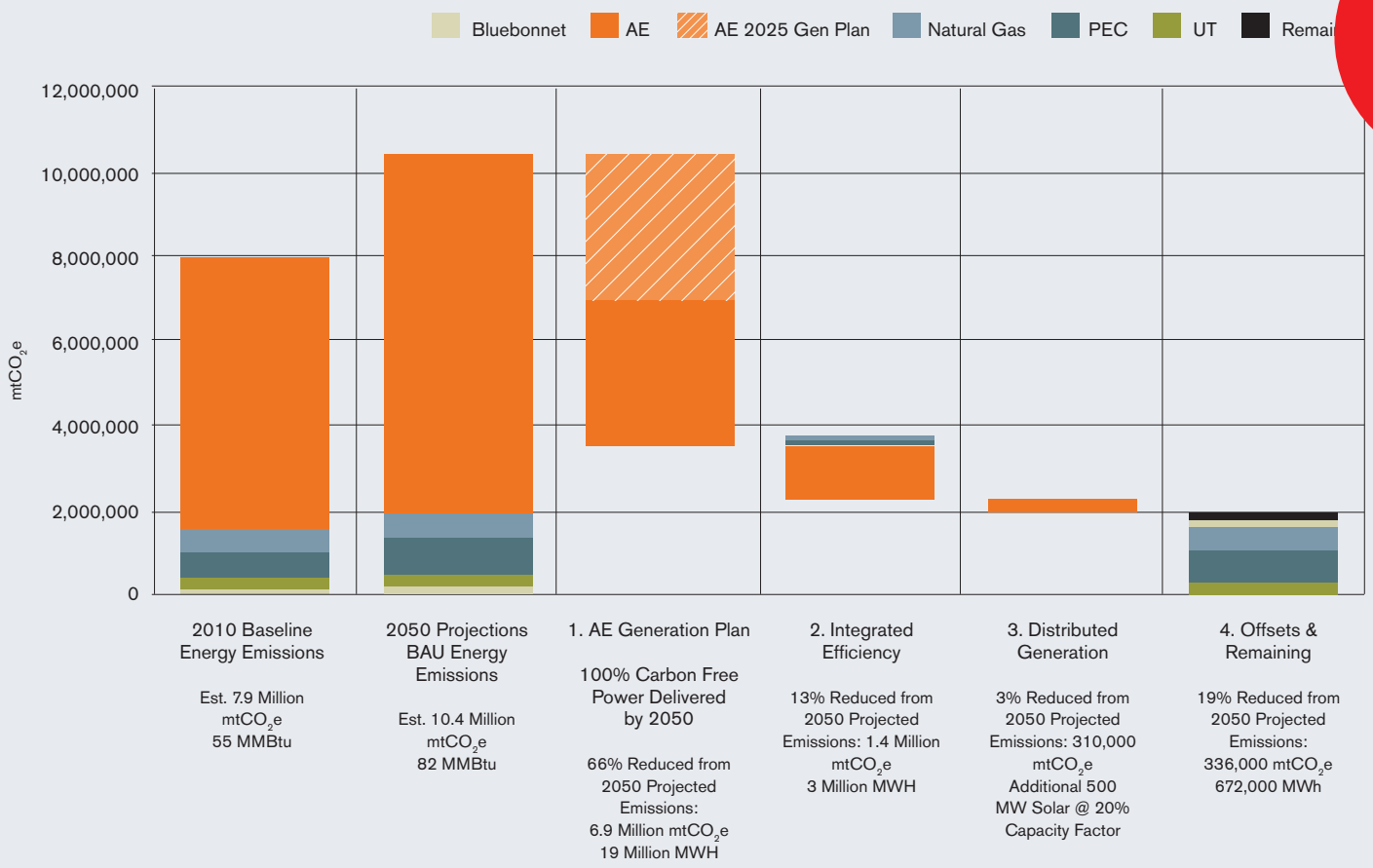

Figure 2: Electricity and Natural Gas Sector - Projected Reductions Needed to Reach Net-Zero-emissions by 2050

in Figure 2 represents the reductions expected by 2025 (white stripes), as well as future implementation of greenhouse gas emissions-free sources by 2050 (solid orange). Implementing the Generation Plan will reduce community-wide greenhouse gas emissions by close to 67% from BAU. Another 16% reduction is projected to result from additional energy efficiency and distributed generation beyond what is planned today, assuming advancements in technologies make this cost-effective. The final 17% emissions are from sources that either currently do not fall under a long-term plan, or for which there are not non-fossil-fueled alternatives readily available.

Challenges and Opportunities

- The electricity sector is transforming–technology developments, new regulations, and consumer preferences are leading to opportunities to transition away from carbon-based generation resources.
- Austin Energy provides the majority of electricity to the community and has met record demand growth almost entirely with demand side management and renewable energy resources, but the pace and extent of further progress must be balanced with the City's commitment to maintain affordable electric rates.
- Energy efficiency remains an affordable way to meet growth while offsetting the need for fossil-fueled energy resources. However, as programs mature and some cost-effective actions are exhausted it will be challenging for local utilities to create new programs that optimize value to customers. Education and partnership with the building community will be important to avoid resistance to more aggressive building codes and mandates.
- Renewables are increasingly cost-competitive with traditional fossil resources, but renewables are carbon-reliant when backed up by dispatchable resources from the grid. Non-fossil-fueled dispatchable resources, including storage, will be key to meeting net-zero goals.

  Distributed renewable energy can potentially avoid the need for centralized resources, but long-term efforts in grid modernization will be required to fully realize that potential. These efforts may be costly but could provide opportunities for job creation.

  The City must take a systems-oriented approach in coordinating climate activities and strategies among different sectors. This will ensure there is no shifting of emissions from one sector to another and limit unintended consequences.
- Some electric utilities in the U.S. and other countries have begun to explore changes to their business models to enable advancements in energy efficiency, distributed generation, and micro grids. Local electric utilities should continue to evaluate whether greenhouse gas reduction strategies recommended here can be implemented within the framework of existing business models and whether the regulatory framework in Texas will allow change.
- The City must ensure that impacts on all members of the community, especially low-income residents, are appropriately taken into consideration. Likewise, the City should ensure that all members of the community have equal opportunity to participate and help achieve long-term carbon goals.
- The City should begin considering the use of offsets and/or carbon sinks as ways to reach net-zero community-wide emissions from this sector if total independence from fossil fuels by 2050 is not achievable.

Existing Plans and Initiatives

The City of Austin's 2007 Climate Protection Resolution included goals for the local electric utility to:

- Achieve 800 MW of peak demand savings by 2020
- Achieve 30% of generated electricity from renewable resources by 2020, including 100 MW of solar
- Reduce CO_2 emissions by 20% from 2005 levels by 2020

Because the City of Austin owns its electric utility and can guide generation planning decisions, City Council can set the direction to achieve significant emissions reductions. The following policies have been adopted by City Council:

Austin Energy Resource, Generation, and Climate Protection Plan: An Update of the 2020 Plan

Adopted on December 11, 2014, the 2025 Generation Plan supports an increase in the amount of renewable energy to 55% of customer demand, as well as investments in local storage and demand response. The following items are included in the new Generation Plan:

- Potential replacement of the Decker steam units with a nominal 500 megawatt highly efficient combined cycle plant, contingent on an independent review and Council approval.
- Supporting creation of a cash reserve fund for Fayette Power Project retirement beginning in 2022.
- Issuing a Request for Proposal for up to 600 megawatts of utility scale solar.
- Achieving a total of at least 900 megawatts of demand side management (DSM) by 2025.
- Developing an implementation plan for distribution connected local storage of at least 10 megawatts, complemented by as much as 20 megawatts of thermal storage.

Contingent upon further study, technological development, progress toward goals, and rate adjustments or restructuring, the Generation Plan also recommends the following:

- An additional 100 megawatts of demand response or energy efficiency to increase the demand side management achieved to 1000 megawatts by 2025.
- An additional 100 megawatts of local solar for a local solar portfolio of 200 megawatts contingent upon a rate structure that maintains equity among customers.
- Issuing a Request For Information for 170 megawatts of large scale storage, such as Compressed Air Energy Storage.

Electricity and Natural Gas Strategies

Strategy 1: Decrease Energy Use in New and Existing Buildings

The City of Austin will continue to be a national leader in energy efficiency and demand management as a result of existing policies. New minimum standards for existing building energy use and enforced through building codes could greatly help drive emissions reductions as opposed to offsetting new demand. However, such standards would represent a significant change for the local building sector and may require phase-in over the long term.

Austin Energy plans to have less carbon-intensive generation by 2025, meaning the effectiveness of building strategies in reducing greenhouse gases will be diminished, but other benefits such as cost savings and greater affordability for individual customers may still be achieved. Local utilities should continue to balance financial benefits to the customer and the utility, respond to customer preferences, and weigh the greenhouse gas benefits from future generation resource plans.

Phase 1 Actions

- BIE-1: Explore financing mechanisms to enable energy efficiency, demand response, distributed generation and energy storage. Possible financing mechanisms which could enable large amounts of private sector retrofits include Property Assessed Clean Energy (PACE) and Warehouse for Energy Efficiency Loans (WHEEL), and privately financed on-bill repayment.
- BIE-2: Increase funding for energy efficiency rebates within the constraints of rate affordability goals. Emphasize and market offerings or higher amounts that may attract new customers.
- BIE-3: Identify high energy users in all sectors and target incentives and initiatives to those users to maximize impact.
- BIE-4: Promote specific high-impact strategies including envelope improvements (biggest impact), lighting retrofits (LEDs), HVAC improvements, water heating efficiency, and plug load reduction.
- BIE-5: Implement programs to reduce energy use and carbon intensity associated with water consumption (caveat: this will have a decreased impact if the water utility uses renewable energy to pump and treat water).

- BIE-6: Coordinate effort with AWU to reduce energy use and carbon intensity associated with consumption, treatment, and delivery of water and wastewater.
- BIE-7: Expand the availability and use of automated demand response to more and new technologies.
- BIE-8: Increase meter reading frequency and use the information to identify opportunities for utility action, customer conservation, and demand response.
- BIE-9: Create a new minimum standard for existing building energy use; enforce the new standard.
- BIE-10: Consider the potential for net-zero new construction of residential and commercial buildings.
- BIE-11: Educate designers, builders, code inspectors, and plan reviewers to gain higher compliance with new energy codes as they are implemented every 3 years.
- BIE-12: Phase-in requirements to submeter new commercial office space as new permits are issued.

Strategy 2: Lower Greenhouse Gas Intensity of Generation Resources Serving the Community

Generation resource planning is a complex economic modeling and risk management exercise since resource decisions are typically long-term commitments that "lock-in" both environmental benefits and costs to customers. Austin Energy developed a Generation Resource Plan in 2014 with input from stakeholders, an independent advisory committee, third-party reviewers, and extensive internal modeling and analysis . This TAG did not attempt to duplicate this detailed resource planning exercise and assumes that the 2007 Climate Protection Resolution goals and the updated 2014 resource plan will direct future City actions to address electricity-related greenhouse gas emissions.

The City of Austin already makes generation resource decisions to minimize greenhouse gas emissions while remaining within the affordability limits set by City Council. Those plans are reviewed bi-annually with participation from stakeholders and the public. This TAG believes that a full transition to renewables for an integrated utility that will serve its entire load is not feasible today; renewables are not dispatchable resources and utilities rely on dispatchable resources to manage cost risk to customers and maintain grid reliability. In the near term, a local utility without any dispatchable resources would indirectly depend on dispatchable, greenhouse gas emitting resources for reliable power because of the interconnected grid. Technologies such as large-scale battery storage that enable utility-scale renewables to dispatch on demand are still in development, untested at scale, and not cost effective. Thus, the transition to a zero or near zero-emissions grid will be incremental, with transitional technologies being used to meet the needs of utilities and their customers.

This TAG assumes that the City will continue to follow resource plans that minimize greenhouse gas emissions in the most affordable and least risky way for its customers, and that other local electricity providers should consider the same.

Technologies that allow users to control, monitor, and generate electricity in their buildings and homes are developing rapidly, driven by end-user demand. Technologies that allow building-to-grid integration must also develop to fully realize opportunities to reduce the need for electricity from large centralized plants. This TAG recommends that local utilities consider supporting or piloting the development and evolution of Smart Grid/Intelligent Energy Management Systems to further enable more user control over electricity use, integrate distributed renewable resources, and enable the use of storage and other means for ensuring grid reliability using intermittent resources.

Phase 1 Actions

- RT-1: Begin a coordinated effort to prioritize strategic development and evolution of Smart Grid/ Intelligent Energy Management Systems, within constraints of rate affordability goals, to further enable intermittent resources and use of electric vehicles for storage/demand shift.
- RT-2: Prioritize investment in zero carbon-emitting resources at utility and/or customer scale: community and distributed solar, including concentrating solar; and wind (inland and coastal).

- RT-3: Routinely evaluate resource technologies for opportunities to incrementally reduce carbon intensity, including storage, distributed chilled water, biomass, geothermal, and nuclear, within constraints of rate affordability goals.
- RT-4: Evaluate technology and cost options for increasing natural gas system leak detection and reduction programs.

Strategy 3: Promote Behavior Change to Reduce Greenhouse Gases

Consumer preferences and willingness to pay upfront for actions that result in lower energy use over time, and concurrently support zero and low-greenhouse gas resources, are key to the effectiveness of net-zero strategies and actions. Electricity and natural gas consumers own their respective carbon footprints, and the City and local utilities should encourage and enable those consumers to proactively reduce that footprint.

Phase 1 Actions

- BC-1: Increase efforts to engage customers to drive energy efficiency and demand response: increase transparency of energy costs in multifamily and commercial buildings; evaluate feasibility of neighborhood-wide energy efficiency challenges.
- BC-2: Implement time of use / dynamic rates, including user educational efforts, supported by advanced metering and other technologies.
- BC-3: Expand educational efforts through social media, applications, competitions (individual and neighborhood scale) and exposure.
- BC-4: Utilize meter reads and bill format/presentation to influence behavior. Present energy use in actionable and timelier ways to customers.

Additional TAG recommendation: Evaluate Peer Utility Models in a Transforming Electricity Sector

Traditional utility models where centralized power plants provide electricity and large utilities distribute the electricity and recover costs on a per kilowatt hour basis, are increasingly incompatible with evolving technology and customer needs. This TAG reviewed different models and concepts that attempt to remove financial disincentives for utilities to encourage or directly support end-use energy efficiency and distributed generation. Changing a utility's business model or rate structure can be a significant undertaking requiring careful consideration of economic and social impacts. Many of the actions identified in this process to achieve net-zero community-wide emissions could be enabled or made more effective under a different utility model.

Next Steps

The City and community partners will focus on Phase 1 actions and continue to fully evaluate and prioritize the remaining proposed actions as part of developing a comprehensive implementation plan. The City should engage with non-City utilities that contribute to greenhouse gas emissions from this sector to communicate the goals and strategies associated with this climate plan.

Electricity and Natural Gas Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Behavior Change and Education	BC-1	Increase efforts to engage customers to drive energy efficiency and demand response: increase transparency of energy costs in multifamily and commercial buildings; evaluate feasibility of neighborhood wide energy efficiency challenges.
1	Behavior Change and Education	BC-2	Implement time of use / dynamic rates, including user educational efforts, supported by advanced metering, and other technologies.
1	Behavior Change and Education	BC-3	Expand educational efforts through social media, applications, competitions (try individual and neighborhood scale competitions) and exposure/Media campaigns using local celebrities to drive behavior change.
1	Behavior Change and Education	BC-4	Utilize meter reads and bill format/presentation to influence behavior. Present energy use in actionable and more timely formats/ways to customers.
2	Behavior Change and Education	BC-5	Promote programs for individuals to manage their own carbon footprint (carbon diet).
2	Behavior Change and Education	BC-6	Educate the local building construction and professional design community about the importance and benefits of climate-appropriate passive solar building design strategies.
1	Buildings and Integrated Efficiency	BIE-1	Explore financing mechanisms to enable energy efficiency, demand response, distributed generation and energy storage. Possible financing mechanisms which could enable large amounts of private sector retrofits include Property Assessed Clean Energy (PACE) and Warehouse for Energy Efficiency Loans (WHEEL), and privately financed on-bill repayment.
1	Buildings and Integrated Efficiency	BIE-2	Increase funding for energy efficiency rebates within constraints of rate affordability goals, and emphasize and market offerings or higher amounts that may attract new customers.
1	Buildings and Integrated Efficiency	BIE-3	Identify high energy users in all sectors; target incentives and initiatives to those users to maximize impact.
1	Buildings and Integrated Efficiency	BIE-4	Promote specific high-impact strategies including envelope improvements (biggest impact), lighting retrofits (LEDs), HVAC improvements, water heating efficiency, and plug load reduction.
1	Buildings and Integrated Efficiency	BIE-5	Implement programs to reduce energy use and carbon intensity associated with water consumption (caveat: decreased impact if the water utility uses renewable energy to pump and treat water).
1	Buildings and Integrated Efficiency	BIE-6	Coordinate effort with AWU to reduce energy use and carbon intensity associated with consumption, treatment, and delivery of water and waste water.
1	Buildings and Integrated Efficiency	BIE-7	Expand the availability and use of automated demand response to more and new technologies.
1	Buildings and Integrated Efficiency	BIE-8	Increase meter reading frequency and use the information to identify opportunities for utility action and to promote customer conservation and demand response.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Generation Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020	N	N	G,B,R	G,B,R (multifamily)	P,BC	DS	A
	2015-2020	N, but in budget docs?	D (Time of use);	G	All	T, BC	DS	Major cost savings by avoiding peak prices (A)
	2015-2020	N, but AE has programs	C, N	G, N	B,R	F	DS	More informed citizenry
	2015-2020	N	N	G	B, R	P,BC	C	A
	2015-2020	N	D	G,B,N	B,R,N	BC	DS	H
	2015-2020	N	N	G,B	G,B,R (multifamily)	BC	C	Q,A
	2015-2020	N	N	G	G, B (lenders, contractors), R (multifamily), N	P	DL if on a large scale	A, J
	2015-2020	N	P	G	All	F	DL if on a large scale	A, J
	2015-2020	N	P	G	All	P,BC,F	DL	A, J
	2015-2020	Y	C	G,B,R	All	P,F,BC	DS	A, J
	2015-2020	Y	C	All	All	F,BC,P	DS	A, W
	2020-2030	Y	C	G	G	T,F	DL	A, W
	2015-2020	N	N	G, B	All	BC,T,P	DS	A, J
	2015-2020	Y, smart meter program	P	G	R, G	F	DS	

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Electricity and Natural Gas Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Buildings and Integrated Efficiency	BIE-9	Create a new minimum standard for existing building energy use; enforce the new standard.
1	Buildings and Integrated Efficiency	BIE-10	Consider the potential for net-zero new construction of residential and commercial buildings.
1	Buildings and Integrated Efficiency	BIE-11	Educate designers, builders, code inspectors, and plan reviewers to gain higher compliance with new energy codes as they are implemented every 3 years.
1	Buildings and Integrated Efficiency	BIE-12	Phase-in requirement to submeter new commercial office space as new permits are issued.
2	Buildings and Integrated Efficiency	BIE-13	Transition the AE Energy Efficiency program and codes to a performance model with measurement and verification; program customers would be incentivized to meet targets. (Includes giving credit for passive design strategies).
2	Buildings and Integrated Efficiency	BIE-14	Enhanced sub-metering for demand response.
2	Buildings and Integrated Efficiency	BIE-15	Incorporate recommendations for passive solar subdivision and street/lot orientation into the land development code.
2	Buildings and Integrated Efficiency	BIE-16	Implement neighborhood-wide projects to weatherize homes and increase energy efficiency and demand response.
1	Resource Technologies	RT-1	Begin a coordinated effort to prioritize strategic development and evolution of Smart Grid/ Intelligent Energy Management Systems, within constraints of affordability goals, to further enable intermittent resources and use of EVs for storage/demand shift.
1	Resource Technologies	RT-2	Prioritize investment in zero carbon-emitting resources at utility and/or customer scale: Utility-scale, community and distributed solar, including concentrating solar; Utility-scale wind (inland and coastal).
1	Resource Technologies	RT-3	Routinely evaluate resource technologies for opportunities to incrementally reduce carbon intensity including storage, distributed chilled water, biomass, geothermal, and nuclear, within constraints of rate affordability goals.
1	Resource Technologies	RT-4	Evaluate technology and cost options for increasing natural gas system leak detection and reduction programs
2	Resource Technologies	RT-5	Explore and pilot storage options with grid functionality. Evaluate technology and cost options for increasing natural gas system leak detection and reduction programs
2	Resource Technologies	RT-6	Explore incentives for electrification of carbon-fueled consumer products: hot water heater extended reservoirs, larger pads for battery-powered lawn mowers, weed whackers, chainsaws, etc.
2	Resource Technologies	RT-7	Explore micro-grids as a carbon reduction, resiliency, and security strategy. Consider tradeoffs.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Generation Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2020-2030	N	N	G	All	P	DL	A, J
	2020-2030	N	P	G	All	P,F,T	DL	J
	2015-2020	Y	C	G, N	All	F,BC	DS	J
	2020-2030	N	N	G	G,B	P	DS	
	2020-2030	N	N	G	All	P,BC	DS	
	2020-2030	N	N	G,B	G,B,R	P,BC,T,F	DS	
	2020-2030	N	N	G	All	P	DS	Q, H, A
	2020-2030	N	N	G	All	F,BC	DS	Q, H, A
	2015-2020	N	C,D,P	G,B	G,B	F,P,T	C	H, J
	2015-2020	Y	C	G,B,R	G,B,R,N	F,T,P,BC	DL	Q, H, J
	Perpetual	Y	C	G	All	F,P,T	DL	
	2015-2020	N	C	G,B	G,B	F,T	C	
	2015-2020	N	C	G,B	G,B	F,T	C	
	2020-2030	N	N	G	G,R	F,BC	C	Q, H
	2030-2050	N	N	G,B	G,B	F,P,T	C	

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Appendix C: Transportation and Land Use Sector Findings

Introduction

In the United States, greenhouse gas emissions from the transportation sector mainly come from burning fossil fuel in cars, trucks, ships, trains, off-road vehicles, and airplanes. In Travis County, approximately 35% of community-wide greenhouse gas emissions come from the transportation sector, and nearly 95% of the transportation-related greenhouse gas emissions in Travis County are from on-road vehicles (cars and trucks). Off-road vehicles, rail, air traffic, and buses contribute a small amount of emissions to the community-wide total, but must also see reductions to meet the net-zero goal by 2050.

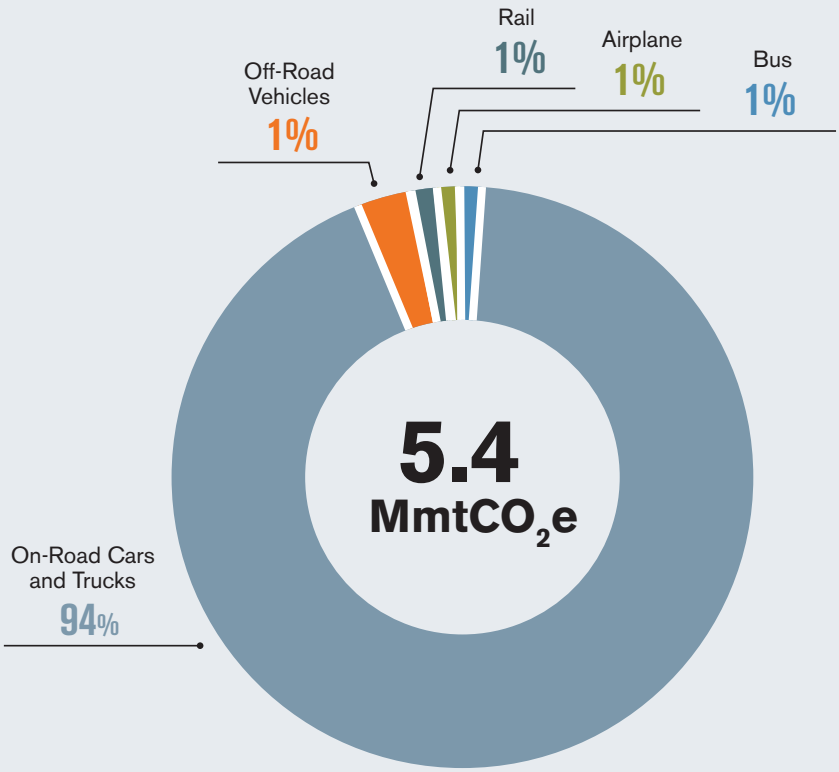

Figure 1:2010 Travis County Community GHG Emissons from Transportation, est. 5.4 million mt CO_2e.

To reduce transportation sector emissions, either vehicle miles traveled must be lowered or vehicle fuel efficiency standards must improve, or both. As expressly stated in the Imagine Austin Comprehensive Plan, coordinated transportation and land use decisions provide significant opportunities for greenhouse gas emission reductions by giving Austinites more options to live, work, and play in compact and connected communities. Specifically, the community must focus on solutions that prioritize affordable, mixed-use developments, along with integrated mobility options for both personal trips and work commutes.

This TAG worked with the Office of Sustainability to develop an estimate of emissions reductions for the proposed strategies and actions in this plan. Figure 3 below shows 2010 emissions for the transportation and land use sector, estimated emissions in 2050 using a Business As Usual (BAU) trend line, and the approximate impact of the various major strategy areas.

The vast majority of the emissions in this sector are associated with on-road light-duty fossil-fueled vehicles. Using the projects within the Capital Area Metropolitan Planning Organization (CAMPO) 2035 plan, the Office of Sustainability estimates emissions would grow above the current baseline, but would be reduced substantially below the BAU trend line by 2050. It is estimated that a 5% reduction from BAU would need to be achieved through policy, planning and land use policies. Another 5% reduction would need to be achieved from demand management and economic pricing strategies, as well as another 5% reduction from new infrastructure and service. The final 40% reduction from BAU would be achieved by vehicle and fuel efficiencies.

The Austin Community Climate Plan does not ensure these reductions, but envisions a future where they could be achieved. The transportation sector in 2050 would include substantially less vehicle miles driven per person, as well as cars that are primarily operating on renewable energy and emitting zero carbon. To the average Austinite, this would mean increased safety, lower costs, less time spent in traffic, and cleaner air.

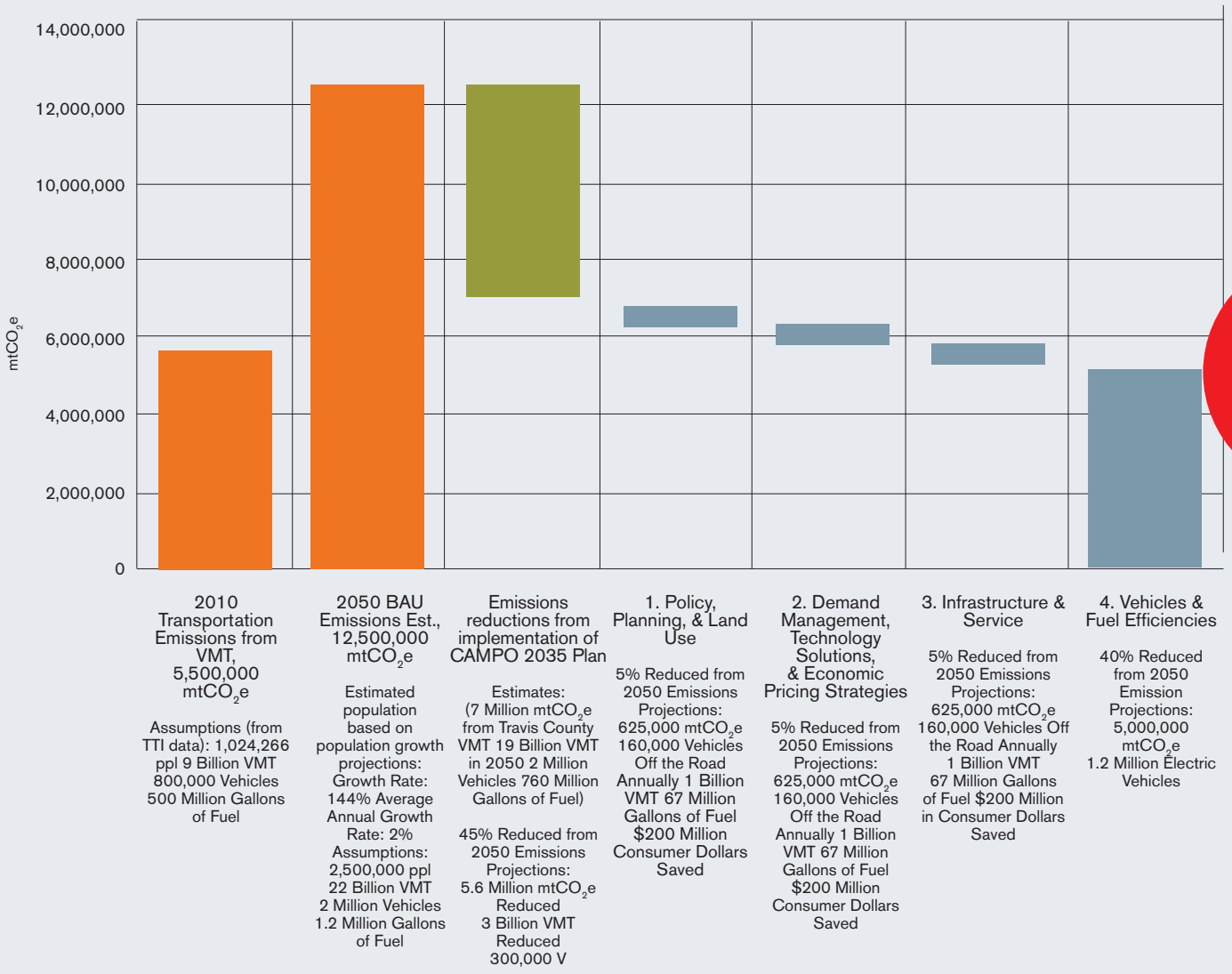

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Figure 2: Estimated Greenhouse Gas Emissions Reduced by Transportation Emission Reduction Strategies TransNET0EV ($mtCO_2e$)

Assumptions: 2050 Business As Usual (BAU) Emissions estimates have been projected out according to Travis County population growth rates (http://www.austintexas.gov/sites/default/files/files/Planning/Demographics/austin_forecast_2014_annual_pub.pdf). CAMPO Plan Emissions have been projected out to 2050 based on an estimated 30% increase of VMT and 20% increase of CO_2. CO_2 estimates are based on EPA's MOVES model VMT On-Road Summary Tables. CO_2/mi ratio is showing a decrease according to VMT tables. Intensity of CO_2 and CH_4 is expected to decrease in the future due to CAFÉ standards, technology advancements Miles per gallon were estimated using a historical change rate applied, increasing fleet wide MPG to 26.32 for 2050 Count of vehicle assumes vehicles drive 11,000 miles per year. Not to be compared with daily vehicle counts. Fuel costs are held constant at an average estimated $3.00/gallon. VMT for Electric vehicles are held constant. Average fuel economy for EV is 100 MPG. Fuel Cost saved for Electric vehicle scenario assumes average cost of electricity is $0.10/kWh. The above calculations are annual estimates of greenhouse gas emissions (in metric tons of carbon dioxide equivalent) coupled with implied co-benefits associated with the particular strategy.

Challenges and Opportunities

- City action versus individual choices
  - The City has produced strategic plans and made investments in alternative transportation options including extended hours for MetroRail, additional miles of new and enhanced bicycle lanes and trails, and various proposals for high-capacity transit. However, it will take many individuals using these options on a regular basis for significant emissions reductions to occur.
- Economic impacts
  - The cost of car ownership can be significant, especially for people who live far from where they work. Because cars typically have a ten to twenty year lifespan, there is a unique opportunity to implement technology changes relevant to the timeframe of this plan. For individuals who choose to use alternative forms of transportation, the cost savings can be measurable and substantial on a monthly budget.
  - Extreme traffic congestion can have a real impact on the local economy if the flow of business is disrupted, or if it is a deciding factor for a company's decision not to move to the Austin area.
- Limiting factors and growth
  - Although the population of the Austin region continues to grow quickly, vehicle miles traveled has begun to level off with more people choosing to drive less and some choosing to use alternative transportation whenever possible.
  - While vehicle fuel efficiency standards are mandated by federal regulations to increase over time, progress is slow and new cars sold today may be on the road for decades to come.
  - There are more electric vehicle models being offered each year and battery technology continues to improve.

Co-benefits of reducing emissions

- Better health outcomes if walking and biking are chosen for alternative commutes.
- Cleaner air and less pollution through a reduced number of vehicles on the road.
- Money saved by reducing reliance on car ownership (purchase, insurance, gas, and maintenance).
- Saving time by avoiding traffic.

Existing Plans and Initiatives

The Transportation Technical Advisory Group identified several existing plans that contribute to the goal of net-zero community-wide greenhouse gas emissions by 2050, but each will need to be funded and fully implemented.

Imagine Austin Comprehensive Plan

The 2012 Imagine Austin plan reflects the first community-wide comprehensive plan to guide future growth since the Austin Tomorrow Comprehensive Plan. Imagine Austin provides a set of defined goals, principles, policies, and actions, many of which support greenhouse gas emissions reductions. Some of these include:

- A more compact and connected city: interconnected development patterns that support public transit and a variety of transportation choices, while reducing sprawl, congestion, and travel times through a focus on infill and redevelopment opportunities.
- An integrated transportation system that is well-maintained, minimizes negative impacts on natural resources, and is affordable for all users.

- Safe bicycle and pedestrian facilities with well-designed routes that provide connectivity throughout the greater Austin area and access to new development in activity corridors and centers.
- An expanded transit network and increased transit use.

Austin Bicycle Master Plan and Urban Trails Master Plan

Austin City Council adopted the Austin Bicycle Master Plan (ABMP) in November 2014. The plan's overarching goal is to significantly increase bicycle use and improve bicycle safety by creating an all ages and abilities bicycle network. By implementing the best practice of focusing on physically protected bicycle lanes, the City hopes to see a 25% increase in riders. As most trips are less than three miles, implementing the plan could significantly help to relieve automobile congestion in key travel corridors. The Urban Trails Master Plan (UTMP) was adopted in September 2014, and works in conjunction with the on-street bicycle network proposed by the ABMP. At full implementation, the UTMP would provide a cohesive recreational and transportation network of non-motorized, multi-use pathways for travelling long distances across all of Austin.

Complete Streets Policy

The City's Complete Streets Policy is integral to a core Imagine Austin Priority Program of investing in a compact and connected Austin. Achieving this goal requires a shift in how the role of roadways is defined: they are public spaces that are designed to move people, not just cars. Complete Streets improvements support safe, efficient, and convenient mobility for all roadway users (pedestrians, bicyclists, transit riders, and motorists) regardless of age or ability. Greenhouse gas emissions reductions will be realized over time as the Complete Streets policy is implemented and community members start to use the streets for more than just single occupancy vehicle travel.

The Capital Area Metropolitan Planning Organization's 2035 Regional Transportation Plan

This plan's vision is to "develop a comprehensive multimodal regional transportation system that safely and efficiently addresses mobility needs over time, is economically and environmentally sustainable, and supports regional quality of life." The plan was developed to ensure that the transportation system is coordinated throughout the entire region and serves the region's current needs while anticipating future needs. It is also designed to balance decisions regarding transportation, land use, and natural resources. CAMPO works with regional partners to reduce greenhouse gas emissions from area vehicles. The City of Austin reduces regional greenhouse gas emissions from transportation by working with regional entities, including CAMPO, to:

- Reduce vehicle miles traveled.
- Increase anti-idling awareness.
- Increase publicly accessible alternative fuel sites.
- Increase alternative fuel vehicle use.
- Secure grant funding to repower and/or replace older vehicles with more fuel-efficient, cleaner burning options.

Austin-Round Rock Metropolitan Statistical Area Ozone Advance Program Plan

In January 2014, the Clean Air Coalition (CAC) entered into its fourth voluntary plan with the U.S. Environmental Protection Agency under the Ozone Advance Program. The plan includes three categories of emission reduction measures: those intended for region-wide implementation, those implemented by CAC member jurisdictions, and those implemented by other participating organizations. Although the plan was written to mitigate ozone pollution there are many measures that also support greenhouse gas emissions reductions: commute trip reduction programs, development guidelines, energy and resource conservation,

fleet and fuel efficiency, outreach and awareness, regulation and enforcement, sustainable procurement, and operations. The City of Austin has committed to complete over 30 measures in the plan and Travis County has committed to nearly 20 measures.

Transportation and Land Use Strategies

Each strategy category below contains a list of actions that will require additional technical review, feasibility assessments, and refinement into near-term solutions that can be implemented effectively.

Strategy 1: Infrastructure and Service

Major greenhouse gas emissions reductions can be achieved when infrastructure and service projects are implemented, such as high capacity transit, signal enhancements, or right of way improvements.

Phase 1 Actions

- IS-1: Continue planning efforts to complete a connected network of proven high-capacity transit, including intracity and intercity systems, using the major projects identified in the Austin Strategic Mobility Plan and Project Connect to improve Austin's transportation and economic connections with other major cities in Texas.
- IS-2: Protect the safety of all right-of-way users and increase mobility by managing traffic speeds with regular synchronizing/retiming all traffic signals along arterials, adjusting speed limits within the urban core as appropriate, adding more volume-count stations to make informed traffic system improvements, installing more roundabouts, using enhanced bicycle signal detection technologies, and installing Pedestrian Hybrid Beacons.

  IS-3: Request and promote extended transit service to suburban areas, while providing more service interconnections, exploring additional transit centers/park-and-rides, and transit vehicle amenities.

Strategy 2: Land Use

Imagine Austin includes a vision to shift from an auto-centric to a more people-centric environment. To make that shift a reality, complete communities must be built that are compact and connected, including activity centers and corridors that promote transportation integration. The way development occurs in the next few decades, with mixed-use development using green infrastructure and green building techniques, will have a significant impact on how residents of the community choose to travel, live, work, and play. These changes will help to reduce vehicle miles traveled and greenhouse gas emissions while increasing quality of life.

Phase 1 Actions

- LU-1: Prioritize mixed-use development integrated with transit and the creation of compact, walkable and bikeable places, with a commitment to plan transportation systems using an objective analysis of environmental considerations, demand models, congestion models, safety, and full life-cycle costs and benefits.
- LU-2: Promote growth within designated activity centers as identified in Imagine Austin, where dense, mixed-use development supports transit corridors; consider incentives for infill development that provides long-term affordability for residents and businesses; develop an outreach program for available incentives and enhanced property locator tools (e.g. location efficient mortgages, tax credits).
- LU-3: Create pedestrian- and bicycle-friendly districts that connect urban centers and transit stops; optimize safety for people of all ages and abilities through clearly marked, dedicated, and separated urban trails and bike lanes; and create wayfinding systems that incorporate national best practices.
- LU-4: Ensure that affordable housing and residential neighborhoods are within a quarter mile of existing or funded new transit options.

- LU-5: Within the CodeNEXT land development code rewrite and its related public process, consider lowering barriers of adoption for duplexes, triplexes, and quadplexes, as well as ADUs (accessory dwelling units), as appropriate.

Strategy 3: Transportation Demand Management

Transportation Demand Management is comprised of many approaches that work together to ease mobility demand, and is specifically aimed at discouraging people from driving alone. Some key approaches that can lead to reduced greenhouse gas emissions include:

- Trip avoidance through options like telework or flexible work schedules.
- Improved intercity and intracity public transit service.
- Connecting people with carpool or vanpool options that allow them to travel more efficiently.
- Enriched options for cycling or walking to destinations.

Phase 1 Actions

- TDM-1: Support efforts to work with large employers and academic institutions to implement and improve trip reduction programs that include a regular survey of how the workforce commutes, explanation of benefits to commuters, and promotion of transportation alternatives (e.g. carpool/vanpool, bus/rail, bike/walk, flex/compressed work schedules) to their employees; celebrate successful programs.
- TDM-2: Seek opportunities to prioritize public transit within the network, and seek financing to extend service hours and frequency to increase use.
- TDM-3: Increase bicycle and pedestrian mode share by promoting cycling for workers living near their workplace and children commuting to school. Increase safety and program performance based engineering, enforcement, education, and evaluation. Encourage the development of web-based tools/mobile applications/other educational materials. Increase the scope and impact of bike promotional events (e.g. Bike to Work Day and VIVA Streets!).
- TDM-4: Support programs that help commuters make first and last mile transit connections, including promotion of first/last mile modes such as free circulator buses, collective zoned vanpool service, flex route systems, and bikeshare.
- TDM-5: Work with major event promoters to establish innovative transportation plans to ensure that visitors to the City have full information about transportation options.
- TDM-6: Perform education and outreach to fleet owners on how to conduct a business evaluation of fleet usage, including operation and right-sizing analysis. Identify which incentives are available to replace older, higher-emission vehicles.
- TDM-7: Provide amenities and incentives for programs that support active transportation, such as showers, tree shading, community gardens, neighborhood bike ambassadors, mobile bike repair, and bike cages.
- TDM-8: Encourage residents to limit single occupancy vehicle trips by taking alternative modes of transportation (e.g. carpool/vanpool, bus/train, bike/walk) by providing adequate information about their travel choices.

Strategy 4: Policy and Planning

Effective land use policies and planning efforts will require both public and private collaboration across municipal boundaries to reap the full benefits. Making the net-zero community-wide emissions goal a key priority in transportation, land use policy, and planning efforts can leverage additional opportunities to prioritize affordable, mixed-use development.

Phase 1 Action

- PP-1: Establish intergovernmental agreements between municipalities that include commitments to increase density around Centers.

Strategy 5: Vehicles and Fuel Efficiencies

In 2015, there were approximately 700,000 light-duty single-occupancy cars and trucks on the road in Travis County. If the population continues to grow as projected, there may be as many as 1,500,000 cars and trucks on the road in 2050. Realizing that travelling by car, truck or bus will still be the best option for some, it is important to focus on the integration of cleaner vehicles and fuels, support advancements in fuel economy, and move away from conventional fuels (gasoline and diesel) to alternative fuels such as biodiesel, hydrogen, or electricity.

The number of hybrid-electric, plug-in electric and battery electric cars on the road continues to grow as vehicle technology evolves. These vehicles offer drivers operational cost savings while also reducing air pollution and greenhouse gas emissions. Battery electric vehicles that are powered by renewable energy provide a real opportunity to fulfill driver needs while emitting zero greenhouse gas emissions. If the transportation sector is to be successful in drastically reducing emissions, zero-emission vehicles will be a major part of the solution. Three scenarios have been analyzed for the number of battery electric vehicles powered by renewable energy to replace gasoline / diesel cars and trucks by the year 2050: low–300,000 (20% of the total), medium–600,000 (40% of the total), and high–1,200,000 (80% of the total). In each scenario, the following renewable energy would be required and result in the following greenhouse gas emission reductions:

# of Battery Electric Vehicles	Annual MWh of renewable energy required	Annual metric tons of CO_2e avoided
300,000	900,000	1,585,800
600,000	1,800,000	3,171,600
1,200,000	3,600,000	6,343,200

It should be noted that this would keep a significant amount of money in the local economy (through Austin Energy) instead of going to oil companies outside Austin. This is a large amount of energy, but even in the scenario of 80% of vehicles in 2050 being battery electric, the total electricity requirements would only be 28% greater than current Austin Energy sales.

Phase 1 Action

- VFE-1: Support programs and efforts that expand electric/alternative fuel infrastructure and consider incentives for the purchase of electric/alternative fuel vehicles by individuals and fleet owners. Pursue code options to increase “charger ready” parking.

Strategy 6: Economic and Pricing Systems

Parking management and road pricing strategies can have a substantial impact on the reduction of greenhouse gas emissions by encouraging people to think about the costs associated with driving a vehicle. In coordination with regional transportation partners, the long-term goal would be to implement pricing systems that reduce emissions along with traffic congestion, increase mobility, and potentially generate revenue to fund other desired transportation-related projects.

Phase 1 Action

- EPS-1: Pursue a fair market value for parking through demand-based commodity pricing.
- EPS-2: Allow high occupancy and zero-emission vehicles access to toll roads at reduced or free rates.

Additional Strategy: Technology Solutions

Technology solutions can move traffic more efficiently through improved planning and management and automation of private and public fleets. Private web and mobile platforms are helping individuals make smart travel choices. Expanding accessibility and speed of internet infrastructure will also increase the viability of telecommuting and teleworking. The City should accelerate early adoption of technology advancements across all modes.

While there are not any Phase 1 actions being proposed in this category, there are some Phase 2 actions that could be done in the near term that may still provide some benefit to the community and in reaching the overall goal.

Next Steps

Implementation of the strategies and actions for this sector will require a community-wide effort that:

- Meets the needs of all residents including college students, families, visitors, the aging, people with disabilities, and lower income residents.
- Assists existing residents and businesses to remain, enhance, and thrive in walkable, transit-oriented communities.
- Expands lower-cost transportation options to mitigate the impacts to lower-income residents.
- Seeks early adoption of new technologies that increase transportation efficiencies and which use cleaner, non-fossil fuels.
- Realizing the full greenhouse gas emissions reduction potential of these strategies will be advanced with new and sustained funding sources at the local, regional, and state levels.

Transportation and Land Use Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Infrastructure and Service	IS-1	Continue planning efforts to complete a connected network of proven high-capacity transit, including intracity and intercity systems, using the major projects identified in the Austin Strategic Mobility Plan and Project Connect to improve Austin's transportation and economic connections with other major cities in Texas.
1	Infrastructure and Service	IS-2	Protect the safety of all right-of-way users and increase mobility by managing traffic speeds with regular synchronizing/retiming all traffic signals along arterials, adjusting speed limits within the urban core as appropriate, adding more volume-count stations to make informed traffic system improvements, installing more roundabouts, using enhanced bicycle signal detection technologies, and installing Pedestrian Hybrid Beacons.
1	Infrastructure and Service	IS-3	Promote and request extended transit service to suburban areas, while providing more service interconnections, exploring additional transit centers/park-and-rides, and transit vehicle amenities.
2	Infrastructure and Service	IS-4	Explore an expansion of new HOV lanes on existing freeways.
2	Infrastructure and Service	IS-5	Continue to expand upon programs that use smoother street pavements to increase fuel efficiency in vehicles and provide safer road conditions for all road users.
2	Infrastructure and Service	IS-6	Enhance movement on existing freeways through operational improvements, coordinated network management, and other strategies.
2	Infrastructure and Service	IS-7	Encourage shared worksites (hotel workstations) close to where employees live.
2	Infrastructure and Service	IS-8	Pursue a regional Transportation Management Center to jointly operate and manage an Intelligent Transportation System to monitor and manage highway and arterial traffic in real-time to maximize safety and mobility to the public, and to provide system operational efficiencies, more robust information to the public, and travel time and cost savings to the public and governments.
3	Infrastructure and Service	IS-9	Plan, finance, design and build toll and/or managed lanes to include construction or operations necessary to increase transportation efficiencies including Park & Ride facilities, transit, higher occupancy vehicles, and freight distribution.
3	Infrastructure and Service	IS-10	Consider mode separation for safety and mobility when considering building new highways, railways, and bicycle/pedestrian facilities; explore dedicated guideways/rights-of-way as reasonable and feasible.
1	Land Use	LU-1	Prioritize mixed-use development integrated with transit and the creation of compact, walkable and bikeable places with a commitment to plan transportation systems using objective analysis of environmental consideration, demand models, congestion models, safety, and full life cycle cost/benefit analysis.
1	Land Use	LU-2	Promote growth within designated activity centers as identified in Imagine Austin where dense, mixed-use development support centers and transit corridors, and incentives for infill development with long-term affordability for residents and businesses; develop an outreach program for the available incentives and enhanced property locator tools (e.g. location efficient mortgages, tax credits).

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Imagine Austin 2013 Austin Mobility 2014 Austin Strategic Mobility Plan Ozone Advance 2035 CAMPO	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020, 2020-2030, 2030-2050	Imagine Austin, 2014 Austin Strategic Mobility Plan	P	G	All	F, BC	DL	A, J
	2015-2020	2013 Austin Mobility	P	G	All	F	DL	Q, A, H, J
	2020-2030		C	G	All	F, P	DL	Q, A, J
	2030-2050		N	G, N	All	F, P	DS	Q
	2015-2020		C	G	All		DS	Q, A, J
	2015-2020		D	G		P, BC	DS	
	2020-2030		D	G, B, N	G,B,N	BC,F	DS	H, J
	2020-2030		N	G	G	F, T	DL	Q, A, H, J
	2020-2030		N	G	B, N	F, P, BC	IS	Q, H, J
	2030-2050		N	G	G, B, R	P, F	IS	Q, A, H, J
	2015-2020	Imagine Austin Comprehensive Plan	P	G, B	All	F	DL	All
	2020-2030		P	G, B	All	F	DL	All

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Transportation and Land Use Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Land Use	LU-3	Create pedestrian- and bicycle-friendly districts connecting urban centers and transit stops, optimizing safety for people of all ages and abilities through clearly marked, dedicated, and separated urban trails and bike lanes and wayfinding systems that incorporate national best practices.
1	Land Use	LU-4	Ensure that affordable housing and residential neighborhoods are within a quarter mile of existing or funded new transit options.
1	Land Use	LU-5	Within the CodeNEXT land development code rewrite and its related public process, consider lowering barriers of adoption for duplexes, triplexes, and quadplexes, as well as ADUs (accessory dwelling units), as appropriate.
2	Land Use	LU-6	Plan the location and design of new school campuses to encourage students to take safe routes to school via walking and biking.
2	Land Use	LU-7	Promote the redevelopment of brownfields and grayfields into compact, walkable places by revising parking requirements that result in more permeable areas and promoting walking, biking, and alternative transit.
1	Policy and Planning	PP-1	Establish intergovernmental agreements between municipalities that include commitments to increase density around Centers.
2	Policy and Planning	PP-2	Consider development of regulations to reduce the number of vehicular parking spaces and to allow parking requirements to be met through alternative approaches demonstrated to reduce parking demand and GHG emissions (e.g. on-site car-sharing, bicycle parking, transit passes).
2	Policy and Planning	PP-3	Advocate for implementation of higher federal fuel efficiency standards.
2	Policy and Planning	PP-4	Establish "tier parking requirements based on context of the site, travel demand management activities, and other factors. 1) In TOD's, Downtown, Core Transit Corridors and other transit-rich locations, remove parking minimums altogether/or put in place parking maximums. 2) Establish a process with defined approval criteria where a developer can adjust parking minimum based on results of a TIA or demonstrated implementation of travel demand management strategies. 3) Define types of parking and set different standards by type. For example, differentiate between long-term and short-term parking and allow higher levels of short term parking in office settings."
3	Policy and Planning	PP-5	Develop and implement strategies that address spillover parking from commercial districts into adjacent residential areas that include increased public transportation, better pedestrian and bicycling amenities, improved signs, and parking management.
2	Technology Solutions	TS-1	Promote trip management technologies (e.g. apps, websites, electronic services) that provide the user with real-time travel information as well as amenities along travel routes as long as the technology shares user data related to GHG performance tracking.
2	Technology Solutions	TS-2	Develop an interactive website where residents and employers can monitor their GHG emissions against others.
2	Technology Solutions	TS-3	Utilize crowdsourcing to collect ideas and develop third-party technology solutions.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Imagine Austin 2013 Austin Mobility 2014 Austin Strategic Mobility Plan Ozone Advance 2035 CAMPO	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020, 2020-2030		P	G, B	G, B	F, BC	DL	All
	2015-2020		P	G, B	All	F, BC	DL	Q, A, H, J
	2015-2020		N	G, B	All	P	DL	Q, A, H, J
	2015-2020		N	G, N	R	F, P, BC	DS	Q, A, H
	2020-2030	Imagine Austin Comprehensive Plan	P	G, B	All	P, BC	DS	Q, A, H, J
	2020-2030		N	G	G	P	IL	Q, A, H, J
	2015-2020		C	G	G, B, R	P, BC	IS	Q, A, H, J
	2020-2030		N	G		P	IL	Q, A, J
	2020-2030	Code Next Recommendation	N	G	All	P, BC	IS	A
	2015-2020	Imagine Austin Comprehensive Plan	C	G	All	BC	C	Q
	2015-2020		C	G, B	All	F, BC	DS	Q, A,H
	2015-2020		N	G, B	All	F, BC	IS	All
	2015-2020		N	G, B	B, R		IS	J

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Transportation and Land Use Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
2	Technology Solutions	TS-4	Implement regenerative braking technology into the public transit system to provide power to the transit vehicle and the energy grid (e.g. train system in Philadelphia).
3	Technology Solutions	TS-5	Deploy travel time data collection equipment along key arterial streets and regularly collect travel time data. Use data on travel times to: (1) influence travel behavior by disseminating traveler information on dynamic message signs and the web; (2) improve traffic flow.
3	Technology Solutions	TS-6	Research sensors for motor vehicles that provide bike detection and/or motion heat detection to improve bike safety and awareness.
3	Technology Solutions	TS-7	Install Smart Parking systems (identifies open spots and directs drivers to them) for compact and connected areas, including on-street parking.
3	Technology Solutions	TS-8	Explore emerging technologies such as an induction charging system inside City streets for fast charging of electric vehicles.
1	Transportation Demand Management	TDM-1	Support efforts to work with large employers and academic institutions to implement and improve trip reduction programs that include a regular survey of how the workforce commutes, explanation of benefits to commuters, and includes promotion of transportation alternatives (e.g. carpool/vanpool, bus/rail, bike/walk, flex/compressed work schedules) to their employees; celebrate successful programs.
1	Transportation Demand Management	TDM-2	Seek opportunities to prioritize public transit within the network, and seek financing to extend service hours and frequency to increase use.
1	Transportation Demand Management	TDM-3	Increase bicycle and pedestrian mode share by promoting cycling for workers living near their workplace and children commuting to school. Increase safety and program performance based engineering, enforcement, education, and evaluation. Encourage the development of web-based tools/mobile applications/other educational materials. Increase the scope and impact of bike promotional events (e.g. Bike to Work Day and VIVA Streets!).
1	Transportation Demand Management	TDM-4	Support programs that help commuters make first and last mile transit connections including promotion of first/last mile modes, such as, free circulator buses, collective zoned vanpool service, flex route systems, and bikeshare.
1	Transportation Demand Management	TDM-5	Work with major event promoters to establish innovative transportation plans that ensure visitors to the City have full information about transportation options.
1	Transportation Demand Management	TDM-6	Perform education and outreach to fleet owners on how to conduct a business evaluation of fleet usage, including operation and right-sizing analysis, and identify which incentives are available to replace older, higher-emission vehicles.
1	Transportation Demand Management	TDM-7	Provide amenities and incentives for programs that support active transportation, such as showers, tree shading, community gardens, neighborhood bike ambassadors, mobile bike repair, and bike cages.
1	Transportation Demand Management	TDM-8	Encourage residents to limit single occupancy vehicle trips by taking alternative modes of transportation (e.g. carpool/vanpool, bus/train, bike/walk) by providing adequate information to advise commuters about their travel choices.
2	Transportation Demand Management	TDM-9	Support widespread telecommunication connectivity (e.g. broadband service, gigabit service) to enable more telework, teleconference, webinar, and e-commerce options.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Imagine Austin 2013 Austin Mobility 2014 Austin Strategic Mobility Plan Ozone Advance 2035 CAMPO	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2020-2030		N	G	G, N	F, T	DS	W
	2015-2020		P	G	All	F	IS	Q, A, H, J
	2015-2020		N	G, B, R	All	F, T	IS	Q, H
	2020-2030		N	G, B	B, R	F, T	DS	Q
	2030-2050		N	G, B	G, B	F, BC, T	DS	A, H, J, W
	2020-2030		P	G	B, N	BC	DL	Q, A, H, J
	2015-2020	Imagine Austin	P	G	All	F, BC	DL	All
	2015-2020	Urban Trails Master Plan, Austin Bicycle Master Plan	P	G, B	All	F, BC	DL	Q, A, H
	2015-2020		C, N	G, B, N	All	F, BC	DL	Q, A, J,H
	2015-2020	2013 Austin Mobility	P	G, B	All		DL	Q, A, J
	2015-2020		N	G, N	B	BC	DL	A, J
	2015-2020	Imagine Austin	P	G, B	All	F, BC	DS	Q, A, H, J
	2020-2030		C	G	All	F, BC	DL	All
	2015-2020		C	G, B	All	BC	DS	Q, A, J

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Phase	Strategy Category	Action #	Actions
2	Transportation Demand Management	TDM-10	Collaborate with community partners to develop community-based engagement campaigns that inform the public of the various ways to reduce emissions using alternative transportation or making more informed choices for trips within a 3-mile radius of their home or office, and track the success of the campaign through surveys.
2	Transportation Demand Management	TDM-11	Encourage larger employers to establish commute reduction programs (that integrate mobile work, commute programs, and incentives such as parking cash-out programs). The City of Austin should become a lead employer with a model commute reduction program and phase out the practice of providing free parking spaces to City employees working in transit-rich locations.
2	Transportation Demand Management	TDM-12	Explore best practice programs and work with local political delegations to revise state laws to allow for revenue/tax/fee mechanisms that could support local low-carbon transportation infrastructure and planning: 1) Set vehicle registration cost based on miles driven 2) Adopt a transportation impact fee 3) Levy a motor vehicle excise tax 4) Implement "feebate" system 5) Tradeable credit scheme 6) Direct toll revenue to increased transit.
2	Transportation Demand Management	TDM-13	Collaborate with the trucking and logistics industry to shift vehicles off major transportation thoroughfares during peak times.
1	Vehicles and Fuel Efficiency	VFE-1	Support programs and efforts that expand electric/alternative fuel infrastructure and consider incentives for the purchase of electric/alternative fuel vehicles by individuals and fleet owners, and pursue code options to increase "charger ready" parking.
2	Vehicles and Fuel Efficiency	VFE-2	Work with community partners to develop a freight plan that reduces emissions within the region from the trucking industry, fosters more efficient freight movement, and provides assistance to freight companies to help them identify how to reduce emissions from their vehicles.
2	Vehicles and Fuel Efficiency	VFE-3	Implement photovoltaic systems that may be embedded in roadways or shade canopies that provide electric vehicle charging.
3	Vehicles and Fuel Efficiency	VFE-4	Research and analyze the potential for self-parking vehicles, driverless vehicles, and other future car models.
1	Economic and Pricing Systems	EPS-1	Pursue a fair market value for parking through demand-based commodity pricing.
1	Economic and Pricing Systems	EPS-2	Allow high occupancy and zero-emission vehicles access to toll roads at reduced or free rates.
3	Economic and Pricing Systems	EPS-3	Encourage more funding to replace older, more polluting cars with newer vehicles that meet the current vehicle emissions standard, and partner with non-governmental organizations where appropriate to implement programs.
3	Economic and Pricing Systems	EPS-4	Work with private developers to facilitate unbundling the cost of renting parking from rented building space, where appropriate, to reduce the number of free, City-controlled parking spaces within or near Centers and Corridors.
3	Economic and Pricing Systems	EPS-5	Research and analyze programs in other cities using congestion pricing to reduce congestion in downtown areas and limit the number of vehicles on the road at peak travel times on specified days.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	Imagine Austin 2013 Austin Mobility 2014 Austin Strategic Mobility Plan Ozone Advance 2035 CAMPO	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior Change **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020		N	G, B, N	R	F, BC	DS	Q, A, H, J
	2015-2020		C, N	G,B	B,G	BC	DS	A, H, J
	2020-2030		N	G	All	P, BC	DL	
			N	G, B	G, B	F, P	DS	H
	2015-2020		C	G, B	All	F, BC	DL	Q, A, J, W
	2020-2030		N	G,B	B, G, N	F, BC, P	DL	Q, J
	2030-2050		N	G	B, R	F, P	DS	Q, A, W
	2020-2030		N	G	B, R	T, BC	C	Q
	2020-2030		D	G, B	All	P, BC, T	DS	Q, J
	2020-2030		N	G	G, R	F, P	DS	Q, A, H
	2015-2020		N	G	B, R	F, P	DS	A, H
	2020-2030		D	G, B	G, B, N, R	P, BC	IS	Q, A
	2030-2050		N	G	B, G, R	P, BC	C	Q, A

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Appendix D: Materials and Waste Management Sector Findings

Introduction

Every product consumed in Travis County has a carbon footprint, which begins with the energy consumed during extraction, or creation of raw materials and includes the processing, manufacture, and transport of the product. Associated with each product are so many raw material and discards that the product itself represents only the tip of a huge iceberg of the materials consumed and emissions resulting from mining, manufacturing, and distributing the product during its lifecycle.

Reusing and recycling materials and products within the local economy and avoiding the dead end of landfilling reduces their carbon footprints. In Figure 1, materials are diverted from disposal by composting, renewal, recycling, remanufacturing, and reuse. This diversion reduces greenhouse gas emissions.

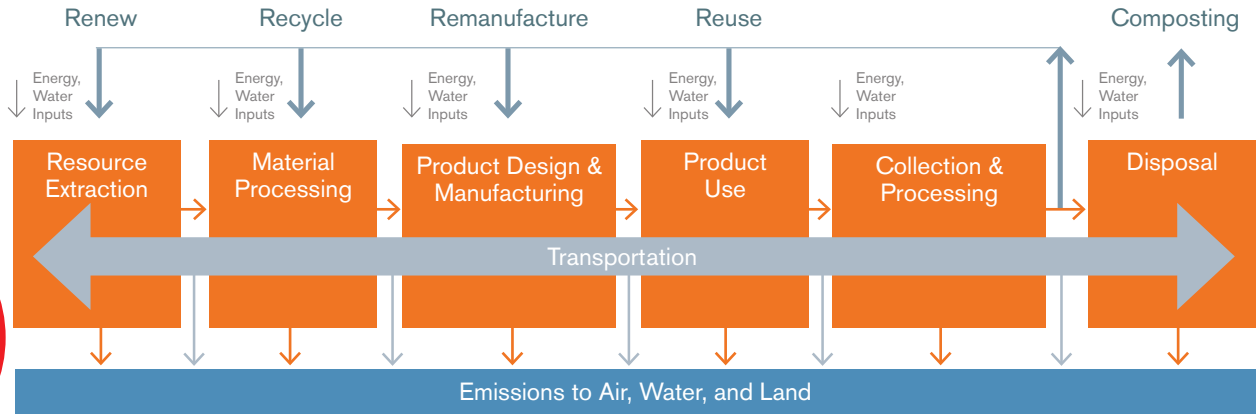

Figure 1: Flow of Materials (Adapted from EPA graphic: www.epa.gov/oswer/docs/ghg_land_and_materials_management.pdf, page 19)

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The calculations for these material-flow emissions (also called Scope 3 emissions) rely on national data with regional adjustments, rather than direct measurements. As such, they are broad and difficult to quantify with any precision. ICLEI does offer a protocol to quantify these emissions, but it was not pursued at this time. Consequently, Scope 3 emissions are not included in this plan. However, this Technical Advisory Group (TAG) and the community believe that including indirect or conceptual benefits in future planning efforts is important. A major strategy area proposed within this plan called “Reduce/Reuse” begins to address Scope 3 emissions. Also, contributing to the carbon footprint of some products is the anaerobic decay in area landfills that produces carbon dioxide and methane. Landfills continue to emit these gases long after they close, which increases the importance of diverting organic material from landfills as soon as possible.

The four landfills in Travis County have been burying materials for decades, the youngest being in operation since 1991. The oldest–the City of Austin landfill on FM 812–opened in 1968 and closed in 2008. The Republic Services landfill in northeast Austin is expected to close in 2015. The landfills operated by Texas Disposal Systems and Waste Management are projected to remain open until 2037 and 2031 respectively, based on current permitted volumes and performance levels.

All the landfills in Travis County capture and destroy methane to varying degrees, producing carbon dioxide. The Republic and Waste Management landfills produce energy, while the other two currently flare the gas. Texas Disposal Systems is designing a full gas collection and utilization system to replace its partial gas

collection system, which will result in significant emission reductions. The closed City landfill will continue to monitor capture rates, and tune the system's methane concentration to optimize flaring or electricity generation, if feasible. While both flaring and energy production convert harmful methane to biogenic carbon dioxide, energy production has the added benefit of displacing a fossil-fuel source of energy.

The U.S. Environmental Protection Agency publishes calculated greenhouse gas emissions estimates that use models, emission factors, and constants that do not take into account an individual landfill's operating practices.

Measure	City of Austin (opened 1968, closed 2008)	Republic Services (opened 1982)	Texas Disposal Systems (opened 1991)	Waste Management of Texas (opened 1981)
Methane (metric tons)	2,123	5,586	15,600	2,700
Landfill Capacity (metric tons)	9,200,000	24,154,220	28,278,369	25,912,577
Surface Area with Waste (sq meters)	655,436	1,017,795	408,732	744,638
2013 Waste Disposal (metric tons)	0	684,889	660,871	208,095
2013 Reported GHG Emissions ($mtCO_2e$)*	53,070	139,648	390,004	67,491

*GHG from: 2013 Greenhouse Gas Emissions from Large Facilities (http://ghgdata.epa.gov/ghgp/main.do)

Table 1: Estimated Emissions From Austin Area Landfills

As a large source of greenhouse gas emissions, landfills present opportunities for large emissions reductions through changes in policies or practices.

Challenges and Opportunities

- City action versus Individual action:
  - Landfill Gas Management: The City owns only one of four landfills in Travis County and it is already closed. The City has no direct control over how other landfills manage methane onsite.
  - Materials Diversion: Initiatives in Austin Resource Recovery Master Plan call for the City and private sector to provide various services to divert materials from landfills. However, the Master Plan does not currently call for mandatory participation, so the potential for success of these initiatives depends on everybody taking action.
- Economics:
  - Landfill Gas Management: According to EPA's Landfill Methane Outreach Program, landfill gas-to-energy systems reduce the costs associated with regulatory compliance by converting pollution into a valuable resource. However, there are considerations regarding the quantity and quality of emissions that can make such a system more or less financially feasible.
  - Materials Diversion: Economies of scale and simplified handling of commingled recyclables have reduced the cost for diversion services so that it competes favorably with disposal. However, the financial aspects of materials management programs are vulnerable to several factors:

- International economics that affect material prices.
- Local building conditions and consumer purchasing habits, which can affect demand for some materials.
- Public attitudes and behavior, which affect contamination and participation rates, which in turn affect material handling costs and revenue.

· Limiting factors and growth:
  - Materials Diversion: The Austin Resource Recovery Master Plan affects approximately 75% of the Travis County population. The collection and processing infrastructure developed in response to Austin initiatives, however, has fostered similar initiatives throughout the region. In addition, the City/County Interlocal Agreement is intended to address diversion from county residents.
  - Materials Diversion: Waste reduction strategies are critical to emissions mitigation, which include keeping recyclable and organic materials out of landfills. However, even aggressive diversion initiatives face the challenges of a fast-growing population and the legacy of years of disposal.
· Co-benefits of reducing emissions:
  - Landfill Gas Management: If a sufficient quantity of methane concentration exists, captured landfill gases can produce process heat, propulsion, or electricity, potentially offsetting greenhouse gas emissions from fossil-fuel energy sources.
  - Recovery of Materials: Materials returned to the economy improve public health, boost employment, save resources, reduce air and water pollution, and conserve energy and water.

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xisting Plans and Initiatives

stin Resource Recovery Master Plan

December 2011, City Council approved the Austin Resource Recovery Master Plan, setting a path to Zero Waste by 2040. A few of the many policies, programs, and services outlined in the Master Plan that are already gathering momentum include:

· A goal of Zero Waste by 2040, as well as interim milestones.
· Waste minimization and reduction, reuse of materials, and recycling of virtually all material streams in Austin.
· Managing landfill gas emissions from the City of Austin's closed landfill and exploring gas-to-energy options.
· Improved routing efficiencies and utilizing compressed natural gas and alternative fuel technologies for Austin Resource Recovery's vehicle fleet.

Independent analysis utilizing the Environmental Protection Agency's Waste Reduction Model (WARM) estimated that implementing the Master Plan could reduce life-cycle emissions by approximately 20 million metric tons of CO_2e from 2014 through 2040[1]. Other initiatives include:

· The Regional Solid Waste Management Plan 2002-2022 adopted by the Capital Area Council of Governments.
· The Sustainable Food Policy Board recommendations regarding food production and delivery.
· Working with the City's Purchasing Office to procure more sustainable products.
· Austin/Travis County Guidelines for Food Donations.

[1] Dr. Mike Blackhurst from the UT Civil and Environmental Engineering department used the WARM model to estimate avoided LCA GHGs for four scenarios of implementing the ARR Master Plan from 2014 to 2040. His two Realistic Scenarios projected net GHG reductions of 17 to 25 million $mtCO_2e$ for 2014 to 2040.

Materials and Waste Management Strategies

This TAG identified the following strategies and Phase 1 actions as making significant reductions in greenhouse gas emissions. The actions in the first strategy apply to landfill operations to control landfill gases. Those in the remaining strategies divert high-carbon materials from landfills that are most conducive to producing methane in anaerobic conditions, such as leaves, grass, food residuals, office paper, and corrugated boxes. In addition, these actions avoid life cycle greenhouse gas emissions by reducing new material demand through reuse or recycling.

Strategy 1: Methane (Landfill Gas) Management

This strategy aims to "destroy" methane through landfill gas capture and combustion. A University of Texas study found that increasing the total area of the landfills in Travis County under active gas collection and flaring from 40% to 100% could avoid more than 860,000 metric tons per year of greenhouse gas emissions in 2030.

Phase 1 Actions

- MM-1: Austin Resource Recovery refines landfill gas capture and combustion system to destroy methane.
- MM-2: Area landfill operators refine landfill gas capture and combustion system to destroy methane at their landfills.

Strategy 2: Recycling

This strategy aims to divert recyclables from residential and commercial sources in Austin (approximately 21 million tons from 2010 to 2030). Local governments set policies on and promote diversion programs. Private haulers provide collection and processing services for their customers who set aside recyclable materials.

Phase 1 Actions

- RE-1: Expand materials accepted by curbside recycling service and increase the service to weekly collection.
- RE-2: Increase convenience, efficiency, and effectiveness of downtown alley trash and recycling collection service.
- RE-3: City maintains its Pay-As-You-Throw rate structure to provide a strong financial incentive for residential customers to reduce disposal.
- RE-4: Ensure that businesses and multifamily properties affected by the Universal Recycling Ordinance maximize diversion of recyclable materials.
- RE-5: Research peer cities and explore phase-in of mandatory recycling and composting.

Strategy 3: Organics Diversion

This strategy aims to divert food residuals, yard trimmings, and non-recyclable organic materials, totaling 3 million tons from 2010 to 2030. It builds on the Master Plan to make this type of diversion a community-wide habit. Residential and commercial generators would subscribe to and participate in organics diversion services. Haulers would transport organics from generators to compost or mulch producers. Residents, businesses, community gardens, and urban and regional farms would use or produce compost and mulch, which would expand the market for these products.

Phase 1 Actions

- OD-1: Ensure that businesses affected by the Universal Recycling Ordinance maximize diversion of organics.
- OD-2: Expand collection of food residuals and other compostable, non-recyclable materials to all residential customers.
- OD-3: Austin Water Utility's compost operation transitions from yard trimmings to other carbon sources and bulking agents, such as clean lumber and tree trimmings from other City departments and their contractors.
- OD-4: Private haulers collect all organics and non-recyclable materials from their customers (including multifamily housing).
- OD-5: Urban agricultural operations, from community gardens to regional farmers, produce and use compost from local sources.

Strategy 4: Purchasing

This strategy aims to leverage the purchasing power of large institutions and enterprises to create opportunities and markets for closed loop systems that recycle and remanufacture products using locally available materials.

Phase 1 Actions

- PU-1: City develops construction specifications for citywide building permits and public works contracts and adopts specifications for roadway projects that include more locally produced recycled-content materials.

PU-2: City adopts procurement specifications for materials reuse, reduced packaging, products with low embodied energy, materials with recycled content, and locally manufactured products and the City encourages other agencies and enterprises to follow suit.

Strategy 5: Reuse/Reduce

This strategy aims to reduce consumption. Preventing the need for purchases by redesigning processes or using product-as-service models encourages efficiency and product durability, which also cuts down on consumption. Organizations and individuals would share materials and products, reusing them multiple times before final disposal. Building contractors and product manufacturers would optimize material use and minimize waste when designing and making structures and goods.

Phase 1 Actions

- RR-1: Austin Resource Recovery adds new Reuse Centers, including for hard-to-recycle items.
- RR-2: City supports local enterprises that repair goods/products.
- RR-3: The City supports local economic development through the (re)Manufacturing Hub, Austin Materials Marketplace, and reuse enterprises for reuse of production byproducts or general reuse of goods.
- RR-4: The City implements policies to reduce the use of single-use products in addition to carryout bags.

Next Steps

Upon adoption of this plan, stakeholders in this sector would establish reporting methods to determine the avoided emissions associated with Austin Resource Recovery initiatives. This group would focus on how to track, evaluate, report, and improve upon emissions reductions.

The Austin Community Climate Plan should be used to help prioritize and support initiatives in the Austin Resource Recovery Master Plan, particularly those that increase diversion of food residuals or paper. The City should continue implementation of the Phase 1 actions that are already in adopted plans and assess what would be required to implement the additional proposed actions. Austin Resource Recovery would also gather data to gauge the material streams with the highest Scope 1 or Scope 3 greenhouse gas emissions impacts.

Materials and Waste Management Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Organics Diversion	OD-1	ARR ensures that businesses affected by the Universal Recycling Ordinance maximize diversion of organics.
1	Organics Diversion	OD-2	ARR expands collection of food residuals and other compostable, non-recyclable materials to all residential customers.
1	Organics Diversion	OD-3	Austin Water's Hornsby Bend compost operation transitions from yard trimmings to other carbon sources and bulking agents, such as clean lumber and tree trimmings from other City departments and their contractors.
1	Organics Diversion	OD-4	Private haulers collect all organics and recyclable materials from their customers (including multifamily housing).
1	Organics Diversion	OD-5	Urban agricultural operations, from community gardens to regional farmers, produce and use compost from local sources.
2	Organics Diversion	OD-6	ARR offers training and rebates for residential and commercial composting to households and businesses.
2	Organics Diversion	OD-7	ARR increases efficiency of brush collection.
2	Organics Diversion	OD-8	ARR increases preparedness for storm debris management.
2	Organics Diversion	OD-9	ARR adds organics collection services to downtown trash and recycling alley collection service.
2	Organics Diversion	OD-10	City adopts and implements construction materials management ordinance.
2	Organics Diversion	OD-11	ARR ensures special event producers provide diversion services, including for organics.
2	Organics Diversion	OD-12	ARR offers training and rebates for residential and commercial composting to households and businesses.
3	Organics Diversion	OD-13	ARR and civic organizations encourage the state to ban landfill disposal of yard trimmings.
3	Organics Diversion	OD-14	Collection and processing businesses expand infrastructure for beneficial reuse of FOGs.
3	Organics Diversion	OD-15	Haulers implement two-bin wet/dry collection service for the materials left over after maximizing diversion.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	ARR Master Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020	ARR Master Plan (adopted 2010)	C	G	B, MF	BC, F	DL	Q, J, W
	2015-2020	ARR Master Plan (in progress)	D	G	R	F, BC, T	DL	Q, W
	2015-2020	ARR Master Plan	P	G	G	P, F	DS	H, W
	2020-2030	Partial	D,P	G, B, N	All	F, P, BC, T	DL	Q, A, H, J, W
	2020-2030		D	G, B, N	All	F, P, BC, T	DL	Q, A, H, J, W
	2015-2020	ARR Master Plan (in progress)	P	G, B	R	F, BC	DS	Q, A, W
	2015-2020	ARR Master Plan	P	G	R	P, T	DS	Operational efficiency
	2015-2020	ARR Master Plan (in progress)	D	G	R	F, P	DS	H
	2015-2020	ARR Master Plan (in progress)	D	G	B, MF	BC	DS	H, J, W
	2015-2020	ARR Master Plan (in progress)	D	G	B	P, BC, F	DS	Q, J, W
	2015-2020	ARR Master Plan (in progress)	D	G	B, R, N	P, BC, F	DS	Q, J, W
	2015-2020	ARR Master Plan (in place)	C	G	B, MF	F, BC	C	Q, A
	2020-2030		N	G, N	All	P, BC	DL	Q, J, W
	2020-2030	No, however, under consideration for Water Plan	D				C	H
	2030-2050		N	B	All	T	DL	Q

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Materials and Waste Management Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
1	Purchasing	PU-1	City develops construction specifications for citywide building permits and public works contracts and adopts specifications for roadway projects that include more locally produced recycled-content materials.
1	Purchasing	PU-2	City adopts procurement specifications for materials reuse, reduced packaging, products with low embodied energy, materials with recycled content, and locally manufactured products and the City encourages other agencies and enterprises to follow suit.
2	Purchasing	PU-3	ARR develops public marketing campaign promoting responsible purchasing.
2	Purchasing	PU-4	ARR encourages groups to purchase items cooperatively to reduce packaging.
2	Purchasing	PU-5	City adopts responsible purchasing policies, including shifting from purchasing products to purchasing services, and encourages other agencies and enterprises to follow suit.
3	Purchasing	PU-6	City encourages retailers to consider life cycle impacts when choosing products to sell, including favoring durable, long-lasting products.
1	Methane Management	MM-1	ARR refines landfill gas capture and combustion system to destroy methane.
1	Methane Management	MM-2	Area landfill operators refine landfill gas capture and combustion system to destroy methane at their landfills.
2	Methane Management	MM-3	Landfills use daily and interim landfill cover that minimizes methane generation.
1	Recycling	RE-1	ARR expands materials accepted by curbside recycling service and increases the service to weekly.
1	Recycling	RE-2	ARR increases convenience, efficiency, and effectiveness of downtown trash and recycling alley collection service.
1	Recycling	RE-3	City maintains its Pay-As-You-Throw rate structure to provide a strong financial incentive for residential customers to reduce disposal.
1	Recycling	RE-4	Ensure that businesses and multifamily properties affected by the Universal Recycling Ordinance maximize diversion of recyclable materials.
1	Recycling	RE-5	Research peer cities and explore phase-in of mandatory recycling and composting.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	ARR Master Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020	ARR Master Plan	P	G	G	F, P	IL, C	Q, J
	2020-2030			G, B, N	G, B, N, R	P, T, F + Analysis	IL	Q, J
	2020-2030			G, B	G, B, N, R	F, BC	C	Q
	2020-2030			B, R	G, B	BC, T	C	Q
	2020-2030			All	All	BC	IS	Q, J
	2030-2050			R, B	G, N, R	F, BC + no standards	IS	Better products, informed consumers
	2015-2020	ARR Master Plan (in progress)	D	G	G	F, T	DL	Renewable energy
	2015-2020	"ARR Master Plan (in progress)	D	G	G	F, T	DL	Renewable energy
	2020-2030		N	B	G	F	DS	H, W
	2015-2020	ARR Master Plan (in progress)	D	G	R, B	T, BC	IL	Q
	2015-2020	ARR Master Plan (in place)	C	G	B, MF	F, BC	IL	Q, H, J
	2015-2020	ARR Master Plan	P	G	SF	P	DL/IS	Q, H, J
	2015-2020	ARR Master Plan (in progress)	D	G	B, MF, N	F, BC	DL, C	Q
	2015-2020		N	B	All	F, P, BC	IL	Q

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Materials and Waste Management Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
2	Recycling	RE-6	ARR increases recycling and reuse of bulky items collected.
2	Recycling	RE-7	City increases convenience of public-area recycling containers and efficiency of servicing them.
2	Recycling	RE-8	City adopts and implements construction materials management ordinance.
2	Recycling	RE-9	ARR ensures special event producers provide diversion services, including for organics.
2	Recycling	RE-10	ARR expands HHW collection by adding a north Austin HHW facility, instituting door-to-door HHW collection, and advocating for CESQGs inclusion.
2	Recycling	RE-11	ARR supports material management aspects of Austin Green Business Leaders and its expansion.
2	Recycling	RE-12	ARR offers commercial recycling rebates, technical assistance, and recognition.
2	Recycling	RE-13	ARR expands production and marketing of ReBlend.
3	Recycling	RE-14	City and Travis County develop decentralized community centers for recycling and composting.
1	Reduction/Reuse	RR-1	ARR adds new Reuse Centers, including for hard-to-recycle items.
1	Reduction/Reuse	RR-2	City supports local enterprises that repair goods/products.
1	Reduction/Reuse	RR-3	City supports local economic development through the (re)Manufacturing Hub, Austin Materials Marketplace, and reuse enterprises for reuse of production byproducts or general reuse of goods.
1	Reduction/Reuse	RR-4	City implements policies to reduce the use of single-use products in addition to carryout bags.
2	Reduction/Reuse	RR-5	City encourages state to adopt policies that reduce single-use packaging and product stewardship, such as container deposits and retail take-back.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits
	2015-2020 2020-2030 2030-2050	ARR Master Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater
	2015-2020	ARR Master Plan	P	G	SF	P, T	IS	Q
	2015-2020	ARR Master Plan (in progress)	D	G	B, R	F, BC	IS	Q
	2015-2020	ARR Master Plan (in progress)	D	G	B	P, BC, F	DS	Q
	2015-2020	ARR Master Plan (in progress)	D	G	B, N, R	P, BC, F	DS	Q
	2015-2020	ARR Master Plan (in progress)	D	G	B	P, T	IS	Q
	2015-2020	ARR Master Plan (in place)	C	G	B, N	F, BC	C	Q
	2015-2020	ARR Master Plan (in place)	C	G	B, MF	F, BC	C	Q, A
	2015-2020	ARR Master Plan (in progress)	D	G	R	F, BC	C	Q, J
	2030-2050	Partial	D	G	B, N	NIMBY	DS	Q
	2015-2020	ARR Master Plan	P	G	G, B, N, R	P, F	IL	Q, A
	2015-2020	ARR Master Plan (in progress)	D	G	B, N, R	P, BC, F	DS	Q
	2015-2020	ARR Master Plan (in progress)	D	G	B	P, T	IS	Q
	2015-2020	ARR Master Plan (in place)	C	G	B, N	F, BC	C	Q
	2015-2020	ARR Master Plan (in place)	C	G	B, MF	F, BC	C	Q, A

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Materials and Waste Management Sector Strategies and Actions

Phase	Strategy Category	Action #	Actions
2	Reduction/Reuse	RR-6	Promote COA Recycled Reads.
2	Reduction/Reuse	RR-7	City departments conduct waste audits to promote waste reduction opportunities in City operations.
2	Reduction/Reuse	RR-8	City supports local economic development through the (re)Manufacturing Hub, Austin Materials Marketplace, and reuse enterprises.
2	Reduction/Reuse	RR-9	ARR increases recycling and reuse of bulky items collected.
2	Reduction/Reuse	RR-10	ARR incentivizes deconstruction and construction material reuse including buildings to be deconstructed instead of demolition, to allow for reuse of materials.
	Reduction/Reuse	RR-11	City incentivizes reducing the generation of fats, oils, and grease and their beneficial reuse.
2	Reduction/Reuse	RR-12	City promotes products and packaging with multi-uses and purposes as alternatives to single-use products.
2	Reduction/Reuse	RR-13	Transfer station and landfill operators establish methods to pre-sort items at their facilities.
2	Reduction/Reuse	RR-14	ARR and Travis County expand reuse and sharing opportunities by supporting existing reuse centers and fostering development of additional community centers for recycling and composting.
2	Reduction/Reuse	RR-15	City promotes efficient material use in home construction and in the design of durable goods.
3	Reduction/Reuse	RR-16	ARR promotes consumer support for durable, long-lasting products.

	Timeframe	Currently in an Adopted City Plan?	Action Status	Owner of the Action	Participating / Active Stakeholders	Barriers or Limiting Factors	Avoided Emissions	Ancillary Benefits	
	2015-2020 2020-2030 2030-2050	ARR Master Plan	**C**urrent **D**evelopment **P**lan **N**ew	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**B**usiness **G**overnment **M**ulti**F**amily **N**onprofit, NGOs **R**esidents, All **SF-**Single-family	**F**unding **P**olicy **B**ehavior **C**hange **T**echnology	**D**irect **I**ndirect **L**arge **S**mall **C**onceptual/ NA	**Q**uality life **A**ffordable **H**ealth **J**obs **W**ater	
	2015-2020	ARR Master Plan (in place)	C	G	G, N	BC	C	Q, A, J	
	2015-2020	ARR Master Plan	P	G	G	P, F	DS, IS	Q, A	
	2015-2020	ARR Master Plan	P	G	N, G, B	F, BC	DS, IS	Q, J	
	2015-2020	ARR Master Plan	P	G	R, N	P, F, BC	DS, IS	Q	
	2020-2030	Partial	D, P	G, B, N	G, B, N, R	F, P, BC	DS, IS	A, J	
	2020-2030	No, however, under consideration for the Water Plan	D	G, B, N	G, B, N, R	F, P, BC	DS, C	Q, A, H, J W	
	2020-2030	Partial	D, N	G, B, N	G, B, N, R	BC, P, T, F	IS, C	Q	
	2020-2030		C, N	B, G	G, B, N	F, BC	DS	Q, A	
	2020-2030		C, D	G, B, N	G, B, N	F	DS, C	Q, A	
	2020-2030		N	G, B, N	G, B, N, R	F, P, BC, T	DS, IS	Q, A	
	2030-2050		N	G, B, N	G, B, N, R	BC, P, T, F	IS, C	Q, A	

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Appendix E: Industrial Process Sector Findings

Introduction

The four companies represented in this plan–Austin White Lime, Samsung Austin Semiconductor, Freescale Semiconductor, and Spansion LLC–produce carbon dioxide (CO_2) or carbon dioxide-equivalent (CO_2e) as a manufacturing byproduct, either directly through the use of certain process chemicals or from burning fuel, or indirectly from electricity usage. With multiple drivers dictating company policies, including safety, regulatory compliance, industry group participation, product demand, and economic competitiveness, achieving reductions in greenhouse gas emissions is not a simple proposition.

Sources of Emissions

Austin White Lime (AWL)

Austin White Lime is the only lime manufacturer located in the Austin Metropolitan Statistical Area (Bastrop, Caldwell, Hays, Travis and Williamson Counties) and one of only three lime producers in the entire state of Texas. Lime is produced from the calcination of limestone. Calcination describes the process that occurs when limestone is heated in kilns to drive off CO_2 and convert the limestone into lime. Kilns are fueled by natural gas, coal, or petroleum coke, singularly or in any combination based on business conditions. AWL's CO_2 emissions are inherent to the manufacturing process and directly tied to their production volume.

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emiconductor Manufacturers (Samsung, Freescale, Spansion)

roximately 70% of the CO_2/CO_2e emissions from semiconductor facilities are indirectly emitted a result of the electricity used for operating manufacturing equipment, and for climate control in the anrooms and support areas. The use of perfluorinated manufacturing chemicals accounts for another 0% of the total emissions. The remainder comes from natural gas used to heat buildings and abate organic materials, heat transfer fluids used to cool manufacturing equipment, and N2O and CO_2 consumed as process gases.

Challenges and Opportunities

Businesses in this sector must address a number of issues in their day-to-day operations:

- Safety: Ensuring the health and safety of employees and neighbors is always a top priority.
- Regulatory compliance: Operating in a manner that meets or exceeds all applicable laws and regulations, including those promulgated by the U.S. Environmental Protection Agency and the Texas Commission on Environmental Quality. Anticipating and responding to changes in this arena is an integral part of corporate responsibility.
- Product demand: Meeting customer demand remains the core of each business.
- Maintaining economic competitiveness: Operating in a profitable manner by implementing efficiency measures and making cost reductions that also result in source reduction and waste minimization.
- Trade association leadership and participation: Collaborating with others in the same industry to establish competitive benchmarks that measure environmental and safety performance promotes efficient manufacturing methods.

Industrial Process Possible Strategies and Actions

CO_2 and CO_2e are inherent in the manufacturing processes for semiconductor and lime production. Austin manufacturers have limited opportunities for actions and reductions without risking negative impacts to business. Many require significant capital funding and would have to offer an acceptable return on investment. Some entail a production change which must be qualified and approved. Others would be accomplished only if there was a regulatory driver. Each potential strategy and action would need to be examined thoroughly so that all impacts, especially those which are unintended, are weighed and evaluated adequately. Examples of potential reduction actions include:

- Fuel switching to less carbon intensive fuels
- Emission capture and destruction
- Chemical substitutions and reduction of use
- Energy conservation and efficiency
- The generation or purchase of renewable energy

Next Steps

Manufacturing facilities in the Austin area are continuously looking for efficiency opportunities that would still meet economic demands, including those which focus on CO_2e reduction. In the short term, some businesses are already making energy reduction projects a priority, which will decrease or at least offset increases in CO_2. In the long term, each will benchmark and collaborate with industry peers to ensure that best practices are incorporated locally. Also for long term consideration, these companies have expressed interest in discussing potential investments in local carbon reduction projects that could help offset industrial emissions.

Appendix F: Public Input and Community Support

A variety of public engagement strategies were utilized to collect input that would inform development of the Austin Community Climate Plan. The Office of Sustainability conducted regular in-person meetings with the Steering Committee, led planning charrettes and presentations to community organizations and Boards & Commissions groups, and used online forums and personal surveys to generate a robust level of interest and feedback that helped craft the plan's content.

Steering Committee

Formed in July 2014, the Steering Committee met bi-weekly for over six months. Web pages were developed on www.austintexas.gov that documented the Steering Committee's efforts, including the meeting schedules, agendas, notes, and presentations. In addition, links for comments and questions were included on the web page. The first part of each Steering Committee meeting was open for public comment; there were also two planning sessions that involved general members of the public.

Technical Advisory Groups

In July 2014, Technical Advisory Groups (TAGs) were created for the four major emissions sectors: Electricity and Natural Gas, Transportation and Land Use, Materials and Waste Management, and Industrial Process. These TAGs were led by City staff from relevant departments and included technical experts from their respective fields. These community members provided important input and helped create many of the strategies and actions included in the plan.

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Speak Up Austin

Speak Up Austin is an online forum that allows individuals to share their ideas and proposals on various topics, which can then be voted or commented on by other members of the public. An open discussion board on Speak Up Austin was used for the Austin Community Climate Plan that encouraged any and all ideas for consideration; it received over 30 responses. Once specific draft strategies and actions were developed for the plan, three forums were provided to allow the public to review these proposals; over 150 comments and votes were received.

Individual Survey

The Office of Sustainability made available, via their website, a 33 question survey for the Austin public in early November of 2014. This online, mobile-friendly, survey based on GetFeedback software was provided to the Austin public in both English and Spanish versions. The survey was used to engage people about actions they are currently taking that would support the net-zero community-wide greenhouse gas emissions goal, actions they would be willing to take in the future, and the barriers that prevent them from taking a new action.

The survey was also made available to the Research Now online panel on January 13th, 2015 and was available up until January 19th. This survey method was chosen as a cost-effective and time-efficient way to increase the response rate to the survey. This method was also a way to efficiently targeted underrepresented zip codes and demographics (including Hispanics and those in younger age groups).

In the end, the survey was completed by 1,065 Austin residents and was somewhat skewed toward females, older respondents, Caucasians, and homeowners. It is believed that the Hispanic population was significantly underrepresented, but this statement is not provided with a high level of certainty. The question in the survey used to identify Hispanic ethnicity was not asked of roughly half of the respondents (and was not included in the initial survey). The data were not weighted to adjust for these demographics because the sampling was non-random (anyone could take it) and because of the limited demographics

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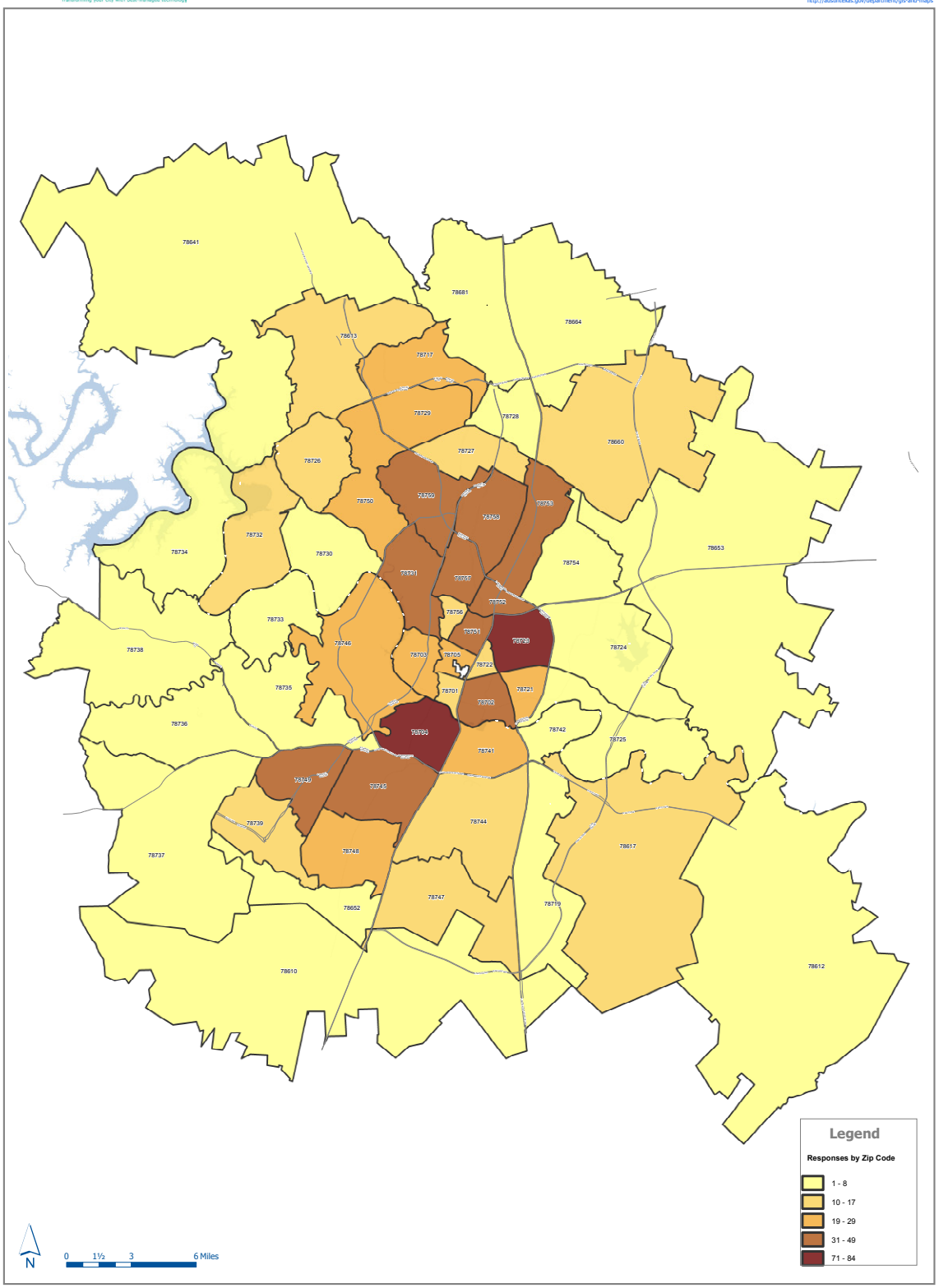

Survey Responses: Individual GHG Reduction Actions by Zip Code

Produced by the Communications and Technology Management Department - GIS Data Services
Date: 3/3/2015
Project Number: M_1477786

City Of Austin
CTM
Communications & Technology Management

This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries.

This product has been produced by the Communications and Technology Department for the sole purpose of geographic reference. No warranty is made by the City of Austin regarding specific accuracy or completeness.

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collected (e.g. Hispanic ethnicity was only collected for half the sample). Nevertheless, the survey results[1] provide important insights:

Willingness to Take Action Regarding Energy

- Easy behaviors that anyone can do (regardless of home ownership) are more enticing to respondents to reduce greenhouse gas emissions. At least 75% of respondents were most willing to turn off light bulbs, use fans to cool rooms, adjust their thermostats, and turn off electronics.
- Unless a home owner, respondents are less willing to engage in more difficult practices such as installing solar panels and weatherizing. However, for home owners, the main reason they are unwilling to engage in these practices is from a lack of budget or a need for a financial incentive.
- Overall, respondents are more likely to weatherize, use energy efficient appliances, and install solar panels if they are home owners, age 35 to 74, and have incomes above $100,000. However, the most significant factor for willingness to engage in these activities is home ownership.

Willingness to Take Action Regarding Transportation

- As with energy-saving practices, easy actions that anyone can do are more enticing to respondents, such as maintaining their cars, walking, adjusting their driving, or telecommuting. Just around half (46-53%) were most willing to use a combination of walking, transit, and/or biking to travel for errands, fun, and work.
- Respondents were more likely to use a combination of transportation methods (both for fun and work), carpool, and be a member of a car-share program if they are renters, younger (age 18-34), and have lower incomes (under $75,000).

  Respondents were most unwilling to become a member of a car-share program or carpool because they prefer to own, or have access, to their own car.

Willingness to Take Action Regarding Recycling and Waste

- 72%+ of respondents were willing to purchase locally raised meat, fruit/vegetable options, and purchase more products in bulk and fewer products with excessive packaging to reduce greenhouse gas emissions.
- About half the respondents were willing to compost, but the other half were unwilling to compost at home, mainly because they are either renting or simply do not want to compost.
- Respondents were more willing to purchase locally, in bulk, and from businesses that use renewable energy if they are female and younger (under age 44). Respondents are more willing to compost if they are homeowners and middle aged (age 35-44).

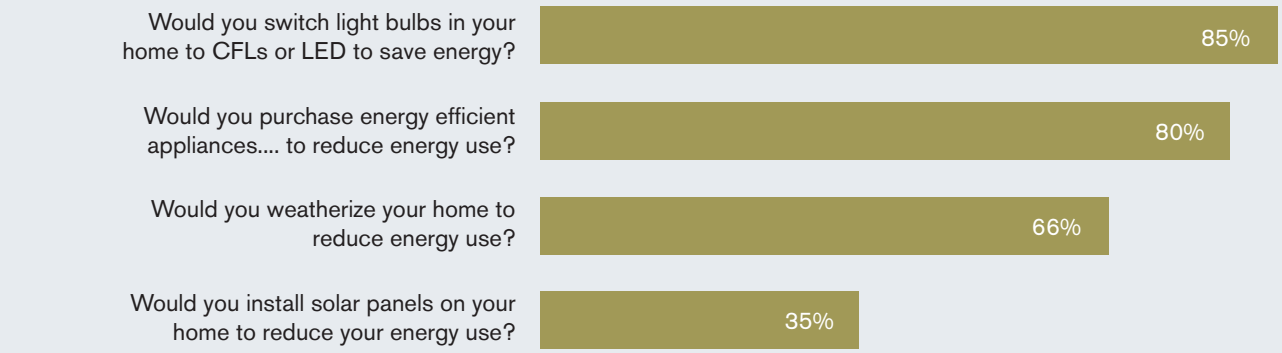
Public Input Next Steps

In April, the Office of Sustainability received comments on the first public draft plan and many changes were incorporated into the final draft plan. For the next phase of planning, it will be critical to continue to involve the public to increase the likelihood of successful implementation.

[1] http://austintexas.gov/sites/default/files/files/Sustainability/Climate/021315_FINAL_PRR_Survey_Presentation.pdf

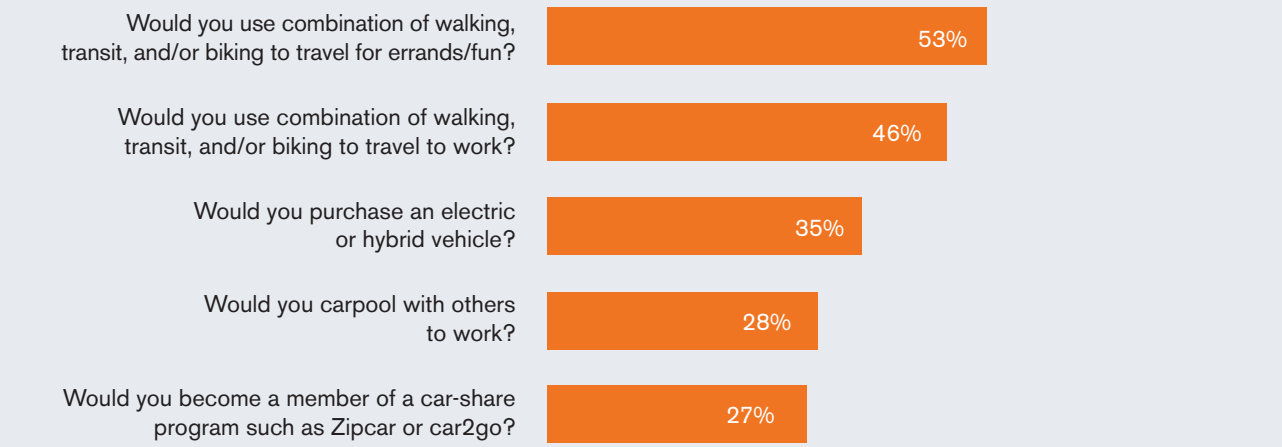
Already or willing to use energy efficient practices

(rated 4 or 5, where 5 is 100% willing) *Base: All Survey Respondents (N=1063)*



Already or willing to make alternative transportation choices to reduce greenhouse emissions

(rated 4 or 5, where 5 is 100% willing) *Base: All Survey Respondents (N=1063)*



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Already or willing to take actions to reduce materials consumption and waste creations

(rated 4 or 5, where 5 is 100% willing) *Base: All Survey Respondents (N=1063)*

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