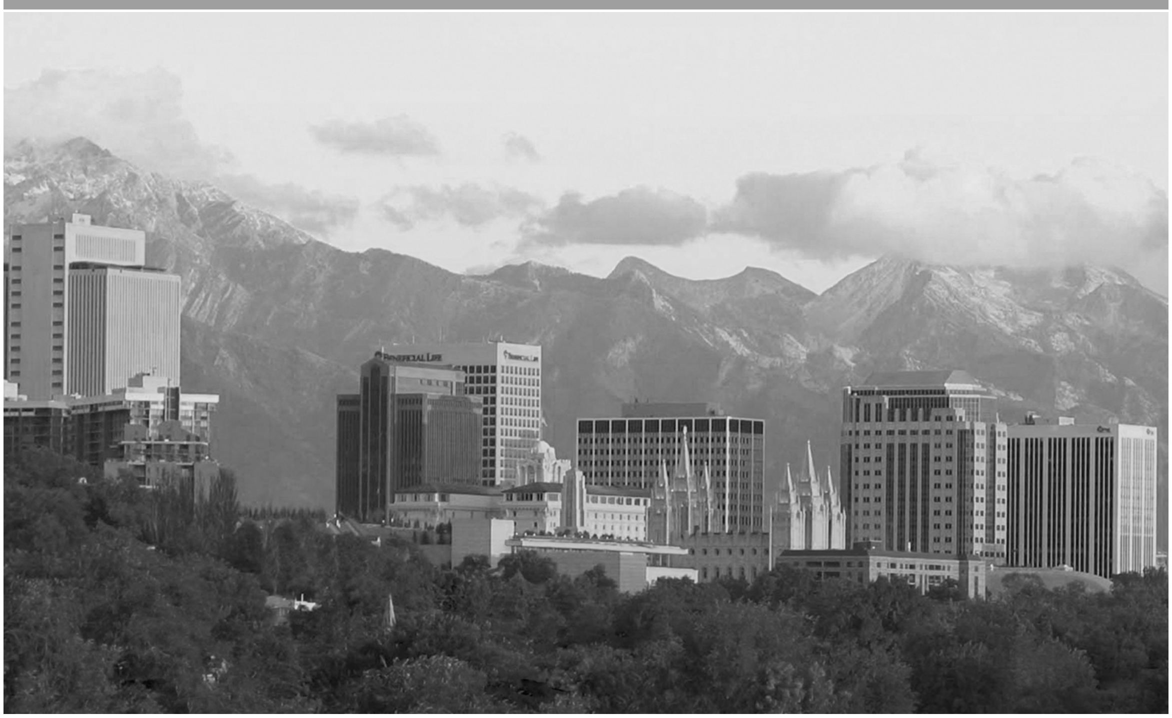

SALT LAKE CITY
Community Carbon Footprint

December 2010

Funded by the U.S. Department of Energy

ACKNOWLEDGEMENTS

The Salt Lake City Corporation would like to acknowledge the following individuals for their time and expertise in contributing to this report:

Salt Lake City Energy and Carbon Advisory Committee (ECAC)

Jason Berry, State Energy Office
Ann Ober, Salt Lake County Mayor's Office
Kimi Barnett, Salt Lake County
Lis Cohen, Governor's Energy Office
Rusty Lundberg, Department of Environmental Quality
Myron Willson, University of Utah
Kerry Case , Westminster College
Troy Justesen, Salt Lake Community College
Eric Hunter, Salt Lake Community College
Greg Libecci, Salt Lake School District
Alene Bentley, Rocky Mountain Power
Dan Dent, Questar Gas
Barrie McKay, Questar Gas
Steve Bateson, Questar Gas
Laura Briefer, Salt Lake City Utilities
Jeff Edwards, Economic Development Corporation of Utah
Bill Krause, Salt Lake Convention and Visitor's Bureau
Sarah Wright, Utah Clean Energy
Sarah Baldwin, Utah Clean Energy
Carrie Giles, Utah Clean Energy
Alan Matheson, Envision Utah
Jeff Grant, Utah Chapter of the Utah Green Building Council
Doug Hattery, Wasatch Front Regional Council
Kip Billings, Wasatch Front Regional Council
Kevin Young, Salt Lake City Transportation Division
Patty Nelis, Salt Lake City International Airport
Kevin Staples, Salt Lake City International Airport
Grantley Martelly, Utah Transportation Authority (UTA)
Jeff Sokol, Varian Medical Systems
J.C. Smith Varian Medical Systems
Babs Delay, Urban Utah Homes & Real Estate
Natalie Gochnour, Salt Lake Chamber of Commerce
Dru Whitlock, CH2M Hill
Jim Holtkamp, Holland & Hart
Diana Johnson, Interfaith Power and Light
Brian Farr, Interfaith Roundtable
Ron Daniels, Energy Advisor's Office for the Governor

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Data Sources and Assistance

Salt Lake City Corporation
Rocky Mountain Power
Questar Gas Company
Wasatch Front Regional Council
Environmental Protection Agency
ACE Recycling and Disposal
Waste Management
Utah Governor's Office of Planning and Budget
Salt Lake Convention and Visitor's Bureau
Blue Ribbon Advisory Council on Climate Change
U.S. Census Bureau
Energy Information Administration
Bureau of Labor Statistics
Bureau of Transportation Statistics
U.S. Department of Transportation
Bureau of Economic Analysis
Utah Department of Environmental Quality

Additional Thanks To

Maria Vyas, Fehr and Peers
Julie Bjornstad, Fehr and Peers
Kyle Cook, Fehr and Peers
Joyce Allgaier, Clarion Associates
Erika Brown, Independent Consultant
Judy Dorsey, Brendle Group
Becky Fedak, Brendle Group
Seth Jansen, Brendle Group

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FOREWORD BY MAYOR RALPH BECKER

Our success in finding solutions to the concurrent challenges of achieving energy security, developing clean energy, averting climate change, and protecting our natural environment will be the legacy of this generation. Inaction is not an option and Salt Lake City is proud to be a leader in seeking solutions that improve the quality of life for our citizens, stimulate economic growth, and protect our natural resources.

Although we have been working hard to improve air quality, develop green energy, and stimulate our economy through responsible planning and development, this community carbon footprint represents a major milestone toward a more unified and quantifiable approach in implementing solutions. Only by understanding our current situation and performance can we best plan our future. We are committed to seeking solutions that not only reduce our impact on climate change, but also improve our air, health, economy, and quality of life.

This baseline inventory tells us that Salt Lake City emitted 4.75 million metric tons of carbon dioxide equivalent - or 26 metric tons per person - in 2009, which is just above the national average per person. The majority of these emissions, 54 percent, results from using electricity. Consequently, there is great opportunity for drastically reducing emissions if we can improve efficiency, particularly in buildings where most electricity is consumed, and use cleaner sources of electricity.

Another result of this inventory tells us that Salt Lake City residents drive less than the average American in large part because we live in a relatively small urban area with increasing access to transit and other alternatives to the single occupant automobile. We are committed to further reducing vehicle miles travelled by making biking, walking, transit, carpooling, and car-sharing as convenient and enjoyable as possible.

We have set an aggressive goal of reducing our local government emissions by 2 percent per year and to reach an overall reduction of 80 percent below 2005 levels by 2050. This initial baseline inventory is just the beginning of a goal-setting process for the community and will drive the forthcoming community energy and sustainability action plan. Developing this plan will involve analyzing and quantifying the challenges and benefits of strategies for reaching our emission reduction goals while continuing to improve the quality of life for our citizens, create a vibrant economy, and benefit our environment.

I am proud of this work and the immense effort of staff, organizations, and community members that committed time and energy to ensure its success. As better data and models become available, we will continue to refine and maintain this inventory to serve the needs of our community and contribute to the welfare of a much larger community. We will continue to call upon and rely on organizations and individual community members to help drive us toward effective and efficient solutions.

- Mayor Ralph Becker

EXECUTIVE SUMMARY

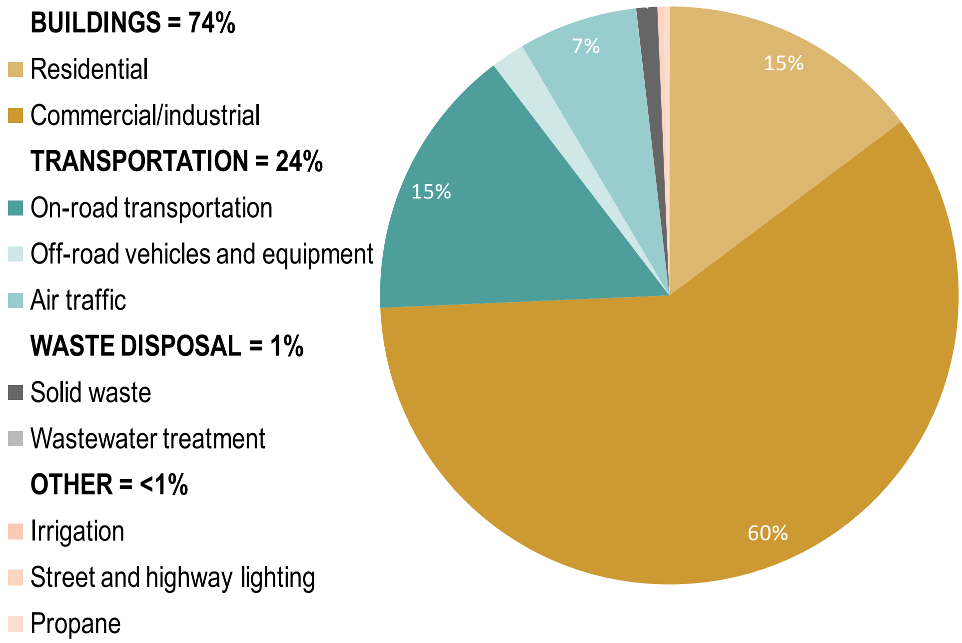
The increase in greenhouse gas emissions over the last 150 years - largely the result of an overwhelming dependence on combusting fossil fuels - is having social, economic, health, ecological, and security impacts on local and regional scales that are only beginning to emerge. This community carbon footprint (inventory) is a critical part of an informed and coordinated effort to ensure a healthy, economically resilient, secure community into the future.

Although the effects of climate change are becoming more apparent and the community has reasons for minimizing its contribution to accelerating these effects, residents also are concerned about quality of life for their families and neighbors. Fortunately, reducing greenhouse gas emissions has the additional and sometimes more tangible benefits of cleaner air and water, which lead to healthier communities and lower healthcare costs. In addition, less reliance on fossil fuels means fewer impacts from volatile energy prices, which can reasonably be expected to rise as demand and environmental regulations increase and supplies decreases. Using less energy without compromising quality of life is the most cost effective method for ensuring energy security. Producing the energy needed from cleaner sources locally also will reduce the community's vulnerability to price volatility and the regulatory environment.

Salt Lake City is recognized as a national leader for its accomplishments in minimizing its carbon footprint as well as for its progressive programs and approach of integrating sustainability into planning and decision-making. Mayor Ralph Becker created the Division of Sustainability and Environment in 2008 when he took office, consolidating and expanding personnel and resources for implementing community-wide initiatives. Major initiatives and successes in the area of energy include the Sustainability Code Revision Project, federal grants to expand solar energy and promote sustainable transportation,

Figure A: 2009 Community GHG Emissions by Sector

Total = 4.75 Million Metric Tons Carbon Dioxide Equivalent



the Idle Free Utah campaign, Energy Efficiency Conservation Block Grants, and a host of incentive programs such as those offered by Rocky Mountain Power and Questar Gas. In addition, Salt Lake City Corporation (the City) is in the process of completing a municipal greenhouse gas inventory through The Climate Registry, an international voluntary greenhouse gas inventory reporting program and protocol.

The City's goal is to continue to reduce local government emissions by 2 percent per year and to reach an overall reduction of 80 percent below 2005 levels by 2050. This baseline inventory will enable the community to complete a similar and complementary goal-setting process. Furthermore, the emissions levels established in this inventory and its continued maintenance will help the community identify reduction strategies and measure progress toward its goals.

This community inventory looks at the calendar years of 2005 through 2009 and includes all the activities - residential, commercial, industrial, and institutional - that occur within Salt Lake City's limits (the community) that could be reasonably estimated. The inventory includes electricity, natural gas, propane, on-road transportation, off-road transportation and equipment, air travel, solid waste, and wastewater treatment. The intent is for the inventory to be updated annually and to evolve with emerging data or modeling approaches.

Outcomes of the inventory indicate that in 2009, the community of Salt Lake City was responsible for 4.75 million metric tons of carbon dioxide equivalent (CO2e) emissions. Electricity consumption, the single largest source of emissions, accounted for 54 percent and natural gas combustion, the second largest source, accounted for 20 percent. Both sources are primarily consumed in buildings and together account for three quarters of all emissions within the community. Electricity, in particular, and building energy in general, offer the greatest opportunity for emissions reductions. Understanding the sources and scale of the community's emissions is the foundation upon which informed strategies can be developed to move forward.

1.0 GREENHOUSE GAS EMISSIONS AND SALT LAKE CITY

Intent and Support

Climate change refers to the wide range of impacts resulting from the increase in accumulated concentrations of greenhouse gases in the atmosphere as a result of human activity, primarily the combustion of fossil fuels and deforestation. Globally, these impacts include changes in temperature, precipitation, sea level, ice melt, frequency and severity of storms, and changes to species and habitats, which ultimately affect human health and economies.

In 2007, Governor Huntsman's Blue Ribbon Advisory Council on Climate Change (BRAC) summarized the scientific consensus regarding climate change and the likely impacts on Utah. Based on BRAC's report, Utah is anticipated to warm more than the average region worldwide, resulting in a longer growing season and more heat waves. Moderate assumptions predict this will be an 8 degree Fahrenheit increase by the end of the century, which is roughly the current difference in annual mean temperature between Salt Lake City and Park City. This change in climate is expected to be accompanied by more frequent and heavy precipitation events punctuating periods of longer dry spells.

Reduced snowfall in the surrounding mountains would drastically change the community's water supply, storage, and tourism economy. Snowpack and stream flows supply roughly half of municipal water requirements. Repercussions from changes to patterns of precipitation resulting from warming for Salt Lake City include lack of water or reduced storage, increased floods, more forest fires, and a smaller winter tourism industry. Winter tourism is estimated to bring more than a billion dollars in revenue to the state annually and supports about 18,000 jobs statewide. Other impacts may include lower stream flows, resulting in more concentrated pollutants; altered habitat for fisheries; reduced hydropower capacity; and less water for irrigation, recreation, and agriculture.

Warmer temperatures and less rainfall leads to increased levels of particulate matter (PM). Salt Lake County is already in non-attainment with the Clean Air Act for PM. Ground-level ozone, or smog, also increases with warmer temperatures. Both ozone and PM are linked to respiratory disorders.

Reducing carbon emissions has benefits that extend well beyond minimizing the impact of climate change. Other benefits include, but are not limited to, improved air quality, lower rates of respiratory disorders such as asthma, less susceptibility to volatile energy costs, reduced vulnerability to federal and state energy regulations, and water security. Protecting the climate also minimizes a range of potential impacts, such as forest fires, extreme weather events, insect outbreaks, climate-sensitive diseases, and agricultural impacts to which response or adaptation could be very costly.

Relationship to Other Initiatives

On a state level under former Governor John Huntsman, Utah signed on as a partner to the Western Climate Initiative (WCI). As a partner, Utah is committed to creating a comprehensive initiative to lower greenhouse gas emissions by 15 percent below 2005 levels by 2020 and to encouraging investment in and development of clean energy technologies, green jobs, and protecting public health. The State of Utah Executive Branch, Utah Transit Authority, and Salt Lake City Corporation are voluntary greenhouse gas reporters with The Climate Registry. The communities of Park City and the Town of Alta have also voluntarily inventoried their greenhouse gas emissions.

Salt Lake City Corporation joined the U.S. Conference of Mayors Climate Protection Agreement, committing to strive to meet or exceed the goals of the Kyoto Protocol targets, urge state and federal government to enact policies and programs to meet or exceed Kyoto Protocol targets, and urge congress to pass bipartisan greenhouse gas legislation. Toward these goals, the City has taken aggressive actions to minimize the carbon intensity of its own operations, including fleet vehicle emissions, street and traffic lights, building efficiency, energy monitoring, and the use of renewable energy.

Nationwide, over 1,000 Mayors have signed the U.S. Mayor's Climate Protection Agreement committing their communities to conduct greenhouse gas inventories. Other inventories that have already been completed in the region of Salt Lake City include:

- State of Utah
- Park City, Utah
- Town of Alta, Utah
- Denver, Colorado

The Salt Lake City Corporation (City) already manages a host of successful programs, primarily through the Division of Sustainability and Environment, for which it has been recognized as a national leader. Additionally, there is a vibrant community of sustainability-minded individuals, organizations, and institutions that are responsible for propelling Salt Lake City toward a more sustainable future. Many individuals from these organizations served as valuable members of the Energy and Carbon Advisory Committee (ECAC), which contributed to the accuracy and thoroughness of this inventory.

This inventory is a benchmark from which to better understand Salt Lake City's current greenhouse gas emissions and assess its success in meeting carbon reduction goals. It also will be used to drive a unified community planning effort to assess the effectiveness of strategies for reaching those goals. This detailed understanding of the community's most carbon intense sectors and sources will drive more effective planning and implementation of initiatives. The hope is it also will enable assessment of specific programs over time.

1.1 APPROACH

Objectives, Methodology, and Tools

The goal for the Salt Lake City community greenhouse gas inventory was for it to be an accurate benchmark as well as a living assessment to be expanded and improved over time. To this end, the objectives were to be as complete, consistent, accurate, and transparent as possible.

To ensure that these objectives were met, the ECAC was formed at the request of the Salt Lake City Corporation to provide insight on the inventory. Members were drawn from a broad group of organizations whose interests they were asked to represent. These members provided data and domain expertise on a number of topics. Members also were asked to provide input as members of the community. Their presence and contributions provided a critical perspective on the process, resulting in a more credible, transparent, and accurate inventory. The ECAC met three times regarding the inventory - once to respond to conceptual questions regarding the design, a second time to provide feedback on an intermediate draft, and a third time to discuss the final report.

This inventory was developed in accordance with the guidance of the International Local Government GHG Emissions Analysis Protocol (IEAP) Version 1.0, which is the first protocol to directly address the unique nature of community greenhouse has inventories. For each source, emissions were estimated using the most direct activity data that were reasonably available, such as utility bills for electricity and natural gas consumption. Accepted and well-documented methodologies from The Climate Registry, the Environmental Protection Agency, and other sources were applied to this activity data to yield an estimate of greenhouse gas emissions.

The majority of the calculations behind this inventory were done in an Inventory Management System (IMS). The IMS is a Microsoft Excel-based spreadsheet incorporating collected data, methodologies, emission factors, forecasting, and summary results. The intention was for the IMS to be a clear and transparent tool for on-going management and benchmarking of the community's greenhouse gas emissions.

What is a metric ton of GHG?

The concept of GHG emissions is fairly abstract and it can be helpful to place emissions in the context of familiar daily activities.

Some equivalencies for 1 metric ton of carbon dioxide equivalent include:

- Driving from Salt Lake City to Park City and back 28 times.
- About one round-trip by commercial airline from Salt Lake City to New York City.

Greenhouse Gases, Units, and Terminology

The terms inventory, greenhouse gas emissions, and carbon footprint are used interchangeably in this report to refer to the results of this effort to quantify greenhouse gas emissions in the community. Furthermore, greenhouse gas emission, or simply emission, refers to the release of any greenhouse gas to the atmosphere.

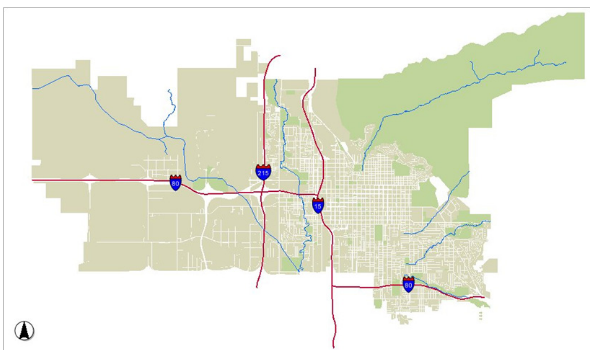
This inventory considered the six greenhouse gases included under the Kyoto framework: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulfur hexafluoride (SF6), and two classes of gases called perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). At the community scale there was insufficient information to estimate emissions of SF6, PFCs, and HFCs. Though these gases have high global warming potentials, their contribution to community greenhouse gas inventories is typically small. These gases comprised only about 2 percent of the U.S. national greenhouse gas inventory in 2008.

Each gas has a different level of impact on global warming, or Global Warming Potential (GWP), so each was converted to carbon dioxide equivalent (CO2e) to allow for simplified reporting in a single unit. Methane and nitrous oxide have GWPs of 21 and 310, respectively. In other words, emitting 1 ton of methane to the atmosphere has the same impact as emitting 21 tons of carbon dioxide. All emissions presented in this report are metric tons of carbon dioxide equivalent (MTCO2e).

Geographic Boundaries and Emission Sources

This inventory attempted to quantify all significant sources of emissions resulting from activities (residential, commercial, industrial, and institutional) that occur within Salt Lake City's limits, or the Salt Lake City community (Figure B). The emissions from municipal operations also were included.

Figure B



All emissions are categorized into three scopes as defined in the IEAP. The purpose of scopes is to prevent double counting emissions between reporting entities. For example, a power plant would report emissions from generating electricity as Scope 1 and consumers using that electricity would report their responsibility to those emissions as Scope 2. By segregating these emissions, they are allocated accurately and not added together.

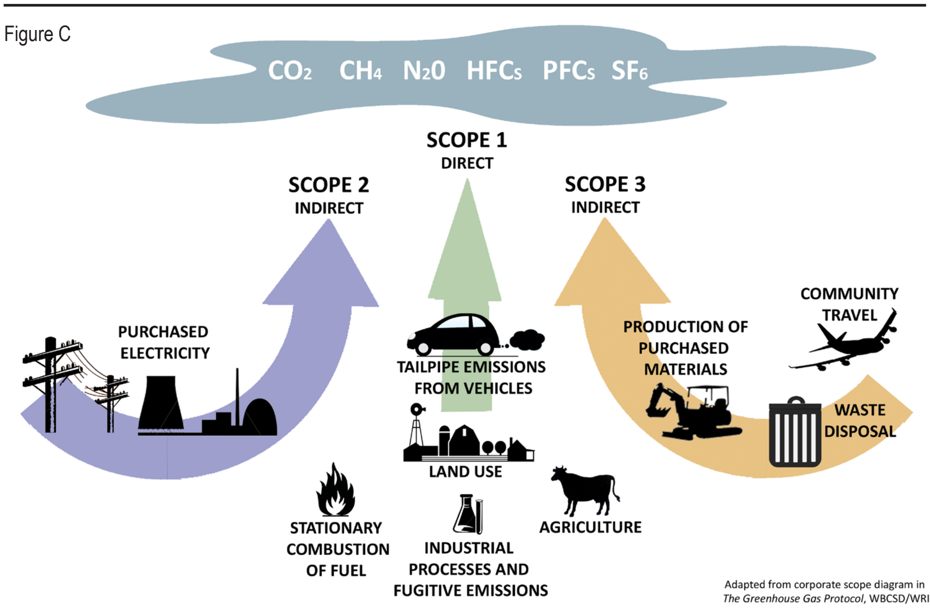
In general, Scope 1 emissions are direct emissions occurring within the community, Scope 2 emissions are those resulting from energy that is purchased by the community but generated elsewhere (primarily electricity), and Scope 3 emissions are other indirect emissions that occur outside of the community as a result of the activities or demand generated by the community. These scopes are outlined graphically in Figure C.

While these scopes are similar in principal to the scopes applied in corporate greenhouse gas inventories they are not identical. For example, the Scope 1 emissions of the community are the aggregate of the Scope 1 emissions of many residential, commercial, industrial, and institutional activities within a geographic boundary.

Most protocols require the reporting of Scope 1 and 2 emissions while Scope 3 emissions are generally at the discretion of the reporting entity and dependent upon available data. There is significant momentum in corporate and community inventories toward increasing reporting of Scope 3 emissions to recognize the full impact of an entity or community's activities. In Scope 3, Salt Lake City has elected to include airline travel and solid waste disposed outside of community boundaries. The embodied or upstream emissions in some materials or products brought into the community from outside are discussed but not quantified at this time.

Total greenhouse gas emissions for 2009 were 4.75 million MTCO2e. Electricity consumption, at 54 percent, represented the single greatest source followed by natural gas at

Figure C



Adapted from corporate scope diagram in *The Greenhouse Gas Protocol*, WBCSD/WRI

Figure A: 2009 Community GHG Emissions by Sector

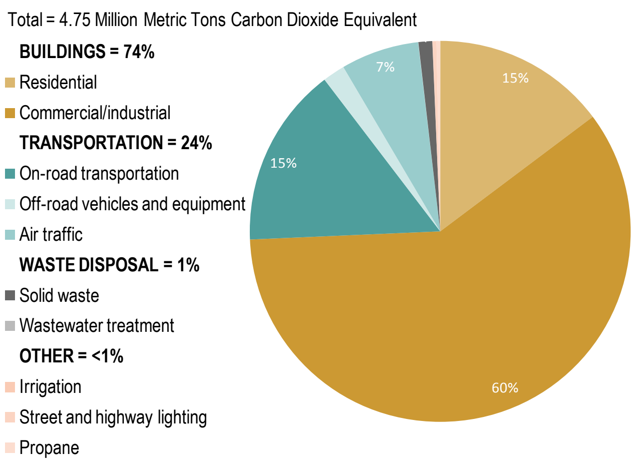
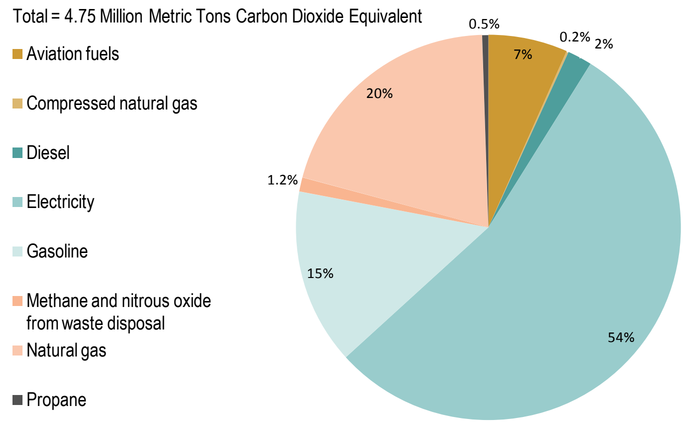


Figure D: 2009 Community GHG Emissions by Source



20 percent. Together these emissions are largely from the building sector and account for nearly 75 percent of the inventory. Transportation made up 24 percent, while about 1 percent of emissions were from waste and other sectors. Scope 1 and 2 emissions made up 38 percent and 54 percent of the 2009 inventory, respectively. Scope 3 emissions, consisting of emissions from air travel and solid waste, made up 8 percent of all emissions.

Emissions between 2005 and 2009 remained relatively steady, with no clear trends. The inventory shows 2007 having slightly higher emissions than 2006 despite downward trending consumption due to a higher emissions intensity in the generation of electricity during that year.

Figure E: 2009 Community GHG Emissions by Scope

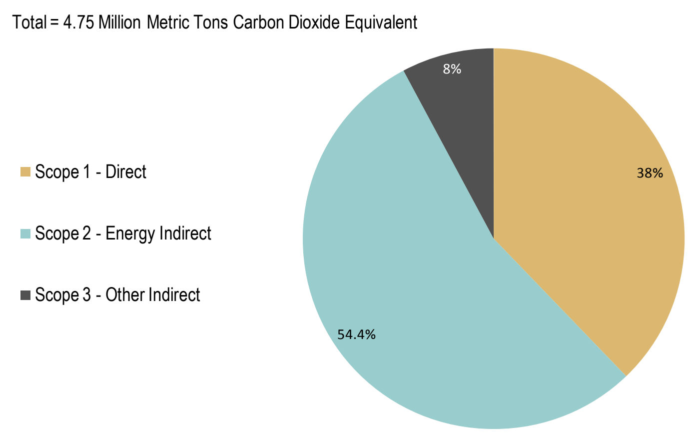


Figure F: 2005-2009 Community GHG Emissions by Sector

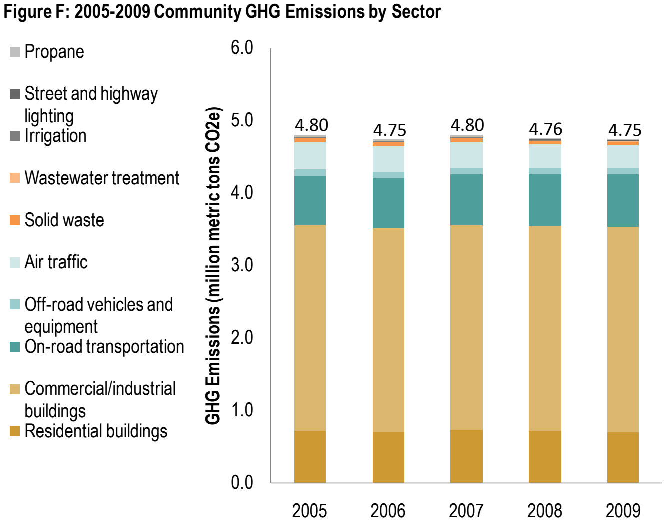
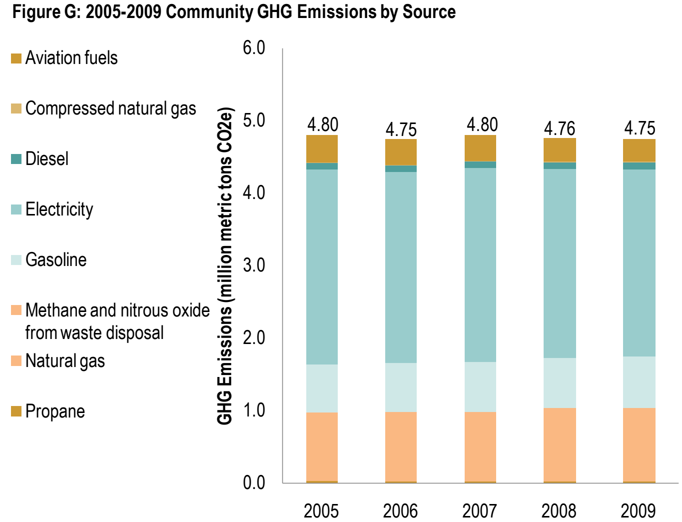


Figure G: 2005-2009 Community GHG Emissions by Source



2.0 COMMUNITY GREENHOUSE GAS INVENTORY

2.1 Energy

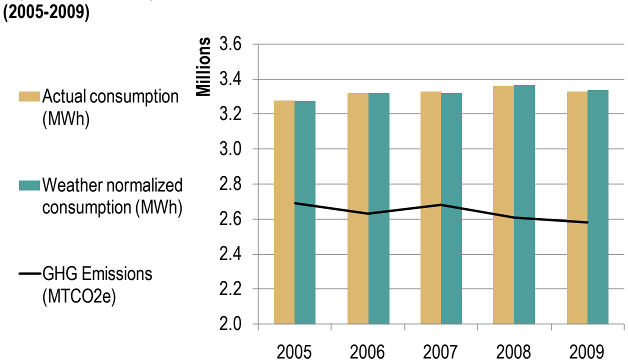
Stationary energy consumption from sources such as electricity and natural gas accounted for about 3.5 million MTCO2e, or 74 percent of total emissions in 2009. This consumption occurs primarily in the building sector for heating, cooling, lighting, and operating processes and equipment. Greenhouse gas emissions resulting from energy consumption include direct emissions from combustion (Scope 1) as well as indirect emissions (Scope 2) from electricity consumption.

Electricity

Electricity is a Scope 2 source of emissions with greenhouse gases emitted at the site of generation, which is generally not within city limits. These emissions primarily come from combusting coal, natural gas, and oil to generate electricity.

Electricity consumption was the single largest source of emissions in the inventory, accounting for about 2.6 million MTCO2e, or 54 percent of total emissions in 2009. The vast majority of electricity is consumed in buildings, with industrial, commercial, and residential accounts responsible for 12.3 percent, 29.9 percent, and 8.6 percent of total emissions, respectively. Accounts specific to irrigation, sales to public authorities, and street and highway lighting contributed an additional 3.5 percent of total emissions.

Figure H: Electricity Consumption and Emissions (2005-2009)



From 2005 to 2009 electricity consumption increased by 1.7 percent, the emissions intensity of the electricity decreased by 5.7 percent, and the resulting greenhouse gas emissions decreased by 4.1 percent. So, while consumption was up over the period, Rocky Mountain Power's movement toward lower-carbon natural gas and wind resources reduced the emissions intensity of the energy being consumed such that emissions were down over the period. Electricity consumption also was normalized for weather to account for the impacts of increased cooling during a hotter year, and it was determined that weather had a relatively minimal impact on consumption in these years.

Rocky Mountain Power, the only electric utility in Salt Lake City, provided consumption data based on billing records for 2006 to 2009. Records were unavailable for 2005 so consumption in that year was estimated based on population and per capita consumption in 2006. Emissions factors that determine the emissions intensity of delivered electricity were obtained from third-party verified reporting by PacifiCorp, Rocky Mountain Power's parent company, to the California Climate Action Registry. The 2008 emission factor was used for 2009 because 2009's factor is not yet publically available.

One of PacifiCorp's natural gas generating facilities, the Gadsby Power Plant, is located in Salt Lake City's limits. The emissions from this facility were incorporated in the emission factor from PacifiCorp and therefore a portion of these emissions were attributed to Salt Lake City by calculating emissions from electricity consumption. However, this facility also is combusting natural gas, which results in direct Scope 1 emissions in the community. To avoid double counting these emissions in both electricity consumption and the combustion of the natural gas, the direct emissions from the natural gas combustion at this facility were subtracted from the rest of the community's natural gas emissions. Salt Lake City's inventory accounted for emissions at this facility through electricity consumption, which is more within the community's realm of influence.

Renewable or Green Energy

Many sources of renewable energy, such as solar and wind, have no direct greenhouse gas emissions and present an opportunity to lower a community's emissions associated with energy consumption. Much of the renewable energy generated in Salt Lake City is likely produced and consumed at the sites on which it is produced, thereby reducing electricity purchased from the grid and associated emissions. Therefore, the benefits of on-site renewable energy are inherently accounted for in the inventory.

The emission benefits potentially associated with Renewable Energy Credits (RECs) are not recognized as deductions from the emissions inventory. This is largely because the renewable energy purchaser does not directly consume the energy, and accounting challenges arise in determining the associated greenhouse gas reduction. Still, purchasing off-site renewable energy (for example, with RECs) can be a powerful force for developing the market for renewable energy and thereby reducing greenhouse gas emissions.

Salt Lake City residents and businesses have had a significant impact with their growing participation in Rocky Mountain Power's Blue Sky Program. This program purchases RECs and develops small-scale renewable energy projects in the communities the utility serves. Since 2005, household participation has grown steadily from 6 percent to more than 9 percent of accounts, with 7,000 customers purchasing more than 22 million kilowatt-hours of renewable energy. Non-residential participation has increased from 1 percent to 1.7 percent of accounts, with purchases exceeding 18.5 million kilowatt-hours in 2009. These REC purchases represent a willingness to pay a premium for clean energy.

Natural Gas

Natural gas is combusted to heat buildings, provide hot water, and provide heat for industrial processes. Resulting emissions occur at the site of combustion. Natural gas also can be used as vehicle fuel, but those emissions are accounted for under the transportation portion of the inventory.

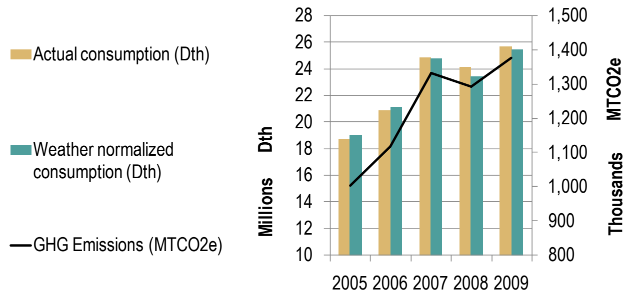
Building energy consumption, electricity and natural gas, in Salt Lake City was found to be similar to average building energy consumption for buildings in similar climate zones according to the Residential Energy Consumption Survey and Commercial Building Energy Consumption Survey.

Residential building energy consumption in Salt Lake City was estimated to be 101 MMBtu/household in 2008 while the national average was 96-101 MMBtu/household. Commercial building energy consumption in Salt Lake City was estimated to be 110 kBtu/square foot in 2009 while the national average was 105 kBtu/square foot.

Natural gas represented the largest Scope 1 emission source in the inventory. In 2009, emissions from natural gas were approximately 960,000 MTCO2e, or about 20.4 percent of the total inventory. The majority of natural gas is consumed in the commercial and industrial sectors, resulting in 14.2 percent of total emissions, while the residential sector contributes an additional 6.1 percent of emissions. The emissions from the Gadsby Power Plant were not included in any of the above values since these emissions are accounted for under electricity consumption.

From 2005 to 2009 natural gas consumption and emissions were up 37 percent. Since the emissions intensity of natural gas is essentially constant, this increase is driven by an increase in consumption. Almost all of this increase occurred in the commercial and industrial sectors. Like electricity, natural gas consumption also normalized for weather to account for the impacts of increased heating during a colder year, and it was determined that weather had a relatively minimal impact on consumption in these years with the exception of 2008. The year 2008 was colder than average, resulting in weather-normalized consumption 3 percent below actual consumption. In all cases, emissions were calculated based on actual consumption since these values represented the actual emissions generated.

Figure I: Natural Consumption and Emissions (2005-2009)



Questar Gas, the only natural gas utility in Salt Lake City, provided consumption data for residential and non-residential accounts based on billing records for 2005 to 2009. Emissions from combusting natural gas were calculated using factors for CO2, CH4, and N20 from The Climate Registry based on the sector consuming the gas (residential, commercial, or industrial).

Propane

Propane is typically used for similar applications as natural gas. However, with the broad availability of natural gas within Salt Lake City limits, propane use for building and water heating is likely limited. Some applications like outdoor grills were included. Emissions from propane consumption occur at the site of combustion.

Propane is likely a very small Scope 1 emission source in the inventory. In 2009, emissions from propane were estimated to be about 25,000 MTCO2e, or about 0.5 percent of the total inventory. State-wide, propane consumption and resulting emissions were down about 7 percent between 2005 and 2009.

Determining the consumption of propane within city limits is difficult. Retail providers are numerous and diversely located and distributors may serve a large area, making it difficult to isolate the sales of propane to a specific region. Furthermore, because of the competitive nature of this industry, providers are often unwilling to disclose sales data. Therefore, sales of propane within city limits were estimated based on the average per capita consumption for the State of Utah, which was determined from sales volumes compiled by the U.S. Energy Information Administration. These per capita averages likely are high for an urban area with access to natural gas service but represent a reasonable upper-bound for emissions. Emissions factors from The Climate Registry were applied.

2.2 TRANSPORTATION

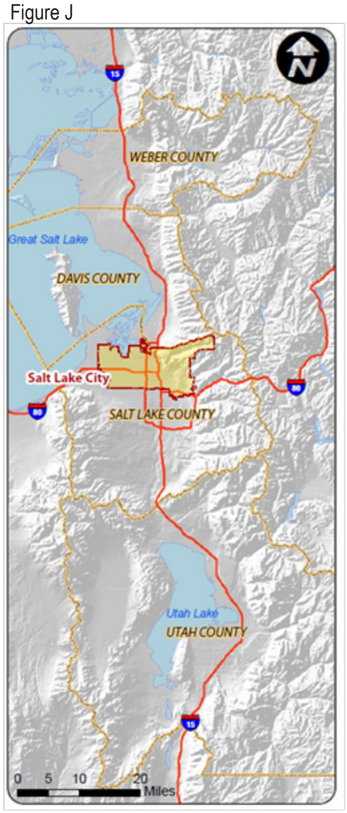
Transportation activities accounted for about 1.3 million MTCO2e, or 24 percent of total emissions, in 2009. Activities in this sector include on-road vehicle transportation, off-road vehicles and equipment, and air travel. Greenhouse gas emissions from transportation are direct and result from the combustion of fossil fuels in the engine, and largely occur within the city limits except as noted.

On-Road Transportation

On-road transportation includes emissions generated by personal and commercial vehicles and transit services within city limits and trips that cross Salt Lake City's boundary. These emissions are generally the result of combusting gasoline or diesel fuel and therefore occur directly, as Scope 1, within the community.

In 2009, on-road transportation accounted for an estimated 727,000 MTCO2e, or about 15.3 percent of total emissions. Gasoline, diesel, and compressed natural gas (CNG) contributed 14.3, 0.9, and 0.1 percent of total emissions, respectively. These emissions were the result of an estimated 1.35 billion vehicle miles traveled (VMT) in 2009.

Figure J



The transportation model employed in this analysis is based on two snapshots: one in 2005 and one in 2030. While unique data are not available for the years 2006 to 2009, it was estimated that greenhouse gas emissions from on-road transportation will increase by 1.4 percent year-over-year between 2005 and 2030.

Fehr and Peers Transportation Consultants estimated on-road vehicle emissions using the Wasatch Front Regional Council's Regional Travel Model, which included land use and transportation infrastructure throughout the Wasatch Front. The model estimated travel demand by determining trip origins, destinations, time, and mode. The model included transit trips made via TRAX light rail, FrontRunner commuter rail, and local buses into/out of and within Salt Lake City limits. Indirectly, the other transit lines, such University of Utah campus shuttles and Salt Lake City school district buses, were accounted for to the degree that they travel on roads that are contained within the travel demand model. The travel demand model for 2030 included major transit facilities that are planned for completion between now and 2030.

> Vehicle miles travelled per capita (VMT/capita) in Salt Lake City was found to be about 7,400 in 2009. The Bureau of Transportation Statistics estimates 10,143 VMT/capita for the State of Utah and the Brookings Institution estimates 9,339 VMT/capita for the Salt Lake City metropolitan area. The per capita VMT for Salt Lake City is likely lower because of the relatively short length of trips occurring within the city limits and the number of people who have short commutes because they live and work in Salt Lake City.

All mileage for trips beginning and ending within the city limits were included in the inventory. For trips beginning or ending outside of the city, the emerging approach is to have each involved community account for half of the mileage. Mileage for trips that pass through the community (those that begin and end outside of the city limits) are not included in the inventory because Salt Lake City has little ability to influence these emissions. Mobile 6, the standard air quality model used for regional air conformity analysis as required by the Clean Air Act, provided emission factors representative of fleet averages and these factors were used to estimate emissions from the modeled vehicle trips.

Air Traffic

Salt Lake City International Airport served residents, visitors, and connecting air travelers with more than 20 million passengers enplaned (boarding departing aircraft) in 2009. The emissions for the ground activities at the airport, including buildings and ground equipment, are accounted for in this inventory's other source categories. The emissions estimated here are for aircraft departing Salt Lake City International.

The air traffic emissions attributed to Salt Lake City are estimated to have been about 315,000 MTCO2e, or about 7 percent of total emissions, in 2009. Between 2005 and 2009, air travel emissions attributed to Salt Lake City decreased by 16 percent because of improvements in aircraft fuel economy and declining numbers of passengers in a down economy.

Methodologies for calculating airport emissions generally agree that each airport should account for the emissions of departing aircraft only and thereby clearly define the split of emissions between origin and destination airports. Fuel consumption data for departing aircraft were not readily available for Salt Lake City International and therefore an estimate was made based on the number of enplaned passengers and data on fuel-efficiency per passenger mile extrapolated from information compiled by the Bureau of Transportation Statistics.

A number of approaches have been proposed for attributing the emissions from air travel to the many communities and the broader region served by an airport such as Salt Lake City International. These approaches range from attributing all of the emissions of departing aircraft to the host community - a large number considering the area that Salt Lake City International serves - to estimating the travel demand of residents in the community only. For Salt Lake City, an intermediate approach was applied that is consistent with the demand-based approach applied by the City and County of Denver in that community's inventory. Air travel emissions were apportioned to Salt Lake City based on the fraction of vehicle trips to Salt Lake City International from Salt Lake City proper as compared to total vehicle trips to the airport from the broader region as estimated by the Wasatch Front Regional Council's Regional Travel Model. This fraction was 16.9% in 2005 and that value was applied for all years.
The result is that air travel emissions attributed to Salt Lake City included those from the direct demand generated by residents, those from visitors that bring economic benefits to the community, and for a portion of the connecting traffic through the airport, which is a function of the airport's status as a hub.

Off-road Vehicles and Equipment

There are many applications of transportation fuels that occur off-road or in equipment that serves other uses. Examples include vehicles and equipment used in agriculture, construction and mining, lawn and garden maintenance, logging, railroad maintenance, watercraft, and other recreational equipment. As with on-road vehicles, emissions resulting from off-road sources are direct, resulting from the combustion of fossil fuels in the engine.

Operation of off-road vehicles and equipment were estimated to have resulted in about 90,000 MTCO2e, or 1.9 percent of total emissions, in 2009. Emissions in this category increased 5 percent over from 2005 to 2009.

Emissions from this category were estimated using the Environmental Protection Agency's NONROAD Emissions Model. The outputs of this model were at the County scale; therefore, the model was run for Salt Lake County. These results were attributed to Salt Lake City based on the ratio of city to county population with the following exceptions:

- Agricultural equipment emissions were assumed to be zero in the city limits.
- Airport equipment emissions were assumed to be entirely within the city limits because of the location of Salt Lake City International Airport.
- Logging equipment emissions were assumed to be zero in the city limits.

2.3 WASTE DISPOSAL

Waste disposal activities accounted for about 56,000 MTCO2e, or about 1 percent of total emissions, in 2009. Activities in this sector include landfill disposal of solid wastes and wastewater treatment processes. Greenhouse gas emissions resulting from waste disposal are direct and result from decomposition of organic materials and waste management processes. For Salt Lake City, the emissions from wastewater treatment occur within city limits while those for waste disposal occur at landfills outside of city limits.

Solid Waste

Emissions from solid waste disposal occur when organic materials decompose in the landfill. These are direct emissions but they occur at landfills outside of city limits and are therefore Scope 3 emissions.

The emissions attributed to Salt Lake City for landfilled solid waste were estimated to be about 56,000 MTCO2e, or about 1 percent of total emissions, in 2009. Between 2005 and 2009, there is insufficient data on commercial waste generation to accurately estimate a trend in emissions from solid waste disposal. However, the rate of diversion of materials from the landfill to other options, such as recycling and composting, has increased for both residential and commercial waste streams and emissions have likely decreased as a result. Based on available data, residential diversion has increased from 13 to 19 percent and commercial diversion has increased to 8 percent over the period.

The residential solid waste in Salt Lake City is collected by Salt Lake City Corporation and complete records of the weight of material disposed and diverted were available.

Residential waste is disposed at the Salt Lake Valley Landfill, which employs a landfill gas capture system to collect methane from decomposing waste. This collected methane is used to generate electricity. The emission factor for waste disposed at this facility was estimated using Environmental Protection Agency Landfill Methane Outreach program data on the performance of the collection system and The Climate Registry's Local Government Operations Protocol.

The commercial solid waste in Salt Lake City is collected by a number of private haulers and the weight of waste collected was provided for a few years in the period. For those years in which data were not available or were incomplete, national average per capita waste generation rates from the Environmental Protection Agency were substituted. Private haulers tend to include customers in multiple municipalities on each route to minimize route distance making it difficult for them to provide data specific to Salt Lake City limits. Landfilled commercial waste is largely disposed in Tooele County according to the haulers that provided data. Since the facility was not specified, a national average emission factor for landfills from the Environment Protection Agency's Waste Reduction Model was applied for commercial waste.

While greenhouse gas emissions for solid waste disposal are small relative to other sources in the community because of existing solid waste diversion programs, landfill methane capture systems, and the relatively low emissions that are typical of landfills in arid regions, it is worthwhile to note that diversion activities like recycling and composting can reduce emissions elsewhere. Many materials can be brought to market with significantly lower greenhouse gas emissions when recycled sources of materials are used instead of virgin sources. For example, the Environmental Protection Agency estimates that over 13 MTCO2e are avoided for each ton of aluminum that is recycled back into the material market.

Wastewater Treatment

Treating municipal wastewater can produce emissions of CH_4 and N_2O from a number of sources depending on the particular treatment process applied. For Salt Lake City, N_2O emissions occur from processes, CH_4 from incomplete combustion of biogas in flares, and CH_4 from combustion of biogas in boilers and cogeneration engines.

A preliminary estimate of process related emissions of CH_4 and N_2O from wastewater treatment in Salt Lake City was less than 200 MTCO2e, or much less than 1 percent of the total inventory, in 2009. These preliminary emissions calculations were done by Salt Lake City Corporation to prepare for forthcoming reporting to The Climate Registry. The emissions were calculated using The Climate Registry's Local Government Operations Protocol.

2.4 OTHER EMISSION SOURCES

There are a number of other potential sources of greenhouse gas emissions in Salt Lake City that were considered but not quantified in this inventory. These sources may be considered for future inventories as available data improve and policy directions change.

Embodied or Life-cycle Emissions: Corporate and community greenhouse gas inventories are increasingly recognizing the significant energy, and resulting emissions, that go into mining and processing, manufacturing and production, and transportation associated with the materials and goods purchased by a community. Well thought-out sourcing, material selection, and buying local are all strategies that communities can consider to reduce these impacts.

Life cycle analysis models are available, such as Carnegie Mellon's Economic Input-Output Life cycle Assessment (EIO-LCA), that estimate at national or broad regional scales the greenhouse gas impacts per dollar spent on different categories of goods. Combined with regional statistics from the Bureau of Labor Statistics on Consumer Expenditures, it is possible to estimate the greenhouse gas impact of a community's purchasing habits. For example, the at-home purchases of food in Salt Lake City could generate greenhouse gas emissions that are as much as 10 percent of the total emissions in this inventory. Since both of these data sources are on a regional scale and not specific to Salt Lake City, these emissions were not included in the inventory at this time.

Land Use: While the indirect effects of land use and planning can be significant in their impact on transportation and greenhouse gas emissions, the direct impacts of land use change are not often considered. Land management and changes in the use of land can alter the vegetation, or biomass, and result in greenhouse gas emissions. For example, a housing development can disturb existing surface and soil biomass and lead to additional greenhouse gas emissions. While these impacts can be significant at the county or larger scale, for a community with mostly urban land use like Salt Lake City, they are likely minimal.

Industrial Process Emissions: A list of businesses and industries in Salt Lake City with air permits were reviewed to assess whether they were likely sources of greenhouse gas emissions from on-site processes that were additional to the emissions from the utilities they purchase (electricity and natural gas) that were otherwise accounted for in this inventory. With the exception of refineries, no likely sources were identified. There were no publically available data identified that could reasonably be used to estimate the emissions of refineries in Salt Lake City.

Under the Environmental Protection Agency's Mandatory Reporting of Greenhouse Gases (40 CFR Part 98), any facility (including refineries) that emits more than 25,000 MTCO2e will be required to report emissions. This reporting starts over the next 2 years and will be an opportunity for Salt Lake City to identify and include any additional significant sources of process emissions.

Fertilizers: Applying fertilizers can be a significant source of N2O emissions in agriculture. However, at the city scale, there was no ready source of information for estimating the quantity of fertilizer applied to lands within city limits, and the likely emissions from this source are negligible.

Refrigerants: There are two classes of gases, PFCs and HFCs, used for applications such as building cooling, food refrigeration, and vehicle air conditioning that are also greenhouse gases. At the city scale there was insufficient information to estimate the emissions of these gases. However, these gases and sulfur hexafluoride together comprised only about 2 percent of the U.S. national greenhouse gas inventory in 2008 and are therefore likely to be minor sources in Salt Lake City as well.

Rail Travel: Insufficient data were readily available to estimate the emissions from passenger and freight rail traffic through Salt Lake City. However, with its relatively small geographic area, Salt Lake City has limited rail mileage with respect to the rest of the state, and emissions occurring within Salt Lake City are likely minimal.

3.0 BENCHMARKING AND FORECAST

3.1 Benchmarks

Many factors can influence the magnitude of a community's greenhouse gas inventory and whether that inventory can be reasonably compared, or benchmarked, with other community's inventories. These factors include aspects largely out of the control of the community, such as the presence of energy intensive industry sectors or factors the community may be able to influence, such as the carbon intensity of the energy sources it uses and the types of new business it seeks to attract.

Further complicating the comparison of emissions between communities is the multitude of approaches a community may take to estimate emissions, including the protocol selected, the available activity data, and the types of emissions a community includes in an inventory. Despite these challenges, it can still be valuable to benchmark against other communities to understand these differences and the opportunities for improvement in both the inventory approach and actual emissions that the approach may reveal.

In 2009, Salt Lake City's emissions were approximately 26.3 MTCO2e per person. From 2005 to 2009, these per capita emissions have decreased over 3 percent from about 27.1 MTCO2e per person. These emissions are consistent in magnitude with the State of Utah and the U.S. National Average, which were 27 MTCO2e and 25 MTCO2e in 2005, respectively.

Figure K: Per Capita GHG Emissions Comparison

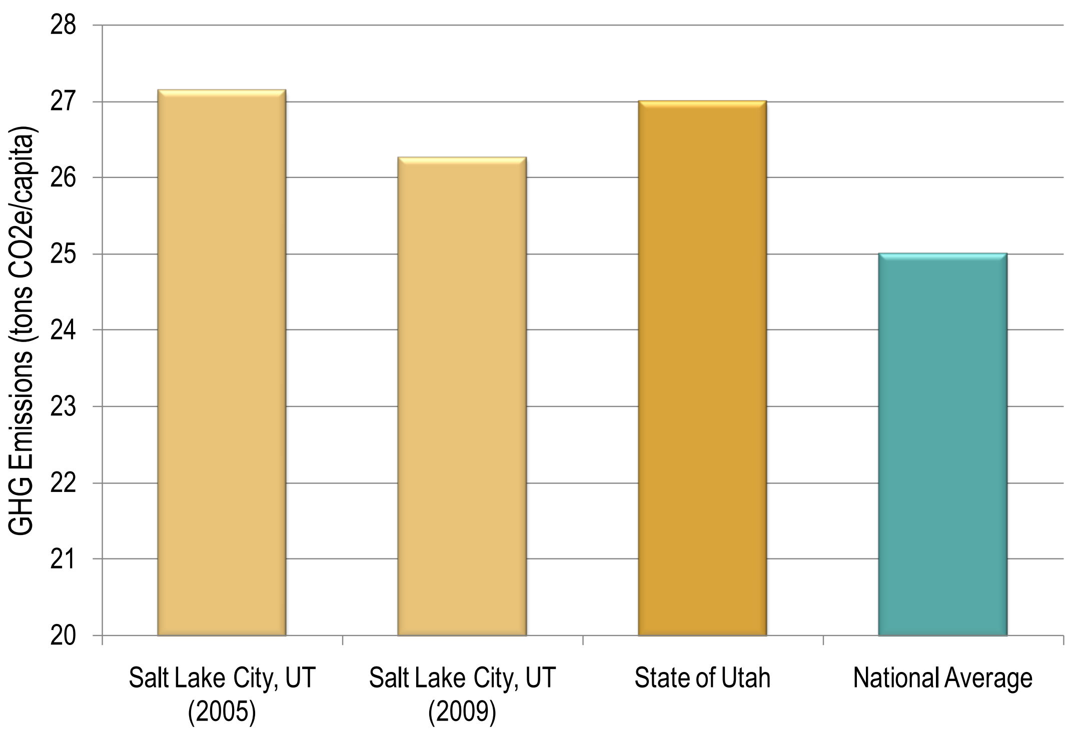
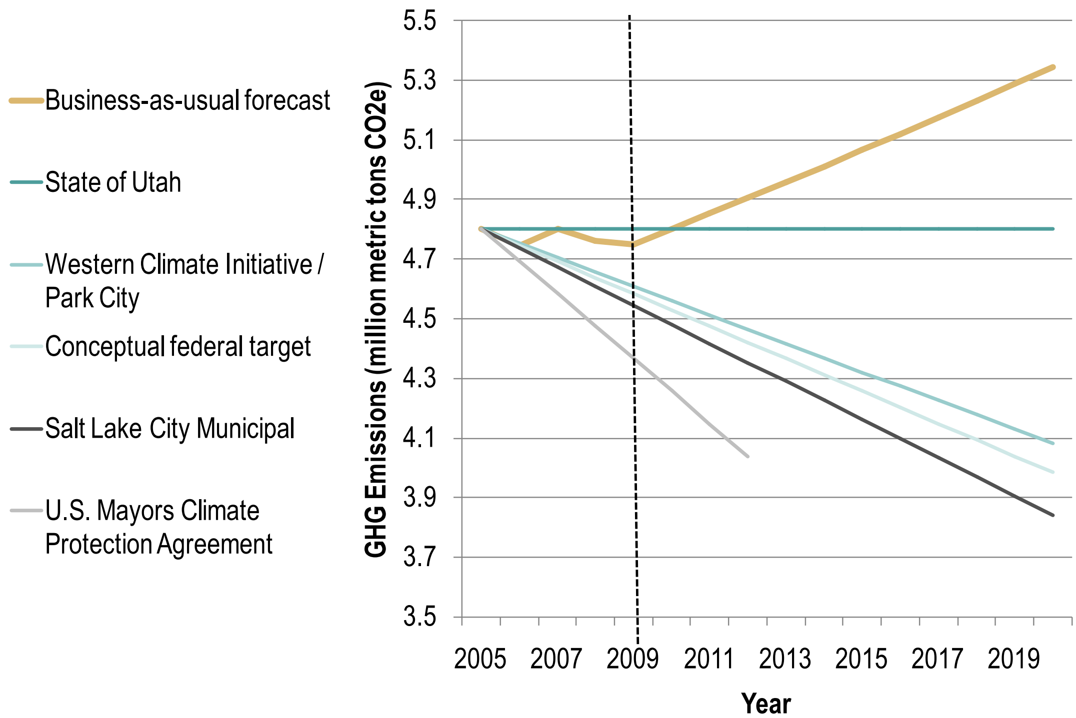


Figure L: 2010-2020 Business-As-Usual Forecast and Target Scenarios



3.2 Forecast of Greenhouse Gas Emissions

This inventory provides greenhouse gas emission estimates over the period from 2005 to 2009 for Salt Lake City. This information will be useful to the City and the community in prioritizing energy consumption and greenhouse gas reduction efforts and estimating the potential benefits of those efforts. In order to set reduction targets and understand those targets in the context of goals being set by other communities, regions, and the nation, it is necessary to forecast emissions into the near future.

A business-as-usual (BAU) forecast was prepared for Salt Lake City from 2010 to 2020. This forecast is based on emissions today and does not account for reduction efforts in progress in Salt Lake City, those that may be implemented in Salt Lake City over the next 10 years, nor those that will occur as a result of changes in state or federal standards, such as increases in fleet fuel efficiency or likely reductions in the emissions intensity of electricity.

Emissions from most sources in the inventory are projected to grow at the projected rate of population growth in Salt Lake City from 2010 to 2020 (1.02 percent year-over-year) based on information from the Utah Governor's Office of Planning and Budget. The one exception is on-road transportation emissions, which are projected to grow by 1.4 percent year-over-year based on the change between the 2005 and 2030 scenarios of the Wasatch Front Regional Council's Regional Travel Model. Some of the other sources of emissions, such as electricity and natural gas, have forecasting available from their respective utility providers but they are usually across a broader service territory where the rate and patterns of growth may differ from Salt Lake City.

4.0 THE ROLE AND FUTURE OF THE GREENHOUSE GAS INVENTORY

This inventory will serve as a tool for the Salt Lake City community and local government to understand the magnitude of their energy consumption and greenhouse gas emissions, to design and implement meaningful efforts to reduce energy consumption, and to track progress toward targets that may be set.

The inventory will be updated every year to incorporate the most recent available data, update any approaches to align with best practices, and account for any significant changes in boundaries or emission sources that are likely to alter community-wide emissions.

The results of this inventory effort will inform the upcoming community energy and sustainability action plan, which is under development by the ECAC and the Salt Lake City Corporation. This plan will establish a community-wide target related to energy and carbon, identify strategies to achieve that target, and provide a roadmap for implementing the strategies.

As a measurement tool, the inventory should reflect the aggregate impacts of Salt Lake City's efforts over the long-term with respect to energy consumption and carbon emissions.