City of Carlsbad

Council Memorandum

July 13, 2020

To:	Honorable Mayor Hall and Members of the City Council
From:	Sheila Cobian, Assistant to the City Manager
Via:	Geoff Patnoe, Assistant City Manager
Re:	**Additional Materials Related to Staff Report Item No. 17 – Amendment No. 1 to the Climate Action Plan**

This memorandum provides additional material regarding the staff report for the July 14, 2020, City Council Meeting Item No. 17 – Amendment No. 1 to the Climate Action Plan.

Exhibit 1 (Resolution) referenced an Attachment A – Climate Action Plan, that was not included in the published staff report. Please find attached the Climate Action Plan.

Attachment: A. City of Carlsbad Climate Action Plan Revised: May 2020

cc: Scott Chadwick, City Manager
Celia Brewer, City Attorney
Mike Grim, Senior Program Manager

City Manager Department
City Clerk Services
1200 Carlsbad Village Drive | Carlsbad, CA 92008 | 760-434-2808 t

Attachment A

City of Carlsbad
California

Climate Action Plan

Adopted: September 2015

Revised: May 2020

Table of Contents

List of Figures iii

List of Tables iv

Introduction 1-1

- **1.1** Scope and Purpose 1-1
- **1.2** Climate Change and Greenhouse Gases Overview 1-2
- **1.3** California GHG Reduction Legal Framework 1-5
- **1.4** Federal and State Emissions Reductions Strategies and Standards .. 1-6
- **1.5** Planning Process 1-7
- **1.6** How to Use This Plan 1-9

Emissions Inventory 2-1

- **2.1** Methodology 2-1
- **2.2** 2012 Baseline Community GHG Inventory 2-4
- **2.3** Government Operations Inventory 2-5

Greenhouse Gas Reduction Target, Forecasts, and Emissions "Gap" 3-1

- **3.1** GHG Reduction Target 3-1
- **3.2** Business as Usual Forecast 3-2
- **3.3** Government Operations Forecast 3-6
- **3.4** GHG Reductions to Community Forecast from Federal and State Actions 3-8
- **3.5** Modified Baseline: GHG Reductions from Additional General Plan Policies and Actions 3-10
- **3.6** Modified Baseline and the GHG Emissions "Gap" 3-19

CAP GHG Reduction Measures 4-1

- **4.1** Residential, Commercial and Industrial Photovoltaic Systems 4-2
- **4.2** Building Cogeneration 4-4
- **4.3** Single-family, Multi-family, Commercial, and City Facility Efficiency Retrofits 4-4
- **4.4** Commercial and City Facility Commissioning 4-7

4.5 Green Building Code 4-8
4.6 Efficient Lighting Standards 4-8
4.7 Solar Water Heater/Heat Pump Installation 4-9
4.8 Transportation Demand Management 4-11
4.9 Increased Zero-Emissions Vehicle (ZEV) Travel 4-13
4.10 Citywide Renewable Projects 4-15
4.11 Water Utilities System Improvements 4-16
4.13 Clean Electricity 4-19
4.14 Combined Effect of CAP GHG Reduction Measures and Forecast with CAP 4-20

Implementation, Monitoring and Reporting.....5-1

5.1 Implementation 5-1
5.2 Monitoring and Reporting 5-13
5.3 Project Review Thresholds and Checklist.....5-15

Appendix A - Climate Change Informational Resources

Appendix B - City of Carlsbad Greenhouse Gas Emissions Inventories

B-1 2012, 2014 and 2016 City of Carlsbad Greenhouse Gas Inventories

B-2 2005 and 2011 Local Government Operations Greenhouse Gas Inventory Updates

Appendix C - References

Appendix D - Applicable General Plan Policies

Appendix E – Project Level Mitigation Measures

List of Figures

Figure 1-1: Greenhouse Gas Effect 1-3
Figure 1-2: History of global surface temperature since 1880 1-4
Figure 2-1: 2012 Community GHG Emissions by Category 2-5
Figure 4-1: Forecast Community Emissions with CAP Reduction Measures and Targets 4-22
Figure 5-1: Process of Climate Action Planning 5-13

List of Tables

Table 2-1: Data Sources for Activities and Emissions Factors In Community Inventories 2-3
Table 2-2: 2012 Community GHG Emissions 2-5
Table 2-3: Buildings and Facilities Inputs; 2011 2-6
Table 2-4: Government Operations Vehicle Fleet Inputs 2-7
Table 2-5: Public Lighting Inputs (kWh) 2-8
Table 2-6: Waste and Wastewater Transport Inputs (kWh) 2-8
Table 2-7: Government Operations Emissions by Sector ($MTCO_2$**e**) 2-9
Table 2-8: Emissions by Source ($MTCO_2$**e**) 2-9
Table 2-9: 2011 Government Operations Emissions vs 2012 Community Emissions ($MTCO_2$**e**) 2-9
Table 3-1: 2012 Emissions and Emissions Targets 3-2
Table 3-2: 2035 Population And Job Growth Forecast 3-3
Table 3-3: 2020 Community Forecast Emissions By Category 3-5
Table 3-4: 2035 Community Forecast Emissions By Category 3-5
Table 3-5: Government Operations Emissions Inventory (2011) and 2020, 2035 Forecast ($MTCO_2$**e**) 3-8
Table 3-6: Community Forecast with State and Federal Actions ($MTCO_2$e) 3-10
Table 3-7: GHG Reductions from Additional General Plan Policies and Actions 3-19
Table 3-8: Modified Baseline Forecast (Forecast Community Emissions with Federal and State Actions and Additional General Plan Policies and Actions) 3-19
Table 4-1: CAP GHG Reduction Measures Summary 4-21
Table 4-2: Forecast Community Emissions with CAP GHG Reduction Measures and Targets 4-21
Table 5-1: CAP Implementation Matrix 5-3

1

Introduction

1.1 Scope and Purpose

Background and Purpose

The Climate Action Plan (CAP) is designed to reduce Carlsbad's greenhouse gas (GHG) emissions and streamline environmental review of future development projects in the city in accordance with the California Environmental Quality Act (CEQA).

The original CAP, adopted in September 2015, was prepared concurrently with the city's updated General Plan and included actions to carry out the General Plan's goals and policies, consistent with the Community Vision articulated during Envision Carlsbad. The original CAP was also correlated with the Environmental Impact Report (EIR) on the General Plan, with the CAP GHG reduction target synchronized with the EIR. CAP Amendment No. 1, adopted in May 2020, revised the greenhouse gas inventory, reduction targets and forecast, updated reductions from existing measures, and incorporated Community Choice Energy as a new reduction measure (Measure P). An Addendum to the EIR was also prepared.

Community Vision and Environmental Stewardship

Carlsbad has long been a steward of environmental sustainability. In 2007, the Carlsbad City Council adopted a set of sustainability and environmental guiding principles (Resolution No. 2007-187) to help guide city investments, activities, and programs. Sustainability emerged as a key theme during the Envision Carlsbad community outreach process, and reflected as a Core Value of the Community Vision:

> ***Core Value 6: Sustainability.*** Build on the city's sustainability initiatives to emerge as a leader in green development and sustainability. Pursue public/private partnerships, particularly on sustainable water, energy, recycling, and foods.

The General Plan

The General Plan includes strategies such as mixed-use development, higher density infill development, integrated transportation and land use planning, promotion of bicycle and pedestrian movements, and transportation demand management. It also includes goals and policies to promote energy efficiency, waste reduction, and resource conservation and

recycling. These strategies, goals, and policies would result in GHG reduction compared to baseline trends.

CAP

The CAP includes goals, policies, and actions for Carlsbad to reduce GHG emissions and combat climate change and includes:

- An inventory of Carlsbad's citywide and local government GHG emissions;
- Forecasts of future citywide and local government GHG emissions;
- A comprehensive, citywide strategy and actions to manage and reduce GHG emissions, with emission targets through 2035; and
- Actions that demonstrate Carlsbad's commitment to achieve state GHG reduction targets by creating enforceable measures, and monitoring and reporting processes to ensure targets are met.

The timeframe for the Plan extends from the date of adoption through 2035.

1.2 Climate Change and Greenhouse Gases Overview

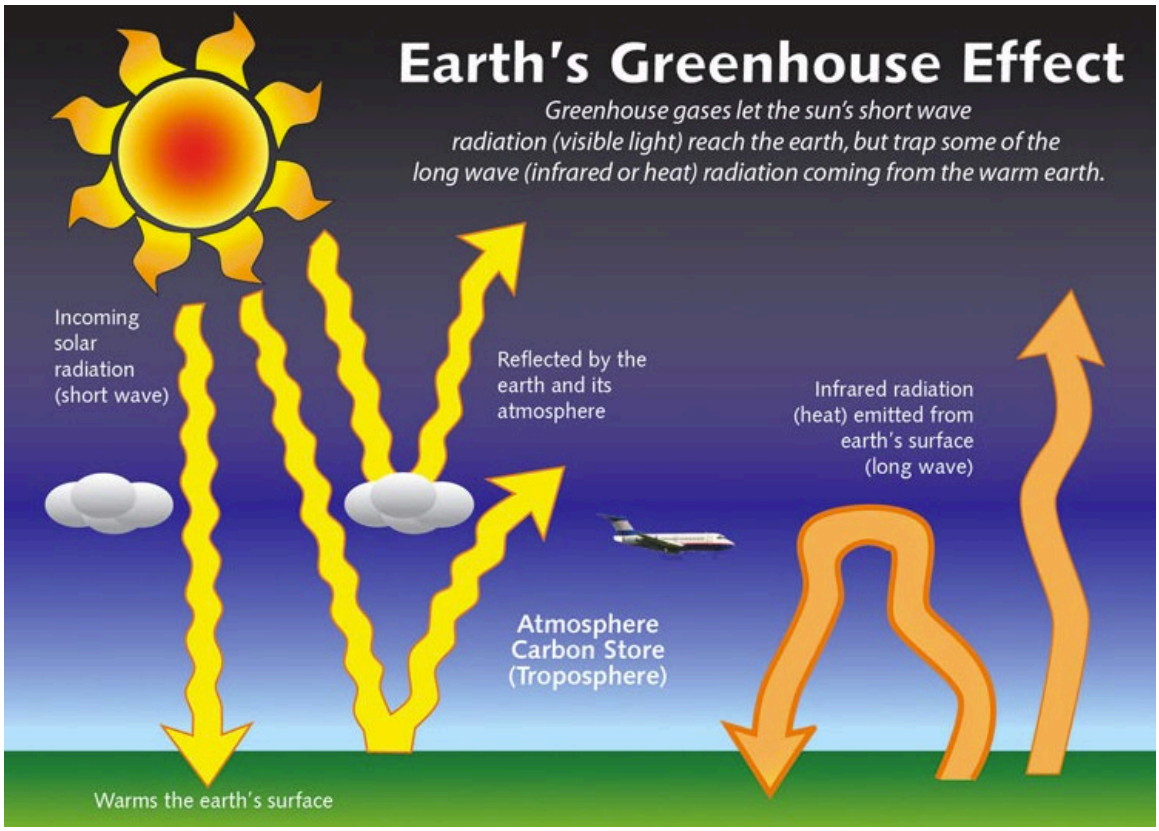
Greenhouse Effect and GHGs

Gases that trap heat in the atmosphere are often called "greenhouse gases" (GHGs). The greenhouse effect traps heat in the troposphere through a threefold process as follows: Short-wave radiation emitted by the sun is absorbed by the earth; the earth emits a portion of this energy in the form of long-wave radiation; and GHGs in the upper atmosphere absorb this long-wave radiation, emitting some of it into space and the rest back toward the earth. This "trapping" of the long-wave (thermal) radiation emitted back toward the earth is the underlying process of the greenhouse effect (Figure 1-1).

Principal GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and water vapor (H_2O). Some GHGs, such as CO_2, CH_4, and N_2O, occur naturally and are emitted to the atmosphere through natural processes and human activities. Since different gases contribute to the greenhouse effect in different proportions, the term CO_2e (carbon dioxide equivalent) provides the reference frame based on comparison to CO_2's contribution.

The greenhouse effect is a natural process that contributes to regulating the earth's temperature. Without it, the temperature of the earth would be about 0°F (−18°C) instead of its present 57°F (14°C) and unlikely to support human life in its current form.

Figure 1-1: Greenhouse Gas Effect



(Source: NYS Department of Environmental Conservation, http://www.dec.ny.gov/energy/76533.html)

Carbon Cycle and Global Temperatures

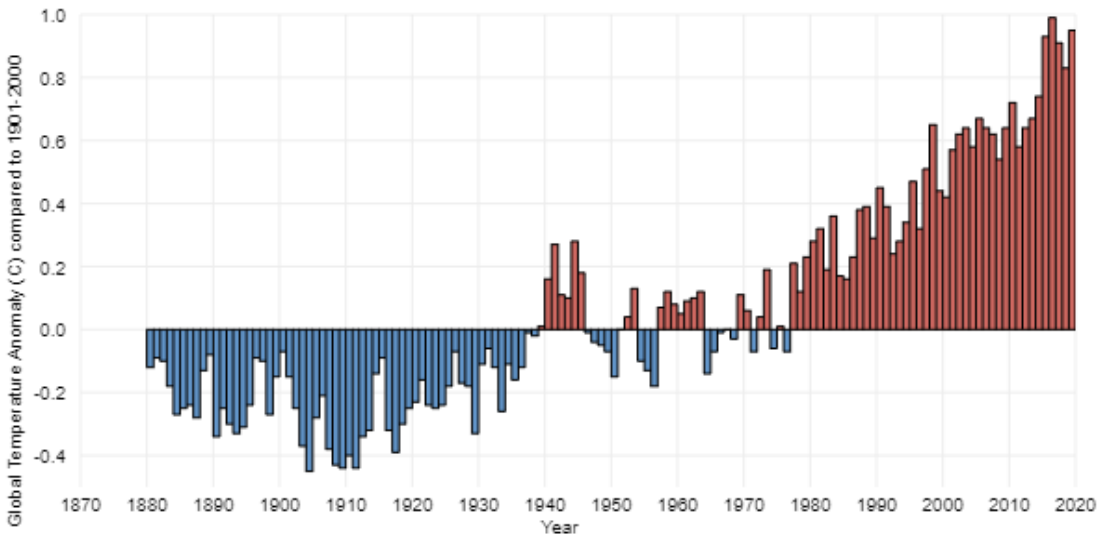
The global carbon cycle is complex and incorporates natural sources of atmospheric carbon dioxide, including respiration of aerobic organisms, wildfires, and volcanic outgassing, and sinks such the removal of CO_2 from by land plants for photosynthesis, and absorption by the ocean. Data collected on global GHG concentrations over the past 800,000 years demonstrates that the concentration of CO_2, the principal GHG, has increased dramatically since pre-industrial times, from approximately below 300 parts per million (ppm) in 1800, to about 353 ppm in 1990, 379 ppm in 2005, and 407 in 2018.[1]

Increased atmospheric concentrations of GHGs have led to a rise in average global temperatures. Figure 1-2 shows the increase in global temperatures from 1880 to 2019. While average global temperatures fluctuate on a yearly basis, the general trend shows a long-term temperature increase. All of the ten warmest years since 1880 have occurred since the year 2000, and scientists expect the long-term temperature increase to continue as well. The consensus among climate scientists is that earth's climate system is unequivocally warming,

[1] Source: NOAA Climate.gov http://www.climate.gov

and rigorous scientific research demonstrates that anthropogenic[2] greenhouse gases are the primary driver.

Figure 1-2: History of global surface temperature since 1880



Source: NOAA Climate.gov, http://www.climate.gov

Climate Change

Global climate change concerns are focused on the potential effects of climate change resulting from excessive GHGs in the atmosphere and how communities can mitigate effects and adapt to change in the short and long term.

Numerous observations document the impacts of global climate change, including increases in global average air and ocean temperatures, the widespread melting of snow and ice, more intense heat waves, and rising global average sea level. Scientists have high confidence that global temperatures will continue to rise in the foreseeable future, largely due to anthropogenic GHG emissions. In addition to the physical impacts to the environment from increased temperatures, sea level rise, and more frequent extreme weather events, global climate change is predicted to continue to cause ecological and social impacts. Ecological impacts of climate change include greater risk of extinction of species, loss of species diversity, and alteration of global biogeochemical cycles, which play an essential role in nutrient distribution. The social

[2] Caused by human activities

impacts of climate change include impacts on agriculture, fisheries, energy, water resources, forestry, construction, insurance, financial services, tourism and recreation.

Higher temperatures, changes in precipitation, decreased water supplies accompanied by increased demand, increased risk of wildfire, a greater number of extremely hot days, the decline or loss of plant and animal species, and other impacts of climate change are expected to continue to affect Carlsbad. Climate change also has public health impacts. City residents who are already more vulnerable to health challenges are likely to be the most affected by climate change. These populations tend to be the young and the old, the poor, and those who are already sick. Increases in extreme heat events can increase the risk of heat-related illness or death, or the worsening of chronic health conditions. Food scarcity and higher food prices from impacts to agriculture can cause increased hunger and reduced availability of nutrition. The increased frequency of natural disasters such as floods, droughts, wildfires, and storm surges can cause injury or death, illness, and increases or shifts in infectious diseases.

1.3 California GHG Reduction Legal Framework

California has taken an aggressive stance to reduce GHG emissions in order to combat the impacts of climate change.

Governor's Executive Order S-3-05

Executive Order S-3-05 (EO S-3-05) recognizes California's vulnerability to increased temperatures causing human health impacts, rising sea levels, and reduced Sierra snowpack due to a changing climate. The Executive Order established targets to reduce GHG emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050.

Global Warming Solutions Act of 2006 and CARB Scoping Plans

The Global Warming Solutions Act of 2006 (Assembly Bill 32, or AB 32) codifies the target set in EO S-3-05 of statewide reductions to 1990 emissions levels by 2020. AB 32 directs the California Air Resources Board (CARB) to develop and implement a scoping plan and regulations to meet the 2020 target.

CARB approved the first Scoping Plan in 2008, which provided guidance for local communities to meet AB 32 and EO S-3-05 targets. The Scoping Plan adopted a quantified cap on GHG emission representing 1990 emission levels, instituted a schedule to meet the emission cap, and developed tracking, reporting, and enforcement tools to assist the State in meeting the required GHG emission reductions. California is currently on track to meet or exceed the AB 32 target of reducing GHG emissions to 1990 levels by 2020.

Executive Order B-3015 (EO B-30-15) established a new GHG emissions reduction target of 40 percent below 1990 levels by 2030 and directed CARB to update the Scoping Plan. In September 2016, Senate Bill 32 (SB 32) was signed into law and codified EO B-30-15. In November 2017, CARB published the 2017 Climate Change Scoping Plan, which offers the framework for achieving the 2030 reductions set forth in EO B-30-15 and SB 32.

1.4 Federal and State Emissions Reductions Strategies and Standards

Several federal and state standards have been adopted to reduce GHG emissions, in addition to and in support of the targets set in EO S-3-05 and AB 32.

Federal Standards

The United States Environmental Protection Agency (EPA) regulates and tests gas mileage or fuel economy in order to deter air pollution in the United States. As the transportation sector produces approximately 30 percent of GHG emissions in the U.S. as a whole, fuel economy regulations are an important way to reduce GHG emissions.[3] The EPA's Corporate Average Fuel Economy (CAFE) standards require vehicle manufacturers to comply with the gas mileage or fuel economy standards to reduce energy consumption by increasing the fuel economy of cars and light trucks. Also, in 2007, the U.S. Supreme Court ruled that CO_2 is an air pollutant under the Federal Clean Air Act, confirming that the EPA can regulate GHG emissions.

State Standards

California Senate Bill 375

SB 375 (2008) requires each Metropolitan Planning Organization (MPO) in the state to adopt a Regional Transportation Plan (RTP) aimed at achieving a coordinated and balance regional transportation system, including mass transit, highways, railroads, bicycles, and pedestrians, among other forms of transit. Each MPO is required to prepare a Sustainable Communities Strategy (SCS) which sets forth forecast development patterns and describes the transportation system that achieve the regional GHG emission reduction targets set by CARB.

Governor's Executive Order S-1-07 (Low Carbon Fuel Standard)

Executive Order S-1-07, the Low Carbon Fuel Standard (LCFS), requires a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020. The LCFS requires oil refineries and distributors to ensure that the mix of fuel sold in California meets this reduction. The reduction includes not only tailpipe emissions but also all other associated emissions from the production distribution and use of transport fuels within the state.

Renewable Portfolio Standards

California's Renewable Portfolio Standard (RPS), established in 2002 by the California State Senate in Senate Bill 1078, accelerated in 2006 and expanded in 2011 through SB X1-2, is one of the most ambitious renewable energy standards in the country. The RPS requires each energy provider to supply electricity from eligible renewable energy resources to 33 percent of the total supply by 2020. In 2015, SB 350 increased the RPS to 50 percent renewable by 2030 and a doubling of energy savings in electricity and natural gas customers. In 2018, SB 100

[3] In 2011, GHG emissions from transportation were about 28 percent of the total 6,702 million metric tons CO_2 equivalents (Source: http://www.epa.gov/climatechange/ghgemissions/sources/transportation.html)

updated SB X1-2 and requires 100 percent of electric retail sales and 100 percent of electricity procured to serve state agencies be carbon-free by 2045.

Pavley Fuel Economy Standards (AB 1493)

In 2009, CARB adopted amendments to the Pavley regulations to reduce GHG emissions in new passenger vehicles from 2009 to 2016. The standards became the model for the updated federal CAFE standards.

Title 24 Building Standards & CALGreen

Title 24 is California's Building Energy Code, which is updated every three years. In 2010, Title 24 was updated to include the "California Green Building Standards Code," referred to as CALGreen. CALGreen requires that new buildings reduce water consumption, increase system efficiencies, divert construction waste from landfills, and install low pollutant-emitting finish materials. CALGreen has mandatory measures that apply to nonresidential and residential construction. The most recent CALGreen code was adopted in 2019 and became effective in 2020. CALGreen contains voluntary Tier 1 and Tier 2 levels, which are designed to exceed energy efficiency and other standards.

1.5 Planning Process

How This Plan Was Prepared

The CAP reflects the city's commitment to the Core Values presented in the General Plan, and links the elements of the plan—including Sustainability; Open Space and the Natural Environment; Access to Recreation and Active, Health Lifestyles; Walking, Biking, Public Transportation, and Connectivity; and Neighborhood Revitalization, Community Design, and Livability—with the goal of GHG reduction. The original CAP was prepared in 2013 by City staff and consultants, with input from the public.

On August 22, 2013 the City of Carlsbad hosted a Community Workshop on the CAP. The workshop provided an opportunity to present the citywide emissions inventory that had been completed, and discuss potential emission reduction strategies. Feedback from the Community Workshop was used to guide the preparation of this document.

Relationship to the California Environmental Quality Act

The California Environmental Quality Act (CEQA) is a statute that requires local agencies to identify significant environmental impacts of their actions and avoid or mitigate those impacts, if feasible. In 2007, California's lawmakers enacted Senate Bill (SB) 97, which expressly recognizes the need to analyze GHG emissions as part of the CEQA process. SB 97 required the Governor's Office of Planning and Research (OPR) to develop recommended amendments to address GHG emissions as an environmental effect.

In 2010, OPR's amendments to the CEQA guidelines addressing GHG emissions became effective. Lead agencies are now obligated to describe, calculate or estimate the amount of GHG emissions resulting from a project, by using a model or methodology to quantify GHG

emissions resulting from a project or relying on a qualitative analysis or performance-based standards. The lead agency should determine whether a project's GHG emissions significantly affect the environment by considering whether the project's emissions, as compared to the existing environmental setting, exceeds a threshold of significance that the lead agency determines applies to the project, and the extent to which the project complies with the regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. In addition, the lead agency is required to impose feasible mitigation to eliminate or substantially reduce significant effects.

The CAP will help the city with compliance with CEQA Guidelines Section 15183.5(b): Tiering and Streamlining the Analysis of Greenhouse Gas Emissions, which became effective in 2010.[4] The required elements of a CAP, as cited in the guidelines, state that a plan for the reduction of GHG emissions should:

- Quantify greenhouse gas emissions, both existing and projected over a specified time period, resulting from activities within a defined geographic area;
- Establish a level, based on substantial evidence, below which the contribution to greenhouse gas emissions from activities covered by the plan would not be cumulatively considerable;
- Identify and analyze the greenhouse gas emissions resulting from specific actions or categories of actions anticipated within the geographic area;
- Specify measures or a group of measures, including performance standards, that substantial evidence demonstrates, if implemented on a project-by-project basis, would collectively achieve the specified emissions level;
- Establish a mechanism to monitor the plan's progress toward achieving the level and to require amendment if the plan is not achieving specified levels;
- Be adopted in a public process following environmental review.

The CAP is intended to fulfill these requirements. The CAP also contains a Project Review Checklist, which allows for streamlined review of GHG emissions for projects that demonstrate consistency with the CAP, as described in CEQA Guidelines Section 15183.5(b).

Relationship to General Plan and Future Projects

Carlsbad's approach to addressing GHG emissions within the General Plan is parallel to the climate change planning process followed by numerous California jurisdictions. A General Plan is a project under CEQA, and projects under CEQA are required to estimate CO_2 and other GHG emissions, as described above. According to the Attorney General, "in the context of a

[4] 15183.5(b) of CEQA Guidelines states, "Plans for the Reduction of Greenhouse Gas Emissions. Public agencies may choose to analyze and mitigate significant greenhouse gas emissions in a plan for the reduction of greenhouse gas emissions or similar document. A plan to reduce greenhouse gas emissions may be used in a cumulative impacts analysis as set forth below. Pursuant to sections 15064(h)(3) and 15130(d), a lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project complies with the requirements in a previously adopted plan or mitigation program under specified circumstances."

general plan update, relevant emissions include those from government operations, as well as from the local community as a whole. Emissions sources include, for example, transportation, industrial facilities and equipment, residential and commercial development, agriculture, and land conversion." The CAP is designed to provide discrete actions to operationalize the General Plan policies that help with GHG reduction, as well as outline additional actions to help meet GHG reduction targets. The preparation of a CAP is also consistent with CEQA Guidelines Section 15183.5 that allows jurisdictions to analyze and mitigate the significant effects of GHG at a programmatic level, by adopting a plan to reduce GHG emissions.

Project-specific environmental documents prepared for projects consistent with the General Plan may rely on the programmatic analysis contained in the CAP and the EIR certified for the Carlsbad General Plan. The thresholds presented in Section 5.3 present a clear method for determining the significance of GHG emissions for future projects.

1.6 How to Use This Plan

The CAP is intended to be a tool for policy makers, community members and others to guide the implementation of actions that limit Carlsbad's GHG emissions. Ensuring that the mitigation measures in the CAP translate from policy language to on-the-ground results is critical to the success of the CAP. Chapter 5 describes how the city will review development projects to achieve the GHG reduction measures in Chapter 4, consistent with state CEQA Guidelines. This chapter also outlines how the city will monitor progress in reducing emissions, and periodically revisit assumptions and key provisions of the plan.

2

Emissions Inventory

This chapter identifies the major sources and the overall magnitude of greenhouse gas (GHG) emissions in Carlsbad, pursuant to Sections 15183.5(b)(1)(A) and 15183.5(b)(1)(C) of the state CEQA Guidelines. The City of Carlsbad prepared an inventory for communitywide GHG emissions in 2012, 2014 and 2016, the latter of which was provided through the San Diego Association of Government's (SANDAG) Regional Climate Action Planning (ReCAP) program. The city also prepared a 2005 and 2011 inventory of government operations. Appendix B-1 provides the communitywide inventories in detail and Appendix B-2 contains the government operations inventories, both of which are summarized in Section 2.2 and 2.3 in this chapter, respectively.

The inventory follows the standards developed by the International Council for Local Environmental Initiatives (ICLEI) for community and government operations GHG inventories. The inventory methodology is described first, followed by the inputs, and results.

2.1 Methodology

The community inventories cover all direct GHG emissions[5] from sources within the boundaries of the City of Carlsbad, including fuel combusted in the community and direct emissions from landfills within the community. Indirect emissions associated with the consumption of energy (such as electricity, with no end point emissions) that is generated outside the borders of the city are also included. The U.S Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol), published by ICLEI USA, requires a minimum of five basic emissions-generating activities to be included in Protocol-compliance community-scale inventories. The emissions from off-road transportation (e.g. lawn and garden, construction and industrial equipment) are considered in the inventories.

[5] GHGs considered in the report are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons. The emissions have been converted to carbon dioxide equivalents (CO_2e), which converts the three other GHGs into the equivalent volume of carbon dioxide.

The seven emissions-generating activities included in the community inventories are:

- On-Road Transportation;
- Electricity;
- Natural Gas;
- Solid Waste;
- Off-Road Transportation;
- Water; and
- Wastewater.

As the city has much greater ability to influence its own operations, the government operations inventory is presented separately, and covers direct emissions from sources the City of Carlsbad owns and/or controls. This includes mobile combustion of fuel for city vehicles and the use of natural gas to heat city buildings. Indirect emissions associated with the consumption of electricity, steam, heating or cooling for city operations that are purchased from an outside utility are also included. All other indirect emissions sources, including employee commutes and the decomposition of government-generated solid waste, are not included as part of the local government operations, but rather counted in the community inventory. The government operations inventory covers emissions from the following sectors:

- Buildings and Facilities;
- Vehicle Fleet;
- Public Lighting; and
- Water and Wastewater Transport within city borders

The majority of emissions are calculated using activity data and emissions factors. Activity data refers to a measurement of energy use or another GHG-generation process, such as residential electricity use, or vehicle miles traveled. Emissions factors are used to convert activity data to emissions, and are usually expressed as emissions per unit of activity data (e.g. metric tons carbon dioxide [CO_2] per kilowatt hour of electricity). To estimate emissions, the following basic equation is used:

$$[\textit{Activity Data}] \; x \; [\textit{Emissions Factor}] = \text{Emissions}$$

As an example, multiplying the total amount of residential electricity use (activity data, expressed in kilowatt-hours) by the emissions factor (expressed as CO_2e emissions per kilowatt-hour) produces the emissions in CO_2e from residential energy use. Table 2-1 below describes data sources for estimating activities and emissions factors.

TABLE 2-1: DATA SOURCES FOR ACTIVITIES AND EMISSIONS FACTORS IN COMMUNITY INVENTORIES

Category	Category Detail	Data Source
On-Road Transportation	Activity	Disaggregated vehicle miles traveled (VMT) using the origin-destination method provided by SANDAG using Activity Based Model
	Emission factor	San Diego region emission factor by vehicle class from latest approved California Air Resources Board (CARB) EMFAC model converted to average vehicle emission factor using VMT distribution by vehicle class
Electricity	Activity	Data from SDG&E based on customer class and customer type, rate schedule and service provider
	Emission factor	Weighted average emission factor based on SDG&E procurement from each fuel type at each facility and emission factor of electricity generation at each facility
Natural Gas	Activity	Data from SDG&E based on customer class and customer type, rate schedule and service provider
	Emission factor	Natural gas emission factor in California from CARB statewide inventory
Solid Waste	Activity	Waste disposal from CalRecycle
	Emission factor	Based on waste composition study from similar jurisdiction (Oceanside) and methane recovery factor at landfills obtained from the landfill
Off-Road Transportation	Activity	CARB off-road model estimates for applicable San Diego sub-categories, adjusted using scaling factors for Carlsbad's proportion of off-road activity.
	Emission factor	
Water	Activity	Jurisdiction-specific water use and energy intensity from the supply agency
	Emission factor	
Wastewater	Activity	Jurisdiction-specific wastewater generation and emission factor based on treatment process from agency
	Emission factor	

Source: ReCAP Technical Appendix I

Certain emissions that occur in the city are not counted in the community inventory. For example, emissions related to the Encina Power Plant are not included in Carlsbad's GHG inventory. The reason is as follows: embodied emissions, such as those resulting from power generation that is produced locally but distributed regionally, are not covered in Carlsbad's inventory, in accordance with ICLEI standards. These emissions are included at the points where energy is *consumed* (some of which are in Carlsbad) rather than where it is simply *produced*—otherwise emissions would either be double counted, or if only counted at the production source, electricity consumption (which is the second largest contributor to GHG) in climate action planning would be meaningless.

The McClellan-Palomar airport is county owned and operated, and is outside of the city's jurisdiction. The city has little, if any, influence over airport operations, and emissions associated with airport flight operations are excluded because they occur in a regional context.

For transportation trips that originate or end in Carlsbad, emissions for half of the entire trip are included, and not just for the miles traveled within Carlsbad; however, trips that just pass through Carlsbad are excluded, as their emissions would be reflected at their trip ends.[6] Furthermore, although pass-through trips contribute a substantial amount to VMT totals, the city and Carlsbad community has limited ability to influence them.

2.2 2012 Baseline Community GHG Inventory

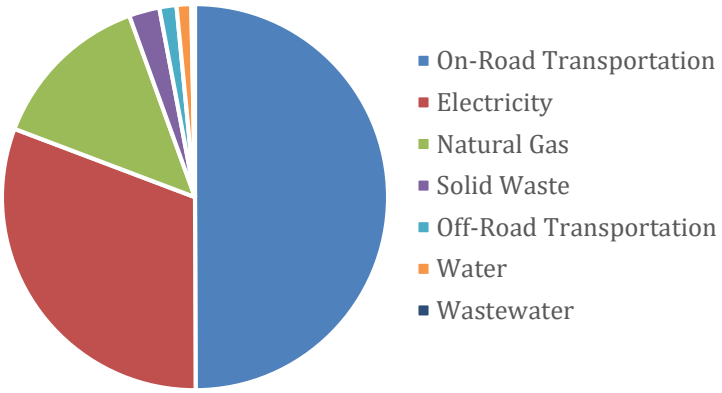
GHG Emissions By Category

As discussed in Section 2.1, a GHG inventory describes the emissions in various categories for a given calendar year. Some of the inputs, such as electricity and natural gas, are based directly on consumption data. Others, such as on-road transportation, are based upon model outputs. In order to determine a community's GHG emissions reduction targets, and its consistency with state reduction targets, a baseline GHG inventory is needed. The City of Carlsbad is using the 2012 community GHG inventory as its baseline for the purpose of deriving GHG reduction targets. A detailed description of the community GHG inventory, including methods and inputs, is contained in Appendix B-1.

[6] For example, for a trip that begins in downtown San Diego and ends in Carlsbad, the entire trip length is calculated for that trip. Half of the entire trip length is assigned to Carlsbad, and the other half is assigned to the City of San Diego. Using half the trip length is standard SANDAG methodology for assigning regional VMT to a particular city.

TABLE 2-2: 2012 COMMUNITY GHG EMISSIONS		
Emissions Category	**GHG Emissions ($MTCO_2e$)**	**Percentage of Total Emissions (%)**
On-Road Transportation	488,000	49.9
Electricity	301,000	30.8
Natural Gas	134,000	13.7
Solid Waste	25,000	2.5
Off-Road Transportation	14,000	1.4
Water	12,000	1.2
Wastewater	3,000	<1
Total	**977,000**	**100**

Figure 2-1: 2012 Community GHG Emissions by Category



2.3 Government Operations Inventory

Government operations represent a small portion (1.2%; see end of this section) of the communitywide GHG emissions. However, more detailed information is available to characterize GHG emissions by source and sector. The city has the ability to directly influence emissions from government operations, and can provide community leadership in reducing GHG emissions. As described before, the four sectors included in the government operations inventory are buildings and facilities, vehicle fleet, public lighting, and water and wastewater transport.

Buildings and Facilities

The inputs for this sector are electricity and natural gas. Data was entered by individual facility along with departmental information. Table 2-8 lists all of the buildings and facilities operated by the city and electricity and natural gas inputs.

TABLE 2-3: BUILDINGS AND FACILITIES INPUTS; 2011

Department	Building	Electricity (kWh)	Natural gas (therms)
City	City Administration	1,203,726	1,738
City	City Hall	233,680	5,313
City	Farmers Insurance Bldgs	112,057	-
City	Hawthorne Equipment Bldg	10,040	-
City Total		**1,559,503**	**7,051**
Community Development	Hiring Center	6,972	-
Community Development	Las Palmas	55,570	-
Community Development Total		**62,542**	
Fire	Fire Station No. 1	63,600	1,358
Fire	Fire Station No. 2	32,643	1,069
Fire	Fire Station No. 3	33,972	675
Fire	Fire Station No. 4	28,867	1,062
Fire	Fire Station No. 5	98,720	2,061
Fire	Fire Station No. 6	55,180	1,464
Fire Total		**312,982**	**7,689**
Golf Course	The Crossings	**1,056,015**	**18,019**
Library	Cole Library	430,160	2,119
Library	Cultural Arts Department	14,444	321
Library	Dove Library	1,432,492	11,200
Library	Library Learning Center	192,000	421
Library Total		**2,069,096**	**14,061**
PD/Fire	Safety Center	**988,001**	**19,816**
Public Works	City Yard	88,335	729
Public Works	CMWD M&O	189,440	86
Public Works	Fleet Yard	72,320	456
Public Works	Parks Maintenance	39,694	149
Public Works Total		**389,789**	**1,420**
Recreation	Calavera Community Center	54,970	-
Recreation	Carrillo Ranch	58,080	-
Recreation	Harding Community Center	60,120	952
Recreation	Parks Total	914,888	3,006
Recreation	Senior Center	308,318	3,349

TABLE 2-3: BUILDINGS AND FACILITIES INPUTS; 2011			
Department	**Building**	**Electricity (kWh)**	**Natural gas (therms)**
Recreation	Stagecoach Community Center	195,920	1,424
Recreation	Swim Complex	247,240	34,266
Recreation	Trails	65,929	-
Recreation Total		**1,905,465**	**42,997**
Housing and Neighborhood Services		**31,277**	**-**
TOTAL		**8,374,670**	**111,053**

VEHICLE FLEET

The inputs for this sector are all vehicles used by the city. The key data used are fuel consumed and VMT, broken out by model year, vehicle type, and fuel type. CACP uses fuel consumption to calculate CO_2 emissions and VMT to calculate NO_2 and CH_4 emissions.

Although the vehicle fleet data from the city was broken down by department, the inputs were loaded into CACP as a single set for the entire city due to the time-consuming nature of processing and entering this very detailed information.

Table 2-9 summarizes the inputs by vehicle and fuel type. Gasoline accounted for the largest amount of fuel consumption (167,345 gallons) and greatest vehicle miles traveled (1,965,416 VMT).

TABLE 2-4: GOVERNMENT OPERATIONS VEHICLE FLEET INPUTS		
	2011	
	Fuel (gal)	**VMT**
Diesel	**62,407**	**407,826**
Light Truck/SUV/Pickup	31,162	298,388
Heavy Truck	31,245	109,438
Gasoline	**167,345**	**1,965,416**
Light Truck/SUV/Pickup	76,663	938,733
Passenger Car	85,874	931,979
Motorcycle	1,787	74,024
Heavy Truck	3,021	20,680
Hybrid	**3,581**	**137,096**
Passenger Car	2,478	108,136
Light Truck/SUV/Pickup	1,103	28,960

For the analysis in CACP, motorcycle inputs were grouped under passenger cars and hybrid fuel consumption was included with gasoline. Hybrid VMT was assumed at one-third of listed

mileage to account for the likely reality of most hybrid miles being under electric power during low speed driving on local streets.

Public Lighting

This sector covers electricity consumed from three sources: traffic signals, streetlights, and other outdoor lighting. As shown in Table 2-10, streetlights make up the great majority of electricity consumption in this sector. Between 2005 and 2011, the city retrofitted its existing streetlights with more energy-efficient lamps.

TABLE 2-5: PUBLIC LIGHTING INPUTS (KWH)

	2011	% of Total
Streetlights	4,403,265	85%
Traffic Signals/Controllers	768,784	15%
Outdoor Lighting	17,740	<1%
TOTAL	**5,189,789**	

Water and Wastewater Transport

This sector covers fuel consumed by pumps and other mechanisms used to convey water and wastewater: water delivery pumps, sprinklers and irrigation, sewage pumps, and recycled water pump stations. These systems all consumed electricity plus a small amount (170 gallons) of diesel fuel for water delivery generators.

Table 2-11 shows the electricity consumed by the city's water and wastewater transport systems in 2011. The greatest electricity consumption is from sewage pumps (53 percent), followed by recycle pump stations (34 percent), water delivery pumps (12 percent), and sprinklers and irrigation (1 percent).

TABLE 2-6: WASTE AND WASTEWATER TRANSPORT INPUTS (KWH)

	2011	% of Total
Sewage Pumps	1,262,824	53%
Recycle Pump Stations	791,732	34%
Water Delivery Pumps	285,345	12%
Sprinklers/Irrigation	22,554	1%
TOTAL	**2,362,455**	

Inventory Results

Emissions by Sector

Government operations in 2011 generated an estimated 8,205 metric tons CO_2e in GHG emissions, as shown in Table 2-12. Emissions for government operations mainly came from

buildings and facilities (42%) and the vehicle fleet (27%), followed by public lighting (21%) and water and wastewater transportation (10%).

TABLE 2-7: GOVERNMENT OPERATIONS EMISSIONS BY SECTOR ($MTCO_2e$)

Source	2011	% of Total
Buildings and Facilities	3,410	42%
Vehicle Fleet	2,253	27%
Public Lighting	1,747	21%
Water and Wastewater Transport	795	10%
TOTAL	**8,205**	

Emissions by Source

Most of the government operations emissions came from electricity consumption, accounting for 65 percent of emissions, as shown in Table 2-13. Gasoline produced about 19 percent of emissions, followed by diesel/propane (8 percent), natural gas (7 percent) and mobile refrigerants (1 percent).

TABLE 2-8: EMISSIONS BY SOURCE ($MTCO_2e$)

Source	2011	% of Total
Electricity	5,362	65.4%
Gasoline	1,538	18.7%
Diesel / Propane	641	7.8%
Natural Gas	590	7.2%
Mobile Refrigerants	74	0.9%
TOTAL	**8,205**	

Comparison of 2011 Government Operations to 2012 Citywide Emissions

Table 2-14 shows a comparison of the 2011 government operations to 2012 citywide emissions. Government operations account for a very small portion of GHG emissions, comprising less than one percent of emissions.

TABLE 2-9: 2011 GOVERNMENT OPERATIONS EMISSIONS VS 2012 COMMUNITY EMISSIONS ($MTCO_2e$)

Government operations emissions	8,205
Community emissions	977,000
Government operations as proportion of community emissions	0.8%

3

Greenhouse Gas Reduction Target, Forecasts, and Emissions "Gap"

This chapter describes the greenhouse gas (GHG) reduction targets provided by state law, provides a baseline forecast of community GHG emissions, and models forecasts of future community and local government GHG emissions through 2035. The chapter also quantifies GHG reductions from (1) state and federal actions and (2) the updated Draft General Plan policies and actions, and applies these reductions to the community forecast. The emissions "gap" between the forecasts (with GHG reductions) and the emissions targets is addressed by the Climate Action Plan (CAP) GHG reduction strategies in Chapter 4.

3.1 GHG Reduction Target

Statewide GHG Reduction Targets and 2017 CARB Scoping Plan

Executive Order S-3-05 (EO S-3-05) and the California Global Warming Solutions Act of 2006 (AB 32 and SB 32) provide the basis for the CAP's GHG emissions targets. Collectively they commit California to reduce its GHG emissions to 1990 levels by 2020, to 40 percent below 1990 by 2030, and to 80 percent below 1990 levels by 2050.

CARB first approved the Scoping Plan in 2008, which provides guidance for local communities to meet AB 32 and EO S-3-05 targets. The Scoping Plan recommended "a greenhouse gas reduction goal for local governments of 15 percent below today's levels by 2020 to ensure that their communitywide emissions match the state's reduction targets.[7] . The 2014 First Update to Scoping Plan repeated that emissions reduction target and provided guidance for local governments to develop post-2020 GHG reduction targets. It stated that "there is a need for local government climate action planning to adopt mid-term and long-term

[7] CARB 2008. *Climate Change Scoping Plan. Pursuant to AB 32 the California Global Warming Solutions Act of 2006,* pg. ES-5.

reduction targets that are consistent with…the statewide goal of reducing emissions 80 below 1990 levels by 2050."[8]

CARB's 2017 Climate Change Scoping Plan recommended statewide targets of "no more than six metric tons CO2e per capita by 2030 and no more than two metric tons CO2e per capita by 2050."[9] These goals are based upon the 2030 and 2050 goals of 40 percent and 80 percent reductions below 1990 levels and the projected population for those years. Using the statewide GHG inventories, percentage reductions can be derived for various baseline years

Total Carlsbad GHG emissions from the 2012 inventory were 977,000 $MTCO_2e$ per year. Therefore, the 2020 target under State guidance is a 4 percent reduction from 2012 emissions, which corresponds to a target of 939,000 $MTCO_2e$. The 2030 target would be 42 percent below 2012 levels and the 2050 goal would be 81 percent below 2012 levels. While CARB's Scoping Plan does not specifically set target levels for intermediate years between 2030 and 2050, the Scoping Plan recommends a linear progression in annual GHG emissions reductions to meet the final targets.

The horizon year for this CAP is 2035, corresponding with the General Plan horizon. The CAP uses a linear trajectory in emissions reductions between 2030 and 2050 to determine the 2035 target. Table 3-1 summarizes these emissions targets and the percentage reduction from 2012 emissions.

TABLE 3-1: 2012 EMISSIONS AND EMISSIONS TARGETS

Year	GHG Emissions and Targets	Reduction From 2012 Baseline
2012	977,000 $MTCO_2e$	N/A
2020	937,920 $MTCO_2e$	4 percent
2035	468,960 $MTCO_2e$	52 percent

3.2 Business as Usual Forecast

The first step in projecting GHG emissions is to calculate the business as usual forecast (BAU). The BAU forecast estimates community emissions through the year 2035, based on the growth in emissions in the absence of any new policies or programs. The BAU calculation relies upon the latest data available, as well as the most recent projections for population, housing and job growth. The BAU calculation typically represents a linear extrapolation of the most recent data, holding other variables constant.

[8] CARB 2014. *First Update to the Climate Change Scoping Plan. Building on the framework pursuant to AB 32 the California Global Warming Solutions Act of 2006,* pg. 113

[9] CARB 2017. *California's2017 Climate Change Scoping Plan. The strategy for achieving California's 2030 greenhouse gas target,* pg. 101.

The BAU includes emissions projections in the following categories:

- On-road Transportation
- Electricity
- Natural Gas
- Solid Waste
- Off-road Transportation
- Water
- Wastewater

Methodology

The Series 14 Regional Growth Forecast included in the SANDAG 2019 Federal Regional Transportation Plan was used to obtain the population and job growth in Carlsbad. As of March 2020, SANDAG Series 14 Growth Forecast does not have a breakdown of the number of jobs by employment type (e.g. construction, agriculture) for each jurisdiction. Therefore, the ratio of the number of jobs by each employment type to total number of jobs from SANDAG Series 13 Growth Forecast were applied to the job forecast from Series 14. The BAU projections of 926,000 $MTCO_2e$ for the Carlsbad community GHG emissions fall below the 2020 target emissions level of 939,000 $MTCO_2e$. Therefore, the next steps in the projections of emissions only include a forecast for 2035.

Table 3-2 shows the population and job growth projections for 2035.

TABLE 3-2: 2035 POPULATION AND JOB GROWTH FORECAST

Year	Population	Commercial Jobs	Industrial Jobs	Total Jobs
2020	116,101	65,880	12,548	78,428
2035	119,798	74,039	14,103	88,142

Source: SANDAG 2013, 2019, Energy Policy Initiative Center, 2020

Inputs

On-Road Transportation

Emissions related to on-road transportation are based upon the vehicle miles traveled (VMT) and the average vehicle emission rate for the San Diego region. VMT is calculated using the SANDAG Activity-Based Model and the Origin-Destination (O-D) method. 2035 VMT projections are estimated from extrapolating SANDAG Series 14 2016 VMT data according to service population. The service population is the sum of population and jobs, which is projected to be 207,940 in 2035. With an average annual VMT of 1,231,554,425 miles, and an average vehicle emission rate of 361 pounds of CO_2e per mile, the projected 2020 emissions from on-road transportation are 452,000 $MTCO_2e$ and 2035 emissions total 445,000 $MTCO_2e$.

Electricity

Emissions projections from the residential electricity sector are based upon the per capita electricity use on 2014 (2,159 kWh per person per year) multiplied by the SANDAG Series 14 population forecast. The commercial and industrial emissions projections are based upon per-job electricity consumption on 2016 (6,936 kWh per commercial job per year and 10,126 kWh per industrial job per year) multiplied by the SANDAG Series 13 job growth forecast. The projected 2020 emissions from electricity are 274,000 $MTCO_2e$ and 2035 emissions total 296,000 $MTCO_2e$.

Natural Gas

The emissions projections for natural gas are calculated similar to those for electricity. Per capita consumption for 2016 (118 therms per person per year, 151 therms per commercial job per year, and 126 therms per industrial job per year) multiplied by population and job growth forecasts. The projected 2020 emissions from natural gas are 137,000 $MTCO_2e$ and 2035 emissions total 147,000 $MTCO_2e$.

Solid Waste

The emissions from solid waste disposal are based upon the per capita disposed in 2016 (3.5 kilograms per person per day) multiplied by forecasted population growth. The projected 2020 emissions from solid waste are 36,000 $MTCO_2e$ and 2035 emissions total 37,000 $MTCO_2e$.

Off-Road Transportation

The emissions from off-road transportation include four categories: lawn and garden equipment, light commercial equipment, construction and mining, and industrial. Lawn and garden equipment include sources such as lawn mowers, chainsaws and leaf blowers. Light commercial equipment includes sources such as generators and pumps. The construction and mining emissions sources include excavators, off highway tractors and paving equipment. Industrial equipment sources include forklifts, aerial lifts and sweepers. These emissions are derived from several models, such as OFFROAD2007 and RV2013, and the CARB In-Use Off-Road Equipment 2011 Inventory. The projected 2020 emissions from off-road transportation are 15,000 $MTCO_2e$ and 2035 emissions total 19,000 $MTCO_2e$.

Water

The emissions from water are based upon the 2016 per capita water consumption (141 gallons per person per day for potable water and 32 gallons per person per day for recycled water) multiplied by forecasted population growth. The projected 2020 emissions from water are 9,000 $MTCO_2e$ and 2035 emissions total 9,000 $MTCO_2e$.

Wastewater

The emissions from wastewater are based upon the 2016 per capita wastewater generation (53 gallons per person per day) multiplied by forecasted population growth. The projected 2035 emissions from wastewater are 3,000 $MTCO_2e$ and 2035 emissions total 3,000 $MTCO_2e$.

Results

Table 3-3 shows the emissions from the business-as-usual community forecast for each sector—residential, commercial, industrial, transportation, solid waste, landfill, and wastewater—and the sum total community emissions.

The greatest projected emissions continue to be from the on-road transportation category, which accounts for 48.9 percent of emissions in 2020 and 46.5 percent in 2035. Electricity emissions are the next largest category, with 29.6 percent of emissions in 2020 and just under 31 percent of the total in 2035. Emissions from solid waste, off-road transportation, water and wastewater remain relatively low compared to other categories.

The BAU projections of 926,000 $MTCO_2e$ for the Carlsbad community GHG emissions fall below the 2020 target emissions level of 939,000 $MTCO_2e$. Therefore, the next steps in the projections of emissions only include a forecast for 2035.

TABLE 3-3: 2020 COMMUNITY FORECAST EMISSIONS BY CATEGORY

Emissions Category	GHG Emissions ($MTCO_2e$)	Percentage of Total Emissions (%)
On-Road Transportation	452,000	48.9
Electricity	274,000	29.6
Natural Gas	137,000	14.8
Solid Waste	36,000	3.9
Off-Road Transportation	15,000	1.6
Water	9,000	<1
Wastewater	3,000	<1
TOTAL	**926,000**	**100**

TABLE 3-4: 2035 COMMUNITY FORECAST EMISSIONS BY CATEGORY

Emissions Category	GHG Emissions ($MTCO_2e$)	Percentage of Total Emissions (%)
On-Road Transportation	445,000	46.5
Electricity	296,000	30.9
Natural Gas	147,000	15.3
Solid Waste	37,000	3.8
Off-Road Transportation	19,000	1.9
Water	9,000	<1
Wastewater	3,000	<1
TOTAL	**956,000**	**100**

3.3 Government Operations Forecast

Methodology

The SEEC government operations forecast, which is a subset of the community forecast, covers direct emissions from the sources the City of Carlsbad owns and/or controls. The emissions from government operations are included in the totals shown in Table 3-4 and Figure 3-4 above. This section separates out emissions from government operations for accounting purposes. The government operations forecast includes mobile combustion of fuel for city vehicles and the use of natural gas to heat city buildings. Indirect emissions associated with the consumption of electricity, steam, heating, or cooling for city operations that are purchased from an outside utility are also forecast. All other indirect emissions sources, including employee commute and the decomposition of government-generated solid waste, are not included as part of the local government forecast, but rather are counted in the community forecast. The government operations inventory covers emissions from the following sectors:

- Buildings and Facilities
- Vehicle Fleet
- Public Lighting
- Water Delivery Facilities
- Wastewater Transport

The government operations forecast uses 2005 inventory to represent baseline emissions, and the 2011 inventory to provide an intermediate value to adjust the model.

Within each sector, certain types of emissions are assumed to scale with population growth, projected to grow at 0.9 percent annually through 2035, while other types of emissions are expected to remain constant or decrease with efficiency improvements. The following sections describe the assumptions underlying the forecast growth rates for each government operations sector.

Buildings and Facilities

The 2005 and 2011 inventories of emissions from all buildings and facilities operated by the city were used to determine the future growth for this sector. The natural gas and electricity demands were assumed to scale with population for departments such as Police, Fire, and Parks and Recreation, while others, such as Administration and Utilities, would remain staffed at current levels. These growth rates were then combined to determine an aggregate annual growth rate of 0.7 percent, which was applied to the buildings and facilities sector.

Vehicle Fleet

An estimate of the growth in the number of City employees was used to determine City fleet use. The growth in fleet emissions beyond 2011 was estimated by assuming—similar to the Buildings and Facilities sector—that certain departments would scale with population growth, while others would remain staffed at current levels. These growth rates were then combined to determine an aggregate annual growth rate of 0.6 percent, which was applied to the city fleet sector.

Public Lighting

From 2005 to 2011, electricity use for streetlights decreased approximately 4 percent due to the installation of some energy-saving induction streetlights. Following the completion of the installation of all induction streetlights, the City's electricity demand for streetlights was further reduced, which is reflected in the forecast energy demands for this sector.

Water Delivery and Wastewater

The increased demand for energy usage for water delivery and wastewater was assumed to be proportional to the amount of water delivered by the Carlsbad Municipal Water District (CMWD), as projected in the 2010 Urban Water Management Plan (UWMP). CMWD's service area covers about 85 percent of the City, and it was assumed that water and wastewater usage in the remaining 15 percent of the City, served by Olivenhain Municipal Water District and Vallecitos Water District, would follow similar water use patterns as outlined in the 2010 UWMP.

Results

The city operations forecast for 2020 and 2035 is shown by sector in Table 3-5. Government operations emissions are projected to decrease from the 2011 inventory total of 8,205 $MTCO_2e$ to 5,185 $MTCO_2e$ in 2020. The decrease in emissions is primarily due to the implementation of the RPS and the fuel efficiency gains from Pavley I standards. Emissions are forecast to then increase at a low rate through the year 2035 to 5,922 $MTCO_2e$, due to projected increases in city staff in select departments to accommodate an increased need for city services.

The relative contribution of each sector to the total city operations emissions is generally constant over time. The two largest emissions sectors are buildings and facilities, comprising about 40 percent of total emissions, and fleet emissions, which are approximately 33 percent of the total emissions. Streetlights are about 15 percent of total emissions, followed by wastewater facilities at 8 percent, and water delivery facilities at 1 percent. Overall, government operations emissions are forecast to remain a small portion of community emissions, about 0.9 percent in 2020 and 1 percent in 2035. Chapter 4 discusses mitigation measures that will reduce government operations emissions.

TABLE 3-5: GOVERNMENT OPERATIONS EMISSIONS INVENTORY (2011) AND 2020, 2035 FORECAST ($MTCO_2e$)			
Sector	**2011**	**2020**	**2035**
Building & Facilities	3,410	2,192	2,409
Streetlights	1,747	902	902
Water Delivery Facilities	79	71	76
Wastewater Facilities	716	470	506
Fleet	2,253	2,092	2,029
TOTAL	**8,205**	**5,185**	**5,922**

3.4 GHG Reductions to Community Forecast from Federal and State Actions

Methodology

The next step in projecting GHG emissions is the consideration of GHG reductions from state and federal actions. This projection is known as the legislatively-adjusted BAU since it still lacks any potential GHG reductions from local policies and programs.

The federal and state actions included in the legislatively-adjusted BAU include the following:

- Federal and California Vehicle Efficiency Standards
- California Energy Efficiency Standards
- California Solar Policy, Programs and 2019 Mandates
- Renewable Portfolio Standard

Federal and California Vehicle Efficiency Standards

The federal and California vehicle efficiency standards vary by type of vehicle. For passenger cars and light-duty vehicles, the applicable standards are the Federal Corporate Average Fuel Economy (CAFE) standards and California Advanced Clean Car (ACC) Program. The CAFE standards are developed by the U.S Department of Transportation's National Highway Transportation Safety Administration (NHTSA) and regulate how far vehicles must travel on a gallon of fuel. The ACC program was adopted by CARB and combined the control of smog-causing pollutants and GHG emissions into a single coordinated package of regulations.

For heavy-duty vehicles (heavy-duty trucks, tractors, and buses), the applicable regulations are the U.S. Environmental Protection Agency's (US EPA) Phase-I GHG Regulation and CARB Tractor-Trailer GHG Regulation. The US EPA regulation was developed in coordination with the NHTSA and calls for GHG emissions and fuel economy standards. The CARB regulation

reduces GHG emissions by improving aerodynamic performance and reducing the rolling resistance of tractor-trailers. The reductions projected from the federal and California vehicle efficiency standards total 113,968 $MTCO_2e$ in 2035.

California Energy Efficiency Programs

In September 2017, the California Public Utilities Commission (CPUC) adopted energy efficiency goals for ratepayer-funded energy efficiency programs (Decision 17-09-025); these went into effect in 2018. The sources of the energy savings include, but are not limited to, rebated technologies, building retrofits, behavior-based initiatives, and codes and standards. The reductions projected from the California energy efficiency programs total 19,110 $MTCO_2e$ in 2035.

California Solar Policy, Programs and 2019 Mandates

California has several policies and programs to encourage customer-owned, behind-the-meter PV systems, including the California Solar Initiatives, New Solar Home Partnership, Net Energy Metering, and electricity rate structures designed for solar customers. The California Solar Initiative is the solar rebate program for customers of the investor-owned utilities, including SDG&E. The New Solar Home Partnership provides financial incentives and other support to home builders to encourage the construction of new, energy efficient solar homes. This assistance terminates on December 31, 2021. Net Energy Metering provides utility customers a credit for the unused electricity produced by their solar system. The new California 2019 Building Energy Efficiency Standards, which went into effect on January 1, 2020, require all newly constructed single-family homes, low-rise multi-family homes, and detached accessory dwelling units (ADUs) to have PV systems installed, unless the building receives an exception. The reductions projected from the California solar policy, programs and 2019 mandates total 37,125 $MTCO_2e$ in 2035.

Renewable Portfolio Standard

SB 100, the 100 Percent Clean Energy Act of 2018, adopts a 60% RPS for all of California's retail electricity suppliers by 2030; this increased the RPS standard from 50% to 60%. The legislation also provides goals for the intervening years before 2030 and establishes a State policy requiring that "zero-carbon" resources supply 100% of all retail electricity sales to end-user customers and all State agencies by December 31, 2045. If interpolated linearly between 60% renewable in 2030 and 100% zero-carbon in 2045, the interim 2035 target would be 73% renewable. The reductions projected from the RPS total 186,115 $MTCO_2e$ in 2035.

RESULTS

The annual reductions from the above state and federal actions—Federal and California Vehicle Efficiency Standards, California Energy Efficiency Standards, California Solar Policy, Programs and 2019 Mandates, and Renewable Portfolio Standard—were combined. Table 3-11 shows the total community forecast in 2035 considering federal and state actions, or legislatively-adjusted BAU.

TABLE 3-6: COMMUNITY FORECAST WITH STATE AND FEDERAL ACTIONS ($MTCO_2e$)						
Year	Business-As-Usual Community Forecast Emissions	Federal and California Vehicle Efficiency Standards	California Energy Efficiency Programs	California Solar Policy, Programs and 2019 Mandates	Renewable Portfolio Standard	Total Forecast Emissions with State and Federal Actions
2035	956,000	113,968	19,110	37,125	186,115	599,682

3.5 Modified Baseline: GHG Reductions from Additional General Plan Policies and Actions

Methodology

This section describes General Plan policies and actions that reduce GHG emissions, quantifies emissions reductions, and explains how these policies and actions will be implemented. These reductions are from policies and actions in addition to BAU and legislatively-adjusted BAU discussed in previous sections. The General Plan policies and actions are organized according to the following categories:

- Bikeway System Improvements
- Pedestrian Improvements and Increased Connectivity
- Traffic Calming
- Parking Facilities and Policies
- Transportation Improvements

The California Air Pollution Control Officers Association's (CAPCOA's) Quantifying Greenhouse Gas Mitigation Measures report was developed as a resource for local governments to assess emissions reductions from GHG mitigation measures. This section uses the methodology outlined in the CAPCOA report for each category to quantify emissions reductions from the General Plan policies and actions.[10] The reductions are applied to the community forecast in the following section to get the "modified baseline" forecast.

[10] While many of the policies and actions quantified in the report are project-level in nature, much of the supporting literature is from studies on a citywide, countywide, or regional context. The methodology in this section is based on these regional studies, which is therefore applicable to the General Plan policies and actions listed in this section.

Bikeway System Improvements

Bikeway System Improvements	*General Plan Policies:* *2-P.24, 2-P.25, 2-P.45, 2-P.46, 2-P.53; 3-P.8, 3-P.15, 3-P.16, 3-P.17, 3-P.20, 3-P.21, 3-P.22, 3-P.24, 3-P.25, 3-P.26, 3-P.27, 3-P.28, 3-P.29, 3-P.31, 3-P.32, 3-P.33, 3-P.34, 3-P.40; 4-P.40*	2035 Reduction: **608 $MTCO_2e$**

Policy/Action Description

The Carlsbad Bikeway Master Plan, referenced in the General Plan, recommends the enhancement of the existing bicycle network with the implementation of new Class I bike paths, new Class II bike lanes, and new Class III bike routes, resulting in a 111.5 mile bikeway system. The planned bikeways include the Coastal Rail Trail, a Class I bike path on Carlsbad Boulevard at Ponto, two Class II bike lanes – one on Hillside Drive and another on Avenida Encinas, and five Class III bike route projects in the northwest quadrant of the city.

In addition to Bikeway Master Plan recommendations, the Mobility Element identifies the following new connections to improve connectivity in the area:

- A new Class I trail at the terminus of Cannon Road and extending eastward toward the City of Oceanside
- A new Class I trail along the Marron Road alignment between El Camino Real and the City of Oceanside
- A new crossing of the railroad tracks at Chestnut Avenue.

Also, CalTrans' North Coast Corridor Public Works Plan includes, among other improvements, a new North Coast Bike Trail and new bicycle/pedestrian connections across Batiquitos and Agua Hedionda Lagoons.

Finally, the city can install new and enhanced bicycle facilities as opportunities arise in conjunction with street maintenance and rehabilitation, and as part of "road diet" projects.

Quantification

An estimated 0.05 percent reduction in transportation GHG emissions is assumed to occur for every two miles of bike lane per square mile in areas with density greater than 2,000 people per square mile.[11] Carlsbad currently has approximately 2,700 people per square mile, greater than the threshold of 2,000 people per square mile.

[11] Cambridge Systematics. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Technical Appendices. Prepared for the Urban Land Institute.

With the 111.5 miles of bicycle facilities, there would be approximately 2.85 miles of bikeways per square mile, which corresponds to a 0.07 percent reduction in VMT emissions, or about 608 $MTCO_2e$ in 2035.

Implementation

The bikeway system enhancements will occur incrementally (at approximately .6 miles/ year) through the implementation of the General Plan and planned and opportunistic bikeway improvements (e.g., in conjunction with street maintenance and rehabilitation, or as part of a "road diet"). Improvements will be funded and/or installed as conditions on new private development as well as through the city's multi-year CIP and annual operating budget process. Funding sources may include development impact fees, general funds, local, state, and federal grants.

Pedestrian Improvements and Increased Connectivity

Pedestrian Improvements and Increased Connectivity	*General Plan Policies:* *2-P.24, 2-P.25, 2-P.45, 2-P.46, 2-P.47, 2-P.48, 2-P.50, 2-P.53, 2-P.72, 2-P.79; 3-P.8, 3-P.16, 3-P.17, 3-P.20, 3-P.21, 3-P.22, 3-P.24, 3-P.25, 3-P.26, 3-P.27, 3-P.28, 3-P.29, 3-P.31, 3-P.32, 3-P.33, 3-P.40; 4-P.40*	2035 Reduction: **615 $MTCO_2e$**

Policy/Action Description

<u>Pedestrian Improvements</u>

Carlsbad has adopted several programs and plans related to improving the walking environment. The city's Pedestrian Master Plan guides the future development and enhancement of pedestrian facilities to ensure that walking becomes an integral mode of transportation in Carlsbad. The Carlsbad Residential Traffic Management Program provides a mechanism for community members to report issues relating to speeding and traffic volumes on residential roadways, assisting the city in "calming" traffic in these areas to make them more comfortable for pedestrian travel.

Physical barriers to pedestrian access include gaps in sidewalks, high-volume, high-speed streets, a circuitous roadway system in several parts of the city, and regional infrastructure such as freeways and railways that presents barriers to pedestrian mobility. There are four significant concentrations of high pedestrian improvement needs across the City of Carlsbad, including the following locations:

- The entire northwest quadrant, especially the Carlsbad Village area
- The southern coastal area along Carlsbad Boulevard, between Cannon Road and La Costa Avenue
- Several locations along El Camino Real, near Camino Vida Roble, Aviara Parkway/Alga Road and La Costa Avenue

- The southeastern portion of the city, stemming from the intersection of La Costa Avenue and Rancho Santa Fe Road

A range of potential improvement projects exists throughout the city, as identified in the pedestrian master plan, to enhance pedestrian mobility, local connectivity, usage, safety and accessibility. These improvements include filling in gaps in sidewalk connectivity, upgrading substandard sidewalks, creating new connections to pedestrian attracting designations (such as access across the railroad track to the beach at Chestnut Avenue, for example), establishing safe routes to school, enhancing crosswalks, installing pedestrian countdown signals, improving signage, and providing ADA improvements.

Increased Connectivity

Increasing connectivity in the city is critical to achieving the Carlsbad Community Vision. There are a number of improvements described in the General Plan that will enhance connectivity for bicycles and pedestrians, as noted below:

- Cannon Road east of College Boulevard – Provide a bicycle/pedestrian facility that would begin at the current eastern terminus of Cannon Road and continue eastward to the city's eastern boundary.
- Marron Road Connection – Provide a bicycle/pedestrian facility that would begin at the current eastern terminus of Marron Road and extend eastward to the city's eastern boundary.
- Additional crossings of Interstate-5 and the railroad – Continue to look for opportunities to add crossings of these two barriers and improve east-west connectivity to and from the coast. Key connections will include a crossing at Chestnut Avenue (bicycle, pedestrian, and vehicular) under the freeway and (bicycle and pedestrian) across the railroad, and a Chinquapin Avenue connection (bicycle, pedestrian, and vehicular) over the freeway and (bicycle and pedestrian) across the railroad. Additionally, Caltrans is designing a number of new pedestrian and bicyclist connections along and across Interstate-5 and near the lagoons as part of the Interstate-5 North Coast Corridor Public Works Plan. The city will continue to coordinate with Caltrans on these improvements.
- Improved accessibility to the lagoons and to the coast are envisioned to improve connectivity to those areas.

Quantification

Providing an improved pedestrian network and increasing connectivity encourages people to walk more and results in people driving less, causing a reduction in VMT. An estimate of a 1 percent reduction in VMT from pedestrian improvements and connectivity was assumed, which corresponds to a reduction of 615 $MTCO_2e$ in 2035.[12]

[12] Center for Clean Air Policy. Transportation Emission Guidebook. http://www.ccap.org/safe/guidebook/guide_complete.html.

Implementation

Pedestrian improvements and increased connectivity will occur through implementation of the Pedestrian Master Plan, the Residential Traffic Management Program, and the General Plan, and through planned and opportunistic pedestrian improvements (e.g., in conjunction with street maintenance and rehabilitation, or as part of a "road diet"). Improvements will be funded and/or installed as conditions on new private development as well as through the city's multi-year CIP and annual operating budget process. Funding sources may include development impact fees, general funds, local, state, and federal grants.

Traffic Calming

Traffic Calming	*General Plan Policies:* *2-P.53; 3-P.16, 3.P-17*	2035 Reduction: **969 MTCO$_2$e**

Policy/Action Description

The Carlsbad Residential Traffic Management Program provides a mechanism for community members to report issues relating to speeding and traffic volumes on residential roadways, assisting the City in "calming" traffic in these areas to make them more safe and comfortable for pedestrian travel. Traffic calming devices include speed tables, speed bumps, roundabouts, and other devices that encourage people to drive more slowly or to walk or bike instead of using a vehicle, especially for short trips in and around residential neighborhoods. The residential traffic management program is implemented by the Transportation Division and funded through the annual budget appropriation process.

Quantification

CAPCOA's "Quantifying Greenhouse Mitigation Measures" was used to quantify the effect of traffic calming devices. A 0.25 percent reduction in VMT was assumed to occur from these improvements, which corresponds to a reduction of 969 MTCO$_2$e in 2035.

Implementation

The traffic calming improvements will occur through the implementation of the Residential Traffic Management Program and the General Plan.

Parking Facilities and Policies

Parking Facilities and Policies	*General Plan Policies:* *2-P.75, 2-P.83; 3-P.28, 3-P.38, 3-P.39, 3-P.40, 3-P.41*	2035 Reduction: **6,618 MTCO$_2$e**

Policy/Action Description

Getting parking right is critical to ensuring the success of any urban area. Inadequate parking is inconvenient and frustrating for businesses and residents. Too much parking underutilizes valuable land, results in lower density development, discourages use of other forms of transportation (such as public transit), spreads out land uses, and creates gaps in store fronts;

thereby practically requiring the use of the automobile. Additionally, too much parking also requires more driveways for accessibility, introducing conflicts between pedestrians and vehicles. Overly high parking requirements—particularly in downtown areas or urban cores—can impact the ability to renovate or repurpose older buildings and revitalize activity centers that can be better served and connected by enhancing facilities and amenities for bicyclists and pedestrians. Therefore, it is important to "right size" and manage parking such that there is enough to support the needs generated by the use, but not so much that it wastes land and impairs other ways of getting around.

The city's Zoning Ordinance provides standards for parking facilities based on development types within the city. To promote "right sizing" of parking facilities, the following techniques are included as part of the General Plan Mobility Element:

- Shared Parking – continue to allow uses that have different parking demands at different times of the day to share the same parking facilities. This is an effective way to minimize pavement, allow denser land use, provide for more landscaping, and provide improved walkability within a mixed use area. The best example of shared parking is an office building and an apartment building as office's peak parking demand occurs at 10:00 a.m. and apartment's peak parking demand occurs at 11:00 p.m.
- Collective Parking – allow uses in mixed use projects/areas to utilize up to 50 percent of project site's vacant on-street parking to count toward their parking supply requirements.
- Unbundled Parking – rather than provide free guaranteed parking, "unbundle" the parking from the development and require residents and/or employees to pay for use of a parking space.
- Park Once – a strategy in destination districts to enable visitors to "park once" and visit a series of destinations. Park once strategies work well in areas like the Village and areas that are well connected by pedestrian and bicycle facilities. The creation of centralized parking areas supports this strategy.
- In Lieu Parking Fees – continue strategies in appropriate areas by which developers can contribute fees toward the development of a common parking facility in lieu of providing on-site parking. This works best in downtown or concentrated commercial areas, works well to assist in paying for unified structured parking, and provides developers an opportunity to increase density on their parcels.
- Parking Management Strategies –a business district or businesses manage high demand parking locations and destinations through a number of different strategies including demand pricing, time restrictions, valet parking, and other techniques.
- Public-Private Partnerships –the city, business owners, and developers collaborate to provide both private and public parking opportunities. Instances where this works well include parcels owned by the city, where a private entity comes in and develops, manages, and enforces the parking in these public lots.
- Parking Locater Signs – electronic monitoring devices that identify the available parking in a given facility and utilize changeable message signs to assist travelers in identifying available parking locations. Please note that this may require modifications to the city's zoning ordinance to be implemented in some areas of the city.

- Parking Wayfinding Signs – signs identifying where public parking is available, which support the "park once" concept.
- Reduced Parking Standards – reduce parking standards in areas that are well served by transit, provide shuttle accessibility to the COASTER station, provide parking cash out programs (where employers pay employees to not park on site), or provide other programs that will reduce parking demand.
- Biking Equals Business Program – businesses provide bicycle parking or corrals and provide incentives to encourage their patrons and employees to ride rather than drive.
- Transit Equals Business Program – businesses provide their customers and employees incentives to encourage them to use transit rather than drive.
- Bicycle Corrals in Lieu of Vehicle Parking – for certain businesses, reduce required onsite parking for vehicles if they provide a bicycle corral that accommodates more people.

Although there are additional parking strategies that are available and may become available in the future, most of the strategies work best in smart growth/mixed use development areas and will be necessary to accomplish the goals and visions identified in the General Plan and the General Plan Mobility Element.

Quantification

According to CAPCOA's Quantifying GHG Mitigation Measures, parking strategies have estimated VMT reductions. Reduced parking standards and other policies reducing parking availability have an estimated 5 to 12.5 percent VMT reduction, unbundled parking cost has a 2.6 to 13 percent VMT reduction, and parking management strategies have a 2.8 to 5.5 percent VMT projection.[13] Conservatively assuming the combined effect of these parking reduction strategies would result in the lower end of the strategies results, and considering that the strategies would be most applicable in future growth and infill areas, the cumulative reduction from implementations would result in a 2 percent VMT reduction to give an estimated 6,618 $MTCO_2e$ reduction by 2035.

Implementation

The parking strategies will occur through the implementation of the Zoning Ordinance and the General Plan. The city's Planning Division is primarily responsible for developing new ordinances and updating existing ones. Parking policy and ordinance changes would be carried out under the Planning division's annual budget authority.

Transportation Improvements

Transportation Improvements	*General Plan Policies:* *2-P.48, 2-P.72; 3-P.8, 3-P.19, 3-P.20, 3-P.27, 3-P.31, 3-P.32, 3-P.35, 3-P.36*	2035 Reduction: **2,085 $MTCO_2e$**

[13] The maximum reduction provided from the combination of all parking policies in the CAPCOA report is a 20 percent reduction in VMT

Policy/Action Description

Transit in Carlsbad includes bus service, ADA paratransit service, and the COASTER commuter rail; indirectly, transit service is also provided by the Sprinter light rail system, Amtrak rail service, and Metrolink commuter rail. Future transit service in the city will primarily be coordinated by the North County Transit District (NCTD). In addition, there are several planned transit improvements for Carlsbad that are part of San Diego Association of Governments (SANDAG) regional planning efforts. These are reflected in the General Plan Mobility Element:

- Coastal rail improvements are proposed for the tracks serving the COASTER and Surfliner trains in San Diego County along the Los Angeles to San Diego Rail Corridor. These proposed improvements include double tracking, bridge replacements, and station improvements. Improvements to the COASTER service (2020 and 2030) are also proposed and would increase service and reduce headways.
- Route 471 (2020) is a proposed rapid bus providing frequent service between Carlsbad and San Marcos via Palomar Airport Road. This route will operate with 10 minute headways during peak and off-peak hours. In the city, this rapid bus route is envisioned to be supported by signal priority at intersections.
- AMTRAK will add service to Carlsbad.
- As previously described, the above future transit improvements will continue to advance the backbone transit infrastructure. However, one key component to improving transit use is improving the "first mile/last mile" access and experience for transit users. This typically includes end of trip facilities (bike racks, showers, changing rooms, etc.) and better connectivity from the transit stop to the ultimate destination via bicycle facilities, pedestrian facilities, local transit circulators, etc.
- Carlsbad's future transit effectiveness will depend on major employers assisting with providing some of these "first mile/last mile" facilities through transportation demand management (TDM) measures. TDM is envisioned to include shuttle circulators to major employers and destinations, showers and changing rooms at those locations, and a host of other typical TDM techniques that would support transit usage and the connection to the ultimate destination. This Mobility Element also supports TDM through potential incentives (such as reduced parking standards for TDM implementation) to further support transit access to these destinations.
- The final component to improving transit use in the city is working with NCTD to improve the transit experience, particularly along the bus routes. This includes improving bus stops in the city to ensure that they are well lit, have seating, and are covered to protect users from inclement weather.

As part of the FY 2014-2015 capital improvement program, the city initiated work on a Coastal Mobility Readiness Plan. This plan will complement current and planned bicycle and pedestrian improvements by recommending policy and infrastructure investments that will: improve accessibility to transit and para-transit services; fill in transportation gaps ("first mile-

last mile" solutions); support and encourage expanded use of low-emission and zero emission vehicles; provide viable alternatives to private, single-occupant vehicle use (such as through car-sharing, bike-sharing, and local shuttles); and recommend other transportation/parking demand management strategies. The plan will emphasize efficiently connecting residents and visitors among the city's various coastal activity centers, beaches, the state campground, and to and from major hotels and resorts, the Village, major shopping centers, and other significant visitor-serving activity centers. The plan will identify effective, proven tools, and seek out promising and emerging technologies. The plan will also identify potential funding partners such as NCTD (e.g. Cooperative Agreements in accordance with NCTD Board Policy 22), private funding and/or public grants. The plan is expected to be completed at the end of 2015, with implementation beginning in 2016.

The city has also implemented a state-of-the-practice traffic signal management (TSM) system. This system integrates traffic signals in the city to a single access point, allowing city staff to monitor and update signal timings to improve safety and mobility for all users in the city. The Mobility Element supports further implementation of this program and use of other technologies that become available, which have the ability to improve mobility for all users of the city's transportation system.

Quantification

Transportation system improvements can result in VMT reductions. According to CAPCOA's Quantifying Greenhouse Gas Mitigation Measures, transit system improvements can result in the following reductions: 0.02 to 3.2 percent VMT reduction from a bus rapid transit system, 0.1 to 8.2 percent VMT reduction from expanding the transit network, 0.02 to 2.5 percent VMT reduction from increasing transit service frequency and speed, and 0.5 to 24.6 percent VMT reduction from increasing transit accessibility. Reductions from TSM were estimated using Cambridge Systematics' Moving Cooler report as a 0.01 percent VMT reduction. Conservatively assuming the combined effect of these strategies, summing the low end of the VMT reduction ranges gives a 0.63 percent reduction in VMT emissions.

Implementation

Transit improvements will primarily be coordinated by NCTD and will also be implemented by SANDAG regional planning and funding efforts. City-led improvements will be carried out through the city's multi-year CIP and annual operating budget appropriation process.

Results

Table 3-12 shows the GHG reductions from each of the above General Plan policies and actions. The largest reduction comes from parking facilities and policies, followed by transportation improvements, traffic calming, pedestrian improvement and increased connectivity, and bikeway system improvements. The reductions from these policies and actions are incorporated into the community emissions forecast in the following section.

TABLE 3-7: GHG REDUCTIONS FROM ADDITIONAL GENERAL PLAN POLICIES AND ACTIONS						
Year	Bikeway System Improvements	Pedestrian Improvements and Increased Connectivity	Traffic Calming	Parking Facilities and Policies	Transportation Improvements	Total GHG Reductions from Additional General Plan Policies and Actions
2035	608	615	969	6,618	2,085	10,895

3.6 Modified Baseline and the GHG Emissions "Gap"

Table 3-13 shows the total community emissions with the reductions from the following policies and actions:

- Federal and State actions
- Additional General Plan policies and actions

The BAU forecast for 2020 already meets the target reduction of four percent below baseline; therefore, no analysis of the effects of federal and state policies and additional General Plan policies was necessary. With the effect of all the GHG reductions considered in this chapter, the total community forecast emissions are 455,556 $MTCO_2e$ in 2035. Table 3-13 shows that Carlsbad met its target for 2020 without any additional measures. However, by 2035, there is a GHG emissions "gap" of 116,817$MTCO_2e$ —approximately 20 percent of the total projected community emissions.

TABLE 3-8: MODIFIED BASELINE FORECAST (FORECAST COMMUNITY EMISSIONS WITH FEDERAL AND STATE ACTIONS AND ADDITIONAL GENERAL PLAN POLICIES AND ACTIONS)				
Year	Business-As-Usual Forecast ($MTCO_2e$)	Total Modified Baseline Forecast ($MTCO_2e$)	GHG Emissions Targets ($MTCO_2e$)	Emissions "Gap" ($MTCO_2e$)
2020	**926,000**	**N/A**	939,000	Target Met
2035	**956,000**	**588,817**	472,000	116,817

Conclusion

The emissions targets are met in the year 2020, with BAU forecast emissions of 926,000 $MTCO_2e$ meeting the target by about 13,000 $MTCO_2e$. There is an emissions "gap" in the year 2035 of about 116,817 $MTCO_2e$ between the forecast emissions of 588,817 $MTCO_2e$ and the emissions target of 472,000 $MTCO_2e$. Chapter 4 contains CAP GHG reduction measures to close the gap between forecast emissions and emissions targets in the year 2035.

4

CAP GHG Reduction Measures

The forecast emissions in Chapter 3 incorporate reductions from (1) state and federal actions, (2) General Plan land use and roadways, and (3) additional General Plan policies and actions. This chapter describes additional GHG reduction measures to close the emissions "gap" between emissions targets and forecast emissions for 2035. These are:

- Commercial and industrial photovoltaic systems
- Single-family, multi-family and commercial efficiency retrofits
- Solar water heater/heat pump installation
- Efficient lighting standards
- Increased zero-emissions vehicle travel
- Transportation Demand Management (TDM)
- Citywide renewable projects
- Water delivery and conservation

The sections below describe the GHG reduction measures and explain how they will be implemented. The GHG reductions from these measures were quantified using the Energy Policy Initiatives Center (EPIC) mitigation calculator, a tool developed by the University of San Diego for cities within San Diego County. The EPIC mitigation calculator includes a "business as usual" (BAU) forecast for each measure estimating GHG reductions from trends already underway that will occur without any additional city intervention, based on regional San Diego Gas & Electric (SDG&E) forecasts. For example, under the BAU forecast for residential photovoltaic (PV) systems, the EPIC mitigation calculator estimates that by the year 2035, energy produced by residential PV systems in the City of Carlsbad will be about 15.9 megawatts (MW), which will offset about 6,233 metric tons CO_2e ($MTCO_2$ e).

The GHG reduction measures describe goals, amount of reduction in 2035, and actions to meet the target levels. The actions are categorized as **short-term** actions that will be implemented within one to two years of CAP adoption; or **mid-term** actions that will be implemented within

two to five years of CAP adoption. Actions identified as **short to long-term**, or **mid to long-term** are those actions that will begin in the short or mid-term, but take longer than five years to fully implement. **Ongoing** actions are those that continue throughout the duration of CAP implementation. The mixture of short-term, mid-term, long-term, and ongoing actions presented for each measure are intended to meet the goals in a realistic timeframe and provide an effective combination to reach the targets set forth. The "already-projected" amount is based on the forecast BAU emissions reduction, followed by a target level to reach the goal of the measure. The measures are then described in greater detail, as is the method of quantifying the GHG emissions reduction, and the responsibility and implementation of the measure is discussed. Each measure qualitatively describes costs and benefits, both to the city and the private sector. Overall benefits of GHG emissions reductions include decreased costs through energy efficiency, reduced risk to human health and welfare, and less global climate change.

The GHG reduction mitigation measures identified in this chapter are expected to achieve the targeted emission reductions. However, the nature, location, timing, size and other characteristics of future development projects may vary widely and additional project-level mitigation measures may be helpful or necessary to assist individual projects to achieve the targeted reductions. Accordingly, Appendix E to this Climate Action Plan provides a non-exclusive list of mitigation measures to be considered by the City and project applicants during project-level environmental review and adopted as needed to ensure that individual development projects achieve the targeted emission reductions.

Note: CAP Amendment No. 1, approved May 5, 2020, recalculated the anticipated 2035 GHG reductions for all measures, based upon new state and federal policies and the interaction between the existing measures and new Measure P – Community Choice Energy. Four measures, Measures A, C, G and H, were eliminated for reasons described below. CAP Amendment No. 1 also updated the Actions calling for ordinance adoption; however, no other Actions were updated with this amendment. This update will occur with the comprehensive CAP update being processed in 2020-21.

4.1 Residential, Commercial and Industrial Photovoltaic Systems

Measure A: Promote Installation of Residential Photovoltaic Systems – Deleted in CAP Amendment No. 1	
Goal: Promote installation of residential PV systems to produce an additional 9.1 MW above already projected amounts, or the equivalent of 2,682 more homes with PV systems, by 2035.	2035 Reduction: N/A
This Measure is no longer needed due to Section 150.1(c)14 of the 2019 California Energy Code, mandating all new low-rise residential construction include solar photovoltaic energy generation systems.	

Measure B: Promote Installation of Commercial and Industrial Photovoltaic Systems	
Goal: Promote installation of commercial and industrial PV systems to produce an additional 11.24 MW per year above projected amounts by 2035.	2035 Reduction: 4,457 $MTCO_2e$
Actions: (*See also actions A1 and A2 above)*. *B-1: Implement and enforce Title 18, Chapter 18.30, Section 18.30.130 of the Carlsbad Municipal Code, mandating solar photovoltaic energy generation systems on new non-residential buildings.* (Ongoing) *B-2: Implement and enforce Title 18, Chapter 18.30, Section 18.30.130 of the Carlsbad Municipal Code, mandating solar photovoltaic energy generation systems on existing non-residential buildings undergoing major renovations.(Ongoing)*	

Already-Projected Amount: The projected power generation from commercial and industrial PV systems is 22.3 MW in the year 2035, which is about 30 percent of projected commercial and industrial electricity use.

Target: The target is the PV production of 33 MW in the year 2035, which is the equivalent amount of power production to supply about 45 percent of projected commercial and industrial demand.

GHG Reduction Measure Description: Photovoltaic (PV) systems convert solar energy into electricity. Measure B promotes the installation of PV systems on commercial buildings and industrial facilities above the already-projected amount of 22.3 MW, by an additional 11.24 MW. Together with the already-projected amount of power generation, Measure B would reach the target PV production of 33 MW in 2035.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure B.

Responsibility and Implementation: Property owners engaging in new construction and major renovations will be responsible for providing PV systems. The City is responsible for enforcing the ordinance, as well as encouraging the voluntary installation of non-residential PV systems through the city website and other means.

Costs and Benefits:

Private: Private costs would result from the installation and maintenance of commercial and industrial PV systems. Benefits would accrue from reduced energy bills and increased property values.

City: City costs would occur from implementing and enforcing a nonresidential PV systems ordinance.

4.2 Building Cogeneration

Measure C: Promote Building Cogeneration for Large Commercial and Industrial Facilities – Deleted in CAP Amendment No. 1	
Goal: Promote building cogeneration for large commercial and industrial facilities, with the goal of producing 6.9 MW.	2035 Reduction: N/A
This Measures will no longer result in significant GHG reductions due to the high renewable electricity content associated with SDG&E's RPS and the CEA CCE.	

4.3 Single-family, Multi-family, Commercial, and City Facility Efficiency Retrofits

Measure D: Encourage Single-Family Residential Energy Efficiency Retrofits	
Goal: Encourage single-family residential efficiency retrofits with the goal of a 50 percent energy reduction compared to baseline in 30 percent of the total single-family homes citywide by 2035 (approximately 10,000 single-family homes out of a total of 35,000).	2035 Reduction: 7,986 $MTCO_2e$
Actions: *D-1: Publicize available incentive and rebate programs, such as SDG&E's Residential Energy Efficiency Program, on the city's website and by other means.* (Short-term) *D-2: Create a citywide "Energy Challenge," similar to the Department of Energy's Better Buildings Challenge, to promote cost-effective energy improvements, while having residents and building owners commit to reducing energy consumption.* (Short-term) *D-3: Implement and enforce Title 18, Chapter 18.30, Section 18.30.190, mandating energy efficiency measures in existing residential buildings undergoing major renovations.* (Ongoing)	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The target is a 50 percent energy reduction in 30 percent of single-family homes citywide by the year 2035.

GHG Reduction Measure Description: As single-family homes use a large portion of the city's total energy and older homes are substantially less efficient than newly constructed homes, there is a large opportunity to reduce GHG emissions through the retrofitting of existing homes. When a single-family homeowner seeks to make major improvements, the owner would be required to meet low-cost energy efficiency measures—such as changing light bulbs and switches, insulating exposed hot water piping, sealing air ducts, improving insulation, or installing a "cool roof." Additional voluntary energy efficiency measures could include providing weather stripping, promoting natural lighting and ventilation, and using "smart" thermostats to regulate energy use for heating and cooling.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure D.

Responsibility and Implementation: Homeowners would implement this measure. SDG&E offers a Residential Energy Efficiency Program, which offers residential customers rebates to improve the efficiency of appliances, such as water heaters, washers, refrigerators, air conditioners, building insulating, and ceiling fans. The City will publicize this and related programs on its website and by other means.

Costs and Benefits:

Private: Private costs would come from homeowners conducting energy audits and implementing efficiency retrofits. The cost of these retrofits is frequently 1 percent or less of the total renovation cost. Benefits would occur through reduced energy costs. Rebates are available as described above.

City: City costs would come from promoting incentive programs and implementing and enforcing a residential energy conservation ordinance.

Measure E: Encourage Multi-Family Residential Efficiency Retrofits	
Goal: Encourage multi-family residential efficiency retrofits with the goal of a 50 percent energy reduction in 30 percent of the projected amount of multi-family homes citywide by 2035 (approximately 5,000 out of a total of 17,000).	2035 Reduction: 3,993 $MTCO_2e$
Actions: *Action D-1: Publicize available incentive and rebate programs, such as SDG&E's Residential Energy Efficiency Program, on the city's website and by other means.* (Short-term) *Action D-2: Implement and enforce Title 18, Chapter 18.30, Section 18.30.190, mandating energy efficiency measures in existing residential buildings undergoing major renovations.* (Ongoing)	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The goal is a fifty percent energy reduction in thirty percent of the projected amount of multi-family homes citywide by the year 2035.

GHG Reduction Measure Description: Multi-family residential retrofits provide an opportunity to reduce building energy use. Multi-family residential retrofits are similar to the single-family retrofits described in Measure D. Other examples of potential multi-family residential energy efficiency improvements include replacing incandescent and halogen lamps with LED or CFL lamps, installing energy-efficient windows and efficient appliances, and using "smart" thermostats to regulate energy use for heating and cooling.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure E.

Responsibility and Implementation: Multi-family residential unit owners would implement this measure. SDG&E offers a Residential Energy Efficiency Program, which offers residential customers rebates to improve the efficiency of appliances, such as water heaters, washers, refrigerators, air conditioners, building insulating, and ceiling fans. The City will publicize this and related programs on its website and by other means.

Costs and Benefits:

Private: Private costs would come from multi-family residential unit owners conducting energy audits and implementing efficiency retrofits. Benefits would occur through reduced energy costs. Rebates are available as described above.

City: City costs would come from promoting incentive programs and implementing and enforcing a residential energy conservation ordinance.

Measure F: Encourage Commercial and City Facility Efficiency Retrofits	
Goal: Encourage commercial and city facility efficiency retrofits with the goal equivalent to a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city facilities by 2035.	2035 Reduction: 7,579 $MTCO_2e$
Actions: *F-1: Undertake a program of energy efficiency retrofits for city-owned buildings, with the goal of 40 percent reduction in energy use, beginning with retrofits that would result in the most substantial energy savings.* (Short-term) *F-2: Promote available incentive and rebate programs, such as SDG&E's Energy Efficiency Business Rebates and Incentives Program, on the city's website and by other means.* (Short-term) *F-3: Implement and enforce Title 18, Chapter 18.21, Section 18.21.155, mandating energy efficiency measures in new non-residential buildings and existing non-residential buildings undergoing major renovations.* (Ongoing)	

Already-Projected Amount: There is no projection for retrofits that would occur without this measure.

Target: The target is equivalent to a 40 percent energy reduction in 30 percent of the projected amount of commercial square footage and in city facilities.

GHG Reduction Measure Description: Relatively straightforward fixes to commercial and city-owned buildings can significantly reduce spending on fuel and electricity for commercial buildings. Examples of retrofits include installing efficient boilers and equipment, installation of high-quality windows, efficient lighting, and other building energy improvements.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure F.

Responsibility and Implementation: Building owners would implement this measure for commercial buildings.[14] Funding is available through incentive and rebate programs, such as SDG&E's Energy Efficiency Business Rebates and Incentives Program. SANDAG prepared an Energy Roadmap for the city, which included energy audits for most municipal facilities and identified energy conservation measures the city can use to reduce energy use in city municipal operations.[15] Funding for city retrofits can be provided through the Energy Efficiency Financing for Public Sector Projects program, described above in Measure C. As well, the city will use its IRF to install energy efficiency retrofits as part of refurbishment of existing city facilities.

Costs and Benefits:

Private: Private costs would come from building owners and business owners implementing efficiency retrofits. Benefits would occur through reduced energy costs. Costs could be offset through incentive and rebate programs.

City: City costs would come from retrofitting city facilities, providing resources to help guide building owners to implement this measure, promoting available incentive and rebate programs, and implementing and enforcing a commercial energy conservation ordinance.

4.4 Commercial and City Facility Commissioning

Measure G: Promote Commercial and City Facility Commissioning – Deleted in CAP Amendment No. 1	
Goal: Encourage commercial and city facility commissioning, or improving existing and new building operations, with the goal equivalent to a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city-owned buildings by 2035.	2035 Reduction: N/A
This measure is now administered through the utility energy efficiency programs and accounted for in the legislative business-as-usual projection for state policy and programs	

[14] AB 802 requires an owner of a nonresidential building 50,000 square feet or larger to benchmark the building's energy use data and annually disclose the energy use to the state.

[15] SANDAG. 2014. "Energy Roadmap for Local Governments." Available: http://www.sandag.org/index.asp?classid=17&projectid=373&fuseaction=projects.detail. Accessed: February 25, 2014.

4.5 Green Building Code

Measure H: Implement Green Building Measures – Deleted in CAP Amendment No. 1	
Goal: Implementation of a 5 percent improvement in energy efficiency above the City of Carlsbad residential green building code (based on CALGreen, the statewide green building code), for new construction.	2035 Reduction: N/A
This Measure is no longer needed because new and future building codes are already more efficient than the 2013 CALGreen code.	

4.6 Efficient Lighting Standards

Measure I: Promote Replacement of Incandescent and Halogen Bulbs with LED or Other Energy Efficient Lamps	
Goal: Replace 50 percent of incandescent and halogen light bulbs citywide with LED or similarly efficient lighting by 2035.	2035 Reduction: 22 $MTCO_2e$
Actions: *I-1:* *Replace 50 percent of incandescent or halogen light bulbs in city facilities with LED or similarly efficient lighting, or follow SANDAG Energy Roadmap recommendations for lighting in city facilities, whichever results in greater energy savings.* (Short-term) *I-2:* *Promote the use of LED or other energy efficient lamps by publicizing rebate programs and information from SDG&E on the benefits of the use of LED or other energy efficient lighting on the city's webpage.* (Short-term) *I-3:* *Evaluate the feasibility of adopting a minimum natural lighting and ventilation standard, developed based on local conditions. Demonstrate natural lighting and ventilation features in future city facility upgrade or new construction.* (Mid-term)	

Already-Projected Amount: There are no projections for this measure.

Target: The target is to replace 50 percent of incandescent and halogen bulbs citywide with LED bulbs or similarly efficient lighting by 2035.

GHG Reduction Measure Description: Replace inefficient incandescent and halogen light bulbs with more efficient light bulbs to reduce the amount of energy needed to power the bulbs, which will reduce the demand for electricity and thus the amount of GHG emissions created by the electrical power generation. In November 2019, the California Energy Commission (CEC) voted to ban the sale of inefficient light bulbs, effective January 2020. Inefficient light bulbs are defined as any general service lamps with a efficacy of less than 45 lumens per watt. SANDAG prepared an Energy Roadmap for the city, which included energy audits for most municipal facilities. The city has, and will continue to, implement the lighting efficiency replacements with the master refurbishment schedule.

Quantification of GHG Emissions Reductions: LED light bulbs reduce energy consumption and therefore GHG emissions by 75 percent compared to incandescent lighting.[16] Promotions and rebates, outreach and education, and the recent CEC decision have all contributed to lighting efficiency replacements in both the residential and commercial sectors. Therefore, the GHG reductions from this measure are not significant.

Responsibility and Implementation: Carlsbad's street lights were replaced in 2011 with energy-saving induction units, leading to a reduction of approximately 1,240 $MTCO_2e$ per year (already taken into account). The City has been and will continue to replace light bulbs within City facilities with LED or similarly efficient lighting. For residential and commercial customers, SDG&E currently does not offer rebates for the purchase of LED or similarly efficient lighting, but the City will promote rebates as they come available on its website and by other means. The City will also provide information on the benefits of the use of LED and efficient lighting from SDG&E and other sources.

Costs and Benefits:

Private: Private costs would be from purchasing LED light bulbs for new construction, and replacing existing light bulbs over time. Benefits would be from reduced energy costs and reduced cost to replace light bulbs (as LED lights last substantially longer).

City: City costs would come from replacing existing inefficient lighting in City facilities with more efficient light bulbs over time, providing information to homeowners and business owners to encourage a switch to LED or other efficient lamps, and evaluating the feasibility of a natural lighting and ventilation ordinance.

4.7 Solar Water Heater/Heat Pump Installation

Measure J: New Construction Residential and Commercial Solar Water Heater Installation	
Goal: Install solar water heaters or heat pumps on all new residential and commercial construction. Retrofit up to 30 percent of existing homes and commercial buildings to include solar water heaters or heat pumps.	2035 Reduction: 2,813 $MTCO_2e$
Actions: *J-1: Promote the installation of solar water heaters and heat pumps by publicizing incentive, rebate and financing programs, such as PACE programs and the California Solar Initiative for renovations of existing buildings by posting this information on the city's website and by other means. (Short-term)* *J-2: Implement and enforce Title 18, Chapter 18.30, Sections 18.30.150 and 18.30.170, mandating alternative water heating requirements in new residential and non-residential buildings.* (Ongoing)	

[16] http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB

Already-Projected Amount: There are no solar water heaters/heat pumps projected to be installed.

Target: The target is to install solar water heaters or heat pumps on all new residential and commercial construction, and retrofit up to 30 percent of existing homes and commercial buildings to include solar water heaters or heat pumps.

GHG Reduction Measure Description: Solar water heaters use water heated by the sun to provide domestic and commercial hot water. Solar water heaters reduce the demand for energy used to heat water. A solar water heater can contribute 30 to 80 percent of the energy needed for residential water heating.[17] Heat pumps are devices that use a small amount of energy to move heat from one location to another.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure J.

Responsibility and Implementation: The City of Carlsbad currently participates in three Property Assessed Clean Energy (PACE) programs: CaliforniaFIRST, Ygrene, and California HERO. PACE programs provide financing to eligible property owners for sustainable energy projects, including the installation of solar water heaters and heat pumps to improve residential energy efficiency. Installation of solar water heaters on all new residential and commercial water heaters could occur through city ordinance. Retrofit of existing homes could occur through a combination of additional encouragement and incentives.

Costs and Benefits:

Private: Private costs would occur through the installation of residential and commercial solar water heaters, which would be passed onto building owners. Benefits would occur through reduced water heating costs.

City: City costs would occur from implementing and enforcing an ordinance requiring new homes and commercial buildings to install solar water heaters or heat pumps.

[17] California Energy Commission. 2009. Go Solar California: A Step by Step Tool Kit for Local Governments to Go Solar. Available: http://www.energy.ca.gov/2009publications/CEC-180-2009-005/CEC-180-2009-005.PDF.

4.8 Transportation Demand Management

Measure K: Promote Transportation Demand Management Strategies	
Goal: Promote Transportation Demand Management Strategies with a goal of achieving a 10 percent increase in alternative mode use by workers in Carlsbad, for a total of 32 percent alternative mode use.	2035 Reduction: 6,325 $MTCO_2e$
Actions: *K-1: Implement the citywide transportation demand management (TDM) plan and strategies.* (Ongoing) *K-2: Implement and enforce Title 18, Chapter 18.51, mandating TDM improvements and strategies for non-residential development.* (Ongoing)	

Already-Projected Amount: There are no projections for this measure. As of 2012, alternative (non-single occupancy vehicle use—such as working at home, carpooling, transit, walking and biking) mode use by Carlsbad workers is 22 percent.[18] Of these alternative uses, most workers work at home (44 percent) and carpool (36 percent), followed by public transit (10 percent), other means (including biking, 6 percent), and walking (5 percent).

Target: The Carlsbad General Plan promotes the use of Transportation Demand Management (TDM), but does not specify a target goal. This measure specifies a goal of achieving an additional 10 percent use of alternative modes, for an overall 32 percent alternative mode use by workers employed in Carlsbad. This is projected to be achieved through 40 percent alternative mode use by workers in new nonresidential buildings, and 30 percent alternative mode use by workers in existing (as of 2013) nonresidential buildings.

GHG Reduction Measure Description: Chapter 3 quantifies emissions reductions from the Carlsbad General Plan due to bikeway system improvements, pedestrian improvements, traffic calming, parking facilities and policies, and transportation improvements. This measure is distinct from these reductions because it focuses on TDM, or the application of strategies and policies to reduce travel demand, or redistribute it in time and space. This measure reduces VMT by shifting single occupancy vehicle use to alternative modes, reducing the average commute length, promoting an alternate work schedule, and promoting telecommuting.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure K.

Responsibility and Implementation: The City of Carlsbad will implement a TDM plan describing strategies to reduce travel demand. The city will also implement an ordinance applying to nonresidential developments meeting a specified minimum trip generation

[18] American Community Survey. 2012. Selected Economic Characteristics for Carlsbad, California. Available: http://factfinder2.census.gov/.

threshold, providing connections to public transportation whenever possible. The city will facilitate a coordinated effort between local businesses and NCTD to develop a route expansion and ridership plan wherever feasible. SANDAG's iCommute program assists commuters by providing free carpool and ridematching services, a subsidized vanpool program, the Guaranteed Ride Home program, SchoolPool carpooling programs for parents, and information about teleworking, all of which can support the city's TDM goals.

Costs and Benefits:

Private: Private costs could include need for a TDM coordinator for private businesses, providing on-site facilities (showers, lockers), and shuttle programs. Benefits would accrue from reduced spending on gasoline, and reduced traffic from less employee commute.

City: City costs would result implementing and enforcing a TDM plan and ordinance. Implementation costs would include conducting an outreach and education campaign to promote the benefits of TDM.

4.9 Increased Zero-Emissions Vehicle (ZEV) Travel

Measure L: Promote an Increase in the Amount of Zero-Emissions Vehicle Travel	
Goal: Promote an increase in the amount of ZEV[19] miles traveled from a projected 4.5 percent to 25 percent of total vehicle miles traveled by 2035.	2035 Reduction: 49,912 $MTCO_2e$
Actions: *L-1: Working with industry partners, construct a "PV to EV" pilot project to install a PV charging station at a city facility (such as the Faraday Center), to charge city ZEVs. The purpose of the pilot project would be to evaluate the feasibility of incorporating more ZEV into the city's fleet. (*Short-term*)* *L-2: Prepare a community-wide charging station siting plan, which evaluates site visibility and exposure, EV driving ranges, high volume destinations, locations with high ownership or interest in EVs, and cost of construction.* (Short-term) *L-3: Construct ZEV charging stations based on the community-wide charging station siting plan described in L-2 above. The ZEV charging stations will be funded by grant funds when available, and the city will post signage directing ZEVs to charging stations.* (Mid-term) *L-4: Offer dedicated ZEV parking, and provide charging stations adjacent to ZEV parking as identified in the community-wide charging station siting plan.* (Mid-term) *L-5: Adopt requirements for ZEV parking for new developments.* (Short-term) *L-6: Implement and enforce Title 18, Chapter 18.21, Sections 18.21.140 and 18.21.150, mandating electric vehicle charging infrastructure in new residential and non-residential building and existing residential and non-residential buildings undergoing major renovations.* (Ongoing) *L-7: Update the city's Fleet Management Program to include a low and zero-emissions vehicle replacement/purchasing policy. Increase the proportion of fleet low and zero–emissions vehicle miles traveled to 25 percent of all city-related VMT by 2035.* (Short-term)	

Already-Projected Amount: According to the EPIC mitigation calculator, 4.5 percent of the vehicle miles traveled in 2035 are projected to be from ZEVs.

Target: The target is to increase the proportion of vehicle miles traveled from 4.5 percent to 25 percent by the year 2035.

GHG Reduction Measure Description: Driving ZEVs reduces carbon emissions by eliminating direct tailpipe emissions of carbon dioxide and other GHGs. The production of electricity used to power electric vehicles generates GHGs; however, SDG&E electricity generates much less GHGs than the direct combustion of fossil fuels. Furthermore, electric vehicles can be charged at home or the workplace using energy produced by PV panels, eliminating GHG emissions completely, at least for the months when PV panels produce the full amount of electricity needed for operations. The ability to provide entirely emissions-free

[19] Zero-Emissions Vehicle (ZEV) is a vehicle that emits no tailpipe pollutants from the onboard source of power. ZEVs include electric vehicles, fuel cell vehicles, and plug-in hybrids, when in electric mode.

transportation through the use of PV panels to charge ZEVs should be capitalized on whenever possible.

Quantification of GHG Emissions Reductions: The EPIC mitigation calculator was used to quantify emission reductions for Measure L.

Responsibility and Implementation: The city will promote an increase in the amount of electric vehicle travel by constructing ZEV charging stations using the community-wide station siting plan. Grant funding for the construction of the ZEV charging stations can come from the California Energy Commission's Electric Vehicle Charging Infrastructure grant, or other similar grant programs. The city would be responsible for operating (including electricity provision, for stations not using PV panels) and maintaining charging stations.

The city is also promoting the use of ZEVs by requiring dedicated ZEV parking and charging infrastructure for new development and major renovations. Through its Fleet Vehicle Replacement Fund, the City of Carlsbad is increasing the city fleet mix of ZEVs, hybrids, and other low- or zero-emissions vehicles to increase low and zero–emissions vehicle miles traveled to 25 percent by 2035.

Costs and Benefits:

Private: The private cost would be the purchase of an electric vehicle and the cost of electricity to power the electric vehicle, for community members who elect to purchase an electric vehicle. Costs may also occur from installing EV chargers or pre-wiring into new residential construction or major renovations. Benefits would accrue from reduced spending on gasoline.

City: City costs would be from planning for, constructing, operating (including providing electricity, for stations not using PV panels) and maintaining ZEV charging stations, which may be offset by potential user fees or grants from the California Energy Commission, or other similar agencies. City costs would also be from implementing ordinances to require the installation of ZEV chargers.. City costs may also occur from fleet purchases of ZEV vehicles. Benefits would accrue from reduced spending on gasoline.

4.10 Citywide Renewable Projects

Measure M: Develop More Citywide Renewable Energy Projects	
Goal: Produce the equivalent amount of energy to power 2,000 homes (roughly equivalent to a 5 percent reduction) by 2035 from renewable energy projects.	2035 Reduction: 2,774 $MTCO_2e$
Actions: *M-1: Conduct a feasibility study to evaluate citywide renewable energy projects and prioritize accordingly. (Short-term)* *M-2: Incorporate renewable energy measures such as PV system installation on city buildings and parking lots, or microturbine installation on city facilities, with the goal of producing approximately 12,000 megawatt-hours per year.* (Mid to Long-term) *M-3: Pursue available funding sources for the construction of renewable energy projects by the city, such as Energy Efficiency Financing for Public Sector Projects and SGIP.* (Mid to Long-term)	

Already-Projected Amount: There is no projected amount for this measure.

Target: The target is the production of 12,341 megawatt-hours per year, approximately the energy required to power 2,000 homes.

GHG Reduction Measure Description: The City of Carlsbad has a number of renewable energy projects in various stages of planning and development. The Maerkle Reservoir Hydropower Project, which has been permitted by the Federal Energy Regulatory Commission (FERC), is estimated to produce about 833 MWh per year. In 2014, Alga Norte Community Park was outfitted with a PV system in the parking area, which will generate some 360 MWh of electricity per year. Other planned projects include a second pressure-reducing hydroelectric generator, similar to the Maerkle Reservoir Hydropower Project, and a potential large PV system at the Maerkle Reservoir property.

Quantification of GHG Emissions Reduction: The production of 12,341 megawatt-hours per year corresponds to a reduction of 2,774 $MTCO_2e$.

Responsibility and Implementation: The City of Carlsbad would be responsible for conducting a feasibility study, determining suitable renewable technologies, siting renewable projects, and constructing and maintaining the renewable energy projects. Funding sources include the Energy Efficiency Financing for Public Sector Projects, which includes renewable energies such as PV systems and other distributed generation technologies, as well as the Self-Generation Incentive Program (SGIP). As well, the city will use IRF to install renewable energy systems as part of refurbishment of existing city facilities, where it is feasible to do so.

Costs and Benefits:

Private: There are no direct private costs from this measure.

City: City costs are planning (including a feasibility study), constructing and maintaining the renewable facilities, some of which may be offset through the funding sources described above. Benefits accrue from electricity savings to City through net energy metering.

4.11 Water Utilities System Improvements

Measure N: Reduce GHG Intensity of Water Utilities Supply Conveyance, Treatment, and Distribution [20]	
Goal: Reduce the intensity of GHG emissions from water utilities (including water supply, wastewater, and recycled water) conveyance, treatment, and distribution by 8 percent by 2035.	2035 Reduction: 713 $MTCO_2e$
Action: *N-1: Improve water utilities (including water supply, wastewater, and recycled water) conveyance, treatment and distribution, and other system improvements.* (Mid to Long-term)	

Already-Projected Amount: The goal of an 8 percent reduction by 2035 is the default value in the EPIC mitigation calculator.

Target: The target is to achieve the already-projected amount.

GHG Reduction Measure Description: This measure estimates emissions reductions from changes in the efficiency of water utilities (including water supply, wastewater, and recycled water) conveyance, treatment, and distribution facilities within the City of Carlsbad.[21] This combines improvements in overall system efficiency, the reduction in GHG intensity of electricity used to move water, wastewater, and recycled water, and replacing potable water needs with expanded recycled water supply. Carlsbad's Sewer Master Plan, for example, calls for eliminating several sewer lift stations and replacing them with gravity pipelines, which would reduce energy usage.[22] The Encina Water Pollution Control Facility exemplifies GHG reductions from water treatment; the facility currently is able to satisfy 60 percent of its energy needs through methane capture and cogeneration and has a long-term goal of energy independence from purchased energy. The 2012 Carlsbad Municipal Water District Recycled

[20] For purposes of this measure, water utilities include potable water treatment and conveyance, sewer conveyance, and recycled water treatment and conveyance systems.

[21] Note: The GHG reductions from water conservation measures detailed in the 2010 Carlsbad Municipal Water District Urban Water Management Plan (UWMP) have already been considered in the GHG forecasts. Further GHG reductions may be possible through greater conservation efforts than those outlined in the UWMP, including Ordinance No. 44 (2009); however, these have not been quantified in this CAP.

[22] The City is replacing three sewer lift stations, which use a combined total of approximately 6,200 kWh of electricity per year with gravity pipelines, in addition to other planned rehabilitation upgrades included in the Sewer Master Plan.

Water Master Plan estimates that, by 2030, recycled water demand could double from 4,100 acre-feet/year to about 9,100 acre-feet/year. Expanding the recycled water system would appreciably reduce the need for more expensive imported water needs in the future.

Quantification of GHG Emissions Reduction: The EPIC mitigation calculator was used to quantify emission reductions for Measure N, which estimates wastewater emissions reductions from methane capture, reductions from water treatment and distribution facilities, and changes in the supply network, including greater use of recycled water.

Responsibility and Implementation: The City of Carlsbad would be responsible for making the improvements to water supply conveyance, treatment, and distribution, which could occur through improvements to the Carlsbad Municipal Water District's system.

Costs and Benefits:

Private: There would be no private costs for this measure.

City: Costs to the City of Carlsbad are from implementing the improvements to the water utilities system. Benefits occur by reducing energy costs and having newer water delivery infrastructure.

Measure O: Encourage the Installation of Greywater and Rainwater Collection Systems	
Goal: Encourage the installation of greywater and rainwater collection systems with a goal of 15 percent of homes by 2035.	2035 Reduction: 137 $MTCO_2e$
Actions: *O-1: Host workshops on greywater and rainwater collection systems through the Carlsbad Municipal Water District, or partner with existing workshop providers, for homeowners interested in installing systems suitable for their property.* (Mid-term) *O-2: Create a design reference manual, or provide links to an existing one, for the design of greywater and rainwater collection systems.* (Mid-term) *O-3: Evaluate the feasibility of offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.* (Mid-term)	

Already-Projected Amount: There is no projection for this measure.

Target: The target is for 15 percent of single-family homes to have greywater and rainwater collection systems installed by 2035.

GHG Reduction Measure Description: Greywater is wastewater generated from hand washing, laundry machines, and showers and baths that have not been contaminated by any toilet discharge. Greywater can be recycled onsite for toilet flushing and subsurface (below ground) landscape irrigation using a greywater system. The regulations for the design, construction and use of greywater systems are in Chapter 16A of the California Plumbing

Code. Some small greywater systems that involve laundry machines or single fixtures only are exempt from permits. More complicated greywater systems require building permits from the City. Rainwater harvesting is the practice of collecting rainwater from hard surfaces, such as roofs, and storing it in barrels or cisterns, which can be used for landscape irrigation. Measure O is to promote the use of on-site greywater and rainwater collection systems for residences.

Quantification of GHG Emissions Reductions: Nationwide, about seven percent of U.S. GHG emissions are from water and wastewater service provision to urban populations.[23] For this measure, it was assumed that seven percent of the citywide emissions are from water provision and wastewater services.[24] Therefore, about 32,000 $MTCO_2e$ of 2035 emissions are from water provision and wastewater services.

If maximally pursued, the use of greywater and rainwater collection systems could reduce water demands by 25 percent on a statewide scale.[25] For this measure, it was assumed the 25 percent reduction in water demand would scale to individual houses that implement greywater and rainwater collection systems. A goal of 15 percent of homes with greywater and rainwater harvesting systems was chosen. A 25 percent reduction of water use in 15 percent of homes corresponds to a GHG reduction of about 137 $MTCO_2e$.

Responsibility and Implementation: Homeowners would be responsible for the installation of greywater and rainwater collection systems. The City of Carlsbad will, through the Carlsbad Municipal Water District, host greywater and rainwater harvesting workshops, or partner with existing workshop providers. The City will also reference or develop a greywater and rainwater collection system design manual and consider offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.

Costs and Benefits:

Private: Costs to homeowners would be from constructing and maintaining greywater and rainwater collection systems. Benefits would accrue over time through water savings.

City: Costs to the City of Carlsbad are from hosting workshops and developing or reviewing greywater and rainwater collection manuals to adopt.

[23] Source: V. Novotny. 2010. "Urban Water and Energy Use: From Current US Use to Cities of the Future." *Cities of the Future/Urban River Restoration*. Water Environment Federation. 9: 118-140.

[24] The 7 percent estimate was used for the purpose of this reduction measure because the Chapter 2 inventory did not directly quantify all emissions associated with water use, but rather included those as part of commercial, industrial and residential energy use (e.g. heating water).

[25] Source: J. Loux, R. Winer-Skonovd, E. Gellerman. 2012. "Evaluation of Combined Rainwater and Greywater Systems for Multiple Development Types in Mediterranean Climates." *Journal of Water Sustainability*. 2(1): 55-77.

4.13 Clean Electricity

Measure P: Increase the Proportion of Clean Electricity in Community Energy Consumption	
Goal: Achieve 100% renewable electricity by 2030 for 95% of the residential bundled load and 85% commercial + industrial bundled load.	2035 Reduction: 56,207 $MTCO_2e$
Action: *P-1: Continue participation in the Clean Energy Alliance Community Choice Energy program* (Ongoing). *P-2 Explore the purchase of renewable energy credits if Community Choice Energy program is not reaching 2035 goal.*	

Already-Projected Amount: There is no projection for this measure.

Target: The target is for 95 percent of the bundled residential load and 85 percent of the bundled commercial plus industrial load to use 100% renewable electricity.

GHG Reduction Measure Description: California Assembly Bill 117 allows local governments to form Community Choice Aggregations, commonly referred to as Community Choice Energy (CCE) program. These programs offer an alternative electric power option to customers with the area currently served by an investor-owned utility. CCEs allow local jurisdictions to increase the proportion of renewable energy available to customers that, in turn, lowers the GHG emissions from electricity consumption. Another means to lower electricity-related GHG emissions is to purchase renewable energy credits as an offset to the consumption of electricity from non-renewable generation sources.

Quantification of GHG Emissions Reductions: The GHG emissions reductions anticipated with this measure are derived from the Community Choice Energy Technical Feasibility Study (prepared by EES Consulting, Inc. and dated March 28, 2019), which was prepared for the cities of Carlsbad, Del Mar, Encinitas and Oceanside. The study evaluates three renewable energy portfolio scenarios: an SDG&E equivalent; 100% renewable by 2030; and, 100% renewable upon inception. The GHG emissions reductions associated with this measure are beyond the reductions assumed by the state mandated renewable portfolio standard.

Responsibility and Implementation: The Clean Energy Alliance Joint Powers Authority and its staff are responsible for implementing the Community Choice Energy program. Electricity customers can choose the proportion of renewable energy they consume (50% or 100%). City staff will monitor the program participation rates and renewable proportions, amount of renewable energy procured, and the resulting GHG emissions reductions to determine the need for purchasing renewable energy credits to meet the 2035 reduction target.

Costs and Benefits:

Private: Costs to electricity customers will be a function of the Clean Energy Alliance rate structure and the proportion of renewable energy purchased through the program.

City: Costs to the City of Carlsbad are from staff and financial contributions to the Clean Energy Alliance Joint Powers Authority and, if needed, the purchase of renewable energy credits.

4.14 Combined Effect of CAP GHG Reduction Measures and Forecast with CAP

Table 4-1 shows a summary of the CAP GHG reduction measures. While the individual measures may be implemented over different timescales, for the purposes of calculating their impact in this section, it was assumed that the effect of all measures would begin in the mid-term time frame and increase linearly to reach the full reduction potential in the year 2035.

As a whole, the CAP GHG reduction measures were designed to enable Carlsbad to achieve its GHG reduction target in the year 2035. The combined GHG reductions from these measures is 142,918 $MTCO_2e$ in 2035, which covers the emissions "gap" identified in Chapter 3. Table 4-2 adds the effect of the CAP GHG reduction measures to the community forecast, and compares the resulting forecast with CAP GHG reduction measures to emission targets. As proposed, this CAP meets the emissions targets for both 2020 and 2035. Figure 4-1 shows the forecast with CAP reduction measures compared to the emissions targets to demonstrate that both 2020 and 2035 targets will be met with the implementation of this CAP.

For this CAP to successfully be implemented, the City of Carlsbad must play a prominent role in implementing the CAP GHG reduction measures. In addition to responsibility and implementation covered for each measure in this chapter, the following chapter discusses how the CAP will be revised and updated in the future to ensure that the targets are met.

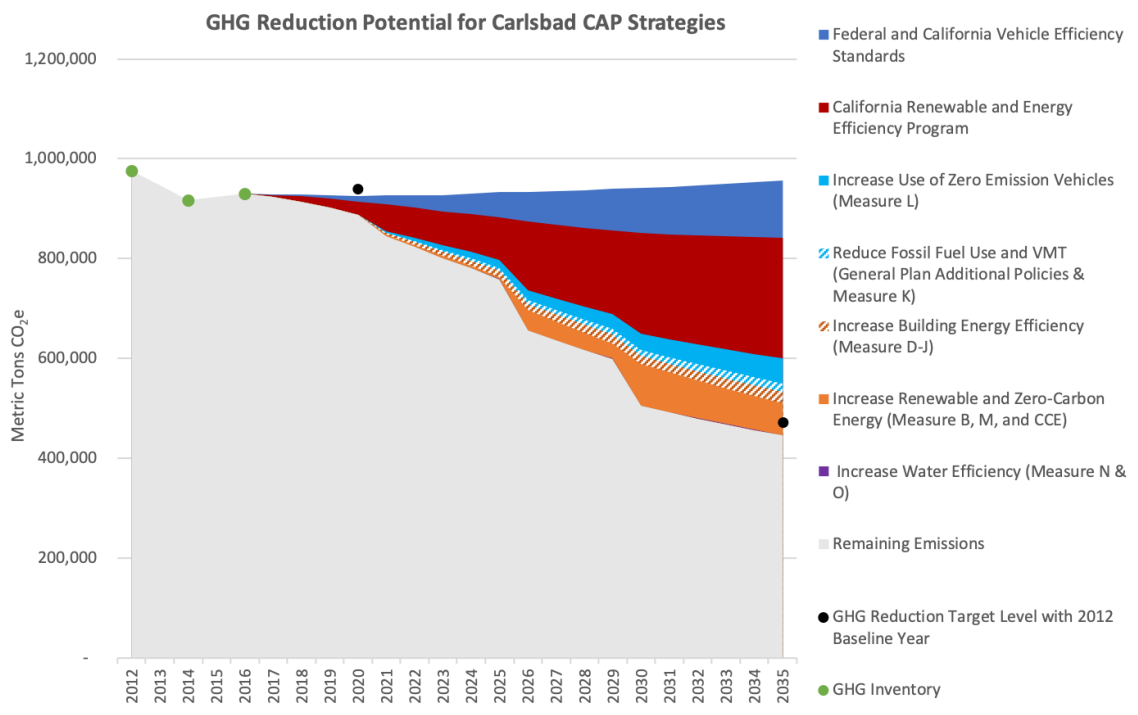
TABLE 4-1: CAP GHG REDUCTION MEASURES SUMMARY

Measure Letter	GHG Reduction Measures	GHG Reduction in 2035 ($MTCO_2e$)
A	Install residential PV systems	N/A
B	Install commercial and industrial PV systems	4,457
C	Promote building cogeneration for large commercial and industrial facilities	N/A
D	Encourage single-family residential efficiency retrofits	7,986
E	Encourage multi-family residential efficiency retrofits	3,993
F	Encourage commercial and city facility efficiency retrofits	7,579
G	Promote commercial and city facility commissioning, or improving building operations	N/A
H	Implementation of Green Building Code	N/A
I	Replace Incandescent bulbs with LED bulbs	22
J	New construction residential and commercial solar water heater/heat pump installation & retrofit of existing residential	2,813
K	Promote Transportation Demand Management	6,325
L	Increase zero-emissions vehicle travel	49,912
M	Develop more citywide renewable energy projects	2,774
N	Reduce the GHG intensity of water supply conveyance, treatment and delivery	713
O	Encourage the installation of greywater and rainwater systems	137
P	Implement Community Choice Energy	56,207
Total GHG Reductions		**142,918**

TABLE 4-2: FORECAST COMMUNITY EMISSIONS WITH CAP GHG REDUCTION MEASURES AND TARGETS

Year	Business-As-Usual Forecast ($MTCO_2e$)	Total Modified Baseline Forecast ($MTCO_2e$)	CAP GHG Reduction Measures ($MTCO_2e$)	Forecast Community Emissions with CAP GHG Reduction Measures	GHG Emission Targets ($MTCO_2e$)	Emission Target Met?
2020	926,000	N/A	N/A	N/A	939,000	Yes
2035	956,000	588,817	142,918	445,899	472,000	Yes

Figure 4-1: Forecast Community Emissions with CAP Reduction Measures and Targets



Energy Policy Initiatives Center 2020

5

Implementation, Monitoring and Reporting

Chapters 3 and 4 identify a comprehensive set of goals and specific, enforceable measures and actions that the city will take in order to meet its GHG emissions targets. Implementation and monitoring are key to ensuring that the city is successful in reaching those targets. The city will use an adaptive management approach to CAP implementation. Adjustments to management actions will be made as needed to support continuous improvement based on measured results, monitoring effectiveness, new technology, or in response to deficiencies in program assessment results. This chapter describes how the City of Carlsbad will implement the CAP and monitor and report on its effectiveness, consistent with State CEQA Guidelines Sections 15183.5(b)(1)(D) and (E).

For discretionary projects seeking to use CEQA streamlining provisions, in an environmental document the city shall refer to the required measures in this CAP as mandatory conditions of approval or as mitigation. This will enable projects to benefit from CEQA streamlining provisions, while ensuring that the city can achieve the reduction targets outlined in this plan.

5.1 Implementation

Table 5-1 lists all of the measures and actions identified in Chapters 3 and 4 along with the following information:

Responsible Department: The city department(s) that will be primarily responsible for implementing, monitoring, and reporting on the progress for each measure.

Annual GHG Reduction Goal: The estimated annual emission reductions anticipated by the 2035 target year.

Performance Target: The expected quantified outcome of the GHG reduction measure.

Progress Indicators: The types of data that will be collected to measure progress toward the performance target and correlate to GHG emissions reductions. Progress indicators will be

confirmed as part of the implementation of each measure. If a recommended progress indicator is found to be infeasible to collect or track, an alternative indicator will be identified.

Unit of Measure: Input units used to calculate GHG emissions reductions ($MTCO_2e$), whereby:

Gallons of water = water consumption
kWh/MWh = electricity consumption in kilowatt-hours or megawatt-hours
$MTCO_2e$ = metric tons of CO2 equivalent emissions
Therm = natural gas consumption in therms
VMT = vehicle miles traveled

Implementation Timeframe: The schedule by which each action is to be implemented, beginning from the year the CAP is adopted, as follows:

Short-term – one to two years
Mid-term – two to five years
Short to Long-term, or Mid-to Long-term – actions that will begin in the short or mid-term, but take longer than five years to fully implement.
Ongoing - continue for the duration of CAP implementation

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
General Plan Measures (see Section 3.6 for complete descriptions)					
Bikeway system improvements	Public Works, Community & Economic Development	**2035: 608**	Achieve 2.85 miles of bike lanes per square mile, corresponding to .07% VMT reduction ○ Miles of bikeways added ○ Miles of bikeways enhanced	VMT	Short to Long-term
Pedestrian improvements and increased connectivity	Public Works, Parks & Recreation, Community & Economic Development	**2035: 615**	1% VMT reduction ○ Miles of pedestrian and trail improvements ○ Number of new connection points	VMT	Short to Long-term
Traffic calming	Public Works, Community & Economic Development	**2035: 969**	.25% VMT reduction ○ Number of traffic calming devices installed ○ Vehicle travelway width reduction ○ Pedestrian crossing width reduction	VMT	Short to Long-term
Parking facilities and policies	Public Works, Community & Economic Development	**2035: 6,618**	2% VMT reduction ○ % reduction in parking standards ○ Number of projects with alternative parking provisions (shared parking, unbundled parking cost, valet, etc.) ○ Number of EV parking spaces installed	VMT	Short to Long-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
Transportation improvements	Public Works, Community & Economic Development	**2035: 2,085**	.63 VMT reduction ○ Transit ridership counts	VMT $MTCO_2e$	Short to Long-term
CAP Measures (see Sections 4.1 - 4.11 for complete descriptions)					
A – Promote installation of residential photovoltaic systems		**N/A**	N/A		
B - Promote Installation of commercial and industrial photovoltaic systems		**2035: 4,457**	Promote installation of commercial and industrial PV systems to produce an additional 10.7 MW per year above projected amounts, or roughly 15 percent of projected commercial and industrial electricity use, by 2035		
B-1: Implement and enforce Title 18, Chapter 18.30, Section 18.30.130 of the Carlsbad Municipal Code, mandating solar photovoltaic energy generation systems on new non-residential buildings.	Community Development		○ MW installed PV	kWh	Ongoing

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
B-2: Implement and enforce Title 18, Chapter 18.30, Section 18.30.130 of the Carlsbad Municipal Code, mandating solar photovoltaic energy generation systems on existing non-residential buildings undergoing major renovations	Community Development		○ MW installed PV	kWh	Ongoing
C - Promote building cogeneration for large commercial and industrial facilities		**N/A**	N/A		
D - Encourage single-family residential efficiency retrofits		**2020: 323** 2025: 593 2030: 862 **2035: 1,132**	Encourage single-family residential efficiency retrofits with the goal of a 50 percent energy reduction compared to baseline in 30 percent of the total single-family homes citywide by 2035 (approximately 10,000 single-family homes out of a total of 35,000)		
D-1: Promote residential energy efficiency incentive and rebate programs	Public Works, Communications		○ Promotional activities conducted	kWh/therms	Short-term
D-2: Create a citywide "Energy Challenge"	Public Works, Communications		○ Program launch ○ Promotional activities conducted ○ Number of program participants and/or sq. footage of buildings in program	kWh/therms	Short-term
D-3: Implement and enforce Title 18, Chapter 18.30, Section 18.30.190, mandating energy efficiency measures in existing residential buildings undergoing major renovations.	Community Development		○ Number and/or sq. footage of existing homes retrofitted	kWh/therms	Ongoing

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
E - Encourage multi-family residential efficiency retrofits		**2035: 3,993**	Encourage multi-family residential efficiency retrofits with the goal of a 50 percent energy reduction in 30 percent of the projected amount of multi-family homes citywide by 2035 (approximately 5,000 out of a total of 17,000)		
E-1 and E-2: See Measures D-1 and D-2 above	Public Works, Communications, Community Development		○ See Actions D-1 through D-2 above	kWh/therms	Short-term
E-3: Implement and enforce Title 18, Chapter 18.30, Section 18.30.190, mandating energy efficiency measures in existing residential buildings undergoing major renovations.			○ Number and/or sq. footage of existing homes retrofitted	kWh/therms	Ongoing
F - Encourage commercial and city facility efficiency retrofits		**2035: 7,579**	Encourage commercial and city facility efficiency retrofits with the goal of a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city facilities by 2035		
F-1: Install energy efficiency retrofits for city-owned buildings	Public Works		○ Sq. footage of buildings retrofitted ○ % energy use reduction	kWh/therms	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
F-2: Promote nonresidential energy efficiency incentive and rebate programs	Public Works, Community Development, Communications		○ Promotional activities conducted ○ Number of program participants and/or sq. footage of buildings retrofitted ○ % energy use reduction	kWh/therms	Short-term
F-3: Implement and enforce Title 18, Chapter 18.21, Section 18.21.155, mandating energy efficiency measures in new non-residential buildings and existing non-residential buildings undergoing major renovations.	Community Development		○ % energy use reduction	kWh/therms	Ongoing
G - Promote commercial and city facility commissioning		**N/A**	N/A		
H - Implement green building measures		**N/A**	construction/A		
I - Promote replacement of incandescent and halogen bulbs with LED or other energy efficient lamps		**2035: 22**	Replace 50 percent of incandescent and halogen light bulbs citywide with LED or similarly efficient lighting by 2035		
I-1: Replace incandescent and halogen light bulbs in city facilities	Public Works		○ Building sq footage upgraded ○ Number of fixtures replaced	kWh	Short-term
I-2: Promote the use of LED rebate programs	Public Works, Communications		○ Promotional activities conducted	kWh	Short-term
I-3: Develop natural lighting and ventilation standards; install city facility demonstration project	Community Development Public Works		○ Feasibility study conducted ○ Number of buildings with natural lighting and ventilation features ○ % energy use reduction	kWh/therms	Mid-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
J - New construction residential and commercial solar water heater/heat pump installation & retrofit of existing residential		**2035: 2,813**	Install solar water heaters or heat pumps on all new residential and commercial construction. Retrofit up to 30 percent of existing homes and commercial buildings to include solar water heaters or heat pumps		
J-1: Promote residential solar water heaters and heat pump retrofit incentive, rebate and financing programs	Public Works, Communications		○ Promotional activities conducted ○ Solar heater/heat pump installations	kWh/therms	Short-term
J-2: Implement and enforce Title 18, Chapter 18.30, Sections 18.30.150 and 18.30.170, mandating alternative water heating requirements in new residential and non-residential buildings.	Community Development		○ Solar heater/heat pump installations ○ MW installed PV	kWh/therms	Ongoing
K - Promote transportation demand management strategies		**2035: 6,325**	Promote Transportation Demand Management Strategies with a goal of achieving a 10 percent increase in alternative mode use by workers in Carlsbad, for a total of 32 percent alternative mode use		
K-1: Implement citywide transportation demand management (TDM) plan	Community Development, Public Works		○ TDM plan adopted ○ TDM participation rates ○ % VMT reduced	VMT	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
K-2: Implement and enforce Title 18, Chapter 18.51, mandating TDM improvements and strategies for non-residential development.	Community Development, Public Works		○ TDM participation rates ○ % VMT reduced	VMT	Ongoing
L - Promote an increase in the amount of zero-emissions vehicle travel		**2035: 56,207**	Promote an increase in the amount of ZEV miles traveled from a projected 15 percent to 25 percent of total vehicle miles traveled by 2035		
L-1: Construct a "PV to EV" pilot project	Public Works, Community Development		○ kW installed PV ○ Number of ZEV charging units	VMT kWh	Short-term
L-2: Prepare a community-wide charging station siting plan	Public Works, Community Development		○ Siting Plan prepared		Short-term
L-3: Construct ZEV charging stations based on the community-wide charging station siting plan	Public Works		○ Number of charging stations installed ○ kWh charging sessions	VMT	Mid-term
L-4: Offer dedicated ZEV parking and charging stations	Public Works, Community Development		○ Number of installed ZEV parking spaces/charging stations ○ kWh charging sessions	VMT	Mid-term
L-5: Adopt requirements for ZEV parking for new developments.	Community Development		○ Number of installed ZEV parking spaces/charging stations ○ kWh charging sessions	VMT	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target	Unit of Measure	Implementation Timeframe
			○ Progress Indicators		
L-6: Implement and enforce Title 18, Chapter 18.21, Sections 18.21.140 and 18.21.150, mandating electric vehicle charging infrastructure in new residential and non-residential building and existing residential and non-residential buildings undergoing major renovations.	Community Development		○ Number of EV chargers installed	VMT	Ongoing
L-7: Increase the proportion of city fleet low and zero–emissions vehicle miles traveled to 25 percent of all city-related VMT	Public Works		○ % LEV and ZEV fleet VMT	VMT	Short-term
M - Develop more citywide renewable energy projects		**2035: 2,774**	Produce the equivalent amount of energy to power 2,000 homes (roughly equivalent to a 5 percent reduction) by 2035 from renewable energy projects		
M-1: Conduct a feasibility study to evaluate citywide renewable energy projects and prioritize accordingly.	Public Works		○ Feasibility study conducted		Short-term
M-2: Incorporate renewable energy measures such as PV system installation on city buildings and parking lots, or microturbine installation on city facilities	Public Works		○ MW installed renewable energy systems	MWh	Mid to Long-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
M-3: Pursue available funding sources for the construction of municipal renewable energy projects	Public Works		○ Number of EEFP or SGIP-funded projects	MWh	Mid to Long-term
N - Reduce the GHG intensity of water supply conveyance, treatment and distribution		**2035: 713**	Reduce the intensity of GHG emissions from water utilities (including water supply, wastewater, and recycled water) conveyance, treatment, and distribution by 8 percent by 2035		
N-1: Improve water utilities (including water supply, wastewater, and recycled water) conveyance, treatment and distribution, and other system improvements.	Public Works, Carlsbad Municipal Water District		○ Number of water system improvement projects ○ % energy use reduction	kWh	Mid to Long-term
O - Encourage the installation of greywater and rainwater systems		**2035: 137**	Encourage the installation of greywater and rainwater collection systems with a goal of 15 percent of homes by 2035		
O-1: Conduct greywater and rainwater collection systems workshops	Carlsbad Municipal Water District, Communications		○ Number of workshops conducted ○ % water use reduction	Gallons of water	Mid-term
O-2: Create a greywater design reference manual	Community Development, Carlsbad Municipal Water District		○ Reference manual created ○ % water use reduction	Gallons of water	Mid-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

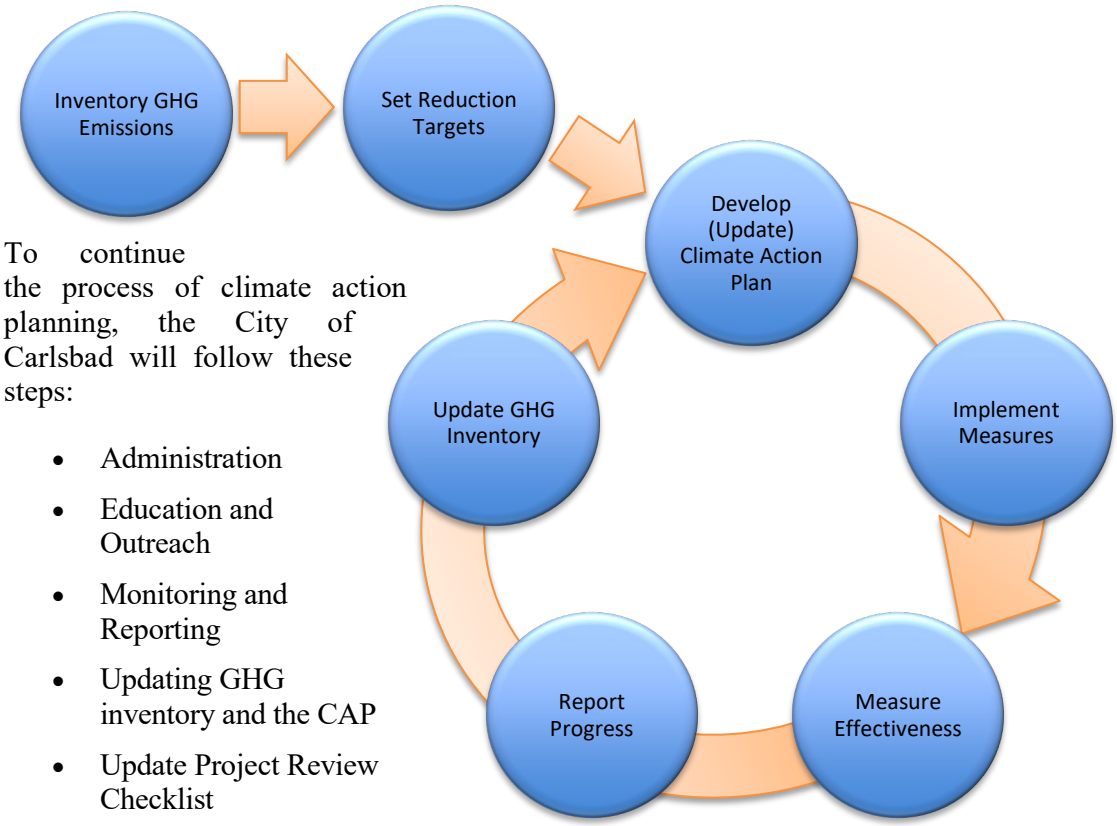
Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target ○ Progress Indicators	Unit of Measure	Implementation Timeframe
O-3: Evaluate the feasibility of offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.	Carlsbad Municipal Water District		○ Feasibility study conducted ○ Number of permit rebates issued ○ % water use reduction	Gallons of water	Mid-term
P – Clean Electricity		**2035: 56,207**	**Achieve 100% renewable electricity by 2030 for 95% of the residential bundled load and 85% commercial + industrial bundled load.**		
P-1: Continue participation in Clean Energy Alliance Community Choice Energy program	City Manager		○ Continued participation	N/A	Ongoing
P-2: Explore the purchase of renewable energy credits if Community Choice Energy program is not reaching 2035 reduction target	Public Works Finance		○ CCE participation rates and percentage of customers at 100% renewable energy.	kWh	Ongoing

5.2 Monitoring and Reporting

This CAP serves as a toolkit for the City of Carlsbad to reduce community-wide GHG emissions and meet emissions targets. Climate action planning, however, is an iterative and adaptive management process: it requires administration, public outreach, monitoring progress and measuring results, periodically revisiting assumptions and adjusting provisions when necessary. Through regular monitoring and measuring the performance of CAP activities, the city will learn what is working and what is not. This will enable the city to make timely adjustments to existing measures, replace ineffective actions, and/or add new measures as changes in technology, federal and state programs, or other circumstances warrant.

Figure 5-1 shows the steps in the process of climate action planning.

Figure 5-1: Process of Climate Action Planning



To continue the process of climate action planning, the City of Carlsbad will follow these steps:

- Administration
- Education and Outreach
- Monitoring and Reporting
- Updating GHG inventory and the CAP
- Update Project Review Checklist

Administration

Following adoption of this CAP, the city will designate a CAP administrator and form an interdisciplinary CAP implementation team from within the city organization. The administrator, in conjunction with the implementation team, will be responsible for initial program start-up activities and for overseeing implementation, monitoring and reporting of all actions described in the CAP. The composition of the implementation team may vary from time to time as needed, but it is expected that core members will include staff from Public

Works, Community and Economic Development, Finance, and Communications departments. As some of the monitoring and reporting activities will require coordination with other agencies, the implementation team will need to foster effective partnerships accordingly.

Operating resources for administering the CAP will be provided through the city's annual budget process. To maximize efficiency and maintain costs, the city will integrate CAP implementation activities into existing workloads and programs whenever possible. Potential private and public funding resources for individual GHG reduction measures are identified in the measure descriptions in Chapter 4. However, since program incentives and funding sources change over time, the CAP administrator and Implementation Team will need to keep current on available resources as GHG reduction measures are implemented.

Education and Outreach

A program of this scope and consequence will require substantial community support in order to succeed. Key to garnering this support is to raise the level of community awareness through education and outreach. Most of the individual GHG reduction measures in Chapter 4 include a promotion and education component. Appendix A provides a listing of internet resources on a variety of climate change-related topics. In addition to these features built into the CAP, the city will utilize its website, social media, and other communications channels to provide information about climate change science and anticipated impacts, and by providing residents and businesses with information and resources to help them take action. The city's website already has a good deal of information related to energy and water efficiency programs, and other environmental sustainability efforts. This Climate Action Plan is also available on the city's website. The city will build upon this base of resources by providing current information and links to various local, state and federal incentive programs to reduce one's carbon footprint, and provide assistance to homeowners, businesses, and contractors seeking to make energy efficiency improvements.

Monitoring and Reporting

The City of Carlsbad will annually monitor and report on CAP implementation activities. The annual monitoring report will include implementation status of each action and progress towards achieving the performance targets of the corresponding emissions reduction measure. The annual monitoring report will also include information on the status of the federal and state level emissions reductions measures identified in Chapter 3 of this CAP, as well as any new efforts that may emerge in the reporting year. The annual report will be presented to the City Council at a public meeting during which interested parties may comment on the report.

Updating GHG Inventory and the CAP

The city will update the community and government operations inventories for calendar year 2014 for inclusion in the first annual report, and then will update the inventories every three years thereafter. For continuity, the inventory updates will tally emissions from the same sectors analyzed in Chapter 2 of this CAP. If an updated inventory reveals that the plan is not making adequate progress toward meeting the GHG target, or that new technologies and programs emerge that warrant inclusion in the CAP, the city will adjust the CAP by modifying, adding, and/or replacing measures as necessary. New opportunities for GHG reductions,

including new funding sources and the ability to link city reduction actions to the city's Capital Improvement Plan, Infrastructure Replacement and Fleet Vehicle Replacement schedules, and other programs can also be incorporated into future updates of the CAP. Interim "milestone" targets for years 2025 and 2030 as shown in Table 4-3 will be used to gauge whether the city is making adequate progress toward meeting the 2035 target. Recommendations to adjust the CAP may be presented to the City Council as part of the annual report or at any other time throughout the year as necessary to ensure effective CAP implementation.

5.3 Project Review Thresholds and Checklist

Compliance with CAP

During the course of project review, city will evaluate whether a project is subject to provisions of this CAP, using the screening criteria below. Once this is established, a project shall comply with the CAP in one of two ways:

- **Checklist Approach.** The Project Review Checklist below provides direction about measures to be incorporated in individual projects, which will be used during the normal development review process. Project features that help a project meet the provisions of the CAP shall then become part of project conditions of approval.
- **Self-Developed Program Approach.** Rather than use the standard checklist, project proponents can develop their own program that would result in the same outcome as the checklist. Appendix E provides a non-exclusive list of potential mitigation measures that can be applied at the project level to reduce project-level greenhouse gas emissions. Other measures not listed in the Appendix may be considered, provided that their effectiveness in reducing greenhouse gas emissions can be demonstrated. The self-developed program approach and selection of mitigation measures shall be subject to city review and approval.

CEQA Streamlining

Project Screening Thresholds

The California Air Pollution Control Officers Association (CAPCOA) public various screening thresholds to guide lead agencies in determining which projects require greenhouse gas analysis and mitigation for significant impacts related to climate change. Utilizing this guidance, the City has determined that new development projects emitting less than 900 MTCO2e annual GHG would not contribute considerably to cumulative climate change impacts, and therefore do not need to demonstrate consistency with the CAP.

The city prepared a "Climate Action Plan Consistency Checklist" and "Guidance to Demonstrating Consistency with the Climate Action Plan For Discretionary Projects Subject to CEQA," which lists the types and sizes of projects that correspond to the 900 MTCO2e screening threshold. The documents were revised to reflect adoption of CAP ordinances. For proposed projects above the screening threshold, project proponents shall complete the Checklist.

Appendix A

Climate Change Informational Resources

Combating climate change requires education and personal action. This section contains resources on climate change and its impacts, calculating individual carbon footprints, and ways to reduce individual carbon footprints.

Education

The evidence is clear that climate change is happening. Humans are largely responsible for recent climate change. International scientific bodies, federal agencies, and state agencies have numerous resources that summarize the current scientific understanding of climate change and the latest projections of climate change impacts.

The Intergovernmental Panel on Climate Change is the leading international body for the assessment of climate change:

- http://www.ipcc.ch/

The National Aeronautics and Space Administration (NASA) has documented recent impacts and future trends of climate change:

- http://climate.nasa.gov/effects

The U.S. Environmental Protection Agency (U.S. EPA) has information of climate change, and it's effects:

- https://www.epa.gov/climate-research

Cal-Adapt, a product of the Public Interest Energy Research (PIER) program, funded by the California Energy Commission, provides California-specific climate change research, including interactive climate tools:

- http://cal-adapt.org/

Carbon Footprint

A carbon footprint is a measure of the total amount of GHG emissions produced by an individual. It can be thought of as a personal inventory of one's impacts on climate change.

There are a number of online calculators that estimate personal carbon footprints. Individuals can use the following carbon footprint calculators as a guide to help reduce personal carbon emissions.

U.S. Environmental Protection Agency (EPA)

- https://www3.epa.gov/carbon-footprint-calculator/

Cool California

- http://www.coolcalifornia.org/calculator

Cool Climate Network

- http://coolclimate.berkeley.edu/carboncalculator

Nature Conservancy

- http://www.nature.org/greenliving/carboncalculator/index.htm

Conservation International

- http://www.conservation.org/act/live_green/carboncalc/Pages/default.aspx

Carbon Footprint

- http://www.carbonfootprint.com/calculator1.html

Global Footprint Network

- http://www.footprintnetwork.org/en/index.php/gfn/page/calculators/

Reducing your Carbon Footprint

Reducing one's personal carbon footprint saves money, decreases impact on the environment, and helps fight climate change. The following links provide resources on changes one can make in his or her day-to-day life to diminish GHG emissions.

Carbon Footprint

- https://www.carbonfootprint.com/minimisecfp.html

COTAP.org

- https://cotap.org/reduce-carbon-footprint/

Cool California: What can you do at home?

- https://coolcalifornia.arb.ca.gov/household

Cool California: What can small businesses do?

- https://coolcalifornia.arb.ca.gov/small-business

Cool California: What can schools do?

- https://coolcalifornia.arb.ca.gov/schools

Appendix B-1

2012, 2014 and 2016 City of Carlsbad Greenhouse Gas Inventories

City of Carlsbad Greenhouse Gas Emissions Inventories and Projection

April 2020

Prepared for the City of Carlsbad

Prepared by the Energy Policy Initiatives Center

About EPIC

The Energy Policy Initiatives Center (EPIC) is a non-profit research center of the USD School of Law that studies energy policy issues affecting California and the San Diego region. EPIC's mission is to increase awareness and understanding of energy- and climate-related policy issues by conducting research and analysis to inform decision makers and educating law students.

For more information, please visit the EPIC website at www.sandiego.edu/epic.

The Energy Policy Initiatives Center (EPIC) prepared this report for the City of Carlsbad. This report represents EPIC's professional judgment based on the data and information available at the time EPIC prepared this report. EPIC relies on data and information from third parties who provide it with no guarantees such as of completeness, accuracy or timeliness. EPIC makes no representations or warranties, whether expressed or implied, and assumes no legal liability for the use of the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. Readers of the report are advised that EPIC may periodically update this report or data, information, findings, and opinions and that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, data, information, findings and opinions contained in the report.

Table of Contents

City of Carlsbad Greenhouse Gas Emissions Inventories and Projection 1

1 Overview 1
1.1 Rounding of Values in Tables and Figures 1

2 Background 1
2.1 Greenhouse Gases 1
2.2 Categories of Emissions 1
2.3 Demographics 2

3 Summary of GHG Emissions Inventory 2

4 Methods to Calculate GHG Emissions Inventory 4
4.1 On-Road Transportation 4
4.2 Electricity 7
4.3 Natural Gas 10
4.4 Solid Waste 11
4.5 Off-Road Transportation 12
4.6 Water 13
4.7 Wastewater 16

5 Business-as-usual (BAU) GHG Emissions Projections 17
5.1 Emissions Projections for 2035 18
5.2 Methods to Project GHG Emissions 19
5.2.1 On-road Transportation 19
5.2.2 Electricity 20
5.2.3 Natural Gas 21
5.2.4 Solid Waste 21
5.2.5 Off-Road Transportation 22
5.2.6 Water 22
5.2.7 Wastewater 23

Appendix A. Carlsbad VMT by Trip Type 1

Appendix B. Source Data For the Solid Waste Emission Factor 1

1 Overview

This document presents a summary of the greenhouse gas (GHG) emissions for the City of Carlsbad (referred to as Carlsbad or the City) for 2012, 2014, and 2016, and the business-as-usual (BAU) emissions projections for 2035. This BAU projection demonstrates emissions growth in the absence of any new policies and programs and does not consider future impacts of adopted federal and State policies. GHG reductions from these policies are considered later in the climate action planning process and are referred to as the "legislatively-adjusted BAU".

Section 2 provides background sources and common assumptions used to estimate GHG emissions and projections. Section 3 provides the GHG emissions for 2012, 2014, and 2016. Details on the methods used to estimate emissions in each category are provided in Section 4. Section 5 provides a summary of the emissions projections and the methods used to project future year emissions.

1.1 Rounding of Values in Tables and Figures

Rounding is used only for the final GHG values within the tables and figures throughout the document. Values for activity data and emission factors are not rounded in the intermediary steps in the calculation. Because of rounding, some totals may not equal the summed values in tables or figures.

2 Background

2.1 Greenhouse Gases

The primary GHGs included in the emissions estimates presented here are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG has a different capacity to trap heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed in carbon dioxide equivalents (CO_2e). In general, the 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used to estimate GHG emissions. The GWPs used in this inventory are from the IPCC Fourth Assessment Report (AR4),[1] provided in Table 1.

Table 1 Global Warming Potentials Used in the Carlsbad GHG Emissions Inventory and Projections

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
IPCC 2013.	

2.2 Categories of Emissions

The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions (U.S. Community Protocol), published by ICLEI USA, requires a minimum of five basic emissions-generating activities to be included in a Protocol-compliant community-scale GHG inventory. These categories are:

[1] IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials (2013).

electricity, natural gas, on-road transportation, water and wastewater, and solid waste.[2] GHG emissions are calculated by multiplying activity data (e.g., kilowatt-hours of electricity, tons of solid waste) by an emission factor (e.g., pounds of CO_2e per unit of electricity). For these five categories, methods used in this inventory were based on the U.S. Community Protocol standard methods and modified with regional- or City-specific data when available. GHG emissions results are based on the best available data and methods for each category and are considered the best available estimates.

Additionally, GHG emissions from off-road transportation were included in the inventory and projections, based on the methods and models used by California Air Resources Board (CARB) in the statewide GHG emission inventory.[3]

All activity data and GHG emissions reported in this document are annual values, and all emission factors reported in this document are annual average values, unless stated otherwise.

2.3 Demographics

The San Diego Association of Governments (SANDAG) estimates and forecasts population and employment for all jurisdictions in the San Diego region. The population and jobs estimate for 2012, 2014, and 2016 are provided in Table 2.[4]

Table 2 Population and Jobs Estimates (Carlsbad 2012, 2014, and 2016)

Year	Population	Jobs
2012	107,929	66,279
2014	110,972	71,060
2016	112,003	75,840
SANDAG 2013, 2019. Energy Policy Initiatives Center 2020.		

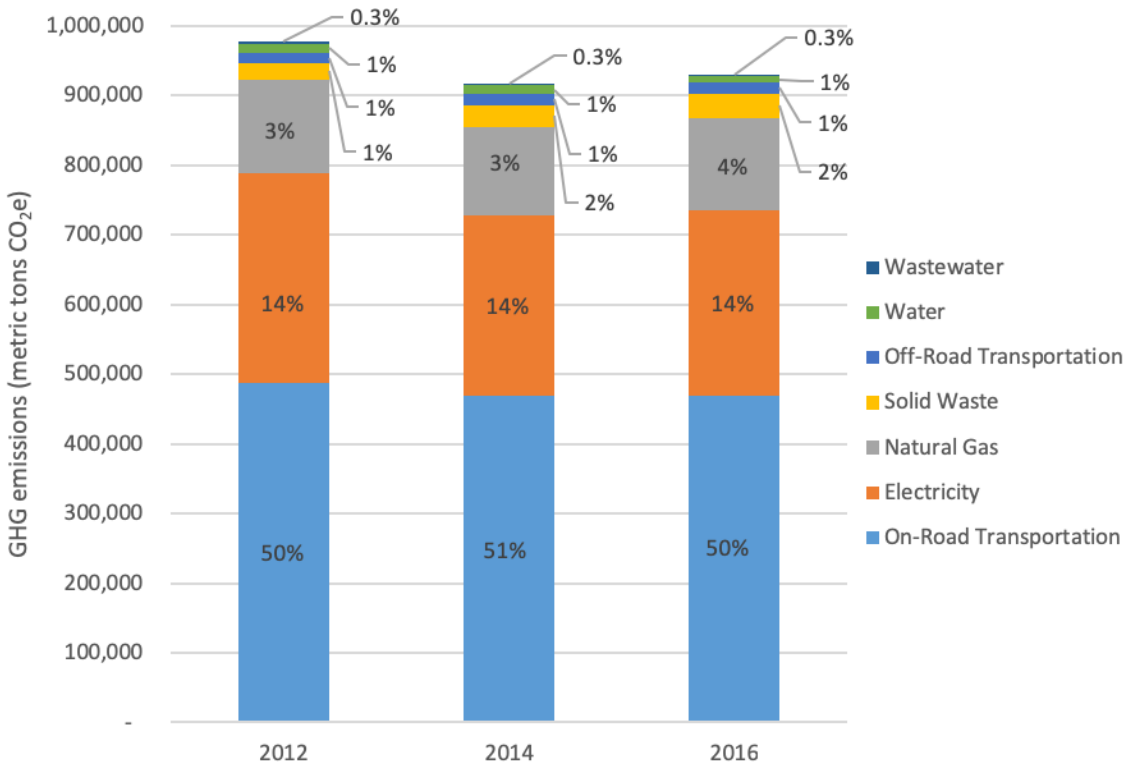
3 Summary of GHG Emissions Inventory

The total and breakdown of GHG emissions from Carlsbad in 2012, 2014, and 2016 are shown in Figure 1 and Table 3.

[2] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012).

[3] California Air Resources Board (CARB): Mobile Source Emissions Inventory – Modeling Tools.

[4] 2012, 2014, and 2016 population are from SANDAG's Demographic & Socio-Economic Estimates (May 25, 2019 Version). SANDAG Data Surfer, accessed March 3, 2020. Jobs in 2012 are from SANDAG Series 13 Regional Growth Forecast (Updated in October 2013), SANDAG Data Surfer, accessed on November 15, 2017. Jobs in 2016 are from SANDAG 2019 Federal Regional Transportation Appendix J: Regional Growth Forecast (October 2019), accessed March 10, 2020. Jobs in 2014 are linearly interpolated between 2012 and 2016.



Percentages may not add to totals due to rounding
Energy Policy Initiatives Center 2020

Figure 1 Distribution of GHG Emissions in Carlsbad (2012, 2014, and 2016)

Table 3 Total and Breakdown of GHG Emissions in Carlsbad (2012, 2014, and 2016)

Emissions Category	2012 GHG Emissions (MT CO_2e)	2014 GHG Emissions (MT CO_2e)	2016 GHG Emissions (MT CO_2e)
On-Road Transportation*	488,000	470,000	470,000
Electricity	301,000	258,000	266,000
Natural Gas	134,000	127,000	133,000
Solid Waste	25,000	15,000	16,000
Off-Road Transportation	14,000	32,000	35,000
Water	12,000	13,000	8,000
Wastewater	3,000	3,000	3,000
Total	**977,000**	**917,000**	**930,000**

Sums may not add up to totals due to rounding.
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
*2012 and 2014 emissions are based on SANDAG Series 13 vehicle miles traveled (VMT) estimates. 2012 is the Series 13 base year. 2016 emissions are based on SANDAG Series 14 VMT estimates. 2016 is the Series 14 base year.
Energy Policy Initiatives Center 2020.

The on-road transportation category contributed the most to the overall GHG emissions in all three inventory years, ranging from 50% to 51%, while the wastewater category contributed the least (<1%) in all three inventory years.

4 Methods to Calculate GHG Emissions Inventory

4.1 On-Road Transportation

The emissions associated with on-road transportation in Carlsbad were estimated based on the vehicle miles traveled (VMT) and the average vehicle emission rate in the San Diego region in a given year. VMT data were provided by SANDAG based on its activity-based model (ABM)[5] and the Origin-Destination (O-D) method.[6] The O-D VMT method is the preferred method proposed by the U.S Community Protocol (TR.1 Emissions from Passenger Vehicles and TR.2 Emissions from Freight and Service Trucks) that estimates miles traveled based on where a trip originates and where it ends to better attribute on-road emissions to cities and regions of miles traveled (Figure 2).[7] The O-D method is also the preferred method used across the San Diego region for consistency across jurisdictions.

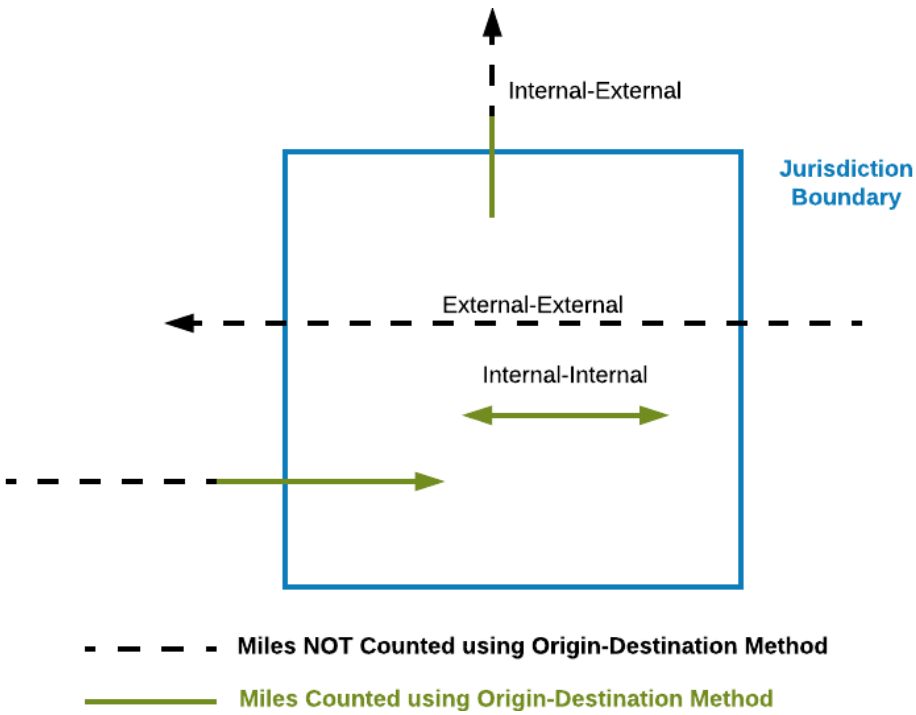


Figure 2 Components of O-D Method for VMT Calculation

O-D VMT data include miles from all trips that originate and end within Carlsbad City limits, referred to as Internal-Internal (I-I), and half of miles from trips that either begin within the boundary and end outside the boundary (referred to as Internal-External, I-E), or vice versa (referred to as External-Internal, E-I). Miles from trips that begin and end outside Carlsbad that only pass through are referred to as External-External (E-E). The average weekday O-D VMT estimates for each trip type in 2012 and 2014

[5] SANDAG (2015): San Diego Forward: The Regional Plan. Appendix T Travel Demand Model Documentation.
[6] SANDAG (2013): Vehicle Miles Traveled Calculation Using the SANDAG Regional Travel Demand Model. Technical White Paper.
[7] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix D: Transportation and Other Mobile Emission Activities and Sources.

were from SANDAG Series 13 estimates; the average weekday O-D VMT estimates for each trip type in 2016 were from SANDAG Series 14 estimates. All are shown in Table 4.[8]

Table 4 O-D VMT and Trip Types (Carlsbad, 2012 and 2014)

Year	Internal-Internal Trips (Miles/Average Weekday)	External-Internal/Internal-External Trips (Miles/Average Weekday)
2012*	563,200	5,015,980
2014*	562,105	5,070,209
2016**	595,962	5,220,336

*Based on SANDAG Series 13 VMT estimates. 2012 is the Series 13 Base Year. **Based on SANDAG Series 14 VMT estimates. 2016 is the Series 14 Base Year.
SANDAG 2017, 2019. Energy Policy Initiatives Center 2020.

The Internal-External and External-Internal miles are divided in half to allocate the miles between Carlsbad and all other outside jurisdictions. The total VMT is multiplied by 347 to adjust from average weekday VMT to average annual VMT which includes weekends.[9]

The average vehicle emission rates expressed in grams of CO_2e per mile driven (g CO_2e/mile) were derived from the statewide mobile source emissions model EMFAC2017, developed by CARB. EMFAC2017 was used to generate CO_2, CH_4 and N_2O emission rates for the San Diego region for all vehicle classes, model years, speeds, and fuel types.[10] The average emission rates were calculated based on the VMT distribution of each vehicle class and its emission rate. The average CO_2, CH_4 and N_2O vehicle emission rates were converted to CO_2e emission rates based on the GWPs in Table 1.

The total VMT, average vehicle emission rates, and corresponding GHG emissions estimates from the on-road transportation category from 2012, 2014, and 2016 are given in Table 5.

[8] Series 13 2012, 2014, 2020 and 2035 average weekday VMT were provided by SANDAG (July 2017). ABM Release 13.3.0. Series 14 2016 average weekday VMT were provided by SANDAG (September 2019). ABM Release 14.0.1.
[9] The conversion of 347 weekdays to 365 days per year as used by CARB. CARB: California's 2000-2014 Greenhouse Gas Emission Inventory Technical Support Document (2016 Edition), p. 41 (September 2016).
[10] CARB: EMFAC2017 Web Database. Emission Rates for SANDAG. Accessed on February 3, 2020. The vehicle classes in EMFAC201y are the same as the vehicle classes in the previous version of the model, EMFAC2014.

Table 5 VMT, Emission Rate and GHG Emissions from On-road Transportation Category (Carlsbad, 2012, 2014, and 2016)

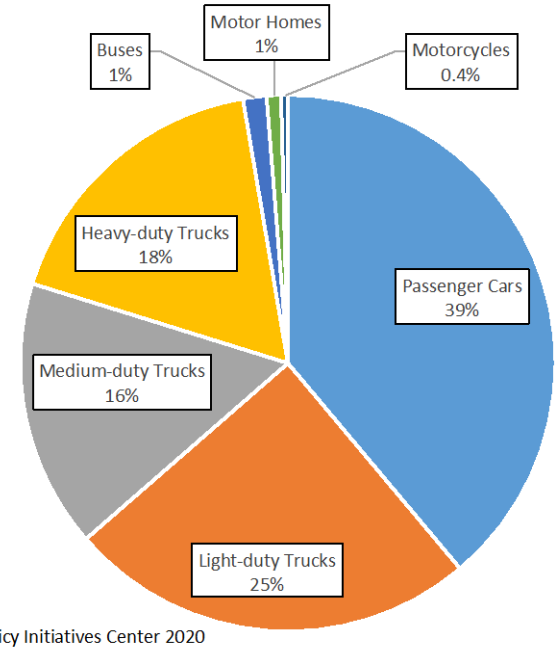
Year	Average Vehicle Emission Rate (g CO_2e/mile)	Total VMT		GHG Emissions (MT CO_2e)
		Average Weekday Miles*	Average Annual Miles	
2012	458	3,071,190	1,065,702,915	488,000
2014	437	3,097,209	1,074,731,692	470,000
2016	422	3,206,130	1,112,527,064	470,000

*Consistent with the methodology, this is the sum of internal-internal and half of both external-internal and internal-external VMT from Table 4. Weekday miles are converted to annual average before converting to GHG emissions.
2012 and 2014 VMT are from SANDAG Series 13 VMT estimates. 2012 is the Series 13 Base Year.
2016 VMT is from SANDAG Series 14 VMT estimates. 2016 is the Series 14 Base Year.
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB 2018. SANDAG 2017, 2019. Energy Policy Initiatives Center 2020.

The average vehicle emission rate in 2014 was lower compared than that in 2012, resulting in lower emissions in 2014 that might be attributed to higher vehicle emission standards for new vehicles and the vehicle fleet turnover rate in the San Diego region. The average vehicle emission rate in 2016 was lower than that in 2014, however, the VMT in 2016 was 4% higher than 2014, resulting in 2016 emissions approximately the same level as the 2014 emissions.

Figure 3 gives the breakdown of emissions by vehicle class in 2012, based on the EMFAC vehicle class distribution in the San Diego region, assuming Carlsbad has the same distribution of vehicle types as the region. Passenger cars contribute the most to emissions with 39%, while motorcycles contribute the least with 0.4%.[11] The breakdown of emissions by vehicle class in 2014 and 2016 are similar to that in 2012.

[11] In California's EMFAC2017, passenger cars are all cars and fuel types designated as Light Duty Automobiles (LDAs). Light Duty Trucks (LDTs) are classified as LDT1 and LDT2, where LDT1 includes gas, diesel, and electric fuel vehicles, while LDT2 does not include electric vehicles. Medium-duty trucks included medium duty vehicles (MDV with Gross Vehicle Weight Rating (GVWR) 5751-8,500 lbs), and heavy-duty trucks (HDTs), with GVWR larger than 8,500 lbs. Under the EPA Emission Standard, vehicles with GVWR under 8,500 lbs are considered light-duty trucks/vehicles



EMFAC2017, Energy Policy Initiatives Center 2020
Percentages may not add to totals due to rounding.
*EMFAC vehilce categorization is different from Enviromental Protect Agency (EPA) Emission Standards vehicle categorization.

Figure 3 On-Road Transportation Emissions by Vehicle Class in the San Diego Region (2012)

4.2 Electricity

Emissions from electricity use in Carlsbad were estimated using the Built Environment (BE.2) method from the U.S Community Protocol.[12] Annual metered electricity sales by the local utility, San Diego Gas & Electric (SDG&E) to Carlsbad customers[13] were adjusted by: 1) a loss factor[14] of 1.07[15] to account for transmission and distribution losses; and 2) subtracting electricity use associated with the distribution of water to avoid double-counting emissions from the water-energy category.

The basic method to calculate GHG emissions is to multiply the adjusted net energy for load (electricity sales + losses) by the corresponding City-specific electricity emission factor, expressed in pounds of CO_2e per megawatt-hour (lbs CO_2e/MWh). For a given year, the City-specific electricity emission factor is developed based on the specific power mix of bundled power[16] and Direct Access power[17] (MWh), and their respective emission factors (lbs CO_2e/MWh). The SDG&E bundled emission factors are calculated

[12] ICLEI – Local Governments for Sustainability USA: U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, Version 1.0 (2012), Appendix C: Built Environment Emission Activities and Sources.
[13] 2012, 2014 and 2016 metered electricity sales were provided by SDG&E (May 11, 2017).
[14] The transmission and distribution loss factor is used to scale end-use demand or retail sales to produce net energy for load. L. Wong, *A Review of Transmission Losses In Planning Studies*, CEC Staff Paper (August 2011).
[15] California Energy Commission (CEC): *California Energy Demand 2015–2025 Final Forecast Mid-Case Final Baseline Demand Forecast Forms*, SDG&E Mid. The transmission and distribution loss factor is calculated based on the ratio of net energy for load (total sales + net losses) and total sales from SDG&E Form 1.2 Mid.
[16] SDG&E bundled power includes the electricity from SDG&E-owned power plants and the electricity from its net procurements.
[17] Direct Access refers to electricity that customers purchase from non-SDG&E electric service providers (ESPs), but SDG&E still provides transmission and distribution services. See SDG&E Direct Access Program.

using Federal Energy Regulatory Commission (FERC) Form 1[18] data, the California Energy Commission (CEC) Power Source Disclosure Program[19] data on SDG&E-owned and purchased power, and U.S. Environmental Protection Agency (EPA)'s Emissions and Generating Resource Integrated Database (eGRID)[20] on specific power plant emissions. The DA emission factor is taken from the California Public Utilities Commission Decision D.14-12-037.[21] The City-specific emission factor are provided in Table 6.

The differences in the electricity emission factors over the years reflect the change in the electricity power mix in the City and in SDG&E's service territory from 2012 to 2014. In the later years, more renewable resources were included in the power mix that have resulted in the decrease of the electricity emission factors. SDG&E had 32% and 43% renewable sources in the electricity supplied to its bundled customers in 2012 and 2014, respectively, increased from 19% renewable sources in 2012.[22]

The net energy for Carlsbad's load (electricity sales + losses), electricity emission factors, and corresponding GHG emissions from the electricity category for the years 2012 and 2014 are given in Table 6.[23]

Table 6 Net Energy for Load, Emission Factor and GHG Emissions from Electricity Category (Carlsbad, 2012, 2014, and 2016)

Year	Net Energy for Load (electricity sales + losses) (MWh)	City-Specific Emission Factor (lbs CO_2e/MWh)	GHG Emissions (MT CO_2e)
2012	875,907	756	301,000
2014	889,039	639	258,000
2016	1,075,609	545	266,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. SDG&E 2017, Energy Policy Initiatives Center 2020.			

The GHG emission factor and emissions from the electricity category decreased from 2012 to 2014 most likely due to the increase of renewable content in the electricity supply. The net energy for load in 2016 is 21% higher than that in 2014. One of the reasons for the increase in net energy for load is likely due to the electricity use at the Carlsbad Desalination Plant for potable water treatment. The Carlsbad Desalination Plant treats water for the San Diego County Water Authority, which is the water wholesaler in the San Diego region. Based on the Plant's Energy Minimization and Greenhouse Gas Reduction Plan, the high energy efficiency plant design will lead to 4,398 kWh per acre-foot (AF) of water treatment

[18] FERC: Form 1 – Electric Utility Annual Report: Report Year 2018, updated July 9, 2019, and accessed September 18, 2019.

[19] CEC: Power Source Disclosure Program under Senate Bill 1305. The SDG&E annual power source disclosure reports from 2012 to 2016 were provided by CEC staff to EPIC.

[20] U.S. EPA. eGRID 2016 Edition, released February 15, 2018, accessed June 29, 2018.

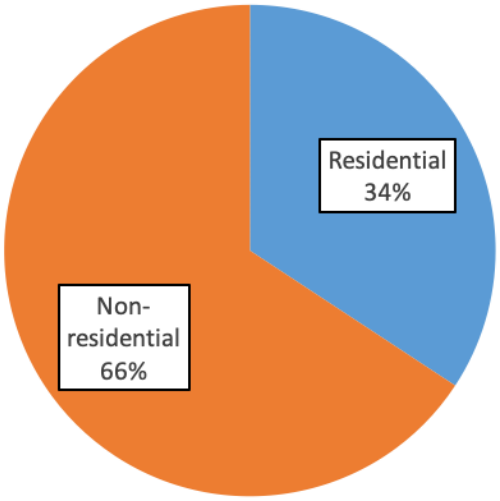
[21] CPUC: Decision 14-12-037, December 18, 2014 in Rulemaking 11-03-012 (filed March 24, 2011). The recommended emission factor is 0.379 MT CO_2e/MWh (836 lbs CO_2e/MWh). However, the recommended emission factor has not changed since 2014 while the all electric service suppliers must meet the Renewables Portfolio Standards in the target years.

[22] California Energy Commission: Utility annual power content label.

[23] The total electricity use was modified to avoid double-counting the electricity consumption associated with water distribution within the community boundary, which is addressed in the water category.

energy intensity.[24] In 2016, the Plant treated approximately 40,000 AF of water, which resulted in approximately 177,000 MWh electricity use.[25]

The emissions can be further separated into residential and non-residential classes. In 2012, 66% of estimated emissions were attributed to non-residential electricity use and the remaining 34% to residential electricity use, as shown in Figure 4.



Energy Policy Initiatives Center 2020

Figure 4 Electricity Emissions by Customer Class (Carlsbad, 2012)

The net energy for load does not include self-serve renewable supply from behind-the-meter photovoltaic (PV) systems or self-serve non-renewable supply. The behind-the-meter PV systems in Carlsbad increased significantly from 2012 to 2016. The number and capacity of newly added PV systems in each of the inventory years, and the total capacity at the end of each inventory year are shown in Table 7.[26] Electricity generation from behind-the-meter PV systems are assumed to have no associated GHG emissions.

[24] Carlsbad Seawater Desalination Project: Energy Minimization and Greenhouse Gas Reduction Plan (2008). Accessed September 2019.

[25] 2016 monthly water production from the Carlsbad Desalination Plant to the SDCWA was provided by SDCWA to EPIC (November 2018).

[26] NEM Interconnection Data Set (current as of November 31, 2019), accessed March 5, 2020. Based on date of NEM interconnection application approved. System capacities are in direct current (DC). Estimated electricity generation is converted from capacity using an average solar PV system capacity factor of 20% and system degradation rate of 1% annually.

Table 7 Behind-the-meter PV System and Electricity Generation (Carlsbad, 2012, 2014, and 2016)

Year	New PV Systems		Cumulative PV Systems since 2000		Estimated Behind-the-meter Solar Generation (MWh)
	Number of Systems	Capacity (MW_{dc})	Number of Systems	Capacity (MW_{dc})	
2012	116	0.7	541	3.7	6,512
2014	596	4.1	1,528	9.8	17,227
2016	1,133	8.6	3,742	26	45,553
California Distributed Generation Statistics 2019, Energy Policy Initiatives Center 2020.					

4.3 Natural Gas

Emissions from natural gas end-use in Carlsbad were estimated using method Built Environment (BE.1) from the U.S Community Protocol.[27] Annual metered natural gas sales were provided by SDG&E.[28] The natural gas use was adjusted to exclude the electricity generation fuel use at the Encina Power Station.[29] To estimate emissions from the combustion of natural gas, fuel use was multiplied by an emission factor for natural gas based on data from CARB.[30] The natural gas use and corresponding GHG emissions from the natural gas category are given in Table 8.

Table 8 Natural Gas Use and GHG Emissions from Natural Gas Category (Carlsbad, 2012, 2014, and 2016)

Year	Natural Gas Use (million therms)	GHG Emissions (MT CO_2e)
2012	24.4	134,000
2014	23.2	127,000
2016	24.3	133,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. SDG&E 2017, Energy Policy Initiatives Center 2020.		

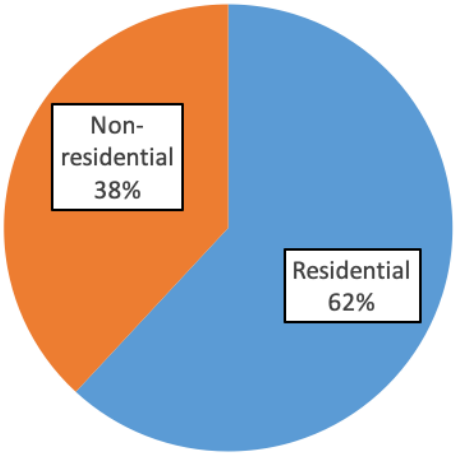
Emissions from the natural gas category can be broken down further into residential and non-residential. In 2012, an estimated 62% of emissions resulted from residential natural gas use and 38% resulted from non-residential natural gas use, as shown in Figure 5.

[27] ICLEI– Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix C: Built Environment Emission Activities and Sources.

[28] 2012, 2014 and 2016 metered natural gas sales were provided by SDG&E (May 11, 2017).

[29] The emissions from electricity generation fuel use at Encina Power Station occur within the City boundary, however, the emissions were accounted for in calculating the electricity emission factors. Natural gas use at Encina Power Station from 2012 to 2016 and emissions are reported in the EPA Greenhouse Gas Reporting Program.

[30] Emission factor for natural gas: 0.0554 MMT CO_2e/MM therms. California Air Resources Board. Documentation of California's GHG Inventory – Index.



Energy Policy Initiatives Center 2020

Figure 5 Natural Gas Emissions by Customer Class (Carlsbad, 2012)

4.4 Solid Waste

Emissions from solid waste disposed by Carlsbad were estimated using method Solid Waste (SW.4) from the U.S. Community Protocol.[31] To estimate emissions, the amount of waste disposed by a city in a given year is multiplied by an emission factor for mixed solid waste. Solid waste disposal data were retrieved from the California Department of Resources Recycling and Recovery (CalRecycle) Disposal Reporting System (DRS).[32]

The emission factor of mixed solid waste depends on the percentage of each waste type within the waste stream disposed in a landfill. The closest city to Carlsbad with a recent waste characterization study is the City of Oceanside, therefore this was used as a substitute for Carlsbad to determine the emission factor based on the percentage of each waste type within the mixed solid waste. This emission factor was applied to 2012, 2014, and 2016 waste disposal for the emission calculation.[33] Only the CH_4 emissions from waste degradation, which are considered non-biogenic, are included in this category. The CO_2 emissions from waste degradation are considered biogenic and not included in this category.

The default capture rate of CH_4 emissions from landfills is 75% based on the U.S. Community Protocol and it is the rest that comprises emissions from the solid waste category. The total and per-capita solid waste disposal and the corresponding GHG emissions from solid waste disposal are given in Table 9. The waste disposal and GHG emissions from waste in 2016 are 40% higher than in 2012.

[31] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix E. Solid Waste Emission Activities and Sources.
[32] CalRecycle Disposal Reporting System (DRS): Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility. 2012, 2014 and 2016 solid waste disposal data from CalRecycle were confirmed by City staff. Download date: June 16, 2017.
[33] City of Oceanside 2017 Organic Management Detailed waste characterization study results were provided by Carlsbad city staff. The emission factor, 0.98 MT CO_2e/short ton was calculated based on waste distribution and emission factor for each waste type in Version 13 Waste Reduction Model (WARM).

Table 9 Solid Waste Disposal and GHG Emissions from Solid Waste Category (Carlsbad, 2012, 2014 and 2016)

Year	Solid Waste Disposal (metric tons/year)	Per Capita Solid Waste Disposal (kg/person/day)	GHG Emissions (MT CO_2e)
2012	102,220	2.6	25,000
2014	130,821	3.2	32,000
2016	143,557	3.5	35,000
GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. CalReycle 2017, Energy Policy Initiatives Center 2020.			

4.5 Off-Road Transportation

The emissions from off-road transportation in Carlsbad such as gasoline and diesel fuel use for off-road vehicles and equipment, were estimated based on CARB off-road models. OFFROAD2007 is the main model for estimating off-road transportation emissions. After the release of OFFROAD2007, CARB has been developing inventories and models for each sub-category based on specific regulatory requirements. For example, the recreational equipment category in OFFROAD2007 was replaced by RV2013. In this section, new inventories and models were used if available; otherwise, OFFROAD2007 was used. [34]

Due to the lack of jurisdiction-specific data from CARB models, the emissions or fuel consumption from the CARB model outputs for the San Diego region were scaled to the City based on sub-category-specific scaling factors. The off-road activity sub-categories that are relevant to Carlsbad and the scaling factors are given in Table 10.[35] The sub-categories do not include all sub-categories identified in CARB off-road models, they are the off-road sub-categories included in the 2015 Carlsbad Climate Action Plan.[36]

Table 10 Sub-Categories included in the Carlsbad Off-Road Transportation Categories

Sub-Category	Model Source	Common Equipment Type	Scaling Factor
Lawn and Garden Equipment	CARB OFFROAD2007	Lawn mowers, trimmers, brush cutters, chainsaws, leaf blowers/ vacuums	Population
Light Commercial Equipment	CARB OFFROAD2007	Generator set, pumps, welders	Commercial Jobs
Construction and Mining	CARB In-Use Off-Road Equipment 2011 Inventory	Excavators, off-highway tractors, loaders, paving equipment	Construction Jobs
Industrial	CARB In-Use Off-Road Equipment 2011 Inventory	Aerial lifts, forklifts, sweepers/scrubbers	Industrial Jobs
Energy Policy Initiatives Center 2020.			

In the In-Use Off-Road Equipment 2011 Inventory, the fuel consumptions for the equipment in the San Diego region were reported in gallons per year and converted to annual GHG emissions. For other sub-categories, the OFFROAD2007 model outputs are annual emissions for the San Diego region. The scaling

[34] CARB: Mobile Source Emissions inventory – Off-Road Diesel Vehicles.
[35] The sub-categories listed in this table are not the comprehensive off-road mobile sources listed in CARB, as some of the sub-categories are not relevant to Carlsbad, such as airport ground support, pleasure craft, commercial marine vessels, etc.
[36] Carlsbad: Climate Action Plan (2015). Table 2-2: 2011 Community GHG Emissions.

factors and the corresponding GHG emissions from the off-road transportation category are given in Table 11.[37]

Table 11 GHG Emissions from the Off-road Transportation Category (Carlsbad, 2012, 2014, and 2016)

Sub-Category	Scaling Factor	San Diego Region (Million MT CO_2e)			Carlsbad (MT CO_2e)		
		2012	2014	2016	2012	2014	2016
Lawn and Garden Equipment	3%	0.095	0.093	0.091	3,272	3,231	3,118
Light Commercial Equipment	5%	0.103	0.102	0.101	4,736	4,904	5,053
Construction and Mining	3%	0.184	0.186	0.186	5,427	6,167	6,753
Industrial	8%	0.012	0.013	0.014	902	986	1,070
				Total	14,000	15,000	16,000

Not all off-road transportation emissions are included, only selected sub-categories are included.
Total GHG emissions are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB 2007, 2011, Energy Policy Initiatives Center 2020.

4.6 Water

The Carlsbad Municipal Water District (CMWD) is a SDCWA member agency that provides both potable and recycled water service within the City of Carlsbad. CMWD services the majority of the City within the potable water service area and covers 77% of the City population.[38] The remaining portion of the City is served by Olivenhain Municipal Water District (OMWD) and Vallecitos Water District (VWD).[39] 100% of the City's potable water supply is imported water from SDCWA.[40] The potable water supplied within CMWD service area and within the entire City is given in Table 12.[41]

[37] The population scaling factors were calculated based on the 2012–2014 populations compared with the regional population. The regional population is from the SANDAG Demographic & Socio-Economic Estimates (Updated in September 2015), download date: October 29, 2015. Regional commercial jobs in 2012 are from the SANDAG Series 13 Regional Growth Forecast (Updated in October 2013), download date: March 29, 2017, SANDAG Data Surfer. Commercial jobs include all employment types other than agriculture and mining, construction and manufacturing. The jobs estimate in 2013 is interpolated linearly based on 2012 and 2020 jobs estimates.

[38] Carlsbad Municipal Water District: 2015 Urban Water Management Plan (June 2016). Section 3.1.3 Population and Demographics.

[39] Carlsbad. Water District Map.

[40] CMWD and VWD import 100% treated water from SDCWA. OMWD imports both treated and untreated water from SDCWA. The untreated water is treated at OMWD's David C. McCollom Water Treatment Plant.

[41] Potable water supplied within the CMWD service area (2012-2016) were provided by City staff (January 2018). Population served by CMWD and population within entire City of Carlsbad (2010-2016) were provided by SANDAG (April 2017). Potable water supplied within entire City was calculated based on the population ratio between CMWD service area and the City (77%).

Table 12 Potable Water Supplied (Carlsbad, 2012, 2014, and 2016)

Year	Carlsbad Municipal Water District (CMWD) Potable Water Supplied (Acre-feet)	City of Carlsbad Potable Water Supplied (Acre-feet)
2012	15,866	20,609
2014	16,665	21,634
2016	13,638	17,734
CMWD services the majority of the City within the potable water service area and covers 77% of the City population. City of Carlsbad 2018, Energy Policy Initiatives Center 2020.		

The energy used to produce and provide potable water from each type of water is different due to the different raw sources and their locations. Emissions from water use in Carlsbad were estimated using method Wastewater and Water (WW.14) from the U.S. Community Protocol.[42] The method considers each segment of the water system (upstream supply and conveyance, local water treatment, and local water distribution) individually, as described below.

Upstream Supply and Conveyance – This is defined as supply and conveyance of water from the raw sources to the local service area. The upstream supply and conveyance energy use for imported water from SDCWA water consists of conveyance of water from the State Water Project and Colorado River through Metropolitan Water District's service area and SDCWA's service area before reaching the City.

Local Potable Water Treatment –This is the energy used for water treatment plant operations. CMWD imports treated water directly and does not own a water treatment plant. Therefore, there is no energy used from local water treatment.

Local Potable Water Distribution – This is defined as the energy required to move treated water from water treatment plants to end-use customers. Distribution energy use includes energy use for water pump stations and/or pressure reduction stations, water tanks, etc.

The energy intensity per unit of potable water for each segment of the water system is given in Table 13.

[42] ICLEI – Local Governments for Sustainability USA. U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. Version 1.0. (2012). Appendix F. Wastewater and Water Emission Activities and Sources.

Table 13 Energy Intensity for Each Segment of Water System

Upstream Supply and Conveyance Energy Intensity (kWh/acre-foot)[43]	1,816
Local Potable Water Distribution Energy Intensity (kWh/acre-foot)[44]	15
MWD 2016, SDCWA 2016, City of Carlsbad 2018.	

For upstream supply and conveyance, the potable water amount was multiplied by the upstream energy intensity to get the total electricity use from upstream supply. This electricity use was multiplied by the average California electricity emission factor to calculate the GHG emissions.[45] Because the electricity use and GHG emissions associated with upstream supply and conveyance are outside the City boundary and would not be included in the electricity category, they are accounted for instead in the water category.

For water distribution emissions, the potable water amount was multiplied by the energy intensity for local water distribution and the SDG&E electricity emission factor. The electricity and GHG emissions associated with water distribution occur within the City boundary, and have been subtracted from the electricity category, as they are accounted for in the water category.

In addition to providing potable water, CMWD delivers recycled water within the entire City.[46] The recycled water delivered by CMWD is from three sources: 1) the Carlsbad Water Recycling Facility (WRF), 2) the Meadowlark WRF, and 3) the Gafner WRF. The Carlsbad WRF is owned by CMWD but operated by the Encina Wastewater Authority (EWA). The Meadowlark WRF is owned by VWD and the Gafner WRF is owned by Leucadia Wastewater District (LWWD), but both agencies sell the recycled water to CMWD for distribution.[47] Recycled water is supplied to golf course, parks, industrial areas, and homeowner association common areas, etc. The recycled water energy intensity, 588 kWh/acre-foot, is based on a regional analysis for the North San Diego Water Reuse Coalition (NSDWRC) is used as the best estimate for the City. [48]

---

[43] Since climate action plans (CAPs) consider the jurisdiction as the unit of analysis, water-related GHG emissions associated with its water use begin at the jurisdiction's water supply agency or district. Anything upstream of the agency or district is considered part of upstream supply and conveyance. Therefore, the upstream supply and conveyance energy intensity for SDCWA treated water for CMWD includes conveyance from the State Water Project and Colorado River water to MWD's distribution system, distribution from MWD to MWD's member agencies, SDCWA conveyance of raw water to its water treatment plants, treatment in SDWCA's plants, and distribution of treated water from SDCWA's treatment plant up to SDCWA's member agency. SDCWA 2016: Urban Water Management Plan 2015, Metropolitan Water District of Southern California, Urban Water Management Plan 2015. EPIC Technical Report: Energy-for-Water Nexus in Cities in San Diego County (2018).

[44] The distribution energy intensity for CMWD service area in 2015 (the latest year with data available) was provided by City staff (January 2018) and used as a proxy for the inventory years.

[45] The Western Electricity Coordinating Council (WECC) CAMX (eGRID Subregion) emission rate (653 lbs CO_2e/MWh in 2012 and 2014, and 530 lbs CO_2e/MWh in 2016) from eGRID was used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID 2016 Edition. Released February 15, 2018, accessed June 29, 2018.

[46] CMWD delivers recycled water within its service area and also adjacent agency service areas. CMWD is the only recycled water provider within the City. The recycled water distribution area is less than half of the City.

[47] Carlsbad Municipal Water District: 2015 Urban Water Management Plan (June 2016). Section 6.7.2 Wastewater Treatment and Collection Facilities.

[48] CMWD is a member of the NSDWRC, which is a coalition of water and wastewater agencies in the Northern San Diego County. Escondido 2015 Urban Water Management Plan (Jun 2016). Section 9.3 Water Sector Energy Intensity.

The total potable and recycled water supplied, as well as the corresponding GHG emissions from the water category from the years 2012 and 2014 are given in Table 14.[49]

Table 14 Water Supplied and GHG Emissions from the Water Category (Carlsbad, 2012 and 2014)

Year	Potable Water		Recycled Water		Total GHG Emissions (MT CO_2e)
	Water Supplied (acre-foot)	GHG Emissions (MT CO_2e)	Water Supplied (acre-foot)	GHG Emissions (MT CO_2e)	
2012	20,609	11,187	4,069	814	12,000
2014	21,634	11,724	4,845	804	13,000
2016	17,734	7,806	4,057	568	8,000

GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
Energy Policy Initiatives Center 2020.

A significant amount of energy is associated with end-use water, such as water heating and cooling. These emissions are included in the electricity and natural gas category, as data are not available to separate out those values.

4.7 Wastewater

The emissions from wastewater generated by Carlsbad were estimated based on the total amount of wastewater generated in a given year and the emission factor of the wastewater treatment processes.

The wastewater in Carlsbad is collected and delivered to the EWA for treatment at the Encina Water Pollution Control Facility (Encina WPCF). The wastewater treatment GHG emissions and total wastewater flow for the Encina WPCF were provided by the Encina Wastewater Authority. In 2013, the Encina WPCF treated an average of 22.8 million of gallons per day (MGD) with annual CO_2e emissions of 11,359 metric tons. This resulted in an emission factor of 1.37 MT CO_2e/million gallons treated, which consists of emissions from: 1) stationary combustion of anaerobic digester gas; 2) process emissions from wastewater treatment with nitrification and denitrification; and 3) direct anaerobic digester gas. The wastewater emission factor derived from the Encina WPCF was applied to all wastewater flow in the City of Carlsbad. As similar data were not available for the other years, the 2013 emission factor was used as an estimate for all inventory years.

The wastewater treated, as well as the corresponding GHG emissions are given Table 15.[50]

[49] Recycled water delivered by CMWD (2012-2016) were provided by City staff (January 2018).

[50] Monthly wastewater (daily average - million gallons per day) data from 2010 to 2016 were provided by City of Carlsbad in January 2018 and converted to million gallons per year.

Table 15 Wastewater Generated and GHG Emissions from Wastewater Category (Carlsbad, 2012, 2014 and 2016)

Year	Total Wastewater Generated (million gallons/year)	GHG Emissions (MT CO_2e)
2012	2,480	3,000
2014	2,275	3,000
2016	2,170	3,000
GHG emissions for each category are rounded to the nearest hundreds. Values are not rounded in the intermediary steps in the calculation. City of Carlsbad 2018, Energy Policy Initiatives Center 2020.		

5 Business-as-usual (BAU) GHG Emissions Projections

To inform the development of GHG reduction strategies within a jurisdiction's Climate Action Plan (CAP), GHG emissions are projected from the latest data available, as well as projections for population, housing, and job growth. This is used to develop a business-as-usual (BAU) projection, which demonstrates emissions growth in the absence of any new policies and programs. Next, emissions reductions attributable to federal and State policies and programs are applied in the future, creating a legislatively-adjusted BAU.

Figure 6 provides an illustrative example of the difference between a BAU and a legislatively-adjusted BAU. Only the BAU projection is discussed in this document; GHG reductions from the policies and programs included in the legislatively-adjusted BAU are considered in the climate action planning process.

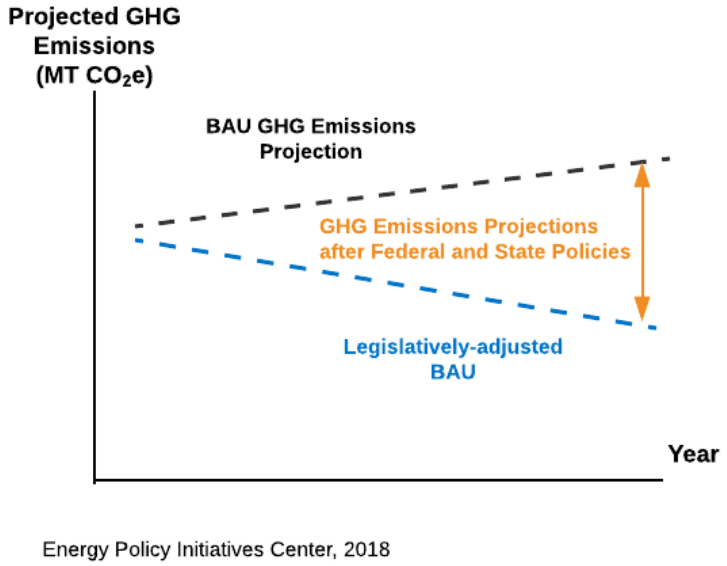


Figure 6 Illustrative Example Only: BAU and Legislatively-adjusted BAU Emissions Projections

Section 5.1 provides a summary of the business-as-usual (BAU) emissions projections for 2035, and Section 0 provides the projection methodologies used for each category.

5.1 Emissions Projections for 2035

The total GHG emissions in 2035 are estimated to be 956,000 MT CO_2e based on projection methods by category described below. Figure 7 below shows a comparison of the emissions breakdown by category for the inventory years (2012, 2014, and 2016) and projection year 2035.

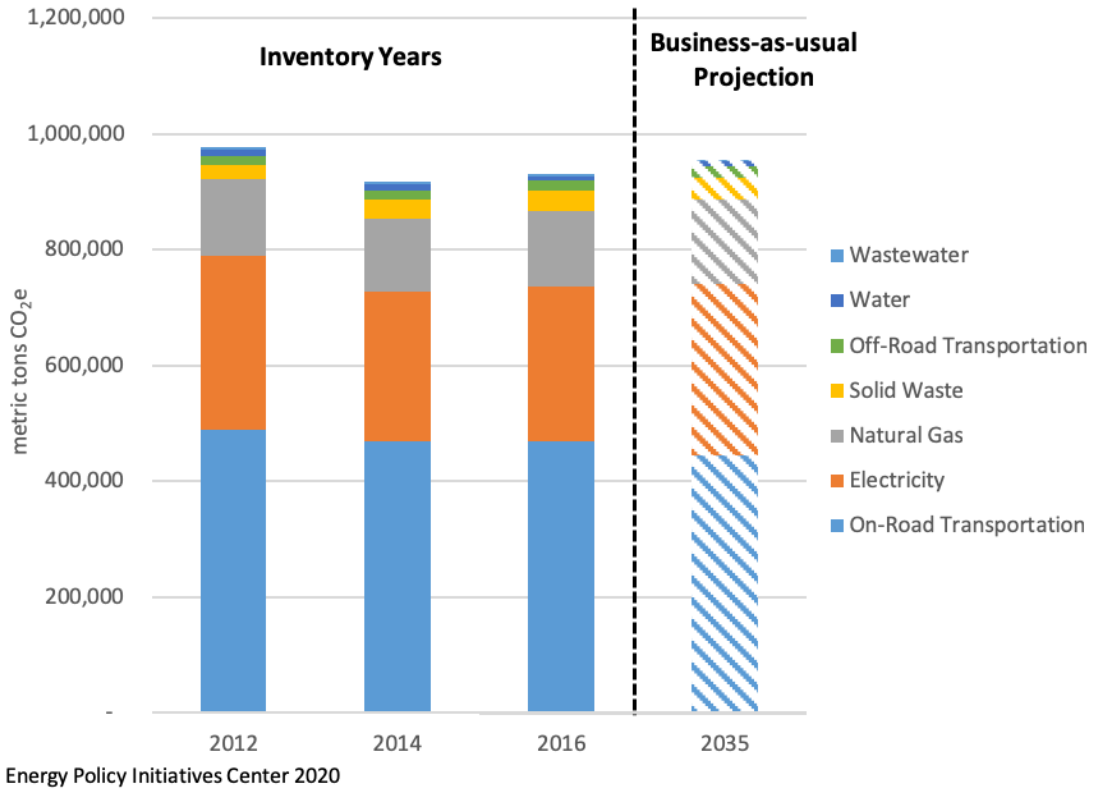


Figure 7 BAU GHG Emissions Projections (Carlsbad, 2035)

As shown in Figure 7, the on-road transportation category remains the largest component of overall emissions in the projection year, but is not projected to be higher than the transportation emissions in inventory years. The decline of on-road transportation emissions is likely due to the decline of average vehicle emission rates, as newer, more efficient vehicles replace old vehicles in the region. The total and breakdown of projected emissions in each category are presented in Table 16.

Table 16 Projected Total and Category-GHG Emissions in Carlsbad (2035)

Emissions Category	Projected Emissions in 2035 (MT CO_2e)
On-Road Transportation	445,000
Electricity	296,000
Natural Gas	147,000
Solid Waste	37,000
Off-Road Transportation	19,000
Water	9,000
Wastewater	3,000
Total	**956,000**
The sum may not add up to totals due to rounding. Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center, 2020.	

5.2 Methods to Project GHG Emissions

The Series 14 Regional Growth Forecast included in the SANDAG 2019 Federal Regional Transportation Plan was used to obtain the population and job growth in Carlsbad. As of March 2020, SANDAG Series 14 Growth Forecast does not have a breakdown of the number of jobs by employment type (e.g., construction, agriculture) for each jurisdiction. Therefore, the ratio of the number of jobs by each employment type to total number of jobs from SANDAG Series 13 Growth Forecast were applied to the jobs forecast From Series 14.[51] The projected population and jobs in 2035 are shown in Table 17.

Table 17 Population and Job Growth Forecast (Carlsbad, 2035)

Year	Population	Commercial Jobs	Industrial Jobs	Total Jobs
2035	119,798	74,039	14,103	88,142
SANDAG 2013, 2019, Energy Policy Initiatives Center, 2020.				

Each category was projected to future years using a method specifically for the category as described in the sections below.

5.2.1 On-road Transportation

Average weekday O-D VMT forecasts for each trip type in 2035 were estimated based on SANDAG Series 14 2016 VMT, as shown in Table 18.[52]

[51] The employment types included in the commercial jobs class exclude construction, manufacturing and agriculture jobs. Construction and manufacturing jobs are considered industrial jobs. Population and Jobs are from the SANDAG Series 14 Regional Growth Forecast, SANDAG 2019 Federal Regional Transportation Plan Appendix J: Regional Growth Forecast (October 2019), accessed March 10, 2020. SANDAG Series 13 Regional Growth Forecast (Updated in October 2013) is used to break down total jobs by employment type.

[52] Series 14 2016 average weekday VMT were provided by SANDAG (September 2019). ABM Release 14.0.1.

Table 18 Projected O-D VMT and Trip Types (Carlsbad, 2035)

Trip Type (miles/average weekday)	2016*		2035**	
	Service Population	Average Weekday Miles	Service Population	Average Weekday Miles
Internal-Internal	187,843	595,962	207,940	659,723
Internal-External/External-Internal		5,220,336		5,778,851

Service population is the sum of population and jobs.
*Based on SANDAG Series 14 VMT estimates. 2016 is the Series 14 Base Year. **Projected based on 2016 VMT with service population projection
SANDAG, 2017.

VMT of each type was converted to total VMT using the method discussed in Section 4.1. The VMT was multiplied by the adjusted average vehicle emission rate derived from EMFAC2017 for each projection year. Two adjustments were made to the EMFAC2014 emission rate: 1) the electric vehicle penetration rate in 2016 was kept constant for all projection years[53], 2) for all new vehicles entering the fleet after 2016, the emission rates are equal to the emission rates of new model year 2016 vehicles with the same vehicle class and fuel type.[54]

The projected total VMT, average vehicle emission rates, and corresponding GHG emissions from the on-road transportation category are given in Table 19.

Table 19 Projected VMT, Average Vehicle Emission Rate and GHG Emissions from On-Road Transportation Category (Carlsbad, 2035)

Year	Projected Total VMT		Average Vehicle Emission Rate (g CO_2e/mile)	Projected GHG Emissions (MT CO_2e)
	Average Weekday Miles	Average Annual Miles		
2035	3,549,148	1,231,554,425	361	445,000

Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation.
CARB 2018, SANDAG 2019, Energy Policy Initiatives Center 2020.

5.2.2 Electricity

Electricity use in the City was projected separately for residential, commercial and industrial customer classes. For the residential customer class, the per-capita electricity use (metered electricity sales) in 2014 (2,159 kWh/person/year), was calculated by dividing the total electricity sales in the residential class by the population. The per-capita electricity use was held constant and used to project total electricity use for a future year by multiplying by the SANDAG Series 14 population forecast for the future year. The projected total electricity use was multiplied by the City-specific electricity emission factor in 2016 (545 lbs CO_2e/MWh), held constant, for a projected total GHG emission.

[53] The fixed 2016 electric vehicle penetration rate is used to remove the impact of the state Zero Emission Vehicle (ZEV) program on BAU emissions. The ZEV program requires auto manufacturers to make and sell ZEVs that will increase VMTs driven by ZEVs.

[54] This uses a fixed actual emission rate of the new 2016 models instead of the effect of adopted federal and state vehicle efficiency standards 2017-2025 for light-duty and heavy-duty vehicles.

A similar method was used for the commercial and industrial class emissions projections. The total commercial electricity use was projected based on job growth and the per-job electricity consumption in 2016 of 6,936 kWh/commercial job/year. For the industrial class, the electricity use at the Carlsbad Desalination Plant (177,000 MWh in 2016) was kept constant, and the remaining industrial electricity use was projected based on the industrial job growth (10,126 kWh/industrial job/year) for all future years. The total projected net energy for load (electricity sales + transmission and distribution losses) and corresponding GHG emissions from the electricity category are given in Table 20.[55]

Table 20 Projected Net Energy for Load and GHG Emissions from the Electricity Category (Carlsbad, 2035)

Year	Projected Net Energy for Load (electricity sales + losses) (MWh)	Projected GHG Emissions (MT CO_2e)
2035	1,195,896	296,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center 2020.		

5.2.3 Natural Gas

The projection method for the natural gas category is similar to that for the electricity category. The natural gas use in residential, commercial and industrial classes is calculated separately. The per-capita residential natural gas consumption (118 therms/person/year) and the per-job natural gas consumption (151 therms/commercial job/year and 126 therms/industrial job/year) in 2016 were held constant with population and job growth for the projection. The natural gas emission factor used in Section 4.3 was held constant. The projected total natural gas use and corresponding GHG emissions from the natural gas category are given in Table 21.

Table 21 Projected Natural Gas Use and GHG Emissions from Natural Gas Category (Carlsbad, 2035)

Year	Projected Total Natural Gas Use (Million Therms)	Projected GHG Emissions (MT CO_2e)
2035	27.1	147,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center 2020.		

5.2.4 Solid Waste

Solid waste disposal in Carlsbad was projected using the population growth and the per-capita solid waste disposed in 2016 (3.5 kg/person/day), to be consistent with other categories. The projected emissions from the disposal were calculated by multiplying the disposal amount with the emission factor for mixed solid waste, provided in Section 4.4. The projected total waste disposal and corresponding GHG emissions from the solid waste category are given in Table 22.

[55] The net energy for load of each future year is adjusted using the method described in Section 4.2. The net energy for load does not include self-serve renewable supply, such as electricity generation from distributed-level solar PV systems.

Table 22 Projected Solid Waste Disposal and GHG Emissions from Solid Waste Category (Carlsbad, 2035)

Year	Projected Solid Waste Disposal (metric tons)	Projected GHG Emissions (MT CO_2e)
2035	153,549	37,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center 2020.		

5.2.5 Off-Road Transportation

In the off-road transportation category, the direct output of OFFROAD2007 (lawn and garden equipment and light commercial equipment), RV2013 model (recreational equipment), and diesel-fueled potable equipment for the San Diego region were used and scaled down to Carlsbad based on the scaling factor as determined in Section 4.5. For the construction and industrial equipment sub-category, the In-Use Off-Road Equipment 2011 Inventory does not include emissions output after 2030. For the projection years 2020 and 2030, the direct output for the San Diego region from the model was used and scaled down to Carlsbad. For 2035, the emissions were estimated based on the commercial and industrial job growth. The projected total and sub-category off-road transportation emissions are given Table 23.

Table 23 Projected GHG Emissions from Off-Road Transportation Category (Carlsbad, 2035)

Year	Projected GHG Emissions (MT CO_2e)				
	Lawn and Garden Equipment	Light Commercial Equipment	Construction and Mining	Industrial	Total
2035	3,419	5,370	8,661	1,577	19,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. CARB. Energy Policy Initiatives Center 2020.					

5.2.6 Water

The total water use for all projection years was determined using the same method as the solid waste section and was based on 2016 per-capita water consumption and population growth. It is assumed that no new potable or recycled water source is developed under the BAU projection.

The per-capita water supplied in 2016 was 141 gallons/person/day for potable water and 32 gallons/person/day for recycled water. The energy intensity for each element of the water cycle (Table 13) and the electricity emission factor were held constant for all projection years. The projected total potable water supplied and corresponding GHG emissions from the water category are given in Table 24.

Table 24 Projected Water and GHG Emissions from the Water Category (Carlsbad, 2035)

Year	Projected Total Water Supplied (acre-foot)	Projected GHG Emissions (MT CO_2e)
2035	23,691	9,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center 2020.		

5.2.7 Wastewater

The total wastewater generation for all projection years was determined using the same method as the solid waste and water sections, based on 2016 per-capita wastewater generation and projected population growth. The per-capita wastewater generated in 2016 (53 gallons/person/day) and the emission factor derived from data based on the Encina Wastewater Authority (Section 4.7) was held constant for all projection years.

The projected total wastewater generated and the GHG emissions from the wastewater category are given in Table 25.

Table 25 Projected Wastewater Treated at the Centralized Treatment Plant and GHG Emissions from the Wastewater Category (Carlsbad, 2035)

Year	Projected Wastewater treated (million gallons)	Projected GHG Emissions (MT CO_2e)
2035	2,321	3,000
Projected GHG emissions for each category are rounded to the nearest thousands. Values are not rounded in the intermediary steps in the calculation. Energy Policy Initiatives Center 2020.		

Appendix A. CARLSBAD VMT BY TRIP TYPE

2012 and 2014 average weekday VMT data tables were from SANDAG ABM Series 13, Release 13.3.0, and 2016 average weekday VMT were from SANDAG ABM Series 14, ABM Release 14.0.1. Emphasis (red squares and text) was added by EPIC.

2012 Base Year (573)

JURISDICTION	TOTAL VMT	TOTAL City of Carlsbad VMT	Two Trip End City of Carlsbad VMT	One Trip End City of Carlsbad VMT	NON-City of Carlsbad VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,112,142	2,027,586	563,200	1,464,386	1,084,556
CHULA VISTA TOTAL	3,516,776	8,996	-	8,996	3,507,780
CORONADO TOTAL	403,278	802	-	802	402,476
DEL MAR TOTAL	77,409	5,309	-	5,309	72,100
EL CAJON TOTAL	1,895,376	4,420	-	4,420	1,890,956
ENCINITAS TOTAL	1,798,588	561,420	-	561,420	1,237,168
ESCONDIDO TOTAL	2,644,337	83,668	-	83,668	2,560,669
External TOTAL	173,565	2,849	-	2,849	170,716
IMPERIAL BEACH TOTAL	92,294	41	-	41	92,253
LA MESA TOTAL	1,529,817	2,372	-	2,372	1,527,445
LEMON GROVE TOTAL	790,801	1,238	-	1,238	789,563
NATIONAL CITY TOTAL	1,545,818	6,239	-	6,239	1,539,579
OCEANSIDE TOTAL	2,675,295	553,013	-	553,013	2,122,282
POWAY TOTAL	868,013	3,858	-	3,858	864,155
SAN DIEGO TOTAL	36,928,734	782,554	-	782,554	36,146,180
SAN MARCOS TOTAL	1,838,273	314,092	-	314,092	1,524,181
SANTEE TOTAL	947,193	9,369	-	9,369	937,824
SOLANA BEACH TOTAL	603,982	132,611	-	132,611	471,371
Unincorporated TOTAL	16,372,819	745,016	-	745,016	15,627,803
VISTA TOTAL	1,610,600	333,727	-	333,727	1,276,873
REGIONWIDE TOTAL	79,425,110	5,579,180	563,200	5,015,980	73,845,930

100% of I-I VMT

50% of I-E/E-I VMT

0% of E-E VMT

Figure A-1 Estimated Carlsbad 2012 VMT by Trip Type (Series 13)

2014 (554)

JURISDICTION	TOTAL VMT	TOTAL City of Carlsbad VMT	Two Trip End City of Carlsbad VMT	One Trip End City of Carlsbad VMT	NON-City of Carlsbad VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E - E
CARLSBAD TOTAL	3,203,488	2,034,073	562,105	1,471,968	1,169,415
CHULA VISTA TOTAL	3,692,997	9,156	-	9,156	3,683,841
CORONADO TOTAL	411,739	809	-	809	410,930
DEL MAR TOTAL	78,343	5,871	-	5,871	72,472
EL CAJON TOTAL	1,995,802	4,497	-	4,497	1,991,305
ENCINITAS TOTAL	1,847,350	553,369	-	553,369	1,293,981
ESCONDIDO TOTAL	2,773,383	84,475	-	84,475	2,688,908
External TOTAL	207,246	3,437	-	3,437	203,809
IMPERIAL BEACH TOTAL	92,994	47	-	47	92,947
LA MESA TOTAL	1,574,973	2,458	-	2,458	1,572,515
LEMON GROVE TOTAL	826,374	1,118	-	1,118	825,256
NATIONAL CITY TOTAL	1,587,714	6,286	-	6,286	1,581,428
OCEANSIDE TOTAL	2,812,792	545,576	-	545,576	2,267,216
POWAY TOTAL	875,057	3,837	-	3,837	871,220
SAN DIEGO TOTAL	37,907,376	773,618	-	773,618	37,133,758
SAN MARCOS TOTAL	1,896,873	323,575	-	323,575	1,573,298
SANTEE TOTAL	973,959	9,299	-	9,299	964,660
SOLANA BEACH TOTAL	623,215	129,534	-	129,534	493,681
Unincorporated TOTAL	17,593,241	805,041	-	805,041	16,788,200
VISTA TOTAL	1,667,838	336,238	-	336,238	1,331,600
REGIONWIDE TOTAL	82,642,754	5,632,314	562,105	5,070,209	77,010,440

100% of I-I VMT

50% of I-E/E-I VMT

0% of E-E VMT

Figure A-2 Estimated Carlsbad 2014 VMT by Trip Type (Series 13)

2016 VMT ID232

JURISDICTION	TOTAL VMT	TOTAL City of Carlsbad VMT	Two Trip End City of Carlsbad VMT	One Trip End City of Carlsbad VMT	NON-City of Carlsbad VMT	City of Carlsbad Intra-Zonal VMT
		I-I, I-E and E-I	I-I	I-E and E-I	E-E	INTRA
CARLSBAD TOTAL	3,325,095	2,157,849	595,962	1,561,887	1,167,246	4,633
CHULA VISTA TOTAL	3,965,775	10,008	-	10,008	3,955,767	
CORONADO TOTAL	278,171	851	-	851	277,320	
DEL MAR TOTAL	69,282	4,143	-	4,143	65,139	
EL CAJON TOTAL	2,038,191	4,953	-	4,953	2,033,238	
ENCINITAS TOTAL	1,848,672	580,816	-	580,816	1,267,856	
ESCONDIDO TOTAL	2,794,689	82,164	-	82,164	2,712,526	
External TOTAL	221,430	2,805	-	2,805	218,625	
IMPERIAL BEACH TOTAL	100,878	108	-	108	100,770	
LA MESA TOTAL	1,666,499	2,981	-	2,981	1,663,519	
LEMON GROVE TOTAL	856,247	1,176	-	1,176	855,071	
NATIONAL CITY TOTAL	1,714,854	6,788	-	6,788	1,708,066	
OCEANSIDE TOTAL	2,898,843	584,404	-	584,404	2,314,439	
POWAY TOTAL	912,421	5,134	-	5,134	907,287	
SAN DIEGO TOTAL	38,879,701	865,613	-	865,613	38,014,087	
SAN MARCOS TOTAL	2,106,532	368,494	-	368,494	1,738,038	
SANTEE TOTAL	1,021,814	10,321	-	10,321	1,011,493	
SOLANA BEACH TOTAL	641,694	147,369	-	147,369	494,325	
Unincorporated TOTAL	16,311,317	651,263	-	651,263	15,660,055	
VISTA TOTAL	1,767,334	329,060	-	329,060	1,438,275	
REGIONWIDE TOTAL	83,419,438	5,816,298	595,962	5,220,336	77,603,140	4,633

100% of I-I VMT

50% of I-I VMT

0% of I-I VMT

Figure A-3 Estimated Carlsbad 2016 VMT by Trip Type (Series 14)

DRAFT

Appendix B. SOURCE DATA FOR THE SOLID WASTE EMISSION FACTOR

Waste Component	Waste Distribution[1] (%)	Landfill Gas Emissions	
		CH_4 without LFG Recovery (MT CO_2e/short ton)	Source[2]
Organics	57.2%	-	-
Food	*22.8%*	1.57	Exhibit 1-49, WARM V14 Organic Materials
Other Misc. Paper-Compostable	*0.4%*	2.24	Average of paper components
Remainder/Composite Paper - Compostable	*10.8%*	2.24	Average of paper components
Leaves and Grass	*3.1%*	0.55	Average of grass (0.51) and leaves (0.59), Exhibit 2-11 WARM V14 Organic Materials
Pruning and Trimmings	*2.1%*	0.59	Exhibit 2-11 WARM V14 Organic Materials
Branches and Stumps	*0.8%*	0.77	Exhibit 2-11 WARM V14 Organic Materials
Manures	*0.1%*	n/a	n/a
Textiles	*3.9%*	n/a	n/a
Carpet	*1.0%*	n/a	Exhibit 3-26, WARM V14 Construction and Demolition Materials, no landfill CH_4
Clean Dimensional Lumber	*1.0%*	0.15	Exhibit 11-19, WARM V14 Construction and Demolition Materials
Clean Engineered Wood	*0.6%*	0.16	Wood flooring, Exhibit 10-13, WARM V14 Construction and Demolition Materials
Clean Pallets & Crates	*1.7%*	0.05	Wood product, Exhibit 11-19, WARM V14 Construction and Demolition Materials
Other Wood Waste	*2.3%*	0.05	Wood product, Exhibit 11-19, WARM V14 Construction and Demolition Materials
Remainder/Composite Organic	*6.6%*	0.84	Average of all organic material
Paper	13.0%	-	-
Uncoated Corrugated Cardboard	*2.3%*	2.36	Exhibit 3-27, WARM v14 Containers /Packaging
Paper Bags	*0.3%*	2.36	Assume the same as cardboard, Exhibit 3-27, WARM v14 Containers /Packaging
Newspapers	*2.1%*	0.95	Exhibit 3-27, WARM v14 Containers /Packaging
White Ledger Paper	*0.8%*	3.50	Exhibit 3-27, WARM v14 Containers /Packaging
Other Office Paper	*1.0%*	3.50	Exhibit 3-27, WARM v14 Containers /Packaging
Magazine and Catalogs	*0.7%*	1.08	Exhibit 3-27, WARM v14 containers /packaging
Phone Books and Directories	*0.0%*	2.14	Exhibit 3-27, WARM v14 containers /packaging
Other Misc. Paper - Other	*3.7%*	2.14	Exhibit 3-27, WARM v14 containers /packaging
Remainder/Composite Paper	*2.1%*	2.14	Exhibit 3-27, WARM v14 containers /packaging
Glass	2.8%	-	-

DRAFT

Waste Component	Waste Distribution[1] (%)	Landfill Gas Emissions	
		CH_4 without LFG Recovery (MT CO_2e/short ton)	Source[2]
Metal	3.5%	-	-
Electronics	0.9%	-	-
Plastic	13.9%	-	-
Inerts and Other Material	3.1%	-	-
Household Hazardous Waste	0.5%	-	-
Special Waste	3.7%	-	-
Mixed Residue	1.3%	-	-
Mixed Waste Emission Factor		**0.98**	
Source: 1 City of Oceanside Waste Characterization Study (2017), 2 EPA Waste Reduction Model (WARM) Version 14 (2016)			

DRAFT

Appendix B-2

2005 and 2011 Local Government Operations Greenhouse Gas Inventory

DYETT & BHATIA
Urban and Regional Planners

M E M O R A N D U M

To: David de Cordova

From: Chris Ford

Re: Carlsbad Government Operations Greenhouse Gas Inventory Update – 2011

Date: June 18, 2013

This memo summarizes the approach taken to update the 2005 Greenhouse Gas (GHG) Emissions Inventory from City of Carlsbad government operations with 2011 data and compares the inputs and outputs. A separate memo covers community emissions, updated with 2011 data. That memo is referenced in this one to minimize repetition of information. The content of these memos will contribute to the summary of Carlsbad's GHG emissions in the forthcoming Climate Action Plan (CAP); the memos may be placed in an appendix to the CAP.

Technical terms and acronyms that appear in this memo are listed in Table 1.

Table 1: Technical Terms and Acronyms

CACP	Clean Air and Climate Protection software, a model developed by ICLEI to inventory and forecast GHG emissions
CAP	Climate Action Plan
CARB	California Air Resources Board, the agency responsible for setting statewide GHG emission reduction targets. CARB also maintains several GHG emission calculation models.
CO_2e	Carbon dioxide equivalents, a measure of GHGs that converts non-CO_2 emissions to the same impact as carbon dioxide
EPA	US Environmental Protection Agency
FTE	Full-Time Equivalent employees
GHG	Greenhouse gases, mainly carbon dioxide (CO_2), carbon dioxide, nitrous oxide (N_2O), and methane (CH_4)
ICLEI	An organization that provides standards and models for measuring and forecasting GHG emissions
SDG&E	San Diego Gas and Electric, the energy utility for Carlsbad
VMT	Vehicle Miles Traveled, a measure of the annual amount of driving within an area, used to calculate GHG emissions from vehicles

755 Sansome St, Suite 400 | T 415 956 4300
San Francisco, CA 94111 | F 415 956 7315
www.dyettandbhatia.com

ASSUMPTIONS

As with the 2005 inventory, ICLEI's CACP[1] model was used to estimate emissions from local government operations across all sectors. Unlike with community emissions, CACP was the only model employed.

Three sectors analyzed— employee commute, stationary refrigerants, and solid waste—are "Scope 3" emissions. These emissions are not part of the government operations emissions inventory as they are indirectly caused by the City, but this memo reports on their impact.

Employees

Between 2005 and 2011, the number of full-time equivalent (FTE) employees at the City of Carlsbad increased by 4.2 percent, growing from 793 to 826 FTE. This percent change is used to estimate pro-rated increases in certain emissions since 2005.

Electricity Coefficients

Electricity coefficients measure how much GHG emission and air pollution is created by various sources of electricity generation. The government operations inventory uses the same electricity coefficients as the community inventory; see that other memo for a discussion on the increase in GHG emissions per megawatt hour from SDG&E electricity since 2005.

Natural Gas Coefficients

The default values in the CACP model were used; they are the same as those used in 2005.

Transportation

Local government emissions from vehicles were estimated using the CACP model. For NO_2 and CH_4 emissions, CACP only includes emissions factors through model year 2005. The CACP instructions include additional factors that can be manually entered for model years 2006-2008; we also got newer information from the latest *US EPA Inventory of US GHG Emissions and Sinks* report, the source used by ICLEI. This 2013 version of the EPA report[2] includes newer emissions factors, although the applicable date is not specified; the factors for gasoline are similar to the 2008 factors, therefore they were applied for model years 2009 onwards. Table 2 shows the emissions factors we entered into CACP for gasoline vehicles with model years of 2006 and later.

Table 2: Emissions Factors from Gasoline Fueled Vehicles, Model Years 2006 On

Fuel	*Vehicle Type*	*Model Year*	*NO_2 factor*	*CH_4 factor*
Gasoline	Passenger car	2006	0.0057	0.0161
Gasoline	Passenger car	2007	0.0041	0.0170
Gasoline	Passenger car	2008	0.0038	0.0172

[1] The 2011 update utilized the CACP 2009 Version 3.0 software.
[2] We found the 2013 report, which includes newer factors in Annex 3 of the report, although the applicable date is not specified. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

Table 2: Emissions Factors from Gasoline Fueled Vehicles, Model Years 2006 On

Fuel	*Vehicle Type*	*Model Year*	*NO_2 factor*	*CH_4 factor*
Gasoline	Passenger car	2009+	0.0036	0.0173
Gasoline	Light trucks	2006	0.0089	0.0159
Gasoline	Light trucks	2007	0.0079	0.0161
Gasoline	Light trucks	2008	0.0066	0.0163
Gasoline	Light trucks	2009+	0.0066	0.0163
Gasoline	Heavy trucks	2006	0.0175	0.0326
Gasoline	Heavy trucks	2007	0.0173	0.0327
Gasoline	Heavy trucks	2008	0.0171	0.0327
Gasoline	Heavy trucks	2009+	0.0134	0.0333

Sources: 2006-08 model years from ICLEI Local Government Operations Inventory Instructions, referencing LGO Protocol table G.12: Based on U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008 (2010). 2009+ model years from EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011 (2013), Annex 3.

The 2013 EPA report's emissions factors for diesel are the same as for model years 1996-2004, so diesel vehicles were handled through the regular CACP calculation.

Solid Waste

The default values in the CACP model were used.

INPUTS AND METHODOLOGY

This section describes the data used to calculate 2011 emissions and the manner in which the data was acquired, transformed, and used. The table at the end of this section compares the 2005 and 2011 inputs.

Buildings and Other Facilities

The inputs for this sector are electricity and natural gas. Data was entered by individual facility with departmental information also entered. Since the 2005 inventory through 2011, a number of new or expanded facilities have been added to the City's operations: Fire Station No. 6, Senior Center expansion, Recycled Water Facility, Aviara Community Park, Hidden Canyon Park, Pine Avenue Park, The Crossings golf course, and the Hawthorne Equipment Building. During the same period, the Library Learning Center replaced the Adult Learning Center and Centro de Informacion. These additional facilities account for the majority of the change in electricity and natural gas consumption.

Table 3 lists all of the buildings and facilities operated by the city, comparing electricity and natural gas inputs between 2005 and 2011. Overall, the City's facilities consumed 21 percent more electricity and 10 percent more natural gas in 2011 compared to 2005.

Table 3: Building and Facilities Inputs

		2005		*2011*		*% Change*	
Department	*Building*	*Electricity (kWh)*	*Natural gas (therms)*	*Electricity (kWh)*	*Natural gas (therms)*	*Electricity (kWh)*	*Natural gas (therms)*
City	City Administration	1,099,520	1,430	1,203,726	1,738	9%	22%
City	City Hall	294,080	8,552	233,680	5,313	-21%	-38%
City	Farmers Insurance Bldgs	167,055	71	112,057	-	-33%	-100%
City	Hawthorne Equipment Bldg	N/A	N/A	10,040	-		N/A
City Total		**1,560,655**	**10,053**	**1,559,503**	**7,051**	**0%**	**-30%**
Community Development	Hiring Center	6,299	-	6,972	-	11%	
Community Development	Las Palmas	22,720	-	55,570	-	145%	
Community Development Total		**29,019**		**62,542**		**116%**	**-**
Fire	Fire Station No. 1	85,720	900	63,600	1,358	-26%	51%
Fire	Fire Station No. 2	29,847	676	32,643	1,069	9%	58%
Fire	Fire Station No. 3	33,713	525	33,972	675	1%	29%
Fire	Fire Station No. 4	31,434	544	28,867	1,062	-8%	95%
Fire	Fire Station No. 5	108,560	2,231	98,720	2,061	-9%	-8%
Fire	Fire Station No. 6	N/A	N/A	55,180	1,464	-	N/A
Fire Total		**289,274**	**4,876**	**312,982**	**7,689**	**8%**	**58%**
Golf Course	The Crossings			**1,056,015**	**18,019**	**-**	**-**
Library	Adult Learning Center	9,078	-	-	-	-	-
Library	Cole Library	454,560	3,835	430,160	2,119	-5%	-45%
Library	Cultural Arts Department	17,506	381	14,444	321	-17%	-16%
Library	Dove Library	1,288,533	15,487	1,432,492	11,200	11%	-28%
Library	Library Learning Center	32,960	766	192,000	421	483%	-45%
Library Total		**1,802,637**	**20,469**	**2,069,096**	**14,061**	**15%**	**-31%**
PD/Fire	Safety Center	**1,163,336**	**20,845**	**988,001**	**19,816**	**-15%**	**-5%**
Public Works	City Yard	100,861	474	88,335	729	-12%	54%
Public Works	CMWD M&O	197,920	754	189,440	86	-4%	-89%
Public Works	Fleet Yard	72,640	1,158	72,320	456	0%	-61%
Public Works	Parks Maintenance	29,474	117	39,694	149	35%	27%
Public Works Total		**400,895**	**2,503**	**389,789**	**1,420**	**-3%**	**-43%**
Recreation	Calavera Community Center	70,318	-	54,970	-	-22%	-
Recreation	Carrillo Ranch	58,320	-	58,080	-	0%	-

Table 3: Building and Facilities Inputs

		2005		*2011*		*% Change*	
Department	*Building*	*Electricity (kWh)*	*Natural gas (therms)*	*Electricity (kWh)*	*Natural gas (therms)*	*Electricity (kWh)*	*Natural gas (therms)*
Recreation	Harding Community Center	76,040	1,063	60,120	952	-21%	-10%
Recreation	Parks Total	773,551	2,122	914,888	3,006	18%	42%
Recreation	Senior Center	224,100	6,319	308,318	3,349	38%	-47%
Recreation	Stagecoach Community Center	215,360	1,602	195,920	1,424	-9%	-11%
Recreation	Swim Complex	202,520	31,116	247,240	34,266	22%	10%
Recreation	Trails	7,115	-	65,929	-	827%	-
Recreation Total		**1,627,324**	**42,222**	**1,905,465**	**42,997**	**17%**	**2%**
Housing and Neighborhood Services		**22,736**	**-**	**31,277**	**-**	**38%**	**-**
TOTALS		**6,895,876**	**100,968**	**8,374,670**	**111,053**	**21%**	**10%**

Public Lighting

This sector covers electricity consumed from three sources: traffic signals, streetlights, and other outdoor lighting. As shown in Table 4, streetlights make up the great majority of electricity consumption in this sector. Between 2005 and 2011, this sector consumed 4 percent less electricity, with the small increase in traffic signal and controller use more than offset by the declines in streetlight and outdoor lighting consumption. During this period, the city retrofitted its existing streetlights with more energy-efficient lamps.

Table 4: Public Lighting Inputs (kWh)

	2005	*% of Total*	*2011*	*% of Total*	*% Change*
Streetlights	4,652,801	86%	4,403,265	85%	-5%
Traffic Signals/Controllers	750,417	14%	768,784	15%	2%
Outdoor Lighting	20,988	0%	17,740	0%	-15%
TOTALS	**5,424,206**		**5,189,789**		**-4%**

Water and Wastewater Transport

This sector covers fuel consumed by pumps and other mechanisms used to convey water and wastewater: water delivery pumps, sprinklers and irrigation, sewage pumps, and recycled water pump stations. These systems all consumed electricity plus a small amount (170 gallons) of diesel fuel for water delivery generators.

Table 5 shows the electricity consumed by the City's water and wastewater transport systems in 2005 and 2011. During that time, electricity used by these systems increased by 29 percent. Much of that change can be attributed to a major increase in electricity used by recycle pump

stations, as the city's recycled water facility came online in late 2005. Sewage pumps also used significantly more electricity (22% increase), as did sprinklers and irrigation (72% increase) although the amount was comparatively small. Water delivery pumps actually decreased in electricity consumption by 21 percent.

Table 5: Waste and Wastewater Transport Inputs (kWh)

	2005	*% of Total*	*2011*	*% of Total*	*% Change*
Recycle Pump Stations	418,980	23%	791,732	34%	89%
Sewage Pumps	1,038,941	57%	1,262,824	53%	22%
Water Delivery Pumps	360,237	20%	285,345	12%	-21%
Sprinklers/Irrigation	13,151	1%	22,554	1%	72%
TOTALS	**1,831,309**		**2,362,455**		**29%**

Vehicle Fleet

The inputs for this sector are all the vehicles used by the City. The key data used are fuel consumed and VMT, broken out by model year, vehicle type, and fuel type. CACP uses fuel consumption to calculate CO_2 emissions and VMT to calculate NO_2 and CH_4 emissions.

Although the vehicle fleet data from the City was broken down by department, the inputs were loaded into CACP as a single set for the entire City due to the time consuming nature of processing and entering this very detailed information.

Table 6 summarizes the inputs in 2005 and 2011 by vehicle and fuel type. There likely was some different categorization in terms of vehicle types in 2005, especially between light and heavy trucks, but overall fuel consumed and VMT by fuel type should be comparable. While there was a notable increase in diesel consumption and VMT, this was more than offset by a sharp decline in gasoline consumption and VMT.

Table 6: Vehicle Fleet Inputs

	2005		***2011***		***% Change***	
	Fuel (gal)	*VMT*	*Fuel (gal)*	*VMT*	*Fuel (gal)*	*VMT*
Diesel	**54,589**	**284,526**	**62,407**	**407,826**	**14%**	**43%**
Light Truck/SUV/Pickup	8,443	87,570	31,162	298,388		
Heavy Truck	46,146	196,956	31,245	109,438		
Gasoline	**207,286**	**2,580,657**	**167,345**	**1,965,416**	**-18%**	**-24%**
Passenger Car	99,396	1,487,843	85,874	931,979		
Motorcycle	2,374	N/A	1,787	74,024		
Light Truck/SUV/Pickup	88,329	982,401	76,663	938,733		
Heavy Truck	17,187	110,413	3,021	20,680		
Hybrid	**-**	**-**	**3,581**	**137,096**		
Passenger Car			2,478	108,136		

Light Truck/SUV/Pickup	1,103	28,960

For the analysis in CACP, motorcycle inputs were grouped under passenger cars and hybrid fuel consumption was included with gasoline. Hybrid VMT was assumed at one-third of listed mileage to account for the likely reality of most hybrid miles being under electric power during low speed driving on local streets.

Mobile Refrigerants

Refrigerants come from stationary and mobile sources. Stationary sources are described under Scope 3 emissions.

Mobile source refrigerants come from estimated leakage from the vehicle fleet. The 2005 inventory undertook a very complex and thorough analysis based on attributes of each vehicle in the fleet, using the make, model, year, and time in service to determine refrigerant type and capacity and calculate estimated emissions. Ultimately, the GHG emissions from mobile refrigerants made up less than one percent of government operations emissions in 2005.

Given the small impact of these mobile refrigerants and the time already invested in the 2005 analysis, we used the 2005 output and pro-rated it for 2011 based on the relative sizes of the vehicle fleet. The 2005 fleet had 264 vehicles compared to 291 vehicles in the 2011 fleet, a 10 percent increase. Therefore, we estimated a 10 percent increase in GHG emissions from mobile sources for 2011.

Scope 3 Emissions

These emissions are not part of the government operations inventory as they are indirectly caused by the City.

Employee Commute

The City conducted an employee commute survey in 2009 which was applied to the 2005 inventory. Given that only two years elapsed between the survey and the year of this GHG emissions inventory update, it was assumed that the mode split, fuel consumption, and VMT data from the survey were still applicable. As with the 2005 inventory, the results from usable survey responses were extrapolated to apply to all City FTE. Since the 2011 FTE is 4.2 percent higher than the 2005 FTE, the fuel usage and VMT inputs for 2011 were 4.2 percent higher than in 2005.

Stationary Refrigerants

Stationary sources come from equipment installed in facilities. The 2005 inventory identified refrigerants used to service equipment in five buildings: Las Palmas, Harding Community Center, City Administration, the Safety Center, and the Senior Center. The 2011 inventory identified refrigerant use in four buildings: City Administration, City Hall, Dove Library, and the Senior Center. Refrigerants use was less in 2011 than in 2005, by around half (117.50 kg compared to 234.51 kg).

Solid Waste

The City undertook a thorough evaluation of solid waste generated by City facilities in 2005. Given that solid waste generation is typically correlated to number of people, we pro-rated the amount of solid waste based on the increase in FTE between 2005 and 2011, which was 4.2 percent.

Sectors Not Considered

The City does not operate port, airport, wastewater, or solid waste facilities, provide transit services, or generate electric power.

CONCLUSIONS

City operations in 2011 generated an estimated 8,205 metric tons CO_2e in GHG emissions, compared to an estimated 6,556 metric tons CO_2e in 2005, an increase of 25 percent, as shown in Table 7. City operations still accounted for a very small proportion of the GHG emissions from Carlsbad in 2011, making up 0.8 percent of emissions, the same as in 2005.

Table 7: Government Operations Emissions – 2005 vs. 2011 (metric tons CO_2e)

	2005	*2011*	*% Change*
Total emissions	6,556	8,205	25.2%
Carlsbad - Service Population	154,270	172,820	12.0%
Community emissions	925,248	1,030,353	11.4%
Government operations as proportion of community emissions	0.7%	0.8%	13.1%

The rate of growth in government emissions between 2005 and 2011 was higher than the rates of increase in Carlsbad's service population (12.0%) and communitywide GHG emissions (11.4%). The main reasons for the increase in government operations emissions appear to be twofold:

- A sharp increase in electricity consumed by water and wastewater transport services, especially recycled water pumps; and
- More emissions from electricity per megawatt hour, an issue that also affected communitywide emissions and further discussed in that memo.

Emissions by Sector

Emissions for government operations mainly came from buildings and facilities (42%) and the vehicle fleet (27%), followed by public lighting (21%) and water and wastewater transportation (10%), as shown in Table 8.

Compared to 2005, the proportion of city government emissions from buildings and facilities increased from 35 percent to 42 percent, increasing by 50 percent and making up more than two-thirds of the growth in emissions. As explained above, this is largely due to the opening of new buildings and recreation facilities since 2005.

Meanwhile, compared to 2005, the proportion of emissions from lighting and water/wastewater transport stayed largely the same, but the actual emissions from these sectors grew by 29 percent and 72 percent, respectively. Note that public lighting emissions increased by despite that sector consuming 4 percent less electricity in 2011 compared to 2005. This outcome is a result of the much greater amount of emissions produced per megawatt hour of electricity in 2011 compared to 2005.

Meanwhile, vehicle fleet emissions decreased by 9 percent during the same period, due to major decreases in the miles driven and gallons of gasoline consumed.

Table 8: Emissions by Sector (metric tons CO_2e)

Source	*2005*	*% of Total*	*2011*	*% of Total*	*2005 to 2011 Increase*	*% Growth*	*% of Growth*
Buildings and Facilities	2,266	35%	3,410	42%	1,144	50%	69%
Vehicle Fleet	2,474	38%	2,253	27%	-221	-9%	-13%
Public Lighting	1,354	21%	1,747	21%	393	29%	24%
Water and Wastewater Transport	461	7%	795	10%	334	72%	20%
TOTALS	**6,556**		**8,205**		**1,650**	**25%**	

Emissions by Source

Most of the government operations emissions in 2011 came from electricity consumption, accounting for 65 percent of emissions, an increase from 59 percent in 2005. GHG emissions from electricity increased by 52 percent between 2005 and 2011, as shown in Table 9. Electricity was the source of almost all of the increase in emissions—more than the total increase, in fact, but offset by the decline in emissions from gasoline. Emissions from gasoline dropped by 17 percent, which caused gasoline to decline from 31 to less than 19 percent of government operation emissions between 2005 and 2011. Emissions from diesel grew by 13 percent and from natural gas and mobile refrigerants by 10 percent each, although all from relatively small bases.

Table 9: Emissions by Source (metric tons CO_2e)

Source	*2005*	*% of*	*2011*	*% of*	*2005 to 2011*	*% Growth*	*% of*

		Total		*Total*	*Increase*		*Growth*
Electricity	3,534	58.7%	5,362	65.4%	1,828	52%	111%
Gasoline	1,853	30.8%	1,538	18.7%	-315	-17%	-19%
Diesel / Propane	566	9.4%	641	7.8%	75	13%	5%
Natural Gas	537	8.9%	590	7.2%	53	10%	3%
Mobile Refrigerants	67	1.1%	74	0.9%	7	10%	0%
TOTALS	**6,557**		**8,205**		**1,648**	**25%**	

Sector 3 Emissions

Employee commute and solid waste emissions were estimated for 2011 based on pro-rating various indicators and loading them into the CACP model for calculation. See the Assumptions section above for more details.

- Employee commute emissions were estimated at 2,567 metric tons CO_2e in 2011, compared to 2,417 metric tons CO_2e in 2005, an increase of 6.2 percent.
- Stationary refrigerant emissions were estimated at 173 metric tons CO_2e in 2011, compared to 399 metric tons CO_2e in 2005, a decrease of 57 percent.
- Solid waste emissions were estimated at 144 metric tons CO_2e in 2005, the same as in 2011.

Appendix C

References

California Air Resources Board (CARB). 2008. Climate Change Scoping Plan. Pursuant to AB 32 the California Global Warming Solutions Act of 2006,

California Air Resources Board (CARB). 2014. First Update to the Climate Change Scoping Plan. Building on the framework pursuant to AB 32 the California Global Warming Solutions Act of 2006.

California Air Resources Board (CARB). 2018. California's 2017 Climate Change Scoping Plan. The strategy for achieving California's 2030 greenhouse gas target.

All available: https://ww3.arb.ca.gov/cc/scopingplan/scopingplan.htm.

California Air Resources Board (CARB). 2011. Emissions Factors On-Road Motor Vehicles (EMFAC 2011). Available: http://www.arb.ca.gov/msei/categories.htm.

California Energy Commission. 2009. Go Solar California: A Step by Step Tool Kit for Local Governments to Go Solar. Available: http://www.energy.ca.gov/2009publications/CEC-180-2009-005/CEC-180-2009-

Cambridge Systematics. 2009. "Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions." Technical Appendices. Prepared for the Urban Land Institute.

Carlsbad Municipal Water District. 2011. 2010 Urban Water Management Plan. Available: http://www.carlsbadca.gov/services/departments/water/Documents/2010-UWMP.pdf.

Center for Clean Air Policy. 2014. Transportation Emission Guidebook. Available: http://www.ccap.org/safe/guidebook/guide_complete.html.

City of Carlsbad. General Plan, September 2015.

City of San Diego. 2013. Draft Significance Thresholds for Greenhouse Gas Emissions. Available: http://www.sandiego.gov/planning/genplan/cap/pdf/ghg_significance_thresholds_032213.pdf.

Energy Star. 2014. "Light Bulbs." Available: http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB.

Gordon, Clark; Silva-Send, Nilmini; and Anders, Scott J. 2013. Energy Policy Initiatives Center: Community-Scale Greenhouse Gas Emissions Model: San Diego Region. Technical Documentation and Methodology. Version 1.0. Available: http://www.sandiego.edu/climate/documents/TechnicalDocumentationandMethodol ogy.pdf.

ICLEI. 2009. Clean Air and Climate Protection (CACP). Available: http://www.icleiusa.org/tools/cacp-2009.

J. Loux, R. Winer-Skonovd, and E. Gellerman. 2012. "Evaluation of Combined Rainwater and Greywater Systems for Multiple Development Types in Mediterranean Climates." Journal of Water Sustainability. 2(1): 55-77. Available: http://www.jwsponline.com/uploadpic/Magazine/pp%2055-77%20JWS-A-12- 002%20New.pdf.

National Oceanic and Atmospheric Administration (NOAA). 2014. "Global Climate Dashboard. Available: https://climate.gov/

SANDAG. 2018. Regional Climate Action Planning Framework. Available: hhttps://www.sandag.org/uploads/cap/ReCAPframework.pdf.

SANDAG. 2014. Draft Climate Change Mitigation and Adaptation White Paper. 2014. Available: http://sdforward.com/sites/sandag/files/Climate%20Change%20White%20Paper%20-%20https://www.sandag.org/uploads/cap/ReCAPframework.pdfDraft_fwe.pdf.

SANDAG. 2014. "Energy Roadmap for Local Governments." Available: http://www.sandag.org/index.asp?classid=17&projectid=373&fuseaction=projects.detail .

U.S. Census Bureau. 2012. American Community Survey. Selected Economic Characteristics for Carlsbad, California. Available: http://factfinder2.census.gov/.

U.S. Energy Information Administration. 2013. "How much electricity is used for lighting in the United States?" Available: http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3.

United States Census Bureau. 2011. "Census Bureau Releases 2010 Census Demographic Profiles for Alaska, Arizona, California, Connecticut, Georgia, Idaho, Minnesota, Montana, New Hampshire, New York, Ohio, Puerto Rico and Wisconsin." Available: http://www.census.gov/newsroom/releases/archives/2010_census/cb11-cn137.html.

United States Department of Energy. 2011. 2010 California Energy Use. Available: http://www.eia.gov/state/?sid=CA/.

United States Environmental Protection Agency (EPA). 2020. "Sources of Greenhouse Gas Emissions." Available: https://www.epa.gov/ghgemissions/sources-greenhosue-gas-emissions.

V. Novotny. 2010. "Urban Water and Energy Use: From Current US Use to Cities of the Future." Cities of the Future/Urban River Restoration. Water Environment Federation. 9: 118-140. Available: http://aquanovallc.com/wp-content/uploads/2010/09/URBAN-WATER-AND-ENERGY-USE.pdf.

This page intentionally left blank.

Appendix D

Applicable General Plan Policies

Chapter 2: Land Use and Community Design

2-P.24 Build and operate commercial uses in such a way as to complement but not conflict with adjoining residential areas. This shall be accomplished by:

a. Controlling lights, signage, and hours of operation to avoid adversely impacting surrounding uses.
b. Requiring adequate landscaped buffers between commercial and residential uses.
c. Providing bicycle and pedestrian links between commercial centers and surrounding residential uses, and providing bicycle-parking racks.
d. Ensuring building mass does not adversely impact surrounding residences.

2-P.25 Ensure that commercial development is designed to include:

a. Integrated landscaping, parking, signs, and site and building design
b. Common ingress and egress, safe and convenient access and internal circulation, adequate off-street parking and loading facilities. Each commercial site should be easily accessible by pedestrians, bicyclists, and automobiles to nearby residential development.
c. Architecture that emphasizes establishing community identity while presenting tasteful, dignified and visually appealing designs compatible with their surroundings.
d. A variety of courtyards and pedestrian ways, bicycle facilities, landscaped parking lots, and the use of harmonious architecture in the construction of buildings

2-P.45 Evaluate each discretionary application for development of property with regard to the following specific criteria:

a. Site design and layout of the proposed buildings in terms of size, height and location, to foster harmony with landscape and adjacent development.
b. Site design and landscaping to provide buffers and screening where appropriate, conserve water, and reduce erosion and runoff.
c. Building design that enhances neighborhood quality, and incorporates considerations of visual quality from key vantage points, such as major transportation corridors and intersections, and scenic vistas.

d. Site and/or building design features that will reduce greenhouse gas emissions over the life of the project, as outlined in the Climate Action Plan.
e. Provision of public and/or private usable open space and/or pathways designated in the Open Space, Conservation, and Recreation Element.
f. Contributions to and extensions of existing systems of streets, foot or bicycle paths, trails, and the greenbelts provided for in the Mobility, and Open Space, Conservation, and Recreation elements of the General Plan.
g. Compliance with the performance standards of the Growth Management Plan.
h. Development proposals which are designed to provide safe, easy pedestrian and bicycle linkages to nearby transportation corridors.
i. Provision of housing affordable to lower and/or moderate-income households.
j. Policies and programs outlined in Local Coastal Program where applicable.
k. Consistency with applicable provisions of the Airport Land Use Compatibility Plan for McClellan-Palomar Airport.

2-P.46 Require new residential development to provide pedestrian and bicycle linkages, when feasible, which connect with nearby shopping centers, community centers, parks, schools, points of interest, major transportation corridors and the Carlsbad Trail System.

2-P.47 At the time existing shopping centers are renovated or redeveloped, where feasible, require connections to existing residential neighborhoods through new pedestrian pathways and entrances, mid-block crossings, new or wider sidewalks, and pedestrian-scaled street lighting.

2-P.48 Enhance walkability on a citywide scale by installing benches and transit shelters and adding landscaping, wayfinding signage, public art, and pedestrian-scaled lighting. Consider ways to improve rail and freeway overpass/ underpass areas, with lighting, sidewalk improvements and public art.

2-P.50 Improve beach access through a variety of mechanisms, including:

a. In the Village and adjacent areas, identify the primary pedestrian connections and entrances to the beach through signage, a consistent landscaping scheme, change in paving materials, wider sidewalks and preservation of view corridors. Identify opportunities for additional access points as improved connectivity and facilities are provided, particularly if new beachfront activity areas are established.
b. In the Barrio neighborhood, provide a pedestrian crossing under or over the rail corridor at Chestnut Avenue.
c. Identify and implement more frequent pedestrian crossings along Carlsbad Boulevard. Identify and prioritize crossings from residential neighborhoods and existing bicycle and pedestrian trails.

For more detailed policies on pedestrian and bicycle movement, see Chapter 3: Mobility.

2-P.53 Plan and design Carlsbad Boulevard and adjacent public land (Carlsbad Boulevard coastal corridor) according to the following guiding principles:

a. Carlsbad Boulevard shall become more than a road. This transportation corridor shall provide for recreational, aesthetic and community gathering opportunities that equal the remarkable character of the land.
b. Community safety shall be a high priority. Create destination that provides a safe public environment to recreate.
c. Strategic public access and parking is a key to success. Development shall capitalize on opportunities to add/enhance multiple public access points and public parking for the beach and related recreational amenities.
d. Open views are desirable and important to maintaining the character of the area. Preservation and enhancement of views of ocean, lagoons, and other water bodies and beaches shall be a high priority in road, landscaping, and amenity design and development.
e. Enhance the area's vitality through diversity of recreational land uses. Carlsbad Boulevard development shall provide for amenities, services and goods that attract a diversity of residents and visitors.
f. Create vibrant and sustainable public spaces. Development shall provide for unique and vibrant coastal gathering spaces where people of all age groups and interests can gather to enjoy recreational and environmental amenities and supporting commercial uses.
g. Connect community, place and spirit. Design shall complement and enhance connectivity between existing community and regional land uses.
h. Environmentally sensitive design is a key objective. Environmentally sensitive development that respects existing coastal resources is of utmost importance.
i. A signature scenic corridor shall be created through design that honors the coastline's natural beauty. The resulting improvements will capture the 'essence' of Carlsbad; making it a special place for people from throughout the region with its natural beauty and vibrant public spaces. Properly carried out, the realigned boulevard will maximize public views and encourage everyone to slow down and enjoy the scenery.
j. Reimagining of Carlsbad Boulevard shall be visionary. The reimagined Carlsbad Boulevard corridor will incorporate core community values articulated in the Carlsbad Community Vision by providing: a) physical connectivity through multi-modal mobility improvements including bikeways, pedestrian trails, and a traffic-calmed street; b) social connectivity through creation of memorable public spaces; and c) economic vitality through a combination of visitor and local-serving commercial, civic, and recreational uses and services.

2-P.72 Enhance the walkability and pedestrian orientation of the Village, including along Carlsbad Village Drive, to enhance the small, beach town atmosphere and improve access to and utilization of transit.

2-P.75 Address parking demand by finding additional areas to provide parking for the Village and beach areas, and by developing creative parking management strategies, such as shared parking, maximum parking standards, "smart" metering, utilizing on-street parking for re-use of existing buildings, etc.

2-P.79 Create a cohesive, pedestrian-scale streetscape that includes improved sidewalks, streetscape, signage and way-finding, and which celebrates the Barrio's heritage and provides better connections between the Barrio and Village and across the railroad at Chestnut Avenue.

2-P.83 West of the railroad tracks:

- Decommission, demolish, remove and remediate the Encina Power Station site, including the associated structures, the black start unit and exhaust stack according to the provisions of a settlement agreement dated January 14, 2014, between and among the City of Carlsbad and the Carlsbad Municipal Water District (CMWD), Cabrillo Power I LLC and Carlsbad Energy Center LLC, and San Diego Gas and Electric Company (SDG&E).
- The desalination plant shall remain on approximately 11 acres (six acres for the desalination plant and approximately five acres of non-exclusive easements) west of the railroad tracks.
- Redevelop the Encina Power Station site, along with the SDG&E North Coast Service Center site, with a mix of visitor-serving commercial uses, such as retail and hotel uses, and with new community-accessible open spaces along Agua Hedionda Lagoon and the waterfront (Carlsbad Boulevard). Encourage community gathering spaces, outdoor dining, and other features to maximize potential views of the ocean and the lagoon. Encourage shared parking arrangements so that a greater proportion of development can be active space rather than parking.
- Determine specific uses, development standards, infrastructure, public improvements, site planning and amenities through a comprehensive planning process (e.g., specific plan, master plan, etc.) resulting in a redevelopment plan approved by the City Council. The redevelopment plan boundaries should include the Encina Power Station and the SDG&E North Coast Service Center sites.
- Work with SDG&E to identify a mutually acceptable alternative location for Its North Coast Service Center. Work with SDG&E, as part of a long-term plan, to identify and ultimately permit an alternate site for its Encina substation.

Chapter 3: Mobility

3-P.8 Utilize transportation demand management strategies, non-automotive enhancements (bicycle, pedestrian, transit, train, trails, and connectivity), and traffic signal management techniques as long-term transportation solutions and traffic mitigation measures to carry out the Carlsbad Community Vision.

3-P.15 Evaluate methods and transportation facility improvements to promote biking, walking, safer street crossings, and attractive streetscapes. The City Council shall have the sole discretion to approve any such road diet or vehicle traffic calming improvements that would reduce vehicle capacity to or below a LOS D; this also applies to streets where the vehicle is not subject to the MMLOS standard as specified in Table 3-1.

3-P.16 Design new streets, and explore funding opportunities for existing streets, to minimize traffic volumes and/or speed, as appropriate, within residential neighborhoods without compromising connectivity for emergency first responders, bicycles, and pedestrians consistent with the city's Carlsbad Active Transportation Strategies. This should be accomplished through management and implementation of livable streets strategies and such programs like the Carlsbad Residential Traffic Management Plan.

3-P.17 Consider innovative design and program solutions to improve the mobility, efficiency, connectivity, and safety of the transportation system. Innovative design solutions include, but are not limited to, traffic calming devices, roundabouts, traffic circles, curb extensions, separated bicycle infrastructure, pedestrian scramble intersections, high visibility pedestrian treatments and infrastructure, and traffic signal coordination. Innovative program solutions include, but are not limited to, webpages with travel demand and traffic signal management information, car and bike share programs, active transportation campaigns, and intergenerational programs around schools to enhance safe routes to schools. Other innovative solutions include bicycle friendly business districts, electric and solar power energy transportation systems, intelligent transportation systems, semi- or full autonomous vehicles, trams, and shuttles.

3-P.19 Encourage Caltrans, SANDAG, NCTD, and adjacent cities to improve regional connectivity and service consistent with regional planning efforts. This includes expansion of Interstate-5 with two HOV lanes in each direction, auxiliary lanes, and associated enhancements, a Bus Rapid Transit (BRT) route along Palomar Airport Road, shuttle bus services from COASTER stations, and other enhancements to improve services in the area.

3-P.20 Engage Caltrans, the Public Utilities Commission, transit agencies, the Coastal Commission, and railroad agency(s) regarding opportunities for improved connections within the city, including:

- Improved connections across the railroad tracks at Chestnut Avenue and other locations
- A grade separated rail corridor that includes grade separated street crossings at Grand Avenue, Carlsbad Village Drive, Tamarack Avenue and Cannon Road, as well as new pedestrian and bicycle crossings
- Completion and enhancements to the Coastal Rail Trail and/or equivalent trail along the coastline
- Improved connectivity along Carlsbad Boulevard for pedestrians and bicyclists, such as a trail
- Improved access to the beach and coastal recreational opportunities
- Improved crossings for pedestrians across and along Carlsbad Boulevard

3-P.21 Implement connections and improvements identified in this Mobility Element, including those identified in policy 3-P.19, as well as:

- Extension of College Boulevard from Cannon Road to El Camino Real
- Completion of the Poinsettia Lane connection near El Camino Real (Reach E)
- Extension of Camino Junipero to the eastern city boundary
- A bicycle/pedestrian trail/pathway connecting the eastern terminus of Marron Road to the east
- A bicycle/pedestrian trail/pathway connecting the eastern terminus of Cannon Road to the east, and coordination with adjacent agencies to appropriately link to their facilities

3-P.22 Support pedestrian and bicycle facilities at all Interstate-5 and State Route 78 interchanges.

3-P.24 Update the pedestrian, trails and bicycle master plans, as necessary, to reflect changes in needs, opportunities and priorities.

3-P.25 Implement the projects recommended in the pedestrian, trails and bicycle master plans through the city's capital improvement program, private development conditions and other appropriate mechanisms.

3-P.26 Identify and implement necessary pedestrian improvements on streets where pedestrians are to be accommodated per Table 3-1, with special emphasis on providing safer access to schools, parks, community and recreation centers, shopping districts, and other appropriate facilities.

3-P.27 Implement the Safe Routes to School and Safe Routes to Transit programs that focus on pedestrian and bicycle safety improvements near local schools and transit stations. Prioritize schools with access from arterial streets for receiving Safe Routes to School projects.

3-P.28 Improve and enhance parking, connectivity, access, and utilization for pedestrians and bicycles to COASTER stations, utility corridors, and open spaces consistent with city planning documents.

3-P.29 Evaluate incorporating pedestrian and bicycle infrastructure within the city as part of any planning or engineering study, private development, or capital project.

3-P.31 Engage the community in the policy setting and planning of street, bicycle, pedestrian, transit, and connectivity studies, plans and programs.

3-P.32 Require developers to improve pedestrian and bicycle connectivity consistent with the city's bicycle and pedestrian master plans and trails master planning efforts. In addition, new residential developments should demonstrate that a safe route to school and transit is provided to nearby schools and transit stations within a half mile walking distance.

3-P.33 Work with existing neighborhoods and businesses to improve pedestrian and bicycle connectivity and safety consistent with the city's pedestrian and bicycle master plans and trails master planning efforts.

3-P.34 Actively pursue grant programs such as SANDAG's Active Transportation Grant Program and Smart Growth Incentive Program to improve non-automotive connectivity throughout the city. The emphasis of grant-funded projects shall be on implementation, which includes planning documents that guide and prioritize implementation, programs that encourage the use of active transportation modes, education for the use of active transportation modes, or physical improvements themselves.

3-P.35 Partner with other agencies and/or developers to improve transit connectivity within Carlsbad. As part of a comprehensive transportation demand management (TDM) strategy and/or with transit oriented development (TOD), a shuttle system could be established that connects destinations and employment centers like LEGOLAND, hotels, the Village, McClellan-Palomar Airport, business parks,

the COASTER and Breeze transit stations, public activity centers (such as senior centers, city hall, libraries, etc.) and key destinations along the coast. The system could incorporate shuttle service in adjacent cities to maximize connectivity.

3-P.36 Encourage NCTD, SANDAG and other transit providers to provide accessibility for all modes of travel to the McClellan-Palomar Airport area.

3-P.38 Develop flexible on-site vehicle parking requirements. Such requirements will include implementation of innovative parking techniques, implementing effective TDM programs to reduce parking demand, and consideration of other means to efficiently manage parking supply and demand.

3-P.39 Require new employment development to provide secure bicycle parking on-site. Major employers should provide shower and changing rooms for employees as appropriate.

3-P.40 Assist Village businesses to manage parking in the Village area to maximize parking efficiency. Any potential parking-related revenues generated in this area should be reinvested into the Village area for implementing livable streets and other parking, pedestrian, and bicycle enhancements, including way-finding signage and maintenance of associated infrastructure.

3-P.41 Consider supporting new development and existing businesses with various incentives (such as parking standards modifications) for implementing TDM programs that minimize the reliance on single-occupant automotive travel during peak commute hours.

Chapter 4: Open Space, Conservation, and Recreation

4-P.40 Prepare a comprehensive Trails Master Plan update, that expands the existing and planned 61-mile trail system, with the following objectives:

- Connectivity between off-road trails and major on-road pedestrian and bicycle routes, such that future improvements in the trail system also contribute to linkages between important sites (beaches, lagoons, schools, commercial centers, master planned communities, and others)
- Design and designate trails as multi-use to be accessible for all user groups, including walkers, bicyclists, and equestrians (as land use policy allows). Ensure that the network provides an appropriate amount of resources for each trail type or user group
- Greenway and trail linkages from major recreational/open space areas to other land use areas or activities, including, but not limited to, residential neighborhoods, places of employment, parks, schools, libraries, and viewpoints
- Linkages/multi-use trails connecting businesses and residential neighborhoods to the beaches

This page intentionally left blank.

Appendix E

Project Level Mitigation Measures

In addition to the programmatic measures contained in this Climate Action Plan, the following is a non-exclusive list of mitigation measures that can be applied at the project level to reduce greenhouse gas emissions. These measures, and other measures not listed in this Appendix which may become available, are intended to assist projects in meeting the performance standard of reducing their greenhouse gas emissions to the level required by federal, state and local law, including the emission reduction targets established in this Climate Action Plan. The city and project applicants may consider these and other project-level mitigation measures, provided that their effectiveness in reducing greenhouse gas emissions can be demonstrated and they are otherwise consistent with all applicable policies and ordinances (e.g., a mixed-use project that is permissible by the zoning ordinance). Sources for additional potential mitigation measures may include those listed in: CAPCOA's "CEQA and Climate Change, Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (January 2008)"; the Attorney General's "Addressing Climate Change at the Project Level"; OPR's CEQA and Climate Change: Addressing Climate Change Through California Environmental Quality Act (CEQA)"; and SANDAG's "Draft Climate Change Mitigation and Adaptation White Paper (2014)". Please see Appendix C for complete references.

Renewable Energy

- Provide onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies
- Include in new buildings facilities to support the use of low/zero carbon fueled vehicles, such as the charging of electric vehicles from green electricity sources
- Provide solar water heaters

Green Building

- Meet recognized green building and energy efficiency benchmarks such as LEED and ENERGY STAR

- Incorporate materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way

Energy Efficiency

- Exceed Carlsbad Green Building Code (Title 24) mandatory efficiency requirements by 15% or more
- Install light colored "cool" roofs (e.g. Energy Star roofing) or other highly reflective, highly emissive roofing materials
- Install a vegetated ("green") roof that covers at least 50% of roof area
- Design project to maximize solar orientation (i.e., 75% or more building face north or south; include roof overhangs that block high summer sun, but not lower winter sun, from penetrating south-facing windows
- Plant trees and vegetation near structures to shade buildings and reduce energy requirements for heating/cooling
- Install energy-reducing ceiling/whole-house fans
- Install energy efficient lighting (e.g., light emitting diodes (LEDs)), heating and cooling systems, appliances, equipment, and control systems. (e.g., Energy Star)
- Install energy-reducing programmable thermostats that automatically adjust temperature settings

Transportation

- Develop commute trip reduction plans that encourage employees who commute alone to consider alternative transportation modes
- Create an online ridesharing program that matches potential carpoolers immediately through email
- Provide fair-share funding of transportation improvements
- Provide shuttle service or public transit incentives such as transit passes to decrease work-related auto trips
- Provide "end-of-trip" facilities including showers, lockers, and changing space (nonresidential projects)
- Incorporate public transit into project design
- Incorporate bicycle lanes, routes and facilities into street systems, new subdivisions, and large developments
- Provide amenities for non-motorized transportation, such as secure and convenient bicycle parking

- Provide plentiful short- and long-term bicycle parking facilities (nonresidential projects)
- Provide long-term bicycle parking is provided at apartment complexes or condominiums without garages
- Create pedestrian (and/or bicycle) access network that internally links all uses and connects to all existing/planned external streets and pedestrian (and/or bicycle) facilities contiguous with the project site
- Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances
- Provide parking for EVs/CNG vehicles
- Install EV charging facilities

Water Conservation

- Install water-efficient fixtures and appliances such as low-flow fixtures, dual flush toilets, and other water efficient appliances
- Install water-efficient irrigation systems and devices, such as soil moisture-based irrigation controls and use water-efficient irrigation methods
- Implement low-impact development practices that maintain the existing hydrology of the site to manage storm water and protect the environment
- Incorporate recycled/reclaimed water for landscape irrigation and other non-potable water use needs
- Incorporate rain barrels and gray water systems for landscape irrigation

Landscaping

- Install native and drought tolerant plant materials into landscapes
- Incorporate into landscapes drought resistant native trees, trees with low emissions and high carbon sequestration potential
- Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect
- Dedicate space for neighborhood gardening

Mixed-Use

- Development projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with

functional interrelationships and a coherent physical design; or projects that have at least three of the following on site and/or offsite within one-quarter mile: residential development, retail development, office, transit, park, or open space

- Provide on-site shops and services for employees, as permitted by zoning and development standards

Solid Waste Measures

- Reuse and recycle construction and demolition waste (including, but not limited to, soil, vegetation, concrete, lumber, metal, and cardboard).
- Provide interior and exterior storage areas for recyclables and green waste and adequate recycling containers located in public areas.
- Provide education and publicity about reducing waste and available recycling services.