February 8, 2021

AGENDA ITEM # 2

TO: Environmental Commission

FROM: Emiko Ancheta, Staff Liaison

SUBJECT: Climate Action and Adaptation Plan Update Status Report

RECOMMENDATION:

A. Receive update on Climate Action and Adaptation Plan (CAAP) progress and schedule
B. Discuss Community Outreach Plan for CAAP Development

BACKGROUND

In 2013 the City of Los Altos adopted the Climate Action Plan in accordance with the State Assembly Bill 32 which required public agencies in California to implement measures to reduce greenhouse gas (GHG) emissions to year 1990 levels by 2020. Cities needed to adopt a plan to addresses carbon emissions and establish an implementation plan for programs and facilities. A Climate Action Plan (CAP) is the policy document that provides the framework to achieve those goals. Since the adoption of the 2013 CAP, two annual report updates were done in 2015 and 2016. The City Council continues to make the environment a priority and directed staff to update the CAP in 2020. In December 2020, the City entered into contract with EcoShift Consultant to prepare a Climate Action and Adaptation Plan (CAAP) for the City of Los Altos.

In January 2021, staff began working with EcoShift and the Environmental Commission Subcommittee to develop the City of Los Altos CAAP. The following summarizes the scope of services.

Task I: Project Management: Consultant Project Team will develop a project management plan in conjunction with City staff. The consultant will use best practices in project management methodologies to ensure the project remains on-task and on schedule. **Task Deliverables** include Kick-Off meeting with City staff, ongoing Bi-Weekly conference call meetings with City staff, attendance at meetings and public hearings for the Environmental Commission and City Council, presentation materials and summaries for meetings and public hearings and Ad hoc communication.

Task II: Data Inventory, GHG Forecast and Vulnerability Assessment: Consultant Project Team will use ICLEI protocols for this project and ClearPath portal to conduct the inventories and forecasting. **Task Deliverables** include update of baseline GHG inventory workbooks, summary GHG Report detailing results of inventory and documenting any methodological changes, forecast municipal and community GHG emissions, update GHG emissions reduction targets, vulnerability Assessment assessing the threats of climate risks.

Task III: Review and Assess Relevant City Plans, Policies, Programs and Codes: Consultant Project Team will conduct a review of current City measures, followed by a systematic process to compile the City's current, relevant goals, strategies, actions, tactics, and recommendations. **Task Deliverables** include collection of all relevant existing GHG reduction efforts, quantify efforts using agreed-upon emission factors, develop matrix detailing the City's current emissions reduction efforts, and explaining the relevance of existing policies to each other and to future CAAP measures, and policy framework matrix.

Task IV: Develop and Evaluate GHG Reduction and Climate Adaptation Measures: Consultant Project Team's roadmap process will identify critical pathways to achieving the City's climate goals, help identify issues and barriers to each pathway, and recommend mitigation strategies to overcome barriers. **Task Deliverables** include list of proposed CAAP measures, summary of transportation scenarios and list of VMT and GHG reduction policies for possible inclusion in the CAAP, adaptation strategies, list of measures and actions to attain City goals, threat matrix detailing types and degree of threats from the effects of climate change and reporting template for reporting on adaptation measures.

Task V: Prepare Draft Climate Action and Adaptation Plan: Consultant Project Team will deliver a comprehensive and robust CAAP that will be designed to be complementary to existing policies for reducing waste and energy use, reducing single occupancy- vehicle trips, and encourage healthy lifestyles. **Task Deliverables** include draft CAAP that includes Executive Summary summarizing report's purpose, methodology, findings, and recommendations, and materials for ongoing outreach and education.

Task VI: Finalize Climate Action and Adaptation Plan: Consultant Project Team will compile all feedback from the draft CAAP review and integrate comments into the final CAAP document. **Task Deliverables** include finalized CAAP, meeting with City to discuss how input and comments were integrated info final CAAP, attendance at 3 public meetings (1 EC meeting and 2 CC meetings).

Task VII: CEQA Compliance: Consultant will prepare an Administrative Draft IS/MND with the following components:

- Project Description
- CEQA Environmental Checklist Form
- Mandatory Findings of Significance
- Contacts and Bibliography
- Mitigated Negative Declaration or Negative Declaration
- Notice of Determination

DISCUSSION

The next steps of the CAAP development will include review of existing inventories, gathering data and documents, vulnerability assessment and inventory input using ICLEI ClearPath.

Staff is working with EcoShift to develop an outline of the goals, policies and programs and set GHG reduction targets. The Environmental Commission CAAP sub-committee members, Bruno Delagneau, Raashina Humayun and Don Weiden attend CAAP meetings and provide support and input to develop the CAAP.

Attachments:
A. CAAP Meetings Summary
B. CAAP Proposed Timeline
C. LAYCAT Draft Recommendation CAP Assessment Form
D. Example CAPs from Other Jurisdictions
E. Community Outreach and Engagement Plan for CAAP Development

Climate Action & Adaptation Plan Meetings Summary

CAAP Kick-Off (January 14, 2021):

- Introduction of lead City staff, Environmental Commission subcommittee and consultant team
- Input for the CAAP development included:
  - Two focus areas should be existing buildings and reducing water use (the City is considering an energy audit of existing buildings)
  - Tie aspirational goals to concrete actions with specific reasons for the recommendations provided
  - HR has some alternative commute benefits in place, including alternative work schedules and a public transit pre-tax benefit
  - Important to present the value proposition of the plan to residents and businesses (explain the costs & benefits) to gain buy-in
  - Two important focus areas will be tracking & measurement of actions and defining the City's GHG reduction target(s)
  - Community outreach will be important to engage the community and obtain input
  - Action items and measures should be simple and conveyable to create a consistent repeatable message
  - Important to identify the key drivers and goals of the plan (regulatory, leadership, etc.), as well as identifying where and how to best invest resources to achieve the plan’s goals
  - An updatable GHG model would be preferable, as well as an investigation of land use-related mitigation measures, and an investigation of future and retroactive actions (ex.: building codes to influence energy intensity)
  - A focus should be on creating a bold plan that incorporates technological advances, as well as raising the visibility of the plan in the eyes of the public and decision-makers
  - The Reach Codes will have a big impact on future energy use in the City
  - Per-capita residential PV and EV charging adoption are high within the City - there is interest in going off-grid among some residents
  - The collection of data and using it in an effective reporting format will be important in demonstrating the plan's ongoing success, as well as communicating local and regional benefits
- A brief presentation was given by the consultant team on the phases of the plan and the role Fehr & Peers' TrendLab+ tool

CAAP Bi-weekly Meeting (January 29, 2021):

- Definition of an innovative plan was discussed: A valuable starting point will be for the City and consultant team to exchange lists of plans they find interesting/important to this project and discuss (see attachment D). This could result in a menu of innovative plans, policies, etc. for consideration for this project.
  - National and international plans and measures should be considered, not just limited to local efforts.
- Potential areas of interest for innovations include:
  - Learning and building on the Open Streets events over the summer

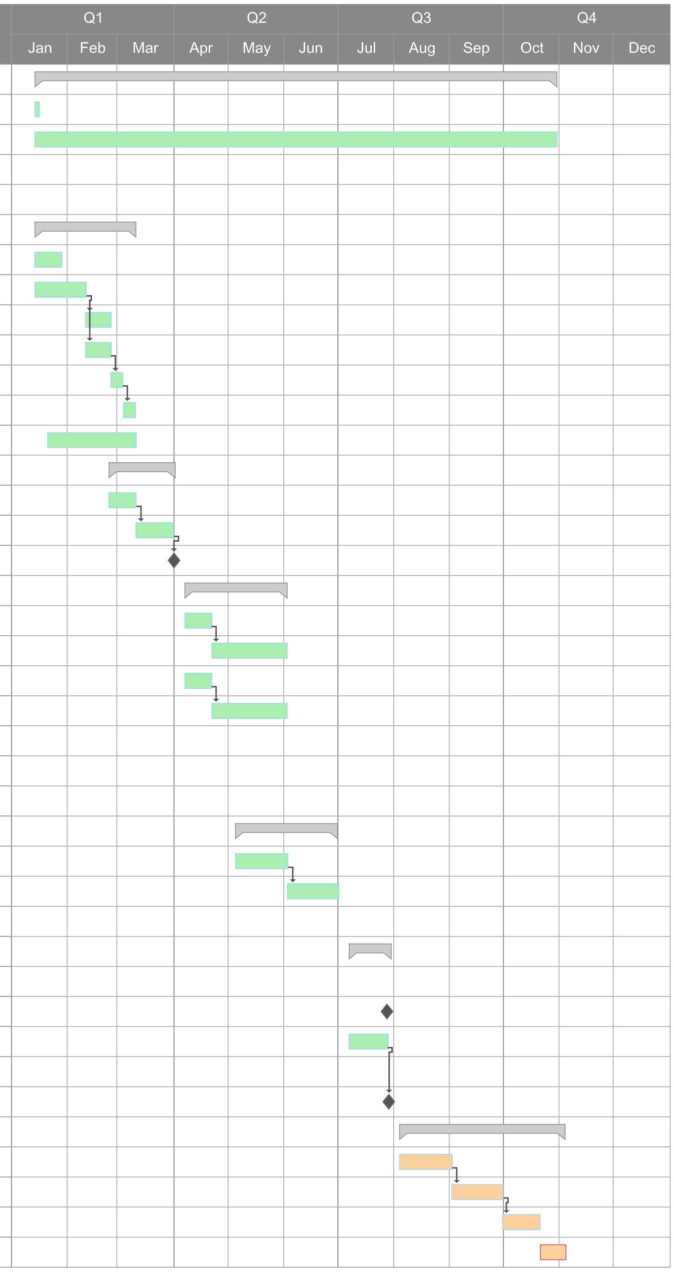
    - Community microgrids (potentially utilizing new Community Center)
    - Utilizing carbon sinks and carbon capture to become Carbon Negative
- Guidelines for private owners as well as enforceable policies for City-owned land and buildings should be looked at when considering innovative measures.
- Planning for stakeholder engagement, the consultant team will send a list of requirements to the City so they can begin the planning process.
- Important to identify when to bring different stakeholder groups into the planning process. Bringing in different stakeholders at the right time will result in a more inclusive plan and help with the plan's adoption and implementation (ex.: downtown businesses will be impacted by changes to parking policies).
- The team discussed options for the timeframe for the Vulnerability Assessment (Mid Century vs End of Century). This should be determined by types of City infrastructure relevant to climate change. The original input from the City was that a Mid Century timeframe would be most appropriate.
- Alignment between the CAAP and the City's Emergency Preparedness Plan was discussed. Alignment between the CAAP and other City plans (current and future) in general will be an important consideration.
- The consultant team gave a brief intro to ClearPath. This will be the central GHG reduction planning tool, and also offers monitoring & reporting modules for ongoing use.
- An initial list of climate threats was reviewed (Flooding from creeks, Extreme Heat, Urban Heat Island effect, Wildfires, Air Pollution, and Drought). The consultant team will send this list to the City along with a framework for capturing stakeholder feedback on each threat. This is an important step in the Vulnerability Assessment.

Attachment B

Los Altos CAAP

smartsheet

Task Name
Task I: Project Management & Meetings
Project Kick-Off meeting
Ongoing project management
Public meeting attendance
Public meeting agendas, presentation materials and summaries
Task II: Data Inventory & Forecast
Gather necessary data
Review and update existing inventories
Revised or additional GHG reduction measures
Quantify baseline GHG emissions
Forecast emission projections
Set new emission reduction targets
Vulnerability assessment
Task III: Review & Assess City Plans, Policies, Programs and Codes
Audit of City's policy framework
Quantify existing efforts
Matrix explaining relevance of existing policies to CAAP
Task IV: Develop & Evaluate GHG Reduction Measures
Identify GHG reduction measures
Quantify and assess GHG reduction measures
Identify adaptation measures
Quantify and assess adaptation measures
TrendLab+ scenario testing study session
TrendLab+ Customization
Reporting template for adaptation reporting
Task V: Prepare Draft CAAP
Prepare administrative CAAP draft
Prepare final CAAP
Attend 2 public meetings each with EC and CC
Task VI: Prepare CAAP
Prepare CAAP
Debrief session with City staff to explain how comments have been addressed
Attend 3 public meetings for final CAAP adoption (1 EC and 2 CC)
PowerPoint presentation for meetings
Certification of CAAP
Task VII: CEQA Compliance
Administrative draft IS/MND
Screencheck draft IS/MND
Public review draft IS/MND
Mitigation Monitoring & Reporting Program



DRAFT

Attachment C

Climate Action Plan Assessment Form

Please look at our proposed plan for Los Altos City and fill out the comments before returning the form to the LAYCAT team (laycatemail@gmail.com)

Action #	Description	Included in CAP?	Comments
1	**Adopt a bold goal** to reduce community-wide GHGs by at least [60%] by 2030, given that scientific findings now show California's goal of a 40% reduction is no longer sufficient to address the severity of the crisis.[5]	☐	
2	**Specify all resources** required to implement each action in the plan, including dollar amounts, staff hours and task owners.	☐	
3	**Identify approximately 10 easy-to-track metrics** to help Council members and the public gauge success of the plan and define a reporting frequency for those metrics.	☐	
4	**New buildings:** plan to immediately stop the expansion of natural gas infrastructure, which can be accomplished by continuing the strong All Electric Reach Code requiring all new buildings to be 100% electric.	☐	
5	**Existing buildings: create a plan to reduce 80% of GHG emissions from existing buildings by 2030**, which can be accomplished with a "Burnout Ordinance" paired with rebates (initiated in the future) that together aim to phase out the burning of natural gas in existing buildings, as was recently proposed in Menlo Park's CAP.[6]	☐	
6	**Create a plan for reducing vehicle miles traveled by 25%**, which can be accomplished by a) rezoning to encourage higher density near transit b) creating a Green Streets network[7] that makes the City easier and safer to navigate without a car and c) working to implement a slow the streets program similar to the one implemented in San Francisco.[8]	☐	
7	**Create a plan for increasing access to electric vehicle (EV) charging**, especially for those living in multi-family housing and where charging can be done during the day, when clean solar energy is abundant on California's electric grid.	☐	
8	**Create a plan to replace 100% of the City's municipal assets that currently use fossil fuels** with efficient electric alternatives, including but not limited to: Gas pool heating equipment, gas and diesel municipal fleet vehicles, gas furnaces, gas water heaters and gas-powered landscaping equipment.	☐	
9	**Create a climate adaptation plan** focused on protecting areas of the community vulnerable to wildfires, extreme heat events, flooding and sea level rise, as forecasted by the National Oceanic and	☐	

	Atmospheric Administration (NOAA) and County agencies.		
10	**Create a citizen's advisory commission** to support the development and implementation of a CAP, and then to monitor staff progress on the CAP.	☐	
11	**Create youth internship opportunities** to engage youth in the community and help with the implementation of climate related actions and solutions. Create a few paid positions in the summer to support the city sustainability efforts and to educate key stakeholders**.**	☐	

[5]Palo Alto has adopted a goal of 80% GHG reduction by 2030 and Menlo Park has adopted a goal of 90% GHG reduction by 2030.

[6]City of Menlo Park 2030 Climate Action Plan, July 2020, https://www.menlopark.org/ArchiveCenter/ViewFile/Item/11486

[7]Sierra Club Guidelines for a Green Streets Network: https://www.sierraclub.org/sites/www.sierraclub.org/files/sce authors/u4142/Sierra%20Club%20Loma%20Prieta%20Open%20Streets%205-1-20.pdf

[8]For an example of a City that has implemented Green Streets, see Oakland's Slow Streets Program, https://www.oaklandca.gov/projects/oakland-slow-streets

ATTACHMENT D

2030 CLIMATE ACTION PLAN

Prepared by the Environmental Quality Commission
Adopted by City Council July 2020 (Resolution No.6575)

A 2030 PLAN TO ELIMINATE CARBON EMISSIONS & PROTECT OUR COMMUNITY FROM CLIMATE CHANGE

JUNE 2020

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INTRODUCTION

Menlo Park is uniquely threatened by climate change and uniquely positioned to tackle it.

Menlo Park's location on the shore of San Francisco Bay places approximately $1.3 billion[1] of property in our Belle Haven neighborhood at risk of flooding from climate change by as early as 2070.[2] While it is impossible for Menlo Park alone to halt the global sea level rise that threatens our city, bold climate leadership on our part is perhaps our only hope of keeping sea level below the height of an "affordable" sea wall. The San Francisquito Creek Joint Powers Authority estimated in a 2016 feasibility study that a combination of levees and sea walls built along the shoreline of Menlo Park and East Palo Alto to address just three feet of sea level rise would cost approximately $100 million.[3]

If we do not provide visible and inspiring leadership on climate and global greenhouse gas emissions continue rising at their current rate, no sea wall or levee will save the portion of our city between Route 101 and the Bay. That land, which includes a disproportionate percentage of our city's low income residents and residents of color, will be inundated and residents and businesses will have to permanently relocate. On the other hand, if we take a leadership position and our bold climate action inspires rapid and far reaching climate action by other cities, we may be able to save our Belle Haven neighborhood with a combination of sea walls and levees.

The good news is that if there is any city well positioned to lead on climate action, it is Menlo Park. Located in Silicon Valley, our residents and leaders embrace innovation. Our county (San Mateo) is one of the wealthiest in the country,[4]

Source: http://data.pointblue.org/apps/ocof/cms/index.php?page=flood-map

YEAR: 2070-2100

the Bay is projected to rise 3.3 feet

which means we have the financial resources to tackle the issue of climate change head on. Analysis conducted by members of the Environmental Quality Commission's Climate Action Plan subcommittee shows that every dollar spent now by the City on bold climate action can be expected to save City residents $100 in future adaptation costs[5] addressing sea level rise alone, not to mention the healthcare costs associated with treating ailments caused by air pollution (see "Natural Gas Phase Out" section below).

Finally, our City Council and staff have already demonstrated a capacity for leadership by passing an innovative all-electric Reach Code that virtually eliminates natural gas from new buildings. At last count, 15 other California cities had adopted a "Menlo Park style" all electric Reach Code for new buildings, proving that courageous action on climate does in fact inspire others to follow.

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1 According to County of San Mateo Sea Level Rise Vulnerability Assessment p. 139, sea level rise of 3.3 feet will inundate Menlo Park real estate valued at $1.288 billion and a rise of 6.6 feet will inundate $1.621 billion in real estate.

2 Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group), Rising Seas in California: An Update on Sea-Level Rise Science, California Ocean Science Trust, April 2017. Ranges shown are from the median (50th percentile) to the extreme (99.9th percentile) range of the projections.

3 Public Draft Feasibility Report, SAFER Bay Project, Strategy to Advance Flood protection, Ecosystems and Recreation along San Francisco Bay, East Palo Alto and Menlo Park, October 2016, p. 37.

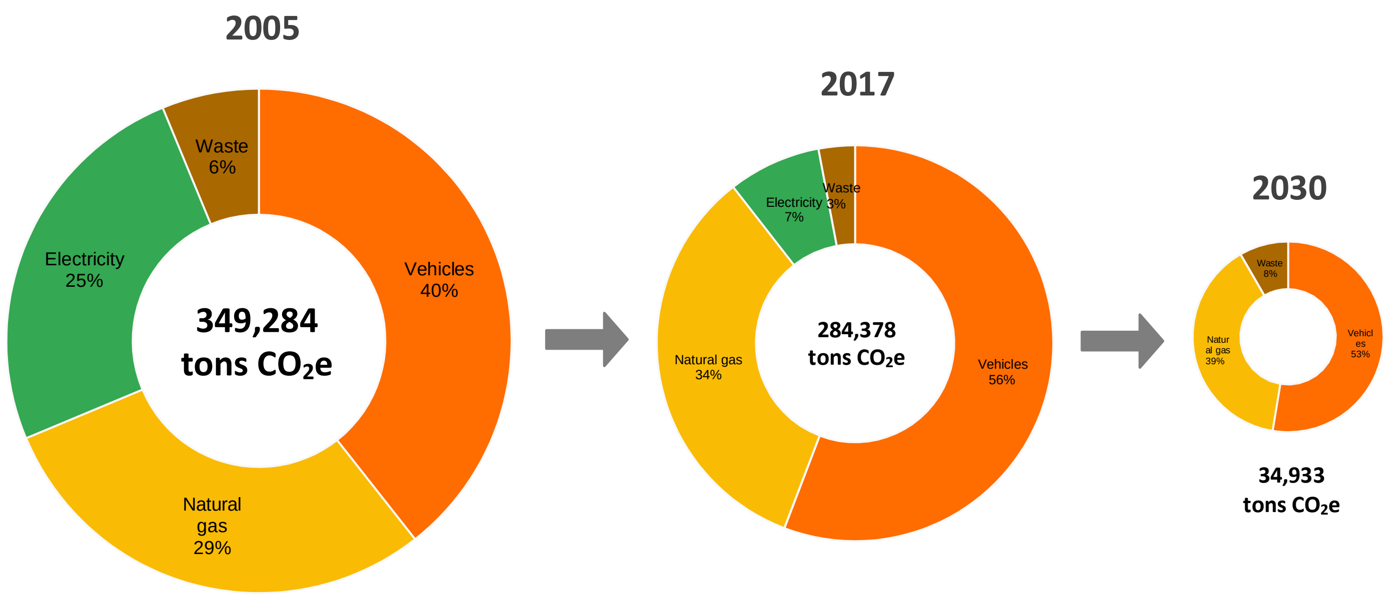
4 https://en.m.wikipedia.org/wiki/List_of_highest-income_counties_in_the_United_States

5 Supporting analysis available in PDF format in Appendix C and in Excel format upon request

ZERO CARBON BY 2030

In order to address the significant threat to Menlo Park posed by climate change, the City Council adopted a bold climate goal of zero carbon by 2030. This will be achieved through a 90% reduction in carbon dioxide equivalent emissions (CO_2e) from 2005 levels, and elimination of the remaining 10% of CO_2e through direct carbon removal measures.

An inventory of greenhouse gas emissions conducted in December 2019 revealed that emissions in Menlo Park fell from 349,284 tons in 2005 to 284,378 tons of CO_2e in 2017, a reduction of 19%. The aim of this plan will be to reduce community-wide emissions by another 71% for a total reduction of 90% from 2005 emissions, leaving just 34,933 tons of CO_2e per year by 2030.



Menlo Park Community Greenhouse Gas Emissions (metric tons of CO_2e)			
	2005	**2017**	**2030**
Vehicles	137,628	158,686	18,373
Natural gas	102,295	95,742	13,656
Electricity	87,617	21,528	-
Waste	21,745	8,424	2,903
Total Emissions	349,285	284,380	34,933

OPTIONS FOR ACTION

In order to achieve a goal of "Zero emissions by 2030," Menlo Park must begin taking bold action immediately. Fortunately, the City has already decarbonized its electricity supply by joining with other cities in the County to create a joint powers authority (Peninsula Clean Energy) that sources power mainly from renewables and hydropower. This creates a clean energy stepping stone from which to decarbonize the rest of the City's economy.

Our next step is to decarbonize all of our buildings and transportation. In an ideal world with more time, the City's climate goals could be achieved simply by unleashing the power of free enterprise and relying on markets and educated consumers to transform our fossil-fuel dependent economy to one that stops emitting greenhouse gases in time to avert catastrophic climate change. Members of the Climate Action Plan (CAP) subcommittee of the Environmental Quality Commission (EQC), who prepared this plan, certainly would prefer this type of approach, as it limits the role of government and would reduce the likely opposition from some interest groups. However, no matter how carefully the subcommittee considered various incentive- and education-based laissez-faire approaches, none of them appears able to solve the climate problem in time to avert catastrophic change to our daily lives. In fact, the less action the City takes now, the costlier the government intervention will be later to deal with the resulting climate disasters.

The key reasons that market approaches alone cannot solve climate change are three-fold:

1) markets are currently distorted by the absence of accurate pricing for key externalities, such as the right to dump harmful greenhouse gas emissions into the atmosphere, which today is virtually free to any person or business who wishes to do it, leaving the rest of us bear the ever increasing cost,

2) powerful political interest groups such as the fossil fuel industry have successfully spread enough disinformation about climate change that Americans significantly underestimate the problem and therefore underestimate the actions that must be taken to address it, and

3) polluting devices last far too long once installed and we simply do not have enough time for the typical market signals to trickle down to those who determine product offerings and today offer environmentally obsolete products to customers.

Just as the US government stepped in forcefully after the bombing of Pearl Harbor to require that much of America's free market economy be transformed to support the war effort, so too must the government now step in forcefully and confidently to lead the American public away from the brink of climate disaster.

Thankfully, the actions required of every American citizen to forcefully combat climate change are much less onerous than the food rations or military conscription imposed on World War II-era Americans. We are fortunate that a robust private sector has already provided every technological solution and innovation necessary to almost completely retire fossil fuels as an energy source in America today.

PERSONAL ACTION

Below is a list of the personal actions that, if every citizen took them, would halt global warming in its tracks:

- Retire all gas vehicles immediately and replace them with electric vehicles, bikes, transit or another form of non-fossil transport
- Replace every gas appliance in a home (including furnace, water heater and stove) with an efficient electric version
- Power every home and car with 100% renewable electricity, either by installing solar panels or purchasing renewable energy from one's utility
- Consider the greenhouse gas emissions associated with every purchase decision and choose "low-carbon" products and services whenever possible

- Reduce weekly consumption of meat and animal products, a move which has significant ancillary health benefits.

GOVERNMENT ACTION

At the local government level, climate action must focus on eliminating the use of two categories of fossil fuels: 1) gasoline and diesel fuel in vehicles, and 2) natural gas in home appliances. Given the 25-year expected life of a typical gas furnace, it is critical for the City to begin prohibiting the installation of new replacement gas furnaces and water heaters as soon as possible.

In considering the wide-reaching actions and change required to meet the City's proposed climate goals, researchers reviewed dozens of approaches employed by cities all over the world, including:

- A "5-minute city" approach to zoning implemented in Copenhagen, Denmark that drastically reduced vehicle miles traveled (VMT) and made the city more walkable
- A carbon fee on buildings recently implemented in New York City
- An announced plan to end the flow of natural gas in the City of Arcata, California and now being considered by Palo Alto.

After months of weighing each of the dozens of approaches, the CAP subcommittee identified three basic options for action: 1) a Bold Plan with 22 actions to be implemented over one year, 2) a Moderate Plan with 76 actions to be implemented over three years and 3) a Go Slow Plan with no specific actions other than to follow evolving state rules.

PLAN CHANGES DUE TO COVID-19 PANDEMIC

Shortly after the CAP subcommittee fleshed out the three different approaches to climate action described above, the world was gripped by the global pandemic of COVID-19. The pandemic has significantly affected the context in which this plan is presented, namely:

- The time and attention of City Council and staff has understandably shifted almost entirely to managing the health risks and economic consequences of the pandemic
- Almost overnight, the country has gone from enjoying robust economic growth to experiencing one of the starkest economic recessions in US history
- Due to the economic recession, the City's budget has shrunk dramatically, with a 2020-21 shortfall of $12.7 million
- Layoffs of dozens of City staff as a result of the City's budget shortfall
- City commissions, including the Environmental Quality Commission (EQC), unable to meet for 4 months, which means the CAP subcommittee has been delayed in vetting the CAP with the EQC

Despite disrupted City operations, the CAP subcommittee continued refining the Climate Action Plan and vetting it with the City Council's CAP subcommittee (distinct from the EQC's CAP subcommittee) to receive their input on what might be politically viable in Menlo Park. The result of that continued work is a significantly pared down plan, presented below. While the CAP subcommittee still believes that the original Bold or Moderate Plans (presented in Appendix B), with their 22 and 76 actions respectively, are in fact what the Climate Crisis requires, we have decided to propose a significantly pared down plan, with the thought that some action is better than no action. This plan includes only the highest impact actions. This does not mean it is the best plan. It means it is only a good subset of the best plan and future efforts should be made to expand it as our ability and the wisdom of doing so becomes ever more apparent.

THE PLAN

Action	#	Description	2030 GHG Reduction (tons/yr)	Estimated Initial Investment for FY 2020-2021
Explore policy/program options to convert 95% of existing buildings to all-electric by 2030	1	Two basic options: **1)** Announce the "end of flow" of natural gas in the City by 2030 **OR** 2) Enact a "burn-out ordinance" requiring that when gas appliances expire, they must replaced by electric (preferably high efficiency heat pump) alternatives; phase in for large commercial, small commercial, residential; may require follow-on compliance ordinance as current permit compliance for residential gas appliances is low; will require follow-up "cash-for-clunkers" program to achieve 2030 goal; relies on PCE subsidies to reduce or eliminate cost differential; may require use of UUT funds to cover additional cost differential for low-income residents. Extend burnout ordinance to expiring air conditioners, to be replaced with heat pumps, eliminating need for separate gas heating.	1) 86,465* **OR** 2) 51,636*	$195,000 to $275,000 *Initial investment to hire contract staff (building official, legal aid, energy analyst) and provide policy options that would lead to adoption of a policy, ordinance, and/or program
Set citywide goal for increasing EVs and decreasing gasoline sales	2	Announce and promote goals of 1) making all new vehicles be electric by 2025 and 2) reducing gasoline sales each year by 10%, based on the total reported in 2018. Track progress on both goals publicly on an annual basis.	<7,120*	$0-$20,000 to influence regional agency to lead on behalf of the city
Expand access to EV charging for multifamily and commercial properties	3	Install or assist building owners in installing EV chargers throughout the City, siting them preferably where they will be used during daylight hours (when solar electricity is abundant on our grid) and also where residents of multi-family housing can access them. Current project to explore and evaluate policy options for existing multifamily properties.	7,370* <13,000* for multifamily	$140,000 *Initial investment for contract analyst to evaluate multifamily properties
Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission	4	Reduce VMT, especially by gasoline vehicles, through a two-pronged approach: 1) Change zoning to encourage higher density (esp. for housing) near transit 2) Make the City easier to navigate without a car by accelerating implementation of the Transportation Master Plan with an emphasis on developing a clear network of protected pedestrian/bike paths throughout town Current projects underway that help achieve this goal: SB2 Housing grant, Transportation Management Plan, Transportation Management Association, and implementation of new VMT guidelines for new development	31,743*	Explore in 2021 or 2022 after current and complimentary projects are completed
Eliminate the use of fossil fuels from municipal operations	5	Replace 100% of the following municipal assets with efficient electric substitutes for: 1) Gas pool heating equipment 2) Gas and diesel municipal fleet vehicles 3) Gas furnaces 4) Gas hot water heaters 5) Gas-powered gardening equipment	879*	Currently budgeted for end of life assets/ appliances, and new community center/library
Develop a climate adaptation plan to protect the community from sea level rise and flooding	6	Develop a climate adaptation plan focused on protecting areas of the community vulnerable to sea level rise and flooding, as forecasted by the National Oceanic and Atmospheric Administration (NOAA) and California State agencies. Consider requiring developers to fund efforts to protect the community.	0	Flood and Sea Level Rise Resiliency District to Lead
		TOTAL (assumes option 2 is chosen in action #1)	**98,748+**	**$355,000 - $435,000**
***GHG emission reductions have been estimated and have not been verified**				

You will notice that the plan, as presented, falls well short of the goal of reducing our greenhouse gas emissions by 249,447 tons/yr by 2030. In fact, the plan only addresses 40% of the sought-after reductions. This simplified 6-action plan is significantly scaled back from the more comprehensive plans envisioned before COVID-19 struck, a compromise the CAP subcommittee felt was warranted, given the City's projected budget short-falls. The CAP subcommittee hopes that market momentum in the EV sector will make a significant contribution to the reduction of Menlo Park's greenhouse gas emissions, an effect not accounted for here. **The Environmental Quality Commission expects the significantly truncated six-action plan presented above to be completed within one year and strongly advises City Council to revisit the original, more comprehensive plan in July 2021, so that as the economy improves, those actions can be reincorporated into the plan.**

NATURAL GAS PHASE OUT

Ending the use of natural gas has multiple benefits, including the avoidance of failures in gas system operations, such as the one that destroyed homes and caused death in Brookline, Massachusetts in 2018 and the one that did even greater harm in San Bruno, California in 2010.

The normal operation of gas appliances in buildings has also been found to cause indoor air pollution that would be illegal outdoors due to its negative health impacts, according to a recent study from UCLA.[6] That study links chronic exposure to the NO_2 emitted from gas stoves to a range of health ailments, including: asthma, lung inflammation, increased risk of respiratory infection, lung and breast cancer and low birth weight in babies. Doctors in a January article in the New England Journal of Medicine wrote the following, "As physicians deeply concerned about climate change and pollution and their consequences, we consider expansion of the natural gas infrastructure to be a grave hazard to human health." They continued, "We also recommend that new residential or commercial gas hookups not be permitted, new gas appliances be removed from the market, further gas exploration on federal lands be banned, and all new or planned construction of gas infrastructure be halted."[7] It is therefore within the City's normal powers, which are aimed at protecting the health and safety of its citizens, to seriously consider announcing the "End of Flow" (EOF) of natural gas.

This is similar to an approach proposed in the City of Arcata, California whereby the City would explore and pass an ordinance that sets an end date, for example 7/4/2030, for the flow of natural gas to all gas customers within the City limits. This sets a date certain by which community members would want to make any needed electrification updates to their homes for water heating, cooking and space heating. The City could then either stand back and let community members educate themselves on choices that would work for them, or the City could be an active partner to interested citizens, perhaps leading a helpful bulk buying program for: water heaters, heat pump HVAC units, EV chargers and installation services, or performing other joint effort transformation activities. There is already a local model for city-led bulk buying called Sunshares, which performs bulk buying for home solar systems and electric vehicles. While the idea of city-led bulk buying may sound new and different at first, we should realize that the City of Menlo Park already performs bulk buying of commodities and services for its citizens and businesses, including water supply, public safety services, street tree maintenance, roads and sidewalks, etc.

SOURCES OF FUNDS

Some of the six proposed actions can most likely be implemented by existing staff with extra support from a contractor/consultants.

Other than the General Fund, there are two other potential sources of funds:

1) the $400,000 presented in the 2020-21 Capital Improvement Plan (CIP) as earmarked for implementation of the Climate Action Plan and

[6] UCLA Fielding School of Public Health, "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," April 2020, https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california

[7] New England Journal of Medicine, "The False Promise of Natural Gas," Philip J. Landrigan, M.D., Howard Frumkin, M.D., Dr.P.H., and Brita E. Lundberg, M.D., https://www.nejm.org/doi/full/10.1056/NEJMp1913663

2) issuing debt or borrowing money.[8]

Saving our community for future generations seems like one of the most prudent uses of borrowed funds one can imagine. Conversely, if we wait until extra City revenue is available to fund climate action, we will most certainly lose the climate fight.

There will be additional capital expenditures incurred as part of the Climate Action Plan, as well, including:

- Investment in EV charging infrastructure
- Street improvements related to the TMP implementation
- Investment in electric replacements for municipal gas and diesel assets

If funds for these capital expenditures have not already been allocated in the City's Capital Improvement Plan (CIP), an amendment would need to be made to the CIP for that purpose. The EQC's CAP subcommittee recommends **against** using funds currently earmarked in the CIP for climate action to pay for municipal greening projects. Such projects are good candidates for outside financing or borrowing, whereas the CAP funds in the CIP should be focused on high impact activities to reduce community-wide greenhouse gas reductions, such as policy development, programs, incentives, education and marketing.

PLAN METRICS

Climate Action Plans have a poor history of being effectively implemented and one reason for that is that progress is typically only measured every five years and with staff turnover, well intentioned plans can go unexamined for years. In order to avoid such an outcome, the CAP subcommittee recommends that a short list of concrete metrics be adopted and that the City Council request quarterly, if not monthly, updates on those metrics.

Key metrics to track include:

1. Number of gas hot water heaters citywide that are replaced with electric versions (data source: Menlo Park Building Department)
2. Number of gas furnaces citywide that are replaced with electric versions (data source: Menlo Park Building Department)
3. Number of utility natural gas accounts terminated (data source: Peninsula Clean Energy or PG&E)
4. Number of new cars registered that are gas vs. EV (data source: DMV)
5. Number of total cars registered that are gas vs. EV (data source: DMV)
6. Gallons of gasoline sold in Menlo Park (data source: City sales tax reports)
7. Percentage of municipal assets converted from gas or diesel to electric (data source: Menlo Park Public Works Department)
8. Vehicle miles traveled, including trips inbound, outbound and within the City (Google Environmental Insights Explorer)
9. Number of other cities that query and/or copy Menlo Park's climate policies and programs (data source: outreach efforts and research by Menlo Park Sustainability staff)

While Sustainability staff and members of the CAP subcommittee question the value of conducting frequent high level greenhouse gas inventories, we do all agree that measurement is important and believe that tracking the specific items listed above will help staff and Council gain insight into the effectiveness of the climate actions that the City decides to undertake. County efforts to measure greenhouse gas emissions are expected to continue and will hopefully reflect progress made by cities within the County.

METHOD FOR EVALUATING ACTIONS

The six actions detailed above were selected from over 76 actions included in the original Bold and Moderate Plans, because they offer the City the most potential for Greenhouse Gas Reductions per dollar spent.

Dozens of potential climate actions were considered. Actions took many forms, including: city ordinances, city directives, programs and collaborations. Each action was evaluated for the

[8] An interesting model for borrowing against existing financial assets (such as the City's reserves) has been employed during the COVID recession by leading charitable Foundations who are borrowing at low interest rates against their endowments in order to continue disbursements, https://www.nytimes.com/2020/06/10/business/ford-foundation-bonds-coronavirus.html.

following key criteria:

- Potential to reduce greenhouse gas (GHG) emissions
- City staff resources required to implement
- City cost to implement
- Out-of-pocket expenses for community members to implement (lifecycle economics for user)
- Political feasibility
- Potential for replication by other cities

The cost estimates above should be viewed as preliminary, requiring further thorough analysis by City staff prior to policy adoption.

THE TRUE COST OF CARBON

As mentioned above, there is in fact a societal cost to burning fossil fuels, sometimes referred to as the “cost of carbon.” There are debates today over how best to calculate that cost. Some say it should be based on the damages caused by those emissions. Others say it should be based on the cost to remove those carbon emissions from the atmosphere, once that becomes possible. In the absence of a global consensus, the EQC’s CAP subcommittee attempted to estimate the cost of carbon to Menlo Park by taking the projected losses from sea level rise in our city alone, $1.3 billion, and dividing that by the tons of CO_2e we expect to emit over the next 40 years in a business as usual situation. Using this simple methodology, we arrived at a “cost of carbon” of $130/ton for Menlo Park.

There are a number of ways the City could use this figure. We could consider levying a tax of $130/ton on fossil fuels, in order to cover future damages the City will incur, in essence internalizing the externalized “cost of carbon.” Another way to use this figure would be for the City to factor it in to all decisions concerning assets in the City that consume fossil fuels, for example in calculating the true cost to the City of a gasoline-powered police car or the true cost to citizens of a gas furnace.

NOTE ON LEADERSHIP

Saving our City from sea level rise will require collective global action, which Menlo Park can likely only influence through bold leadership. In evaluating the relative effectiveness of various climate actions, the CAP subcommittee noted the significant impact that replicability and demonstration of feasibility of a policy or program had on its potential to generate emissions reductions. If other cities can easily copy a policy or program, it is likely to **catalyze emissions reductions many times greater** than our City’s emissions reductions alone. Therefore, it is strongly advised that City staff favor simplicity and replicability in its design of climate policies and programs and it is further advised that the City invest resources in proactively sharing its climate policies and programs with other cities, counties and government entities.

We must also be nimble and ready to act on economic stimulus opportunities that may present themselves, as the Country attempts to pull itself out of a recession.

NOTE ON UTILITY PARTNERS

An analysis of community member economics for each action revealed that rebates can make or break the economics behind purchasing decisions for equipment like electric vehicles and electric heat pumps for space and water heating, all of which are essential for progress on climate action. The City can greatly increase the political feasibility of many climate actions included in this plan by calling on its local Community Choice Energy (CCE) provider to rapidly deploy the significant capital currently held on its balance sheet to fund rebates on electric replacements of gas appliances. Such rebates can make climate friendly replacements cost effective and that enables city councils like ours to pass ordinances requiring such replacements. In turn, the new electric devices generate net revenue that rebuilds the CCE’s financial reserves.

To this end, Peninsula Clean Energy’s board recently signaled its support for local cities’ efforts to electrify, voting on May 28, 2020 to invest $6 million to electrify existing buildings in San Mateo County. This program will reportedly include substantial incentives for: 1) the installation of electric heat pump water heaters, 2) upgrades to electric service panels so they can handle the increased electric demands of all-electric homes, and 3) whole-home electric conversions for low income residents. Such programs are a promising signal that local CCEs intend to help ease the financial burden of converting homes from natural gas to all-electric, since it is not only essential for fighting climate change but also in their long-term financial interest to do so.

NOTE ON EQUITY

Climate change does not affect all members of society equally. Tragically it disproportionately affects low income people and people of color, as evidenced right here in Menlo Park, where sea level rise is expected to have a devastating impact on residents of our Belle Haven neighborhood. A similar pattern is observed all over the globe, where poor island nations are becoming the first to be wiped off the globe. Climate justice advocate Hop Hopkins illustrates the connection between climate change and racism by explaining how allowing climate change to occur requires that we accept that portions of our local and global communities are “sacrifice zones, and you can’t have sacrifice zones without disposable people, and you can’t have disposable people without racism.”

Meanwhile wealthier segments of society go on emitting greenhouse gases at ten times the rate of poorer segments, unwilling to make even small changes to their purchasing decisions. The COVID crisis has shed a light on the shocking inequity in health outcomes for people of color, some of which can be attributed to well documented racial disparities in exposure to air pollution from fossil fuels. Menlo Park must ask itself whether it wishes to continue contributing to this global and local inequity, or whether it can strongly prioritize leadership in solving these interconnected problems.

Finally, although Menlo Park is situated in one of the wealthiest Counties in the country, that wealth is not equally distributed and some residents may find it difficult to afford at least the capital outlay for the changes recommended in this plan. To address issues of equity, there are a number of options for ensuring that low-income residents have the financial support they need to make the required changes to their homes and vehicles. Both the State and local CCEs have shown a willingness to provide financial subsidies specifically targeted at low income residents. Peninsula Clean Energy recently set aside $2 million, out of a $6 million program, just to assist low-income residents with all-electric retrofits of their homes. If the City wishes to further bolster that support, it could consider allowing the Utility User’s Tax (UUT) on natural gas sales to increase from its current 1% level to the existing voter-approved level of 3.5%. That would provide an estimated $500,000 in additional funding every year to low-income families converting gas appliances to all-electric. The City must take an active role in ensuring that low-income residents are not unfairly disadvantaged by the requirements of its Climate Action Plan.

ANOTHER NOTE ON COVID-19

Lastly, this Climate Action Plan is being presented to City leaders in the midst of a generation-defining event, namely the global COVID-19 pandemic. It is understandable and appropriate that City leaders would devote their immediate attention to protecting the health and wellbeing of our community, as we fight this deadly virus.

As the health emergency wanes, however, the CAP subcommittee hopes that Council members will view the proposed Climate Action Plan as an opportunity for Menlo Park. COVID-19 has jolted us all out of our routines and everyday existence, highlighting in a graphic way our vulnerability as a species. Climate change has the potential to do the same, only on an even greater scale. If we are able to take in the lessons presented to us by this current crisis, we will be better prepared to address the climate crisis that is coming. For example, we should ask ourselves: Do we want to be like South Korea and flatten the carbon “curve” by proactively investing in mitigating the carbon dioxide “contagion”? Or will we delay, like Italy, and only take decisive action once the problem has ballooned? Is it still acceptable to stand by and watch one window of opportunity after another close before our eyes, leaving us with a much larger problem, the only response to which threatens to destroy our economy? Can we accept that this problem, like COVID, will ravage poor communities and people of color? The choice is ours. How will we act?

This Climate Action Plan presents us with economic opportunities as well. If enacted, this plan will jumpstart a new local market in electric appliance installation, injecting money into the economy and providing hundreds of new jobs, just when they are needed.

Finally, as medical professionals learn more about the adverse health impacts of burning fossil fuels in our homes, the Climate Action Plan offers Menlo Park an opportunity to set a new standard for health and safety in our homes and places of work by removing fossil fuels from our air completely.

Our future is in our hands. It is time to act.

APPENDIX A

ORIGINAL PLAN OPTIONS – BOLD, MODERATE AND GO SLOW

Dr. John Holdren, scientific advisor to President Obama, advised that humans have three basic choices when it comes to climate change: 1) mitigate the problem by reducing our emissions, 2) adapt to the problem and try to move out of harm's way, or 3) suffer. What every civic leader must do today is pick the mix of those three options that they are willing to bring to their communities.

A summary of the benefits and drawbacks of each plan, from a City official's perspective, is offered below.

Bold Plan	Moderate Plan	Go Slow Plan
• A few bold actions • One-year implementation • Achieves goal of Zero by 2030 • Less $ now (staff resources) • Less $ later (lower sea walls) • Subject to opposition • Less human suffering • Regional leadership role	• Many moderate actions • Three-year implementation • Makes progress toward goal of Zero by 2030 • More $ now (staff resources) • Some $ later (sea walls) • Subject to some opposition • Some human suffering • Regional leadership role	• No proactive actions • No specific implementation time • Falls well short of Zero by 2030 goal • Less $ now (staff resources) • More $ later (high sea walls) • Subject to some opposition • More human suffering • No regional leadership role

THE MODERATE PLAN
The Moderate Plan is a set of 60+ actions (Appendix B), implemented over 3 years, that involve working with the community (residents, businesses and commuters) to assist and compel them to change, while simultaneously working with other cities, the County, the State and utilities to make such change easier. This would be accomplished by changing laws, capabilities and economics in a way that transforms standard practice, similar to the way that our all-electric Reach Codes are transforming standard practice in new construction. Menlo Park is gaining credibility in this area and therefore has a reasonable chance of catalyzing regional change through bold leadership and knowledge sharing.

The Moderate Plan would also seek an expanded vision and commitment from Community Choice Energy providers (CCEs), who will reap considerable benefit in the form of increased net revenue from electrification, just as oil companies will see diminishing revenue. According to this plan, the CCEs would be advised to rapidly deploy their net revenue, in order to quickly transform the market to support building electrification.

The Moderate Plan is the most time-intensive option of those presented, with significant staff resources deployed in the next three years to pass incremental ordinances that will drive needed behavior change. **Sustainability staff currently estimate that implementing the Moderate Plan would require approximately 6 incremental full time equivalent (FTE) staff for the first year and a similar or smaller number in the remaining two years included in the plan.** These incremental staff resources could be hired as consultants and would not be needed past the 3-year term of the plan.

While the action-intensive approach of the Moderate Plan may seem cumbersome, the CAP subcommittee suspects that the public requires incremental education and a piecemeal approach to rule changes, in order to have time to adjust to change. As such, the Moderate Plan also includes significant public outreach and education efforts to assist the public and businesses in understanding the benefits of mutual cooperation.

Finally, the Moderate Plan by itself would not guarantee that the City would reach its proposed climate goal of Zero emissions by 2030. Instead, this plan would put us on a path to achieve that goal in a later year or, alternatively, could be seen as laying the groundwork for implementation of additional measures, such as those outlined in the Bold Plan, starting in year 4 of climate action when the public may be more receptive to bolder action.

THE BOLD PLAN

The Bold Plan is much simpler (Appendix B) in that it involves far fewer actions and therefore fewer staff resources to implement. It also has the advantage of nearly guaranteeing achievement of the City's climate goals. It achieves this primarily by announcing to the community that the City will stop the flow of natural gas (a potent greenhouse gas) and restrict the use of gasoline vehicles within City limits by a certain date in the future, possibly by the year 2030. This approach gives community members time to make the needed adjustments to their homes and transportation, all of which are perfectly feasible, within an announced 10-year timeframe.

As for the elimination of gasoline and diesel (GAD) fuels from Menlo Park vehicles, the Bold Plan could include a normal health-and-safety powers type ordinance, requiring the phasing out of underground fuel tanks by 7/4/2030, for example. Any businesses that used underground fuel storage tanks would need to remove them for certain by that date. If climate preservation is being seriously pursued in the next decade and automobile makers follow their plans for electric vehicle production, there will be much lower need for GAD stations left in our area and those that remain will be selling a fraction of the volume of gasoline that they do now. This could mean that, regardless of which climate plan the City pursues, the number of local gasoline stations is likely to drop significantly within the next decade from the current 12 to as few as six. Some locations could be repurposed as EV charging stations with amenities such as a coffee shop, convenience store or car wash.

Another approach to eliminating GAD fuels would be for the City to pass a number of ordinances that reduce the subsidies currently offered to GAD-powered cars and trucks. Some of the subsidies that could be reduced or eliminated for GAD vehicles include City-provided free parking in downtown lots and free parking on the side of public streets, a subsidy the City already limits overnight in Menlo Park. Both of these measures would encourage reductions in vehicle miles traveled (VMT) in the City, as well as conversions to electric vehicles (EVs). These shifts would also offer residents the ancillary benefits of reduced traffic congestion and/or reduced air pollution.

THE GO SLOW PLAN

The Go Slow Plan (GSP) would entail stepping back from climate leadership and following other entities, if and when they step forward to lead. The City would forgo the opportunity to carve out its own unique approach to problems, as we did with the recent Reach Codes, and would likely end up joining County efforts or copying other Cities' approaches. A Go Slow Plan would likely entail sitting quietly on the sidelines and following plans developed and offered by regional or state entities, as they emerge. The Go Slow Plan is by far the most risky of the plans in that it results in the highest likely damage cost to public and private property from sea level rise and would cause the most human suffering in vulnerable parts of our City. Gut-wrenching decisions will face City officials as they decide how much money to spend delaying the eventual loss of real estate valued at over $1 billion along our Bay shoreline. One can imagine weighty decisions about what neighborhoods to save resulting in heated disagreement among residents that would tear at the fabric of our community.

Although the Go Slow Plan may look "easy" in the short term, due to the lower staffing requirements and the slower pace of change required now, this approach may in fact prove to be penny wise and pound foolish. In reality, a Go Slow approach simply hands a growing problem to a future City Council, who would have even less time and resources at their disposal to battle climate change and oversee adaptation on multiple fronts.

We understand from the worldwide scientific body, the Intergovernmental Panel on Climate Change (IPCC), that time is of the essence and that in order to have a meaningful impact on climate change, any mitigation efforts must start immediately. This would render the Go Slow Plan scientifically imprudent, leaving the City Council to choose between: a) implementing the Moderate Plan immediately and simultaneously exploring the Bold Plan for later implementation if needed, b) cutting to the chase and just pursuing the Bold Plan immediately or c) developing a plan they feel would perform better.

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2020

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost ($/ton) *	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
A: Municipal Greening												
Develop and implement plan for electrifying municipal fleet	1	Directive	Public Works/ Sustainability		0.05		446	-$7,624	3,000	$980,000	$3,406,667	Develop clear plan for converting 100% of municipal vehicles to EVs
Expand city owned, public EV charging infrastructure throughout City	2	Directive	Sustainability/ Public Works		0		714	-$53.16	6,000	$400,000	$151,880	CAP sub note: Focus on parking lots at city facilities, inc. parks, library, community center and areas that serve multi-family housing. (1) Analyze EV infraststruce needs of the city and design accordingly (2) Establish rules for use of chargers and best practices for signage and other use factors (3) Jump start infrastructure development with initial public investments (4) Develop partnerships with utlities and private businesses as long term investors when building out the city's EV-charging infrastructure (5) Monitor and adapt to trends in the eV market and with EV technologies, use of city infrastructure, and shifts in national, regional policy
Develop and Implement plan for electrifying all municipal buildings + pools	3	Directive	Public Works/ Sustainability		0.05		433	-$33.94	39,000	$360,000	$225,305	Install heat pumps and heat pump water heaters in all municipal buildings and the 2 pool complexes
For Resiliency purposes only: Develop and implement plan for installing batteries for resiliency in key municipal facilities, starting with new community center	4	Directive	Public Works/ Sustainability		0.05		1	$16,781	109	$360,000	-$300,000	Install solar and batteries in municipal facilities for resiliency during emergencies.
Adopt CA regulations + Marin concrete language on embodied carbon in municipal construction, e.g. sidewalks	5	Directive	Public Works		0		54	$16.67	3,000	$9,000	-$9,000	Review state purchasing guidelines published recently and adopt those as a starting point, create signage for carbon-free sidewalks.
Raise Nat Gas UUT to 3.5% (to fund electrification of low income households, municipal electrification program and other Council-directed GHG reductions)	6	Directive	Finance/ Sustainability		0.125		579	$2.16	35,000	$5,000	$473	First step is to increase UUT rate on natural gas. City Council then decides where to apply funds: electrification (+ batteries?) in 1) day cares, 2) municipal buildings, 3) schools, 4) low income residents' homes.
				Subtotal	**0.275**							
B: Commercial Greening												
Facilitate daytime EV charging at commercial establishments and allow public access use at night	7	Ordinance	Sustainability/ Planning/ Building		0.5		1,428	$3.50	85,700	$90,000	$134,256	Facilitate installation of EV chargers for commercial establishments of a certain size to encourage charging from 9am to 3pm when supply of renewable energy is abundant and cheap; also allow public charging access at night
Work with Facebook to develop a bus electrification plan, including shuttle	8	Collaboration			0.05		1,631	$0.61	8,200	$1,400,000	-$110,000	
Require electrification of gas appliances (space heating and water heating) and A/C upon burnout to heat pump - commercial	9	Ordinance	Sustainability/ Building		0.5		19,469	$0.26	3,115,100	$24,000	$7,650	Require property owner to replace gas HVAC units at end of life with electric heat pump HVAC. Also require that replaced A/C be provided by heat pumps; limit to commercial establishments of a certain size
Adopt Marin limits on embodied carbon in construction and require materials that sequester carbon in commercial construction	10	Ordinance	Sustainability/ Building		0.5		2,835	$1.76	170,100	$3,600	-$3,600	
				Subtotal	**1.55**							

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2020

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost ($/ton) *	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
C: Residential Greening												
Require access to EV charging in existing multi-family buidlings	11	Ordinance	Sustainability/ Planning/ Building		0.5		5,942	$1.68	178,300	$21,000	$21,048	Ideas: 1) City resources could defray costs for projects at affordable housing developments, 2) Prohibit landlord from raising rent as a result by exempting this change from "significant renovation" definition in rent control laws. Copy Mountain View?
Achieve 100% permit compliance for heating and water heating appliances upon property sale	12	Ordinance	Sustainability/ Building		0.5		15,449	$0.32	772,500	$500	-$500	This action is needed to make a burnout ordinance enforcable. Build in a 1-year lag to give market time to adjust. Deferred date of implementation: Jan 1, 2021.
Explore legislation to require homebuyer notification re: sea level rise in flood areas	13	Collaboration			0.05		-	$0.00	-	$0	$0	
Require residents installing solar to also install conduit and circuits for heat pump water heater and EV charger	14	Ordinance			0		7,784	$0.00	653,900	$300	$2,338	This facilitates conversion to electric for emergency water heater burnouts
Update permits and fees to encourage electrification, including battery storage. Recommend to contractors and clients that they electrify all gas burnouts and that they heat pump all AC burnouts.	15	Directive			0		1,712	$0.00	41,100	-$200	$200	Develop recommended device type lists for building department display (and handouts)
				Subtotal	**1.05**							
D: VMT Reduction												
Explore options for VMT reduction and set a city goal	16	Ordinance	Transportation/ Planning		0.5		5,714	$0.88	228,500	-$20,000	$20,000	Consider adjusting zoning & land use regs to encourage mixed use, dense development near transit to reduce the number of cars and car trips due to commuting; reduce parking minimums for new development; rezone single-family to include multi-family; explore electric shuttle service between Belle Haven and Caltrain; expand network of multi-use paths; explore electric "last mile" options from transit to common destinations
Establish a Transportation Management Association (TMA)	17	Program			0.5		647	$15.45	9,700	$0	$0	Leverage small and large businesses for transit pass discounts, shuttle shares, discounts, etc.
Electrify city shuttle buses to transit, esp. on busy streets	18	Program			0.5		126	$49.67	2,000	$280,000	-$22,000	Possible e-bus vendors: Proterra (US), BYD (China)
Bike/Scooter Share Ordinance	19				0.5		286	$35.00	2,900	$0	$0	
Consider Copenhagen-style zoning oriented around 5-minute walking city approach	20	Ordinance			0.5		660	$5.05	39,600	$0	$4,557,940	
				Subtotal	**2.5**							
E: Zero Waste												
Adopt Foodware Ordinance to reduce/eliminate plastics and single use disposable foodware	21	Ordinance			0		136	$0.00	300	$2,000	-$2,000	San Mateo County has a model ordinance for compostable only and is willing to enforce on behalf of cities.
Apply single-use plastic prohibition to City operations	22	Directive			0		0	$0.00	-	$2,000	-$2,000	
Update solid waste ordinance to require recycling and composting services for all accounts	23	Ordinance			0		404	$0.00	8,100	$600	-$600	
Implement zero waste requirements for new development in the Bayfront area	24	Directive			0		168	$0.00	800	$25,000	-$25,000	

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2020

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost ($/ton) *	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
				Subtotal	**0**							
G: Adaptation Measures												
Monitor and participate in County preparations for sea level rise	25	Directive	Public Works		0.05		-	N/A	-	$100,000,000	-$100,000,000	Strongly recommend that Council request quarterly update from Public Works on City's plans and projected cost for addressing Sea Level Rise
Increase urban canopy in Belle Haven to protect against urban heat island effect	26	Directive	Public Works		0.05		7	$12,736	100	$12,000	-$912,000	
				Subtotal	**0.1**							
H: Public Education												
Launch CAP education campaign w/ churches, Rotary clubs and PTAs	27	Program	Public Engagement/ Sustainability		0.125		1,447	$1.73	28,900	$0	$0	Council members present to local groups
Create City web page featuring Climate Action Plan, building electrification	28	Program			0.125		579	$4.32	31,800	$0	$0	
Develop and publish electrification FAQ (copy an available version)	29	Program			0.125		579	$4.32	31,800	$0	$0	Post on a City web page for Climate Action Plan and give to elected officials to help them counter misinformation and answer questions from public
Speaker series on climate change and solutions	30	Program			0.125		96	$25.91	1,400	$0	$0	- Stanford professors: Mark Jacobson, sea level rise expert, VMT expert? - Berkeley professors: Dan Kammen, Bay sea level rise expert, levees and sea walls experts - Carbon-free aviation experts - Location: City hall
Invite “ride and drive” organizers to showcase EVs at every City public event	31	Program, Collaboration	Sustainability/ Public Engagement		0.125		1,223	$2.56	9,800	$200	-$200	Connect city to Acterra
Induction cooking demonstration party for realtors, kitchen designers, architects, home cooks	32	Program, Collaboration			0.125		24	$103.57	500	$0	$0	
Educate public on the merits of solar + batteries for resiliency during power outages	33	Program			0.125		644	$6.47	5,800	$0	$0	
Hire marketing firm for city-wide CAP campaign	34	Program	Communication/ Sustainability		0.125		3,859	$1.08	$11,600	$0	$0	Share aspirational CAP goals; Educate residents about what they can do; Share what will happen if we don't act; Digital campaign, newspaper articles, speakers, classes, radio PSAs, TV?, mailers, signs around town, billboard?, signs on buses, banners downtown
				Subtotal	**1**			Based on Future prices				
				Grand Total	**6.5**			Nat Gas	$ 2.00	Per Therm		
				Cost/ FTE	$100,000			Gasoline	$ 3.40	Per Gallon		
				Costs	$647,500	0		Electricity	$ 0.22	Per kWh		

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2021

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
A: Municipal Greening												
Require % of construction vehicles to be EV on municipal construction projects	35	Directive			carry over resources from 2020		76	-$512.90	1,500	$80,000	$244,000	
B: Commercial Greening												
Install highway exit signs for EV fast charging	36	Directive			carry over		159	$105.01	2,900	$8,000	-$8,000	Shows residents and commuters that EV Fast charging will help them go EV.
Consider other cities' ordinances requiring clean (EV) commercial fleets w/i city limits, e.g. FedEx, UPS	37	Ordinance	EQC		0.50		1,438	$4.97	40,300	$45,000	$150,000	Consider: Recology garbage trucks, package delivery, Uber, construction vehicles, USPS, etc.
Apply reach codes to commercial remodels	38	Ordinance			0.50		6,922	$2.41	124,600	$5,000	$5,550	Similar to ROB ordinance but captures opportunities before waiting for burnout after remodel
C: Residential Greening												
Set City goal of 100% new cars to be EV within 3 years	39				0.05		7,120	$0.18	113,900	$0	$0	Metrics
Require electrification of gas appliances and A/C upon burnout - residential	40	Ordinance			carry over		9,463	$1.06	236,600	$2,000	$1,956	Also require A/C be converted Heat Pump
Make sure reach codes apply fairly to ADUs, attached and detached	41	Ordinance					2,086	$0.00	4,200	$2,000	$2,748	Plugs gap noticed in other towns where garage is built new and then suddenly converted to ADU
Apply reach codes to residential remodels and additions	42	Ordinance	Sustainability/ Building		0.50		4,171	$4.00	137,700	$2,010	$1,155	
Explore removing exemptions from reach codes	43	Ordinance			carry over		2,773	$9.01	33,300	$0	$528	No gas stoves or fireplaces no gas heating in labs
Create program for assisting low income homes w/ electrification	44	Program			0.25		4,635	$1.80	152,900	$2,000	$1,165	Possibly funded by UUT rev or by collaboration w/ PCE, and Rebuilding Together teaching on a MP home
Adopt Marin limits on embodied carbon in construction and require materials that sequester carbon in residential construction (beyond state mandated GreenCode)	45	Ordinance			carry over		1,862	$5.37	37,200	$25	-$25	
Require electrification upon sale of property + complimentary rebate program	46	Ordinance			carry over		12,583	$0.79	188,700	$10,500	$50	Assumes 30% rebate
Consider extending EV wiring requirement to remodels and at resale	47	Ordinance			carry over		6,602	$1.51	132,000	$400	$44,362	
Consider leading regional effort to prohibit the sale of gas appliances w/i City limits	48	Ordinance			0.50		3,082	$1.62	339,000	$50	$2,060	Includes contracting, distributors & retail. Essentially no permits allowed for gas devices.
D: VMT Reduction												
Designate car-free and low emission vehicle zones or premium parking	49	Ordinance			0.50		1,266	$3.95	151,900	$50,000	$196,375	(1) Design the geographic zone and the restrictions, exemptions, and prices (2) Build public support through consultation and experimentation (3) Designate the use of congestion-charge revenue for investments that benefit the city (4) Invest in mobility alternatives using public transit, bicycles, and walking (5) Consider what related policies may be needed (e.g. reduce parking requirements for new developments).
Create safe thoroughfares for getting across town via protected multi-use paths	50	Directive			0.50		306	$8.18	73,400	$0	$15,000	

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2021

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
Explore micro mobility options for last-mile transportation to/from transit	51	Directive			0.50		475	$35.11	17,100	$0	$0	
E: Zero Waste												
Continue 2020 zero waste actions	52				0.00		709	$0.00	8,500	$0	$0	
F: Carbon Removal												
Research multiple options for achieving 10% carbon removal	53	Program			0.125		28,400	$25.44	113,600	$0	-$710,000	
Explore plan for reforestation with Peninsula Open Space Trust (POST) or other partner	54	Program, Collaboration					9,457	$16.32	37,800	$0	-$141,858	Research where state planted 9 million trees from Carbon Cap and Trade money allocation report
Arbor Day mass tree planting	55	Program			0.125		9,457	$10.00	37,800	$0	-$94,572	If every MP resident planted 10 trees per year for 10 years, we would sequester 10% of our annual GHG emissions
Consider having City fund a Recology biochar program, inc. City tree trimmings	56	Directive					9,457	$30.00	37,800	$0	-$283,716	Biochar sequesters carbon by turning dead trees and trimmings into charcoal that is then used as a healthy soil amendment
G: Adaptation Measures												
Propose building moratorium or developer-funded escrow to cover building decommisioning cost in areas to be flooded deeper than 1 foot within 30 years	57	Ordinance			0.50	$200,000		N/A	-	$0	$0	
H: Public Education												
Cooking class/demo with induction stove	58	Program, Collaboration			carry over			$22.19	9,000	$0	$0	
Class for City residents: Zero Out Your Carbon Emissions	59	Program			carry over		1,081	$23.12	8,600	$0	$0	Idea is to create a class for city residents (in the catalogue) that will show them how to reduce their carbon footprint. Intro: What are greenhouse gases and why are they warming our atmosphere? 1. How to calculate your carbon footprint 2. How to buy and drive an EV 3. How to install a heat pump and HPWH 4. How to choose and use an induction stove 5. How to install solar + batteries 6. How to choose low-carbon construction materials 7. How to create a Zero Waste home 8. How to repair your broken items, instead of throwing them out 9. How to buy carbon offsets and other sequestration options 10. How to use transit and "last mile" vehicles to get to transit 11. How to use ride share services

Grand Total	4.6	
Cost/ FTE	$100,000	
Costs	$455,000	$200,000.00

Based on Future prices

Nat Gas	$	2.00	Per Therm
Gasoline	$	3.40	Per Gallon
Electricity	$	0.22	Per kWh

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Moderate 3-yr Climate Action Plan - 2022

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
A: Municipal Greening												
Support Menlo Park school districts in transitioning to electric school buses (Not really municipal Greening since it's a separate school district)	60	Collaboration					127	$0.00	3,000	$1,600,000	-$310,000	Improves student health, reduces air pollution, reduces GHGs and could provide power during grid outages. Council members meet w/ superintendents; request vehicle-to-grid charging capability for powering schools during power shut-offs
B: Commercial Greening												
Explore Petaluma-style moratorium on 1) new gas stations and 2) expansion of existing ones or, as an alternative, limiting the permitted life of underground fuel storage tanks	61	Ordinance					159	$0.00	6,000	-$50,000	-$490,000	See Petaluma
Explore a NYC-style carbon emissions fee on buildings	62	Ordinance					2,596	$0.00	104,000	$10,500	$50	
Ban gas-powered lawn equipment	63	Ordinance					15	$0.00	-	$300	$7,292	Encourage county region and state to lead. Although this has tiny GHG savings it has large Nox and Sox pollutant savings
C: Residential Greening												
Announce an Arcata-style end date for the flow of natural gas in Menlo Park	64	Ordinance					86,465	$0.00	3,458,600	$11,250	-$5,777	Assumes higher inc cost than burn-out ordinance because replaced equipment still has useful life
Consider expanding fire inspection to include gas appliances	65	Ordinance					7,471	$0.00	149,400	$0	$0	
Consider Floor Area Ration (FAR) bonus for passive house building construction	66	Ordinance					-	N/A	-	$0	$0	Passive House design increases energy efficiency of homes, important as temps rise with climate change and grid is stressed by increased demand
Decrease subsidies (free parking) and privileges (the ability to pollute roads) for gas cars	67	Ordinance					476	$0.00	19,000	$30,000	$1,250,000	
Adopt ordinance prohibiting idling for vehicles with gas engines	68	Ordinance					286	$0.00	5,700	$0	$0	
Announce gradual plan to make public parking for EVs only: 20%, 40%, 60%, 80%, 100%	69	Ordinance					5,714	$0.00	160,000	$8,000	$81,524	
Increasingly restrict use of gas cars in city (not allowed on certain roads, parking lots)	70	Ordinance					5,714	$0.00	160,000	$8,000	$81,524	

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City of Menlo Park
Moderate 3-yr Climate Action Plan - 2022

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
Implement public safety rule on underground gasoline tanks	71	Ordinance					7,936	$0.00	317,400	$150,000	-$1,770,000	
D: VMT Reduction												
End subsidies for parking downtown for all vehicles	72	Ordinance					317	$0.00	12,700	$405,000	$10,545,000	
E: Zero Waste Initiatives												
Explore hyper management of fugitive methane emissions from landfill and composting facilities	73	Directive					2,250	$8.00	90,000	$180,000	-$180,000	Could create local offsets for 10%
Update construction and demolition ordinance	74	Directive					189	$0.00	2,300	$600	-$600	
Establish library of things to reduce waste, improve access and equity, and enhance community relations	75	Directive					50	$180.00	2,000	$90,000	$22,500	
Establish a grant program to convert privately owned drinking fountains to bottle filling stations	76	Directive					84	$0.00	1,700	$4,000	$21,000	

Grand Total		**0**	
Cost/ FTE	$100,000		
Costs	$ -		0

Based on Future prices			
Nat Gas	$	2.00	Per Therm
Gasoline	$	3.40	Per Gallon
Electricity	$	0.22	Per kWh

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

City of Menlo Park
Bold 1-yr Climate Action Plan - 2020

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
B: Commercial Greening												
Adopt Petaluma-style moratorium on 1) new gas stations and 2) expansion of existing ones	61	Ordinance					159	$0.00	6,000	-$50,000	-$490,000	See Petaluma
Prohibit use of gas vehicles for delivery (e.g. Amazon, FedEx, UPS)	77	Ordinance			0.5		1,438	$4.97	40,269	$45,000	$150,000	
Adopt Marin limits on embodied carbon in construction and require materials that sequester carbon in all commercial, residential and municipal construction	78	Ordinance	Sustainability/ Building		0.5		6,286	$0.80	377,000	$1,200	-$1,200	
C: Residential Greening												
Announce an Arcata-style end date for the flow of natural gas in Menlo Park	64	Ordinance					86,465	$0.00	3,459,000	$11,250	-$5,777	Assumes higher inc cost than burnout ordinance because replaced equipment still has useful life
Announce gradual plan to make public parking for EVs only: 20%, 40%, 60%, 80%, 100%	69	Ordinance					5,714	$0.00	160,000	$8,000	$81,524	
Increasingly restrict use of gas cars in city (not allowed on certain roads, parking lots)	70	Ordinance					5,714	$0.00	160,000	$8,000	$81,524	
Implement public safety rule on underground gasoline tanks	71	Ordinance					7,936	$0.00	317,000	$150,000	-$1,770,000	
Raise Nat Gas UUT to 3.5% (to fund electrification of low income households, municipal electrification program and other Council-directed GHG reductions)	6	Directive	Finance/ Sustainability		0.125		579	$2.16	35,000	$5,000	$473	First step is to increase UUT rate on natural gas. City Council then decides where to apply funds: electrification (+ batteries?) in 1) day cares, 2) municipal buildings, 3) schools, 4) low income residents' homes.
D: VMT Reduction												
Explore options for VMT reduction and set a city goal	16	Ordinance	Transportation / Planning		0.5		5,714	$0.88	228,500	-$20,000	$20,000	Consider adjusting zoning & land use regs to encourage mixed use, dense development near transit to reduce the number of cars and car trips due to commuting; reduce parking minimums for new development; rezone single-family to include multi-family; explore electric shuttle service between Belle Haven and Caltrain; expand network of multi-use paths; explore electric "last mile" options from transit to common destinations
Create safe thoroughfares for getting across town via protected multi-use paths	50	Directive			0.5		306	$8.18	73,400	$0	$15,000	
End subsidies for parking downtown for all vehicles	72	Ordinance					316	$0.00	12,700	$405,000	$10,545,000	
E: Zero Waste Initiatives												
Adopt Foodware Ordinance to reduce/eliminate plastics and single use disposable foodware	21	Ordinance			0		136	$0.00	300	$2,000	-$2,000	San Mateo County has a model ordinance for compostable only and is willing to enforce on behalf of cities.
Apply single-use plastic prohibition to City operations	22	Directive			0		0	$0.00	-	$2,000	-$2,000	

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City of Menlo Park
Bold 1-yr Climate Action Plan - 2020

Action	Action #	Type of Action	Lead Dept/ Supporting Dept	Community Engagement Req'd	FTEs Required (per yr)	3-yr Non-Staff Costs (consultants, studies)	2030 Ann. GHG Reduced (tons/yr)	City Cost * ($/ton)	2030 State-wide GHG Reductions Inspired by MP (tons/yr)	Upfront Incremental Cost to Participant** After Rebates	Net Savings to Participant**	Notes & Assumptions
Update solid waste ordinance to require recycling and composting services for all accounts	23	Ordinance			0		404	$0.00	8,100	$600	-$600	
Implement zero waste requirements for new development in the Bayfront area	24	Directive			0		168	$0.00	800	$25,000	-$25,000	
Explore hyper management of fugitive methane emissions from landfill and composting facilities	73	Directive					2,250	$8.00	90,000	$180,000	-$180,000	Could create local offsets for 10%
Update construction and demolition ordinance	74	Directive					189	$0.00	2,300	$600	-$600	
Establish library of things to reduce waste, improve access and equity, and enhance community relations	75	Directive					50	$180.00	2,000	$90,000	$22,500	Include: toys, kitchen appliances and tools
Establish a grant program to convert privately owned drinking fountains to bottle filling stations	76	Directive					84	$0.00	1,700	$4,000	$21,000	
F: Carbon Removal												
Research multiple options for achieving 10% carbon removal	53	Program			0.125		28,400	$25.44	113,600	$0	-$710,000	
G: Adaptation Measures												
Propose building moratorium or developer-funded escrow to cover building decommisioning cost in areas to be flooded deeper than 1 foot within 30 years	57	Ordinance			0.5	$200,000	-	N/A	-	$0	$0	
Monitor and participate in County preparations for sea level rise	25	Directive	Public Works		0.05		-	N/A	-	$100,000,000	-$100,000,000	Strongly recommend that Council request quarterly update from Public Works on City's plans and projected cost for addressing Sea Level Rise

Grand Total	2.8		
Cost/ FTE	$100,000		
Costs	$280,000	$	200,000

Based on Future prices			
Nat Gas	$	2.00	Per Therm
Gasoline	$	3.40	Per Gallon
Electricity	$	0.22	Per kWh

* City Cost = (staff cost + capital inv + operating savings or cost) / tons of CO2e saved. Negative number is good.
** Participant is emitter targetted by aciton, e.g. muni, business or resident

Model Assumptions

Captured below are key assumptions used throughout this model. Input cells are marked in yellow.

City Staff FTE Cost	$100,000	per year

Fossil Fuel Assumptions			
Type	**Units**	**GHG Emissions (CO2e lbs/unit)**	**2020 Future Price Projection ($/unit)**
Natural Gas	therms	11.7	$2.00
Gasoline	gallons	19.6	$3.40
Electricity	kWh		$0.22

Equipment Efficiency Assumptions	
Equipment Type	**Efficiency Ratio (BTUs out/BTUs in)**
Electric Heat Pump	3.5
Natural Gas Furnace	0.8

2017 City-Wide Annual GHG Emissions by Source*				
Buildling Source	**Natural Gas Emissions (tons/year)**	**Electricity Emissions (tons/year)**	**Building Emitter****	**Number of Building Emitters****
Municipal Buildings + Pools	865	-	The City	1
Commercial Buildings	53,414	23,467	Commercial Building Owners	700
Houses + Apartments	32,186	7,013	Homeowners + Landlords	14,000
Community Buildings Emissions	**86,465**	**30,481**	**All Buildling Owners**	**14,701**
Vehicle Source	**Gasoline & Diesel Emissions (tons/year)**		**Vehicle Emitter****	**Number of Vehicle Emitters****
Municipal Vehicles	496		The City	1

Commercial Vehicles	35,954	Business Owners with Fleets	3,000
Residential Vehicles	122,265	Households w/ Gas Vehicles	13,500
Community Vehicle Emissions	**158,715**	**All Vehicle Owners**	**16,501**
Waste Source	**Waste Emissions (tons/year)**	**Waste Emitter****	**Number of Waste Emitters****
Ox Mountain Landfill (active)	8,424	All Building Owners	14,701
Plastic Foodware		Restaurants	200
Marsh Road Landfill (retired)	5,000	The City	1
TOTALS			
Total City-Wide Emissions	**284,085**	**All Bulding Owners**	**14,701**
City-Wide Building & Vehicle Emissions (excl. Waste)	**275,661**	**All Vehicle Owners**	**16,501**

* Taken from December 2019 Sustainability Staff Report on Menlo Park Greenhouse Gas Inventory

** A target "emitter" is an entity that has decision-making authority over an emissions source and therefore may be a target "participant" in CAP policies and programs

From [GHG inventory summary 2005-2017t.xlsx]bucket'!

Building Emitter Qty Breakdown

Building Type	Number of Building Emitters**
Multi-Family Buildings	200
Multi-Family Units	2,000
Single Family Dwellings	12,000
Accessory Dwelling Units	100
Commercial + Multi-Family Buildings	900

Embodied GHG Emissions from Construction Activities in Community Buildings

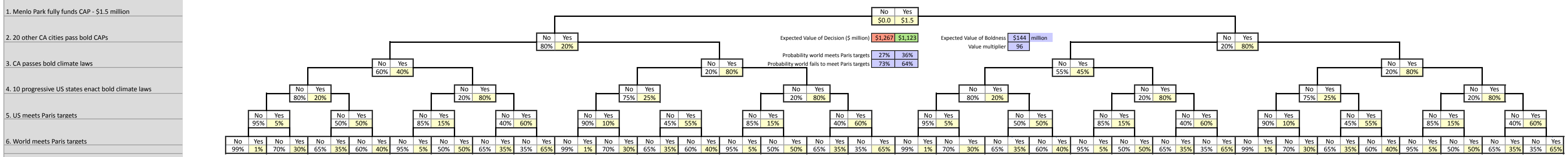
Building Type	Number of Building Owners	Avg. Sq. Footage per Building Owner	% of Building Owners Who Remodel or Build Each Year	Construction Volume (sq ft/year)	Embodied GHG Emissions in Construction Materials (CO2e lbs/sq ft)	Embodied Construction GHG Emissions (tons CO2e)	Number of Building Owners Who Build Each Year
Municipal Buildings + Pools	1	1,200,000	1%	12,000	100	600	0.01
Commercial Buildings	700	20,000	5%	700,000	100	35,000	35

Households	14,000	2,000	5%	1,400,000	60	42,000	700
TOTAL				**2,112,000**		**77,600**	**735**

ATTACHMENT D

Expected Value of Menlo Park Expenditures on Climate Action Plan + Related Adaptation Measures - 64 Scenarios and Probabilities

Question: What happens if Menlo Park does or does not fully fund ($500k/yr for 3 yrs) a bold climate action plan (CAP)?



Probability of this outcome		36%	0%	1%	1%	3%	2%	3%	2%	5%	0%	0%	0%	7%	4%	5%	10%
	Adaptation Costs ($ mil)																
3-foot Sea Walls req'd @ $100 million*	$100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6-foot Sea Walls req'd @ $300 million additional**	$300	x		x		x		x		x		x		x		x	
Abandon land between 101 and Bay @ $1.288 billion***	$1,288	x		x		x		x		x		x		x		x	
Adaptation costs ($ million)		$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100
Expected value of adaptation costs ($ million)		$610	$0	$23	$1	$53	$2	$49	$2	$87	$0	$8	$0	$112	$4	$91	$10
Scenario #		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Probability of this outcome	3%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	3%	2%	3%	5%
3-foot Sea Walls req'd @ $100 million*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6-foot Sea Walls req'd @ $300 million additional**	x		x		x		x		x		x		x		x	
Abandon land between 101 and Bay @ $1.288 billion***	x		x		x		x		x		x		x		x	
Adaptation costs ($ million)	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100
Expected value of adaptation costs ($ million)	$45	$0	$4	$0	$5	$0	$6	$0	$44	$0	$4	$0	$56	$2	$45	$5
Scenario #	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

Probability of this outcome	8%	0%	0%	0%	1%	0%	1%	0%	1%	0%	0%	0%	2%	1%	2%	3%
3-foot Sea Walls req'd @ $100 million*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6-foot Sea Walls req'd @ $300 million additional**	x		x		x		x		x		x		x		x	
Abandon land between 101 and Bay @ $1.288 billion***	x		x		x		x		x		x		x		x	
Adaptation costs ($ million)	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100
Expected value of adaptation costs ($ million)	$140	$0	$5	$0	$12	$0	$11	$0	$25	$0	$2	$0	$32	$1	$26	$3
Scenario #	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

Probability of this outcome	11%	0%	1%	0%	1%	1%	1%	1%	10%	1%	1%	1%	13%	7%	11%	20%
3-foot Sea Walls req'd @ $100 million*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6-foot Sea Walls req'd @ $300 million additional**	x		x		x		x		x		x		x		x	
Abandon land between 101 and Bay @ $1.288 billion***	x		x		x		x		x		x		x		x	
Adaptation costs ($ million)	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100	$1,688	$100
Expected value of adaptation costs ($ million)	$180	$0	$14	$0	$20	$1	$22	$1	$174	$1	$16	$1	$225	$7	$181	$20
Scenario #	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64

* Source: "Public Draft Feasibility Report, SAFER Bay Project Strategy to Advance Flood protection, Ecosystems and Recreation along San Francisco Bay East Palo Alto and Menlo Park (Task Order 1) October 2016," p. 37/49, http://www.sfcjpa.org/documents/SAFER_Bay_Public_Draft_Feasibility_Report_Summary_Oct._2016_.pdf

** Source: "Choosing a Future Shoreline for San Francisco Bay: Strategic Coastal Adaptation Insights from Cost Estimation," The Journal of Marine Science and Engineering, p. 12 shows that increasing levee height by 2x results in 4x increase in cost, https://www.researchgate.net/profile/Daniella_Hirschfeld/publication/320111123_Choosing_a_Future_Shoreline_for_the_San_Francisco_Bay_Strategic_Coastal_Adaptation_Insights_from_Cost_Estimation/links/5a947590aca2721405674b35/Choosing-a-Future-Shoreline-for-the-San-Francisco-Bay-Strategic-Coastal-Adaptation-Insights-from-Cost-Estimation.pdf?origin=publication_detail

*** Source: "County of San Mateo Sea Level Rise Vulnerability Assessment, March 2018," p. 139. https://seachangesmc.org/wp-content/uploads/2018/03/2018-03-12_SLR_VA_Report_2.2018_WEB_FINAL.pdf

City of
Carlsbad
California

Climate Action Plan

September 2015

City Council

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Table of Contents

List of Figures

List of Tables

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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 CAP has been prepared concurrently with the city's updated General Plan and includes actions to carry out the General Plan's goals and policies, consistent with the Community Vision articulated during Envision Carlsbad. The CAP is also correlated with the Environmental Impact Report (EIR) on the General Plan, with the CAP GHG reduction target synchronized with the EIR.

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

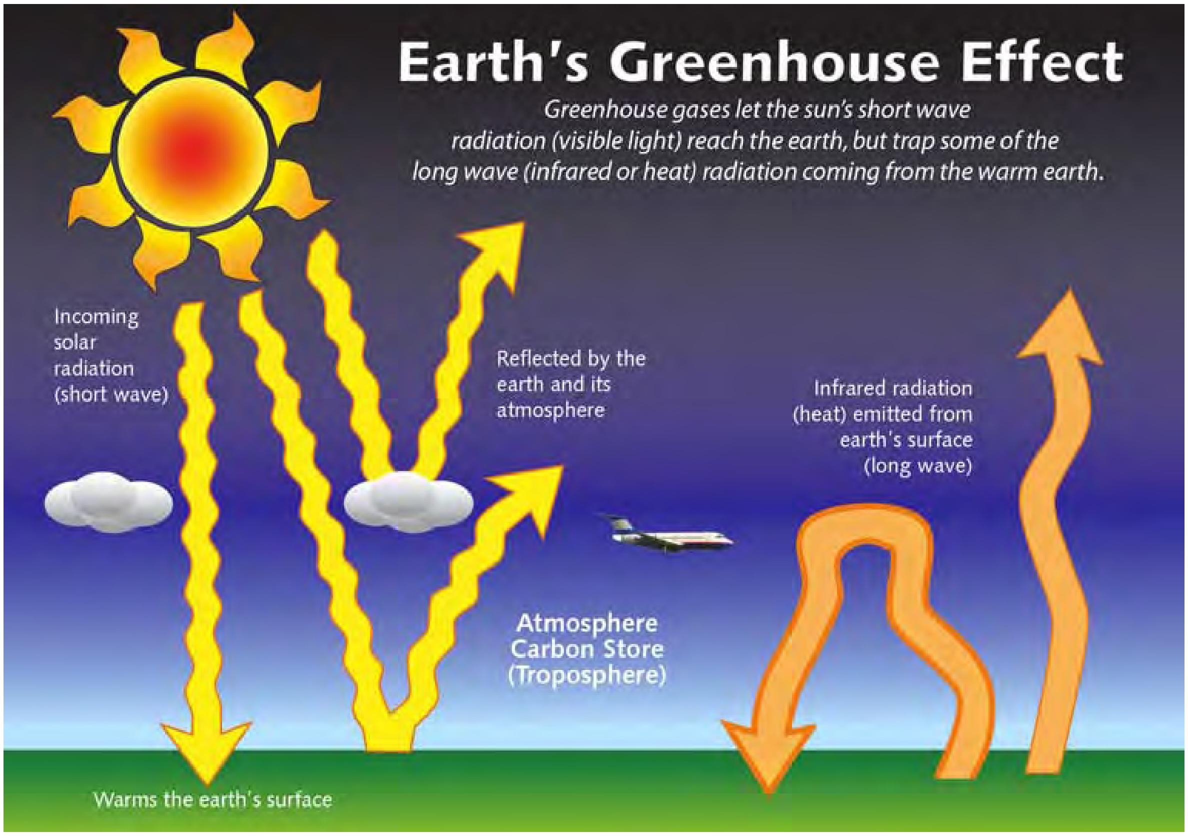
Greenhouse Effect and GHGs

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

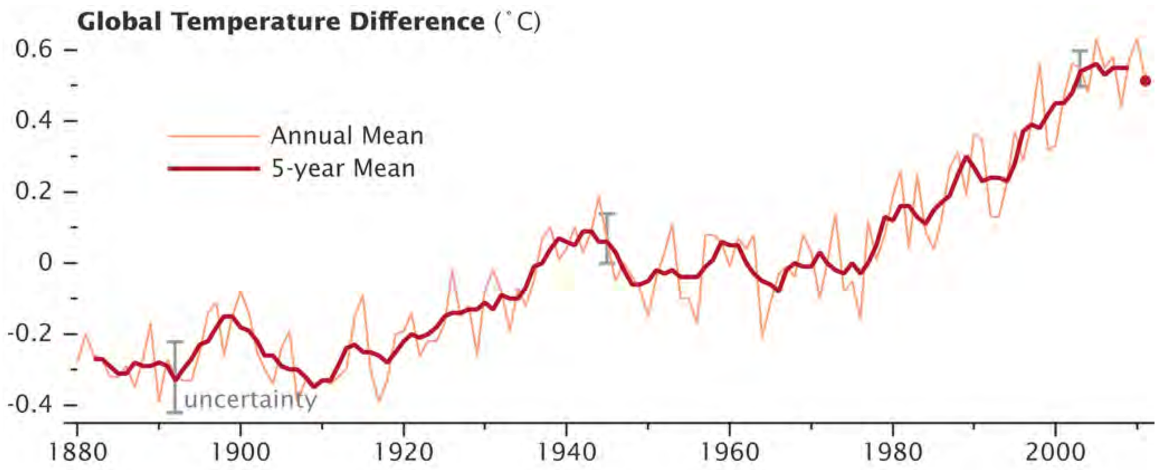
The global carbon cycle is complex and incorporates natural sources of atmospheric carbon dioxide, including respiration of aerobic organisms, wildfires, and volcanic outgassing, and sinks such the removal of CO_2 from by land plants for photosynthesis, and absorption by the ocean. Data collected on 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 399 ppm in early 2013.[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 2011. While average global temperatures fluctuate on a yearly basis, the general trend shows a long-term temperature increase. Nine 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 "Trends in Atmospheric Carbon Dioxide," http://www.esrl.noaa.gov/gmd/ccgg/trends/

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

Figure 1-2: Change in Average Global Temperatures



(Source: NASA Headquarters Release No. 12-020, http://www.nasa.gov/topics/earth/features/2011-temps.html)

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

According to the International Panel on Climate Change (IPCC) in North America, the regional impacts of climate change are a forecast of decreased snowpack in the western mountains, a 5 to 20 percent decrease in the yields of rain-fed agriculture in some regions,

[2] Caused by human activities

and increased frequency, intensity and duration of heat waves in cities that currently experience them.

In California, the Climate Action Team (CAT)—a group of state agency secretaries and the heads of agency, boards and departments, led by the Secretary of the California Environmental Protection Agency—synthesized current research on the environmental and economic impacts of climate change. The CAT found that climate changes are poised to affect virtually every sector of the state's economy and most ecosystems. Key findings of the CAT include predicted decreases in water supply that could cause revenue losses of up to $3 billion in the agricultural sector by 2050, increases in statewide electricity demand of up to 55 percent by the end of the century, increased wildfire risk that may cause monetary impacts of up to $2 billion by 2050, and ecosystems impacts affecting California's historic ranching culture and a source of local, grass-fed beef.

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 Plan

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 Scoping Plan in 2008, which provides 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. The Scoping Plan recommends that local governments target 2020 emissions at 15 percent below 2005 levels to account for emissions growth since 1990, as proxy for 1990 emissions, since few localities know those levels.

The Carlsbad CAP's GHG emission targets are based on meeting the goals set in EO S-3-05 and AB 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. The most recent CAFE GHG emissions standards were set in 2012, which will increase the fuel economy to 54.5 miles per gallon average for cars and light trucks by Model Year 2025, and reduce U.S. oil consumption by 12 billion barrels per year. The EPA also imposes the Gas Guzzler Tax on manufacturers of new cars that do not meet required fuel economy levels, to discourage the production and purchase of fuel-inefficient vehicles.

The EPA is taking further action to reduce GHG emissions in addition to setting fuel economy standards. The EPA established a renewable fuel standard to include a minimum volume of renewable fuel in 2013, which applies to all gasoline and diesel produced or imported. On September 20, 2013, the EPA proposed the first national limits on the amount of carbon pollution that new power plants will be allowed to emit. The EPA will propose standards for existing power plants by June 1, 2014. The EPA also approved oil and natural gas air pollution standards in 2013 to reduce pollution from the oil and natural gas industry.

[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)

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.

CARB's targets for San Diego County call for the region to reduce per capita emissions 7 percent by 2020 and 13 percent by 2035 based on a 2005 baseline. There are no mandated targets beyond 2035. San Diego Association of Governments (SANDAG), the San Diego County MPO, adopted its current RTP/SCS in October 2011. The SCS lays out how the region will meet the CARB GHG targets to the year 2035. As the SCS is focused on passenger vehicle emissions on a regional scale, it is considered separate from the reductions outlined in this CAP.

Senate Bill 1368

SB 1368 creates GHG emissions performance standards for baseload generation[4] from investor-owned utilities. The bill requires that any long-term financial investment in baseload generation resources made on behalf of California customers must meet a performance standard of producing below 1,000 lbs CO_2 per MWh (megawatt-hour), approximately equal to a combined-cycle natural gas plant.

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, 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.

[4] Baseload generation is the minimum amount of power that a utility must make available to customers to meet minimum demands based on customer usage.

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 2013 and became effective in 2014. CALGreen contains voluntary Tier 1 and Tier 2 levels, which are designed to exceed energy efficiency and other standards by 15 percent or 30 percent.

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 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.[5] 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 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,

[5] 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."

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 of 2005 communitywide GHG emissions, including emissions from government operations, in 2008. As part of the Climate Action Plan (CAP) preparation effort, this inventory was updated to 2011 to provide a more current measure of emissions, and is summarized in this chapter. Appendix B provides the 2005 inventory and 2011 update in detail, which is summarized in Section 2.2 in this chapter.

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 inventory covers all direct GHG emissions[6] 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 community inventory tallies emissions from six sectors:

- Residential;
- Commercial;
- Industrial;
- Transportation;
- Solid waste; and
- Wastewater.

[6] 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.

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

ICLEI's CACP[7] model is used to estimate emissions from residential, commercial, and industrial consumption of energy and solid waste disposal. The California Air Resource Board's (CARB's) EMFAC[8] models were used to calculate transportation emissions, and other sources were used for solid waste and wastewater sectors.

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. The following section describes the inputs for the community inventory based on activity data (or usage).

Certain emissions that occur in the city are not counted in the community inventory. For example, during the community workshop on the CAP some participants questioned why 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

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[7] Clean Air and Climate Protection (CACP) is a model developed by ICLEI to inventory and forecast GHG emissions. The 2011 update utilized the CACP 2009 Version 3.0 software.

[8] The Emissions Factors (EMFAC) model was developed by CARB to measure various emissions from vehicles. There are multiple versions of EMFAC which focus on different vehicle types.

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. Similarly, for water consumed in Carlsbad, emissions associated with its transport from Northern California and Colorado are counted in Carlsbad's inventory, rather than elsewhere.

The Carlsbad Desalination Plant, which will begin operations in 2016, would therefore not contribute emissions to the 2011 GHG inventory. The emissions forecast (Chapter 3) uses a regional average for water consumption emissions, which accounts for the effect of the desalination plant. In general, including these large regional facilities would effectively add GHGs from consumption of services outside of Carlsbad to the city's emission totals.

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.[9] 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 Community Inventory

Residential, Commercial, and Industrial (RCI) Electricity and Natural Gas Usage

The inputs for the CACP model for the residential, commercial and industrial (RCI) sectors are electricity and natural gas consumed. Table 2-1 shows RCI electricity and natural gas consumption, and the total citywide consumption of electricity and natural gas. The commercial sector has the largest electric consumption followed by residential and industrial. The greatest natural gas consumption is from the residential sector, used for heating homes and water, followed by commercial and industrial sectors.

[9] 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 2-1: RESIDENTIAL, COMMERCIAL AND INDUSTRIAL (RCI) INPUTS; 2011		
		Inputs
Residential	Electric (kWh)	275,033,189
	Natural Gas (therms)	15,769,481
Commercial	Electric (kWh)	411,249,580
	Natural Gas (therms)	7,844,336
Industrial	Electric (kWh)	116,341,521
	Natural Gas (therms)	1,536,470
Total by Source		
Electricity (kWh)		802,624,290
Natural Gas (therms)		23,613,817

Source: SDG&E, 2013

Differing emissions based on the source of electricity, either bundled or direct access electricity, were taken into account. Bundled electricity is produced for SDG&E and transmitted by SDG&E. Direct access electricity is produced elsewhere in the region but ultimately transmitted to the consumer by SDG&E. Natural gas produces CO_2e regardless of source.

Transportation

Transportation emissions are based on vehicle miles traveled (VMT) for vehicles and off-road equipment. GIS-based 2011 VMT data from SANDAG for all roadways was used. All roadways including the zone connectors were used. The SANDAG data is reported as daily weekday VMT. This was converted to annual VMT by multiplying it by 347, as recommended by CARB.[10] The total annual VMT in 2011 was 510,973,969 vehicle miles traveled.

CARB's latest model, EMFAC2011, is made up of three modules: -SG, -LDV, and –HD. The SG module covers all vehicle types, while LDV calculates light duty vehicles and HD calculates heavy duty vehicles. Appendix B provides a more detailed explanation of how CO_2e were calculated using each module. As inputs, emissions from local roadway VMT and freeway VMT were determined separately.

Off-road emissions in Carlsbad include lawn and garden equipment, construction equipment, industrial equipment, and light commercial equipment. While CARB's OFFROAD2007 model generates emission outputs for 16 categories across San Diego County, only the off-road emissions listed above are included, as they generate the most emissions in Carlsbad in this category. The CO_2, N_2O, and CH_4 emissions were calculated in short tons per day for the county. These emissions were then pro-rated by the city's share of the county population, multiplied by 365 days, and converted to metric tons.

[10] CARB recommends that 347 be used instead of 365 to convert from average daily VMT to annual VMT to account for less travel on weekends.

Solid Waste

The default values in the CACP were used for solid waste emissions. For methane emissions from the one landfill in the city limits—the closed Palomar Airport Landfill—the same data from the 2005 community inventory was used, as it was unlikely to have changed substantially, if at all.[11]

For emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, 2011 data for Carlsbad was obtained from CalRecycle. The composition of waste was estimated from the latest such survey, the 2008 CalRecycle Statewide Waste Characterization Study, which has averages for the southern region of California. The amount of average daily cover, which is made of plant debris, was also entered.

Wastewater Treatment

Emissions from methane and nitrous oxide generated in the process of wastewater treatment were determined using the University of San Diego's EPIC (Energy Policy Initiatives Center) model. The EPIC estimate of GHG emissions from countywide wastewater treatment was used and pro-rated to Carlsbad's share of the county population.

Total Community Emissions

The total community GHG emissions were 705,744 $MTCO_2e$ in 2011. Table 2-2 summarizes the sources and quantities of community emissions, and Figure 2-1 shows the emissions graphically by sector. The largest sector is transportation, at 39 percent, followed by commercial and industrial (32 percent), residential (25 percent), solid waste (3 percent) and wastewater (1 percent).

[11] In November 2014, city staff contacted the County of San Diego Public Works Department in response to a comment on the draft CAP. County staff reported that for 2011, it calculated GHG emissions from Palomar landfill at 6,703 $MTCO_2e$. Although it is unknown why the reported figure is higher than the assumed figure for the city's GHG inventory update, County staff did note that their GHG calculation methodology had changed in 2010. The difference in the County's calculations of GHG emissions from Palomar landfill does not have a material effect on the assumptions, conclusions, or recommendations of this CAP.

Figure 2-1: 2011 Community GHG Emissions by Sector ($MTCO_2e$)

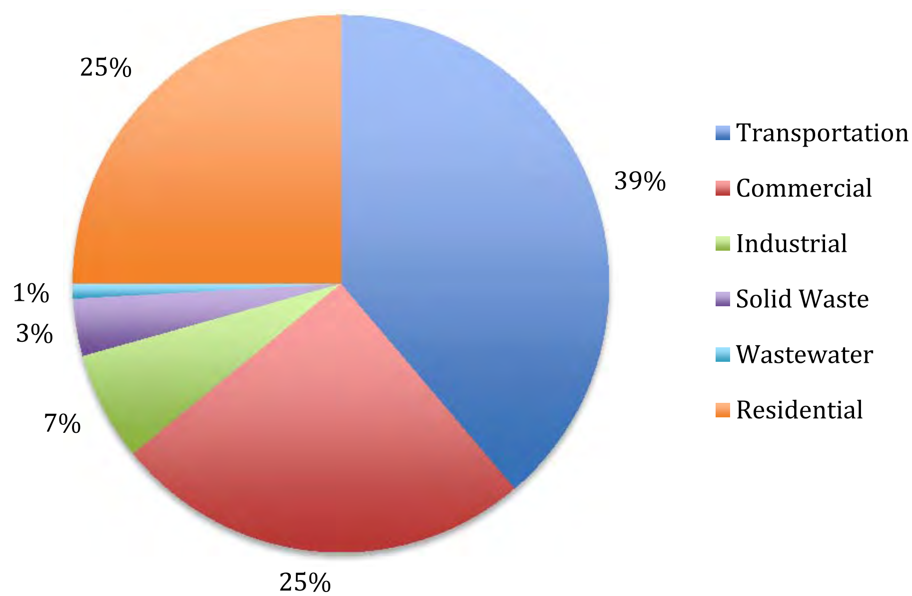
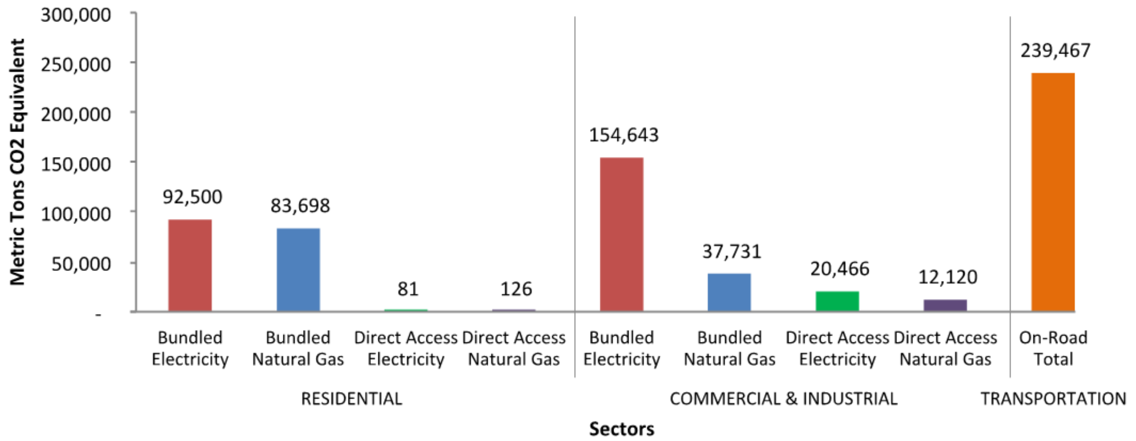


TABLE 2-2: 2011 COMMUNITY GHG EMISSIONS (MTCO$_2$E)		
Sector	**Subsector**	**Emissions**
	Bundled Electricity	92,500
	Bundled Natural Gas	83,698
	Direct Access Electricity	81
	Direct Access Natural Gas	126
Residential	**Total Residential**	**176,405**
	Bundled Electricity	125,314
	Bundled Natural Gas	37,731
	Direct Access Electricity	11,701
	Direct Access Natural Gas	3,966
Commercial	**Total Commercial**	**178,712**
	Bundled Electricity	29,329
	Bundled Natural Gas	-
	Direct Access Electricity	8,765
	Direct Access Natural Gas	8,154
Industrial	**Total Industrial**	**46,248**
	On-Road Total	*239,467*
	Lawn and Garden Equipment	2,449
	Construction Equipment	23,830
	Industrial Equipment	4,943
	Light Commercial Equipment	3,056
	Off-Road Subtotal	*34,279*
Transportation	**Total Transportation**	**273,745**
	Community-generated solid waste	21,719
	Landfill Waste-in-Place	2,598
Solid Waste	**Total Solid Waste**	**24,317**
Wastewater	**Total Community-generated Wastewater**	**6,317**
GRAND TOTAL		**705,744**

Figure 2-2 shows the emission by source for the three largest sectors: residential, commercial and industrial, and transportation. The largest individual sources are on-road transportation, bundled commercial and industrial electricity, and bundled residential electricity.

Figure 2-2: 2011 Community GHG Emissions by Source for Three Largest Sectors ($MTCO_2e$)



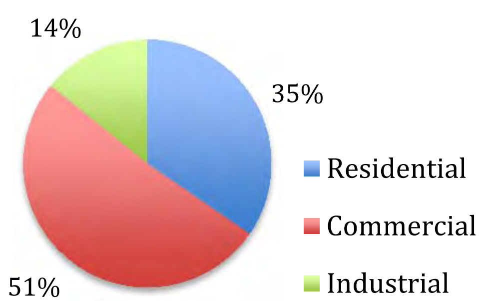
Emissions By Source

Electricity

Electricity emissions account for 38 percent of the total emissions. Table 2-3 and Figure 2-3 show electricity use by sector—commercial sector consumes more than half of all electricity in Carlsbad, followed by residential sector, which accounts for just over a third of total electricity use.

TABLE 2-3: ELECTRICITY EMISSIONS BY SECTOR ($MTCO_2e$)	
Sector	**2011 Emissions**
Residential	92,581
Commercial	137,015
Industrial	38,093

Figure 2-3: Electricity Emissions by Sector



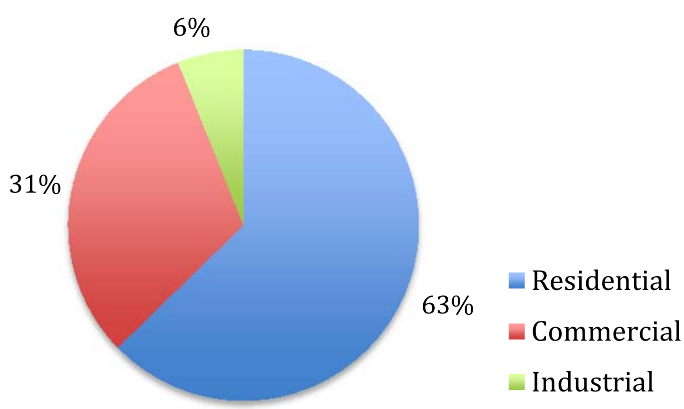
Natural Gas

Natural gas use accounts for 19 percent of total emissions in Carlsbad. The residential sector accounts for 63 percent of natural gas use, while the commercial sector accounts for 31 percent. Table 2-4 and Figure 2-4 show natural gas use emissions by sector.

TABLE 2-4: NATURAL GAS EMISSIONS BY SECTOR ($MTCO_2e$)

Sector	2011 Emissions
Residential	83,824
Commercial	41,697
Industrial	8,154

Figure 2-4: Natural Gas Emissions by Sector



Change Between 2005 and 2011 Community Emissions

Total community emissions in 2005 were 630,310 $MTCO_2e$ compared with 705,744 in 2011. The increase in total GHG emissions of 12 percent in the period parallels the population and jobs increase, as well as the service population increase (the number of residents plus number of jobs). While total GHG emissions have increased, emissions per service population (population plus workers) have held steady since 2005. Table 2-5 summarizes these changes.

TABLE 2-5: POPULATION AND JOBS, 2005 AND 2011

	2005	2011	% Change
Carlsbad Population[a, b]	94,961	106,403	12.0%
Carlsbad - # of Jobs[c]	59,309	66,417	12.0%
Carlsbad – Service Population[d]	154,270	172,820	12.0%
GHG Emissions ($MTCO_2e$)	630,310	705,744	12.0%
Emissions per Service Population	4.09	4.08	-0.1%

a. 2011 population from the California Department of Finance, Table E-5.

b. The 2005 Inventory used different populations for the community and local government analyses. This is the population used for the community inventory.

c. Numbers from SANDAG.

d. The service population is the total number of residents plus workers

Table 2-6 shows the source of growth in emissions. The largest increase in emissions came from commercial electricity usage (37% of increase), followed by residential electricity usage (29%). All other emissions increased at a slower pace than the rate of population growth, with emissions from residential natural gas consumption increasing by 9 percent, and all other sources increasing by 5 percent, or decreasing, in the case of roadway emissions.

For electricity, the increase was largely caused by the increase (35%) in the CO_2 generated by SDG&E electricity since 2005. For example, residential electricity consumption increased by 10 percent but emissions from that source increased by 29 percent. Commercial electricity consumption went up by 8 percent while related emissions increased by 37 percent—an even higher increase as some commercial customers in the greater San Diego region switched from cleaner direct access electricity to sources producing more CO_2.

TABLE 2-6: SOURCES OF GROWTH IN GHG EMISSIONS (METRIC TONS CO2E)

Source	2005 CO2e	2011 CO2e	Growth	% of Growth
Commercial-Electric	98,352	137,015	38,663	37%
Residential-Electric	62,290	92,581	30,291	29%
Residential-NG	74,137	83,824	9,688	9%
Roads	260,467	239,467	-21,000	-8%
Industrial-Electric	32,417	38,093	5,676	5%
Commercial-NG	36,259	41,697	5,438	5%
Off Road	28,963	34,279	5,315	5%
Industrial-NG	3,013	8,154	5,141	5%
Wastewater	4,397	6,317	1,920	2%
Solid Waste	30,015	24,317	-5,698	-5%
TOTAL	**630,310**	**705,744**	**75,434**	

Table 2-7 shows the sources of emissions, ordered by volume of overall contribution. The largest contributor continues to be transportation, but that has declined in proportion as emissions from building energy consumption have grown faster. These sources—roadway VMT, off-road vehicles, and private electricity and natural gas consumption—account for 96 percent of Carlsbad's communitywide GHG emissions.

TABLE 2-7: GREENHOUSE GAS EMISSIONS SUMMARY BY SECTOR (METRIC TONS CO2E)

Sector	2005	% of Total	2011	% of Total
Transportation	289,431	46%	273,745	39%
Commercial / Industrial	170,041	27%	224,960	32%
Residential	136,427	22%	176,405	25%
Solid Waste	30,015	5%	24,317	3%
Wastewater	4,397	1%	6,317	1%
TOTAL	**630,310**		**705,744**	

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 2-8: 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	-

TABLE 2-8: BUILDINGS AND FACILITIES INPUTS; 2011			
Department	**Building**	**Electricity (kWh)**	**Natural gas (therms)**
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
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 2-9: 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 2-10: 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 2-11: 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 2-12: 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 2-13: 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 Government Operations to Citywide Emissions

Table 2-14 shows a comparison of the government operations to citywide emissions. Government operations account for a very small portion of GHG emissions in 2011, comprising about 1.2 percent of emissions.

TABLE 2-14: GOVERNMENT OPERATIONS EMISSIONS VS COMMUNITY EMISSIONS ($MTCO_2e$)	
	2011
Government operations emissions	8,205
Community emissions	705,744
Government operations as proportion of community emissions	1.2%

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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

Governor's Executive Order S-3-05 and the Global Warming Solutions Act of 2006

Executive Order S-3-05 (EO S-3-05) and the California Global Warming Solutions Act of 2006 (AB 32) provide the basis for the CAP's GHG emissions targets. EO S-3-05 commits California to reduce its GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. AB 32 codifies the 2020 target and tasks CARB with developing a plan to achieve this target.

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 recommends that local governments target 2020 emissions at 15 percent below 2005 levels to account for emissions growth since 1990, as proxy for 1990 emissions, since few localities know those levels.

Total Carlsbad GHG emissions from the 2005 inventory were 630,310 metric tons carbon dioxide equivalents ($MTCO_2e$) per year. Therefore, the 2020 target under State guidance is a 15 percent reduction from 2005 emissions, which corresponds to a target of 535,763 $MTCO_2e$.

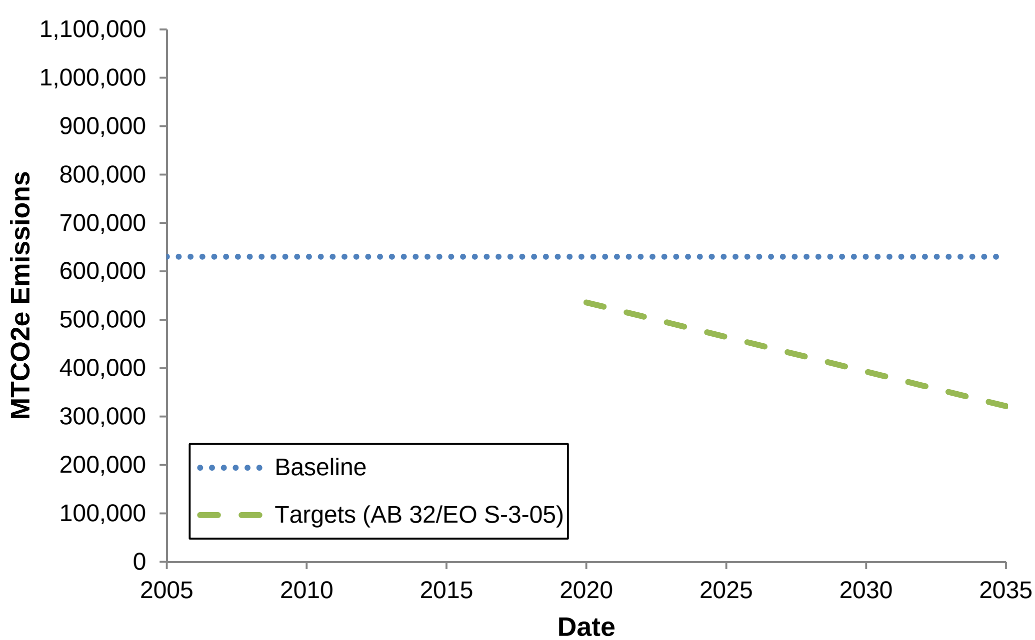
The long range 2050 target set by EO S-3-05 is an 80 percent reduction from 2020 emissions target, which represents the level scientists believe is necessary to stabilize the climate. The 2050 target for Carlsbad is citywide emissions of 107,153 $MTCO_2e$. This is a substantial decrease in overall emissions, over 500,000 $MTCO_2e$ below baseline 2005 emissions levels. While CARB's Scoping Plan does not specifically set target levels for intermediate years between 2020 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 Draft General Plan horizon. The CAP uses a linear trajectory in emissions reductions between 2020 and 2050 to determine the 2035, target. Table 3-1 summarizes these emissions targets and the percentage reduction from 2005 emissions. Figure 3-1 graphs the emissions targets, following a linear trajectory, from 2020 to 2035. As can be seen, the baseline exceeds the 2020 reduction target by 15 percent, and the 2035 target by 49 percent.

TABLE 3-1: 2005 EMISSIONS AND EMISSIONS TARGETS

Year	GHG Emissions and Targets	Reduction From 2005 Baseline
2005	630,310 $MTCO_2e$	N/A
2020	535,763 $MTCO_2e$	15 percent
2035	321,458 $MTCO_2e$	49 percent

Figure 3-1: 2005 Emissions and Emissions Targets

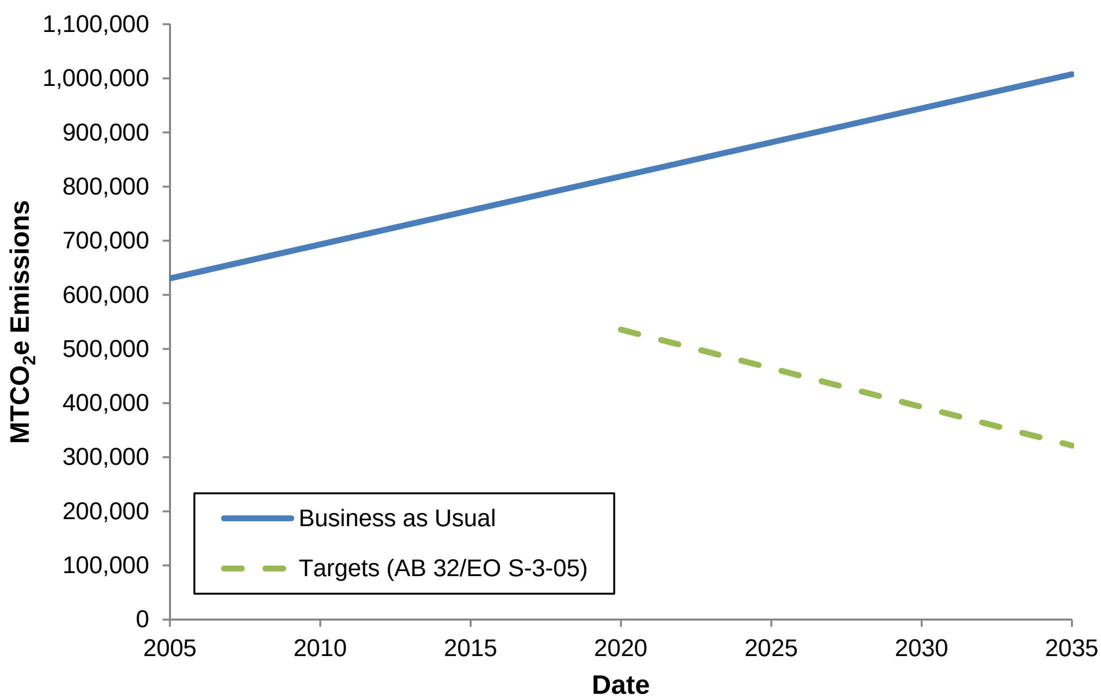


3.2 Business as Usual Forecast

The business as usual (BAU) forecast estimates emissions through the year 2035, based on the growth in emissions from the 2005 to 2011 citywide inventory. The increase in community emissions from 2005 to 2011 was linearly projected outward to the year 2035. The BAU forecast simply assumes that emissions will increase in the future at the same growth rate that occurred between the 2005 and 2011 citywide inventories. Thus, BAU emissions are forecast to reach 1,007,473 $MTCO_2e$ in the year 2035.

Figure 3-2 shows the difference between emissions under the business as usual forecast and the 2020 and 2035 emissions targets.

Figure 3-2: Business as Usual Forecast and Emissions Targets



3.3 Community Forecast with General Plan Land Use and Circulation System

Methodology

The Statewide Energy Efficiency Collaborative model (SEEC) is used to predict community GHG emissions across all sectors to 2035. A product of the collaborative, this tool is based on the International Council for Environmental Initiatives' (ICLEI's) Clean Air and Climate Protection (CACP) model used to estimate the 2005 and 2011 emissions inventories. The primary reason for using SEEC rather than CACP is that SEEC includes the effects of the Renewable Portfolio Standard (RPS) and Pavley I Fuel Economy Standards, whereas CACP requires manual adjustment to account for the state-mandated electrical production and fuel efficiency improvements. Section 3.4 quantifies other state and federal actions that reduce GHG emissions and incorporates these actions into the forecast.

The SEEC community forecast predicts all direct GHG emissions[12] from sources within the boundaries of the City of Carlsbad, including fuel combusted in the community[13] and direct emissions from landfills within the community. Indirect emissions associated with the consumption of energy that is generated outside the borders of the city are also included. Other indirect or embodied emissions are not covered in the forecast, in accordance with ICLEI standards. The SEEC community forecast tallies emissions from seven sectors:

- Residential
- Commercial
- Industrial
- Transportation
- Solid Waste
- Landfills[14]
- Wastewater

The emissions projected in the SEEC community forecast use the activity data (or usage) from the 2005 community inventory as an initial value, and the 2011 inventory to provide an intermediate value to adjust the model. The predicted growth in each sector is then added into the model to project future emissions. The following section describes how the predicted growth in each section was determined.

[12] 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.

[13] This does not include the Encina Power Station, for reasons described in Chapter 2.

[14] The 2011 inventory considered landfill emissions as part of solid waste. The SEEC model separates out landfills from solid waste as an emissions source, so the separation has been preserved in this chapter.

Inputs

Residential

Emissions from the residential sector are from electricity and natural gas demand. The growth in residential electricity and natural gas consumption was assumed to scale with population growth, estimated at 0.9 percent per year thorough 2035, based on General Plan buildout estimates.

Commercial

The increase in commercial demand for electricity and natural gas was assumed to scale with the General Plan employment forecasts to 2035 in the commercial sector by land use category: commercial, hotel, office, and other, including construction and transportation-related employment. For 2010 to 2035, an annual growth of 1.1 percent was used.

Industrial

The growth rate in industrial electricity and natural gas demand was based on General Plan employment forecasts to 2035 in the industrial sector. An annual growth rate of 0.8 percent was used through 2035.

Transportation—With General Plan Land Use and Circulation System

Transportation emissions are based on the emissions associated with VMT. The VMT projections were taken from SANDAG GIS models of regional VMT projections clipped to the city boundaries and adjusted to remove through trips, or trips that did not originate nor end within city boundaries.[15] The SANDAG data was reported as daily weekday VMT. This was converted to annual VMT by multiplying it by 347, as recommended by CARB.[16]

The VMT forecasts incorporate GHG reductions from General Plan land use projections and new roadway construction thorough 2035. These VMT forecasts reflect the General Plan land use patterns, include the effects of compact and infill, mixed-use, and transit-oriented development, and the protection of open space. New roadway construction includes the effects of street extensions and citywide traffic signalization. The land use projections and new roadway construction are described in detail in the General Plan.

The SEEC model automatically incorporates the effect of Pavley I Fuel Economy Standards. Table 3-2 shows the citywide VMT for 2011 and projected VMT forecast, used to estimate transportation emissions.

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[15] Excluding through trips removes much of the regional traffic through the Interstate 5 Freeway.

[16] 347 was used instead of 365 to average out the effect of a dip in traffic during the weekend.

TABLE 3-2: 2011 VMT AND PROJECTED 2020 AND 2035 VMT[17]

Year	Vehicle Miles Traveled
2011	510,973,969
2020	560,972,562
2035	651,739,086

Solid Waste

Waste emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, was assumed to scale with population growth at 0.9 percent per year through 2035.

Landfill

Emissions from the landfill sector are an estimate of methane generation from the anaerobic decomposition of all organic waste sent to a landfill. Within city boundaries, landfill emissions are comprised of leaking methane from the closed Palomar Airport Landfill. Currently, most of the methane generated at this capped landfill is captured. The EPA estimates 95 percent methane capture rate for capped landfills and estimates that emissions follow a first-order exponential decay. Therefore, baseline landfill emissions were estimated to decrease exponentially over time, at a decay rate of 5 percent over 10 years to 2035, the largest allowed percentage decrease in the model.

Wastewater

The Carlsbad Municipal Water District's 2010 Urban Water Management Plan (UWMP) was used to determine the growth in emissions from wastewater treatment.[18] The demand for wastewater treatment was assumed to scale with projected 2035 water deliveries listed in the UWMP. The UWMP includes the effect of conservation policies. Table 3-3 shows water deliveries and annual growth rates used in the forecast.

[17] VMT includes the effect of an additional 327 units above the growth cap in the Northwest Quadrant by 2035, as shown in the 2014 Draft General Plan. While the City Council will adjust housing sites or densities at adoption time so that the development cap is not breached, the inclusion of these units in the CAP represents a conservative estimate that leads to a slightly higher VMT (and corresponding GHG emissions) above levels anticipated under General Plan that would be adopted.

[18] Carlsbad Municipal Water District serves the majority of the city, with the exception of the southeast corner of the City, which is served by Olivenhain Municipal Water District, and Vallecitos Water District. The changes in water demand from the UWMP were assumed to be representative of the city as a whole for the purposes of the SEEC model.

TABLE 3-3: PROJECTED UWMP WATER DELIVERY, USED TO DETERMINE WASTEWATER EMISSIONS		
Year	Water Delivery (acre-feet per year, all sectors)	Annual Percentage Growth
2005	19,759	-
2010	15,076	-5.3%
2020	20,529	3.1%
2030	21,147	0.3%
2035	22,122	0.9%

Source: 2010 Carlsbad Municipal Urban Water Management Plan

Results

Table 3-4 shows the emissions from the SEEC community forecast for each sector—residential, commercial, industrial, transportation, solid waste, landfill, and wastewater—and the sum total community emissions. The forecast includes the reduction from RPS and Pavley I Fuel Economy Standards, which are quantified separately in Section 3.5, below. The forecast also includes the effect of the General Plan land use and circulation system on transportation emissions (compact, infill, mixed-use, and transit-oriented development, open space protection, new traffic signals and roadway extensions). The Carlsbad General Plan EIR quantifies the reduction in VMT due to the proposed General Plan in comparison to higher VMT under the existing General Plan (the No Project alternative).

The greatest projected emissions continue to be from the transportation sector, which accounts for 41 percent of emissions in 2020 and 36 percent of emissions in 2035. Residential emissions are the next largest sector, with 26 percent of emissions in 2020 and 28 percent of the total in 2035. Commercial, industrial, and solid waste, wastewater, and landfill emissions are the next largest sectors in order of total emissions.

TABLE 3-4: COMMUNITY FORECAST EMISSIONS BY SECTOR, 2011, 2020, AND 2035 ($MTCO_2e$)			
Sector	**2011**	**2020**	**2035**
Residential	176,405	145,419	163,881
Commercial	178,712	126,431	148,978
Industrial	46,248	31,278	35,249
Transportation	273,745	234,113	210,568
Solid Waste	21,719	23,073	26,002
Landfill	2,598	1,204	558
Wastewater	6,317	4,355	4,601
TOTAL	**705,744**	**565,873**	**589,837**

Figure 3-3: Comparison of Emissions by Sector in 2011, 2020 and 2035

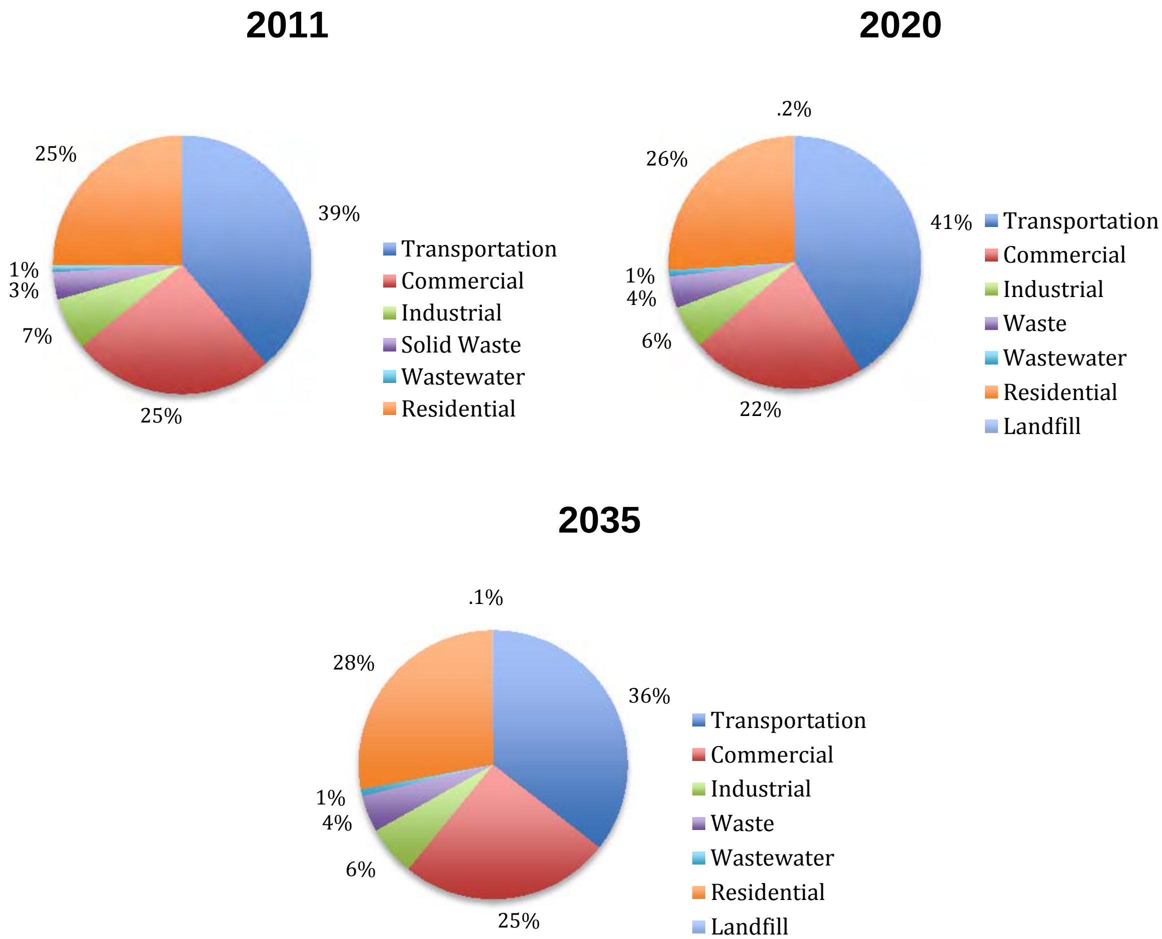
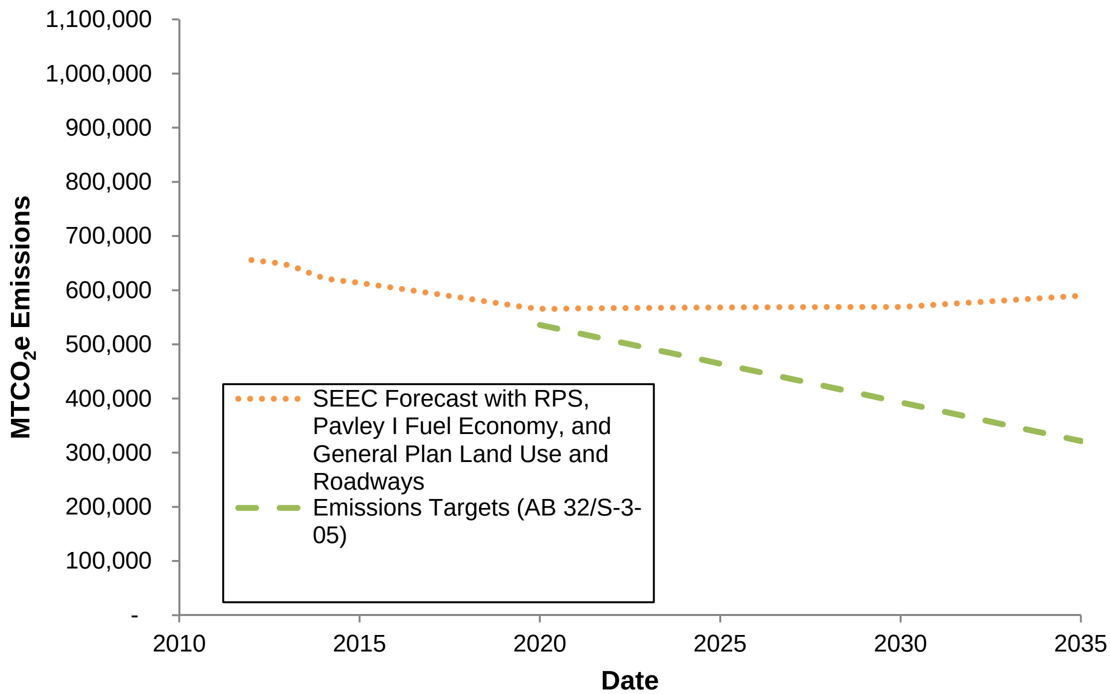


Figure 3-4 shows the change in SEEC-modeled community forecast emissions over time. Total emissions are projected to decrease from 705,744 $MTCO_2e$ in 2011 to 565,873 $MTCO_2e$ in 2020 (a decrease of 20 percent). The initial drop in emissions is mostly caused by the implementation of the RPS, which causes a decrease in residential, commercial, and industrial emissions, and Pavley I Fuel Economy Standards, which decrease transportation emissions. Over time, the decreases in emissions from an increased amount of renewable power usage and fuel efficiency improvements are canceled out by population growth, which cause emissions to increase from 2020 values to 589,873 $MTCO_2e$ in 2035 (an increase of 4 percent).

In 2020, the total emissions of 565,873 are about 30,000 $MTCO_2e$ above the AB 32 target emissions. The following section quantifies GHG reductions from State and Federal actions and applies them to the emissions forecast.

Figure 3-4: Community Forecast with RPS, Pavley I Fuel Economy Standards, and General Plan Land Use and Roadways



3.4 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**

3.5 GHG Reductions to Community Forecast from State and Federal Actions

Methodology

GHG reductions from state and federal actions and other trends to the community forecast are quantified in this section. These reductions include the following:

- Renewable Portfolio Standard
- Pavley I fuel economy standards

- Low Carbon Fuel Standard
- Title 24 building efficiency improvements
- Reductions in VMT from rising gasoline prices[19]

The GHG reductions from these factors were quantified using the EPIC mitigation calculator. The Energy Policy Initiatives Center (EPIC) at the University of San Diego developed this model to create business-as-usual projections, set targets, and calculate levels of mitigation measures for all local jurisdictions in the San Diego region. As the EPIC model was developed specifically for cities within San Diego County and the mitigation calculator calculates the effect of the federal and statewide reductions, it was selected to quantify these policies and actions. GHG reductions from the RPS and Pavley I fuel economy standards were accounted for in the SEEC model; however, they are quantified separately in this section for informational purposes.

Renewable Portfolio Standard (RPS)

California's RPS, established in 2002 by the California State Senate in Senate Bill 1078, accelerated in 2006 and expanded in 2011, is one of the most ambitious renewable energy standards in the country. The RPS requires that investor-owned utilities like SDG&E supply 33 percent of their electricity from renewable resources by 2020. While a renewable portfolio standard past 2020 has not been established, the assumption used in the EPIC mitigation calculator was that the 33 percent renewable standard would be extended through the year 2035—a conservative assumption, given that this is targeted to already be attained by 2020. Table 3-6 lists the reductions from the RPS in 2020 and 2035.

TABLE 3-6: RPS GHG REDUCTIONS

Year	$MTCO_2e$ Reductions
2020	48,962
2035	36,160

Pavley I Fuel Economy Standards

In 2009, CARB adopted amendments to the Pavley regulations to reduce GHG emissions in new passenger vehicles from 2009 to 2016. The standards set became the model for the updated Corporate Average Fuel Economy (CAFE) standards set by the US EPA. The emissions reductions from the improved fuel efficiency standards were calculated using the EPIC mitigation calculator, and were phased in following the 2011 inventory. Table 3-7 lists the emissions reductions from Pavley I fuel economy standards in 2020 and 2035. These reductions are already quantified and applied in the SEEC community forecast, and have been listed separately here for reference purposes.

[19] The rise in gasoline prices are not a result of any state or federal policy or action, but are included in this section as part of a larger systemic trend forecast to occur regardless of other emission reduction measures.

TABLE 3-7: PAVLEY I FUEL ECONOMY STANDARD GHG REDUCTIONS	
Year	**$MTCO_2e$ Reductions**
2020	40,354
2035	48,369

Low Carbon Fuel Standard

The Low Carbon Fuel Standard, adopted by CARB, is performance-based and is designed to reduce the GHG intensity of transportation fuels by 10 percent by 2020. The regulation established annual performance standards that fuel producers and importers must meet beginning in 2011. The Low Carbon Fuel Standard applies to all fuels used for transportation in California, including gasoline, diesel fuel, E85, compressed or liquefied natural gas, biogas, and electricity. The Standard is also "lifecycle" based, meaning the entire extraction, recovery, production and transportation of the fuel is taken into account. The default assumption of 10 percent reduction in GHG intensity was assumed to continue through 2035 for the EPIC mitigation calculator. Table 3-8 shows the reductions from the Low Carbon Fuel Standard in 2020 and 2035.

TABLE 3-8: LOW CARBON FUEL STANDARD GHG REDUCTIONS	
Year	**$MTCO_2e$ Reductions**
2020	20,545
2035	14,906

Title 24 Building Efficiency Improvements

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 became effective in 2014.

The Title 24 building efficiency improvements determine the effect of the CALGreen code mandatory measures for new building construction using the 2010 code update.[20] Table 3-9 lists the GHG reductions from building efficiency improvements in new construction calculated using the EPIC mitigation calculator in 2020 and 2035.

[20] The EPIC mitigation calculator is based on the 2010 CALGreen code. The 2014 CALGreen code and subsequent updates will likely result in greater GHG reductions as building efficiency standards improve.

TABLE 3-9: TITLE 24 BUILDING EFFICIENCY IMPROVEMENTS GHG REDUCTIONS	
Year	**MTCO$_2$e Reductions**
2020	1,836
2035	3,582

Reduction in VMT from Rising Gasoline Prices

The U.S. Energy Information Administration (EIA) collects, analyzes and disseminates independent and impartial energy information, including projections of future gasoline prices. The 2013 EIA gasoline projection estimate a pump price of gasoline of $4.00 per gallon in 2020 and $6.00 in 2035 per gallon in California.[21]

The EPIC mitigation calculator measures emissions reductions from changes in fuel consumption as a result of gasoline price increases. The reductions in GHG emissions based on the Energy Information Administration gasoline prices are shown in Table 3-10. Although the projected rise in gasoline prices is not the direct result of a federal or state policy, this effect was considered in this section, as it is a larger systemic trend that is forecast to occur regardless of other emissions reductions measures.

TABLE 3-10: GHG REDUCTIONS FROM RISING GASOLINE PRICES	
Year	**MTCO$_2$e Reductions**
2020	12,201
2035	71,316

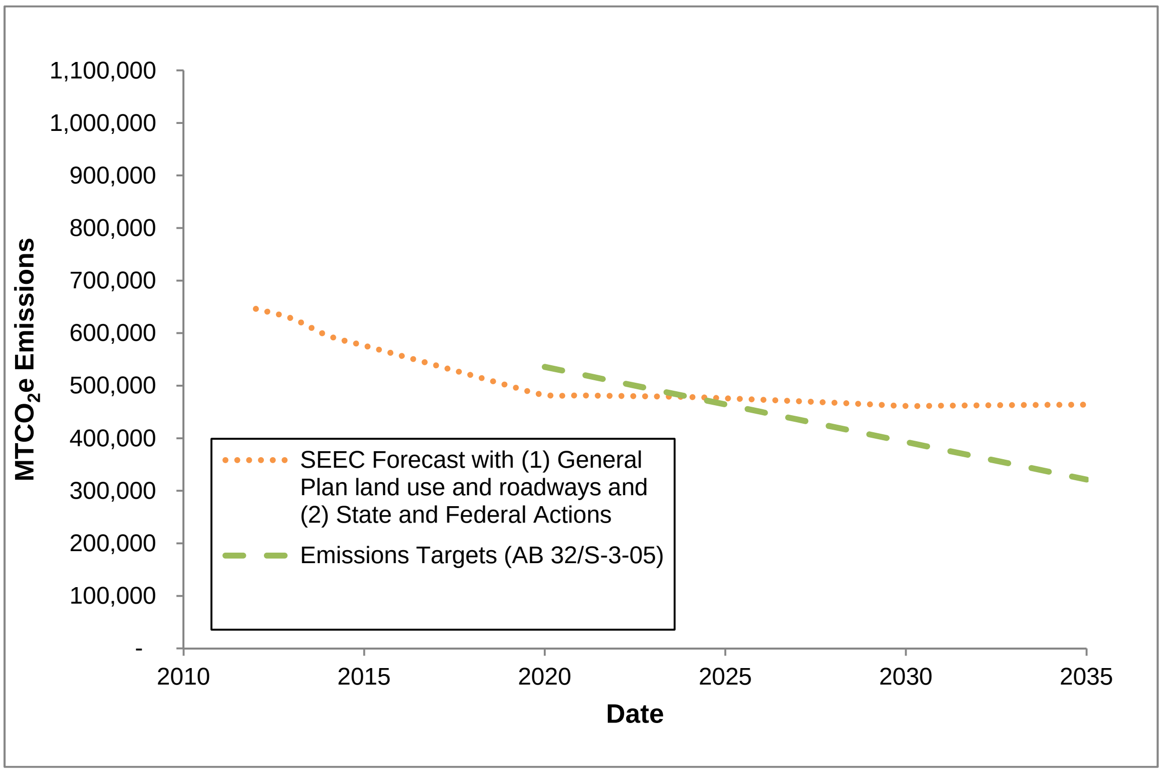
RESULTS

The annual reductions from the above state and federal actions—RPS, Pavley I Fuel Economy Standards, Low Carbon Fuel Standard, Title 24 building efficiency improvements, and the reductions in VMT from rising gasoline prices—were combined. Table 3-11 lists the total SEEC community forecast in 2020 and 2035, juxtaposed with reductions from state and federal actions not accounted for in the SEEC forecast: the Low Carbon Fuel Standard, Title 24 Building Standards, reductions in VMT from higher gasoline prices, and the assumed continuation of the Renewable Portfolio Standard after the year 2020. Figure 3-5 shows the SEEC Forecast with General Plan land use and new roadways, as well as state and federal actions.

[21] Both values are listed in 2010 dollars.

TABLE 3-11: COMMUNITY FORECAST WITH STATE AND FEDERAL ACTIONS ($MTCO_2e$)						
Year	**Community Forecast Emissions with General Plan Land Use and New Roadways**	**Low Carbon Fuel Standard Reduction**	**Title 24 Building Efficiency Improvements**	**Reductions in VMT from Rising Gasoline Prices**	**Continuation of Renewable Portfolio Standard, 2020 to 2035***	**Total Forecast Emissions with General Plan Land Use and New Roadways & State and Federal Actions**
2020	565,873	20,545	1,836	12,201	48,962	482,329
2035	589,837	14,906	3,582	71,316	36,160	463,873
*RPS considered in SEEC forecast through 2020, RPS continuation through 2035 modeled in EPIC						

Figure 3-5: Community Forecast with (1) General Plan Land Use and New Roadways and (2) State and Federal Actions ($MTCO_2e$)



3.6 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 Pavley I, the RPS, and the General Plan land use and circulation system, which incorporate reductions from "No Project" conditions which are already reflected in the SANDAG modeling discussed previously. 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.[22] The reductions are applied to the community forecast in the following section to get the "modified baseline" forecast.

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*	2020 Reduction: **164 $MTCO_2e$** 2035 Reduction: **147 $MTCO_2e$**

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

[22] 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.

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.[23] Carlsbad currently has approximately 2,700 people per square mile, greater than the threshold of 2,000 people per square mile.

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 164 $MTCO_2e$ in 2020, and 147 $MTCO_2e$ in 2035.[24]

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.

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

[24] In this chapter, reductions based on a portion of VMT have lower reductions in 2035 than in 2020 because they are assumed to decrease with greater vehicle efficiency standards over time.

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*	2020 Reduction: **2,341 $MTCO_2e$** 2035 Reduction: **2,106 $MTCO_2e$**

Policy/Action Description

Pedestrian Improvements

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 2,341 $MTCO_2e$ in 2020 and 2,106 $MTCO_2e$ in 2035.[25]

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.

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

Traffic Calming

Traffic Calming	*General Plan Policies:* *2-P.53; 3-P.16, 3.P-17*	2020 Reduction: **585 $MTCO_2e$** 2035 Reduction: **526 $MTCO_2e$**

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 585 $MTCO_2e$ in 2020 and 526 $MTCO_2e$ 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*	2020 Reduction: **4,682 $MTCO_2e$** 2035 Reduction: **4,211 $MTCO_2e$**

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.[26] 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 4,682 $MTCO_2e$ reduction by 2020, and a 4,211 $MTCO_2e$ 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*	2020 Reduction: **1,475 $MTCO_2e$** 2035 Reduction: **1,327 $MTCO_2e$**

[26] 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 pedestrian improvement and increased connectivity, transportation improvements, traffic calming, and bikeway system improvements. VMT emissions are projected to fall in the future due to higher fuel efficiency standards; however, as the efficiency gains are expected to be largely achieved by 2020 but the VMT is projected to continue climbing in the future, the effect of the VMT reductions are greater in 2020 than in 2035 for all General Plan policies and actions considered in this section. For example, the reductions from traffic calming in 2035 are 526 $MTCO_2e$, which is less than the reduction in 2020 of 585 $MTCO_2e$. The reductions from these policies and actions are incorporated into the community emissions forecast in the following section.

TABLE 3-12: 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
2020	164	2,341	585	4,682	1,475	9,247
2035	147	2,106	526	4,211	1,327	8,317

3.7 Modified Baseline and the GHG Emissions "Gap"

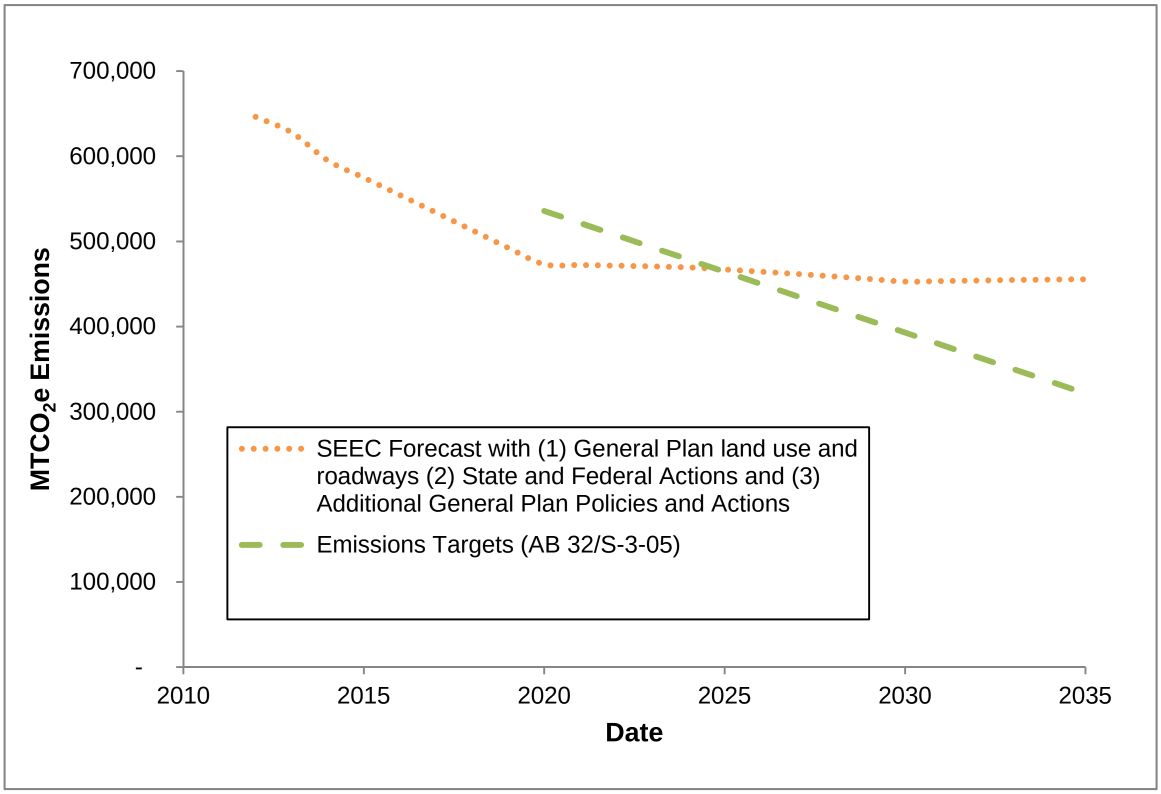
Table 3-13 shows the total community emissions with the reductions from the following policies and actions:

- General Plan land use and circulation system
- State and federal actions
- Additional General Plan policies and actions

Figure 3-6 shows the "modified baseline forecast," which incorporates the reductions discussed thus far in comparison to the emissions targets. Emissions drop steeply to 2020 from the combined effect of GHG reduction policies and actions, continue a gradual decline to 2030, but then start rising again after that, given that no increases in federal or state standards relating to fuel efficiency or renewable energy are assumed, even though these may well occur by that time. With the effect of all the GHG reductions considered in this chapter, the total community forecast emissions are 473,082 $MTCO_2e$ in 2020, and 455,556 $MTCO_2e$ in 2035. Table 3-13 shows that Carlsbad will meet its target for 2020 without any additional measures. However, by 2035, there is a GHG emissions "gap" of 134,098 $MTCO_2e$ — approximately one-third of the total projected community emissions.

TABLE 3-13: MODIFIED BASELINE FORECAST (FORECAST COMMUNITY EMISSIONS WITH GENERAL PLAN LAND USE AND ROADWAYS, STATE AND FEDERAL ACTIONS, AND ADDITIONAL GENERAL PLAN POLICIES AND ACTIONS)			
Year	Total Modified Baseline Forecast ($MTCO_2e$)	GHG Emissions Targets (Linear Scaling of AB 32/S-3-05) ($MTCO_2e$)	Emissions "Gap" ($MTCO_2e$)
2020	473,082	535,763	Target Met
2025	467,018	464,328	2,690
2030	452,762	392,893	59,869
2035	455,556	321,458	134,098

Figure 3-6: Modified Baseline Forecast (Forecast Community Emissions with General Plan Land Use and Roadways, State and Federal Actions, and Additional General Plan Policies and Actions)



Conclusion

The emissions targets are met in the year 2020, with forecast emissions of 473,082 $MTCO_2e$ meeting the target by about 63,000 $MTCO_2e$. There is an emissions "gap" in the year 2035 of about 134,000 $MTCO_2e$ between the forecast emissions of 455,556 $MTCO_2e$ and the emissions target of 321,458 $MTCO_2e$. 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:

- Residential, commercial and industrial photovoltaic systems
- Building cogeneration
- Single-family, multi-family and commercial efficiency retrofits
- Commercial commissioning
- CALGreen building code
- 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 ($MTCO_2e$).

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. The mixture of short-term, mid-term, and long-term 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.

4.1 Residential, Commercial and Industrial Photovoltaic Systems

Measure A: Promote Installation of Residential Photovoltaic Systems	
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: 10,136 $MTCO_2e$
Actions: A-1: *Temporarily—for a period of one year—suspend residential and commercial PV system permit fees, together with a publicity campaign to promote PV systems installation* (Short-term) A-2: *On a continuing basis, ensure that regulatory provisions - such as complying with regulations for zoning, structure height, permit submittal and review, etc. - do not hinder residential and commercial PV system installation.* (Short to Long-term) A-3: *Adopt an ordinance, similar to those passed by Lancaster and Sebastopol, which requires new homes to install PV panels to offset a portion of their energy use.* (Short-term)	

Already-Projected Amount: Solar photovoltaic (PV) systems convert solar energy into electricity. The projected power generation[27] of residential PV systems at 4,685 homes is 15.9 MW[28] in the year 2035, which is enough to fully power these homes.[29]

Target: The target is 25 MW in the year 2035, which is the equivalent amount of production to power 7,367 homes.[30]

GHG Reduction Measure Description: PV systems convert solar energy into electricity. Producing renewable energy locally through residential, commercial, and industrial PV systems reduces the need to construct costly new power plants that produce air pollution, use natural resources, and impact the environment.

The San Diego region has among the highest rates of solar energy production in the nation, producing an annual average of about 6.5 kWh per square meter per day, according to the National Renewable Energy Laboratories. A 2006 estimate found that existing PV technology could supply over 100 percent of the peak electricity demands for San Diego County, and over half of the total energy load.[31] Measure A is to promote the installation of PV systems on single-family and multi-family homes above the already-projected amount (4,685 homes) by an additional 2,682 homes, or a total of about 15 percent of homes.

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

Responsibility and Implementation: The City of Carlsbad currently participates in three Property Assessed Clean Energy (PACE) programs: CaliforniaFIRST, FigTREE, and California HERO. PACE programs provide financing to eligible property owners for sustainable energy projects, thereby offering a source of funding for residential PV systems. Property owners can finance PV system installations and energy efficiency improvements through a voluntary assessment on their property tax bills. Several other financing options are available to residents, including Federal Housing Financing Administration- (FHFA) insured Energy Efficient Mortgages, HUD Title 1 Home Improvements Loans, and FHA PowerSaver Loans.

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[27] The maximum amount of power produced is also referred to as solar capacity.

[28] Solar capacity (MW) was converted into an annual energy total (kWh per year) as follows: The standard assumption is about 5 hours of production per day per solar system. The capacity was multiplied by 5 hours per day times 365 days per year to get a total production in kWh per year. Therefore, 15.9 MW converts to 29,017,500 kWh per year.

[29] Average household energy use was calculated as follows: The California per capita electricity use in 2010 was 2,337 kWh (source: http://www.eia.gov/state/?sid=CA). The average household size in 2010 was 2.65 people per household (source: http://www.census.gov/newsroom/releases/archives/2010_census/cb11-cn137.html). Therefore, the average household energy use in 2010 was: 6,193.1 kWh per year.

[30] It was assumed that residential PV systems produce the equivalent amount of energy to the amount consumed in each household on an annual basis.

[31] Anders, Scott and Bialek, Tom. 2006. Technical Potential for Rooftop Photovoltaics in the San Diego Region. Available: http://www.sandiego.edu/documents/epic/060309_ASESPVPotentialPaperFINAL_000.pdf.

The city will temporarily suspend residential and commercial solar PV system permit fees. The city will also on a continuing basis ensure that regulatory provisions—such as complying with regulations for zoning, structure height, permit submittal and review process, etc.—do not hinder PV panel installation.

Costs and Benefits:

Private: Private costs would come from the installation and maintenance of a residential PV system, which can be supported by PACE programs and other incentives. Benefits would accrue from reduced energy bills and increased property values.

City: City costs would occur from the analysis of potential regulatory barriers and adopting an ordinance requiring new homes to install PV systems. Revenue would be lost when permit fees are temporarily suspended.

<table>
<tr><th colspan="2">Measure B: Promote Installation of Commercial and Industrial Photovoltaic Systems</th></tr>
<tr><td>Goal: 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.</td><td>2035 Reduction: 13,336 $MTCO_2e$</td></tr>
<tr><td colspan="2">Actions: (See also actions A1 and A2 above).

B-1: Adopt a commercial energy conservation ordinance requiring all new nonresidential developments with more than 50 cars surface parked or on roofs of parking structures to use PV panels over at least half of the surface/roof-parked cars, or provide equivalent energy conservation/generation by other means (over and above other requirements). (Short-term)

B-2: Adopt an ordinance requiring existing nonresidential developments to install PV panels to offset a portion of their energy use. (Mid-term)</td></tr>
</table>

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 10.7 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: See Measure A (above) for implementation.

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 removing potential regulatory barriers and preparing and enforcing a nonresidential PV systems ordinance. Revenue would be lost when permit fees are temporarily suspended.

4.2 Building Cogeneration

Measure C: Promote Building Cogeneration for Large Commercial and Industrial Facilities	
Goal: Promote building cogeneration for large commercial and industrial facilities, with the goal of producing 6.9 MW.	2035 Reduction: 1,067 $MTCO_2e$
Actions: C-1: *Promote cogeneration by publicizing grant opportunities and financial incentives, such as the Self-Generation Incentive Program and feed in tariffs for cogeneration systems, for renovations of existing buildings by posting these on the city's website and by other means.* (Short-term) C-2: *Install cogeneration systems on large city facilities that can benefit from the installation of these systems, and apply for funding through the Energy Efficiency Financing for Public Sector Projects program, or other similar funding sources.* (Mid to Long-term) C-3: *Require cogeneration systems for large commercial and industrial facilities that have on-site electricity production, both for new construction and retrofits.* (Mid-term)	

Already-Projected Amount: The forecast capacity of building cogeneration systems is 6.9 MW in the year 2035.

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

GHG Reduction Measure Description: Building cogeneration, also known as combined heat and power (CHP), is the use of building power stations to simultaneously generate electricity and heat. Instead of purchasing electricity from a utility and burning fuel in an on-site furnace to produce needed heat, an industrial or commercial user can use building cogeneration to provide both electricity and heat in one energy-efficient step. Examples of facilities able to use building cogeneration include manufacturing plants, hospitals, water and wastewater treatment facilities,[32] and large office buildings.

[32] The Encina wastewater treatment plant operates a cogeneration plant that produces over 60 percent of the electricity used by the facility.

Building cogeneration reduces building energy costs, provides stability in the face of uncertain electricity prices, and enhances energy reliability. Building cogeneration also provides the opportunity to improve critical infrastructure resiliency, by allowing critical facilities to run without any interruption in service if the electrical grid is impaired. Measure C is to promote the installation of building cogeneration systems on large commercial and industrial facilities to reach the projected capacity of 6.9 MW by 2035.

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

Responsibility and Implementation: The City of Carlsbad will apply for funding to install cogeneration systems on city facilities that would benefit from the use of these systems. The city will also publicize incentives for the construction of cogeneration systems, and require cogeneration systems for new construction and retrofits of large commercial and industrial facilities through the permitting process, where the facility has on-site non-renewable electricity generation.

A number of funding sources exist to provide financial support for the installation of cogeneration systems. Funding for cogeneration systems for city facilities is available through the Energy Efficiency Financing for Public Sector Projects program. In addition to city government buildings, the program also applies to schools and other public or institutional facilities. There is no minimum loan amount, but the maximum loan amount per application is $3 million. The interest rate is 1 percent, and loans must be repaid from energy cost savings within 15 years, including principal and interest. As well, the city will consider use of its Infrastructure Replacement Funds (IRF) to install feasible cogeneration systems as part of refurbishment of existing city facilities.

The Self-Generation Incentive Program (SGIP) provides financial incentives for the installation of new qualifying technologies, including cogeneration, that are installed to meet all or a portion of the electric energy needs of a facility.[33] SGIP is funded by the California Public Utilities Commission, and administered by the California Center for Sustainable Energy in SDG&E's service area. San Diego's 2014 share is approximately $10 million per year. Under the SGIP program, cogeneration systems receive an incentive of $1.83 per watt produced. SDG&E also offers seminars on the benefits of cogeneration and fuel cell options for large facilities.

For cogeneration systems that produce electricity in excess of the facility's needs, the state of California has initiated a feed-in tariff, which provides a cost-based price for renewable energy produced.

[33] See the 2014 Self-Generation Incentive Program Handbook. Available: https://www.selfgenca.com/documents/handbook/2014

Costs and Benefits:

Private: Private costs would come from the installation and maintenance of building cogeneration systems, and which could be reduced through funding programs, such as SGIP. Benefits would accrue from reduced energy bills and increased property values.

City: City costs would come from promoting cogeneration systems, and incorporating the consideration of cogeneration into the permitting process for commercial and industrial facilities. Benefits could accrue from reduced energy bills for city facilities that utilize cogeneration systems.

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: 1,132 $MTCO_2e$
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: Adopt a residential energy conservation ordinance, which requires residential property owners to conduct and disclose an energy audit at the time of major renovations (as defined by the ordinance), to ensure that homes and residential developments meet specified low cost energy efficiency measures—such as requisite ceiling insulation, insulated pipes, water heater blankets and exterior door weather stripping.* (Short-term)	

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 conduct an energy audit, and meet low-cost energy efficiency measures—such as improving insulation, 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:

<u>Private:</u> 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.

<u>City:</u> City costs would come from promoting incentive programs, creating an "Energy Challenge" program, and adopting 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: 351 $MTCO_2e$
Actions: *See Measure D (above)*.	

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, but can provide increased energy savings; for example, increasing insulation between residential units benefits both units. Other examples of multi-family residential retrofits 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 creating an "Energy Challenge" program.

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: 18,377 $MTCO_2e$
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:* *Adopt a commercial energy conservation ordinance, which requires property owners to ensure that commercial buildings meet specified energy efficiency measures—such as requisite heating, ventilation, and air conditioning improvements, service water system requirements, and improved refrigeration equipment, at the time of conducting major renovations (as defined by the ordinance).* (Short-term)	

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.[34] Funding is available through incentive and rebate programs, such as SDG&E's Energy Efficiency Business Rebates and Incentives Program. SANDAG is preparing an Energy Roadmap for the city, which will identify energy conservation measures the city can use to reduce energy use in city municipal operations.[35] 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 adopting and enforcing a commercial energy conservation ordinance.

4.4 Commercial and City Facility Commissioning

Measure G: Promote Commercial and City Facility Commissioning	
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: 18,377 $MTCO_2e$
Actions: *G-1: Promote commissioning programs on the city's website such as San Diego RCx, and similar programs for commercial buildings.* (Short-term) *G-2: Commission city facilities to improve building operations and reduce energy costs, with a goal of 40 percent energy reduction in 30 percent of city facility square footage. (Mid-term)*	

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

[34] AB 1103, the California Nonresidential Building Energy Use Disclosure Program, requires an owner of a nonresidential building to benchmark the building's energy use data and disclose the energy use prior to the sale of the building, or the lease and financing of the entire building. This benchmark data can be used to guide implementation of efficiency measures for buildings renovated after a recent sale.

[35] 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.

Target: The target is equivalent to a 40 percent energy reduction in 30 percent of existing and new commercial square footage citywide and in city facilities.

GHG Reduction Measure Description: Commercial commissioning is a systematic process of ensuring that a building performs according to its design and the occupant's operational needs. Commissioning allows the design developed to be successfully constructed and operated. Examples includes measuring temperatures and flow rates from heating, ventilation, and air conditioning (HVAC) systems to calibrate to a known standard, as well as reviewing operations to verify that controls are properly functioning.

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

Responsibility and Implementation: The City is responsible for commissioning city facilities. Building owners would implement this measure for commercial buildings. Programs exist to offer assistance with the commissioning. San Diego RCx, a SDG&E program, provides a free engineering study to qualified buildings to identify opportunities to save energy. After opportunities are identified, the program offers financial assistance to help pay the cost of implementing measures, which are typically low or no cost. Once implementation is complete, energy savings are confirmed with the utility, and the program pays the building owner the cost of the improvements. Commissioning of existing city facilities can occur concurrently with the 10-year master refurbishments schedule, using IRF.

Costs and Benefits:

<u>Private:</u> Private costs would come from building owners paying for building commissioning, which may be offset entirely through commissioning programs. Benefits would occur through reduced energy costs.

<u>City:</u> City costs would come from commissioning city facilities and from promoting commissioning programs to help guide building owners to implement this measure. Benefits would occur through reduced energy costs.

4.5 Green Building Code

Measure H: Implement Green Building Measures	
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: 179 $MTCO_2e$
Action: *H-1: Adopt residential and commercial energy conservation ordinances requiring a 5 percent improvement in energy efficiency for residential and nonresidential new construction, above the existing City of Carlsbad green building code.* (Short-term)	

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

Target: The target is a five percent improvement in energy efficiency above the mandatory requirements set in CALGreen.

GHG Reduction Measure Description: CALGreen, also known as Title 24, is California's Building Energy Code. 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 2013 and became effective in 2014. This measure applies a five percent improvement in energy efficiency above CALGreen as part of a local Green Building Code.

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

Responsibility and Implementation: The City of Carlsbad shall adopt a Green Building Code with a standard of five percent improvement in energy efficiency above CALGreen, which would also apply to any subsequent updates of the CALGreen Building Code. The Green Building Code would apply to new construction within the city.

Costs and Benefits:

Private: Private costs would occur in implementing the improvements in energy efficiency above the CALGreen code in new construction.

City: There is no cost to the City of Carlsbad, other than adopting the ordinance.

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: 21,900 $MTCO_2e$
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. Under AB 1109 (2007), minimum energy efficiency standards are structured to reduce statewide electrical consumption by 50 percent or greater from 2007 levels for indoor residential lighting and by 25 percent or greater from 2007 levels for indoor commercial and outdoor lighting by 2018. The improved efficiency standards from AB 1109 will help to meet the goals of this measure. SANDAG is preparing an Energy Roadmap for the city, which may include lighting replacement recommendations for city facilities. Either the measures in the Energy Roadmap or the goal of 50 percent of incandescent and halogen light bulbs will be followed for city facilities, whichever results in greater energy savings. For existing city facilities, the city will also time the lighting efficiency replacements with the master refurbishment schedule.

Quantification of GHG Emissions Reductions: An estimated 17 percent of residential and commercial energy nationwide[36] and about 25 percent in California[37] is used for lighting. Applied to citywide energy use, 25 percent corresponds to about 78,000 MTCO$_2$e of forecast emissions in 2035 (from the SEEC community forecast with General Plan land use and roadways). LED light bulbs reduce energy consumption and therefore GHG emissions by 75 percent compared to incandescent lighting.[38] This measure assumes that about 75 percent of the bulbs citywide are currently incandescent or halogen, and sets the target of replacing half of these bulbs with more efficient ones by 2035. [39] New construction could set at a goal of 75 percent of bulbs to be LED or similarly efficient. This would overall lead to a 28 percent decrease in emissions compared to halogen/incandescent bulbs, which equates to emissions reductions of 21,900 MTCO$_2$e.[40]

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$_2$e 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, as facilities are upgraded. For residential and commercial customers, SDG&E currently does not offer rebates for the

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[36] http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3

[37] California Public Utilities Commission; http://www.cpuc.ca.gov/NR/rdonlyres/6234FFE8-452F-45BC-A579-A527D07D7456/0/Lighting.pdf

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

[39] It is estimated that 75 percent of lighting within the City is currently incandescent, halogen, or linear fluorescent. U.S. Department of Energy, 2010 U.S. Lighting Market Characterization, January 2012, Table 4.1; http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf

[40] 75 percent reduction in energy use in half of the 75 percent total incandescent bulbs is (75 percent)*(75 percent)*(50 percent)= 28 percent reduction

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: 11,604 $MTCO_2e$
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: Adopt residential and commercial energy conservation ordinances requiring new residential and commercial buildings to install solar water heaters or heat pumps, or use alternative energy (such as PV-generated electricity) for water heating needs. (Short-term)*	

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.[41] 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 three PACE programs described in Measure A also provide financing for the installation of solar water heaters and heat pumps to improve residential energy efficiency. The California Solar Initiative has a low-income solar water heating rebate program and solar thermal program, which offers rebates for solar water heaters. 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 adopting and enforcing an ordinance requiring new homes and commercial buildings to install solar water heaters or heat pumps.

[41] 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: 23,549 $MTCO_2e$
Actions: *K-1: Adopt a citywide transportation demand management (TDM) plan, as described in the General Plan Mobility Element, detailing a mix of strategies to reduce travel demand, specifically of single occupancy vehicles. SANDAG's 2012 "Integrating Transportation Demand Management Into the Planning and Development Process"*[42] *provides a guide to designing and implementing a TDM plan and will be used as a reference document to develop the city's TDM plan. TDM strategies evaluated in the plan include parking ordinances, subsidized or discounted transit programs, transit marketing and promotion, carsharing, bikesharing, parking pricing, and bike parking.* (Short-term) *K-2: Adopt a TDM ordinance, defining a minimum trip generation threshold for nonresidential development projects. The city will set performance requirements for minimum alternative mode use based on project type. All projects above the threshold shall submit a TDM plan, which includes a description of how the minimum alternative mode use will be achieved and maintained over the life of the project. Potential TDM trip reduction measures can include carpool and vanpool ridematching services; designated employees as contacts for trip reduction programs; providing a direct route to transit in coordination with NCTD; developing public-private transit partnerships; passenger loading zones; pedestrian connections; showers and clothes lockers; carsharing, bikesharing long–term bicycle parking and shuttle programs.* (Mid-term)	

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.[43] 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,

[42] Available: http://www.icommutesd.com/documents/tdmstudy_may2012_webversion_000.pdf.

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

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 develop a TDM plan describing strategies to reduce travel demand. The city will also develop an ordinance applying to nonresidential developments meeting a specified minimum trip generation 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:

<u>Private:</u> 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.

<u>City:</u> City costs would result from developing, 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[44] miles traveled from a projected 15 percent to 25 percent of total vehicle miles traveled by 2035.	2035 Reduction: 54,158 $MTCO_2e$
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: Adopt a residential energy conservation ordinance, similar to Palo Alto, requiring the installation of EV chargers or pre-wiring in new residential construction and major renovations.* (Short-term) *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, 15 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 15 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

[44] 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 will also promote the use of ZEVs by offering dedicated ZEV parking and adopting requirements for ZEV parking for new development. The city will create an ordinance requiring the installation of ZEV chargers or pre-wiring in new residential construction and major renovations.[45] Through its Fleet Vehicle Replacement Fund, the City of Carlsbad will increase 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 may occur from developing ordinances to require the installation of ZEV chargers in new residential construction and major renovations. City costs may also occur from fleet purchases of ZEV vehicles. Benefits would accrue from reduced spending on gasoline.

[45] Assembly Bill 1092 (2013) requires the Department of Housing and Community Development to propose minimum building standards for the installation of future electric vehicle charging infrastructure for parking spaces in multi-family dwellings and nonresidential development.

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: 4,580 $MTCO_2e$
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 was converted into $MTCO_2e$ using the 2010 SDG&E coefficient of 742.2 lb CO_2e per megawatt-hour. This corresponds to a reduction of 4,580 $MTCO_2e$.

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 SGIP, as described above in Measure C. 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:

<u>Private:</u> 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 [46]	
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: 5,968 $MTCO_2e$
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.[47] 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.[48] 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 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.

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

[47] 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.

[48] 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.

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: 1,205 $MTCO_2e$
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.[49] For this measure, it was assumed that seven percent of the citywide emissions are from water provision and wastewater services.[50] 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.[51] 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 1,205 $MTCO_2e$.

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:

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

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

[49] 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.

[50] 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).

[51] 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.

4.12 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. Table 4-2 shows proposed residential energy conservation, commercial energy conservation, and transportation demand management ordinances adjacent to the applicable reduction measures.

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 185,919 $MTCO_2e$ in 2035, which cover the emissions "gap" identified in Chapter 3. Table 4-3 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. Interim "milestone" years 2025 and 2030 are presented in Table 4-3 in order for the city to check its progress towards meeting the 2035 target. 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.

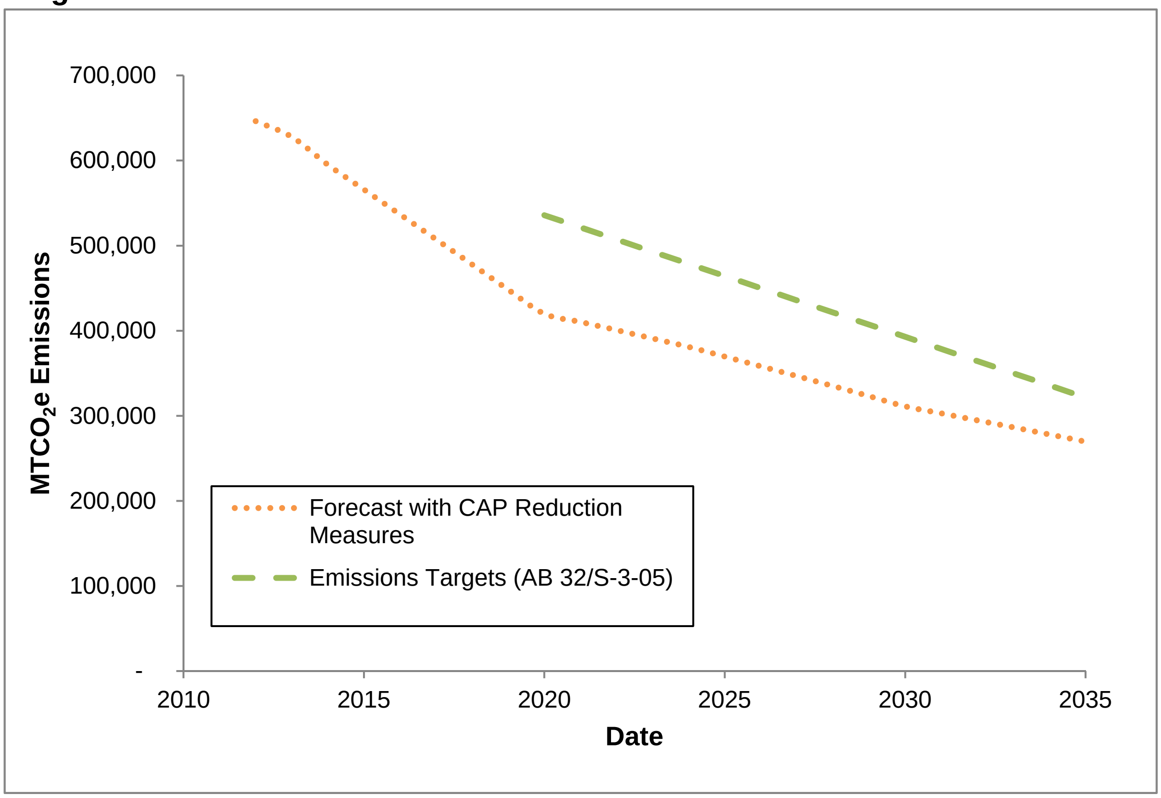
TABLE 4-1: CAP GHG REDUCTION MEASURES SUMMARY		
Measure Letter	**GHG Reduction Measures**	**GHG Reduction in 2035 ($MTCO_2e$)**
A	Install residential PV systems	10,136
B	Install commercial and industrial PV systems	13,336
C	Promote building cogeneration for large commercial and industrial facilities	1,067
D	Encourage single-family residential efficiency retrofits	1,132
E	Encourage multi-family residential efficiency retrofits	351
F	Encourage commercial and city facility efficiency retrofits	18,377
G	Promote commercial and city facility commissioning, or improving building operations	18,377
H	Implementation of Green Building Code	179
I	Replace Incandescent bulbs with LED bulbs	21,900
J	New construction residential and commercial solar water heater/heat pump installation & retrofit of existing residential	11,604
K	Promote Transportation Demand Management	23,549
L	Increase zero-emissions vehicle travel	54,158
M	Develop more citywide renewable energy projects	4,580
N	Reduce the GHG intensity of water supply conveyance, treatment and delivery	5,968
O	Encourage the installation of greywater and rainwater systems	1,205
Total GHG Reductions		**185,919**

TABLE 4-2: LIST OF PROPOSED ORDINANCES AND APPLICABLE MEASURES	
PROPOSED ORDINANCES	**Applicable Measures**
Residential Energy Conservation Ordinance	A, D, E, H, I, J, L
Commercial Energy Conservation Ordinance	B, F, H, I, J, L
Transportation Demand Management Ordinance	K

TABLE 4-3: FORECAST COMMUNITY EMISSIONS WITH CAP GHG REDUCTION MEASURES AND TARGETS

Year	Modified Baseline Forecast (From Chapter 3) ($MTCO_2e$)	CAP GHG Reduction Measures (Phased in Linearly to 2035) ($MTCO_2e$)	Forecast Community Emissions with CAP GHG Reduction Measures	GHG Emission Targets (Linear Scaling of AB 32/S-3-05) ($MTCO_2e$)	Emission Target Met?
2020	473,082	53,120	419,962	535,763	Yes
2025	467,018	97,386	369,632	464,328	
2030	452,762	141,654	311,108	392,893	
2035	455,556	185,919	269,637	321,458	Yes

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



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 target years 2020 and 2035, and interim milestone years 2025 and 2030.

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.

TABLE 5-1: CAP IMPLEMENTATION MATRIX					
Measure / Actions	**Responsible Department(s)**	**Annual GHG Reduction Goals ($MTCO_2e$)**	**Performance Target** o **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	**2020: 164** 2025: 159 2030: 153 **2035: 147**	Achieve 2.85 miles of bike lanes per square mile, corresponding to .07% VMT reduction o Miles of bikeways added o Miles of bikeways enhanced	VMT	Short to Long-term
Pedestrian improvements and increased connectivity	Public Works, Parks & Recreation, Community & Economic Development	**2020: 2,341** 2025: 2,268 2030: 2,194 **2035: 2,106**	1% VMT reduction o Miles of pedestrian and trail improvements o Number of new connection points	VMT	Short to Long-term
Traffic calming	Public Works, Community & Economic Development	**2020: 585** 2025: 567 2030: 548 **2035: 526**	.25% VMT reduction o Number of traffic calming devices installed o Vehicle travelway width reduction o Pedestrian crossing width reduction	VMT	Short to Long-term
Parking facilities and policies	Public Works, Community & Economic Development	**2020: 4,682** 2025: 4,535 2030: 4,388 **2035: 4,211**	2% VMT reduction o % reduction in parking standards o Number of projects with alternative parking provisions (shared parking, unbundled parking cost, valet, etc.) o Number of EV parking spaces installed	VMT	Short to Long-term
Transportation improvements	Public Works,	**2020: 1,475**	.63 VMT reduction	VMT	Short to Long-

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target o Progress Indicators	Unit of Measure	Implementation Timeframe
	Community & Economic Development	2025: 1,429 2030: 1,383 **2035: 1,327**	o Transit ridership counts	$MTCO_2e$	term
CAP Measures (see Sections 4.1 - 4.11 for complete descriptions)					
A – Promote installation of residential photovoltaic systems		**2020: 2,896** 2025: 5,309 2030: 7,723 **2035: 10,136**	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		
A-1: Temporarily suspend PV system permit fees	Community & Economic Development, Communications		o Number of promotional events o MW installed PV	kWh	Short-term
A-2: Review local regulations for constraints on PV	Community & Economic Development		n/a		Short to Long-term
A-3: Adopt ordinance requiring PV in new residential construction	Community & Economic Development		o Ordinance adoption o MW installed PV	kWh	Short-term
B - Promote Installation of commercial and industrial photovoltaic systems		**2020: 3,810** 2025: 6,986 2030: 10,161 **2035: 13,336**	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		

TABLE 5-1: CAP IMPLEMENTATION MATRIX					
Measure / Actions	**Responsible Department(s)**	**Annual GHG Reduction Goals ($MTCO_2e$)**	**Performance Target** o **Progress Indicators**	**Unit of Measure**	**Implementation Timeframe**
B-1: Require PV on large new nonresidential construction	Community & Economic Development		o Ordinance adopted o MW installed PV	kWh	Short-term
B-2: Adopt an ordinance requiring existing nonresidential developments to install PV panels to offset a portion of their energy use	Community & Economic Development		o Ordinance adopted o MW installed PV	kWh	Mid-term
C - Promote building cogeneration for large commercial and industrial facilities		**2020: 305** 2025: 559 2030: 813 **2035: 1,067**	Promote building cogeneration for large commercial and industrial facilities, with the goal of producing 6.9 MW		
C-1: Promote cogeneration	Public Works, Communications		o Promotional activities conducted o Number and/or sq. footage of SGIP-funded projects	kWh/therms	Short-term
C-2: Install cogeneration systems for large city facilities where beneficial	Public Works		o MW installed co-generation systems	kWh/therms	Mid to Long-term
C-3: Require cogeneration systems for large commercial and industrial facilities that have on-site electricity production	Community & Economic Development		o MW installed co-generation systems	kWh/therms	Mid-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target o Progress Indicators	Unit of Measure	Implementation Timeframe
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		o Promotional activities conducted	kWh/therms	Short-term
D-2: Create a citywide "Energy Challenge"	Public Works, Communications		o Program launch o Promotional activities conducted o Number of program participants and/or sq. footage of buildings in program	kWh/therms	Short-term
D-3: Require residential energy audits/retrofits	Community & Economic Development		o Ordinance adopted o Number and/or sq. footage of existing homes retrofitted	kWh/therms	Short-term
E - Encourage multi-family residential efficiency retrofits		**2020: 100** 2025: 184 2030: 267 **2035: 351**	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)		
(See Measure D above)	Public Works, Communications, Community & Economic Development		o See Actions D-1 through D-3 above	kWh/therms	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX					
Measure / Actions	**Responsible Department(s)**	**Annual GHG Reduction Goals ($MTCO_2e$)**	**Performance Target** o **Progress Indicators**	**Unit of Measure**	**Implementation Timeframe**
F - Encourage commercial and city facility efficiency retrofits		**2020: 5,251** 2025: 9,626 2030: 14,002 **2035: 18,377**	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		o Sq. footage of buildings retrofitted o % energy use reduction	kWh/therms	Short-term
F-2: Promote nonresidential energy efficiency incentive and rebate programs	Public Works, Community & Economic Development, Communications		o Promotional activities conducted o Number of program participants and/or sq. footage of buildings retrofitted o % energy use reduction	kWh/therms	Short-term
F-3: Require nonresidential energy audits/retrofits	Community & Economic Development		o Ordinance adopted o Number and/or sq. footage of existing buildings retrofitted o % energy use reduction	kWh/therms	Short-term
G - Promote commercial and city facility commissioning		**2020: 5,251** 2025: 9,626 2030: 14,002 **2035: 18,377**	Encourage commercial and city facility commissioning, or improving existing and new building operations, with the goal of a 40 percent energy reduction in 30 percent of commercial square footage citywide and in city-owned buildings by 2035		

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target o Progress Indicators	Unit of Measure	Implementation Timeframe
G-1: Promote commercial commissioning	Public Works, Community & Economic Development, Communications		o Promotional activities conducted o Number and/or sq. footage of commissioned buildings o % energy use reduction	kWh/therms	Short-term
G-2: Commission city facilities	Public Works		o Number and/or sq. footage of commissioned buildings o % energy use reduction	kWh/therms	Mid-term
H - Implement green building measures		**2020: 51** 2025: 94 2030: 136 **2035: 179**	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		
H-1: Increase Green Building Code requirements by five percent.	Community & Economic Development		o Ordinance adopted o Number and/or sq. footage of buildings with enhanced GBC features	kWh/therms $MTCO_2e$	Short-term
I - Promote replacement of incandescent and halogen bulbs with LED or other energy efficient lamps		**2020: 6,257** 2025: 11,471 2030: 16,686 **2035: 21,900**	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		o Building sq footage upgraded o Number of fixtures replaced	kWh	Short-term
I-2: Promote the use of LED rebate programs	Public Works, Communications		o Promotional activities conducted	kWh	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX					
Measure / Actions	**Responsible Department(s)**	**Annual GHG Reduction Goals ($MTCO_2e$)**	**Performance Target** o **Progress Indicators**	**Unit of Measure**	**Implementation Timeframe**
I-3: Develop natural lighting and ventilation standards; install city facility demonstration project	Community & Economic Development Public Works		o Feasibility study conducted o Number of buildings with natural lighting and ventilation features o % energy use reduction	kWh/therms	Mid-term
J - New construction residential and commercial solar water heater/heat pump installation & retrofit of existing residential		**2020: 3,315** 2025: 6,078 2030: 8,841 **2035: 11,604**	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		o Promotional activities conducted o Solar heater/heat pump installations	kWh/therms	Short-term
J-2: Solar water heater and heat pump ordinance for new nonresidential construction	Community & Economic Development		o Ordinance adopted o Solar heater/heat pump installations o MW installed PV	kWh/therms	Short-term
K - Promote transportation demand management strategies		**2020: 6,728** 2025: 12,335 2030: 17,942 **2035: 23,549**	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: Adopt citywide transportation demand management (TDM) plan	Community & Economic Development, Public Works		o TDM plan adopted o TDM participation rates o % VMT reduced	VMT	Short-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target o Progress Indicators	Unit of Measure	Implementation Timeframe
K-2: Adopt TDM ordinance	Community & Economic Development, Public Works		o TDM ordinance adopted o TDM participation rates o % VMT reduced	VMT	Mid-term
L - Promote an increase in the amount of zero-emissions vehicle travel		**2020: 15,474** 2025: 28,368 2030: 41,263 **2035: 54,158**	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 & Economic Development		o kW installed PV o Number of ZEV charging units	VMT kWh	Short-term
L-2: Prepare a community-wide charging station siting plan	Public Works, Community & Economic Development		o Siting Plan prepared		Short-term
L-3: Construct ZEV charging stations based on the community-wide charging station siting plan	Public Works		o Number of charging stations installed o kWh charging sessions	VMT	Mid-term
L-4: Offer dedicated ZEV parking and charging stations	Public Works, Community & Economic Development		o Number of installed ZEV parking spaces/charging stations o kWh charging sessions	VMT	Mid-term
L-5: Adopt requirements for ZEV parking for new developments.	Community & Economic Development		o Number of installed ZEV parking spaces/charging stations o 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** o **Progress Indicators**	**Unit of Measure**	**Implementation Timeframe**
L-6: Require EV chargers or pre-wiring in new residential construction and major renovations.	Community & Economic Development		o Ordinance adopted o Number of EV chargers installed	VMT	Short-term
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		o % LEV and ZEV fleet VMT	VMT	Short-term
M - Develop more citywide renewable energy projects		**2020: 1,309** 2025: 2,399 2030: 3,490 **2035: 4,580**	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		o 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		o MW installed renewable energy systems	MWh	Mid to Long-term
M-3: Pursue available funding sources for the construction of municipal renewable energy projects	Public Works		o Number of EEFP or SGIP-funded projects	MWh	Mid to Long-term

TABLE 5-1: CAP IMPLEMENTATION MATRIX

Measure / Actions	Responsible Department(s)	Annual GHG Reduction Goals ($MTCO_2e$)	Performance Target o Progress Indicators	Unit of Measure	Implementation Timeframe
N - Reduce the GHG intensity of water supply conveyance, treatment and distribution		**2020: 1,705** 2025: 3,126 2030: 4,547 **2035: 5,968**	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		o Number of water system improvement projects o % energy use reduction	kWh	Mid to Long-term
O - Encourage the installation of greywater and rainwater systems		**2020: 344** 2025: 631 2030: 918 **2035: 1,205**	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		o Number of workshops conducted o % water use reduction	Gallons of water	Mid-term
O-2: Create a greywater design reference manual	Community & Economic Development, Carlsbad Municipal Water District		o Reference manual created o % water use reduction	Gallons of water	Mid-term

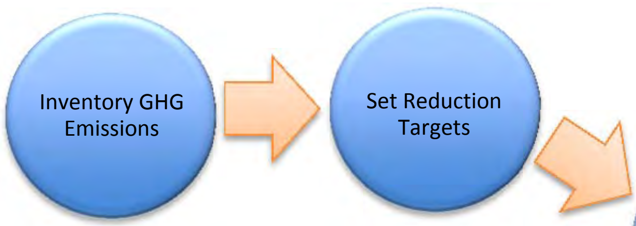
TABLE 5-1: CAP IMPLEMENTATION MATRIX					
Measure / Actions	**Responsible Department(s)**	**Annual GHG Reduction Goals ($MTCO_2e$)**	**Performance Target** o **Progress Indicators**	**Unit of Measure**	**Implementation Timeframe**
O-3: Evaluate the feasibility of offering a rebate for residential greywater systems that require a permit to cover the cost of obtaining a permit.	Carlsbad Municipal Water District		o Feasibility study conducted o Number of permit rebates issued o % water use reduction	Gallons of water	Mid-term

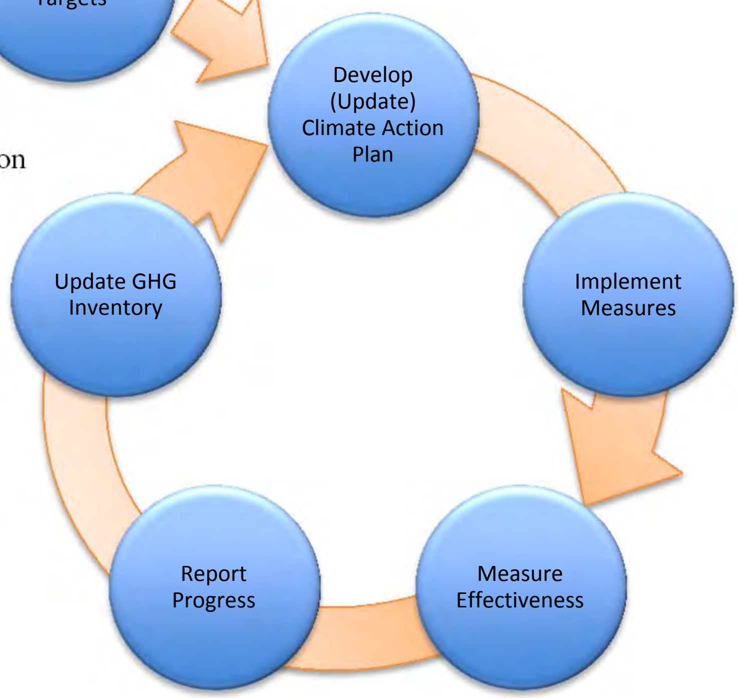
5.2 Monitoring and Reporting

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) published 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 $MTCO_2e$ annual GHG would not contribute considerably to cumulative climate change impacts, and therefore do not need to demonstrate consistency with the CAP. Table 5-2 lists types and sizes of projects that correspond to the 900 $MTCO_2e$ screening threshold; projects equal to or exceeding these thresholds would be subject to CAP measures.[52]

TABLE 5-2: PROJECT REVIEW THRESHOLDS

Project/Plan Type	Screening Threshold
Single-Family Housing	50 dwelling units
Multi-family Housing	70 dwelling units
Office	35,000 square feet
Retail Store	11,000 square feet
Grocery Store	6,300 square feet

Source: Adapted from California Air Pollution Control Officers Association (CAPCOA). CEQA and Climate Change, Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act (January 2008).

Note: For project types not listed in this table, the need for GHG analysis and mitigation will be made on a project-specific basis, considering the 900 $MTCO_2e$ screening threshold.

Project Review Checklist

For proposed projects above the screening thresholds, project proponents shall complete the CAP Project Review Checklist (similar to that shown in Table 5-3). For each item on the checklist, project proponents shall indicate whether or not the measure is included as part of the project, or if it is not applicable. The checklist is designed to meet the targets set for the measures presented in Chapter 4. The checklist shown in Table 5-3 is preliminary and illustrative of the items that will be included in the finalized checklist. The city will provide a final checklist incorporating requirements in ordinances drafted for the CAP.

TABLE 5-3: PRELIMINARY CAP PROJECT REVIEW CHECKLIST

RENEWABLE ENERGY PRODUCTION		
1. For new nonresidential projects with more than 50 cars surface parked or on roofs of parking structures, would the project include PV panels over at least half of the surface/roof-parked cars or other equivalent renewable energy production?	☐ Included	☐ Not Applicable
Explanation: *Describe the measures taken to meet this requirement, if applicable.*		

[52] If a proposed project is below the screening criteria, GHG emissions would still be reduced through compliance with applicable City of Carlsbad General Plan goals and policies, ordinances and regulations.

TABLE 5-3: PRELIMINARY CAP PROJECT REVIEW CHECKLIST		
COGENERATION		
2. For the construction or retrofit of a large commercial or industrial facility with an on-site electricity production, would the proposed project include a building cogeneration system?	☐ Included	☐ Not Applicable
Explanation:		
ENERGY CONSERVATION ORDINANCES		
3. For residential and commercial construction or major renovations, would the proposed project meet the requirements in the applicable energy conservation ordinance?	☐ Included	☐ Not Applicable
Explanation:		
GREEN BUILDING CODE		
4. Would the proposed project meet the energy efficiency standard of 5 percent above Title 24 standards (CALGreen)?	☐ Included	☐ Not Applicable
Explanation:		
SOLAR WATER HEATERS/HEAT PUMPS		
5. For residential and commercial projects, does the project include solar water heaters to reduce the energy needed for residential water heating by 50 percent, or heat pumps to reduce the heating/cooling load by 50 percent?	☐ Included	☐ Not Applicable
Explanation:		

TABLE 5-3: PRELIMINARY CAP PROJECT REVIEW CHECKLIST		
TRANSPORTATION DEMAND MANAGEMENT		
6. For proposed projects that meet the minimum trip generation thresholds set in the City of Carlsbad Transportation Demand Management (TDM) ordinance, does the project include a TDM plan, containing a description of how minimum alternative mode use will be achieved and maintained over the life of the project?	☐ Included	☐ Not Applicable
Explanation: *Include TDM plan if applicable.*		
ZERO-EMISSIONS VEHICLES		
7. For proposed projects subject to the City of Carlsbad off-street parking requirements, does the proposed project provide preferential parking for electric vehicles and/or charging stations for electric vehicle use?	☐ Included	☐ Not Applicable
Explanation:		
OTHER GHG REDUCTION MEASURES AND/OR FEATURES		
8. Describe other GHG reductions measures and/or features of the proposed project:	☐ Included	☐ Not Included
Explanation:		

A completed CAP Project Review Checklist, including supporting documentation for applicable measures, demonstrates a proposed project complies with the CAP.

As an alternative to utilizing the Project Review Checklist, a project proponent may develop a project-specific GHG emissions reduction program that would achieve the same required GHG reductions. Appendix E to the CAP provides a non-exclusive list of mitigation measures which may be considered by a project proponent for inclusion in a project-specific GHG emissions reduction program. The reduction measures identified in the CAP and Appendix E are non-exclusive, and other effective reduction measures may be available or become available in the future. The type, character, and level of mitigation would depend on the project type, size, location, context, and other factors. The availability of mitigation measures changes over time, as well, with new technologies, building materials, building design practices, and other changes. Therefore, in developing project-specific reductions measures, the city recommends that a project proponent refer to current guidance from CAPCOA, ARB, OPR, California Attorney General, and SANDAG to determine applicable mitigation measures and estimate their effectiveness (see references in Appendix C).

Updating Project Review Checklist

The Project Review Checklist will be finalized by the City of Carlsbad during the first year of CAP implementation, and updated as necessary to reflect lessons learned through project streamlining. Federal, state, and San Diego Air Pollution Control District actions will be monitored to identify future changes to federal or state standards or guidelines that affect implementation of the CAP. Any changes to California Environmental Quality Act (CEQA) and CEQA Guidelines will also be integrated into the Project Review 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:

- http://www.epa.gov/climatechange/basics/

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)

- http://www.epa.gov/climatechange/ghgemissions/ind-calculator.html

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

Earth Lab

- https://www.earthlab.com/createprofile/reg.aspx

Carbon Footprint

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

EarthLab

- http://www.earthlab.com/carbon-footprint/California-carbon-calculator.aspx

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 from federal and state agencies on changes one can make in his or her day-to-day life to diminish GHG emissions.

U.S. EPA: What can you do at home?

- http://www.epa.gov/climatechange/wycd/home.html

U.S. EPA: What can you do at school?

- http://www.epa.gov/climatechange/wycd/school.html

U.S. EPA: What can you do on the road?

- http://www.epa.gov/climatechange/wycd/road.html

U.S Department of Energy: Save energy, save money

- http://energy.gov/energysaver/energy-saver

California Environmental Protection Agency: Climate change resources for individuals

- http://www.climatechange.ca.gov/individuals.html

California Air Resources Board: Low emissions vehicles

- http://www.arb.ca.gov/msprog/consumer_info/advanced_clean_cars/consumer_acc.htm

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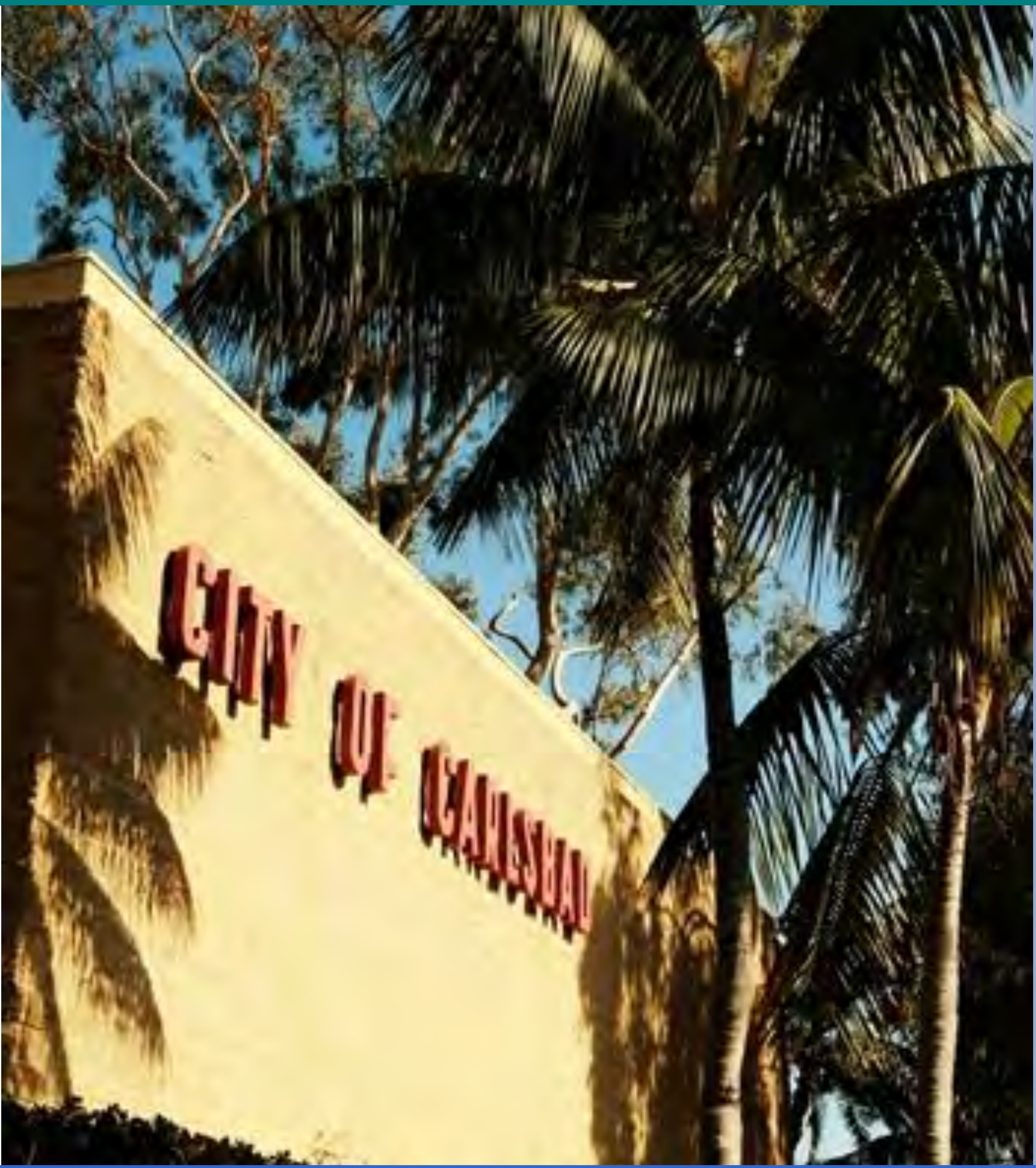
Appendix B-1

2005 City of Carlsbad Greenhouse Gas Inventory

City of Carlsbad 2005 Greenhouse Gas Emissions Inventory

CITY OF CARLSBAD



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The San Diego Foundation

Bob Kelly, President and Chief Executive Officer

With a dynamic mix of leadership, grantmaking, and civic engagement, The San Diego Foundation makes the San Diego region a better place to live. Founded in 1975, The Foundation addresses evolving issues facing our region by convening community leaders, providing research and expertise on topics important to our citizens, and partnering with nonprofit organizations to meet urgent and changing needs. By working with individuals, families and organizations to carry out their giving plans, The San Diego Foundation utilizes charitable dollars toward the ultimate goal of improving the quality of life in the greater San Diego region, now and for generations to come.

www.sdfoundation.org

The San Diego Foundation launched its Climate Initiative in 2006, to raise public awareness about the local implications of climate change and catalyze more comprehensive regional action on global warming. The initiative represents a multi-year effort to bring government, business, the research community, and nonprofits together to tackle one of the greatest challenges of our time.

Over the next few years, The San Diego Foundation will work in partnership with ICLEI to engage local governments and public agencies to develop local climate action plans to reduce emissions and vulnerabilities to climate change in our region, bring more resources to support model programs to promote ―green" economic growth and build a more sustainable region, and build public awareness and support for climate action.

ICLEI-Local Governments for Sustainability USA

Jeb Brugmann, Interim Executive Director

ICLEI-Local Governments for Sustainability USA (ICLEI) is a membership association of more than 1,000 local governments worldwide—more than 500 in the United States—committed to advancing climate protection and sustainability. Through technical expertise, direct network engagement, and the innovation and evolution of tools, ICLEI strives to empower local governments to set and achieve their emissions reduction and sustainability goals.

http://www.icleiusa.org

LETTER FROM MAYOR

Table of Contents

Executive Summary

Introduction

Methodology

Government Operations Inventory Results

Community Inventory Results

Conclusion

Appendix A: The Local Government Operations Protocol

Appendix B: LGOP Standard Report

Appendix C: Reporting on Scope 3 Emissions from Government Operations

Appendix D: Employee Commute Methodology

Appendix E: Government-Generated Solid Waste Methodology

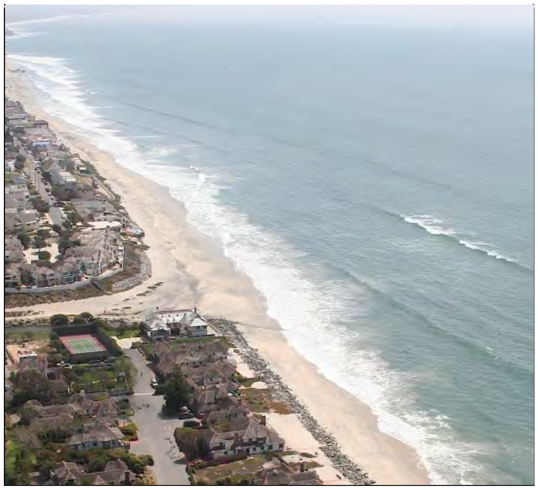
Appendix F: Community Inventory Methodology

Appendix G: Conducting a Monitoring Inventory

List of Tables and Figures

List of Tables

List of Figures



Executive Summary

The City of Carlsbad has established strategic goals that help guide the Council in it decisions and in its direction to City staff. Included within these strategic goals is the concept of creating a community that will help provide a sustainable high quality of life for its citizens for generations to come. The Council recognizes that the concept of sustainability includes social, economic and environmental components which must be considered and provided for in order to achieve a healthy community.

In August, 2007 the Council formally adopted a set of guiding principles describing the overarching goal of sustainability and the environmental component. By adopting these principles, the Council clarified its commitment to creating a community with a sustainable environmental component including, but not limited to, the efficient use of non-renewable resources, stewardship of natural and constructed open spaces, development of a drought resistant water supply, reduction in the City's waste stream and clean air and water.

Specifically, Carlsbad adopted a principal titled the Ethic of Conservation, which supports the conservation of non-renewable resources, including efforts to reduce the use of energy, greenhouse gas emissions (consistent with AB 32) and to find new and more energy efficient methods for delivering services. Carlsbad recognizes that local governments play a leading role in reducing greenhouse gas emissions. Local governments can dramatically reduce emissions from their government operations through such measures as increasing energy efficiency in facilities and vehicle fleets, utilizing renewable energy sources, enacting sustainable purchasing policies and reducing waste. The co-benefits of these measures may include lower energy bills, improved air quality, and more efficient government operations.

Carlsbad has begun its efforts in this area with the assistance of the partners in the San Diego Regional Climate Protection Initiative. These partners include the San Diego Foundation; local governments in San Diego County; and ICLEI.

This greenhouse gas emissions inventory is an important step in helping Carlsbad to understand the various sources of green house gas emissions within Carlsbad operations and to learn where there are opportunities to improve our operations to not only reduce emissions but also make save money by making investments in more energy efficient programs. . As advised by ICLEI, it is essential to first quantify emissions to establish:

- A baseline emissions inventory, against which to measure future progress.
- An understanding of the scale of emissions from various sources.

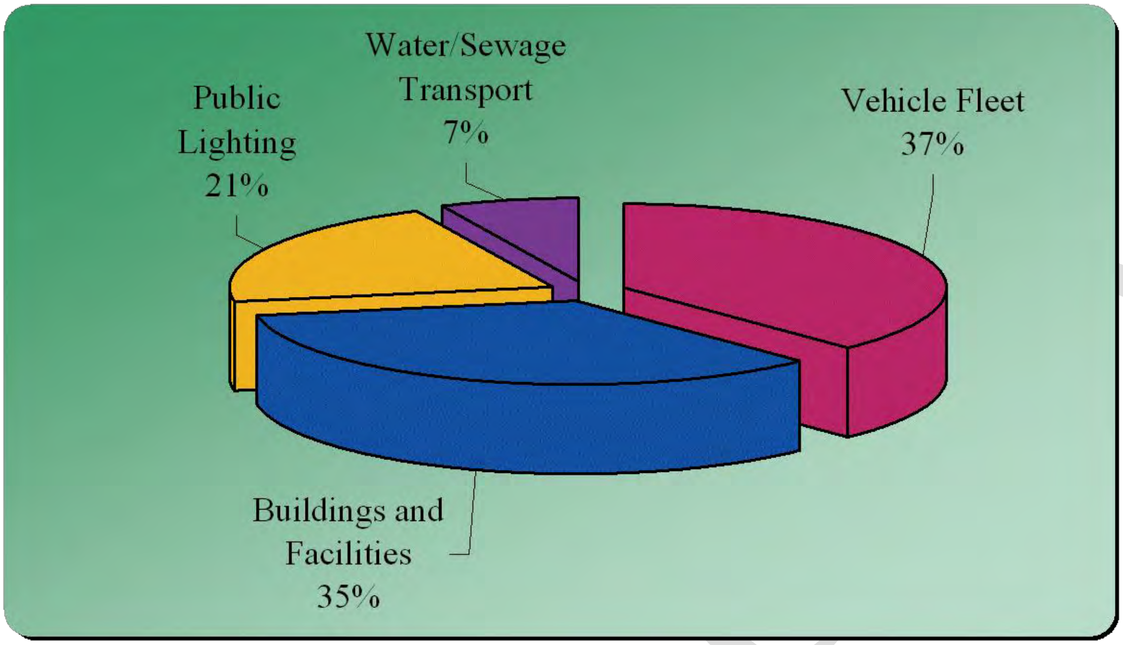
Presented here are estimates of greenhouse gas emissions in 2005 resulting from the City of Carlsbad's government operations and from the Carlsbad community-at-large. With one exception,[1] all government operations emissions estimates in this report refer to emissions generated from sources over which the City has direct operational control, exclusive of physical location.[2] This includes all government-operated facilities, streetlights, and other stationary sources; the on-road vehicle fleet and off-road equipment. The inventory also estimates emissions from the community-at-large. Community-scale emissions are reported by five primary sectors: residential, commercial/industrial, transportation, waste, and wastewater.

Like all emissions inventories, this document must rely on the best available data and calculation methodologies. Emissions estimates are subject to change as better data and calculation methodologies become available in the future. Nevertheless, the findings of this analysis provide a solid basis upon which Carlsbad can begin planning and taking action to reduce its greenhouse gas emissions.

This inventory is one of the first inventories to use a new national standard developed and adopted by the California Air Resources Board (CARB) in conjunction with ICLEI, the California Climate Action Registry, and The Climate Registry. This standard, called the Local Government Operations Protocol (LGOP), provides standard accounting principles, boundaries, quantification methods, and procedures for reporting greenhouse gas emissions from local government operations. The LGOP represents a strong step forward in standardizing how inventories are conducted and reported, providing a common national framework for all local governments to establish their emissions baseline.

1 The exception is emissions from employee-owned vehicles that are used by employees during commuting.
2 Facilities, vehicles, or other operations wholly or partially owned by, but not operated by the City of Carlsbad are not included in this inventory. See Appendix A for more details on the boundaries of the inventory.

Figure ES.1 2005 Carlsbad Government Operations Emissions by Sector



Government Operations Inventory Results

In 2005, Carlsbad's operational greenhouse gas emissions totaled 6,555 metric tons of CO_2e.[3] Of the total emissions accounted for in this inventory, emissions from the City's vehicle fleet were the largest (37 percent as shown in Figure ES.1 and Table ES.1). The next largest source of emissions resulted from buildings and facilities, followed by emissions from energy use in public lighting.

Cumulatively, Carlsbad spent approximately $2,621,937 on energy for government operations in 2005. Of this total, 74 percent of these energy expenses ($1,943,359) resulted from electricity consumption and 4 percent ($108,321) from natural gas purchases from SDG&E. Fuel purchases (gasoline, diesel) for the vehicle fleet and mobile equipment totaled $570,257, or 22 percent of total costs included in this inventory. These figures demonstrate the potential for significantly reducing energy costs while also mitigating climate change impacts and helping to stimulate green job development and economic recovery.

3 This number represents a ―roll-up" of emissions, and is not intended to represent a complete picture of emissions from Carlsbad's operations. This roll-up number should not be used for comparison with other local government roll-up numbers without a detailed analysis of the basis for this total.

Table ES.1: 2005 Government Operations Emissions by Sector

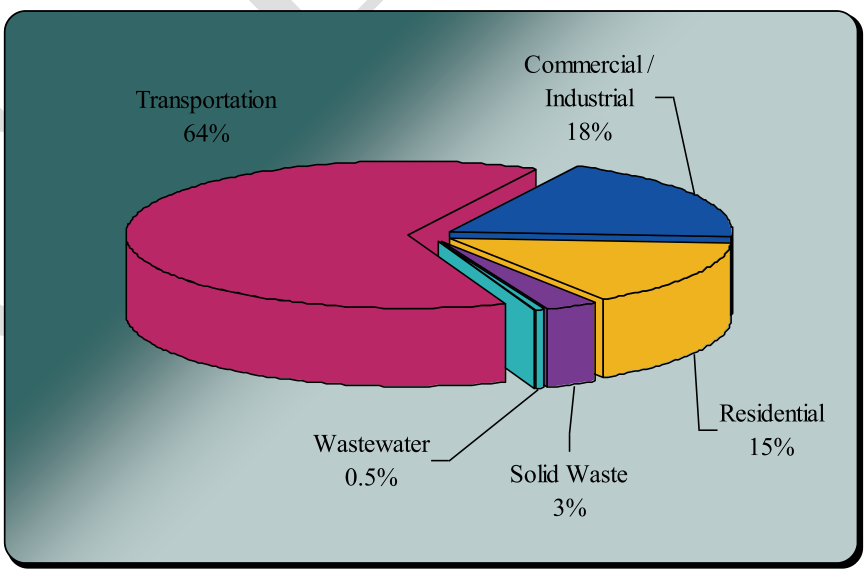
Sector	Greenhouse Gas Emissions
Vehicle Fleet	2,474
Buildings and Facilities	2,266
Public Lighting	1,354
Water/Sewage Transport	461

All units are in metric tons CO_2e

Community Inventory Results

In 2005, the Carlsbad community emitted approximately 925,248 metric tons of CO_2e. As shown in Figure ES.2 and Table ES.2 below, the transportation sector was by far the largest source of emissions, generating approximately 584,369 metric tons of CO_2e, or 64 percent of total 2005 emissions. Transportation sector emissions are the result of diesel and gasoline combustion in vehicles traveling on both local roads and state highways that pass through the jurisdictional boundaries of Carlsbad. Electricity and natural gas consumption within the Commercial / Industrial Sector, the second greatest source of 2005 emissions, generated 170,041 metric tons CO_2e, or 18 percent of the total.[4] Similarly, electricity and natural gas use in Carlsbad's Residential Sector produced 136,427 metric tons CO_2e, or 15 of total community emissions. The remaining 3 percent (34,412 metric tons) are estimated methane emissions from the solid waste and wastewater sectors.

Figure ES.2 2005 City of Carlsbad Community Emissions by Sector



[4] This estimate excludes emissions from the combustion of natural gas at the Encina electricity generation facility, which totaled approximately 1,251,972 metric tons CO_2e. These emissions occur in within the jurisdictional boundaries of Carlsbad.

Table ES.2: 2005 Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO2e)
Transportation	584,369
Commercial / Industrial	170,041
Residential	136,427
Solid Waste	30,015
Wastewater	4,397

Section One: Introduction

Introduction

Within the context of government operations, local governments have direct control over their emissions-generating activities. They can reduce energy consumption in buildings and facilities, reduce fuel consumption by fleet vehicles and equipment, reduce the amount of government-generated solid waste that is sent to a landfill, and increase the amount of energy that is obtained through alternative energy sources. By quantifying the emissions coming from government operations, this report will assist policymakers and stakeholders in developing plans that will assist Carlsbad in reducing GHG emissions and more efficiently using the limited resources we have available to us.

Local jurisdictions in California also have broad influence over activities in the community that generate greenhouse gas emissions, such as new construction, the operation of buildings and transportation, and solid waste disposal. That influence may be exercised directly through the jurisdiction's authority over local land use planning and building standards, and indirectly through programs that encourage sustainable behavior among local residents and businesses. The community inventory provides a starting point for addressing how the City can impact emissions within its jurisdictional boundaries.

1.1 Purpose of Inventory

The objective of this greenhouse gas emissions inventory is to identify the sources and quantities of greenhouse gas emissions resulting in Carlsbad in 2005. This inventory is a necessary first step in addressing greenhouse gas emissions, serving two purposes:

- It creates an emissions baseline against which Carlsbad can set emissions reductions targets and measure future progress.
- It allows local governments to understand the scale of emissions from various sources.

While the City of Carlsbad has already begun to reduce greenhouse gas emissions through its actions (See Section 1.4 for more detail), this inventory represents the first step in a systems approach to reducing the City's emissions.

1.2 Climate Change Mitigation Activities in California

Since 2005, the State of California has responded to growing concerns over the effects of climate change by adopting a comprehensive approach to addressing emissions in the public and private sectors. This approach was officially initiated with the passage of the Global Warming Solutions Act of 2006 (AB 32), which requires the state to reduce its greenhouse gas emissions to 1990 levels by 2020. It also requires the California Air Resources Board (CARB) to develop a policy plan for reaching AB32 emissions reduction goals and to adopt and enforce regulations to implement the plan.

The resulting AB 32 Scoping Plan was adopted by CARB in December 2008. Among many other strategies, it encourages local governments to reduce emissions in their jurisdictions by a degree commensurate with state goals, approximately 15 percent below current levels. In addition, it identifies the following strategies that will impact local governance:

- Develop a California cap-and-trade program
- Expand energy efficiency programs
- Establish and seek to achieve reduction targets for transportation-related GHG emissions
- Expand the use of green building practices
- Increase waste diversion, composting, and commercial recycling toward zero-waste
- Continue water efficiency programs and use cleaner energy sources to move and treat water
- Preserve forests that sequester carbon dioxide

Other measures taken by the state include mandating stronger vehicle emissions standards (AB 1493, 2002), establishing a low-carbon fuel standard (EO # S-01-07, 2007), mandating a climate adaptation plan for the state (S-EO # 13-08, 2008), establishing a Green Collar Job Council, and establishing a renewable energy portfolio standard for power generation or purchase in the state. The state also has made a number of legislative and regulatory changes that have significant implications for local governments:

- SB 97 (2007) requires the Office of Planning and Research to create greenhouse gas planning guidelines for the California Environmental Quality Act (CEQA). In addition, CARB is tasked with creating energy-use and transportation thresholds in CEQA reviews, which may require local governments to account for greenhouse gas emissions when reviewing project applications.

- AB 811 (2007) authorizes all local governments in California to establish special districts that can be used to finance solar or other renewable energy improvements to homes and businesses in their jurisdiction.
- SB 375 (2008) revises the process of regional transportation planning by metropolitan planning organizations (MPOs), which are governed by elected officials from local jurisdictions. The statute calls on CARB to establish regional transportation-related greenhouse gas targets and requires the MPO to develop a regional ―Sustainable Communities Strategy" of land use, housing and transportation policies that will move the region towards its GHG target. The statute stipulates that transportation investments must be consistent with the Sustainable Communities Strategy and provides CEQA streamlining for local development projects that are consistent with the Strategy.

1.3 Climate Change Mitigation Activities in Carlsbad

The City of Carlsbad has been very progressive in the energy and climate change arena and has already taken many steps to evaluate and reduce the City's energy consumption.

California Climate Action Registry

The City of Carlsbad is a member of the California Climate Action Registry (CCAR) and has voluntarily monitored and reported the City's greenhouse gas (GHG) emissions since 2006.

Energy Efficiency Improvements

In 2005 the City of Carlsbad was selected as the pilot jurisdiction for an Energy Efficiency Program developed by the San Diego Association of Governments' (SANDAG) Energy Working Group (EWG). The Program was designed to help local governments reduce energy use, save on their utility bills, and promote conservation. This pilot project included developing a comprehensive energy management plan and facilitating energy-saving projects. Energy engineers from the San Diego Regional Energy Office (now the California Center for Sustainable Energy) performed energy assessments at several of the City of Carlsbad's buildings and identified energy-related improvements. This study identified thirty Energy Conservation Opportunities (ECOs) and estimated a total annual savings of $150,408 with an implementation cost of $1,039,868 (taking into account rebates), equating to a 6.9 year payback or a 15% return on investment.

Since the completion of the Energy Assessment Report in 2005, the City of Carlsbad has implemented many of the recommended energy-related improvements. For example, lighting retrofits have been completed in various facilities including the Senior Center, City Hall, Stagecoach and Calavera Community Centers, and the Carlsbad Municipal Water

District Maintenance and Operations Building. New chillers have been installed in the City Hall, Cole Library, and the Safety Center, and HVAC equipment efficiency has been improved in the Cole and Dove Libraries.

Thus far, the energy-related measures the City has taken are projected to save an annual 116,713 kWh and $155,204.

Policy 71

The City Council adopted Policy 71 in July of 2006. This Policy outlines the following measures to help Carlsbad reach the goals set out by the City's Energy Conservation and Management Program:

- Maximize energy conservation measures when purchasing equipment and products
- Whenever practicable, design new facilities to be at least 25% more energy efficient than required by the State of California, Title 24 Energy Regulations.
- Strive to achieve LEED "Silver" Level Certification or the equivalent for all new City facilities.
- Maintain and operate City buildings in such a fashion that the minimum amounts of energy are consumed.
- Reduce demand on the energy grid and to enhance energy reliability and independence for City facilities.
- Continually evaluate and update the Building Code so that the most current energy conservation regulations are incorporated in the plans for the construction of buildings by the private sector.
- Create non-financial, building permit processing incentives (e.g. priority building permit processing and inspections) to developers of private property that demonstrate a commitment to building projects that exceed the minimum standards in the State of California, Title 24 Energy Regulations

Sustainable Energy Master Plan

In December of 2008 the City of Carlsbad released their Sustainable Energy Master Plan, a report on potential renewable energy sources and measures to reduce power consumption. This report evaluated a variety of energy efficiency and reduction measures including automated meter readings to monitor water meters and reduce operating costs, off peak water pumping to lower power costs, and variable speed motors to increase efficiency of HVAC systems and water pumps. The Report also evaluated green roofs which reduce inside building temperatures and remove GHGs from the air, as well as solar water heating systems and tankless water heating systems that would reduce energy consumption. Also discussed were hybrid and electric vehicles, energy efficient chillers, LEED, LED traffic signals and interconnection, induction and LED streetlights, and Energy Management Systems.

In terms of renewable energy, the report details solar photovoltaic systems and outlines potential locations for solar PV panels. Wind power and bioenergy were also examined as potential renewable energy sources. The Report also describes hydrokinetic and wave energy, micro-hydropower generators, hydroelectric pressure-reducing stations, microturbine power generation, and fuel cells.

To save on vehicle fuel consumption, the City is pursuing traffic signal coordination on major corridors. The City of Carlsbad has also encouraged water conservation and has implemented water recycling projects to reduce the demand for imported water, thereby reducing energy consumption for pumping.

Fleet Related Energy Management

Over the last several years the City of Carlsbad has downsized their fleet while population continued to grow and service demands continued to increase. A large number of full-size pickups and sedans have been replaced with mid-size, compact, and hybrid vehicles.

Hydro-Electric Project

In early 2009 the City Council authorized moving forward with the development of a hydro-electric project which will produce an estimated 2,200 MWh of electricity per year. The energy is created by using micro-turbines instead of pressure reducing stations to adjust water pressure coming from the County aqueduct. The project is out for design now and is expected to be operational within 12-18 months.

Street Light Retrofit

In 2009 the City Council authorized changing all of the City's street lights (7,000+) from High Pressure Sodium lights to Induction lights. This shift in technology will result in a projected savings of 3,000 MWh per year in electricity with an annual savings of more than $400,000. The California Energy Commission has approved a loan to help the City with the project, and it is anticipated that replacement will begin within the next couple of months.

1.4 The San Diego Regional Climate Protection Initiative

The San Diego Regional Climate Protection Initiative is a joint effort between The San Diego Foundation, ICLEI, and 10 local governments in San Diego County. ICLEI is working directly with local governments in the San Diego region to quantify greenhouse gas emissions and drive regional activity to reduce emissions and enhance resiliency to a changing climate. In addition to performing greenhouse gas inventories for each local jurisdiction, ICLEI is providing ongoing training and technical assistance to participating agencies. The Initiative also includes the initiation and facilitation of a formal regional network of local governments and key stakeholders focused on climate protection initiatives, including both mitigation and adaptation activities. The Network mirrors similar networks across the country that ICLEI supports to engage local governments in information and resource exchange, best practices and lessons learned, as well as collaboration opportunities.

Section Two: Methodology

Methodology

The inventories in this report follow two standards, one for government operations emissions and one for community emissions. As local governments all over the world continue to join the climate protection movement, the need for common conventions and a standardized approach to quantifying greenhouse gas (GHG) emissions is more pressing than ever.

The government operations component of the greenhouse gas emissions inventory follows the standard methodology outlined in the Local Government Operations Protocol (LGOP), which was adopted in 2008 by CARB and serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. By participating in the San Diego Regional Climate Protection Initiative, the City of Carlsbad has the opportunity to be one of the first in the nation to follow LGOP when inventorying emissions from government operations.

The community emissions inventory follows the standard outlined in the draft International Local Government GHG Emissions Analysis Protocol (IEAP). ICLEI has been developing this guidance since the inception of its Cities for Climate Protection Campaign in 1993, and has recently formalized version 1 of the IEAP as a means to set a common framework for all local government worldwide. The community inventory also draws on the methodology developed in the *San Diego County Greenhouse Gas Inventory* developed by the Energy Policy Initiatives Center (EPIC) at the University of San Diego in September 2008.

This chapter outlines the basic methodology utilized in the development of this inventory to provide clarity on how the inventory results were reported. Specifically, this section reviews:

- What greenhouse gases were measured in this inventory.
- What general methods were used to estimate emissions.
- How emissions estimates can be reported (the scopes framework, roll-up numbers).
- How emissions estimates were reported in this inventory.

A more detailed account of the methodology used in this inventory can be found in Appendices A, B, and E.

2.1 Greenhouse Gases

According to both the LGOP and the IEAP, local governments should assess emissions of all six internationally recognized greenhouse gases regulated under the Kyoto Protocol. These gases are outlined in Table 2.1, which includes the sources of these gases and their global warming potential (GWP).[5] This report focuses on the four GHGs most relevant to local government policymaking: CO_2, CH_4, N_2O, and hydrofluorocarbons. These gases comprise a large majority of greenhouse gas emissions at the community level, and are the only gases emitted in Carlsbad's government operations. The omitted gases, SF_6 and perfluorocarbons, are emitted primarily in private sector manufacturing and electricity transmission, and are the subject of regulation at the state level.

Table 2.1 Greenhouse Gases

Gas	Chemical Formula	Activity	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organic Waste (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbons	Various	Leaked Refrigerants, Fire Suppressants	12–11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500–9,200
Sulfur Hexafluoride	SF_6	Transmission and Distribution of Power	23,900

2.2 Calculating Emissions

The majority of the emissions recorded in this inventory have been calculated using **calculation-based methodologies** to derive emissions using activity data and emission factors. To estimate emissions accordingly, the basic equation below is used:

Activity Data x Emission Factor = Emissions

Activity Data

Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see the appendices for detailed listing of the activity data used in composing this inventory.

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5 Global warming potential (GWP) is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide.

Emission Factors

Emission factors are used to convert energy usage or other activity data into associated emissions quantities. They are usually expressed in terms of emissions per unit of activity data (e.g. lbs CO_2/kWh). Please see Appendix B for a listing of emissions factors used in this report. Table 2.2 demonstrates an example of common emission calculations that use this formula.

Table 2.2 Basic Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kilowatt hours)	CO_2 emitted/kWh	CO_2 emitted
Natural Gas Consumption (therms)	CO_2 emitted/therm	CO_2 emitted
Gasoline/Diesel Consumption (gallons)	CO_2 emitted /gallon	CO_2 emitted
Waste Generated by Government Operations (tons)	CH_4 emitted/ton of waste	CH_4 emitted

2.3 Reporting Emissions

LGOP provides two reporting frameworks: reporting by scope and reporting by sector. This section defines the two reporting frameworks and discusses how they are used in this inventory. It also discusses the concept of ―rolling up" emissions into a single number. The section provides guidance on communicating the results of the inventory and using the inventory to formulate emissions reductions policies.

2.3.1 The Scopes Framework

For government operations and community inventories, emissions sources can be categorized by ―scope" according to the entity‘s degree of control over the emissions source and the location of the source. Emissions sources are categorized as direct (Scope 1) or indirect (Scope 2 or Scope 3), in accordance with the World Resources Institute and the World Business Council for Sustainable Development‘s *Greenhouse Gas Protocol Corporate Standard.* The standard is to report emissions by scope as a primary reporting framework.[6]

Community Scope Definitions

The scopes framework includes three emissions scopes for community emissions:

Scope 1: All direct emissions from sources located within the jurisdictional boundaries of the local government, including fuel combusted in the community and direct emissions from landfills in the community.

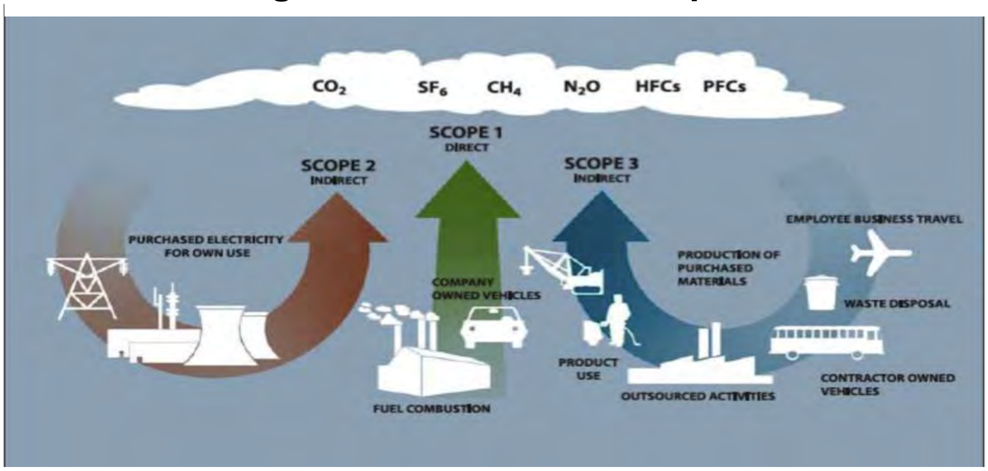
Scope 2: Indirect emissions associated with the consumption of energy that is generated outside the jurisdictional boundaries of the local government.

[6] Another common reporting framework is emissions by sector: See Section 2.3.3-Emisisons Sectors for details

Scope 3: All other indirect or embodied emissions not covered in Scope 2, that occur as a result of activity within the jurisdictional boundaries.

Scope 1 and Scope 2 sources are the most essential components of a community greenhouse gas analysis. This is because these sources are typically the most significant in scale, and are most easily impacted by local policy making. The IEAP also includes, in its *Global Reporting Standard,* the reporting of Scope 3 emissions associated with the future decomposition of solid waste generated in the community in the base year.

Figure 2.1 Emissions Scopes



Source: WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition), Chapter 4.

Government Scope Definitions

Similar to the community framework, the government scopes are divided into three main categories:

Scope 1: Direct emissions from sources within a local government‘s operations that it owns and/or controls. This includes stationary combustion to produce electricity, steam, heat, and power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; leaked refrigerants; and other sources.

Scope 2: Indirect emissions associated with the consumption of electricity, steam, heating, or cooling that are purchased from an outside utility.

Scope 3: All other emissions sources that hold policy relevance to the local government that can be measured and reported. This includes all indirect emissions not covered in Scope 2 that occur as a result of activities within the operations of the local government. Scope 3 emission sources include (but are not limited to) tailpipe emissions from employee commutes, employee business travel, and emissions resulting from the decomposition of government-generated solid waste.

2.3.2 Double Counting and Rolling Up Scopes

Many local governments find it useful for public awareness and policymaking to use a single number (a ―roll-up” number) to represent emissions in its reports, target setting, and action plan. A roll-up number allows local governments to determine the relative proportions of emissions from various sectors (e.g., 30 percent of rolled up emissions came from the vehicle fleet), which can help policymakers and staff identify priority actions for reducing emissions from their operations.

For these reasons, this report includes roll-up numbers as the basis of the both the government operations and community emissions analyses in this inventory. This roll-up number is composed of direct emissions (Scope 1), all emissions from purchased electricity (Scope 2), and other indirect emissions (Scope 3).

While this report uses a standard roll-up number, these numbers should be used with caution, as they can be problematic for three reasons:

First, a roll-up number does not represent all emissions from Carlsbad‘s operations, only a summation of inventoried emissions using available estimation methods. Reporting a roll-up number can be misleading and encourage citizens, staff, and policymakers to think of this number as the local government‘s ―total” emissions. Therefore, when communicating a roll-up number it is important to represent it only as a sum of inventoried emissions, not as a comprehensive total.

Second, rolling up emissions may not simply involve adding emissions from all sectors, as emissions from different scopes can be double-counted when they are reported as one number. For example, if a local government operates a municipal utility that provides electricity to government facilities, these are emissions from both the power generation and facilities sectors. If these sectors are rolled up into a single number, these emissions are double counted, or reported twice. For these reasons, it is important to be cautious when creating a roll-up number to avoid double counting; the roll-up number used in this report was created specifically to avoid any possible double counting.

Third, it is very difficult to use a roll-up number as a common measure between local governments, which is how the results are sometimes applied. Currently, there is no national or international standard for reporting emissions as a single roll-up number. In addition, local governments provide different services to their citizens, and the scale of the services (and thus the emissions) is highly dependent upon the size of the jurisdiction. For these reasons, comparisons between local government roll-up numbers should not be made without significant analysis of the basis of the roll-up number and the services provided by the local governments being compared.

Furthermore, the results from the government operations component and community component of the inventory should not be rolled-up into one number, as government operations emissions are already accounted for as one source among many in the community inventory.

2.3.3 Emissions Sectors

In addition to categorizing emissions by scope, ICLEI recommends that local governments examine their emissions in the context of the sector that is responsible for those emissions. Many local governments will find a sector-based analysis more directly relevant to policy making and project management, as it assists in formulating sector-specific reduction measures and climate action plan components. The government operations inventory uses LGOP sectors as a primary reporting framework, including the following sectors:

- Buildings and other facilities
- Streetlights, traffic signals, and other public lighting
- Water delivery and collection facilities
- Recycled water facilities
- Vehicle fleet and mobile equipment
- Government-generated solid waste
- Emissions from employee commutes

The community inventory reports emissions by the following sectors:

- Residential. This sector includes Scope 1 natural gas combustion and Scope 2 electricity consumption.
- Commercial/Industrial. This sector includes Scope 1 fuel combustion and Scope 2 electricity consumption.
- Transportation. The transportation sector includes exclusively Scope 1 transportation fuel combustion.
- Solid Waste. The sector includes Scope 1 emissions from landfills located in the jurisdiction and Scope 3 emissions from future decomposition of solid waste generated in the community in the base year.
- Wastewater. This sector includes Scope 3 emissions from treatment of wastewater generated in the community.

Section Three: Government Operations Inventory Results

Government Operations Inventory Results

This chapter provides a detailed description of Carlsbad's greenhouse gas emissions from government operations in 2005, rolling up and comparing emissions across sectors and sources as appropriate. This chapter also provides details on emissions from each sector, including a breakdown of emissions types and, where possible, an analysis of emissions by department. This information identifies more specific sources of emissions (such as a particular building) that can help staff and policymakers in Carlsbad to best target emissions reduction activities in the future.

For a report of emissions by scope, and a detailed description of the methodology and emission factors used in calculating the emissions from Carlsbad's operations, please see Appendix B: LGOP Standard Report.

In 2005, Carlsbad's government operations greenhouse gas emissions totaled 6,556 metric tons of CO_2e. In this report, this number is the basis for comparing emissions across sectors and sources (fuel types), and is the aggregate of all emissions estimates included in the body of this inventory.

3.1 Summary by Sector

Reporting emissions by sector provides a useful way to understand the sources of Carlsbad's emissions. By better understanding the relative scale of emissions from each of the sectors, Carlsbad can more effectively focus emissions reductions strategies to achieve the greatest emissions reductions.[7]

7 The sectors with the largest scale of emissions do not necessarily represent the best opportunity for emissions reductions. Cost, administration, and other concerns may affect Carlsbad's ability to reduce emissions from any one sector.

Figure 3.1 2005 Carlsbad Government Operations Emissions by Sector

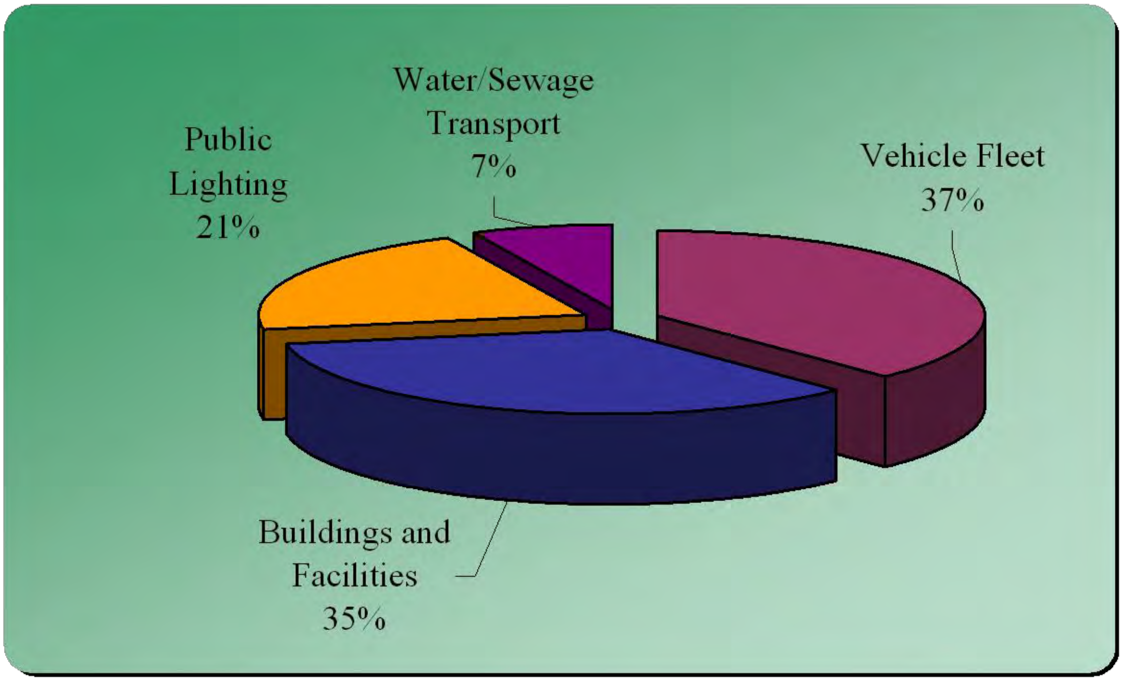


Table 3.1: 2005 Carlsbad Government Operations Emissions by Sector

Sector	Greenhouse Gas Emissions
Vehicle Fleet	2,474
Buildings and Facilities	2,266
Public Lighting	1,354
Water/Sewage Transport	461
All units are in metric tons CO_2e	

As visible in Figure 3.1, the City's vehicle fleet was the largest emitter (2,474 metric tons CO_2e) in 2005. Emissions from building and facilities produced the second highest quantity of emissions, resulting in 2,266 metric tons of CO_2e. Carlsbad's public lighting produced 1,354 metric tons of CO_2e of total emissions with the remainder coming from water and sewage transport.

3.2 Summary by Source

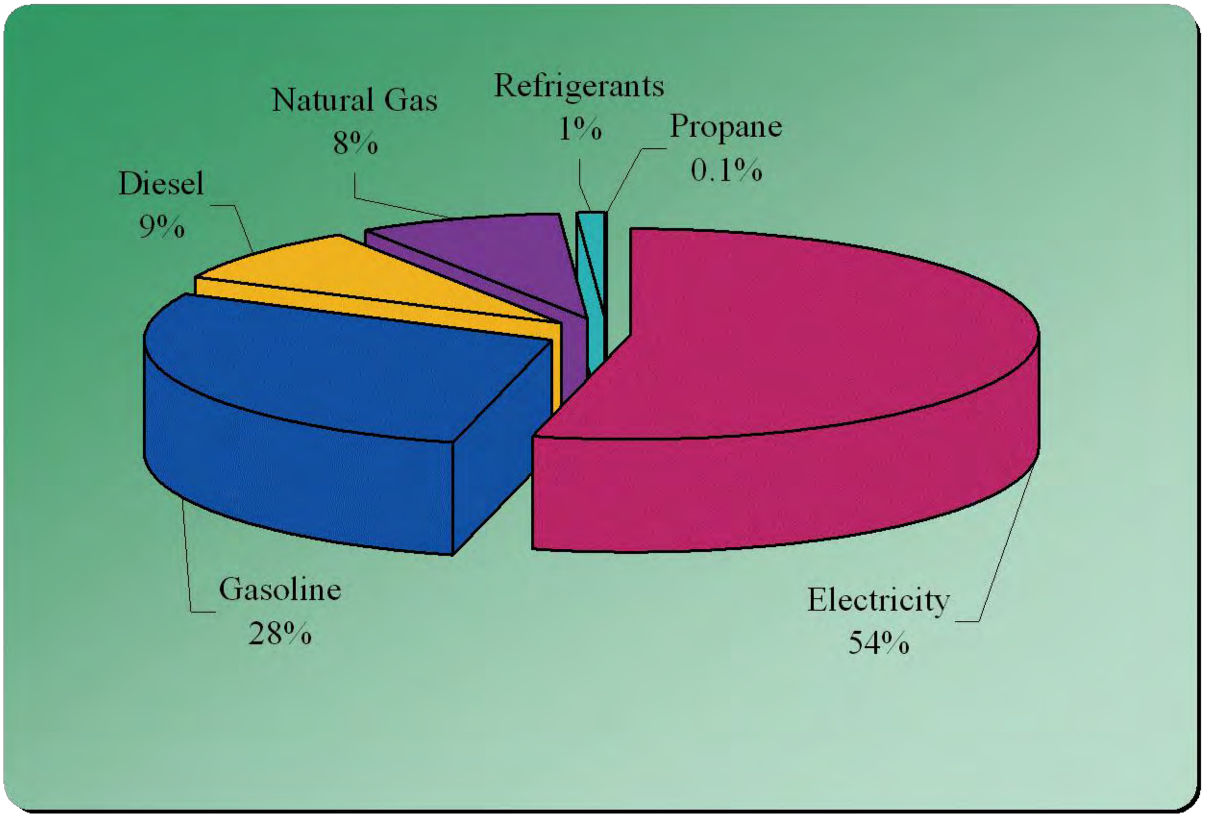
When considering how to reduce emissions, it is helpful to look not only at which sectors are generating emissions, but also at the specific raw resources and materials (gasoline, diesel, electricity, natural gas, solid waste, etc.) whose use and generation directly result in the release of greenhouse gases. This analysis can help target resource management in a way that will successfully reduce greenhouse gas emissions. Table 3.2 and Figure 3.2 provide a summary of Carlsbad's government operations 2005 greenhouse gas emissions by fuel type or material.

Table 3.2: 2005 Government Operations Emissions by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)
Electricity	3,534
Gasoline	1,853
Diesel	560
Natural Gas	537
Refrigerants	67
Propane	6

All units are in metric tons CO_2e

Figure 3.2 2005 Carlsbad Government Operations Emissions by Source



3.3 Summary of Energy-Related Costs

In addition to tracking energy consumption and generating estimates on emissions per sector, ICLEI has calculated the basic energy costs of various government operations. During 2005, Carlsbad spent approximately $2,621,937 on energy (e.g., electricity, natural gas, gasoline, and diesel) for its operations. Over 78 percent of these energy expenses ($2,051,680) are the result of electricity and natural gas purchases from SDG&E. Carlsbad spent approximately $570,257 on gasoline and diesel for the municipal fleet (22 percent of total costs). Beyond reducing harmful greenhouse gases, any future reductions in energy use will have the potential to reduce these costs, enabling Carlsbad to reallocate limited funds toward other municipal services or create a revolving energy loan fund to support future climate protection activities.

Table 3.3 2005 Carlsbad Energy Costs by Sector

Sector	Cost
Buildings and Facilities	$1,071,484
Public Lighting	$696,130
Vehicle Fleet	$570,257
Water / Sewage Transport	$284,066
TOTAL	**$2,621,937**

3.4 Detailed Sector Analyses

3.4.1 Buildings and Other Facilities

Through their use of energy for heating, cooling, lighting, and other purposes, buildings and other facilities operated by local governments constitute a significant amount of their greenhouse gas emissions. Carlsbad operates 27 facilities and numerous parks, including City administration buildings, two libraries, five fire stations, a swim complex, and three community centers. Facility operations contribute to greenhouse gas emissions in two main ways. The majority of emissions are related to the consumption of electricity and fuels such as natural gas and diesel. In addition, fire suppression, air conditioning, and refrigeration equipment in buildings can emit hydrofluorocarbons (HFCs) and other greenhouse gases when these systems leak refrigerants or fire suppressants.

In 2005, the operation of Carlsbad's facilities produced approximately 2,266 metric tons of CO_2e from the above sources. Table 3.4 shows estimated costs associated with the activities that generated these emissions, and Figure 3.3 depicts 2005 emissions per facility or department. Of total facility emissions, 76 percent came from the consumption of electricity, 24 percent came from the combustion of natural gas, and less than 1 percent came from the combustion of other fuels such as diesel and propane (see Figure 3.4). Carlsbad spent approximately $1,071,484 in 2005 on the fuels and electricity that were the cause of these emissions.

Table 3.4: Energy Use and Emissions from Major Facilities

Facility	Greenhouse Gas Emissions (metric tons CO_2e)	Percent Emissions of All Facilities	Electricity Use (kWh)	Natural Gas Use (therms)	Total Energy Cost
Libraries	559	25%	1,802,637	20,467	$227,777
Safety Center	402	18%	1,163,336	20,845	$138,705
Parks and Recreation	335	15%	1,230,178	4,904	$271,295
City Administration	282	12%	1,099,520	1,430	$126,845
Swim Complex	216	10%	202,520	31,116	$58,415
City Hall	119	5%	294,080	8,552	$52,086
Fire Stations	98	4%	289,274	4,876	$52,705
Senior Center	90	4%	224,100	6,319	$44,890
Maintenance Yards	56	2%	173,501	1,632	$30,140
CMWD M&O	53	2%	197,920	754	$29,993
Other Facilities	55	2%	218,810	71	$38,633
TOTAL	**2,266**	**100%**	**6,895,876**	**100,966**	**$1,071,484**

Figure 3.3: Emissions from Major Facilities

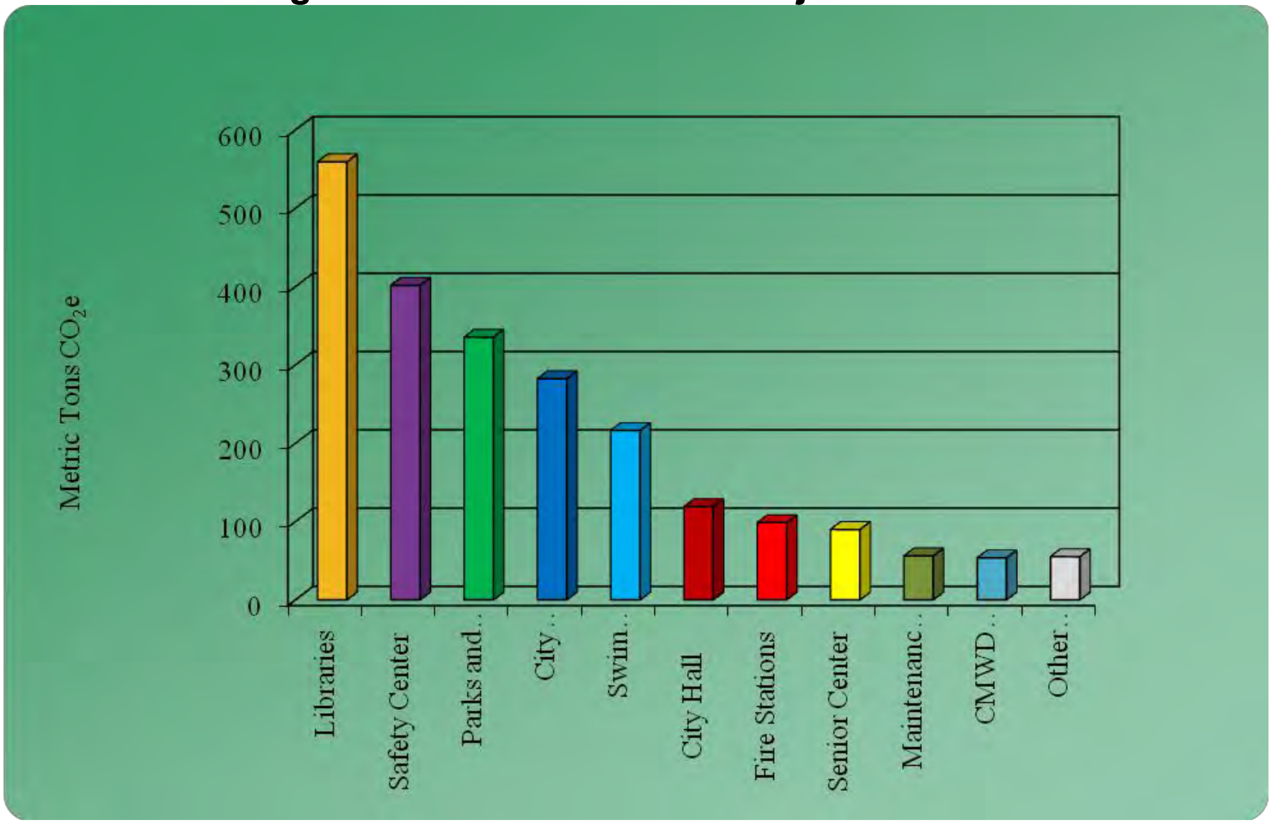
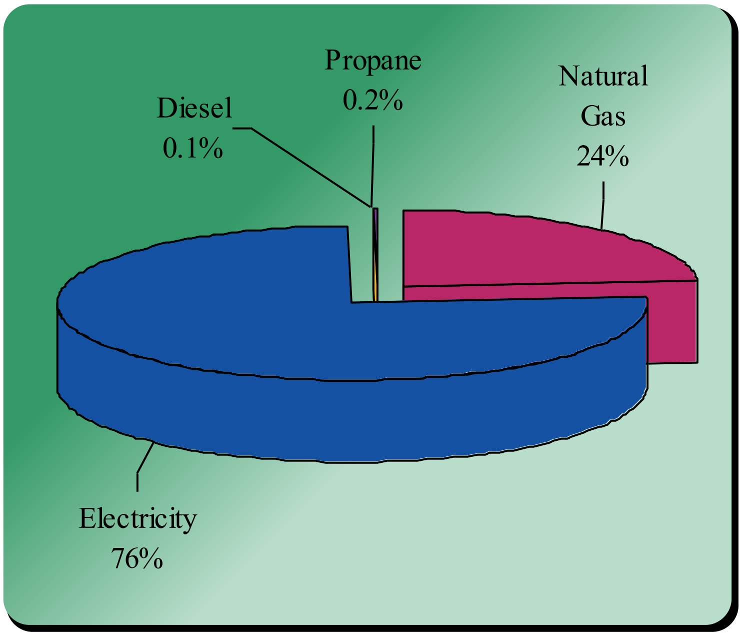


Figure 3.4: Emissions from Major Facilities by Source



3.4.2 Streetlights, Traffic Signals, and Other Public Lighting

Like most local governments, Carlsbad operates a range of public lighting, from traffic signals and street lights to outdoor and park lights. Electricity consumed in the operation of this infrastructure is a significant source of greenhouse gas emissions.

In 2005, public lighting in Carlsbad consumed a total of 5,424,206 kWh of electricity, producing approximately 1,354 metric tons CO_2e. Table 3.5 depicts 2005 emissions per lighting type and estimated electricity consumption and costs associated with the activities that generated these emissions. Carlsbad spent approximately $696,130 in 2005 on the fuels and electricity that were the cause of these emissions.

Table 3.5: Energy Use and Emissions from Public Lighting

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent Emissions of All Lighting	Electricity Use (kWh)	Cost
Streetlights	1,162	86%	4,652,801	$572,637
Traffic Signals/Controllers	187	14%	750,417	$116,364
Outdoor Lighting	5	0.4%	20,988	$7,129
TOTAL	**1,354**	**100%**	**5,424,206**	**$696,130**

3.4.3 Water Transport

This section addresses any equipment used for the distribution of water and collection of wastewater.[8] Typical systems included in this section are water pumps/lifts and sprinkler and other irrigation controls. Carlsbad operates a range of water transport equipment, including water distribution pumps, recycled water pumps, and wastewater collection systems. Electricity consumption is the most significant source of greenhouse gas emissions from the operation of Carlsbad‘s water transport equipment.

In 2005, the operation of Carlsbad‘s water transport equipment produced approximately 461 metric tons of CO_2e from the above sources. Table 3.6 depicts 2005 emissions per equipment type and shows estimated activities and costs associated with the operation of this equipment. Carlsbad spent approximately $284,066 in 2005 on the fuels and electricity that were the cause of these emissions.

Table 3.6: Energy Use and Emissions from Water Transport Equipment

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent Emissions of Water Transport Equipment	Electricity Use (kWh)	Cost ($)
Sewage Pumps	263	57%	1,038,941	$156,370
Recycle Pump Stations	105	23%	418,980	$59,035
Water Pumps	90	19%	360,237	$65,862
Irrigation / Sprinkler Systems	3	1%	13,151	$2,799
TOTAL	**461**	**100%**	**1,831,309**	**$284,066**

3.4.4 Vehicle Fleet and Mobile Equipment

The majority of local governments use vehicles and other mobile equipment as an integral part of their daily operations—from maintenance trucks used for parks and recreation to police cruisers and fire trucks. These vehicles and equipment burn gasoline, diesel, and other fuels, which results in greenhouse gas emissions. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle. Emissions from vehicles and mobile equipment compose a significant portion of emissions within most local governments.

8 While equipment that transports water and stormwater may be managed separately in Carlsbad‘s operations, the types of equipment are similar, and therefore the ways to reduce emissions from this equipment, are similar. For this reason, this section groups equipment used for transporting water and wastewater.

Table 3.7: Vehicle Fleet and Mobile Equipment Emissions[9]

Function	Greenhouse Gas Emissions (metric tons CO_2e)	Percent of All Mobile Emissions	Gasoline Consumption (gal)	Diesel Consumption (gal)	Cost
Police Department	967	40%	108,626	124	$233,062
Fire Department	317	13%	8,769	23,452	$77,670
Parks and Recreation	308	13%	23,725	9,238	$70,638
Water Operations	254	11%	23,870	3,974	$59,316
Street Maintenance	229	9%	11,479	12,359	$51,931
Engineering	100	4%	11,071	0	$23,362
Sewer Operations	81	3%	2,899	5,378	$18,397
Facilities Maintenance	52	2%	5,757	0	$12,187
Building	47	2%	5,292	0	$11,245
Stormwater	3	0.1%	284	65	$761
Other	50	2%	5,515	0	$11,688
TOTAL	**2,408**	**100%**	**207,286**	**54,589**	**$570,257**

In 2005, the City of Carlsbad operated a vehicle fleet with 279 vehicles and 45 pieces of equipment. Carlsbad‘s vehicle fleet performed a number of essential services, from maintaining parks, streets, and facilities, to protecting the City through the fire and police fleets. In 2005, the police department made up the majority of vehicles in the fleet (38 percent), followed by the fire department while other departments including parks and recreation, water operations, street maintenance, and engineering made up the rest of the fleet.

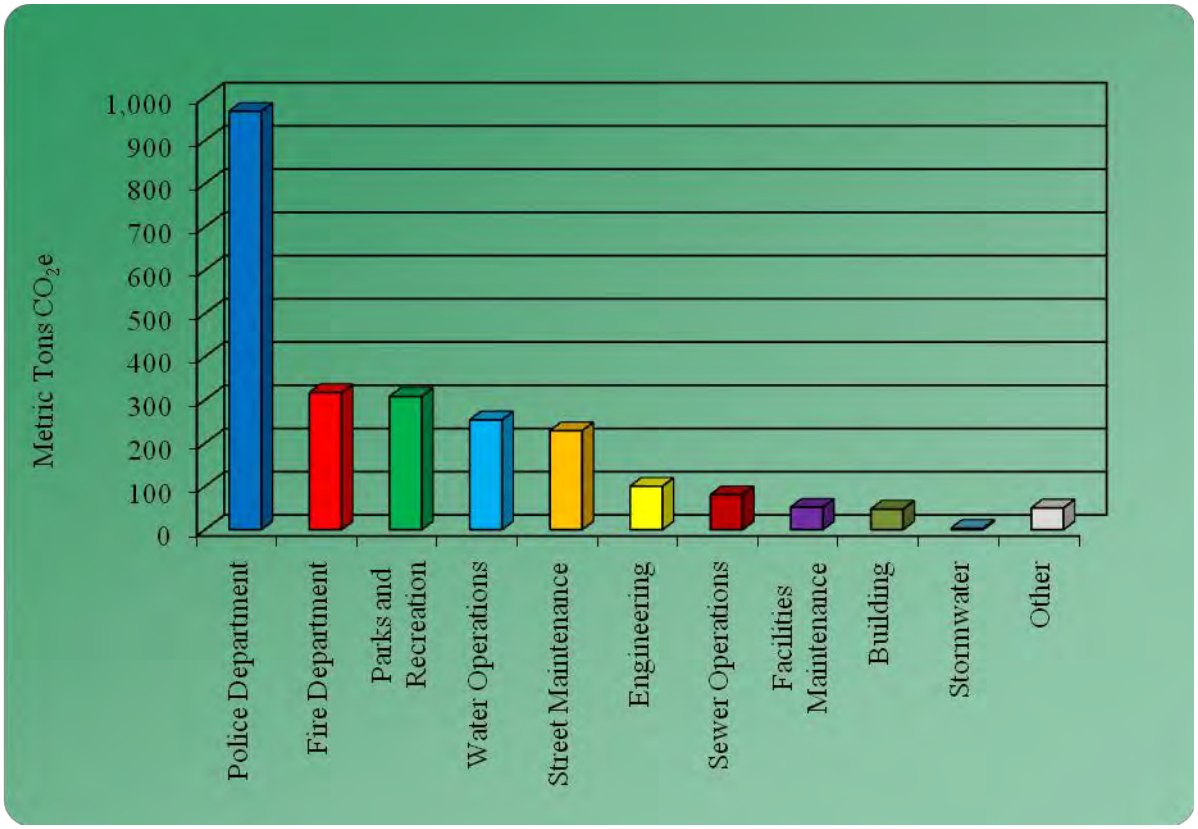
In 2005, Carlsbad emitted approximately 2,408 metric tons of CO_2e as a result of the combustion of fuels to power the City‘s vehicle fleet. Table 3.7 shows estimated costs associated with the activities that generated these emissions, and Figure 3.5 depicts 2005 emissions per department. Across departments, the vehicles used by the police department were the largest emitters of greenhouse gases, representing 40 percent of total vehicle fleet emissions. The fire department and parks and recreation were the next largest emitters of greenhouse gases responsible for 13 percent of emissions each respectively.

Across all government operations, emissions from mobile sources made up 27 percent of all inventoried emissions. Of total mobile emissions, 75 percent came from the consumption of gasoline, 22 percent came from the combustion of diesel, and the remaining 3 percent came from leaked refrigerants[10].The City of Carlsbad spent approximately $570,257 in 2005 on the fuels that were the cause of these emissions.

9 The numbers reported here include emissions from fuel consumption only-emissions from leaked refrigerants are reported separately.

10 The LGOP Alternative Method (Mobile Fugitive Emissions) was used to estimate emissions from leaked refrigerants. This amount is likely to be a significant overestimate due to high default ranges but in line with LGOP methods.

Figure 3.5: Emissions from Mobile Sources



Section Four: Community Inventory Results

Community Inventory Results

4.1 Community Inventory Summary

In 2005, activities and operations taking place within Carlsbad's jurisdictional boundaries resulted in approximately 925,248 metric tons of CO_2e. This number includes Scope 1 emissions from the on-site combustion of fuels in the residential and commercial / industrial sectors,[11] and from the combustion of gasoline and diesel in vehicles traveling on local roads and state highways within Carlsbad. This figure also includes all Scope 2 emissions associated with community electricity consumption, and Scope 3 emissions from waste and wastewater generated by the Carlsbad community.[12]

4.1.1 Summary by Scope

As shown in Table 4.1, Scope 1 sources produced the largest amount of community greenhouse gas emissions in 2005, totaling 700,375 metric tons of CO_2e. Scope 2 emissions constituted the second largest amount (193,059 metric tons of CO_2e), and Scope 3 emissions totaled 31,814 metric tons of CO_2e.[13]

Scope 1 Emissions

In 2005, Carlsbad's community produced 700,375 metric tons CO_2e of Scope 1 greenhouse gas emissions. As seen in Figure 4.1, the largest percent (84 percent) of Scope 1 emissions resulted from combustion of transportation fuels. The second largest source of Scope 1 emissions was stationary natural gas combustion, constituting 16 percent of Scope 1 emissions.

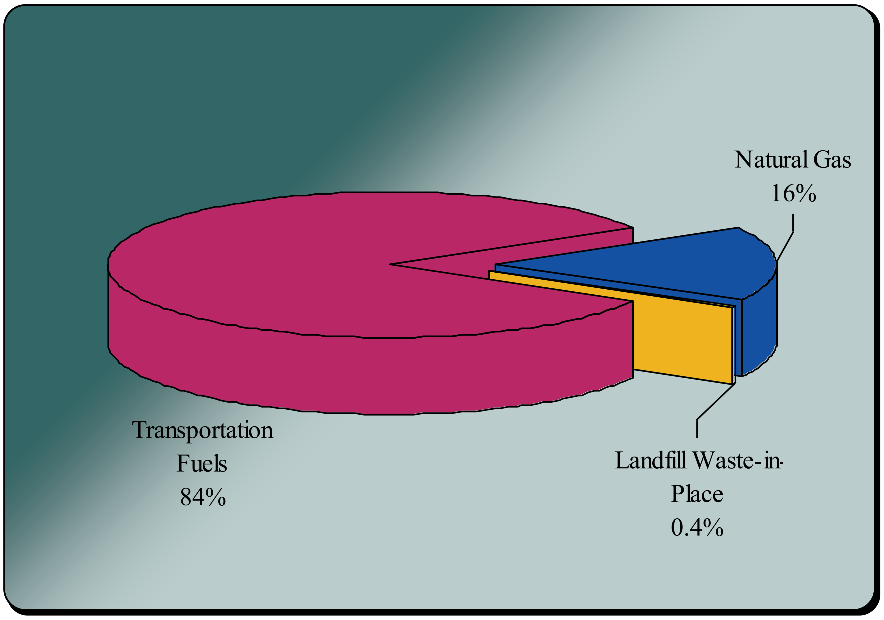
[11] Emissions from the combustion of natural gas at the Encina electricity generation facility were excluded from reporting of emissions in this inventory. While the emissions occur inside the boundaries of Carlsbad, the City elected not to report these emissions to allow for a more straightforward comparison of sectors over which the City has jurisdictional influence. The emissions were estimated at 1,251,972 metric tons CO_2e.
[12] For a detailed description of scopes, please see Section 2: Methodology
[13] These emissions have not been totaled as this may result in double counting and a percentage is not significantly relevant to forming emissions reduction policy. The summaries by sector and source have percentage breakdowns, as do individual sources of emissions.

Table 4.1: Community Emissions Summary by Scope in Metric Tons

Activity	CO_2e emitted	Scope Total
Scope 1		**700,375**
Transportation Fuels	584,369	
Natural Gas*	113,409	
Landfill Waste-in-Place	2,598	
Scope 2		**193,059**
Purchased Electricity	193,059	
Scope 3		**31,814**
Community-Generated Solid Waste	27,417	
Wastewater	4,397	

*In addition to approximately 1,251,972 metric tons CO_2e emitted at the Encina generation facility

Figure 4.1 Community Scope 1 Emissions



Scope 2 Emissions

In 2005, Carlsbad's community generated 193,059 metric tons of CO_2e in the form of Scope 2 emissions. All Scope 2 emissions in this inventory result from electricity consumed within Carlsbad but purchased from outside entities.

Scope 3 Emissions

In 2005, Carlsbad's community generated 31,814 metric tons of CO_2e in the form of Scope 3 emissions. Scope 3 emissions reported include those resulting from the decomposition of solid waste and the treatment of wastewater generated by the community in 2005, as well as from the decomposition of waste-in-place at the inactive Palomar Airport Landfill.

4.1.2 Summary by Sector

By better understanding the relative scale of emissions from each primary sector, Carlsbad can more effectively focus emissions reductions strategies to achieve the greatest emission reductions. For this reason, an analysis of emissions by sector is included in this report, based on the total of 925,248 metric tons of CO_2e. The five sectors included in this inventory are the following:

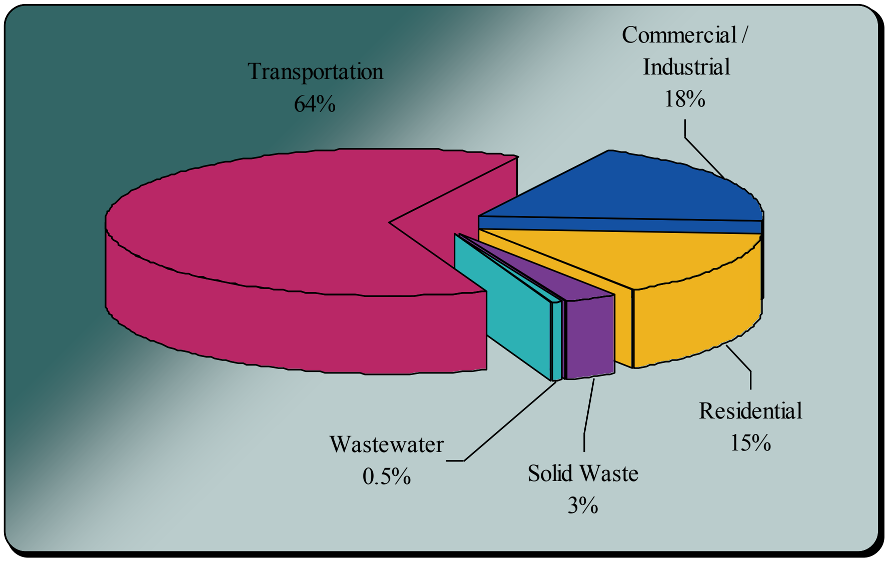
1. Residential
2. Commercial / Industrial
3. Transportation
4. Solid Waste
5. Wastewater

As shown in Figure 4.2, the transportation sector was the largest emitter (64 percent) in 2005 (584,369 metric tons of CO_2e). Emissions from the commercial / industrial sector produced the second highest quantity, resulting in 18 percent of total emissions, or 170,041 metric tons of CO_2e. The remainder of emissions came from the residential sector (15 percent), the solid waste sector (3 percent), and the wastewater sector (0.5 percent). Please see detailed sector emissions analyses below for more detail.

Table 4.2: Community Emissions Summary by Sector

Sector	Greenhouse Gas Emissions (metric tons CO_2e)
Transportation	584,369
Commercial / Industrial	170,041
Residential	136,427
Solid Waste	30,015
Wastewater	4,397

Figure 4.2 Community Emissions Summary by Sector



4.1.3 Summary by Source

When considering how to reduce emissions, it is also helpful to look not only at which sectors are generating emissions, but also at the specific raw resources and materials whose use and generation directly result in the release of greenhouse gases. Such analysis can help target resource management in a way that will successfully reduce greenhouse gas emissions. Below (Figure 4.3 and Table 4.3) is a summary of Carlsbad_s 2005 greenhouse gas emissions by fuel type or material, based upon the total community emissions of 925,248 metric tons.

Figure 4.3 Community Emissions Summary by Source

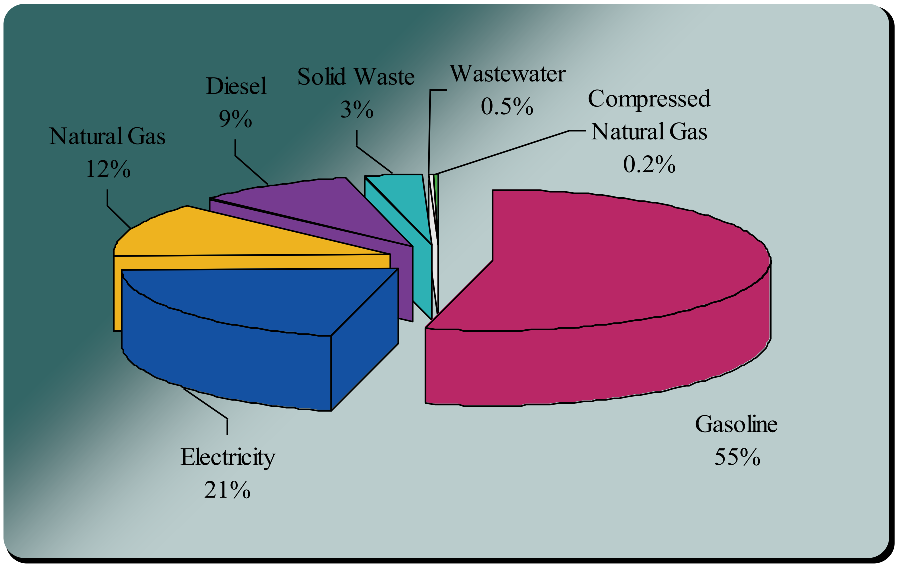


Table 4.3: 2005 Community Emissions by Source

Source	Greenhouse Gas Emissions (metric tons CO_2e)
Gasoline	497,869
Electricity	193,059
Natural Gas	113,409
Diesel	84,958
Solid Waste	30,015
Wastewater	4,397
Compressed Natural Gas	1,542
TOTAL	**925,248**

4.1.4 Per Capita Emissions

Per capita emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one community's emissions with neighboring cities and against regional and national averages. That said, due to differences in emission inventory methods, it can be problematic to produce directly comparable per capita emissions numbers, and one must be cognizant of a margin of error when comparing figures between jurisdictions.

As shown in Table 4.4, dividing the total community-wide GHG emissions by population yields a result of 9.7 metric tons of CO_2e *per capita*. It is important to note that this number is not the same as the carbon footprint of the average individual living in Carlsbad (which would include lifecycle emissions, emissions resulting from air travel, and other indirect emissions).

Table 4.4: Per Capita Emissions

Estimated 2005 Population*	94,961
Community GHG Emissions (MT CO_2e)	925,248
Per Capita GHG Emissions (MT CO_2e)	9.7

4.2 Community Inventory Detail by Sector

This section explores community activities and emissions by taking a detailed look at each primary sector. As listed above, the sectors included in the community emissions analysis are:

- Residential
- Commercial / Industrial
- Transportation

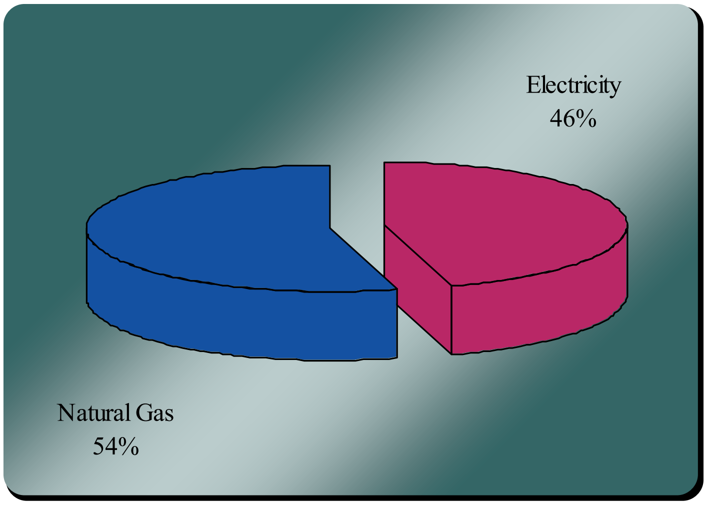
- Solid Waste
- Wastewater

4.2.1 Residential Sector

Energy consumption associated with Carlsbad homes produced 136,427 metric tons of greenhouse gas emissions in 2005 (15 percent of total community emissions). All residential sector emissions are the result of electricity consumption and the on-site combustion of natural gas. Emissions from lawn equipment, wood-fired stoves, transportation and waste generation are not included in these totals.

In 2005, Carlsbad's entire residential sector consumed 249,287 MWh of electricity and around 13.9 million therms of natural gas. As shown in Figure 4.4, 54 percent of total residential emissions were the result of natural gas use, and 46 percent were the result of electricity consumption. Natural gas is typically used in residences as a fuel for home heating, water heating and cooking, and electricity is generally used for lighting, heating, and to power appliances.

Figure 4.4 Residential Emissions by Source



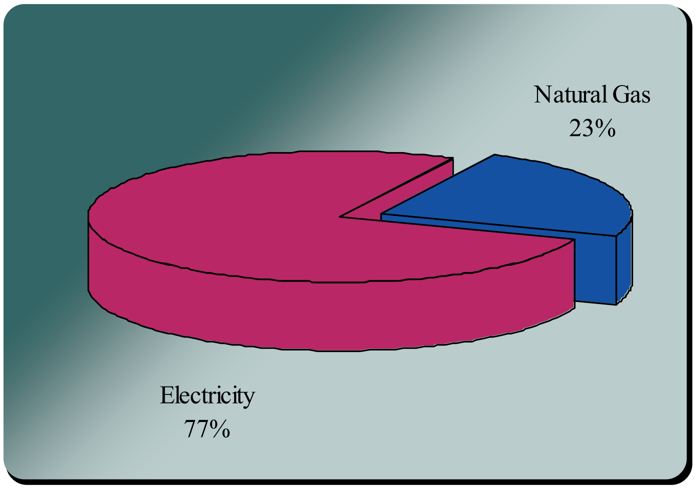
4.2.2 Commercial / Industrial Sector

The commercial / industrial sector includes emissions from the operations of businesses as well as public agencies. For example, the majority of buildings and facilities included in the government operations inventory are also included as a subset of the commercial / industrial sector. In 2005, buildings and facilities within the commercial / industrial sector produced 170,041 metric tons of greenhouse gas emissions (18 percent of total community emissions). All commercial / industrial sector emissions included in this inventory are the result of electricity consumption and the on-site combustion of natural gas. It is important to note that emissions from off-road equipment, transportation, waste generation, stationary combustion other than natural gas, and other industrial processes are not included in these totals.

Carlsbad businesses generated 2.9 metric tons of GHG emissions per job in 2005.[14] This metric provides an indication of the carbon intensity of economic activity in Carlsbad.

As shown in Figure 4.5, 23 percent of total commercial / industrial emissions were the result of natural gas use,[15] and 77 percent were the result of electricity consumption. Natural gas is typically used in the commercial / industrial sector to heat buildings, fire boilers, and generate electricity; and electricity is generally used for lighting, heating, and to power appliances and equipment.

Figure 4.5 Commercial / Industrial Emissions by Source



4.2.3 Transportation Sector

As with many other local governments, transportation within Carlsbad's geographical boundary constitutes the greatest percentage (64 percent) of community wide greenhouse gas emissions – 584,369 metric tons CO_2e.

As shown in Table 4.5, 95 percent of transportation sector emissions came from on-road travel, with the remaining five percent originating from off-road vehicle use. Of on-road transportation activity, travel on local city roads

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[14] 2005 jobs data was provided by SANDAG Technical Services Department, *Current Estimates,* August 2009.
[15] As previously noted, emissions from the combustion of natural gas at the Encina electricity generation facility were not reported in this inventory.

constituted 52 percent of emissions, and 43 percent came from travel on state highways within the jurisdictional boundaries of Carlsbad. An estimated 84 percent of transportation emissions were due to gasoline consumption with just less than 15 percent coming from diesel use and a small fraction from compressed natural gas in off-road vehicles.[16] Please see Appendix E for more detail on methods used in calculating emissions from the transportation Sector.

Table 4.5: 2005 Transportation Emissions by Type

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Share of Total Transportation Emissions
On-Road Transportation		
Local Roads	302,370	52%
State Highways	253,036	43%
On-Road Subtotal	*555,405*	*95%*
Off-Road Transportation	28,963	5%
TOTAL	**584,369**	**100%**

4.2.4 Solid Waste Sector

As noted above in Figure 4.2, the solid waste sector constituted three percent of total emissions for the Carlsbad community in 2005. Emissions from the solid waste sector are an estimate of methane generation from the decomposition of municipal solid waste (MSW) and alternative daily cover (ADC) sent to landfill in the base year (2005). These emissions are considered Scope 3 because they are not generated in the base year, but will result from the decomposition of 2005 waste over the full 100+ year cycle of its decomposition. As stated in the Government Inventory section, about 75 percent[17] of landfill methane emissions are captured through landfill gas collection systems, but the remaining 25 percent escape into the atmosphere as a significant contributor to global warming. The solid waste sector also includes base year emissions from waste-in-place at the inactive Palomar Airport Landfill. Please see Table 4.6 on the next page for a summary of emissions per waste type.[18]

[16] These figures do not account for alternative fuels in on-road transportation, which continue to comprise a negligible portion of on-road emissions.
[17] US EPA AP 42.
[18] Waste characterization figures were provided by the 2004 *California Waste Characterization Study*, http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097

Table 4.6: Waste Emissions Sources

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Share of Total Waste Emissions
Paper Products	13,887	51%
Food Waste	5,465	20%
Wood / Textiles	4,080	15%
Plant Debris	3,985	15%
TOTAL	**27,417**	**100%**

4.2.5 Wastewater Sector

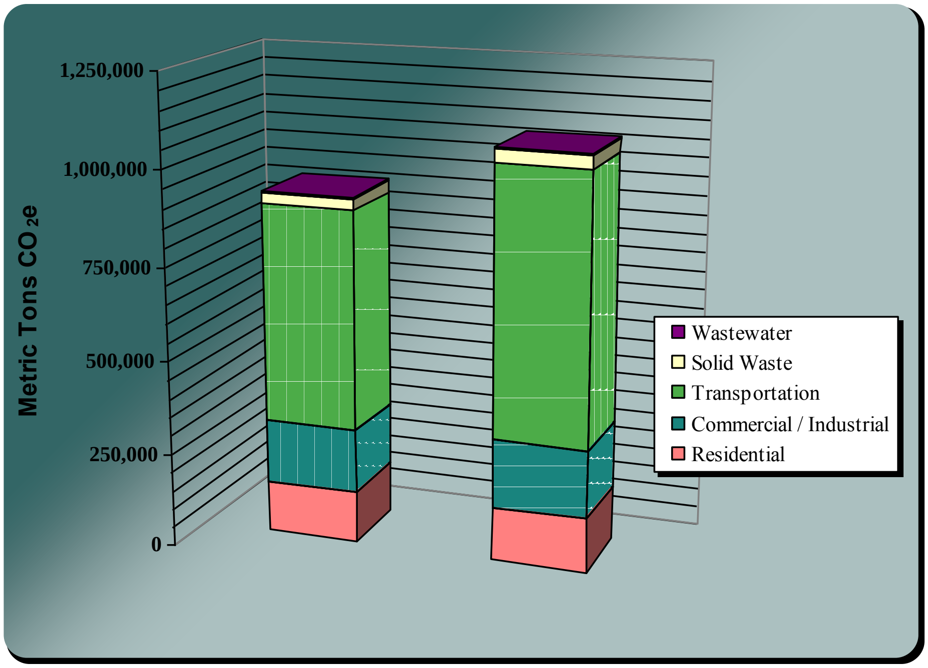
The wastewater sector contributed 4,397 metric tons of greenhouse gas emissions, constituting 0.5 percent of total emissions for the Carlsbad community in 2005. Emissions from the wastewater sector are an estimate of methane and nitrous oxide generated in the process of wastewater treatment. These emissions are considered Scope 3 because occur ―downstream" from the community where the wastewater was generated. Scope 1 emissions from the Encina Water Pollution Control Facility, like those of the Encina electricity generation facility, are not included in this inventory. In the San Diego region, about 71 percent[19] of wastewater treatment methane emissions are captured through biogas collection systems, but the remainder escape into the atmosphere and contribute the jurisdiction's impact on climate change.

4.3 Community Emissions Forecast

To illustrate the potential emissions growth based on projected trends in energy use, driving habits, job growth, and population growth from the baseline year going forward, this report includes an emissions forecast for the year 2020. Under a business-as-usual scenario, Carlsbad's emissions will grow by approximately 16 percent by the year 2020, from 925,248 to 1,121,673 metric tons CO_2e. Figure 4.6 and Table 4.7 show the results of the forecast. A variety of different reports and projections were used to create the emissions forecast, as profiled on the following page.

[19] *San Diego County Greenhouse Gas Inventory*, USD Energy Policy Initiatives Center.

Figure 4.6 Community Emissions Growth Forecast for 2020



4.3.1 Residential Forecast

For the residential sector, a households projection for Carlsbad conducted by the San Diego Association of Government (SANDAG) was used to estimate average annual compound growth in residential energy demand (1.4 percent). SANDAG estimates that the number of Carlsbad households was 37,467 in 2005, and will be 46,157 in 2020.[20]

4.3.2 Commercial / Industrial Forecast

The California Energy Commission's *California Energy Demand 2008-2018* shows that commercial floor space and the number of jobs have closely tracked the growth in energy use in the commercial sector. Using job growth projections for Carlsbad also provided by SANDAG, it was calculated that the average annual growth in energy use in the commercial / industrial sector between 2005 and 2020 will be 0.97 percent.[21]

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[20] SANDAG 2030 Regional Growth Forecast Update (2006).
[21] Ibid.

4.3.3 Transportation Forecast

Growth in transportation emissions over the forecast period is closely related to planned transportation infrastructure investments and the associated vehicle activity, as measured in vehicle miles traveled (VMT). Long-term transportation infrastructure is planned through the 2030 San Diego Regional Transportation Plan, published by SANDAG in 2007, and travel activity projections performed by SANDAG are based on this plan. These projections forecast a 22 percent increase in regional VMT between 2005 and 2020; this trend was applied to Carlsbad's 2005 VMT to estimate 2020 travel activity. While this increase is attributed to regional travel as a whole and not specifically local travel in Carlsbad, local VMT is likely to follow a similar trend, and this forecasting approach is more reliable than applying state-wide travel forecasts to the local level.[22]

4.3.4 Solid Waste and Wastewater Forecast

Population is the primary determinate for growth in emission pertaining to solid waste and wastewater generation. Therefore, the average annual population growth rate from 2005 to 2020 (1.52 percent, as calculated from above-referenced SANDAG projections) was used to estimate future emissions from waste disposal and wastewater treatment.

Table 4.7: 2005 Community Emissions Growth Forecast by Sector

Sector	2005 (metric tons $CO_{2e)}$	2020 (metric tons CO_2e)	Annual Growth Rate	Percent Change from 2005 to 2020
Residential	136,427	168,069	1.40%	23%
Commercial / Industrial	170,041	196,669	0.97%	16%
Transportation	584,369	713,778	1.34%	22%
Solid Waste	30,015	37,643	1.52%	25%
Wastewater	4,397	5,514	1.52%	25%
TOTAL	**925,248**	**1,121,673**	**--**	**21%**

[22] New fuel efficiency standards under the federal Corporate Average Fuel Economy (CAFE) program and State of California ―Clean Car" standards under AB 1493 (Pavley) could significantly reduce the demand for transportation fuel in Carlsbad. An analysis of potential fuel savings from these measures at a scale that would be useful for the purpose of this report has not been conducted, nor would such an analysis produce a true business-as-usual estimation.

Section Five: Conclusion

Conclusion

By participating in the San Diego Regional Climate Protection Initiative and other sustainability initiatives, the City of Carlsbad has taken bold steps toward reducing its impacts on the environment. Policymakers and have chosen to take a leadership role in addressing climate change, and this leadership will allow Carlsbad to make tough decisions to create and implement innovative approaches to reduce its emissions. With increasing guidance and support from the state and the federal governments, Carlsbad should be increasingly empowered to make the necessary changes to promote its vision for a more sustainable future.

This conclusion discusses the inventory as a baseline for emissions targets and suggests steps for the City of Carlsbad to move forward to reduce emissions both from its internal operations and from the Carlsbad community.

5.1 Toward Setting Emissions Reduction Targets

This inventory provides an emissions baseline that the City can use to inform Milestone Two of ICLEI's Five-Milestone process—setting emissions reduction targets. The greenhouse gas emissions reduction target is a goal to reduce emissions to a certain percentage below base year levels by a chosen planning horizon year. An example target might be a 20 percent reduction in emissions below 2005 levels by 2020. A target provides an objective toward which to strive and against which to measure progress. It allows a local government to quantify its commitment to fighting climate change—demonstrating that the jurisdiction is serious about its commitment and systematic in its approach.

In selecting a target, it is important to strike a balance between scientific necessity, ambition, and what is realistically achievable. Carlsbad will want to give itself enough time to implement chosen emissions reduction measures—but note that the farther out the target year is, the more that Carlsbad should pledge to reduce. ICLEI recommends that regardless of the City's chosen long-term emissions reduction target (e.g., 15-year, 40-year), it should establish interim targets for every two- to three-year period. Near-term targets facilitate additional support and accountability, and help to ensure continued momentum around Carlsbad's local climate protection efforts. To monitor the effectiveness of its programs, Carlsbad should plan to re-inventory its emissions on a regular basis;

many jurisdictions are electing to perform annual inventories. See Appendix F for more information on how to re-inventory the City's emissions.

5.1.1 The Long-Term Goal

ICLEI recommends that the City of Carlsbad's near-term climate work should be guided by the long-term goal of reducing its emissions by 80 percent to 95 percent from the 2005 baseline level by the year 2050. By referencing a long-term goal that is in accordance with current scientific understanding, Carlsbad can demonstrate that it intends to do its part to reduce emissions over the long haul.

It is important to keep in mind that it will be next to impossible for local governments to reduce emissions by 80 to 95 percent without the assistance of state and federal policy changes that create new incentives and new sources of funding for emissions reduction projects and programs. However, in the next 15 years, there is much that local governments can do to reduce emissions independently.

5.1.2 State of California Targets and Guidance

An integral component of the State of California's climate approach has been establishing three core emissions reduction targets at the community level. While these targets are specific to the community-scale, they can be used to inform emissions targets for government operations as well. Figure 4.1 highlights adopted emissions targets for the State. The AB 32 Scoping Plan also provides further guidance on establishing targets for local governments; specifically the Plan suggests creating an emissions reduction goal of 15 percent below —current" levels by 2020. This target has informed many local government's emission reduction targets for municipal operations—most local governments in California with adopted targets have targets of 15 to 25 percent reductions under 2005 levels by 2020.

Figure 5.1: **California Greenhouse Gas Reduction Targets**

On June 1, 2005, California Governor Schwarzenegger signed Executive Order S-3-05 establishing climate change emission reductions targets for the State of California. The California targets are an example of near-, mid- and long-term targets:

Reduce emissions to 2000 levels by 2010
Reduce emissions to 1990 levels by 2020
Reduce emissions to 80 percent below 1990 levels by 2050

5.1.3 Department Targets

If possible, ICLEI recommends that Carlsbad consider department-specific targets for each of the departments that generate emissions within its operations. This allows the City's staff to do a more in-depth analysis of what is achievable in each sector in the near, mid and long-term, and also encourages each department head to consider their department's impact on the climate and institute a climate-conscious culture in its operations.

5.2 Creating an Emissions Reduction Strategy

This inventory identifies the major sources of emissions from Carlsbad‘s operations and, therefore, where policymakers will need to target emissions reductions activities if they are to make significant progress toward adopted targets. For example, since the vehicle fleet was a major source of emissions from Carlsbad‘s operations, it is possible that the City could meet near-term targets simply by implementing a few major actions within this sector. In addition, medium-term targets could be met by focusing emissions reduction actions on the other major sources of emissions including employee commutes and the operations of buildings, facilities, and parks. The long term (2050) target will not be achievable without major reductions in all of those sectors.

Given the results of the inventory, ICLEI recommends that Carlsbad focus on the following tasks in order to significantly reduce emissions from its government operations:

- Reduce the vehicle fleet size and replace vehicles with alternative fueled vehicles.
- Replace non-road vehicles and equipment with low or zero emission technologies.
- Offer transportation benefits and alternatives to employees.
- Coordinate land use planning and greenhouse gas (GHG) accountability with regional transportation infrastructure investments.
- Continue to promote energy efficiency and renewable energy in public facilities.
- Expand recycling program and ensure recycling containers are provided at each park and facility.

In addition to the types of actions described above, which reduce emissions from government operations, ICLEI recommends developing policies and actions that will help to reduce emissions throughout the community. Examples include:

- Promoting growth through redevelopment and infill that maintains or improves the quality of life for existing neighborhoods.
- Adopting local parking standards that encourage reduced single-occupancy vehicle travel.
- Adopting building codes that exceed Title 24 energy requirements, on either a mandatory or voluntary basis.
- Establish water conservation guidelines and standards for existing development, new development and City facilities
- Provide public education programs on waste prevention, source reduction, recycling, yard waste, wood waste, and hazardous waste

By identifying and implementing a set of these types of strategies, Carlsbad should be able to reduce and reverse its impact upon global warming. In the process, it may also be able to improve the quality of its services, reduce costs, stimulate local economic development, and inspire local residents and businesses to redouble their own efforts to combat climate change.

Appendices

Appendix A: The Local Government Operations Protocol

This inventory follows the standard outlined in the Local Government Operations Protocol, which was adopted in 2008 by the California Air Resources Board (CARB) and serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. This and the other inventories conducted for the San Diego Regional Climate Protection Initiative are among the first to follow LGOP, representing a strong step toward standardizing how inventories are conducted and reported.

A.1 Local Government Operations Protocol

A.1.1 Background

In 2008, ICLEI, CARB, and the California Climate Action Registry (CCAR) released LGOP to serve as a U.S. supplement to the International Emissions Analysis Protocol. The purpose of LGOP is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory. It leads participants through the process of accurately quantifying and reporting emissions, including providing calculation methodologies and reporting guidance. LGOP guidance is divided into three main parts: identifying emissions to be included in the inventory, quantifying emissions using best available estimation methods, and reporting emissions.

The overarching goal of LGOP is to allow local governments to develop emissions inventories using standards that are consistent, comparable, transparent, and recognized nationally, ultimately enabling the measurement of emissions over time. LGOP adopted five overarching accounting and reporting principles toward this end: relevance, completeness, consistency, transparency and accuracy. Methodologies that did not adhere to these principles were either left out of LGOP or included as Scope 3 emissions. LGOP was created solely to standardize how emissions inventories are conducted and reported; as such it represents a currently accepted standard for inventorying emissions but does not contain any legislative or program-specific requirements. Mandates by the State of California or any other legislative body, while possibly using LGOP as a standard, do not currently exist, and California local governments are not currently required to inventory their emissions. Program-specific requirements, such as ICLEI‘s Milestones or CCAR‘s reporting protocol, are addressed in LGOP but should not be confused with LGOP itself.

Also, while LGOP standardizes inventories from government operations, it does not seek to be a wholly accurate inventory of all emissions sources, as certain sources are currently excluded or otherwise impossible to accurately estimate. This and all emissions inventories therefore represent a best estimate of emissions using best available data and calculation methodologies; it does not provide a complete picture of all emissions resulting from Carlsbad‘s operations, and emissions estimates are subject to change as better data and calculation methodologies become available in the future.

A.1.2 Organizational Boundaries

Setting an organizational boundary for greenhouse gas emissions accounting and reporting is an important first step in the inventory process. The organizational boundary for the inventory determines which aspects of operations are included in the emissions inventory, and which are not. Under LGOP, two control approaches are used for reporting emissions: operational control or financial control. A local government has operational control over an operation if it has full authority to introduce and implement its operating policies at the operation. A local government has financial control if the operation is fully consolidated in financial accounts. If a local government has joint control over an operation, the contractual agreement will have to be examined to see who has authority over operating policies and implementation, and thus the responsibility to report emissions under operational control.[23] Local governments must choose which approach is the most applicable and apply this approach consistently throughout the inventory.

While both control approaches are acceptable, there may be some instances in which the choice may determine whether a source falls inside or outside of a local government‘s boundary. LGOP strongly encourages local governments to utilize operational control as the organization boundary for a government operations emissions inventory. Operational control is believed to most accurately represent the emissions sources that local governments can most directly influence, and this boundary is consistent with other environmental and air quality reporting program requirements. For this reason, all inventories in the San Diego Regional Climate Protection Initiative are being conducted according to the operational control framework.

23 Please see Local Government Operations Protocol for more detail on defining your organizational boundary: http://www.icleiusa.org/programs/climate/ghg-protocol

A.1.3 Types of Emissions

The greenhouse gases inventoried in this report are described in Section 2.1 As described in LGOP, emissions from each of the greenhouse gases can come in a number of forms:

Stationary or mobile combustion: These are emissions resulting from on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat, electricity, or to power vehicles and mobile equipment.

Purchased electricity: These are emissions produced by the generation of power from utilities outside of the jurisdiction.

Fugitive emissions: Emissions that result from the unintentional release of greenhouse gases into the atmosphere (e.g., leaked refrigerants, methane from waste decomposition, etc.).

Process emissions: Emissions from physical or chemical processing of a material (e.g., wastewater treatment).

A1.4 Quantifying Emissions

Emissions can be quantified two ways:

Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This methodology is not generally available for most types of emissions and will only apply to a few local governments that have these monitoring systems.

The majority of the emissions recorded in the inventory can be and will be estimated using **calculation-based methodologies** to calculate their emissions using activity data and emission factors. To calculate emissions, the equation below is used:

Activity Data x Emission Factor = Emissions

Activity data refer to the relevant measurement of energy use or other greenhouse gas–generating processes such as fuel consumption by fuel type, metered annual energy consumption, and annual vehicle mileage by vehicle type. Emissions factors are calculated ratios relating emissions to a proxy measure of activity at an emissions source (e.g., CO_2 generated/kWh consumed). For a list of common emissions calculations see Table 2.2.

The guidelines in LGOP are meant to provide a common method for local governments to quantify and report greenhouse gas emissions by using comparable activity data and emissions factors. However, LGOP recognizes that local governments differ in how they collect data concerning their operations and that many are not able to meet the data needs of a given estimation method. Therefore, LGOP outlines both ―recommended" and ―alternative" methods to estimate emissions from a given source. In this system, recommended methods are the preferred method for estimating emissions, as they will result in the most accurate estimate for a given emission source. Alternative methods often require less intensive data collection, but are likely to be less accurate. This approach allows local governments to estimate emissions based on the data currently available to them. It also allows local governments that are unable to meet the recommended methods to begin developing internal systems to collect the data needed to meet these methods.

This inventory has used the recommended activity data and emissions factors wherever possible, using alternative methods where necessary. For details on the methodologies used for each sector, see Appendix B.

A.1.5 Reporting Emissions

A.1.5.1 Significance Thresholds

Within any local government's own operations there will be emission sources that fall within Scope 1 and Scope 2 that are minimal in magnitude and difficult to accurately measure. Within the context of local government operations, emissions from leaked refrigerants and backup generators may be common sources of these types of emissions. For these less significant emissions sources, LGOP specifies that up to 5 percent of total emissions can be reported using estimation methods not outlined in LGOP.[24]

In this report, the following emissions fell under the significance threshold and were reported using best available methods:

- Scope 1 stationary diesel generator fuel use

A.1.5.2 Units Used in Reporting Emissions

LGOP requires reporting of individual gas emissions, and this reporting is included in Appendix B. In this narrative report, emissions from all gases released by an emissions source (e.g., stationary combustion of natural gas in facilities) are combined and reported in metric tons of carbon dioxide equivalent (CO_2e). This standard is based on the global warming potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide. For the GWPs of reported greenhouse gases, see Table 2.1.

24 In the context of registering emissions with an independent registry (such as the California Climate Action Registry), emissions that fall under the significance threshold are called *de minimis*. This term, however, is not used in LGOP and was not used in this inventory.

A.1.5.3 Information Items

Information items are emissions sources that, for a variety of reasons, are not included as Scope 1, 2, or 3 emissions in the inventory. In order to provide a more complete picture of emissions from Carlsbad‘s operations, however, these emissions should be quantified and reported.

In this report, the following emissions are included as information items (emission quantities are reported in Appendix B):

- Ozone depleting chemicals used as refrigerants (R-22 in facilities and R-12 in vehicles)

A common emission that is categorized as an information item is carbon dioxide emitted in the combustion of biogenic fuels. Local governments will often burn fuels that are of biogenic origin (wood, landfill gas, organic solid waste, biofuels, etc.) to generate power. Common sources of biogenic emissions are the combustion of landfill gas from landfills or biogas from wastewater treatment plants, as well as the incineration of organic municipal solid waste at incinerators.

Carbon dioxide emissions from the combustion of biogenic fuels are not included in Scope 1 based on established international principles. [25] These principles indicate that biogenic fuels (e.g., wood, biodiesel), if left to decompose in the natural environment, would release CO_2 into the atmosphere, where it would then enter back into the natural carbon cycle. Therefore, when wood or another biogenic fuel is combusted, the resulting CO_2 emissions are akin to natural emissions and should therefore not be considered as human activity-generated emissions. The CH_4 and N_2O emissions, however, would not have occurred naturally and are therefore included as Scope 1 emissions.

A.2 Baseline Years

Part of the local government operations emissions inventory process requires selecting a ―performance datum" with which to compare current emissions, or a base year. Local governments should examine the range of data they have over time and select a year that has the most accurate and complete data for all key emission sources. It is also preferable to establish a base year several years in the past to be able to account for the emissions benefits of recent actions. A local government‘s emissions inventory should comprise all greenhouse gas emissions occurring during a selected *calendar* year.

For the San Diego Regional Climate Protection Initiative, 2005 was chosen as the baseline year, since this year is increasingly becoming the standard for such inventories; the 1990 baseline year for California is usually difficult for most local governments to meet and would not produce the most accurate inventory.

25 Methane and nitrous oxide emissions from biogenic fuels are considered Scope 1 stationary combustion emissions and are included in the stationary combustion sections for the appropriate facilities.

After setting a base year and conducting an emissions inventory for that year, local governments should make it a practice to complete a comprehensive emissions inventory on a regular basis to compare to the baseline year. ICLEI recommends conducting an emissions inventory at least every five years.

Appendix B:
LGOP Standard Report

Local Government Operations Standard Inventory Report

ICLEI Local Governments for Sustainability

1. Local Government Profile

Jurisdiction Name:	City of Carlsbad
Street Address:	1200 Carlsbad Village Dr.
City, State, ZIP, Country:	Carlsbad, CA 92008
Website Address:	www.carlsbadca.gov
Size (sq. miles):	42.19
Population:	95,146
Annual Budget:	$190,416,353
Employees (Full Time Equivalent):	794
Climate Zone:	3B
Annual Heating Degree Days:	1063*
Annual Cooling Degree Days:	866**
Lead Inventory Contact Name:	Linda Kermott
Title:	Manager- Public Works Administration and Environmental Programs
Department:	Public Works
Email:	linda.kermott@carlsbadca.gov
Phone Number:	(760) 602-2753

* www.ncdc.noaa.gov/oa/climate/online/ccd/nrmhdd.txt
** www.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.txt

Services Provided:

☐ Water treatment	☐ Mass transit (buses)	☐ Hospitals	☐ Natural gas utility
☑ Water distribution	☐ Mass transit (light rail)	☐ Airport	☐ Other (Specify below)
☐ Wastewater treatment	☐ Mass transit (ferries)	☐ Seaport/shipping terminal	
☑ Wastewater collection	☐ Schools (primary/secondary)	☐ Marina	
☐ Electric utility	☐ Schools (colleges/universities)	☐ Stadiums/sports venues	
☑ Fire Protection	☐ Solid waste collection	☐ Convention center	
☑ Police	☐ Solid waste disposal	☑ Street lighting and traffic signals	

Local Government Description:

The City of Carlsbad is a unique coastal community located 35 miles north of the City of San Diego surrounded by mountains, lagoons and the Pacific Ocean. Although the "village" dates back more than 100 years, the City was incorporated July 16, 1952. The

2. GHG Inventory Details

Reporting Year:	2005
Protocol Used:	Local Government Operations Protocol, Version 1.0 (September 2008)
Control Approach:	Operational Control

GHG Emissions Summary (All Units in Metric Tons Unless Stated Otherwise)

Note: CO_2e totals listed here are summed totals of the estimated emissions of each inventoried gas based upon their global warming potentials (Appendix E of LGOP)

BUILDINGS & OTHER FACILITIES

SCOPE 1	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	543.984	542.567	0.052	0.001			
Fugitive Emissions							
Total Direct Emissions from Buildings & Facilities	543.984	542.567	0.052	0.001	0.000	0.000	0.000

SCOPE 2	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	1,721.852	1,709.281	0.091	0.034
Purchased Steam				
District Heating & Cooling				
Total Indirect Emissions from Buildings & Facilities	1,721.852	1,709.281	0.091	0.034

STREETLIGHTS AND TRAFFIC SIGNALS

SCOPE 2	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	1,354.387	1,344.498	0.071	0.027
Total Indirect Emissions from Streetlights and Traffic Signals	1,354.387	1,344.498	0.071	0.027

WATER DELIVERY FACILITIES

SCOPE 1	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	3.652	3.632	0.001	0.000			
Total Direct Emissions from Water Delivery Facilities	3.652	3.632	0.001	0.000	0.000	0.000	0.000

SCOPE 2	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	457.265	453.927	0.024	0.009
Total Indirect Emissions from Water Delivery Facilities	457.265	453.927	0.024	0.009

VEHICLE FLEET

SCOPE 1	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs
Mobile Combustion	2,407.444	2,378.995	0.070	0.087		
Fugitive Emissions	67.002					
Total Direct Emissions from Vehicle Fleet	2,474.446	2,378.995	0.070	0.087	0.000	0.000

INDICATORS	
Number of Vehicles	278
Vehicle Miles Traveled	2,865,183
Number of Pieces of Equipment	45

WASTE GENERATION

SCOPE 3	CO_2e
Waste All Facilities	143.803

INDICATORS	
Short tons of solid waste accepted for disposal	567.000

EMPLOYEE COMMUTE

SCOPE 3	CO_2e
Mobile Combustion	2,417.227

INDICATORS	
Vehicle Miles Traveled	4,584,643

INFORMATION ITEMS

	CO_2e
R12	16.228
R22	398.660
Total Information Items	414.888

Total Emissions

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
SCOPE 1	3,022.083	2,925.194	0.122	0.088	0.000	0.000	0.000
SCOPE 2	3,533.504	3,507.707	0.186	0.071	0.000	0.000	0.000
SCOPE 3	2,561.030						
INFORMATION ITEMS	414.888						

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS	POSSIBLE INFORMATION ITEMS
Employee Commute	Biogenic $C0_2$ from Combustion
Employee Business Travel	Carbon Offsets Purchased
Emissions From Contracted Services	Carbon Offsets Sold
Upstream Production of Materials and Fuels	Renewable Energy Credits (Green Power) Purchased
Upstream and Downstream Transportation of Materials and Fuels	Renewable Energy Credits Sold (GreenPower)
Waste Related Scope 3 Emissions	Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Purchase of Electricity Sold to an End User	Other Information Items
Transmission and Distribution Losses from Consumed Electricity	
Other Scope 3	

Local Government Operations Standard Inventory Report

3. Activity Data Disclosure

Every emission source must be accompanied by a reference for the activity data. This worksheet is meant to assist in recording activity data and the methods used to gather those data for government operations. Activity data represent the magnitude of human activity resulting in emissions; data on energy use, fuel consumtion, vehicle miles traveled, and waste generation are all examples of activity data that are used to compute GHGs. Detailed disclosure should be made of the activity data used and at what quantities. This disclosure should also cite the source(s) of the data and the methodology used, including whether that methodology is a recommended method or an alternate method.

Deviations from the primary methodology should be explained in detail. All assumptions and estimations should be cited as such. Local governments may also use this space in the reporting format to discuss the rationale for the inclusion or exclusion of optional inventory components. It is good practice to include appropriate citations (such as website URL, report title, etc) and all contact information that is necessary to verify the source and accuracy of the activity data.

BUILDINGS & OTHER FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Natural Gas	CO_2e					
	CO_2	Primary	Known fuel use	69,852	therms	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	CH_4	Primary	Known fuel use	69,852	therms	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	N_2O	Primary	Known fuel use	69,852	therms	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	HFCs					
	PFCs					
	SF_6					
Generators	CO_2e					
	CO_2	Alternate	Known and estimated fuel use from Aug '05-Apr '06	125	gallons	Bob Richardson, bob.richardson@carlsbadca.gov, (760) 434-2944
	CH_4	Alternate	Known and estimated fuel use from Aug '05-Apr '07	125	gallons	Bob Richardson, bob.richardson@carlsbadca.gov, (760) 434-2944
	N_2O	Alternate	Known and estimated fuel use from Aug '05-Apr '08	125	gallons	Bob Richardson, bob.richardson@carlsbadca.gov, (760) 434-2944
	HFCs					
	PFCs					
	SF_6					
Propane	CO_2e					
	CO_2	Primary	Approximate Yearly Fuel Use	960	gallons	Bonnie Elliott, (760) 602-7515, bonnie.elliott@carlsbadca.gov
	CH_4	Primary	Approximate Yearly Fuel Use	960	gallons	Bonnie Elliott, (760) 602-7515, bonnie.elliott@carlsbadca.gov
	N_2O	Primary	Approximate Yearly Fuel Use	960	gallons	Bonnie Elliott, (760) 602-7515, bonnie.elliott@carlsbadca.gov
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	6,693,356	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	CH_4	Primary	Known Electricity Use	6,693,356	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	N_2O	Primary	Known Electricity Use	6,693,356	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	HFCs					
	PFCs					
	SF_6					

STREETLIGHTS AND TRAFFIC SIGNALS (Chapter 6.2)

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	5,424,206	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	CH_4	Primary	Known Electricity Use	5,424,206	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	N_2O	Primary	Known Electricity Use	5,424,206	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@semprautilities.com
	HFCs					
	PFCs					
	SF_6					

WATER DELIVERY FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
	CO_2e					
	CO_2	Alternate	Approximate Annual Fuel Use	358	gallons	Don Wasco, don.wasco@carlsbadca.gov, (760) 438-2722 x7138
						Don Wasco,

WATER DELIVERY FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Diesel Generators	CO_2e					
	CO_2	Alternate	Approximate Annual Fuel Use	358	gallons	Don Wasco, don.wasco@carlsbadca.gov, (760) 438-2722 x7138
	CH_4	Alternate	Approximate Annual Fuel Use	358	gallons	Don Wasco, don.wasco@carlsbadca.gov, (760) 438-2722 x7139
	N_2O	Alternate	Approximate Annual Fuel Use	358	gallons	Don Wasco, don.wasco@carlsbadca.gov, (760) 438-2722 x7140
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	1,831,309	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@sempratutilities.com
	CH_4	Primary	Known Electricity Use	1,831,309	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@sempratutilities.com
	N_2O	Primary	Known Electricity Use	1,831,309	kWh	Karen Brown, SDG&E, (858) 650-4132, kwbrown@sempratutilities.com
	HFCs					
	PFCs					
	SF_6					

VEHICLE FLEET (Chapter 7)

SCOPE 1

Mobile Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Gasoline	CO_2e					
	CO_2	Primary	Known Fuel Use	204,551	gallons	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	CH_4	Primary	Annual Mileage by vehicle type, model year, and fuel type; fuel use by vehicle type, model year, and fuel type; annual mileage by vehicle type and fuel type; proxy year data	204,551	miles	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	N_2O	Primary	Annual Mileage by vehicle type, model year, and fuel type; fuel use by vehicle type, model year, and fuel type; annual mileage by vehicle type and fuel type; proxy year data	204,551	miles	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	HFCs					
	PFCs					
	SF_6					
Diesel	CO_2e					
	CO_2	Primary	Known Fuel Use	42,580	gallons	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	CH_4	Primary	Annual Mileage by vehicle type, model year, and fuel type; fuel use by vehicle type, model year, and fuel type; annual mileage by vehicle type and fuel type; proxy year data	42,580	miles	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	N_2O	Primary	Annual Mileage by vehicle type, model year, and fuel type; fuel use by vehicle type, model year, and fuel type; annual mileage by vehicle type and fuel type; proxy year data	42,580	miles	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov
	HFCs					
	PFCs					
	SF_6					

Fugitive Emissions

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Refrigerants	R134A	Alternate	Based on Fleet Inventory and Capacities Available Online. Defaults used for Unknown Capacities	52	kg	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov. NAPA AC System Refrigerant and Oil Capacity Guide

WASTE GENERATION (Scope 3)

SCOPE 3

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Generated Waste	CH_4	Alternate	Estimated waste weight based upon volume and number of containers	573	tons	Lori Somers, Waste Management, Community and Municipal Relations Representative, (760) 754-4122, lsomers1@wm.com

EMPLOYEE COMMUTE (Scope 3)

SCOPE 3

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Gasoline	CO_2e					
	CO_2	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	251,075	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	CH_4	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	251,075	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	N_2O	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	251,075	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	HFCs					
	PFCs					
	SF_6					
Diesel	CO_2e					
	CO_2	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	13,102	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	CH_4	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	13,102	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	N_2O	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	13,102	gallons	Online and paper surveys of all employees; see Appendix C of Narrative report for examples; Data in posession of Linda Kermott, Environmental Services Director
	HFCs					
	PFCs					
	SF_6					

INFORMATION ITEMS

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Ozone Depleting Refrigerants	R12	Alternate	Based on Fleet Inventory and Capacities Available Online. Defaults used for Unknown Capacities	2	kg	Dale Schuck, Public Works Superintendent, (760) 434-2949, dale.schuck@carlsbadca.gov. NAPA AC System Refrigerant and Oil Capacity Guide
	R22	Primary	Actual leakage. Based on invoices from contractor	235	kg	Charlie, Seaside Heating & Air Conditioning, Inc., 760-643-1100,

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS

Employee Commute
Employee Business Travel
Emissions From Contracted Services
Upstream Production of Materials and Fuels
Upstream and Downstream Transportation of Materials and Fuels
Waste Related Scope 3 Emissions
Purchase of Electricity Sold to an End User
Transmission and Distribution Losses from Consumed Electricity
Other Scope 3

POSSIBLE INFORMATION ITEMS

Biogenic CO_2 from Combustion
Carbon Offsets Purchased
Carbon Offsets Sold
Renewable Energy Credits (Green Power) Purchased
Renewable Energy Credits Sold (GreenPower)
Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Other Information Items

4. Calculation Methodology Disclosure

In addition to activity data, every emission source must be accompanied by the emission factor used, a reference for each emission factor, and the calculation

BUILDINGS & OTHER FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Natural Gas	CO_2e			
	CO_2	Default	53.06 Kg /MMBtu	LGOP, Table G.1
	CH_4	Default	5 g /MMBtu	LGOP, Table G.3
	N_2O	Default	0.01 g /MMBtu	LGOP, Table G.3
	HFCs			
	PFCs			
	SF_6			
Diesel Generators	CO_2e			
	CO_2	Default	73.15 Kg /MMBtu	LGOP, Table G.1
	CH_4	Default	11 g /MMBtu	LGOP, Table G.3
	N_2O	Default	0.6 g /MMBtu	LGOP, Table G.3
	HFCs			
	PFCs			
	SF_6			
Propane	CO_2e			
	CO_2	Default	5.74 kg CO2/gal	LGOP, Table G.1
	CH_4			
	N_2O			
	HFCs			
	PFCs			
	SF_6			

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	546.46 lbs /MWh	LGOP, Table G.5
	CH_4	Default	0.029 lbs/ MWh	LGOP, Table G.6
	N_2O	Default	0.011 lbs /MWh	LGOP, Table G.6
	HFCs			
	PFCs			
	SF_6			

STREETLIGHTS AND TRAFFIC SIGNALS (Chapter 6.2)

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	546.46 lbs /MWh	LGOP, Table G.5
	CH_4	Default	0.029 lbs/ MWh	LGOP, Table G.6
	N_2O	Default	0.011 lbs /MWh	LGOP, Table G.6
	HFCs			
	PFCs			
	SF_6			

WATER DELIVERY FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Diesel Generators	CO_2e			
	CO_2	Default	73.15 Kg /MMBtu	LGOP, Table G.1
	CH_4	Default	11 g /MMBtu	LGOP, Table G.3
	N_2O	Default	0.6 g /MMBtu	LGOP, Table G.3
	HFCs			
	PFCs			
	SF_6			

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	546.46 lbs /MWh	LGOP, Table G.5
	CH_4	Default	0.029 lbs/ MWh	LGOP, Table G.6
	N_2O	Default	0.011 lbs /MWh	LGOP, Table G.6
	HFCs			
	PFCs			
	SF_6			

VEHICLE FLEET (Chapter 7)

SCOPE 1

Mobile Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Gasoline	CO_2e			
	CO_2	Default	8.81 kg CO2 / gallon	LGOP, Table G.9
	CH_4	Default	Varies by Model Year	LGOP, Table G.10
	N_2O	Default	Varies by Model Year	LGOP, Table G.10
	HFCs			
	PFCs			
	SF_6			
Diesel	CO_2e			
	CO_2	Default	10.15 kg /gallon	LGOP, Table G.9
	CH_4	Default	Varies by Model Year	LGOP, Table G.10
	N_2O	Default	Varies by Model Year	LGOP, Table G.10
	HFCs			
	PFCs			
	SF_6			

Fugitive Emissions

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Refrigerants	R134A	None	GWP-1300	LGOP v1 Table E.1&E.2

WASTE GENERATION (Scope 3)

SCOPE 3

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Generated Waste	CH_4	Alternate	Varies by waste type	EPA Waste Reduction Model http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html; Public Administration waste charaterization provided by CIWMB

EMPLOYEE COMMUTE (Scope 3)

SCOPE 3

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Gasoline	CO_2e			
	CO_2	Default	8.81 kg CO2 / gallon	LGOP, Table G.9
	CH_4	Default	.03451 g/mi (light trucks)	LGOP, Table G.13
	N_2O	Default	.04935 g/mi (light trucks)	LGOP, Table G.13
	HFCs			
	PFCs			
	SF_6			
Diesel	CO_2e			
	CO_2	Default	10.15 kg/gallon	LGOP, Table G.9
	CH_4	Default	.00098 g/mi (light trucks)	LGOP, Table G.13
	N_2O	Default	.00148 g/mi (light trucks)	LGOP, Table G.13
	HFCs			
	PFCs			
	SF_6			

INFORMATION ITEMS

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Ozone Depleting Refrigerants	R12	None	GWP- 10600	http://www.epa.gov/ozone/science/ods/classone.html
	R22	None	GWP- 1700	http://www.epa.gov/ozone/science/ods/classone.html

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS	POSSIBLE INFORMATION ITEMS
Employee Commute	Biogenic $C0_2$ from Combustion
Employee Business Travel	Carbon Offsets Purchased
Emissions From Contracted Services	Carbon Offsets Sold
Upstream Production of Materials and Fuels	Renewable Energy Credits (Green Power) Purchased
Upstream and Downstream Transportation of Materials and Fuels	Renewable Energy Credits Sold (GreenPower)
Waste Related Scope 3 Emissions	Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Purchase of Electricity Sold to an End User	Other Information Items
Transmission and Distribution Losses from Consumed Electricity	
Other Scope 3	

Appendix C

Reporting on Scope 3 Emissions from Government Operations

This appendix presents 2005 emissions from Scope 3 government operations sources, reporting on which is considered optional in the LGOP. The two Scope 3 sectors reported here are emissions from government-generated solid waste and from employee commutes.

C.1 Government-Generated Solid Waste

Many local government operations generate solid waste, much of which is eventually sent to a landfill. Typical sources of waste in local government operations include paper and food waste from offices and facilities, construction waste from public works, and plant debris from parks departments. Organic materials in government-generated solid waste (including paper, food scraps, plant debris, textiles, wood waste, etc.) generate methane as they decay in the anaerobic environment of a landfill. An estimated 75 percent of this methane is routinely captured via landfill gas collection systems;[26] however, a portion escapes into the atmosphere, contributing to the greenhouse effect. As such, estimating emissions from waste generated by government operations is an important component of a comprehensive emissions inventory.

Inventorying emissions from government-generated solid waste is considered optional by LGOP for two reasons. First, the emissions do not result at the point of waste generation (as with fuel combustion), but in a landfill located outside of Carlsbad‘s jurisdictional boundaries. In addition, the emissions are not generated in the same year that the waste is disposed, but over a lengthy decomposition period. Since inventorying these emissions is considered optional, LGOP does not provide guidance on recommended methods for quantifying these types of emissions. ICLEI therefore devised data collection and calculation methods based upon previous experience and national standards. See Appendix D for more information for more detail on quantifying emissions from government-generated solid waste.

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26 This is a default methane collection rate per LGOP. This rate can vary from 0 to 99 percent based upon the presence and extent of a landfill gas collection system at the landfill/s where the waste is disposed. Most commonly, captured methane gas is flared into the atmosphere, which converts the methane gas to CO_2 and effectively negates the human-caused global warming impact of the methane. Increasingly, landfill methane is being used to power gas-fired turbines as a carbon-neutral means of generating electricity.

It is estimated that the waste disposed by Carlsbad‘s government facilities in 2009 will cumulatively produce 6.8 metric tons of methane gas, or 144 metric tons CO_2e. More recent data from 2009 was used as a proxy as 2005 waste disposal data was not available. Please see Table 3.8 for a breakdown of emissions per facility.

Table C.1: Emissions from Government-Generated Solid Waste

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Estimated Landfilled Waste (Tons)
Parks and Recreation	75	297
Maintenance Yards	13	52
Libraries	13	52
Safety Center	8	31
City Administration	8	31
Fire Stations	7	26
Senior Center	5	21
CMWD M&O	5	21
Other	5	21
City Hall	3	10
Swim Complex	1	5
TOTAL	**144**	**567**

C.2 Employee Commute

Fuel combustion from employees commuting to work is another important emissions source from Carlsbad‘s operations. Similar to the City‘s vehicle fleet, personal employee vehicles use gasoline and other fuels which, when burned, generate greenhouse gas emissions. Emissions from employee commutes are considered optional to inventory by LGOP because the vehicles are owned and operated privately by the employees. However, LGOP encourages reporting these emissions because local governments can influence how their employees commute to work through incentives and commuting programs. For this reason, employee commute emissions were included in this appendix as an area where Carlsbad could achieve significant reductions in greenhouse gases.

To calculate emissions, Carlsbad administered a survey to all of its employees regarding their commute patterns and preferences. ICLEI then extrapolated the results of the survey to represent emissions from all employees. See Appendix C for a detailed description of the survey and methods used to calculate emissions.

In 2009, employees commuting in vehicles to and from their jobs at Carlsbad emitted an estimated 2,417 metric tons of CO_2e. Table 3.9 shows estimated emissions and vehicle miles traveled for all the City‘s employees.

Table C.2: Emissions from Employee Commutes

	Greenhouse Gas Emissions (metric tons CO_2e)	Estimated Vehicle Miles Traveled to Work	Average Estimated Vehicle Miles Traveled to Work
All Employees (Estimated)	2,417	4,584,643	5,781

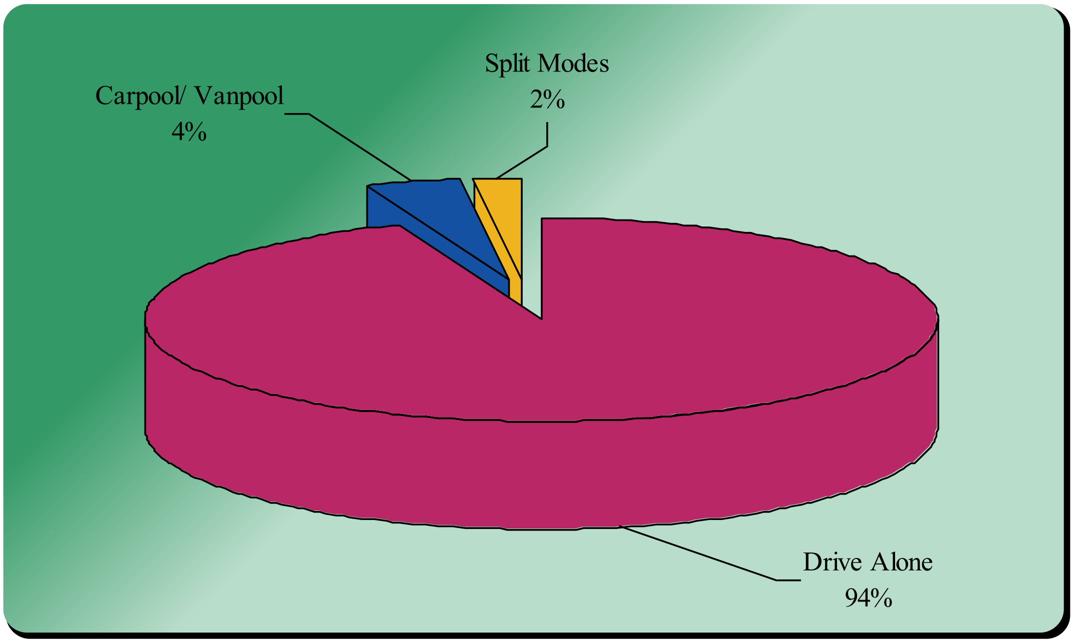
C.2.1 Employee Commute Indicators

In addition to estimating greenhouse gas emissions from employee commutes, ICLEI examined other policy-relevant information that was extracted from the employee commute survey—in this way City staff can develop the most effective policies to reduce emissions from employee commutes. These measures often have co-benefits including increased productivity, reduced commute times and costs, and improvement in the quality of life for employees. No extrapolation was done with the following data; analyses were done using data from survey respondents only.

Commute Modes

In 2009, the majority (94 percent) of respondents commuted to work in single occupancy vehicles. Six percent of all respondents used some form of alternative transportation (bicycle, public transit, carpool, etc) to commute to work with carpooling being the most used form of alternative transportation (4 percent of total respondents), followed by split modes (2 percent of total respondents), likely including a combination of driving alone and carpooling. See Figure 3.6 for an analysis of the most common commute mode for employees who responded to the survey.

Figure C.1: Employee Commute Modes



Commute Time and Costs

Table 3.10 shows the median time, cost (weekly), and distance of Carlsbad‘s employees‘ commutes. In addition to reducing the City‘s greenhouse gas emissions, commuting alternatives may reduce commuting costs, time spent in traffic, and overall employee satisfaction.

Table C.3: Distance and Time to Work and Cost of Employee Commutes

Median Time to Work (minutes)	Median Cost of Commute	Median Distance To Work (Miles)
15	$20	8

Appendix D: Employee Commute Methodology

Emissions from employee commutes make up an important optional source of emissions from any local government‘s operations. The scale of emissions from employee commutes is often large in comparison with many other facets of local government operations, and local governments can affect how their employees get to and from work through a variety of incentives. For this reason, ICLEI recommends estimating emissions from employee commutes as part of a complete government operations greenhouse gas emissions inventory.

To assist in the data collection process, ICLEI provided the jurisdictions with both an online and a paper copy of an employee commute survey. The questions in the survey were aimed at finding three categories of information:

- **Activity data** to calculate emissions from employee commute (vehicles miles traveled, vehicle type, vehicle model year) both current and in 2005.
- **Indicator data** to help Carlsbad understand how much time and money employees spend as they commute, as well as how many employees use alternative modes of transportation to get to work.
- **Policy data** that will serve as guidance for Carlsbad as it adopts policies aimed at reducing emissions from employee commutes. These questions asked employees for their interest in alternative modes of transportation as well as what policies would be most effective in allowing them to switch modes of transportation away from driving alone.

This section provides the emissions estimation methodology and both surveys. Individual survey results are in the possession of Carlsbad staff.

D.1 Methodology Summary

The methodology for estimating the employee commute emissions portion of the inventory is similar to the mobile emissions methodology outlined in the mobile emissions section of Appendix B. Carlsbad administered the employee commute survey to 793 current employees working for the City, and 249 employees responded to the survey (a response rate of 31 percent). The survey was administered in 2009 and current data was used as a proxy for 2005 data. Both full time and part-time employee data were included.

To calculate emissions, the survey collected the following information:

- The number of days and number of miles employees drive alone to work (one-way) in an average week
- The number of days they carpooled and how often they drove the carpool in an average week
- The vehicle type of their vehicle and the type of fuel consumed

These weekly data were then converted into annual VMT estimates by the following equation:

Number of days driven to work/week x to-work commute distance x 2 x 48 weeks worked/year

Actual CO_2e emissions from respondents' vehicles were calculated by converting vehicle miles traveled per week by responding employees into annual fuel consumption by fuel type (gasoline, diesel). The VMT data collected were converted to fuel consumption estimates using fuel economy of each vehicle type.[27]

ICLEI then extrapolated estimated fuel consumption to represent all 793 of Carlsbad's employees in 2005. This was a simple extrapolation, multiplying the estimated fuel consumption number by the appropriate factor to represent all current employees. For example, if 33.3 percent of employees responded, fuel consumption numbers were tripled to estimate fuel consumption for all employees. This is not a statistical analysis and no uncertainty has been calculated as there is uncertainty not only at the extrapolation point but also in the calculation of actual emissions. Therefore, the resulting calculated emissions should be seen as directional and not as statistically valid.

27 Fuel efficiency estimates from www.fueleconomy.gov, EPA *Green Fleets Guide* and other national sources.

D.2 Employee Commute Survey

1. Introduction
The purpose of this survey is to gather information on your commute to work so your employer can offer the best transportation options to you while reducing the jurisdiction's impact on the environment. The survey should take no more than 15 minutes.

Unless otherwise indicated, all questions refer to a ONE-WAY commute TO WORK only. Please do not include any traveling you do during work hours (meetings, site visits, etc). Any question with an asterisk (*) next to it requires an answer in order to proceed.

Please note that this survey is completely anonymous. We will not collect or report data on any individuals who respond to the survey.

Thank you very much.

2. Workplace
Please provide the following information regarding your workplace. Click "Next" at the bottom when finished or click "Prev" to go back.

*1. What local government do you currently work for?
Carlsbad
County of San Diego
Encinitas
Imperial Beach
La Mesa
National City
Poway
Solana Beach
San Marcos
Vista

*2. What department do you work in?

3. Commuter Background Information
Please provide the following information regarding your background. Click "Next" at the bottom when finished or click "Prev" to go back.

*1. What city/town do you live in?

*2. How many miles do you live from your place of work?
(please enter a whole number)

3. How many minutes does your commute to work typically take?
(please enter a whole number)

4. In a typical week, how much money do you spend on your ROUND TRIP commute? (transit fees, gas, tolls, etc-please enter a number)

5. If you drive to work, what type of vehicle do you usually drive?
Full-size auto
Mid-size auto
Compact/hybrid
Light truck/SUV/Pickup
Van

Heavy Truck
Motorcycle/scooter

6. What year is your vehicle?
(please enter a four digit year)

7. What type of fuel does your vehicle use?
Gas
Diesel
Biodiesel (B20)
Biodiesel (B99 or B100)
Electric
Other (please specify-if Ethanol please indicate grade)

4. Employment Information
Please provide the following information regarding your employment. Click "Next" at the bottom when finished or click "Prev" to go back.

1. Do you typically travel to work between 6-9 am Monday-Friday?
Yes
No
If No, please specify what time of day you commute:

2. Does your position allow you to have flexible hours or to telecommute?
Yes
No

*3. Are you a full time employee or part time employee?
Full
Part

5. Part Time Employees
Please provide the following information regarding your part time employment. Click "Next" at the bottom when finished or click "Prev" to go back.

*1. What is the average number of days you work per week?
(please enter a number)

6. Temporary Employees

Are you a temporary employee?
Yes
No

7. Temporary Employees

How many weeks is your temporary assignment? (please enter a number)

8. Current Daily Commute
Please provide the following information regarding your current daily commute. Click "Next" at the bottom when finished or click "Prev" to go back.

*1. In a typical week, do you drive to work alone at least once?
Yes
No

9. Drive Alone

Click "Next" at the bottom when finished or click "Prev" to go back.

*1. How many DAYS a week do you drive alone to work?
(please enter a number)

*2. How many MILES PER DAY do you drive TO WORK ONLY?
(please enter a number)

10. Carpool
Click "Next" at the bottom when finished or click "Prev" to go back.

*1. In a typical week, do you carpool to work at least once?
Yes
No

11. Carpool
*1. How many DAYS a week do you carpool?
(please enter a number)

*2. How many MILES do you drive TO WORK ONLY when you carpool?
(please enter a number)

3. How many PEOPLE are in your carpool?
(please enter a number)

*4. How many DAYS a week are you the driver of the carpool?
(please enter a number)

12. Public Transit
*1. In a typical week, do you take public transit to work at least once?
Yes
No

13. Public Transit
*1. How many DAYS a week do you take public transit TO WORK?
(please enter a number)

2. What type of public transit do you take TO WORK?
Bus
Ferry
Light Rail
Train
Other (please specify)

14. Bike/Walk
*1. In a typical week, do you bike or walk to work at least once?
Yes
No

15. Bike/Walk
1. How many DAYS a week do you bike to work?
(please enter a number)

2. How many DAYS a week do you walk to work?
(please enter a number)

16. Telecommute

1. If you telecommute:
How many DAYS do you telecommute in a typical week?
(please enter a number)
If you do not telecommute, leave this question blank.

17. Commute Preference Information
Please answer the following questions regarding your CURRENT commute.

1. Why have you chosen your current commute mode?

2. Would you consider taking any of the following transportation modes? (check all that apply):
Public Transportation
Carpooling
Vanpooling
Bicycling
Walking
Other (please specify)

*3. Is there a transit route that you would use to commute by public transit?
Yes
No

4. If no to question 3, please explain why not.

5. If you drive alone, which, if any, of the following benefits would encourage you to take alternative forms of transportation? (check all that apply)
Vanpool/carpool incentives
Pre-tax transit checks
Parking cash-out (reimbursement to give up your parking spot)
Improved transit options
Improved walking routes/conditions
Telecommuting option
Free/inexpensive shuttle
Free public transit benefit
Subsidizing bicycle purchase
Improved bike routes/conditions
Better information about my commute options
None of the above
Other (please specify)

28. Comments

1. If you have other concerns or issues related to your commute, or if something we should know about was not captured in any survey questions, please describe below.

29. Thank You
Thank you for responding to this survey!

Appendix E: Government-Generated Solid Waste Methodology

Emissions from the waste sector are an estimate of methane generation that will result from the anaerobic decomposition of all organic waste sent to landfill in the base year. It is important to note that although these emissions are attributed to the inventory year in which the waste is generated, the emissions themselves will occur over the 100+ year timeframe that the waste will decompose. This frontloading of emissions is the approach taken by EPA‘s Waste Reduction Model (WARM). Attributing all future emissions to the year in which the waste was generated incorporates all emissions from actions taken during the inventory year into that year‘s greenhouse gas release. This facilitates comparisons of the impacts of actions taken between inventory years and between jurisdictions. It also simplifies the analysis of the impact of actions taken to reduce waste generation or divert it from landfills.

E.1 Estimating Waste Tonnages from Carlsbad's Operations

Like most local governments, Carlsbad does not directly track the amount of waste generated from its operations. Therefore, to estimate the amount of waste generated, ICLEI worked with Waste Management, the hauler of waste for Carlsbad in 2005. The amount of waste was estimated by compiling pick-up accounts owned by the City. Garbage trucks do not weigh waste at each pick-up, therefore, it is not possible to directly track disposal figures in mass per facility. Mass of waste generation was estimated using volumetric container size (gallons, yards, etc.) data, along with pick-up frequency and average fill of containers. These data produced a comprehensive annual volumetric figure, which was then converted to mass using standard conversion factors supplied by the California Integrated Waste Management Board (CIWMB). Estimated waste *generation* was converted to final *disposal* (quantity sent to landfill) by applying average waste diversion percentages for each account. Where applicable, self-haul waste (waste brought directly from the local government to landfills) was included as part of this total.

E.2 Emissions Calculation Methods

As some types of waste (e.g., paper, plant debris, food scraps, etc.) generate methane within the anaerobic environment of a landfill and others do not (e.g., metal, glass, etc.), it is important to characterize the various components of the waste stream. Waste characterization for government-generated solid waste was estimated using the CIWMB's 2004 statewide waste characterization study.[28]

Most landfills in the San Diego region capture methane emissions either for energy generation or for flaring. EPA estimates that 60 percent to 80 percent[29] of total methane emissions are recovered at the landfills to which Carlsbad sends its waste. Following the recommendation of LGOP, ICLEI adopted a 75 percent methane recovery factor.

Recycling and composting programs are reflected in the emissions calculations as reduced total tonnage of waste going to the landfills. The model, however, does not capture the associated emissions reductions in "upstream" energy use from recycling as part of the inventory.[30] This is in-line with the "end-user" or "tailpipe" approach taken throughout the development of this inventory. It is important to note that, recycling and composting programs can have a significant impact on greenhouse gas emissions when a full lifecycle approach is taken. Manufacturing products with recycled materials avoids emissions from the energy that would have been used during extraction, transporting and processing of virgin material.

E.2.1 Methane Commitment Method

CO_2e emissions from waste disposal were calculated using the methane commitment method outlined in the EPA WARM model. This model has the following general formula:

$CO_2e = W_t * (1-R)A$

Where:

W_t is the quantify of waste type "t"

R is the methane recovery factor,

A is the CO_2e emissions of methane per metric ton of waste at the disposal site (the methane factor)

While the WARM model often calculates upstream emissions, as well as carbon sequestration in the landfill, these dimensions of the model were omitted for this particular study for two reasons:

This inventory functions on an end-use analysis, rather than a life-cycle analysis, which would calculate upstream emissions), and this inventory solely identifies emissions sources, and no potential sequestration "sinks."

28 CIWMB Waste Characterization Study-Public Administration Group available at http://www.ciwmb.ca.gov/WasteChar/BizGrpCp.asps.
29 AP 42, section 2.4 Municipal Solid Waste, 2.4-6, http://www.epa.gov/ttn/chief/ap42/index.html
30 "Upstream" emissions include emissions that may not occur in your jurisdiction resulting from manufacturing or harvesting virgin materials and transportation of them.

Appendix F: Community Inventory Methodology

This appendix expands on the description of methodology provided in Section 2, describing in more detail the data sources and processes used to calculate emissions in the community inventory.

F.1 Overview of Inventory Contents and Approach

The community inventory describes emissions of the major greenhouse gases from the residential, commercial / industrial, transportation, solid waste, and wastewater sectors. As explained in Section 2, emissions are calculated by multiplying activity data—such as kilowatt hours or gallons of gasoline consumed—by emissions factors, which provide the quantity of emissions per unit of activity. Activity data is typically available from electric and gas utilities, planning and transportation agencies and air quality regulatory agencies. Emissions factors are drawn from a variety of sources, including the California Climate Action Registry, the Local Governments Operations Protocol, and air quality models produced by the California Air Resources Board (CARB).

In this inventory, all GHG emissions are converted into carbon dioxide equivalent units, or CO_2e, per guidance in the Local Government Operations Protocol (LGOP). The LGOP provides standard factors to convert various greenhouse gases into carbon dioxide equivalent units; these factors are known as Global Warming Potential factors, representing the ratio of the heat-trapping ability of each greenhouse gas relative to that of carbon dioxide.

The community inventory methodology is based on guidance from ICLEI's draft International Local Government GHG Emissions Analysis Protocol (IEAP), as well as methods utilized in the *San Diego County Greenhouse Gas Inventory* produced by the University of San Diego's Energy Policy Initiatives Center (EPIC), and in ongoing climate change planning work at SANDAG.

F.1.1 Emissions Sources Included and Excluded

In general, local jurisdictions should seek to measure all emissions of the six Kyoto Protocol greenhouse gases[31] occurring within the jurisdictional boundaries. In practice, this level of detail may not be feasible for the local jurisdiction. The table below describes sources included in this community inventory, followed by sources that were excluded:

Sector	Emissions Source	Sector	Emissions Source
Residential	Bundled Electricity	**Transportation**	***On-Road Transportation***
	Direct Access Electricity		Travel on Local/Regional Roads
	Bundled Natural Gas		Travel on State Highways
	Direct Access Natural Gas		
Commercial / Industrial	Bundled Electricity		***Off-Road Sources***
	Direct Access Electricity		Lawn and Garden Equipment
	Bundled Natural Gas		Construction Equipment
	Direct Access Natural Gas		Industrial Equipment
Solid Waste	Community-generated Solid Waste		Light Commercial Equipment
	Landfill Waste-in-Place	**Wastewater**	Community-generated Wastewater

Local governments will often choose to exclude emissions sources that meet the following criteria:

- ***Below the significance threshold***. In the ICLEI reporting standard, emissions sources can be excluded from the analysis (e.g. are ―de minimis”) if, when combined, the excluded emissions total less than 5% of the total of the emissions from the Community or Government Inventory.[32]
- ***Insufficient data or accepted standard methodology.*** The science is still evolving in many sectors, and accurate records or standards for measuring emissions are not always available. Examples include non-combustion industrial emissions sources or emissions from composting activities.
- ***Emissions largely located outside the jurisdiction's boundaries.*** These types of emissions could include such sources as aviation departing from local airports or regional transit emissions.

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[31] CO_2, CH_4, N_2O, SF_6, perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs)

[32] Note: an inventory should include at least 95% of the emissions released by the government and community as a whole. Therefore, if a large number of small emissions sources occur within the jurisdiction, they cannot all be ignored.

In this inventory, the following emissions were below the significance threshold and were not included:

- SF_6, perfluorocarbons (PFCs), and hydrofluorocarbon (HFCs) emissions
- N_2O emissions from transportation
- Mobile emissions from alternative fuels
- Emissions of minor off-road sources (those not included in the table above)
- Stationary emissions from propane and diesel fuels
- Non-combustion industrial emissions sources

The following sources were excluded because they occurred in a largely regional context:

- Aviation
- Rail
- Regional public transit
- Emissions from the Encina electricity generation facility and Encina wastewater treatment facility

F.2 Emissions Forecast

This inventory includes a ―business-as-usual" forecast to 2020, estimating emissions that will occur if no new emissions reduction policies are implemented. The forecast is based on household, population, and job projections from SANDAG's *2030 Regional Growth Forecast Update*. As a business-as-usual projection, the forecast does not take into account legislation or regulation currently under development, and relies on demographic data as the basis for estimating growth in each sector. The forecasting approach varies for each sector:

- Residential emissions are based on projected growth in local jurisdiction *households*.
- Commercial / industrial sector emissions are correlated with forecasted *job growth* in the local jurisdiction.
- Transportation emissions are based on projected growth rates in *regional vehicle miles traveled* associated with SANDAG's Regional Transportation Plan 2030.
- Solid waste and wastewater emissions are correlated with forecasted *population* growth in the local jurisdiction.

F.3 The Built Environment: Residential, Commercial, and Industrial Sectors

Electricity and natural gas sold to San Diego Gas & Electric customers as bundled service (both energy generation and transmission/distribution) was provided by Benjamin Lopez at SDG&E. Direct access electricity and natural gas was also provided by SDG&E, which records the direct access resources that are distributed through its grid.

Bundled SDG&E electricity emissions were calculated in ICLEI's CACP software using SDG&E-specific emissions factors provided by the California Climate Action Registry. Direct access electricity consumption was calculated in CACP using EPA eGrid emissions factors for the WECC California eGrid subregion. All natural gas emissions were calculated in CACP with default emissions factors from the Local Government Operations Protocol.

F.4 On-road Transportation and Off-road Mobile Sources

F.4.1 On-road Transportation

On-road transportation emissions were derived from local jurisdiction vehicle miles traveled (VMT) data and regional vehicle and travel characteristics. Observed 2005 VMT on non-State facilities (referred to in the inventory as ―local roads") was obtained from Caltrans' Highway Performance Monitoring System reports. VMT on state highways in the local jurisdiction was derived from a GIS shapefile output from the SANDAG transportation model, which is the basis of air quality reporting associated with the Regional Transportation Plan. For state highway segments that crossed jurisdictional boundaries, the segments were clipped in GIS and only the portion within the boundaries was accounted for.

The EMFAC2007 model developed by CARB was used to calculate emissions from these VMT figures. EMFAC defaults for San Diego County include regionally-specific information on the mix of vehicle classes and model years, as well as ambient conditions and travel speeds, that determine fuel efficiency. The model estimates carbon dioxide and methane emissions from these factors and inputted vehicle activity data.

Because inputting local VMT without changing regional defaults for vehicle population and vehicle trips would result in an over-estimation of emissions, regionally-specific ratios of VMT to vehicle population and trips were held constant.

EMFAC outputs are reported in short tons per day. Results were converted to metric tons per year. Because state highway VMT and associated emissions were based on average *weekday* traffic volumes, a 5-day to 7-day conversion factor was obtained from Caltrans and applied to the output to allow for annualizing.[33] Methane emissions were converted to carbon dioxide equivalent units based on the Global Warming Potential factor from LGOP.

[33] Provided by Kim Sturmer, Caltrans. The 2008 5-day to 7-day factor (only available) for state highways is 0.94.

F.4.2 Off-road Mobile Sources

Off-road emissions were obtained from the CARB OFFROAD2007 model. The model was run using default equipment population, usage, and efficiency data for San Diego County. Emissions outputs were scaled to the local jurisdiction level by population share. Results were converted from short tons per day to metric tons per year. Methane and nitrous oxide emissions were converted to carbon dioxide equivalent units based on the Global Warming Potential factors from LGOP.

F.5 Solid Waste

Emissions from solid waste were captured in two ways: emissions from landfills located in the jurisdiction in the base year (―landfill waste-in-place”), and future emissions from decomposition of waste generated in the local jurisdiction in the base year (―community-generated solid waste”).

F.5.1 Landfill Waste-in-Place

Methane emissions were obtained from CARB, which utilized a First Order Decay Model (FOD) to estimate emissions from County waste disposal facilities.[34] The FOD incorporates data on waste disposal and facility conditions extending back several decades to calculate methane and carbon dioxide equivalent emissions.

F.5.2 Community-Generated Solid Waste

Community-generated solid waste emissions were calculated in CACP using waste disposal data obtained from the California Integrated Waste Management Board Disposal Reporting System, which records tonnages of municipal solid waste and alternative daily cover by local jurisdiction. Emissions were calculated using the same methodology as described in Appendix D for government-generated solid waste.

F.6 Wastewater

This inventory utilizes wastewater emissions estimates from the EPIC San Diego County inventory. EPIC obtained a per capita wastewater emissions estimate from CARB for 2005. This figure was reduced to account for biogas capture at regional wastewater facilities using gas capture data provided by the San Diego County Air Pollution Control District. For the purposes of this inventory, this per capita County-wide emissions rate was scaled to the local jurisdiction level by population share.

[34] Provided by Larry Hunsaker, CARB, on November 27, 2007. This data is embedded in the community master data file provided to the local jurisdiction with this report.

Appendix G: Conducting a Monitoring Inventory

The purpose of this appendix is to assist the City of Carlsbad‘s staff in conducting a monitoring inventory to measure progress against the baseline established in this inventory report. Conducting such an inventory represents milestone five of the Five- Milestone Process, and allows a local government to assess how well it is progressing toward achieving its emissions reduction targets.

This inventory was conducted by ICLEI in conjunction with Linda Kermott, Manager of Public Works Administration and Environmental Programs in Carlsbad, who served as the lead data gathering coordinator for the inventory. To facilitate a monitoring inventory, ICLEI has documented all of the raw data, data sources, and calculation methods used in this inventory. Future inventories should seek to replicate or improve upon the data and methods used in this inventory. Wherever possible, however, ICLEI strongly recommends institutionalizing internal data collection in order to be able to meet the recommended methods outlined in LGOP.

G.1 ICLEI Tools for Local Governments

ICLEI has created a number of tools for Carlsbad to use to assist them in future monitoring inventories. These tools are designed to work in conjunction with LGOP, which is, and will remain, the primary reference document for conducting an emissions inventory. These tools include:

- A ―master data sheet" that contains most or all of the raw data (including emails), data sources, emissions calculations, data templates, notes on inclusions and exclusions, and reporting tools (charts and graphs and the excel version of LGOP reporting tool).
- A copy of all electronic raw data, such as finance records or Excel spreadsheets.
- LGOP reporting tool (included in the master data sheet and in Appendix B) that has all activity data, emissions factors, and methods used to calculate emissions for this inventory.
- Sector-specific instructions that discuss the types of emissions, emissions calculations methods, and data required to calculate emissions from each sector, as well as instructions for using the data collection tools and calculators in the master data sheet.

- The appendices in this report include detailed methodologies for calculating emissions from Scope 3 employee commute and government-generated solid waste, as well as two versions of the employee commute survey.

It is also important to note that all ICLEI members receive on-demand technical assistance from their ICLEI liaison, which local staff should feel free to contact at any point during this process.

G.2 Relationship to Other San Diego Regional Climate Protection Initiative Inventories

While the emissions inventories for the 10 participating local governments were conducted simultaneously using the same tools, a local government operations inventory is based on data specific to each local government's operations. For this reason, data must be collected internally within each local government, and the availability of data (and thus emissions estimation methods) will vary between local governments.

That said, local governments in the San Diego Regional Climate Protection Initiative may benefit by cooperating during the re-inventorying process. For example, by coordinating inventories, they may be able to hire a team of interns to collectively perform the inventories – saving money in the process. In addition, local staff may be able to learn from each other during the process or conduct group training sessions if necessary. As a whole, the Climate Protection Initiative provides the basis for a continuing regional platform for climate actions, and ICLEI recommends taking advantage of this opportunity during all climate actions, including conducting future greenhouse gas emissions inventories.

G.3 Improving Emissions Estimates

One of the benefits of a local government operations inventory is that local government staff can identify areas in their current data collection systems where data collection can be improved. For example, a local government may not directly track fuel consumption by each vehicle and instead will rely upon estimates based upon VMT or purchased fuel to calculate emissions. This affects both the accuracy of the emissions estimate and may have other implications for government operations as a whole.

During the inventory process, ICLEI and local government staff identified the following gaps in data that, if resolved, would allow Carlsbad to meet the recommended methods outlined in LGOP in future inventories.

- Direct tracking of fire suppressants recharged into fire suppression equipment
- Odometer readings of individual vehicles
- Fuel consumption by mobile equipment
- Fuel consumption by diesel and other generators (propane)
- Direct tracking of refrigerants recharged into vehicles in the vehicle fleet

- Waste generated from government facilities

ICLEI encourages staff to review the areas of missing data and establish data collection systems for this data as part of normal operations. In this way, when staff are ready to re-inventory for a future year, they will have the proper data to make a more accurate emissions estimate.

G.4 Conducting the Inventory

ICLEI recommends the following approach for San Diego Regional Climate Protection Initiative local governments that wish to conduct a monitoring inventory:

Step 1: Identify a Climate Steward

This steward will be responsible for the jurisdiction's climate actions as a whole and could serve as an ICLEI liaison in all future climate work. In the context of a monitoring inventory, the steward will be responsible for initiating discussions on a new inventory.

Step 2: Determine which Sectors to Inventory

There are many ways to determine which sectors apply to a local government's operations, but the easiest to review will be LGOP Standard Report, which is located both in Appendix B and in the master data sheet. This document clearly delineates which sectors will need to be inventoried within a local government's operations and which LGOP sectors do not apply to a jurisdiction.

Step 3: Gather Support: Identify Data Gathering Team and Leads

Coordination and acceptance among all participating departments is an important factor in coordinating a successful inventory. To that end, the inventory coordinator should work with the city/town/county administrator to identify all staff who will need to be part of the inventory. To facilitate this process, ICLEI has documented all people associated with the inventory in the master data sheet—these names are located in the final completed data form for each sector. Once this team has been identified, the inventory coordinator should hold a kickoff meeting with the administrator, all necessary staff, and relevant department heads which clearly communicates the priority of the inventory in relationship to competing demands. At this meeting, the roles of each person, including the inventory coordinator, should be established.

Step 4: Review Types of Emissions and Available Methodologies for Applicable Sectors

Local staff should then review LGOP and the instructions documents provided through this inventory to better understand the types of emissions for each sector (for example, within Mobile Emissions, CO_2 emissions and CH_4/N_2O emissions represent two different data requirements and emissions calculations methodologies). Each emissions type may have more than one possible estimation methodology, and it is important that the inventory coordinator understands all possible methodologies and be able to communicate this to all parties assisting in the data gathering.

Step 5: Review Methodologies Used for the 2005 Inventory to Determine Data to Collect

In order to duplicate or improve upon the methods used in this inventory, local staff should again review the methods used for this inventory—these methods are again located in Appendix B—and within the master data sheet. These methods reflect the data limitations for each local government (as many local governments could not obtain data necessary to meet the recommended methods in LGOP). Wherever possible, these methods should be duplicated or, if it is possible, replaced with the recommended methods outlined in LGOP. Using these methodologies, staff will determine what data needs to be collected and communicate this effectively to the data gathering team.

Step 6: Begin Data Collection

With the exception of electricity and natural gas for stationary sources, all data collection will be internal. To obtain stationary source energy consumption data, staff will need to contact the ICLEI representative to determine who the contact is for PG&E data (other utilities will need to be contacted directly).

Step 7: Use the Data Forms as a Resource During Data Gathering

A number of questions will come up during the data gathering process that may be difficult to answer. ICLEI has attempted to capture all of the questions that arose during the 2005 inventory and how they were addressed through the master data sheet. Within the master data sheet, staff should review the raw data, working data, and completed data forms to review how raw data was converted to final data, and also to review any notes taken by ICLEI staff during the 2005 inventory process.

For example, reviewing the stationary sources PG&E data within the master data sheet will allow local staff to review how individual accounts were separated into each category and which counts may have been excluded from the inventory.

Step 8: Use Emissions Software to Calculate Emissions

ICLEI has provided the staff lead on the 2005 inventory with a backup of the software used to calculate many of the emissions included in this report. Staff should use this (or more current ICLEI software) to calculate emissions by inputting the activity data into the software. ICLEI staff and ICLEI trainings are available to assist local government staff in calculating emissions.

Step 9: Report Emissions

The master data sheet also contains the LGOP Standard Reporting Template, which is the template adopted by CARB as the official reporting template for government operations emissions inventory. This tool, as well as the charts and graphs tool provided by ICLEI can be used to report emissions from government operations. Also, local government staff should utilize this narrative report as guide for a narrative report if they so choose.

Step 10: Standardize and Compare to Base Year

Conducting a monitoring inventory is meant to serve as a measuring point against the baseline year represented in this report. In order to make a more accurate comparison, it is necessary to standardize emissions from stationary sources based upon heating and cooling degree days (staff can use a ratio of heating /cooling degree days to standardize across years).

In addition, it is important, when comparing emissions across years, to clearly understand where emissions levels may have changed due to a change in methodology or due to excluding an emissions source. For example, if the default method was used to estimate refrigerant leakage in 2005 (this method highly overestimates these emissions), and the recommended method was available in a monitoring year, this would appear as a dramatic reduction in these emissions even though actual leaked refrigerants may be similar to the base year. Changes such as these should not be seen as progress toward or away from an emissions reduction target, but emissions estimates should be adjusted to create as much of an apples-to-apples comparison as possible. If such an adjustment is not possible, staff should clearly note the change in methodology between years when comparing emissions.

Appendix B-2

2011 Carlsbad Community and Local Government Operations Greenhouse Gas Inventory Updates

DYETT & BHATIA
Urban and Regional Planners

M E M O R A N D U M

To:	David de Cordova
From:	Chris Ford, Josh Pollak
Re:	Carlsbad Community Greenhouse Gas Inventory Update – 2011
Date:	August 26, 2013

This memo highlights the approach taken to update the City's 2005 Greenhouse Gas (GHG) Emissions Inventory with 2011 data and compares the inputs and outputs. A separate memo will cover local government operations. The content of these memos will then 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.

This memo reviews the assumptions employed, the quantitative inputs and methodology of estimating the emissions by sector, and the outputs.

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
EMFAC	The EMissions FACtors model developed by CARB to measure various emissions from vehicles. There are multiple versions of EMFAC which focus on different vehicle types.
EPA	US Environmental Protection Agency
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
Service Population	Residents + employees, a rough measure of how many people may be generating emissions within a defined area.
VMT	Vehicle Miles Traveled, a measure of the annual amount of driving within an area, used to calculate GHG emissions from vehicles

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ASSUMPTIONS

As with the 2005 inventory, ICLEI's CACP[1] model was used to estimate emissions from residential, commercial, and industrial consumption of energy and solid waste disposal; CARB's EMFAC models were used to calculate transportation emissions; and other sources were used for wastewater and Palomar landfill emissions.

Between 2005 and 2011, the population and jobs of Carlsbad increased by an estimated 12 percent as did the service population of Carlsbad—the number of residents plus number of jobs, reflecting the number of people who may generate GHG emissions. Since 2005, Carlsbad's share of the county population has increased from 3.13 percent to 3.41 percent, due to a faster rate of growth than the overall county. Table 2 summarizes these changes.

Table 2: Population and Jobs, 2005 and 2011

	2005	*2011*	*% Change*
San Diego County Population[1]	3,034,388	3,115,810	2.7%
Carlsbad Population[1, 2]	94,961	106,403	12.0%
Carlsbad - % of County Population	3.13%	3.41%	8.9%
Carlsbad - # of Jobs[3]	59,309	66,417	12.0%
Carlsbad – Service Population	154,270	172,820	12.0%

1. The 2011 populations for the county and Carlsbad come from the California Department of Finance, Table E-5.
2. The 2005 Inventory used different populations for the community and local government analyses. This is the population used for the community inventory.
3. Numbers from SANDAG.

Electricity Coefficients

Electricity coefficients measure how much GHG emission and air pollution is created by various sources of electricity generation. They are measured as pounds of emission per megawatt hour (lb/MWh). The CACP model includes "back end" settings and assumptions that can be adjusted from defaults:

- Bundled customers purchase electricity from SDG&E. The CACP model has built-in values for SDG&E, although the most recent data is from 2007. Dudek provided 2010 numbers from SDG&E from the Climate Registry, which are the most recent available; these 2010 numbers were substituted in for the 2007 data.
- CACP also allows the manual entry of coefficients. This is used for direct electricity consumers, who purchase power from elsewhere, with SDG&E handling delivery to the customer. The power is purchased from across the region. We used the regional energy coefficients from the EPA's 2009 eGRID tables, which are the most recent available.

Table 3 compares the coefficients used for the 2005 and 2011 inventories. The table shows that since 2005, the pounds of GHG emissions (carbon dioxide, nitrous oxide, and methane) produced

[1] The 2011 update utilized the CACP 2009 Version 3.0 software.

per megawatt hour of electricity fell for both SDG&E and regional power generation—except for CO_2 emissions from SDG&E power, which rose significantly (35%). The reason for this difference is unknown; SDG&E would not respond to our questions. The coefficients for SDG&E in 2005 were notably lower than in all other recent years, however, with a major decline from 2004 to 2005, followed by large increases between 2005 and 2007, and thereafter. This pattern suggests that SDG&E's low energy coefficients for 2005 were abnormal, with the 2010 coefficients (used for the 2011 Inventory) more in line with recent trends.

A second issue shown by Table 3 is that in 2005, SDG&E power was significantly cleaner than power purchased from elsewhere (about 24% less CO_2), but by 2009-2010 SDG&E power produced more GHG emissions than other regional power (12% more CO_2).

Table 3: Electricity Coefficients (lb/MWh)

Year	*CO_2*	*N_2O*	*CH_4*
Bundled Service (SDG&E)			
2005[1]	546.50	0.011	0.030
2010[2]*	739.05	0.0081	0.0302
% Increase	*+35%*	*-26%*	*+1%*
Direct Access Electricity (eGRID)			
2005	724.12	0.00808	0.03024
2009[3]*	658.68	0.00617	0.02894
% Change	*-9%*	*-24%*	*-4%*

**Data used for Carlsbad 2011 inventory update.*

1. Data from CACP model.
2. Data from www.climateregistry.org
3. 2009 eGRID coefficients for N_2O and CH_4 converted from lb/GWh by dividing by 1,000. All 2009 coefficients are the "subregion annual total output emission rate."

Natural Gas Coefficients

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

Transportation

We used the default assumptions for San Diego County within CARB's GHG emissions models, EMFAC2007 and OFFROAD2007 (from 2007) and EMFAC2011 (from 2011).

Solid Waste

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

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 2005 emissions measurement process was organized around source sector; this structure was maintained for the 2011 effort. The table at the end of this section compares the 2005 and 2011 inputs.

Residential / Commercial / Industrial (RCI)

The inputs for these three sectors are the same: inputs are electricity and natural gas consumed, broken into bundled and direct access, and entered into CACP. All of the data is from SDG&E.

- Bundled electricity is produced for SDG&E and transmitted by SDG&E. The electricity coefficients for SDG&E, based on the utility's mix of power sources and technology, determine the CO_2e produced.
- Direct access electricity is produced elsewhere in the region but ultimately transmitted to the consumer by SDG&E. Given the wide mix of possible producers, regional electricity coefficients are applied to determine CO_2e.
- Natural gas produces the same CO_2e regardless of source.

Table 4 shows the 2011 RCI inputs compared to the 2005 inputs. There were some changes between bundled and direct access service—see the data file for those details. Most energy consumption increased between 1.4 and 2.5 percent per year. The exceptionally high industrial natural gas consumption in 2005 appears to include use by the Encina Power Station, which was removed from the final numbers of that inventory; the 2011 Inventory data does not include the station.

Table 4: RCI Inputs

		2005	*2011*	*Change*	*Avg Annual*
Residential	Electric (kWh)	249,286,797	275,033,189	10%	1.7%
	Natural Gas (therms)	13,861,471	15,769,481	14%	2.2%
Commercial	Electric (kWh)	379,244,330	411,249,580	8%	1.4%
	Natural Gas (therms)	6,779,454	7,844,336	16%	2.5%
Industrial	Electric (kWh)	114,639,521	116,341,521	1%	0.2%
	Natural Gas (therms)	234,647,345*	1,536,470	-	-

*Includes use by Encina Power Station

Table 5 summarizes the communitywide consumption of electricity and natural gas. Electricity consumption grew at the rate of job creation and below the rate of population growth, but natural gas consumption grew faster than the city.

Table 5: Communitywide Summary of Electricity and Gas Consumption

	2005	*2011*	*Change*	*Avg Annual*
Electric (kWh)	743,170,648	802,624,290	8%	1.3%
Natural Gas (therms)*	20,640,925	23,613,817	14%	2.3%

*Excludes industrial

Transportation – Vehicles

The 2005 inventory used the EMFAC2007 model created by CARB due to its "regionally-specific information on the mix of vehicle classes and model years, as well as ambient conditions and travel speeds, that determine fuel efficiency." As inputs, emissions from local roadway VMT and freeway VMT were determined separately.

- Local roadway VMT was taken from the Caltrans HPMS (Highway Performance Monitoring System), which provides a citywide daily VMT for all local roadways except federal and state highways (i.e., I-5).
- Daily VMT for I-5 was acquired from SANDAG regional GIS files and clipped to the city limits.
- EMFAC2007 apparently produced CO_2 and CH_4 outputs in short tons (2,000 pounds) for each VMT, broken down by gasoline and diesel.
- CH_4 was converted into CO_2e by multiplying it by 21.
- Daily CO_2e was multiplied by 365 days and converted to metric tons, which are 1,000 kilograms, but multiplying "short tons" by 0.9072.
- The State highway CO_2e was also multiplied by 0.94 to convert weekday only data into average 7-day data.

For the 2011 inventory update, SANDAG provided 2008 and 2011 VMT data for two scenarios: the first which captures all VMT within the City of Carlsbad, the second excluding pass-through trips, or trips neither originating nor ending within the City of Carlsbad. Examples of pass-through trips are trips on the I-5 freeway and other major streets where drivers do not begin or end within the City of Carlsbad. Table 6 shows a comparison of VMT from 2005 and 2011 both including and excluding pass-through trips. In both 2005 and 2011, the VMT excluding pass-through trips was less than one-half of the total VMT.

Table 6: Annual Vehicle Miles Travelled within City of Carlsbad Including and Excluding Pass-Through Trips

	2005*	% of Total	2011	% of Total
VMT including pass-through trips	1,077,348,687	-	1,203,623,632	-
VMT excluding pass-through trips	505,241,237	47%	510,973,969	42%

*Estimated by linear interpolation of 2008 SANDAG data

The 2011 Inventory uses VMT excluding pass-through trips to capture transportation emissions from trips originating or ending within the City of Carlsbad. Residents, commuters and the City have a limited ability or are unable to influence pass-through trips, which contribute a substantial amount to VMT totals. Therefore, pass-through trips were excluded from this inventory.

Table 7 compares the 2005 annual VMT to 2011 VMT. The VMT in Carlsbad grew at a slower rate than population growth. The low rate of growth in VMT could have been caused by regional economic slowdown.

Table 7: Annual Vehicle Miles Travelled within City of Carlsbad Excluding Pass-Through Trips

	2005*	2011	Change	Avg Annual
VMT	505,241,237	510,973,969	1%	0.2%

*Estimated by linear interpolation from 2008 SANDAG data

The inventory update uses CARB's latest model, EMFAC2011, which is made up of three modules, -SG, -LDV, and –HD. The SG module covers all vehicle types, while LDV calculates light duty vehicles and HD calculates heavy duty vehicles.

- Carbon dioxide emissions were calculated using the SG module. The model was set to San Diego County, CY 2011, Annual, using the citywide annual VMT for 2011. We used the CO_2 emissions output that assumes Pavley I and low carbon fuel standard (LCFS).
- Methane emissions are not calculated by the SG module, so the LDV module was used to calculate CH_4 from light duty vehicles, with emissions from heavy duty vehicles calculated using a formula. We used the following process:
  - The SG module automatically distributes overall VMT into different vehicle types using a regionally-specific mix.
  - These SG vehicle types were compared to the vehicle models in the LDV module and manually categorized into light and heavy duty.
  - The VMT for light duty vehicles was then entered into the LDV module, which calculated CH_4 for light duty vehicles.
  - For heavy duty vehicles, we summed the Total TOG Emissions and multiplied by 0.0408 to get CH_4. Calculation is from CARB: http://www.arb.ca.gov/msei/emfac2011-faq.htm#emfac2011_web_db_qstn07

Transportation – Off Road

As with the 2005 inventory, CARB's OFFROAD2007 model was used. It was run with the settings: 2011 CY, Mon-Sun (all days), Annual, HC emissions as TOG, Area = San Diego County; all equipment, fuel, and horsepowers.

The model generates emission outputs for 16 categories across San Diego County. The 2005 inventory used 4 categories that generate the most emissions: lawn and garden equipment, construction equipment, industrial equipment, and light commercial equipment.

The CO2, N2O, and CH4 emissions are calculated in short tons per day for the county. These emissions were then pro-rated by the city's share of the county population, multiplied by 365 days, and converted to metric tons.

Solid Waste

For methane emissions from the one landfill in the city limits, the closed Palomar Airport Landfill, we used the same data from 2005 – it is unlikely to have changed much, if at all.

For emissions from solid waste disposed of in Carlsbad and taken to landfills elsewhere, 2011 data for Carlsbad was obtained from CalRecycle. The composition of waste was estimated from the latest such survey, the 2008 CalRecycle Statewide Waste Characterization Study, which has averages for the southern region of California. The amount of average daily cover, which is made of plant debris, was also entered.

Wastewater

As in 2005, the EPIC estimate of GHG emissions from countywide wastewater treatment was used and pro-rated to Carlsbad's share of the county population. For unknown reasons, countywide GHG emissions from wastewater treatment went up significantly from 2005 to 2011, increasing by 32 percent. While this emissions increase was not caused by Carlsbad per se, the community is considered responsible for it. That said, these emissions from wastewater make up a very small proportion of Carlsbad's overall GHG emissions.

OUTPUTS

The majority of emissions growth came from commercial and residential electricity and natural gas consumption, although this was highly influenced by the large increase in emissions from SDG&E electricity generation since 2005. Transportation emissions decreased by 5 percent, though VMT rose by 1 percent, likely a sign that cleaner vehicles are making an impact. Emissions from solid waste decreased along with the decline in the tonnage of waste disposed, possibly due to the economic recession, while emissions from wastewater treatment went up regionally but are a relatively small number. Table 8 summarizes the sources and amounts of communitywide emissions.

Table 8: GHG Emissions 2005 vs. 2011 (metric tons CO2e)

Sector	*Subsector*	*2005 Emissions*	*2011 Emissions*	*% Growth*	*Avg Annual Rate*
Residential	Bundled Electricity	62,105	92,500		
	Bundled Natural Gas	74,137	83,698		
	Direct Access Electricity	185	81		
	Direct Access Natural Gas	-	126		
	Total Residential	**136,427**	**176,405**	**29%**	**4.38%**
Commercial	Bundled Electricity	83,303	125,314		
	Bundled Natural Gas	35,843	37,731		
	Direct Access Electricity	15,049	11,701		
	Direct Access Natural Gas	416	3,966		
	Total Commercial	**134,611**	**178,712**	**33%**	**4.84%**
Industrial	Bundled Electricity	16,812	29,329		
	Bundled Natural Gas	3,013	-		
	Direct Access Electricity	15,605	8,765		

	Direct Access Natural Gas	-	8,154		
	Total Industrial	**35,430**	**46,248**	**31%**	**4.54%**
Transportation	On-Road Total	260,467	239,467	-8%	-1.39%
	Lawn and Garden Equipment	2,099	2,449	17%	2.60%
	Construction Equipment	19,861	23,830	20%	3.08%
	Industrial Equipment	4,349	4,943	14%	2.16%
	Light Commercial Equipment	2,654	3,056	15%	2.38%
	Off-Road Subtotal	*28,963*	*34,279*	*18%*	*2.85%*
	Total Transportation	**289,430**	**273,745**	**-5%**	**-0.9%**
Solid Waste	Community-generated solid waste	27,417	21,719	-21%	-3.81%
	Landfill Waste-in-Place	2,598	2,598	0%	0.00%
	Total Solid Waste	**30,015**	**24,317**	**-19%**	**-3.45%**
Wastewater	Total Community-generated Wastewater	4,397	6,317	44%	6.23%
GRAND TOTALS		**630,310**	**705,744**	**12%**	**1.90%**

The RCI numbers in the above table can be hard to compare, due to growth in energy consumption being mixed with switches between bundled service and direct access. Table 9 summarizes emissions by power source and sector. From this table, it is clear that the relative and absolute increase in emissions from electricity is a major contributor to the communitywide growth in emissions.

Table 9: Emissions from Electricity and Natural Gas Summarized

Category	*2005 CO2e*	*2011 CO2e*	*% Growth*	*AARG*
Residential-Electric	62,290	92,581	49%	6.8%
Residential-NG	74,137	83,824	13%	2.1%
Commercial-Electric	98,352	137,015	39%	5.7%
Commercial-NG	36,259	41,697	15%	2.4%
Industrial-Electric	32,417	38,094	18%	2.7%
Industrial-NG	3,013	8,154	171%	18.0%
OVERALL RCI	**306,468**	**401,365**	**31%**	**4.6%**

CONCLUSIONS

Overall the communitywide GHG emissions from Carlsbad increased by 12 percent between 2005 and 2011, equivalent to the rate of population and job household growth during that time. As a result, the GHG emissions per service population held steady since 2005, as shown in Table 10.

Table 10: Emissions per Service Population

	2005	*2011*	*% Change*
GHG Emissions ($MTCO_2e$)	630,310	705,745	12.0%
Service Population	154,270	172,820	12.0%
Emissions per Service Population	4.09	4.08	-0.1%

Table 11 shows where the growth in emissions came from. The largest contributors to additional emissions came from commercial electricity usage (37%), followed by residential electricity usage (29%). All other emissions increased lower than the rate of population growth, with emissions from residential natural gas consumption increasing by 9 percent, and all other sources increasing by 5 percent, or decreasing, in the case of roadway emissions.

For electricity, this increase is largely fueled by the large increase (35%) in the CO_2 generated by SDG&E electricity since 2005. For example, residential electricity consumption increased by 10 percent but emissions from that source increased by 29 percent. Commercial electricity consumption went up by 8 percent while related emissions increased by 37 percent—an even higher increase as some commercial customers switched from cleaner direct access electricity to “dirtier” sources.

Table 11: Sources of Growth in GHG Emissions (metric tons CO2e)

Source	*2005 CO2e*	*2011 CO2e*	*Growth*	*% of Growth*
Commercial-Electric	98,352	137,015	38,663	37%
Residential-Electric	62,290	92,581	30,291	29%
Residential-NG	74,137	83,824	9,688	9%
Roads	260,467	239,467	-21,000	-8%
Industrial-Electric	32,417	38,093	5,676	5%
Commercial-NG	36,259	41,697	5,438	5%
Off Road	28,963	34,279	5,315	5%
Industrial-NG	3,013	8,154	5,141	5%
Wastewater	4,397	6,317	1,920	2%
Solid Waste	30,015	24,317	-5,698	-5%
TOTALS	**630,310**	**705,744**	**75,434**	

Table 12 shows the sources of emissions, ordered by volume of overall contribution. The largest contributor continues to be transportation, but that has declined in proportion as emissions from energy consumption have grown faster. These sources—roadway VMT, off-road vehicles, and private electricity and natural gas consumption—account for 96 percent of Carlsbad's communitywide GHG emissions.

Table 12: Greenhouse Gas Emissions Summary by Sector (metric tons CO2e)

Sector	*2005*	*% of Total*	*2011*	*% of Total*
Transportation	289,431	46%	273,745	39%
Commercial / Industrial	170,041	27%	224,960	32%
Residential	136,427	22%	176,405	25%
Solid Waste	30,015	5%	24,317	3%
Wastewater	4,397	1%	6,317	1%
TOTAL	**630,310**		**705,744**	

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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

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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

Department	Building	2005 Electricity (kWh)	2005 Natural gas (therms)	2011 Electricity (kWh)	2011 Natural gas (therms)	% Change Electricity (kWh)	% Change 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

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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

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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.

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City of
ENCINITAS

Final

CLIMATE ACTION PLAN

JANUARY 2018

City of Encinitas

City of Encinitas

Climate Action Plan

PREPARED BY:

The City of Encinitas

IN CONSULTATION WITH:

Ascent Environmental, Inc.

Energy Policy Initiatives Center

Prepared in partnership with the San Diego Association of Governments (SANDAG) and the Energy Roadmap Program. This Program is partially funded by California utility customers and administered by San Diego Gas & Electric Company under the auspices of the California Public Utilities Commission.

January 2018

RESOLUTION 2018-04

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ENCINITAS APPROVING AND ADOPTING THE UPDATED CITY OF ENCINITAS CLIMATE ACTION PLAN

WHEREAS, that the City of Encinitas is committed to the long-range goal of protecting the natural environment, increasing sustainability efforts, and improving overall quality of life;

WHEREAS, carbon dioxide (CO_2) and other greenhouse gases released into the atmosphere have a profound effect on the Earth's climate and reducing the potential magnitude of climate change may lower its harmful effects on public health and safety;

WHEREAS, achieving greenhouse gas emission reductions to protect the climate is important to the City of Encinitas, which relies heavily on the stability of the climate for our environment, economy, and quality of life;

WHEREAS, in 2006, the State of California adopted the Global Warming Act of 2006 (Assembly Bill 32) which created a statewide greenhouse gas emission requirement and goal to reduce emissions to 1990 levels by 2020; and in 2016, California Senate Bill 32 established a new mid-term greenhouse gas reduction target of 40 percent below 1990 levels by 2030;

WHEREAS, local actions, whenever taken by cities and counties nationwide, can help provide a collective response and may also provide the benefits of testing and developing model programs, methods, and technologies for achieving greenhouse gas reductions;

WHEREAS, on March 9, 2011, the City Council of the City of Encinitas approved and adopted a Climate Action Plan;

WHEREAS, on June 17, 2015, at the recommendation of the Environmental Commission, the City Council of the City of Encinitas directed staff to work with the Environmental Commission to update of the City's Climate Action Plan;

WHEREAS, on February 10, 2016, a temporary acting staff assignment, Climate Action Plan Program Administrator, was established as part of the City's Fiscal Year 2016-17 Work Program to facilitate the update of the City Climate Action Plan;

WHEREAS, on November 21, 2016, SANDAG extended and initiated climate action planning services to the City of Encinitas through its Energy Roadmap Program to support the update of the City's Climate Action Plan;

WHEREAS, the Climate Action Plan update included a revised greenhouse gas emission inventory and forecast, analysis and qualification of updated greenhouse gas reduction measures and targets, clarification to the process for implementation, monitoring and reporting of progress, and meaningful community engagement.

WHEREAS, four public workshops were hosted by the City of Encinitas and an online forum was set up to gather public input during the update of the Climate Action Plan;

WHEREAS, the updated Climate Action Plan includes a set of Strategies, Goals, Emission Reduction Targets, City Actions, Supporting Measures and Adaptation Strategies based on regional climate planning and consulting expertise, City staff knowledge, and Environmental Commission and public input;

WHEREAS, an Environmental Initial Study determined that the Climate Action Plan would not have a significant impact on the environment;

WHEREAS, a Negative Declaration was prepared for the Climate Action Plan and so deems the document a California Environmental Quality Act Qualified Climate Action Plan;

WHEREAS, greenhouse gas reduction actions contribute to the achievement of many of the City's environmental values and are consistent with the City's Environmental Policy, including promoting clean and efficient energy use, transitioning to greater proportion of renewable electricity sources, reducing vehicle miles traveled and promoting active transportation, implementing an organic waste recycling program and diverting solid waste from the landfill; promoting water conservation; and planning for anticipated future climate change impacts;

WHEREAS, many of the components of a the updated Climate Action Plan are under development or are currently being implemented by the City of Encinitas, including the Green Building Program, the condensed City employee work schedule, Public Transportation Commuter Reimbursement Policy, among others; and

WHEREAS, mechanisms employed and installed to reduce greenhouse gas emissions will also contribute to the economic vitality of the City through the development and use of clean technologies and the addition of local jobs.

NOW, THEREFORE, BE IT RESOLVED, DETERMINED AND ORDERED by City Council of the City of Encinitas that:

1. The updated Climate Action Plan is a California Environmental Quality Act Qualified Climate Action Plan.
2. Based on its consideration, the City Council hereby determines that the adoption of the Climate Action Plan is consistent with the provisions of the General Plan, the Local Coastal Program Land Use Plan, State law, and is in the public interest.
3. It is also understood that where City Actions, Supporting Measures, or Adaptation Strategies require ordinance or zoning code amendments further evaluation and analysis will be conducted to determine adequacy prior to implementation.

BE IT FURTHER RESOLVED that the City will pursue the greenhouse gas emission reduction goals and targets identified in the Climate Action Plan through the implementation of the identified City Actions and by encouraging the community to support Climate Action Plan goals and targets through various actions, ordinances, policies, incentive-based programs, and education programs.

BE IT FURTHER RESOLVED that the City will monitor and report progress towards meeting greenhouse gas emission reduction goals and targets identified in the Climate Action Plan. Since all levels of government continue to monitor, lead and participate in activities, it may be necessary to adjust the measures described therein as necessary to ensure Assembly Bill 32 and other related legislation is fully implemented.

PASSED AND ADOPTED this 17th day of January, 2018, by the following vote, to wit:

AYES: Blakespear, Boerner Horvath, Kranz, Mosca, Muir
NAYS: None
ABSENT: None
ABSTAIN: None

Catherine S. Blakespear, Mayor
City of Encinitas

ATTEST:

Kathy Hollywood, City Clerk

ACKNOWLEDGEMENTS

City of Encinitas

Rob Blough	Crystal Najera	Ashlee Stratakis
Jessica Contreras	Janet Ramos	Scott Vurbeff
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TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
ºF	degrees Fahrenheit
AB	Assembly Bill
BAU	business-as-usual
CAA	Clean Air Act
CAFE	Corporate Average Fuel Economy
CAL FIRE	California Department of Forestry and Fire Protection
CALGreen	California Green Building Standards Code
CalOES	California Office of Emergency Services
CAP	Climate Action Plan
CARB	California Air Resources Board
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CFCs	chlorofluorocarbons
CH_4	methane
City	City of Encinitas
CNG	Compressed Natural Gas
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CoSMoS	Coastal Storm Modeling System
CSE	Center for Sustainable Energy
DWR	Department of Water Resources
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPIC	Energy Policy Initiatives Center
EVs	Electric vehicles
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
GWP	global warming potential
HFCs	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
kWh	kilowatt hours
MHMP	Multi-Jurisdictional Hazard Mitigation Plan

MPOs	Metropolitan Planning Organizations
$MTCO_2e$	metric tons of carbon dioxide equivalent
N_2O	nitrous oxide
O_3	ozone
OMWD	Olivenhain Municipal Water District
OPR	Office of Planning and Research
PACE	Property Assessed Clean Energy
PFCs	perfluorocarbons
ppm	parts per million
PVs	photovoltaics
RTP	Regional Transportation Plan
SANDAG	San Diego Association of Governments
SB	Senate Bill
SCS	Sustainable Communities Strategy
SDCWA	San Diego County Water Authority
SDG&E	San Diego Gas and Electric
SDWD	San Dieguito Water District
UHIE	Urban Heat Island Effect
USGS	U.S. Geological Surveys
UWWUI	urban-wildland interface
VMT	Vehicle Miles Traveled

CITY OF Encinitas

Executive Summary

A Climate Action Plan provides a comprehensive roadmap to address the challenges of climate change in the City of Encinitas (City). To combat the effects of climate change, the City will need to reduce greenhouse gas (GHG) emissions from activities within the City while supporting the community in adapting to and improving its resiliency to a changing climate over the long term. The City previously developed a CAP in 2011 (2011 CAP) based on a 2005 baseline inventory. The 2018 CAP has been prepared as an update to the 2011 CAP to account for new legislation, improved technology, and a more recent baseline inventory year of 2012.

The scientific consensus is that there is substantial evidence that human activity is the causal agent of global climate change and that significant reductions in human-caused GHG emissions are needed by the mid-21st century to prevent the most catastrophic effects of climate change (Intergovernmental Panel on Climate Change [IPCC] 2014). To this end, in 2006, the California Global Warming Solutions Act (Assembly Bill [AB] 32) established the State's first target to reduce GHG emissions, which established a goal of lowering emissions to 1990 levels by 2020. California has been making steady progress and is expected to achieve the 2020 target through actions outlined in the California Air Resources Board (CARB) Scoping Plan; however, ongoing reductions in GHG emissions are needed.

In 2016, Governor Brown signed Senate Bill (SB) 32 into law, which established a new mid-term GHG reduction target of 40 percent below 1990 levels by 2030. This target aligns with those of leading international governments such as the 28-nation European Union which adopted the same target in October 2014. The new 2030 target places California on a trajectory towards meeting its longer-term goal, which is to bring emissions down to 80 percent below 1990 levels by 2050.

In its Scoping Plan, CARB recognizes local governments as "essential partners" in achieving California's goals to reduce GHG emissions. Local governments can implement climate strategies to address local conditions and issues, and can engage citizens more effectively than the State. Local governments have broad jurisdiction and in some cases, unique authorities, through community-scale planning and permitting processes, discretionary actions, local codes and ordinances, outreach and education efforts, and local government operations. CARB contends that local government efforts are critical to supporting the State's efforts to reduce emissions and can ultimately deliver additional emissions reductions beyond what State policy can, along with local economic benefits (CARB 2017). Climate action plans are an effective way for local governments to support the State in its GHG reduction efforts.

The key components of the climate action planning process are shown in Figure ES-1 and briefly summarized below:

1. Prepare a baseline GHG emissions inventory (provided in Chapter 2)

   - The baseline year of 2012 was established for the 2018 CAP.
   - Approximately 483,773 metric tons of carbon dioxide equivalent ($MTCO_2e$) were emitted by communitywide sources in the City in 2012.
   - The largest source of emissions was the on-road transportation sector which accounted for 54 percent of the inventory; the electricity sector, the next largest, accounted for approximately 23 percent of the inventory.

GHG Emission Sectors in 2012 Baseline Inventory:

1. On-Road Transportation (54%)
2. Electricity (23%)
3. Natural Gas (13%)
4. Solid Waste (5%)
5. Water (3%)
6. Off-Road Transportation (2%)
7. Wastewater (0.4%)

Note: Values may not add to totals due to rounding

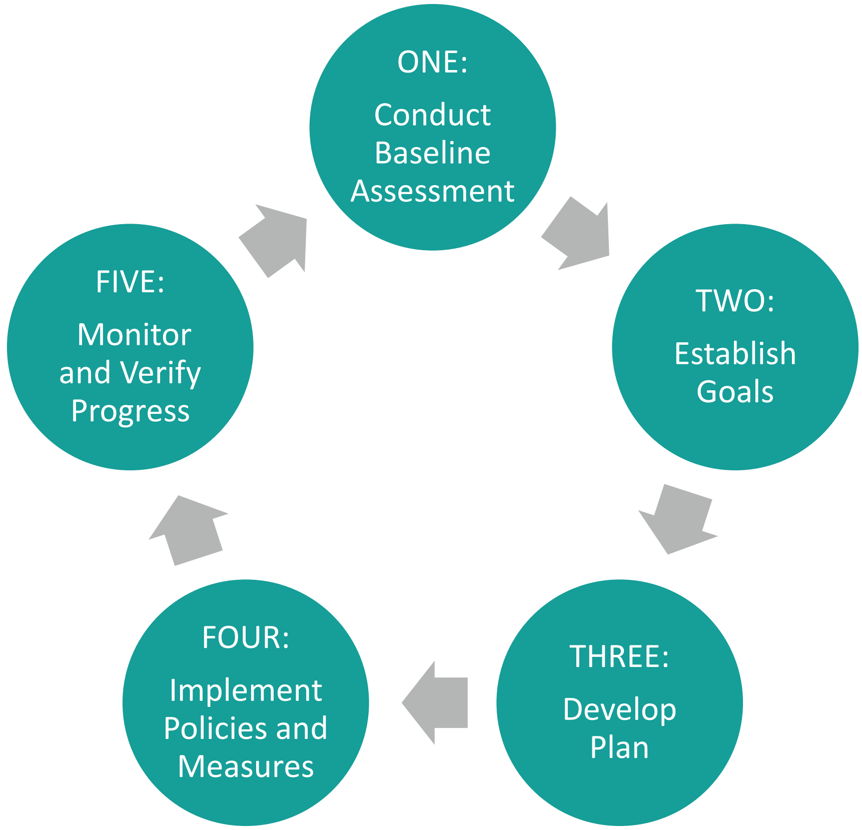


Figure ES-1: Climate Action Planning Milestones

2. Calculate GHG emissions forecasts and develop reduction targets (provided in Chapter 2)

- Future emissions were estimated based on business-as-usual (BAU) conditions. Without any actions taken by the City, GHG emissions are expected to increase by 2020 and 2030.

- GHG emissions reduction targets for the 2018 CAP were established consistent with State guidance:

  - Reduce emissions 13 percent below 2012 baseline levels by 2020; and

  - Reduce emissions 41 percent below 2012 baseline levels by 2030.

> The 2018 CAP contains a total of 19 local GHG reduction actions. The combination of all actions contributes towards achieving the 2020 and 2030 targets.

- Legislative actions by federal or State agencies help to reduce emissions in the future but are not sufficient to achieve the 2020 and 2030 targets.

- Achieving the 2020 and 2030 targets will require local action to help close the gap between legislative-adjusted emissions forecasts and the emissions limits established by the 2018 CAP targets.

3. Identify local GHG emissions reduction strategies, goals, actions, and supporting measures to help the City achieve the 2020 and 2030 targets (provided in Chapter 3).

   - GHG reduction strategies in the 2018 CAP are aligned with the GHG inventory sectors and include a total of 19 specific local GHG reduction actions.

   - The top three actions in the 2018 CAP that will achieve the highest local GHG emissions reductions include:

     - City Action RE-1: Establish a Community Choice Energy Program. This action will reduce emissions by 43,644 $MTCO_2e$ by 2030.

     - City Action ZW-1: Implement a Zero Waste Program. This action will reduce emissions by 2,830 and 11,921 $MTCO_2e$ by 2020 and 2030, respectively.

     - City Action CET-3: Improve traffic flow, promote active transportation, and plan for complete streets. This action would reduce emissions by 3,671 and 2,839 $MTCO_2e$ by 2020 and 2030, respectively.

> The top three GHG reduction actions will reduce City emissions by a total of 6,501 and 58,404 $MTCO_2e$ by 2020 and 2030, respectively.

   - Each strategy is supported by a number of non-quantifiable supporting measures. These are programs, policies, or projects the City will implement that will have an indirect effect on GHG emissions reductions.

   - While the actions and supporting measures in the 2018 CAP are generally geared towards reducing GHG emissions, many will also result in health, environmental, and/or economic "co-benefits," in additional to climate adaptation co-benefits.

> Co-benefits are the collateral positive side effects that result from GHG reducing strategies and actions identified in the CAP.

4. Develop implementation and monitoring mechanisms that will help the City ensure the goals and targets are achieved (provided in Chapter 4).

   - Implementation of the actions and measures in the 2018 CAP will require the City to develop and implement new ordinances, programs, and projects, or modify existing ones. This will require careful consideration of the operational and capital resources needed, as well as the timing and phasing of implementation. Chapter 4 outlines these considerations.

> Climate change is a global problem but one that must be addressed at the local level through partnerships and individual actions.

   - Monitoring is an important aspect of the 2018 CAP to ensure that the City is on track to achieve the GHG reduction targets and desired outcomes for increasing resilience in the face of a changing climate. To this end, the City will need to review and update the GHG emissions inventory periodically (every two years), track the community's progress on the implementation status of each action in the 2018 CAP, and conduct future CAP updates periodically (every five years).

- Local action on climate change cannot be addressed insularly by one agency or community, but requires active and ongoing partnerships between residents, businesses, the City, and other agencies and organizations in the region. On a communitywide level, individuals and businesses can play an important role in combating climate change. By changing habits to consume less energy; producing less waste through recycling, organics processing, and conserving water; and driving less by choosing to carpool, take transit, or walk and bike more frequently, individuals and businesses can work towards reducing their carbon footprint. The combination of these small efforts can lead to better outcomes for the environment and the City.

5. Address climate change vulnerability with adaptation strategies that would improve community sustainability and resilience.

   - Specific adaptation strategies are included in Chapter 5 to address the effects of climate change. Many of the strategies require the City and other partnering agencies to address climate-related risks as part of existing planning processes, as well as making incremental changes in the way City services and infrastructure are maintained and operated. Community education and awareness-building are also important components of the adaptation strategies.

CITY OF Encinitas

CHAPTER 1

Introduction

1.1 Climate Action Plan Overview

Climate Action Plans (CAPs) serve as comprehensive roadmaps that outline the specific activities that a community and municipality will take to reduce greenhouse gas (GHG) emissions and the potential impacts of climate change within the borders of a jurisdiction. In developing a CAP, jurisdictions evaluate the volume of GHGs emitted during a baseline year (2012 for this CAP) and determine the amount of emissions that need to be reduced to achieve statewide GHG reduction targets (discussed in further detail in Section 1.3, “Regulatory Framework”).

2011 CAP

In March of 2011, the City of Encinitas (the City) adopted the *City of Encinitas Climate Action Plan* (2011 CAP) to provide guidance to the City to achieve statewide reduction targets and to respond and adapt to the impacts of climate change. In 2009, the City partnered with members of the San Diego Regional Climate Protection Initiative, local governments in the County of San Diego, and Local Governments for Sustainability (ICLEI) to discuss how the region was going to monitor and address global climate change. This partnership facilitated the City’s initial GHG inventory for the year 2005, which served as the 2011 CAP’s baseline year. The 2005 baseline totaled 548,993 metric tons of carbon dioxide equivalent ($MTCO_2e$) emissions per year, or 8.78 $MTCO_2e$ per year per capita. Under a business-as-usual (BAU) scenario which assumes the continuation of conventional behaviors without the inclusion of any additional efforts or legislative actions to reduce GHG emissions, the 2011 CAP determined that the City’s GHG inventory for 2020 would be 646,947 $MTCO_2e$ per year or 9.5 $MTCO_2e$ per year per capita. To achieve consistency with federal and State GHG reduction goals, the CAP specified that the City would reduce emissions 12 percent below 2005 levels by 2020, equivalent to reducing emissions by 164,159 $MTCO_2e$ in 2020.

2018 CAP

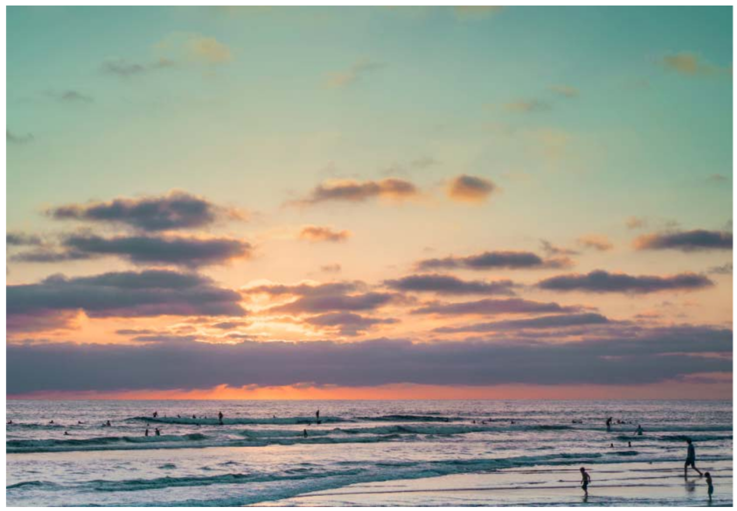
The 2018 CAP builds upon the goals of the 2011 CAP and provides a more recent inventory for the City (2012). As discussed in greater detail in Chapters 2 and 3, the inventory performed for 2012 demonstrated that the activities within the City emitted 483,773 $MTCO_2e$. Consistent with recommendations from the Assembly Bill (AB) 32 2008 Scoping Plan, the City must achieve a 13 percent reduction from 2012 levels by 2020 and a 41 percent reduction by 2030 to be in line with the statewide targets discussed in Section 1.3. This equates to reducing emissions by 53,232 $MTCO_2e$ by 2020 and 197,724 $MTCO_2e$ by 2030.

The 2018 CAP organizes strategies, goals, and actions based on the sectors evaluated in the 2012 inventory (i.e., on-road transportation, electricity, natural gas, solid waste, water, off-road transportation, and wastewater). Strategies were developed to target improving the GHG efficiency of citywide community and municipal activities. For example, GHG reductions will be made through the incorporation of renewable energy in residential and nonresidential buildings while simultaneously improving the efficiency of such buildings. Specific actions and their supporting measures are outlined in Chapter 3 and their reductions disclosed.

The 2018 CAP represents an important step in acknowledging global climate change and its effects on the City. Chapter 2 includes details on the City’s baseline emissions inventory and projections, and establishes reduction targets for 2020 and 2030. Chapters 3, 4, and 5 of the 2018 CAP include strategies, specific actions and supporting measures, and implementation and monitoring mechanisms to reduce GHG emissions and plan for climate change impacts. A more detailed comparison of the 2011 and 2018 CAPs is provided in Appendix C.

1.2 Introduction to Climate Change Science

The greenhouse effect results from the concentration of atmospheric gases referred to as GHGs, which insulate the Earth and help regulate its temperature. The most prevalent GHGs in our atmosphere include water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), chlorofluorocarbons (CFCs), and hydrofluorocarbons (HFCs). These gases serve as global insulators, reflecting Earth's visible light and infrared radiation to keep temperatures on Earth stable. Without the greenhouse effect, Earth would not be able to support life as we know it.



Over the past two decades, human activities (e.g., the burning of fossil fuels for transportation and energy, increasing rates of deforestation and development) have contributed to elevated concentrations of GHGs in the atmosphere. Human-caused (i.e., anthropogenic) emissions of GHGs have resulted in above-normal ambient concentrations of GHGs, intensifying the greenhouse effect, and leading to a trend of abnormal warming of the Earth's climate known as *global climate change*. There is a strong scientific consensus that there is substantial evidence to indicate that most of the changes in the Earth's climate during the last 50 years are a result of anthropogenic GHG emissions (Intergovernmental Panel on Climate Change [IPCC] 2014: 3, 5). Global climate change, in turn, is the driver behind changes in precipitation patterns, rising temperatures, shrinking polar ice caps, sea-level rise, and other impacts to biological resources and humans. Chapter 3 of the 2018 CAP summarizes the City's GHG emissions and local contribution to global climate change.

Climate change is a global problem and can lead to significant fluctuations in regional climates. While there is consensus that global climate change is occurring and that it is exacerbated by human activity, there is less certainty as to the timing, severity, and potential consequences of climate change phenomena, particularly at the local level. Chapter 5 of the 2018 CAP discusses the predicted climate change effects in the City and recommends strategies to adapt to climate change.

1.3 Regulatory Framework

In response to the threat of global climate change, the State and City have already taken several steps to both reduce GHG emissions and adapt to climate change. These efforts, and the legislative background summarized in the following sections, provide important policy drivers and context for the 2018 CAP.

1.3.1 California

In 2005, Governor Arnold Schwarzenegger signed Executive Order (EO) S-3-05, which directed California to reduce GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. A year later, in 2006, the Global Warming Solutions Act (Assembly Bill [AB] 32) was passed, establishing regulatory, reporting, and market mechanisms to achieve quantifiable reductions in

GHG emissions. AB 32 put a cap on GHG emissions, setting a target of reducing GHG emissions to 1990 levels by 2020. As part of its implementation of AB 32 and EO S-3-05, the California Air Resources Board (CARB) developed a Scoping Plan in 2008. The Scoping Plan, along with its update in 2014, describes the approach California will take to reduce GHGs to achieve reduction targets and goals. California is currently on track to meet or exceed the AB 32 current target of reducing GHG emissions to 1990 levels by 2020.

On April 20, 2015, Governor Edmund G. Brown Jr. signed EO B-30-15, establishing a new GHG emissions reduction target of 40 percent below 1990 levels by 2030. This target aligns with those of leading international governments such as the 28-nation European Union which adopted the same target in October 2014. EO B-30-15 also directed CARB to update the AB 32 Scoping Plan to reflect the path to achieving the 2030 target. In September 2016, Governor Brown also signed Senate Bill (SB) 32, which codified into statute the mid-term 2030 target established by EO B-30-15. The new 2030 GHG emissions reduction target places California on a trajectory towards meeting the goal of reducing statewide emissions to 80 percent below 1990 levels by 2050.

On December 14, 2017, CARB released the final *2017 Climate Change Scoping Plan Update* (2017 Scoping Plan Update), which lays out the framework for achieving the 2030 reductions as established in EO B-30-15 and SB 32. The 2017 Scoping Plan Update identifies GHG reductions by emissions sector to achieve a statewide emissions level that is 40 percent below 1990 levels by 2030.

In addition to legislation setting statewide GHG reduction targets, SB 375, signed by Governor Schwarzenegger in 2008, better aligned regional transportation planning efforts, regional GHG emissions reduction targets, and land use and housing allocations. SB 375 requires Metropolitan Planning Organizations (MPOs) to adopt a Sustainable Communities Strategy (SCS) or Alternative Planning Strategy, showing prescribed land use allocations in each MPO's Regional Transportation Plan (RTP). CARB, in consultation with the MPOs, provides each affected region with reduction targets for GHGs emitted by passenger cars and light trucks in their respective regions for 2020 and 2035. The San Diego Association of Governments (SANDAG) adopted *San Diego Forward: The Regional Plan* that integrates the RTP and SCS in October 2015.

To effectively address the challenges that a changing climate will bring, the State also prepared the 2009 California Climate Adaptation Strategy, which highlights climate risks and outlines possible solutions that can be implemented throughout the State. This Strategy was updated in 2014 and is now known as *Safeguarding California*. In 2015, the State also developed the Safeguarding California Implementation Action Plans.

Other federal and State regulations relevant to the 2018 CAP are identified below:

Table 1-1 Relevant Federal and State Regulations

Federal	Federal Clean Air Act (CAA)	In 2007, the U.S. Supreme Court ruled that CO_2 is an air pollutant as defined under the CAA, and the U.S. Environmental Protection Agency has the authority to regulate emissions of GHG.
Federal	Corporate Average Fuel Economy (CAFE) Standards	The federal CAFE Standards determine the fuel efficiency of certain vehicle classes in the U.S.
State	SB 97	The State Office of Planning and Research prepared, and the Natural Resources Agency adopted, amendments to the State California Environmental Quality Act (CEQA) Guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions. Effective as of March 2010, the revisions to the CEQA Environmental Checklist Form (Appendix G) and the Energy Conservation Appendix (Appendix F) provide a framework to address global climate change impacts in the CEQA process; State CEQA Guidelines Section 15064.4 was also added to provide an approach to assessing impacts from GHGs.
State	Executive Order S-21-09	Executive Order S-21-09 directed CARB, under its AB 32 authority, to adopt a regulation by July 31, 2010 that sets a 33 percent renewable energy target as established by Executive Order S-14-08.
State	Executive Order S-01-07	Executive Order S-01-07 set forth a low carbon fuel standard for California, whereby the carbon intensity of California's transportation fuels is to be reduced by at least 10 percent by 2020.
State	California Building Efficiency Standards Title 24 Part 6	The California Code of Regulations Title 24 Part 6: California's Energy Efficiency Standards for Residential and Nonresidential Buildings are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods.
State	AB 1493	AB 1493 (Pavley) required CARB to develop and adopt regulations that reduce GHGs emitted by passenger vehicles and light-duty trucks.
State	AB 197	AB 197 creates a legislative committee to oversee CARB and requires CARB to take specific actions when adopting plans and regulations pursuant to SB 32 related to disadvantaged communities, identification of specific information regarding reduction measures, and information regarding existing GHGs at the local level.
State	SB 350	SB 350 requires the State to set GHG emission reduction targets for the load-serving entities through Integrated Resource Planning. SB 350 requires an increase in the Renewable Portfolio Standard to 50 percent by 2030 and doubling energy savings in electricity and natural gas end uses.
State	Advanced Clean Cars Program	In January 2012, CARB approved the Advanced Clean Cars program, which combines the control of GHG emissions and criteria air pollutants, as well as requirements for greater numbers of zero-emission vehicles, into a single package of standards for vehicle model years 2017 through 2025.
State	SB X1-2	SB X1-2 of 2011 requires all California utilities to generate 33 percent of their electricity from renewables by 2020. SB X1-2 mandates that renewables supplied to the California grid from sources within, or directly proximate to, California make up at least 50 percent of the total renewable energy for the 2011-2013 compliance period, at least 65 percent for the 2014-2016 compliance period, and at least 75 percent for 2016 and beyond.
State	SB 379	Beginning January 1, 2017, SB 379 requires California cities and counties, upon the next revision of their local hazard mitigation plan, to include climate adaptation and resiliency strategies in the safety elements of their general plans. The bill requires the safety element update to include a set of goals, policies, and objectives for their communities based on a vulnerability assessment, as well as implementation measures to increase community resilience to climate change. The safety element update can incorporate these components by reference from an adopted local hazard mitigation plan and/or climate adaptation plan.

1.3.2 City of Encinitas

The City is actively engaged in addressing climate change, sustainability, and reductions in GHG emissions. The 2011 CAP quantified GHG emissions for 2005 and provided a forecast for 2020. Based on this analysis, the City adopted both GHG reduction and climate change adaptation measures to demonstrate consistency with statewide goals set forth in AB 32.

The 2011 CAP included six strategies from the transportation, residential building, non-residential building, solid waste, water, and municipal operations sectors. Examples of GHG- reducing actions adopted as a component of the 2011 CAP include the deployment of a Bikeway Master Plan and a Green Building Incentive Program, new requirements for inclusion of solar photovoltaics for residential and non-residential buildings, and inclusion of transportation demand management strategies for municipal operations. These measures, as well as others not listed here, have been or are in the process of being implemented.

The 2018 CAP builds upon this past effort by creating a GHG inventory for 2012 and forecasting emissions for 2020, 2030, and 2050 consistent with current legislated targets and State Executive Order goals. City actions and supporting measures for the 2018 CAP were developed, in part, by evaluating the 2011 CAP measures to assess their current applicability and relevance. Reduction measures from the 2011 CAP were significantly reworked, while obsolete measures were removed and replaced with new actions and supporting measures. City actions and supporting measures in the 2018 CAP include applicable measures from the 2011 CAP and new actions and measures necessary to meet the 2020 and 2030 GHG reduction targets. A comparison of measures and actions from the 2011 and 2018 CAPs is provided in Appendix C.

Relationship to CEQA

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 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.

CAPs are considered a “project” subject to compliance with CEQA because they are activities undertaken by a public agency that are subject to discretionary approval and may cause direct or indirect effects on the environment. SB 97 clarified that GHG emissions are within the scope of environmental review. CAPs include strategies that can change the physical environment and influence development patterns that affect GHG emissions.

In response to the mandate of SB 97, the CEQA Guidelines (specifically Section 15183.5) establish standards for the contents and approval process of plans to reduce GHGs. With associated CEQA coverage, the 2018 CAP has been prepared consistent with those standards. As a CEQA Section 15183.5-qualified plan, the 2018 CAP affords development applicants the opportunity to use CEQA streamlining tools for analysis of GHG emission and related impacts for projects that are consistent with the 2018 CAP.

1.4 Community Action and Co-Benefits

While global change is happening worldwide, local efforts to reduce human-induced GHG emissions and build resilience in the face of adverse climate change effects can make a difference. Local action on climate change cannot be addressed insularly by one agency or community, but requires active and ongoing partnerships between residents, businesses, the City, and other agencies and organizations in the region. By beginning to plan now and engaging in more sustainable practices, communities will be better suited to adapt to climate change and be more resilient in the future.

At the regional and local scale, individuals and businesses can play an important role in mitigating climate change. Individuals and businesses can work towards reducing their carbon footprint by changing habits to consume less energy, generate less waste through recycling and composting, conserve water, and drive less by choosing to carpool, take transit, or walk and bike more frequently. The combination of these small efforts can lead to better outcomes for the environment and the City.

Effective and long-term climate action and resiliency in the City can only be achieved through efforts that continue to change the way individuals interact with the environment. The 2018 CAP serves as a resource and starting point to support long-term community sustainability efforts. The City is committed to implementing the action to advance equality and reduce disparities. Opportunities to participate and share the benefits of the City's actions will be inclusive for all City residents. For instance, incentive programs to implement City actions and supporting measures will be available to all City residents, regardless of income levels. In addition, the City will promote existing State and local incentive programs specifically targeted towards low-income communities. Impacts of climate change can disproportionately affect disadvantaged communities and the City will work to proactively identify them and implement strategies to reduce impacts. Additional detail will be provided in an implementation plan developed in early Fiscal Year (FY) 2017-18.

While the actions and supporting measures included in the 2018 CAP are generally geared towards reducing GHG emissions, many will also result in environmental or economic "co-benefits." Environmental co-benefits include improvements to air quality, water supplies, and biological resources; public health outcomes; and beneficial outcomes for other resources. For example, a significant co-benefit of implementing 2018 CAP strategies related to reductions in motor vehicle use and associated fuel combustion will result in fewer toxic air contaminants, leading to better air quality and improved health for everyone. Other strategies focus on improving energy and water-use efficiency in new and existing buildings, lowering overall housing and operation costs for residents and businesses.

Co-benefits are the complementary, positive side effects that would result from strategies, actions, and measures identified in the CAP.

1.5 Climate Action Plan Update

The City's 2011 CAP was adopted by council on March 9, 2011 to serve as a guiding document that outlines the course of action for identifying and implementing strategies to achieve citywide reductions in GHG emissions for both municipal and community operations. The 2011 CAP was designed to:

- Benchmark where the City currently stands relative to statewide emission goals.
- Provide a roadmap for achieving statewide GHG emissions reduction targets.
- Create a plan that meets specific city-wide needs and objectives.
- Provide guidance for the City to respond and adapt to the impacts of climate change.

In January 2016, the update of the City's Climate Action Plan was included in the City's FY 2015-16 and 2016-17 Work Program and in March 2016, staff was assigned to update the plan.

1.5.1 Climate Action Plan Update Elements

The 2018 CAP outlines a course of action for the City to reduce community-wide GHG emissions, as well as prepare for and adapt to climate change.

The overarching goals of the 2018 CAP are to:

- Reduce GHG emissions from the on-road transportation, electricity, natural gas, solid waste, water, off-road, and wastewater sectors

- Identify adaptation strategies for City government, businesses, and residential sustainability

The GHG reduction targets for the City were developed based on State goals embodied in AB 32, SB 32, and EOs B-30-15 and S-3-05. The 2018 CAP aims to achieve the following local community-wide GHG reduction targets:

- 13 percent below 2012 levels by 2020
- 41 percent below 2012 levels by 2030

To achieve these objectives, the 2018 CAP identifies the following:

- A summary of baseline GHG emissions and the potential growth of these emissions over time

- The expected climate change effects on the City

- GHG emissions reduction targets and goals to reduce the community's contribution to global warming

- Identification of strategies, specific actions, and supporting measures to comply with statewide GHG reduction targets and goals, along with strategies to help the community adapt to climate change impacts.

As part of the 2018 CAP implementation, each strategy, action, and supporting measure will be continually assessed and monitored. Reporting on the status of implementation of these strategies, periodic updates to the GHG emissions inventory, and other monitoring activities will help to ensure that the 2018 CAP is making progress. See Chapter 4 for more information on administering, implementing, and monitoring the 2018 CAP.

1.5.2 Climate Action Plan Update Process

As part of the 2018 CAP update, the City developed and implemented a Public Outreach and Engagement Plan (included as Appendix D) providing local residents, stakeholders, interested parties, and other agencies and/or individuals with the opportunity to participate in the climate action planning process. The goals of outreach and engagement are to: (1) raise awareness of the 2018 CAP update; (2) educate the public and other organizations about the 2018 CAP; (3) provide opportunities for input at the various steps of 2018 CAP development; (4) provide opportunities to influence decision-making; and (5) provide a public process that meets the CEQA Guidelines' requirements for a Plan for the reduction of GHG emissions. The rationale for each of these goals includes the following principles:

- *Awareness* – Stakeholders must be aware of the planning process before they can participate.

- *Education* – Stakeholders must be educated and knowledgeable about the 2018 CAP and planning process before they can participate effectively.
- *Input* – Stakeholders' knowledge and perspectives help the planning team verify or expand on available information.
- *Decision-making* – Stakeholders are encouraged to engage in the decision-making process.
- *Open and public process* – As stated in CEQA Guidelines Section 15183.5 (b)(1)(F), a "qualified" GHG reduction plan must be adopted in a public process. Once adopted, the updated 2018 CAP would represent a qualified plan for reduction of GHG emissions, consistent with the requirement set forth in the *CEQA Guidelines* section cited above, and would support tiering of future development projects for purposes of CEQA review of GHG impacts.

Having a clear process by which the public can be involved, review, and comment on the 2018 CAP resulted in a better document that can be used to streamline CEQA analysis and compliance for many types of projects in the City.

2018 CAP Workgroup Meetings

Internal feedback and review was facilitated through the CAP Workgroup. The CAP Workgroup is composed of staff members of the following departments: City Manager's Office, Development Services, Public Works, Human Resources, Information Technology, Finance, San Dieguito Water District, Parks, Recreation and Cultural Arts, and Fire and Marine Safety. The CAP Workgroup's responsibilities include reviewing and providing comments and recommendations for key work products; providing recommendations for the feasibility of 2018 CAP measures; and using local expertise to offer recommendations of new and revised 2018 CAP measures and goals. The CAP Workgroup met biweekly through the CAP update process to serve these functions.

Environmental Commission and City Council Meetings

At the Environmental Commission's regular monthly meetings, the CAP Program Administrator briefed the commission on the status and progress of the Climate Action Plan update process. In these meetings, the Environmental Commission discussed preliminary GHG results, proposed reduction targets, and the preliminary list of GHG reduction actions and provided comments to staff. The Environmental Commission also convened their Ad-Hoc Subcommittee on the Climate Action Plan Update to review draft elements of the 2018 CAP update and provide recommendations. The Environmental Commission reviewed the draft list of City Actions and Supporting Measures on May 11, 2017 and unanimously approved the list with minor revisions. The draft list forms the foundation of the 2018 CAP update. City Council members were briefed on 2018 CAP update progress at Council meetings on January 18 and April 26, 2017.

Public Workshops

The City hosted two public workshops on February 21 and March 1, 2017 to share information with the community on the 2018 CAP and to receive public input on specific measures and actions that the City can implement to reduce GHG emissions. These workshops have been centered on a number of posters that provided an overview of potential actions and measures that the City can implement to engage 2018 CAP strategies and accomplish goals. Additionally, on February 21, 2017, a PlaceSpeak topic was posted to gather public input using an online platform, to provide the same information on the 2018 CAP process, and receive input on the proposed reduction strategies; identical to those evaluated at the public workshops. All comments received were tracked and evaluated for inclusion in the 2018 CAP. A majority of comments were incorporated into the 2018 CAP. See Appendix E for a summary of public input received.

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CHAPTER 2

Greenhouse Gas Emission Inventory, Projections, and Targets

This chapter summarizes the community's contribution to global climate change by offering a detailed accounting of greenhouse gas (GHG) emissions within the City of Encinitas (City). It includes a discussion of the primary sources and annual levels of GHG emissions from 2012 (i.e., baseline inventory); describes likely trends if emissions are not reduced for 2020, 2030, and 2050 (i.e., projections); and sets a roadmap forward to reduce emissions for 2020 and 2030 (i.e., targets). Emissions from community activities are discussed in Sections 2.2 through 2.4.

2.1 Why Prepare a Greenhouse Gas Emissions Inventory?

Recent increases in global temperatures are highly correlated with elevated GHG emissions resulting from human activities. Per the scientific community, to avoid "dangerous climate change" in the Earth's climate system, GHG emissions will need to be stabilized so that global temperatures do not increase more than 3.6 degrees Fahrenheit (°F) (2 degrees Celsius [°C]) above pre-industrial levels. To achieve this outcome, global carbon dioxide (CO_2) concentrations must be stabilized at 450 parts per million (ppm) (Intergovernmental Panel on Climate Change [IPCC] 2014).

The inventory baseline is used to:

- Project emissions
- Develop reduction targets
- Develop, evaluate, and implement strategies to achieve the targets

One of the main objectives of the 2018 Climate Action Plan (2018 CAP) is to identify and reduce local contributions to global GHG emissions. This chapter is intended to serve as a foundation for the strategies and actions that will implement the City's commitment to reduce emissions. Measuring GHG emissions is a critical first step in developing the 2018 CAP for several reasons. First, the GHG inventory identifies major sources and quantification of GHG emissions associated with the activities and choices currently made by residents, businesses, and municipal operations. Second, the inventory provides the baseline that is used to project emissions trends and to develop accurate reduction targets and interim goals consistent with State objectives. Finally, the inventory sets the baseline for the City to develop, evaluate, and implement strategies and actions to achieve its targets and goals.

The GHG emissions inventory also plays a role in ensuring that the City stays on course to meet the GHG reduction targets. After the 2018 CAP is adopted, the City will prepare regularly updated GHG emissions inventories that will be compared to the baseline inventory. This will track the City's progress in reducing emissions as 2018 CAP actions are implemented.

The emissions inventory is limited to GHGs that are generated from activities within the City from a defined set of sources (e.g., electricity and natural gas use, transportation, waste) that can be readily monitored and reduced through quantifiable City actions.

The inventory establishes 2012 as the baseline year from which the City determines GHG reduction targets. The baseline year aligns with the base year for the San Diego Association of Governments (SANDAG) travel demand model. Appendix A provides additional information on baseline year selection and inventory methodologies.

2.2 Baseline Inventory

The first step in the City's climate action planning process is to understand the sources and amount of GHG emissions generated from activities occurring within the City. A GHG emissions inventory is an estimate of the emissions of a defined set of gases (e.g., CO_2, methane [CH_4], nitrous oxide [N_2O]) that contribute to global climate change. The emissions inventory prepared for the 2018 CAP is limited to emissions that are generated from activities within the City from a defined set of sources (e.g., transportation, electricity use, waste disposal, etc.). These include emissions that are within the City's jurisdictional control and can be readily estimated, monitored, and reduced by City action while supporting the efforts of residences and businesses.

The City's 2012 GHG emissions Inventory has seven emission sectors:

1. On-Road Transportation;
2. Electricity;
3. Natural Gas;
4. Solid Waste;
5. Water;
6. Off-Road Transportation; and
7. Wastewater.

The City's previous CAP (2011 CAP), developed the initial GHG inventory for the year 2005. The 2005 baseline totaled 548,993 metric tons of carbon dioxide equivalent ($MTCO_2e$) per year, or 8.78 $MTCO_2e$ per year per capita. Under a business-as-usual (BAU) scenario which assumes the continuation of conventional behaviors without the inclusion of any additional efforts or legislative actions to reduce GHG emissions, the 2011 CAP determined that the City's GHG inventory for 2020 will be 646,947 $MTCO_2e$ per year or 9.5 $MTCO_2e$ per year per capita. To achieve consistency with federal and State GHG reduction goals, the 2011 CAP specified that the City will be required to reduce emissions 12 percent below 2005 levels by 2020, equivalent to reducing emissions by 164,159 $MTCO_2e$ in 2020. The 2005 inventory was organized by the following emissions sectors: transportation (70 percent of total emissions), residential buildings (15 percent), commercial and industrial buildings (11 percent), solid waste (3 percent), wastewater (0.6 percent), and municipal operations (0.4 percent).

The 2012 emissions inventory performed for the 2018 CAP evaluated emissions from the following sectors as summarized in Figure 2-1 and discussed below:

- **On-road transportation:** Emissions associated with passenger cars; light-, medium-, and heavy-duty trucks; buses; mobile homes; and motorcycles.
- **Electricity:** Emissions from building energy use associated with electricity in residential, commercial, and industrial buildings.
- **Natural gas**: Emissions from building energy use associated with combustion of natural gas in residential, commercial, and industrial buildings.
- **Solid waste:** Emissions from the disposal of organic materials in landfills and community-generated mixed waste from residences and business in the City.
- **Water:** Emissions associated with the energy consumed during treatment, transport, and distribution of water.
- **Off-road transportation:** Emissions from air and water vessels, heavy-duty construction equipment (e.g., excavators, cranes, dozers), landscaping equipment, and other off-road equipment.
- **Wastewater:** Fugitive emissions resulting from the treatment process for domestic sewage.

Further details regarding sources and methodology for the 2012 inventory can be found in Appendix A.

Notably, residents, businesses, and organizations make daily choices that result in GHG emissions and may be beyond the influence of the City or the 2018 CAP; however, individual residents or businesses should not feel limited to only the identified strategies, which are focused on the City's inventoried emissions. As such, community members are encouraged to engage in climate-friendly actions such as purchasing locally-sourced foods and products to reduce transportation emissions or install efficient or clean-energy appliances and infrastructure to lower energy-related emissions. The City's contribution to global climate change can be reduced through efforts at the individual level beyond what is described in the 2018 CAP.

2.2.1 City of Encinitas 2012 Greenhouse Gas Emissions

The 2012 GHG emissions inventory accounts for six primary GHGs: CO_2, CH_4, N_2O, sulfur hexafluoride, hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs); however, each GHG has varying levels of potency in the atmosphere. To simplify discussion and comparison of these emissions collectively, CAPs use a measurement referred to as carbon dioxide equivalent (CO_2e).

Breakdown of Emitting Sectors in 2012:

1. On-Road Transportation (54%)
2. Electricity (23%)
3. Natural Gas (13%)
4. Solid Waste (5%)
5. Water (3%)
6. Off-Road Transportation (2%)
7. Wastewater (0.4%)

Note: Values may not add to totals due to rounding

CO_2e translates each GHG to an equivalent volume of CO_2 by weighting it by its relative global warming potential (GWP). For example, per IPCC's Fourth Assessment Report, CH_4 and N_2O are 25 and 298 times more potent, respectively, than CO_2 in their ability to trap heat in the atmosphere (IPCC 2007). Converting these gases into CO_2e allows consideration of all the gases in comparable terms to make it easier to communicate how various sources and types of GHG emissions contribute to climate change. A metric ton of CO_2e ($MTCO_2e$) is the standard measurement of GHG emissions.

In 2012, community and municipal activities in the City generated 483,773 $MTCO_2e$. The sector with the greatest contribution to global climate change was on-road transportation accounting for 54 percent of the City's total GHG emissions or 260,127 $MTCO_2e$. The electricity and natural gas sectors contributed 23 and 13 percent of the City's overall emissions, or 113,556 and 62,027 $MTCO_2e$, respectively.

To put these emissions into perspective, 483,773 $MTCO_2e$ is equivalent to combusting 54 million gallons of gasoline, combusting 258,000 tons of coal, or a year's worth of carbon sequestration from 458,000 acres of U.S. forests (U.S. Environmental Protection Agency [EPA] 2017).

The City's 2012 emissions are equal to combusting 54 million gallons of gasoline, combusting 258,000 tons of coal, and losing the carbon sequestration potential from 457,000 acres of forest.

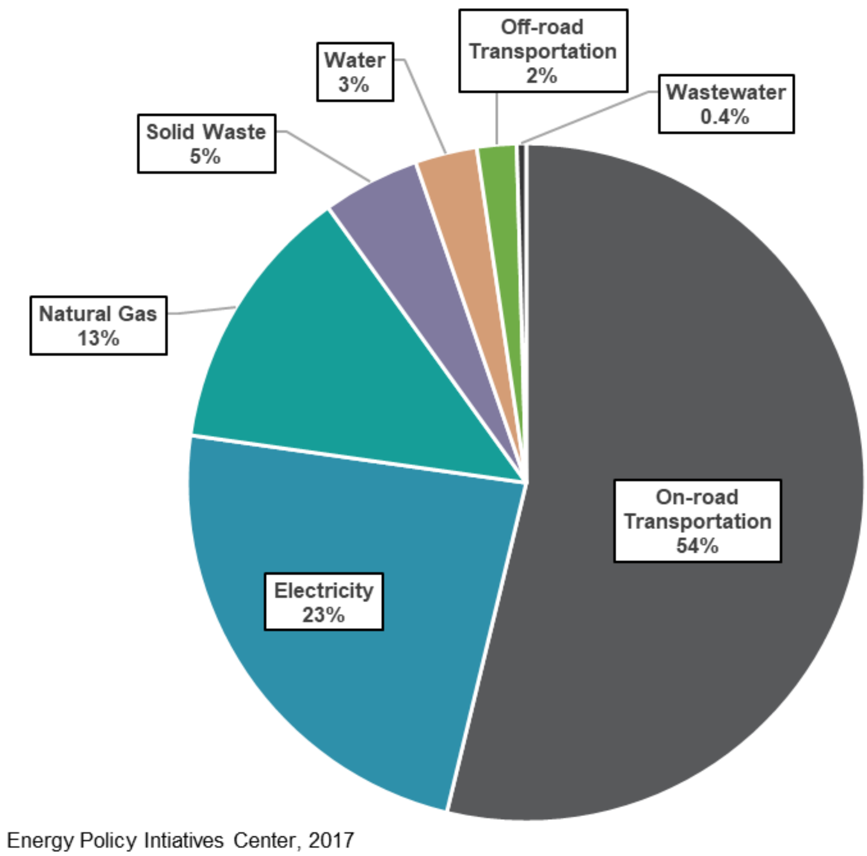

Figure 2-1: Greenhouse Gas Inventory for the City of Encinitas in 2012 by Emission Sector

Additional details related to the specific emission sectors, data sources, assumptions, and methods can be found in Appendix A. Figure 2-1 above and Table 2-1 below show the breakdown of the City's GHG emissions in 2012.

Table 2-1 Greenhouse Gas Inventory for the City of Encinitas in 2012 by Sector Inventory

Emissions Sector	$MTCO_2e$	Percent (%)
On-Road Transportation	260,127	54
Electricity	113,556	23
Natural Gas	62,027	13
Solid Waste	22,471	5
Water	14,299	3
Off-Road Transportation	9,138	2
Wastewater	2,155	0.4
Total	483,773	100

Notes: Columns may not add to totals due to rounding.

$MTCO_2e$ = metric tons of carbon dioxide equivalent

Source: EPIC 2017.

2.3 Emission Projections

GHG emissions projections provide an estimate for future levels based on a continuation of current trends in activity, while also accounting for known regulatory actions by federal and State agencies (i.e., "legislative" actions) that can reduce emissions in the future if implemented. Through GHG projections, communities gain insight into the scale of local reductions needed to achieve statewide GHG reduction targets, in addition to legislative actions.

The business-as-usual (BAU) GHG emissions forecasts in the CAP assume a continued increase in population, housing units, employment, and vehicle activity. Projections are based on SANDAG's Series 13 Regional Growth Forecast.

The first step in preparing comprehensive GHG emissions projections is the development of a BAU scenario, which assumes the continuation of conventional behaviors without the inclusion of any additional efforts or legislative actions beyond what has already been adopted at the time of the baseline year (i.e., 2012). Namely, federal, State, and local policies, programs, and regulations designed to take effect in future benchmark years (e.g., 2020, 2030), and the GHG reductions that will occur with their implementation, are not considered. The BAU model also assumes the population, housing, employment, and transportation activity will grow over time, consistent with projections. Further, the BAU model does not account for GHG emission reductions that will occur through implementation of the 2018 CAP.

Using these parameters, BAU projections were developed for the years 2020, 2030, and 2050. GHG estimates were determined to be 474,712 $MTCO_2e$ in 2020 or 2 percent lower than 2012 emissions, 483,150 $MTCO_2e$ in 2030 or 0.1 percent higher than 2012 emissions, and 497,811 $MTCO_2e$ in 2050 or 3 percent higher than 2012 emissions. Details regarding BAU assumptions and methodology can be found in Appendix A.

2.3.1 Demographic Trends

The City's population is expected to increase by 6% in 2020, 7% in 2030, and 10% in 2050.

GHG emission projections were estimated for 2020, 2030, and 2050 using City-specific demographic and vehicle projections from the San Diego Association of Governments' (SANDAG's) Series 13 Regional Growth Forecast. The City is expected to experience modest population growth by 2020, 2030, and 2050, as reflected in the emissions projections. Based on data used by the Energy Policy Initiatives Center (EPIC) to estimate projections, the City's population is expected to increase by 6 percent in 2020, 7 percent in 2030, and 10 percent in 2050 as compared to 2012 population levels. Total jobs are expected to increase by 4 percent by 2020, 6 percent by 2030, and 12 percent by 2050 as compared to 2012 job levels. Further details on the underlying SANDAG data used for emissions projections can be found in Appendix A.

The milestone years of 2020, 2030, and 2050 were selected for BAU projections to provide a comprehensive picture of the City's short-term and long-term emissions levels without considering reductions realized through federal and State regulations. Further, 2020, 2030, and 2050 represent benchmark years in terms of achieving reductions goals (i.e., 1990 levels of GHGs by 2020 as mandated by Assembly Bill [AB] 32, 40 percent below 1990 levels of GHGs by 2030 as mandated by Senate Bill [SB] 32, and 80 percent below 1990 levels as directed by Executive Order [EO] S-3-05). As such, certain legislative-related reductions will be anticipated to occur by 2020, 2030, and 2050. Projecting a BAU scenario for these years serves as the basis for the remainder of the climate action planning process.

2.3.2 Legislative Reductions

The second step in the climate action planning process is to model future emissions for benchmark years (i.e., 2020 and 2030) including a variety of legislative actions targeting future GHG reductions without any additional local governmental action contained in the 2018 CAP. The applied legislative reductions include:

- California Renewables Portfolio Standards
- California Solar Policies and Programs
- California Energy Efficiency Standards
- Federal and California Vehicle Efficiency Standards

A detailed description and analysis of how specific legislative reductions are included in the City's BAU GHG emissions inventory and projections can be found in Appendix A and B. Table 2-2 below shows the summary of the City's projected BAU GHG emissions with and without legislative action for the years 2020 and 2030. A BAU scenario including emissions reductions from legislative action was not modeled for 2050 because of the inherent uncertainty regarding political climate, advances in technology and climate science, and efficacy of existing or planned programs.

Table 2-2 City of Encinitas Emissions Business-as-Usual and Legislative-Adjusted Projections ($MTCO_2e$/year)

Emissions Sector	2012	2020		2030	
		BAU Projection	Legislative-Adjusted Projection	BAU Projection	Legislative-Adjusted Projection
On-Road Transportation	260,127	229,059	213,334	221,787	165,001
Energy[1]	175,583	194,621	157,114	206,743	119,587
Solid Waste[2]	22,471	24,575	24,575	25,014	25,014
Water	14,299	15,055	15,055	15,541	15,541
Off-Road Transportation	9,138	8,943	8,943	11,441	11,441
Wastewater	2,155	2,460	2,460	2,625	2,625
Total	483,773	474,712	419,873	483,150	339,209
Percent change from 2012 (%)	-	-2%	-13%	0.1%	-30%

Notes: Columns may not add to totals due to rounding. BAU = business as usual, GHG = greenhouse gas emissions, $MTCO_2e$ = metric tons of carbon dioxide equivalent, CAP=climate action plan.

[1] Emissions from energy are combined emissions from electricity usage and natural gas combustion.

[2] The solid waste sector includes emissions from solid waste disposal in landfills and waste-in-place emissions from the closed Encinitas Landfill.

Source: EPIC 2017.

2.3.3 Business-as-Usual Greenhouse Gas Emissions Projections with Legislative Reductions

Implementation of the legislative actions listed above will contribute to reductions in GHG emissions in the City, as shown in Table 2-2. By 2020, emissions are projected to decline by approximately 13 percent below 2012 levels; by 2030, emissions are projected to decrease by approximately 30 percent as compared to 2012 levels. The overall decrease in emissions is because of federal and State policies existing in the baseline year of 2012.

2.4 Reductions Targets

The 2018 CAP aims to reduce GHG emissions by 13 percent below 2012 levels by 2020 and 41 percent by 2030. As directed by AB 32, SB 32, and Executive Orders S-3-05 and B-30-15, the State targets a reduction in statewide GHG emissions of:

- 1990 levels by 2020;
- 40 percent below 1990 levels by 2030; and
- 80 percent below 1990 levels by 2050.

AB 32, SB 32, and EO B-30-15 use 1990 levels as a benchmark to identify statewide reduction targets. Because the City's 1990 emissions level was not estimated, proportional targets for the City's CAP were developed from the 2012 baseline that are consistent with direction from the 2008 Scoping Plan.

The California Air Resources Board (CARB) released the *2017 Climate Change Scoping Plan Update* (proposed 2017 Scoping Plan Update) pursuant to AB 32 and SB 32. The proposed 2017 Scoping Plan Update concluded that the State's emissions goal of 80 percent below 1990 by 2050 will be consistent with the IPCC's analysis specifying the global emissions trajectory needed to stabilize atmospheric concentration (i.e., levels of 450 ppm of CO_2 or less is needed to reduce the likelihood of catastrophic global climate change) (CARB 2017).

Taking into consideration CARB's recommendation in the 2008 Scoping Plan, the 2011 CAP developed a 12 percent reduction target from 2005 baseline levels (546,548 $MTCO_2e$) by 2020 (646,947 $MTCO_2e$ under the BAU scenario). The 2017 Scoping Plan Update recommends local targets of 6 $MTCO_2e$ per capita by 2030 and 2 $MTCO_2e$ in 2050. In addition, the statewide 2020 target is to reduce 2020 emissions to 1990 levels. Estimating the equivalent reduction needed from the 2012 baseline based on the State inventory, the City would need to reduce emissions 4 percent below 2012 levels by 2020 to be consistent with AB 32. Recognizing that anticipated State, federal, and local actions would achieve significant reductions by 2020, the City elected to set a more ambitious target for 2020. In summary, the City will aim to achieve the following reduction targets:

Taking legislative reductions into account, emissions are projected to decrease in the BAU forecast in 2020 to meet the State goals. Legislative actions are expected to reduce the BAU forecast in 2030; however, reductions in emissions in 2020 and 2030 are not, in and of themselves, enough to meet established targets.

- 13 percent below 2012 levels by 2020; and
- 41 percent below 2012 levels by 2030.

To reach the short-term reduction goal of 13 percent below 2012 GHG emissions levels, the City will need to reduce emissions by 53,232 $MTCO_2e$ to 421,481 $MTCO_2e$ by 2020.

California's GHG reduction targets have been legislatively adopted for 2020 and 2030, while the 2050 goal is expressed in an executive order. In addition, CARB 's 2017 Scoping Plan Update focuses on meeting the 2030 reduction target, as directed in SB 32. Therefore, the 2018 CAP aligns with the State in proposing actions and supporting measures to meet the 2030 target. As climate change science and policy continues to advance, the City will be able to apply new reductions toward meeting a long-term 2050 GHG emissions reduction goal in future CAP updates, as outlined in Chapter 4. Over the coming decades new innovations and technologies will likely become available that will enable further GHG reductions. New methods may become available to quantify measures that are currently unquantifiable. Finally, new State and federal regulations may further reduce emissions in sectors currently addressed primarily by local actions and supporting measures.

To achieve the long-term GHG reductions, the City will need to reduce emissions by 197,724 $MTCO_2e$ to 285,426 $MTCO_2e$ (41 percent below 2012 levels) by 2030. The City achieves the 2020 target because of federal and State legislative measures; however, such GHG-reducing legislation alone is not sufficient to achieve the 2030 target. As described in Chapter 3, to meet the City's 2030 target, the City will need to implement local GHG reduction strategies. A detailed technical analysis of the City's emissions reduction targets and goals can be found in Appendix B. Figure 2-2 shows the City's BAU emissions and legislative-adjusted BAU forecasts alongside the City's GHG reduction targets over time, discounting any strategies or actions proposed in the Chapter 3.

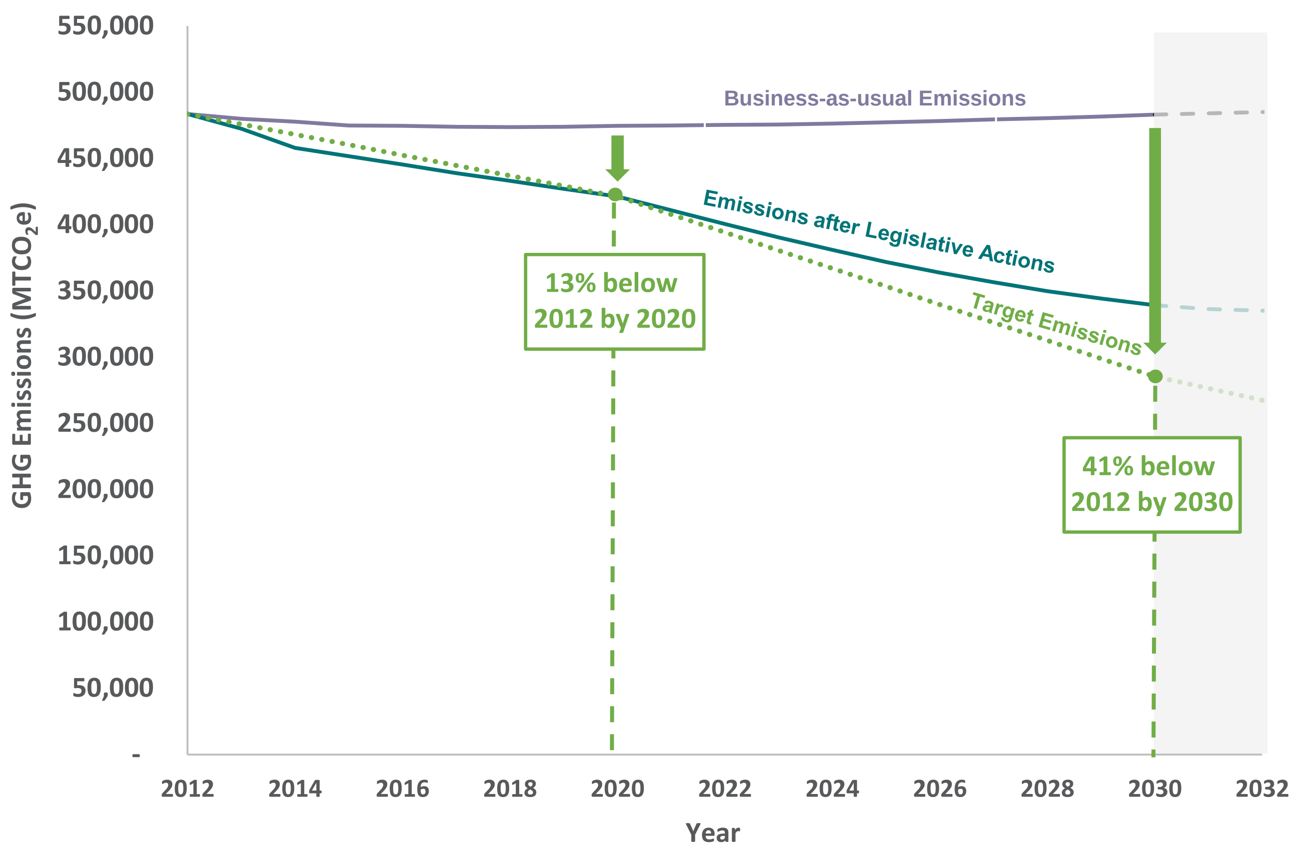

Figure 2-2: BAU and Legislative-Adjusted Forecasts and Targets without CAP Actions

CHAPTER 3

Greenhouse Gas Reduction Strategies, Goals, and Actions

This chapter outlines the strategies, goals, and specific actions that the City of Encinitas (City) will implement to achieve its greenhouse gas (GHG) reduction targets, as outlined in Chapter 2. Strategies, goals, and actions focus on locally-based programs, policies, and projects that will reduce GHG emissions in various categories as a complement to legislative actions taken by the federal and State governments.

Strategies, which represent the primary ways to achieve GHG reductions, are organized under six GHG emissions categories. Within each strategy are a series of goals, actions, and supporting measures that define the objectives, programs, policies, and projects the City will implement to reduce GHG emissions. These actions and measures mainly focus on community-scale reductions, but also include local government operations. Through partnerships with and among residents, businesses, agencies, and other organizations, these actions and measures will provide net benefits for everyone.

Emissions categories include:

- Electricity & Natural Gas
- Water
- On-Road Transportation
- Off-Road Transportation
- Solid Waste
- Carbon Sequestration

The 2018 Climate Action Plan (2018 CAP) accounts for existing plans, programs, and activities that the City has already undertaken to reduce emissions by acknowledging these efforts and, in some cases, building or expanding upon them. The 2011 CAP included 34 GHG reduction measures from the transportation, energy, solid waste, and water sectors designed to reduce emissions through the incorporation of renewable energy; increased energy, fuel, and water efficiency; parking maximums; zero-emission vehicle infrastructure; and more. The 2018 CAP encompasses and expands upon the goals of the 2011 CAP reduction measures by including measurable and quantifiable goals. The 2018 CAP has been prepared to be consistent with Section 15183.5 of the CEQA Guidelines. For more details on how proposed strategies and actions differ from the 2011 CAP, see Appendix C.

Many of the strategies and actions to reduce GHG emissions will also have important co-benefits, which are discussed in this chapter. Co-benefits are the additional beneficial effects that will result from implementation of strategies and actions. Climate change adaptation and building community resilience are important components of climate action planning, and this is discussed in further detail in Chapter 5.

Climate action planning is important because if community emissions in the City were to continue to grow under business-as-usual (BAU) practices and activities, the City's GHG emissions would meet and exceed the 2020 reduction target by approximately 50,000 metric tons of carbon dioxide equivalent ($MTCO_2e$), but would fall short of the 2030 target by 53,783 $MTCO_2e$. As described in Chapter 2, the City has established a 2020 GHG emissions reduction target (13 percent below 2012 levels) and a 2030 target (41 percent below 2012 levels) to reduce annual emissions levels. With the strategies proposed in the 2018 CAP, the City's GHG emissions will exceed 2020 and 2030 targets by 9,532 and 69,159 $MTCO_2e$ per year, respectively.

Under a business-as-usual (BAU) scenario, the City would meet its 2020 target, but would fall short of meeting the 2030 target by 53,783 $MTCO_2e$.

Table 3-1 below shows the GHG reductions attributable to the strategies included in the 2018 CAP. Table 3-2 demonstrates how the anticipated reductions will help the City meet its GHG reduction targets. Detailed calculations and description of the calculation methodologies are provided in Appendix B.

Table 3-1 GHG Reductions from Proposed Reduction Strategies for 2020 and 2030 ($MTCO_2e$)

Strategy	2020	2030
Building Efficiency	941	4,355
Renewable Energy	434	45,456
Clean and Efficient Transportation	4,481	6,526
Water Efficiency	712	735
Zero Waste	2,830	11,921
Reduce Off-Road Equipment	128	142
Carbon Sequestration	5	23
Federal and State Regulations	53,232	143,941
Total Reductions	62,764	213,100

Notes: Columns may not add to totals due to rounding.

$MTCO_2e$ = Metric Tons of Carbon Dioxide Equivalent

Source: EPIC 2017.

Table 3-2 Effect of Plan Actions on City of Encinitas Emissions and Target ($MTCO_2e$)

Emissions	2020	2030
BAU Emission Projection	474,712	483,150
Legislative Reductions	53,232	143,941
Legislative-Adjusted BAU Emissions Projection (BAU Projection – Legislative Reductions)	421,480	339,209
Baseline Emissions (2012)	483,773	483,773
City of Encinitas GHG Reduction Target (Percent below 2012)	13%	41%
Target Emissions	421,481	285,426
Reductions from 2018 CAP Actions	9,532	69,159
City of Encinitas Emissions with 2018 CAP (Legislative-Adjusted BAU – 2018 CAP Reductions)	411,949	270,050
Target Achieved?	YES	YES

Notes: Columns may not add to totals due to rounding.

$MTCO_2e$ = Metric Tons of Carbon Dioxide Equivalent

Source: EPIC 2017.

3.1 GHG Reduction Strategy Framework

The 2018 CAP actions were developed using a GHG reduction strategy framework that was based on a combination of factors. These include:

- The feasibility of the action to be implemented by the City.
- The need for greater reductions in categories with the most emissions (i.e., electricity and on-road transportation).
- Existing programs, policies, or projects that can be expanded or proposed policies yet to be adopted.
- Feedback from the community and other stakeholders (e.g., Environmental Commission and public workshops).
- Technological innovations.

The reduction strategy framework consists of emissions categories, strategies, goals, actions, and supporting measures, which are defined below:

Emissions Category	Source of GHG emissions, as defined by the City's baseline assessment. Emissions categories include: Electricity & Natural Gas, Water, On-Road Transportation, Off-Road Transportation, Solid Waste, and Carbon Sequestration. Emissions categories, except for Carbon Sequestration, align with the GHG Emissions inventory outlined in Chapter 2. Carbon Sequestration is additionally included in this reduction strategy framework as a category by which to reduce overall emissions.
Strategy	High-level plans the City will implement to achieve GHG reductions in a specific emissions category. Each emissions category may have one or more associated strategies. The framework includes 7 overall strategies.
Goal	The general objective that the City will strive to achieve to address the defined strategy. Each strategy will have at least one or more goals.
Target Year	Year corresponding to the emissions targets set by the City and that are in line with State laws and guidelines. For the 2018 CAP, the City's proposed target years include 2020 and 2030.
Performance Metric	Quantitative metric by which achievement of the specified goal will be measured. Each goal will have two performance metrics, one for each target year (i.e., 2020 and 2030).

GHG Reduction Potential	Estimated reduction in local greenhouse gas emissions if the performance metric is met. The reduction is presented in $MTCO_2e$.
City Actions (Actions)	Programs, policies, or projects the City will implement that will cause a *direct* and *measurable* reduction in greenhouse gas emissions.
Supporting Measures	Programs, policies, or projects the City will implement that could not be quantified, but will have an indirect effect on greenhouse gas emissions reductions.

To help meet designated targets, the 2018 CAP proposes 19 actions and numerous supporting measures organized under 7 strategies and 6 emissions categories. The following sub-sections detail GHG reduction strategies under each emissions category. A description of the emissions category is followed by separate tables describing each strategy, its goal(s), performance metrics, GHG reduction potential, and any supporting measures. While many of the emission reductions of the city actions can be quantified, others are difficult to quantify and are thus classified as supporting measures. Supporting measures cannot be quantifiable because of data limitation or lack of an available method to quantify emissions reductions; however, the combination of all actions and measures contribute towards achieving 2020 and 2030 targets and are important to include.

Additional detail and calculations can be found in Appendix B. Chapter 4 further describes how City actions will be implemented.

3.1.1 Electricity and Natural Gas

Electricity and natural gas consumption accounted for 36 percent of the City's total emissions in 2012. Legislative reductions from State actions will reduce electricity and natural gas emissions by 45 percent. Emissions reductions from the Electricity and Natural Gas Category are divided into two strategies: Building Efficiency and Renewable Energy. The success of these strategies relies on coordination with local utilities and organizations, participation from the community, and administration of new or revised local policies and programs. All Electricity and Natural Gas strategies also serve as adaptation strategies by reducing overall energy demand and increasing the ability of the community and local economy to weather future change.

Strategy 1: Building Efficiency

Co-Benefits of Building Efficiency:
- Improved Air Quality
- Reduced Fossil Fuel Reliance
- Energy Savings
- Cost Savings
- Increased Renewable Energy

The energy (electricity and natural gas) used in buildings accounts for the majority of GHG emissions in the Electricity and Natural Gas category. Although legislative reductions related to State actions will help reduce emissions associated with building energy, additional reductions can help to increase building efficiency in the City. Under this strategy emissions are reduced by requiring residential and commercial units to be more energy efficient, and by improving energy efficiency beyond State requirements. Implementation of the Building Efficiency Strategy would reduce the City's emissions by 941 $MTCO_2e$ by 2020 and 4,355 $MTCO_2e$ by 2030. Table 3-3 outlines the framework for this strategy.

Table 3-3 Strategy 1: Building Efficiency

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
Goal 1.1: Reduce Building Energy Consumption		
City Action: BE-1 Require Energy Audits of Existing Residential Units		
Starting in 2018, require all existing residential residential units that seek building permits for modifications, alterations, and additions to perform energy audits.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce energy use by 15% in residential units that complete energy efficiency audits and implement energy retrofits. 80 units implement energy retrofits (reduce 85,000 kWh and 4,500 therms)	47
2030	Reduce energy use by 15% in residential units that complete energy efficiency audits and implement energy retrofits. 330 units implement energy retrofits (reduce 380,000 kWh and 20,000 therms)	122
City Action: BE-2 Require New Single-Family Homes to Install Solar Water Heaters		
Starting in 2018, require all new single-family homes to install solar water heaters or other efficiency technology, unless the installation is impracticable due to poor solar resources. Other efficiency technology would include installation of a renewable energy technology system that uses renewable energy as the primary energy source for water heating.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	130 solar water heaters installed on new single-family homes (reduce 150,000 kWh and 17,000 therms)	130
2030	410 solar water heaters installed on new single-family homes (reduce 470,000 kWh and 230,000 therms)	1,241
City Action: BE-3 Adopt Higher Energy Efficiency Standards for Commercial Buildings		
Starting in 2018, require 1) all new commercial buildings, including commercial portion of mixed-use projects, and 2) commercial building modifications, alterations, and additions that require building permits with an area larger than 10,000 square feet to meet the 2016 California Green Building Standards Code Nonresidential Tier 1 Voluntary Measures.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce energy use in new commercial spaces by 6% (reduce 232,000 kWh and 7,200 therm)	98
2030	Reduce energy use in new commercial spaces by 6% (reduce 1.1 million kWh and 34,000 therm)	220
City Action: BE-4 Require Commercial Buildings to Install Solar Water Heaters		
Starting in 2018, require 1) all new commercial buildings, including the commercial portion of mixed-use projects, 2) commercial building modifications, alterations, and additions that require building permits with an area larger than 10,000 sq. ft, to install solar water heaters or other efficiency technology, unless the installation is impracticable due to poor solar resources. Other efficiency technology would include installation of a renewable energy technology system that uses renewable energy as the primary energy source for water heating.		

Table 3-3 Strategy 1: Building Efficiency		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce energy use in commercial spaces (reduce 12,000 kWh and 112,000 therm)	612
2030	Reduce energy use in commercial spaces (reduce 54,000 kWh and 500,000 therm)	2,728

Supporting Measures for Goal 1.1:

- Facilitate homeowner and business owner financing of energy efficiency measures by expanding PACE financing options.
- Expand and implement a Green Building Incentive Program to promote energy retrofits at homes and businesses.
- Educate homeowners about the energy audit process and any applicable incentives and streamline the process of identifying energy auditing contractors.
- Educate homeowners and businesses about incentive programs offered by SDG&E, CSE, and others in the region.
- Promote pool pump conversions to variable speed pumps.
- Continue energy efficiency permit fee waiver program.

Goal 1.2: Reduce Municipal Operation Energy Consumption

City Action: MBE-1 Continue Implementation of Energy Efficient Projects in Municipal Facilities

Reduce municipal energy use below 2012 baseline energy use. Municipal facilities include the Civic Center, libraries, Community Center, fire stations, parking lots and more.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce energy use (electricity and natural gas) by 7.5% in municipal facilities (not including street lights)	54
2030	Reduce energy use (electricity and natural gas) by 15% in municipal facilities (not including street lights)	44

Supporting Measures for Goal 1.2:

- Conduct audits to quantify energy use and to identify and quantify energy efficiency and conservations opportunities.
- Identify grants, rebate and incentive programs, and financing opportunities for municipal energy efficiency programs.
- Adopt a policy that new municipal buildings will be ZNE buildings.
- Convert City streetlights, traffic signals, and outdoor lighting to LED or other efficient lighting technology and monitor with energy management system.
- Implement the Environmentally Preferable Purchase Policy.
- Continue to track State legislation and lobby for change were proposals align with City goals and vision.

Notes:
CSE = Center for Sustainable Energy; kWh = kilowatt-hour; LED = low-emitting diode; $MTCO_2e$ = metric tons of carbon dioxide equivalent; SDG&E = San Diego Gas & Electric; PACE = Property Assessed Clean Energy; ZNE = zero net energy
Source: EPIC 2017.

Strategy 2: Renewable Energy

Transition from fossil fuels to renewable energy for electricity generation will reduce emissions and provide a more sustainable source of electricity. Under this strategy, emissions are reduced by streamlining access to renewable energy; increasing the supply of renewable energy for residences, commercial, and municipal operations within the City; and increasing the amount of onsite renewable energy at existing and new residential and non-residential development. Implementation of Strategy 2 would reduce the City's emissions by 434 $MTCO_2e$ by 2020 and 45,456 $MTCO_2e$ by 2030. Table 3-4 outlines the framework for this strategy.

Co-Benefits of Renewable Energy:

- Improved Air Quality
- Improved Public Health
- Green Jobs
- Reduced Fossil Fuel Reliance
- Energy Savings
- Cost Savings
- Increased Renewable Energy

Table 3-4 Strategy 2: Renewable Energy

Goal 2.1: Achieve 100% Renewable Electricity Supply in Homes and Businesses

City Action: RE-1 Establish a Community Choice Energy Program

Present to City Council for consideration a Community Choice Energy program that increases renewable electricity supply.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Launch a CCE Program with renewable electricity sources as a percentage of overall energy supplies equal to or greater than the current percentage of renewable electricity provided by SDG&E[1] and 80% customer participation.	-
2030	100% renewable electricity supply and 80% customer participation.	43,644

City Action: RE-2 Require New Homes to install Solar Photovoltaic Systems[2]

Starting in 2018, require
1) New single-family homes to install at least 1.5 W solar per square feet (e.g., 2,000 sq. ft. home = 3 kW) or minimum 2 kW per home; 2) New multi-family homes to install at least 1 W solar per square feet (e.g., 1,000 sq. ft. home = 1 kW) or minimum 1 kW per unit, to install solar PV systems, unless the installation is impracticable due to poor solar resources.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Install 400 kW (0.4 MW) of solar photovoltaics on new homes.	141
2030	Install 1,000 kW (1 MW) of solar photovoltaics on new homes.	614

City Action: RE-3 Require Commercial Buildings to install Solar Photovoltaic Systems[1]

Starting in 2018, require installation of at least 2 W per sq. ft. of building area (e.g., 2,000 sq. ft. = 3 kW) on 1) all new commercial buildings, including the commercial portion of mixed-use projects, 2) commercial building modifications, alterations, and additions that require building permits with square footage larger than 10,000 sq. ft., unless the installation is impracticable due to poor solar resources.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Install 200 kW (0.2 MW) of solar photovoltaics new commercial spaces.	59
2030	Install 800 kW (0.8 MW) of solar photovoltaics on new commercial spaces.	452

Supporting Measures for Goal 2.1:

- Develop RFP and allocate funds for CCE Technical Feasibility Study.
- Expand and implement a Green Building Incentive Program to increase the installation of solar PV, solar water heating at homes and businesses.
- Facilitate homeowner and business owner financing of renewable energy systems by expanding PACE financing options.
- Educate homeowners and businesses about incentive programs offered by SDG&E, CSE, and others in the region.
- Consider the purchase of Renewable Energy Credits (RECs), if needed, to achieve to achieve 100% renewable electricity supply in 2030.

[1] The renewable electricity supply requirement would be compliant with the State's most current RPS target (at least 33% by December 31, 2020, 40% by December 31, 2024, 45% by December 31, 2027, and 50% by December 31, 2030 (SB 350, §399.15(b)(2)(B))) and would be equal to or exceed the year 2020 power mix of the existing utility provider SDG&E (which was 43% "Eligible Renewable" in 2016 and projected to be approximately 49% in 2021). Current Power Content Labels of utility providers showing the power mix is provided by the California Energy Commission, Utility Annual Power Content Labels (http://www.energy.ca.gov/pcl/labels/).

[2] In a mixed-use building that includes one type of use on top of another (e.g., residential above commercial), photovoltaic systems may be installed on the roof of the entire building to offset electricity usage from both land use types.

Goal 2.2: Increase Renewable Electricity Supply in Municipal Operations		
City Action: MRE-1 Supply Municipal Facilities with Onsite Renewable Energy		
Supply municipal facilities with onsite renewable energy to achieve "Net Zero Electricity" municipal operations. Implement "City of Encinitas Solar Assessment Report" by installing 1.3 MW of solar systems at city facilities.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	50% of City facility electricity is supplied by onsite renewable energy generation (0.65 MW equivalent).	233
2030	100% of City facility electricity is supplied by onsite renewable energy generation (1.3 MW equivalent).	746

Supporting Measures for Goal 2.2:

- Conduct audits to quantify energy use and to identify and quantify energy efficiency and conservations opportunities.
- Identify grants, rebate and incentive programs, and financing opportunities for municipal energy efficiency and renewable energy programs.
- Implement the Environmentally Preferable Purchase Policy.

Notes:
CCE = Community Choice Energy; CSE = Center for Sustainable Energy; kWh = kilowatt; $MTCO_2e$ = metric tons of carbon dioxide equivalent; MW = megawatt; RFP = Request for Proposal; SDG&E = San Diego Gas & Electric; PACE = Property Assessed Clean Energy; W = watt
Source: EPIC 2017.

3.1.2 Water

GHG emissions are produced through the energy used to pump, transport, and treat water and wastewater. Although water and wastewater-related GHG emissions only accounted for three percent of the City's emissions in 2012, water conservation is needed to address serious periodic drought issues that frequently affect the City and the State. As discussed in Chapter 5, drought conditions could increase in frequency and severity because of climate change over the long-term. All water strategies also serve as adaptation strategies by preserving water quality and encouraging water conservation.

Strategy 3: Water Efficiency

Co-Benefits of Water Efficiency:

- Water Supply and Conservation
- Improved Public Health
- Energy Savings
- Cost Savings
- Increased Resiliency

Water and wastewater-related actions and supporting measures under this strategy will reduce both the strain on water supplies and GHG emissions from pumping and treatment activities. Under Proposition 218, local jurisdictions must follow cost of service principles when setting water rates. As a result, the San Dieguito Water District (SDWD) can only charge customers what it costs SDWD to serve them with water. For this reason, water rates cannot be directly used to encourage water conservation. However, to account for the increased costs associated with supplying and producing water, water rates can be tiered, to make higher levels of water use more expensive. City Action WE-1 takes into consideration the indirect effects increased water rates could have on water consumption. With increased water rates, water consumption, and thus GHG emissions, will likely decrease. Furthermore, the supporting measures proposed will reduce emissions primarily through water conservation in new and existing facilities, providing incentives to reduce indoor and outdoor water consumption, and providing education and outreach on water efficiency. Emissions reductions from Water Efficiency Strategy rely on successful coordination with and participation from SDWD, City residents, and businesses. Implementation of Strategy 3 would reduce the City's emissions by 712 and 735 $MTCO_2e$ by 2020 and 2030, respectively. Table 3-5 outlines the framework for this strategy.

Table 3-5 Strategy 3: Water Efficiency

Goal 3.1: Reduce City-wide Potable Water Consumption		
City Action: WE-1 Regularly Conduct Water Rate Studies and Implement Approved Water Rates		
SDWD and OMWD Board of Directors' approved water rate increase from 2012 to 2017.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Save 5 GPCD water use (258 million gallon water saving).	712
2030	Save 5 GPCD of water use (266 million gallon water saving).	735

Supporting Measures for Goal 3.1:

- Facilitate homeowner and business owner financing of water efficiency measures by expanding PACE financing options.
- Educate homeowners and businesses about water efficiency rebate and incentive programs offered to SDWD and OMWD customers.
- Evaluate key challenges that were identified in the 2016 SDWD Potable Reuse Feasibility Study.
- Conduct audits and retrofit all municipal facilities with water-efficient features to reduce potable water use at municipal facilities.
- Convert all current municipal landscape adjacent to recycled water pipelines to recycled water. Look for opportunities to work with the San Elijo Joint Powers Authority to extend recycled water pipelines to additional municipal facilities, when economically viable.
- Evaluate reducing the landscape area thresholds for projects to meet regulations outlined in the City's existing Water Efficient Landscape Ordinance (EMC Chapter 23.26). This ordinance promotes water conservation by requiring new and redeveloped landscapes to use water efficient plants and technology.
- Implement and enforce the Water Supply Shortage Response Program ordinances (administered by SDWD and OMWD) which require citywide water conservation during drought conditions.
- The City's Clean Water Program will continue to be actively involved in the Carlsbad Watershed Water Quality Improvement Plan development and implementation.
- Implement a Low Impact Development Outreach and Incentive Program for residents and businesses.
- Work with developers to implement Low Impact Development and other stormwater features on new and redevelopment projects.
- Source water from least-cost sources first, whenever possible.

Notes:
GPCD = gallons per person per day; SDWD = San Dieguito Water District; $MTCO_2e$ = metric tons of carbon dioxide equivalent; OMWD = Olivenhain Municipal Water District; PACE = Property Assessed Clean Energy
Source: EPIC 2017.

3.1.3 On-Road Transportation

Internal combustion from on-road transportation is the largest contributor to the City's GHG emissions. Emissions from on-road transportation sources accounted for 54 percent of the City's total emissions in 2012. Legislative reductions, mainly from improvements in State and federal vehicle fuel efficiency standards, will contribute to reducing transportation emissions. While these legislative reductions apply to the fuel efficiency of vehicle operations, strategies that affect the frequency or distance of vehicle travel are within local or regional control and can be addressed in a local CAP.

Strategy 4: Clean and Efficient Transportation

Under this strategy, emissions are reduced by reducing vehicle trips through consolidation of vehicle trips and non-motorized solutions, encouraging the use of electric and alternative fuel vehicles, and reducing vehicles miles traveled (VMT) through smarter land use planning. Emissions reductions from this strategy rely on coordination with, and participation from local and regional transportation and planning agencies, residents, and businesses. Implementation of the Clean and Efficient Strategy would reduce the City's emissions by 4,481 and 6,526 MTCO2e by 2020 and 2030, respectively. Table 3-6 outlines the framework for this strategy.

Co-Benefits of Clean and Efficient Transportation:

- Improved Air Quality
- Reduced Fossil Fuel Reliance
- Improved Public Health
- Improved Mobility
- Cost Savings

Table 3-6 Strategy 4: Clean and Efficient Transportation

Goal 4.1: Reduce Vehicle Miles Traveled		
City Action: CET-1 Complete and Implement the Citywide Active Transportation Plan		
The Citywide Active Transportation Plan is under development, therefore, the emissions reduction is currently not quantifiable. The Active Transportation Plan will integrate the existing transportation and mobility plans including Bike Master Plan and Pedestrian Master Plan.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Non-Quantified[3]	-
2030	Non-Quantified[3]	-
City Action: CET-2 Implement a Local Shuttle System		
Implement service routes recommended in Encinitas Transit Feasibility Study, using CNG buses for these routes: • By 2020: Express Services to educational facilities - one route to Mira Costa College and and one route to La Costa Canyon High School. • By 2025: One route to Encinitas Circulator and one to Encinitas COASTER connection.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce 365,000 VMT.	130
2030	Reduce 875,000 VMT.	172
Supporting Measures for Goal 4.1: • Develop and implement a complete streets policy. • Develop program to support car sharing and bike sharing for the community.[4] • Complete Safe Routes to Schools projects to decrease need to drive students to school. • Coordinate with regional transit authorities and local school districts to improve student busing and public transit options. • Support SANDAG iCommute Program for guaranteed ride home for the community.		

[3] Commuter mode share targets will be included in the CAP once the Active Transportation Plan (ATP) and the ATP Implementation Plan are complete. These plans will form the basis for the commuter mode share shift targets and are necessary to be completed in order to calculate numeric mode shift targets. The ATP is expected to identify a variety of strategies and specific projects that the City will implement to encourage and enhance mobility throughout the City. Many mobility projects will be part of the plan, including several railroad crossings connecting residential areas with commercial centers and recreational areas, bike lanes, bike paths, bike boulevards, new and improved sidewalks, and many traffic calming improvements. Other components of the CAP will also support commuter mode share shift, including the implementation of a local shuttle system (CET-2), development of a regional bikeshare program, and others. It is anticipated that implementation of the ATP will produce a significant shift from primarily single-occupancy vehicle commuting to carpooling, transit ridership, biking and walking. The ATP and associated Implementation Plan are expected to be complete in 1-2 years. Upon completion of these plans, the City will update the CAP (prior to the routine 5-year update) to incorporate numeric commuter mode share shift targets and associated emissions reduction targets.

[4] A regional Bikeshare program for the North County coastal area is currently in the works and a pilot program may be in operation as soon as April 2018. The Bikeshare program is expected to increase the number of trips taken by bike and reduce car trips. The program will have the capability to track increased ridership through an on-bike GPS, in-app tracking and data collection system.

Table 3-6 Strategy 4: Clean and Efficient Transportation

- Develop and implement a City Bike Rack Program.
- Develop and implement a program to incentivize City employees commuting to work by bike or other modes of alternative transport as a model for other local employers.
- Adopt the National Association of City Transportation Officials *Urban Bikeway Design Guide* and utilize as a policy in the Capital Improvement Program (CIP) roadway projects.
- Update the City's Housing Element[5] and implement and enforce the City's existing specific plans (Downtown Encinitas Specific Plan and the North 101 Corridor Specific Plan) to reduce Vehicle Miles Traveled and encourage dense, infill development.

Goal 4.2: Reduce On-road Fuel Use

City Action: CET-3 Improve Traffic Flow

Improve traffic flow by retiming traffic signals and installing roundabout at intersections in the City.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Retime 60 traffic signals and install 3 roundabouts.	3,671
2030	Install 4 roundabouts.	2,839

Supporting Measures for Goal 4.2:

- Identify rebate and incentive programs and financing opportunities for installing roundabouts.
- Update the City's Circulation Element to support improved traffic flow.

Goal 4.3: Increase Use of Alternative Fuels

City Action: CET-4 Require Residential Electric Vehicle Charging Stations

Starting in 2018, require new residential units to install EVCS equipment. For 1) Single Family: Install complete 40-Amp electrical circuit (EV Ready) 2) Multi-Family: Install EVCS equipment at 5% of the total number of parking spaces.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Install 65 electric vehicle charging stations.	185
2030	Install 370 electric vehicle charging stations.	1,357

City Action: CET-5 Require Commercial Electric Vehicle Charging Stations

Stating in 2018, require installation of EVCS at 8% of the total number of parking spaces. For 1) all new commercial buildings, including the commercial portion of mixed-use projects, 2) commercial building modifications, alterations, and additions that require building permits with square footage larger than 10,000 sq. ft.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Install 150 electric vehicle charging stations.	440
2030	Install 490 electric vehicle charging stations.	1,789

Supporting Measures for Goal 4.3:

- Expand and implement a Green Building Incentive Program to increase electric vehicle charging at home and businesses.
- Complete and implement an Electric Vehicle Charging Station Master Plan to increase the use of Zero-Emission vehicles by the community.
- Work with SDG&E to explore projects through their Power Your Drive Program.
- Develop and implement EV charging plan for municipal facilities.
- Pursue partnerships with school districts and NCTD to explore the use of electric busing or public transit busing for schools.

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[5] The City is currently in the process of updating its Housing Element to be compliant with state law. The updated Housing Element will promote higher density, infill development for low income housing throughout City at specific locations. The Housing Element will aim to add at least 1,286 new affordable housing units. Infill development sites have been targeted as potential locations for the increased housing, with preferences given to locations served by public transportation. Up-zoning to increase density will also be a component of the updated Housing Element. The Downtown Encinitas and North 101 Corridor Specific Plans also encourage denser development opportunities, including allowances for mixed use. These more densely developed areas can support greater usage of alternative transportation modes, including biking, walking and transit. The City's NCTD Coaster station is located within downtown Encinitas and one of the most popular cycling routes in the county is located along North Coast Highway 101.

Table 3-6 Strategy 4: Clean and Efficient Transportation

- Implement a wayfinding program with signage and information systems to facilitate walking, biking, and efficient driving and parking.
- Implement educational activities to raise awareness about EVs among residents and businesses.
- Develop and implement a program to incentivize City employees commuting to work by Electric Vehicle or other modes of alternative transport as a model for other local employers.

City Action: MCET-1 Transition to Zero Emission Vehicle (ZEV) Municipal Fleet

Develop a municipal fleet replacement plan to 1) convert gasoline-fueled cars and light-duty trucks to Zero Emission Vehicles, including all-electric vehicles or other ZEV technology by 2030. 2) convert to renewable diesel for all diesel-fueled heavy-duty trucks by 2020.[6]

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Reduce City fleet fossil fuel use (gasoline and diesel) by 10%.	55
2030	Reduce City fleet fossil fuel use (diesel) by 30% and convert gasoline-fueled cars and light duty trucks to ZEV.	370[7]

Supporting Measures for Goal 4.3:

- Install EV charging stations at municipal facilities.
- Develop a City vehicle fleet conversion plan and identify funding to support conversion of fleet vehicles.

Notes:
CNG = Compressed Natural Gas; electric vehicle = E; EVCS = electric vehicle charging stations; $MTCO_2e$ = metric tons of carbon dioxide equivalent; SDG&E = San Diego Gas & Electric; VMT = vehicle miles traveled
Source: EPIC 2017.

3.1.4 Off-Road Transportation

Off-road transportation accounted for 2 percent of the City's total emissions in 2012. Transitioning from fossil-fuel based to renewable or electric off-road equipment is a key strategy for reducing emissions.

Strategy 5: Reduce Off-Road Equipment

Co-Benefits of Off-Road Equipment Reduction:
- Improved Public Health
- Improved Air Quality

Under this strategy, emissions are reduced by eliminating the use of two-stroke engine leaf blowers, which are known to emit a number of air pollutants. Because a percentage of the fuel engine fails to undergo complete combustion, the engine produces GHG emissions. Emissions reductions from this strategy relies on coordination with the City's Environmental Commission as well as public outreach and education on alternatives to gas-powered leaf-blowing technologies. Implementation of Reduce Off-Road Equipment Strategy would reduce the City's emissions by 128 $MTCO_2e$ by 2020 and 142 $MTCO_2e$ by 2030. Table 3-7 outlines the framework for this strategy.

[6] At the time that commuter mode share measures are calculated and included in the CAP, as described in CET-1, ZEV options for heavy duty fleet vehicles will also be evaluated and a revised target for heavy duty vehicles will be consider based on any advances in ZEV technology.

[7] The 2030 performance metric and target for MCET-1 were revised subsequent to the preparation of the "Methods for Estimating Greenhouse Gas Emissions Reduction from Encinitas Climate Action Plan," dated September 2017 (Appendix B).

Table 3-7 Strategy 5: Reduce Off-Road Equipment

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
Goal 5.1: Reduce Off-Road Fuel Use		
City Action: OR-1 Adopt a Leaf Blower Ordinance to Limit Use of 2-stroke Leaf Blowers		
Starting in 2018, prohibit 2-stroke leaf blowers and implement the phase-out of leaf blower emissions.		
2020	Reduce all emissions from 2-stroke leaf blowers use.	128
2030	Reduce all emissions from 2-stroke leaf blowers use.	142

Supporting Measures for Goal 5.1:

- Evaluate the use of alternative fueled landscaping equipment to reduce emissions.
- Educate home and business owners about alternatives to gas-powered leaf-blowing technologies.

Notes: $MTCO_2e$ = metric tons of carbon dioxide equivalent
Source: EPIC 2017.

3.1.5 Solid Waste

The solid waste category accounted for approximately 5 percent of the City's total emissions in 2012. The Zero Waste Strategy aims to reduce emission through diverting solid waste from landfills. Solid waste disposal in a landfill generates emissions of GHGs through the anaerobic decomposition of organic products. To reduce these emissions, methane-generating organic material must be diverted away from landfills where they can properly decompose. Solid waste emissions reductions depend on expansion of County waste reduction, recycling, and composting programs; and participation from City residents and businesses to reduce waste and increase recycling.

Source: Solana Center for Environmental Innovation

Strategy 6: Zero Waste

Unlike the transportation, electricity, and natural gas categories, the City has greater jurisdiction over the handling of solid waste generated by the community. This strategy focuses on diverting a greater percentage of waste from landfills, through such method as composting and increased recycling. This strategy will also reduce waste in landfills, which will reduce costs to the City and reduce local odor impacts. Implementation of Strategy 6 would reduce the City's emissions by 2,830 $MTCO_2e$ by 2020 and 11,921 $MTCO_2e$ by 2030. Table 3-8 outlines the framework for this strategy.

Co-Benefits of Zero Waste:
- Improved Air Quality
- Improved Water Quality
- Improved Public Health
- Cost Savings

Table 3-8 Strategy 6: Zero Waste

Goal 6.1: Divert Solid Waste		
City Action: ZW-1 Implement a Zero Waste Program		
Implement a Zero Waste Program to reduce waste disposal from residents and businesses in the community.		
Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	Divert 65% of total solid waste generated (equivalent to 5.3 pounds per capita per day waste disposal).	2,830
2030	Divert 80% of total solid waste generated (equivalent to 3 pounds per capita per day waste disposal).	11,921

Supporting Measures for Goal 6.1:

- Implement an Organic Waste Recycling Program through the following measures:
  - Support regional efforts to plan for and develop residential and commercial food scrap composting programs.
  - Facilitate the establishment of fully-permitted community appropriate compost facilities in the City.
  - Continue to support at-home management of food waste through educational workshops and subsidies of compost bins and worm bins.
  - Continue to support Zero Waste programs at local schools.
  - Provide free audits of restaurants and grocery stores to reduce waste generation.
  - Develop City Hall waste audits and consider pilot composting project based on audit results.
- Develop education program for textile recycling.
- Evaluate and expand existing recycling requirements at City permitted events and activities.
- Expand outreach and education on the City's C&D Ordinance that has a lower threshold for covered projects.
- Support product stewardship and extended producer responsibility initiatives.

Notes:
C&D = Construction and Demolition; $MTCO_2e$ = metric tons of carbon dioxide equivalent
Source: EPIC 2017.

3.1.6 Carbon Sequestration

Carbon sequestration refers to the process of removing atmospheric carbon dioxide (CO_2) through artificial or natural processes and occurs daily through the natural respiration of vegetation and trees. Carbon sequestration potential is lost when natural carbon sinks (e.g., trees) are cut down or removed. Conversely, a community can enhance or improve its carbon sequestration potential by increasing the volume and rate of planting trees and nurturing an urban canopy.

Co-Benefits of Carbon Sequestration:
- Improved Air Quality
- Improved Water Quality
- Improved Biological Resources

Strategy 7: Carbon Sequestration

As part of the natural carbon cycle, photosynthesis in plants takes CO_2 in the atmosphere and converts it into oxygen and carbon-based plant matter, storing the carbon captured from the atmosphere. Trees are significant sources of carbon storage and sequestration because of their size and longevity and provide essential habitat for local fauna. The most recent urban tree canopy assessment in San Diego region, based on high-resolution Light Detection and Ranging (LiDAR), shows the City has approximately 22% existing urban tree canopy.[8] This strategy focuses on the preservation and expansion of tree growth in

[8] The assessment was done in 2014 for all urban areas in the San Diego County using method developed by University of Vermont and USDA Forest Service. https://www.sandiego.gov/sites/default/files/san_diego_tree_canopy_assessment_05oct2016.pdf

the City to increase the amount of carbon sequestered in hopes of offsetting CO_2 emissions generated by other sources to the extent feasible. Increased carbon sequestration and new tree plantings will also improve air quality through the capture of air pollutants, water quality through reduced erosion, biological resources by providing additional habitat and improved water quality, and community and public health through the provision of shade and positive impacts on mental health. Implementation of the Urban Forest Strategy would reduce the City's emissions by 5 $MTCO_2e$ by 2020 and 23 $MTCO_2e$ by 2030. Table 3-9 outlines the framework for this strategy.

Table 3-9 Strategy 7: Carbon Sequestration

Goal 7.1: Increase Urban Tree Cover

City Action: CS-1 Develop and Implement an Urban Tree Planting Program

Starting in 2018, develop and implement an Urban Tree Planting Program, including standards to right-size trees and minimize pruning and irrigation needs, to promote increased carbon sequestration by trees within the community.

Target Year	Performance Metric	GHG Reduction Potential ($MTCO_2e$)
2020	150 net new trees planted.	5
2030	650 net new trees planted, increasing the tree canopy coverage from 22 to 22.16 percent, an increase in overall tree canopy of 0.16 percent.	23

Supporting Measures for Goal 7.1:

- Continue turf management practices which specify the top-dressing of compost to increase carbon sequestration at City parks.
- Partner with schools to develop programs to educate students about planting trees.
- The City will continue to encourage developers to avoid the removal of any mature trees when a property is developed or redeveloped. If the removal of mature trees in unavoidable, trees are required to be replaced at a 1:1 ratio.
- When new parking lots are part of a development, trees are required to be planted at a ratio of one tree for every 5 parking spaces.
- Present to Council for consideration an ordinance to require and/or incentivize additional tree planting on private property throughout the city.
- The City will incentivize tree planting on private property by giving away tree seedlings during Arbor Day events.
- Supports regional LiDAR imagery data collection and analyze future LiDAR data to determine the overall increase in tree canopy as compared to the City CAP goals and targets.

Notes:
$MTCO_2e$ = metric tons of carbon dioxide equivalent
Source: EPIC 2017.

CITY OF Encinitas

CHAPTER 4

Implementation and Monitoring

This chapter outlines how the City of Encinitas (City) will implement and monitor the 2018 Climate Action Plan (2018 CAP) strategies, City actions, and supporting measures over time to reduce greenhouse gases (GHGs). To achieve the GHG emissions reductions described in Chapter 3, actions should also be continuously assessed and monitored to ensure that: 1) the actions are effective; 2) the 2018 CAP is on track to achieve GHG reduction targets; and 3) desired community outcomes are met.

A separate and detailed Implementation Plan was prepared in conjunction with the final draft of the 2018 CAP. The Final CAP, CEQA document, and the standalone Implementation Plan will be presented to City Council concurrently. The more detailed Implementation Plan identifies key costs to the City including staffing needs, budget, and funding sources. It also includes a timeline for implementation of each GHG reduction action and supporting measure. All actions and supporting measures requiring significant funding will be brought to City Council for consideration and approval, either through the City's standard budget process or as an off-cycle budget request. This chapter provides a brief overview of the range of implementation needs and considerations for the 2018 CAP.

To adequately prepare an implementation strategy, this chapter assigns implementation timelines, staffing needs, funding needs, and relative cost where available. In terms of implementation timelines, actions and supporting measures were categorized into the following:

- Ongoing: already occurring or to occur in perpetuity.
- Short-term: within the next five years.
- Mid-term: within the next 10 years.
- Long-term: to occur beyond 10 years.

Specific timelines for action implementation will be delineated in the Implementation Plan. The cost to the City associated with each action and supporting measure was given values of low, medium, or high based on the anticipated level of resources, staffing, and time required to implement each action and/or supporting measure. Similarly, certain actions and measures may have associated costs for the community upfront that may be partially or wholly offset through increased efficiencies. Further, success of the 2018 CAP will require capital improvements, investments, and increased operations and maintenance costs. Definitions of the low, medium, and high descriptors are shown in the table below.

Relative Cost	Description
Low	Assumes that less than one full-time-equivalent employee and/or financing less than $20,000 would be required to oversee implementation, and that sufficient incentives, subsidies, or rebates would be available to nearly offset the upfront cost of implementation to individuals or businesses
Medium	Assumes at least one full time equivalent employee, operational and maintenance costs and/or capital improvement financing between $20,000 and $100,000 would be required to construct new permanent facilities, and that private businesses or individuals would incur short-term costs of improvements, infrastructure, or employee training
High	Assumes need for more than one full time equivalent employees, operational and maintenance costs and/or capital improvement financing of $100,000 or more would be required to construct new permanent facilities, and that private businesses or individuals would incur short-term and long-term costs of improvements,

Relative Cost	Description
	infrastructure, or employee training

4.1 Implementation Strategy

Proper implementation and tracking of the 2018 CAP allows City Staff, the Climate Action Working Group, City Council, and the public to monitor the effectiveness of each measure as well as the overall CAP.

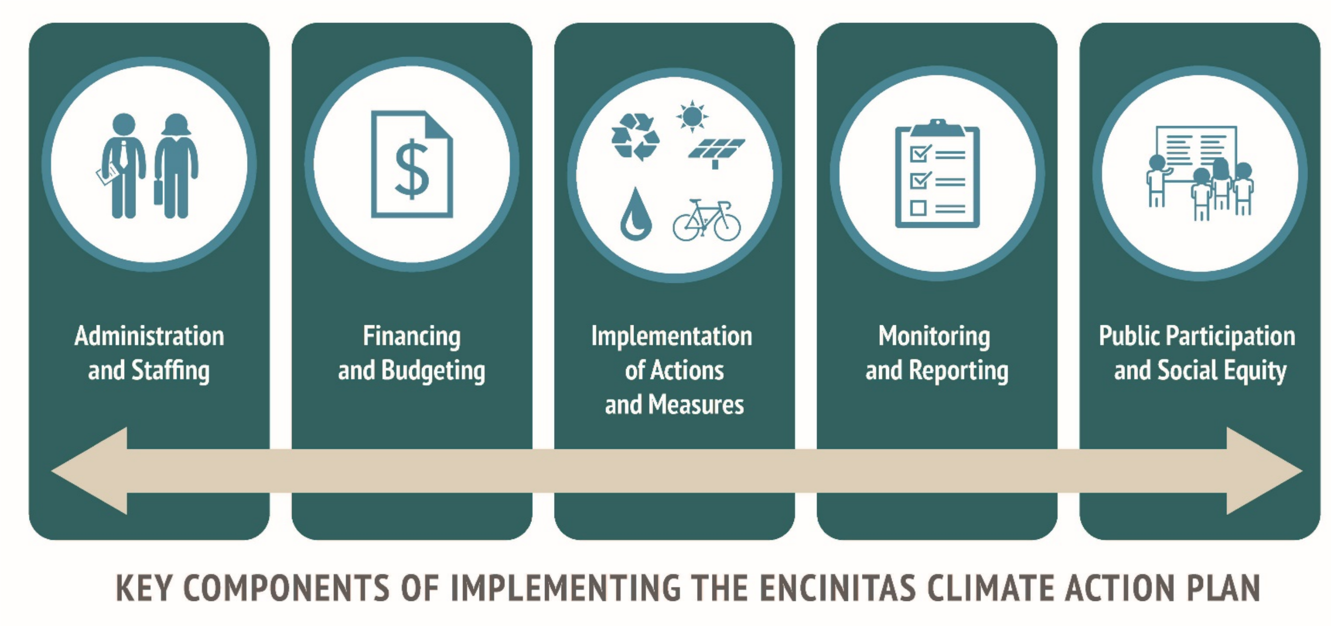
The recommended emission reduction actions and supporting measures were evaluated qualitatively to assess the cost, timeline, administrative and staffing needs, and responsible parties required for implementation. The City will incur costs to implement the actions and supporting measures proposed in the 2018 CAP. These include initial start-up, ongoing administration, and enforcement costs. While some actions and measures will only require funding from public entities, others will result in increased costs for businesses, contractors, and residents. However, most actions and measures provide substantial cost-savings in the long-term (e.g., improved energy efficiency will reduce energy costs over time). The City will be diligent in seeking cost-effective implementation and strategic funding opportunities while using partnerships to share the cost. Table 4-1 provides a summary of the relevant parties and responsible agencies, timeline, approximate costs to the City and community, and potential funding sources for implementation of each GHG reduction action and supporting measures.

A separate and detailed Implementation Plan was prepared in conjunction with the final draft of the 2018 CAP. The Final CAP, CEQA document, and the standalone Implementation Plan will be presented to City Council concurrently. The more detailed Implementation Plan identifies key costs to the City including staffing needs, budget, and funding sources. It also includes a timeline for implementation of each GHG reduction action and supporting measure. All actions and supporting measures requiring significant funding will be brought to City Council for consideration and approval either through the City's standard budget process or as an off-cycle budget request.

CAP Administration

If a project can demonstrate consistency with the land use projections and applicable GHG reduction measures in the CAP, the level of environmental review for the project required under CEQA with respect to GHG emissions can be considerably reduced.

The City will establish a permanent CAP Program Administrator position, or similar position, to ensure City Actions and Supporting Measures are implemented effectively and on time. The CAP Program Administrator will lead the overall implementation of the CAP and play a key role in implementing some of the most critical actions and supporting measures. The CAP Program Administrator will also be responsible for monitoring and reporting progress towards meeting 2018 CAP goals and emissions targets. Implementation of the 2018 CAP will be facilitated by appointed staff leads within various departments (see Table 4-1) and these staff leads would comprise the staff level CAP Workgroup. The CAP Program Administrator will manage the CAP Workgroup, convening and managing regular meetings to facilitate coordination of CAP implementation among the various City departments. The CAP Program Administrator will also seek regional funding, grant funding and other support such as the acquisition of a CivicSpark Fellow to assist with CAP implementation, monitoring and update. CivicSpark is an AmeriCorps program administered by the Local Government Commission to support local governments in addressing climate change.



Social Equity

Incorporating equity into implementation of the CAP will be key to a successful outcome. Equity would ensure just distribution of the benefits of climate protection efforts and would help alleviate unequal impacts created by climate change. Social equity is a broad subject that transcends the CAP and intersects with multiple facets of City operations. However, the CAP presents an opportunity to begin addressing climate equity and laying the foundation for further action by the City. The City intends to address social equity in a holistic manner through its General Plan.

The City currently manages various programs to address equity in planning. The City of Encinitas Housing Authority operates a Section 8 Rental Assistance program for very-low income families. The City of Encinitas also receives an annual federal grant for the Community Development Block Grant Program (CDBG) program. Funds for the CDBG program are provided for affordable housing and community development activities within communities. The City also has an Inclusionary Housing requirement, whereby, developments of 10 or more units must provide affordable housing or pay an in-lieu fee to be used for affordable housing in the City.

The City will continue to incorporate equity considerations into implementation of the CAP. Local actions such as the Community Choice Energy (CCE) program and residential and commercial photovoltaic programs would create and promote jobs for the local workforce. The City will provide climate action related resources and knowledge-sharing opportunities for small-business owners at workshops and outreach events. The City will also consider low-income areas when locating and installing electric vehicle (EV) charging stations. Needs of underserved communities, such as low-income and seniors, would be considered when siting local transit shuttle routes and stops. Active transportation-related actions would be implemented to provide benefits to low-income populations, students, children, and other groups that do not have access to other transportation choices. The City is a participant in the North Coast Energy Action Collaborative, which supports energy savings for local businesses, including small businesses. The City would also partner with schools and local businesses to promote climate action. The City will also evaluate opportunities to install energy efficiency upgrades, photovoltaic systems, and EV charging stations at City-owned low-income housing. The City will actively prioritize actions and measures that include consideration of social equity. In preparing a holistic approach to equity, the City will develop tracking and reporting metrics to determine progress and success.

Green Jobs Creation

According to the Bureau of Labor Statistics, green jobs are defined as the following:

A. Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.

B. Jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources.

To provide support for the creation of green jobs within the City, the following measures will be implemented as part of the 2018 CAP:

1. The City's Economic Development effort, which serves to support local business development, will support the creation of green jobs through targeted workshops, customer service programs, funding of mainstreet and chamber associations and services offered via a business ombudsperson. In addition to green jobs, the CAP will support the "greening of jobs" by reducing the environmental impact of businesses associated with transportation, water use, energy use and solid waste generation.

2. The City will develop a Green Business Program for local businesses and restaurants. The program will include minimum participation requirements, awards for high achieving green businesses, the promotion of green jobs, and encouragement of local businesses to work on climate-related projects and programs through press releases, workshops, incentive programs, and social and other media outreach.

3. The City will facilitate the creation of green jobs through the promotion and support of the City's green business corridor, called the "E^3 Cluster", which includes the Leichtag Foundation, the San Diego Botanic Garden, and the Encinitas Union School District Farm Laboratory. As the E^3 Cluster develops, it will serve as a direct source of a significant number of additional green jobs within the City as well as promote and support other businesses and organizations to add green jobs throughout the City.

4. The City will track performance goals for green jobs and green businesses through the City's business license tracking system and report on green jobs and green businesses as part of the regular CAP monitoring report.

5. The City will provide efficiency and renewable energy training for the City employees responsible for the management of City facilities.

6. The City will ensure that all climate action-related work done through City programs comply with the California Statewide Prevailing Wage Ordinance, where applicable.

7. The City is currently in the process of updating its Housing Element to be compliant with State law. The updated Housing Element will include housing options for all facets of the City's workforce and will create a more sustainable live/work community. This more complete community will facilitate a reduction in vehicle miles traveled and encourage the use of greener transportation modes like biking, walking and public

transit. In compliment to the Green Business Program described above, these new residents could seek local employment and support the city's transition to a workforce made up of more local and green jobs.

Table 4-1 Implementation Strategy Matrix

City Action Number	City Action	Reductions in 2020 ($MTCO_2e$)	Reductions in 2030 ($MTCO_2e$)	Implementation Timeline	Cost		City Department/Division Responsibility
					City[9]	Community	
BE-1	Require Energy Audits of Existing Residential Units	47	122	Short-Term, then Ongoing	Low	Low	Development Services/Planning
BE-2	Require New Single-Family Homes to Install Solar Water Heaters	130	1,241	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
BE-3	Adopt Higher Energy Efficiency Standards for Commercial Buildings	98	220	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
BE-4	Require Commercial Buildings to Install Solar Water Heaters	612	2,728	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
MBE-1	Continue Implementation of Energy Efficient Projects in Municipal Facilities	54	44	Mid-Term	Medium	Low	Public Works/Facilities
RE-1	Establish a Community Choice Energy Program	0[3]	43,644	Mid-Term	High	Low	City Manager/Environmental Services
RE-2	Require New Homes to install Solar Photovoltaic Systems	141	614	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
RE-3	Require Commercial Buildings to install Solar Photovoltaic Systems	59	452	Short-Term, then Ongoing	Low	Medium	Development Services/ Planning
MRE-1	Supply Municipal Facilities with Onsite Renewable Energy	233	746	Short-Term	Low	Low	Public Works/Facilities
WE-1	Complete Water Rate Study and Implement New Water Rates	712	735	Ongoing	Medium	Low	SDWD & OMWD

[9] Administrative costs to the City to implement the CAP will be quantified in the Implementation Plan.
[3] Reductions for CCE are assumed to be zero for 2020 to allow time for program development and implementation.

Table 4-1 Implementation Strategy Matrix

City Action Number	City Action	Reductions in 2020 ($MTCO_2e$)	Reductions in 2030 ($MTCO_2e$)	Implementation Timeline	Cost		City Department/Division Responsibility
					City[9]	Community	
CET-1	Complete and Implement the Citywide Active Transportation Plan	Non-Quantified	Non-Quantified	Long-Term	High	Low	Development Services/Planning & Development Services/Engineering
CET-2	Implement a Local Shuttle System	1130	172	Mid-Term, then Ongoing	High	Low	City Manager/Environmental Services
CET-3	Improve Traffic Flow	3,671	2,839	Mid-Term	High	Low	Development Services/Engineering
CET-4	Require Residential Electric Vehicle Charging Stations	185	1,357	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
CET-5	Require Commercial Electric Vehicle Charging Stations	440	1,789	Short-Term, then Ongoing	Low	Medium	Development Services/Planning
MCET-1	Transition to Zero Emission Vehicle (ZEV) Municipal Fleet	55	370	Short-Term, then Ongoing	Low	Low	Public Works/Fleet
OR-1	Adopt a Leaf Blower Ordinance to Limit Use of 2-stroke Leaf Blowers	128	142	Short-Term, then Ongoing	Low	Low	Development Services/Engineering
ZW-1	Implement a Zero Waste Program	2,830	11,921	Mid-Term	High	Low	City Manager/Environmental Services
CS-1	Develop and Implement an Urban Tree-Planting Program	5	23	Short-Term, then Ongoing	Medium	Low	Public Works/Streets & Parks/Parks, Beaches, Trails

Notes: $MTCO_2e$ = metric tons of carbon dioxide equivalent; SANDAG=San Diego Association of Government; SDG&E=San Diego Gas and Electric; EV=electric vehicle; PACE=Property Assessed Clean Energy; CSE=Center for Sustainable Energy; SDWD=San Dieguito Water District; CalRecycle=California Department of Resources Recycling and Recovery; OMWD = Olivenhain Municipal Water District

Actions and supporting measures considered to be a "project" subject to the environmental review process under the California Environmental Quality Act (CEQA) may be streamlined using a CAP Consistency Review Checklist. CEQA guidelines require that a project perform an analysis of GHG emissions and potential climate change impacts from new development. With associated CEQA coverage, the 2018 CAP qualifies under Section 15183.5 of the CEQA Guidelines as a plan for the reduction of GHG emissions for use in cumulative impact analysis pertaining to development projects. Demonstrating consistency with a CAP Consistency Review Checklist establishes that a project will not result in an "additional environmental effect" in the City's initial study checklist. Projects that do not demonstrate consistency may, at the City's discretion, prepare a more comprehensive project-specific analysis of GHG emissions consistent with CEQA requirements. The Consistency Review Checklist will be prepared concurrent with CEQA review for the 2018 CAP.

4.2 Monitoring and Updates

The 2018 CAP presents a broad-based strategy to reduce GHG emissions and improve the sustainability and resilience of the community. However, the 2018 CAP will need to be updated and maintained if it is to remain relevant and effective. Thus, City staff will need to evaluate and monitor plan performance over time and make recommendations to alter or amend the plan if it is not achieving the proposed reduction targets. This will include periodic GHG emissions inventory updates and analyzing action and supporting measure performance.

Over time, new technology will become available and new federal and State laws will influence how GHG emissions are reduced. The City will need to be flexible to ensure the CAP remains effective and relevant.

The 2018 CAP is a dynamic document that will be continuously assessed and monitored. Regular monitoring and performance measuring of activities will allow the City to make timely adjustments to existing actions; replace ineffective or obsolete actions; or add new actions as technology, federal and State programs, and circumstances change. Adjustments will be made to the 2018 CAP if actions fall short of the targets or additional actions become available. As new data and resources, future federal and State legislation and regulations, improvements in energy and efficiency technology, new regional plans, updates to building standards, or new GHG emission calculation standards become available, the City may amend the 2018 CAP to provide additional flexibility or clarity. The City recognizes that flexibility in implementation is necessary to allow the City to evolve its strategies to achieve the most effective CAP.

4.2.1 CAP Monitoring Report

It is anticipated that the City will spend two years after the 2018 CAP's adoption in January 2018 for initial start-up and to initiate data tracking. The City will conduct ongoing monitoring beginning in 2019 to track progress and identify where further efforts and additional resources may be needed. A monitoring report that summarizes the ongoing monitoring will be presented to the Environmental Commission and City Council biannually, which will include the status of action implementation using monitoring metrics and the progress in meeting the reduction targets.

Pursuant to Step 7 of the 2011 CAP's Implementation Plan, the City has developed and implemented a systematic reporting process to inform decision makers and the public through an online GHG "dashboard," which provides an annual report of measurements, monitoring, and management of key CAP activities. The CAP dashboard serves as a performance monitoring tool and can assist staff and policy makers in making objective decisions regarding CAP implementation. The CAP dashboard can be viewed here: www.EncinitasEnvironment.org.

4.2.2 Greenhouse Gas Emissions Baseline Inventory Updates

While based on extensive research and analysis, the City's GHG inventory represents a snapshot in time. As technologies and markets change, and the City implements the actions and supporting measures in the 2018 CAP, new inventories will be prepared to track progress. As a result, the GHG inventory will be updated on a regular basis for an updated baseline year using current data and assumptions. Through the climate planning services offered via its Energy Roadmap Program, the San Diego Association of Governments (SANDAG) will be updating GHG emissions inventories every two years, beginning with the 2016 baseline year. To remain consistent with SANDAG's schedule, the City will coordinate updates to its GHG inventory every two years beginning with the 2016 baseline year following adoption of the 2018 CAP. The GHG inventory updates will provide information about emission reductions over time, in comparison to the 2012 baseline inventory and 2020, 2030, and 2050 emission projections.

4.2.3 CAP Updates

Based on the findings from the monitoring reports and inventory updates, the City will continue to prepare CAP updates every five years beginning in 2023. Future CAP updates will be guided by recommendation by the City Council and Environmental Commission and will include updated baseline inventories, adjustments to reduction actions and supporting measures, as necessary, and any changes to land use projections to achieve consistency with zoning and then-current General Plan land use designations and policies.

CAP Implementation and Monitoring Schedule

2018	**CAP Adopted** Council adopts CAP and staff begins to implement actions and supporting measures.
2018	**Begin Implementation and Monitoring** Staff performs initial start-up tasks and implementation of data tracking.
2018	**GHG Emissions Baseline Inventory Update** Staff conducts an update to the emissions inventory every two years, starting with the 2016 baseline year, consistent with SANDAG's Energy Roadmap Program timeline.
2019	**Annual CAP Monitoring Report** Staff prepares and presents first annual monitoring report to City Council and Environmental Commission assessing the CAP's annual performance in achieving targeted goals.
2023	**CAP Update** Based on findings from the annual monitoring reports and inventory updates, staff prepares a CAP update every five years.

4.3 Ongoing Engagement

As the City continues to implement and monitor progress on the 2018 CAP, continued engagement with and participation by the community is critical. This includes individual residents and businesses, community organizations, schools, developers, property owners, other local and regional government agencies, and others. While the 2018 CAP focuses on actions and measures in which the City has a role, many of the actions and measures require partnerships and collaboration.

The City is also committed to public education about the important role individuals play in combatting climate change and its effects. Education and outreach is especially key for the younger generation, as they will be exposed to the worsening impacts of climate change. The Encinitas City Council has a School District Liaison Commission (SDLC) which facilitates collaboration with local school districts. Ongoing engagement for the CAP will include coordination and educational outreach to local schools and school children through the SDLC and other avenues. Effective and long-term climate action and resiliency in the City can only be achieved through efforts that continue to change the way individuals interact with the environment. Many of the actions and measures in Chapter 3, as well as the strategies outlined in Chapter 5, are focused on increasing community awareness and participation in existing programs or connecting the community with new information, tools, funding, or resources to act. Thus, the 2018 CAP serves as a resource that supports community-based action. To meet the City and State's GHG reduction goals, individual participation will be key. Further, the City's CAP Dashboard will provide a publicly available, up-to-date inventory for City residents and stakeholders facilitating engagement in CAP Update activities.

CHAPTER 5

Climate Adaptation

Climate change is a global phenomenon that, over the long term, will cause a wide variety of impacts on human health and safety, economic vitality, water supply, ecosystem function, and the provision of basic services (California Natural Resources Agency [CNRA] 2012:3). Locally in the San Diego region, as well as throughout California, climate change is already affecting and will continue to affect the physical environment. Because impacts of climate change vary by location and other social and economic characteristics, it is important to specifically identify the projected severity of these impacts on the City of Encinitas (City) and the surrounding area.

The California Adaptation Planning Guide (APG), developed by California Office of Emergency Services (CalOES) and CNRA, helps communities throughout California plan for and adapt to the impacts of climate change. The APG includes a nine-step process, illustrated in Figure 5-1, which allows communities to assess their specific climate vulnerabilities and provides strategies for communities to reduce climate-related risks and prepare for current and future impacts of climate change.

The first phase of the nine-step process focuses on preparing a Vulnerability Assessment, which is a method for determining the anticipated impacts of climate change on community assets and populations. This phase evaluates a community's level of exposure to climate-related impacts and analyzes how these impacts will affect a community's populations, functions, and structures. The second phase of the process uses the information gathered in the Vulnerability Assessment to develop adaptation strategies and measures to help the community prepare for, respond to, and adapt to local climate change impacts. The strategies support a collaborative planning process that involves a variety of City departments and State agencies, including, but not limited to, CalOES, CNRA, and the California Department of Public Health (CDHP). This chapter serves as an abbreviated version of a full Vulnerability Assessment, identifies key climate-related risks faced by the City, and provides key strategies to increase the City's climate resilience and adaptive capacity.

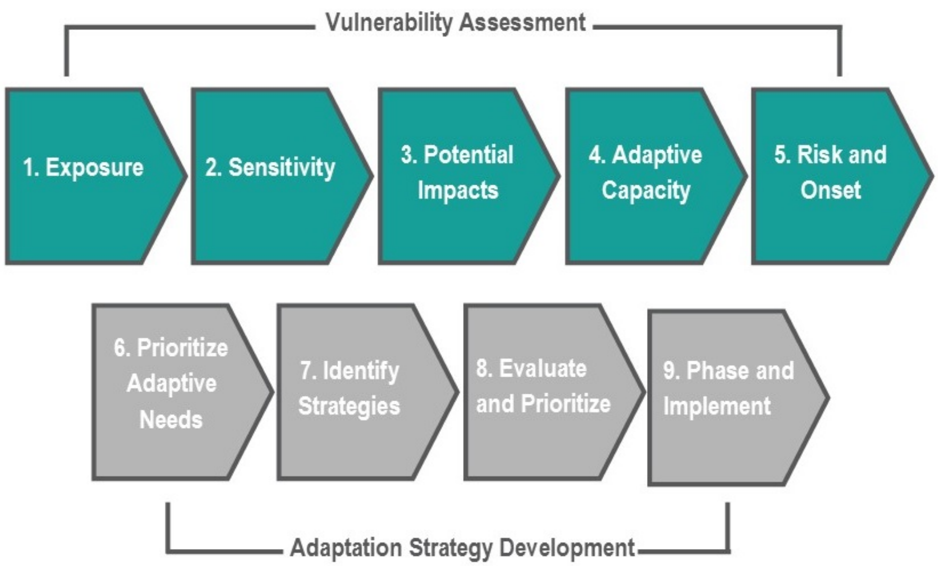


Figure 5-1: The Nine Steps in the Adaptation Planning Process

5.1 Climate Change Effects and Vulnerability Assessment

This section summarizes the climate-related impacts that may affect the City and evaluates how these impacts will potentially affect the community's populations, functions, and structures.

5.1.1 Climate Change Effects

The first step in the climate adaptation planning process is to assess the vulnerability of the City's populations, functions, and structures and the regional impacts of climate change. Using climate scenario planning tools, including Cal-Adapt and the U.S. Geological Survey's (USGS's) Coastal Storm Modeling System (CoSMoS 3.0), the assessment focuses on the climate-related impacts most likely to affect the City. Cal-Adapt is a climate change scenario planning tool developed by the California Energy Commission (CEC) and the University of California, Berkeley Geospatial Innovation Facility. Cal-Adapt downscales global climate simulation model data to local and regional resolution under both high and low global greenhouse gas (GHG) emissions scenarios. CoSMoS is a dynamic modeling tool developed to predict coastal flooding because it includes both future sea level rise and storms integrated with long-term coastal evolution. Data from the CoSMoS modeling tool are used specifically in sea-level rise predictions and serve to identify the City's key sea-level rise vulnerabilities.

The projections included in the Vulnerability Assessment discuss impacts that the City will experience from mid-century to the end of the century (2050-2099). Climate-related impacts are included for both a Low-Emissions Scenario and a High-Emissions Scenario based on predictive scenarios included in the Intergovernmental Panel on Climate Change's (IPCC's) Fifth Assessment Report (AR5) published in 2014. The Low-Emissions Scenario assumes GHG emissions will peak around the year 2040 and begin to decline steadily. The High-Emissions Scenario assumes GHG emissions continue to rise strongly through 2050 and plateau around the year 2100.

The direct, or primary, changes analyzed for the City include average temperature, annual precipitation, and sea-level rise. Secondary impacts, which can occur because of individual changes or a combination of these changes, are also assessed and include extreme heat and its frequency, wildfire risk, and changes in hydrology (CNRA 2012:16-17).

Increased Temperature

Annual temperatures in the City are projected to increase steadily under both emissions scenarios. The City's historical average annual maximum temperature, based on data from 1950 to 2005, is 73.8 degrees Fahrenheit (°F). Under the Low-Emissions Scenario, annual average maximum temperature is projected to reach 77.5 °F by 2050 and 78.3 °F by 2099, a total increase of 4.5 °F (CEC 2017a). The annual average maximum temperature under the High-Emissions Scenario is projected to be 78.2 °F by 2050 and 83.1 °F by 2099, a total increase of 9.3 °F (2099) (CEC 2017b).

The City's historical average annual minimum temperature, based on data from 1950 to 2005, is 52.4 °F. Under the Low-Emissions Scenario, annual minimum temperature is projected to be 55.8 °F by 2050 and 57.4 °F by 2099, a total increase of approximately 5 °F (CEC 2017c). The annual average minimum temperature under the High-Emissions Scenario (where emissions continue to rise strongly through 2050 and plateau around 2100) is projected to reach 56.5 °F by 2050 and 61.5 °F by 2099, an increase of approximately 9.1 °F (CEC 2017d).

In urban areas, increased average temperatures, as well as more frequent and extreme heat events, can exacerbate the effects of urban heat islands. Urban areas are characterized by the predominance of asphalt, paved surfaces, and buildings combined with limited vegetation and green space. During periods of high temperatures, asphalt and darker surfaces tend to absorb and retain heat for longer periods of time. These effects can be exacerbated by activities such as operating vehicles, air conditioning units, as well as industrial activities. This phenomenon raises average temperatures in urban areas and is known as the Urban Heat Island Effect (UHIE). The UHIE can impact a City in several ways, including increased energy demand for cooling, decreased ambient air quality, and increased heat-related public health risks such as heat stroke, dehydration, and exposure to degraded air quality.

Increased Frequency of Extreme Heat Events and Heat Waves

Cal-Adapt defines the "extreme heat" day threshold for the City as 93.3 °F or higher. Historically (i.e., between 1960 and 2005, within the warmer season of April 1st through October 31st, where the maximum temperature exceeds the historical maximum temperatures), the City has experienced an average of four extreme heat days annually. Because of climate change, the number of extreme heat days is projected to increase substantially by 2099. Under the Low-Emissions Scenario, the City is projected to experience an average of 12 extreme heat days per year between 2090 to 2099, an increase of about eight days (CEC 2017e). Under the High-Emissions Scenario, the City is projected to experience an average of 37 extreme heats days per year between 2090 to 2099, an increase of about 33 days (CEC 2017f).

Heat waves can be defined as five or more consecutive extreme heat days. These events have been historically infrequent in the City, with no more than two heat waves occurring in a year. Climate change will likely cause a considerable rise in the frequency of heat waves in the City under both emissions scenarios. Under the Low-Emissions Scenario, projections show an increase of heat wave events, with roughly four per year at the middle of the century and up to seven per year in 2099. The High-Emissions Scenario also shows an increase in annual heat wave events, with up to five heat wave events occurring annually by midcentury and as high as 10 heat wave events occurring annually by 2099. Along with an increased frequency of heat events, heat waves are also projected to occur both earlier and later in the season. In the historic record, heat waves have started in August and ended in October; in the future, they will extend from June through October.

Increases in the severity and length of extreme heat events caused by climate change will affect the City's assets and population in several ways. Heat waves and extreme heat events, intensified by the UHIE, produce a number of public health risks, particularly for vulnerable populations including children, the elderly, and those who work outside (e.g. construction workers, agricultural workers). Heat waves and extreme heat events can cause a number of heat-related illnesses including heat cramps, heat exhaustion, and heat stroke, leading to increased hospital visits and emergency services.

Changes in Precipitation Patterns

While projections generally show little change in total annual precipitation in California, even modest changes could have a dramatic effect on California's ecosystems, which are conditioned to historic precipitation levels. Changes in weather patterns resulting from increases in global average temperatures could also result in a decreased proportion of precipitation falling as snow in California and an overall reduction in snowpack in the Sierra Nevada. Based on historical data and modeling, the California Department of Water Resources (DWR) projects that the Sierra Nevada spring snowpack will decrease by 25 to 40 percent from its historic average by 2050 and 48 to 65 percent by 2100 (DWR 2008:4, 2013:3-64). If GHG emissions continue unabated (i.e., the High-Emissions Scenario), the Sierra Nevada spring snowpack could decline by as much as 70 to 90 percent by 2100 (CEC 2017g).

Using Cal-Adapt's Annual Averages Tool, historical annual average precipitation in the City from 1950 to 2005 is estimated to be 10.9 inches. Under the Low-Emissions Scenario, annual precipitation in the City is projected remain or decrease slightly by 2050 (10.8 inches per year by 2050), and increase slightly to 11.6 inches per year by 2099, a rise of 0.7 inches per year (CEC 2017h). Under the High-Emissions Scenario, annual precipitation in the City is projected to increase to 11.1 inches by 2050 and 14.5 inches by the end of the century (2099), a total rise of 3.6 inches (CEC 2017i).

Increased temperatures, particularly in the Sierra Nevada region, which supports the State Water Project, as well as the Rocky Mountains, which heads the Colorado River, will lead to earlier and faster snowmelt and could leave the City vulnerable to water resource fluctuation during historically dry months (July-September). Additionally, as temperatures rise and snowpack decreases, the dry season may manifest earlier in the year and extend later, leading to a longer season of water insecurity. Further, as the climate warms, precipitation will fall more often at high elevations as rain rather than snow, which will reduce the Sierra Nevada and Rocky Mountain snowpacks that the City and surrounding regions need for surface water supply.

Increased Wildfire Risk

The City's landscape consists of rugged coastal terrain and includes one low-lying coastal ridge. There are several open space areas within the City, characterized by shrubs and native trees. During the dry months, the wildfire risk in these open, vegetated areas can increase when exacerbated by occasional Santa Ana winds and high temperatures. Additionally, extreme weather conditions, such as high temperature, low humidity, and/or winds of extraordinary force, may cause an ordinary, localized fire to expand into a more intense and difficult to control wildfire. Currently, many homes within Encinitas are located in the urban-wildland interface (UWI), which is characterized by zones of transition between wildland and developed areas and often include heavy fuel loads that increase wildfire risk. These areas within Encinitas include neighborhoods near Saxony Canyon, South El Camino Real/Crest Drive, and Olivenhain. Most recently, the 1996 Harmony Grove wildfire in Encinitas resulted in the loss of three homes and the evacuation and sheltering of hundreds of Encinitas residents (San Diego County Multi-Jurisdictional Hazard Mitigation Plan [MHMP] 2015:5-80).

Increased temperatures and changes in precipitation patterns associated with climate change are expected to increase the risk of wildfire in the City. Cal-Adapt's Wildfire Tool can predict the potential increase in the amount of area at risk of burning through the year 2085, as compared to 2010 conditions. Under the Low-Emissions Scenario, the amount of area at risk of burning relative to 2010 levels would be approximately 1.3 percent greater in 2020 and remains similar through 2085. Under the High-Emissions Scenario, the amount of area at risk of burning remains at approximately 1.3 percent greater in 2020 and decreases slightly to 1.2 in 2085. Based on Cal-Adapt's Wildfire Tool, this increase in burned area is most likely to occur in eastern portions of the City, such as Lux Canyon, Saxony Canyon, the Manchester Preserve, and the areas surrounding Escondido Creek (CEC 2016j).

The California Department of Forestry and Fire Protection (CAL FIRE), in collaboration with the City, has developed the City's Fire Hazard Severity Zone Map. identifying Very High Fire Hazard Severity Zones (VHFHSZ) in the City that are included in the Local Responsibility Area (LRA) (See Appendix F). The map identifies three key areas in the City included in the VHFHSZ. The areas include the neighborhoods surrounding Saxony Canyon and the Encinitas Ranch Golf Course, neighborhoods surrounding and to the northeast of the Val Sereno Preserve, and properties directly north of San Elijo Lagoon near Interstate 5. Due to the topography and vegetation of these locations, surrounding properties are at increased risk of wildfire and associated hazards.

In addition to increased threats to human safety, the increased frequency of wildfire results in the release of harmful air pollutants into the atmosphere, which dissipate and can affect the respiratory health of residents across a broad geographical scope. Particulate matter (soot and smoke), carbon monoxide, nitrogen oxides, and other pollutants are emitted during the burning of vegetation, and can cause acute (short-term) and chronic (long-term) cardiovascular and respiratory illness, especially in vulnerable populations such as the elderly, children, agricultural and outdoor workers, and those suffering from pre-existing cardiovascular or respiratory conditions.

Additionally, wildfire can cause direct and indirect damage to electrical infrastructure. Direct exposure to fire can sever transmission lines, and heat and smoke can affect transmission capacity. Furthermore, because of historical forest management trends over the past century, increased temperatures, and more frequent drought, California wildfires are characteristically hotter and more intense as compared to naturally occurring fire regimes. As such, soil structure and moisture retention are damaged leading to increased susceptibility to erosion or landscapes.

Increased Likelihood of Flooding

Climate change is predicted to modify the frequency, intensity, and duration of extreme storm events, such as sustained periods of heavy precipitation and increased rainfall intensity during precipitation events. These projected changes could lead to increased flood magnitude and frequency (IPCC 2001:14). Currently, the City experiences localized flooding in several areas during heavy rainfall and extreme weather events. These areas include "Restaurant Row" in Cardiff (south of San Elijo State Beach Campgrounds), Encinitas, and Cottonwood Creek and low-lying areas of Leucadia and Old Encinitas. Historically, the City has experienced property-related losses and damage because of localized flooding in Leucadia and coastal flooding in portions of Cardiff. Specifically, winter storms in 1997, 2005-2006, and 2010-2011 caused damage resulting in approximately $500,000 in recovery and cleanup costs from the Federal Emergency Management Agency (FEMA) (MHMP 2015:5-81).

According to Cal-Adapt's Annual Averages Tool, average annual precipitation in the City is currently 10.9 in. As discussed previously, annual average precipitation in the City is likely to remain the same under a Low-Emissions Scenario and increase slightly under a High-Emissions Scenario. Several factors determine the severity of floods, including rainfall intensity and duration. Flash floods occur when a large amount of rain falls over a short period of time. When accounting for a 125 centimeter (cm) increase in mean sea level by 2099 in CoSMoS, the City is likely to experience an increase in flood-prone low-lying areas. The majority of the area subject to this increased flood risk is located in and around the San Elijo Lagoon State Marine Conservation Area (USGS 2013).

The City's flooding potential will also be exacerbated when experiencing atmospheric rivers, or narrow streams of warm, concentrated precipitation often resulting in the deposition of considerable rainfall over a short period of time. Under higher emissions scenarios wherein temperatures are expected to increase more when compared to lower emissions scenarios, the intensity and magnitude of atmospheric rivers are expected to become more severe, resulting in increased regional and localized flooding (Dettinger 2011).

During flooding events, infrastructure (e.g., roadways, power lines) may be damaged, in turn disrupting communications, energy transmission, public services, and transportation systems. Floodwaters during storm events can interact with sources of pollution and distribute hazardous pollutants locally and regionally. The resulting water contamination may lead to human health impacts as well as degradation of ecosystems. Flood events can also cause considerable property damage through flooding damage, as well as structural damage, through erosion and increased risk of mudslides. In consideration of these efforts, aside from the following proposed strategies, the City should continue to participate in updates to the MHMP when appropriate to comprehensively assess and plan for all local hazards that may be intensified by climate change.

Sea-Level Rise

An important impact of global climate change is sea-level rise. The average global sea-level rose approximately 7 inches during the last century. If sea-level changes along the California coast continue to reflect global trends, sea-level along the State's coastline in 2050 could be 10-18 inches (0.25-0.45 meters [m]) higher than in 2000, and 31-55 inches higher (0.78-1.4 m) than 2000 levels by the end of this century (CEC 2012:9). According to the MHMP for the region, sea-levels measured in La Jolla show a 6-inch rise over the last century (OES 2015a).

Considering the City's location, which runs along the coastline, sea-level rise is an important concern for potential climate-related risks. Sea-level rise may endanger the City in several key ways, including property damage to development along the coast; damage to transportation, electrical, and wastewater infrastructure; and compromised or lost public access to the coast. Sea-level rise can also have considerable effects on coastal ecosystems, such as rocky intertidal areas, beaches, dunes, wetlands, estuaries, lagoons and tidal marshes, tidal flats, eelgrass beds, and tidally-influenced streams and rivers (CCC 2015). Impacts can include coastal bluff erosion; alterations in long-shore sediment transport; and salt water intrusion into wetlands, estuaries, and aquifers.

Historically, the City has already experienced considerable coastal erosion from El Niño storms in 1982-1983, which eroded sand from beaches by up to 20 feet (ft.) in depth, structurally compromising bluffs and damaging coastal homes in the City. Segments of shoreline along Moonlight Beach and Cardiff-by-the-Sea are at great risk of coastal inundation from storm wave run-up with future sea-level rise. Destabilized coastal cliffs at Stonesteps Beach caused a bluff failure, resulting in a fatality. Public safety is the top priority for Encinitas so reducing the possibility of bluff failures is of the highest importance.

The City, in collaboration with the San Diego Foundation and Local Governments for Sustainability (ICLEI), is in the process of developing the San Diego Regional Coastal Resilience Assessment, a report to assess the vulnerability of coastal assets in Encinitas. The report uses CoSMoS to assess potential sea-level rise impacts on the City and surrounding area. The report identifies potential risks from sea-level rise to key assets in the City including the building stock, stormwater infrastructure, wastewater treatment systems, transportation infrastructure, beach and coastal access, and local ecosystem health.

As noted in the San Diego Regional Coastal Resilience Assessment, a 2012 National Research Council report projected sea-level rise in the San Diego region to rise 4-30 centimeters (2-12 inches) by 2030, 12-61centimeters (5-24 inches) by 2050, and 42-167 centimeters (17-66 inches) by 2100, relative to 2000 levels. Based on this and other sea-level rise studies considered, this report utilizes a 50 centimeter increase in sea-level by 2050, and a 200 centimeter rise in sea-level by 2100. As the report notes, these higher-end sea-level rise scenarios have been chosen to encourage a risk-averse approach to planning for sea-level rise resilience.

Through the use of a Vulnerability Assessment specific to sea-level rise, the Regional Coastal Resilience Assessment provides information on how sea-level rise will affect the City. Table 5-1 provides brief summaries of the key areas within the City that may be affected by sea-level rise. Full descriptions of these impacts are provided in the San Diego Regional Coastal Resilience Assessment.

Table 5-1 Potential Sea-Level Rise Impacts in Encinitas for 2050 and 2100	
Impact Sector	Vulnerability Areas
Buildings Stock	• Low-lying areas surround San Elijo Lagoon • Erosions impacts to residential areas near Sea Cliff County Park
Social Sector	• Census tract 177.02, located North of B Street and South of Leucadia Street Census tract 177.01 North of Leucadia Street may be adversely impacted by and have difficulty revering from sea-level rise impacts due to high unemployment rates in this area. • Declines in tourism are expected to directly impact service-economy employees
Storm Water	• Storm water systems north and west of San Elijo Lagoon (See Figure 5.2) and outlets on Moonlight Beach will be impacted by 2100. • Cliff retreat has a high potential impact on the stormwater system, including for inlets and outlets west of South Coast Highway 101 between San Elijo Lagoon and Sea Cliff County Park.
Wastewater	• By 2100, flooding is projected to impact Cardiff Sewer Pump Station, sewer system infrastructure surrounding San Elijo Lagoon, wastewater infrastructure at Moonlight Beach, and two lift stations in Batiquitos Lagoon. • Higher water levels could potentially cause sewer spills into environmentally sensitive areas, such as the mouth of San Elijo Lagoon.
Drinking Water	• By 2100, aboveground water distribution components, such as valves, meters, and service points north and west of San Elijo Lagoon will be exposed to impacts of flooding.
Transportation	• Sections of Highway 101 near San Elijo Lagoon with experience flooding impacts by 2050 and 2100. • Erosion is projected to impact Coast Highway 101 south of the Self-Realization Fellowship Temple and local roads along the coastal bluff, including Neptune Ave and 4th Street.
Beach and Public Access	• Boneyard Beach and D Street Beach, located south of Moonlight Beach, also are projected to experience shoreline change. • Cardiff State Beach-Seaside and Cardiff State Beach-North Beach are located along the San Elijo Lagoon, which is projected to be impacted by flooding and shoreline change.
Biodiversity and Habitat	• Eighty-six species within the study area are categorized as sensitive species, including the California Least Tern, the Western Snowy Plover, and the Ridgway Rail.

Source: San Diego Regional Coastal Resilience Assessment Draft Report (2017)

5.2 Current Adaptation Efforts

The City is addressing many of the challenges associated with climate change impacts through existing local policies, plans, programs, resources, and institutions. As highlighted in the 2015 MHMP, the City has begun to identify existing plans and policies, and key City staff, which can contribute to the City's climate adaptation efforts. As part of the MHMP, the City has adopted several Goals, Policies, and Objectives relevant to climate adaptation. As the City continues to conduct current and future planning efforts, it is critical that climate change and climate-related risks are incorporated into efforts to protect City residents and create a climate resilient community. The following sections discuss how the City is currently working to address each of the climate-related impacts.

Figure 5-2: Annual wave impacts in San Elijo State Beach (2099) (The locations marked in yellow highlight areas where increased erosion is expected.)

Source: USGS 2013

Efforts Related to Increased Temperature and Extreme Heat Events

The 2015 MHMP included several objectives and actions to decrease the risks associated with increased temperature and extreme heat events. Goal 7 of the 2015 MHMP Chapter on Encinitas intends to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, because of severe weather, including extreme heat" (MHMP 2015:5-97). The goal includes three corresponding objectives and seven actions to help the City prepare for the impacts of extreme heat events. Objectives and actions focus on urban heat islands, vulnerable populations susceptible to extreme heat, and emergency services.

Efforts Related to Changes in Precipitation Patterns

Goal 8 of the MHMP Chapter on Encinitas is intended to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, due to drought" (MHMP 2015:5-98). The goal includes four corresponding objectives and 11 actions to help the City prepare for the impacts of drought events. Objectives and actions focus on protecting assets that may be damaged by drought (e.g. trees, landscaping), and increasing the use of recycled water for City landscaping and educating citizens about drought preparedness.

The City relies on a combination of water resources to support the City's water services. The City is served by two water districts. San Dieguito Water District (SDWD) supplies potable water to approximately 38,000 residents within the City and the remainder of the City is served by the Olivenhain Municipal Water District (OMWD). The City receives raw water resources from several sources, including Lake Hodges and the San Diego County Water Authority (SDCWA). SDWD has a Water Conservation Division, which administers outreach, education, and incentive programs to help residents and businesses reduce water consumption in the District. The City also uses recycled water from the San Elijo Water Reclamation Facility to irrigate City-owned facilities, such as the Encinitas Ranch Golf Course and landscaped traffic medians in the City. For each water district, the proportion of water from each source can vary significantly from year to year. For example, in the San Dieguito Water District, on average, approximately 30% of the water supply comes from Lake Hodges, 60% of the water supply is imported from the Colorado River and State Water Project, and 10% is recycled water from the San Elijo Joint Powers Authority.

Efforts Related to Increased Wildfire Risk

Goal 4 of the MHMP Chapter on Encinitas is intended to "[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure and City-owned facilities, because of wildfires/structural fires" (MHMP 2015:5-93). The goal includes three corresponding objectives and 16 actions to help the City prepare for the impacts of wildfire events. Objectives and actions focus on improving emergency response efforts related to wildfires, protecting key City assets susceptible to wildfire impacts, and educating residents about wildfire preparedness.

In 2008, the City of Encinitas Fire Department received a FEMA Fire Prevention and Safety Grant to conduct a public education program to educate Encinitas residents on defensible spaces, firewise gardening techniques, and how best to protect homeowners from wildfires. The program included a defensible space miniature exhibit house and garden at San Diego Botanic Gardens.

In 2013, the City worked with CAL FIRE, to develop the City's Fire Hazard Severity Zone Map. The map identifies the VHFHSZ within the City, locating regions in the City at increased risk of wildfire risk and related hazards.

Efforts Related to Increased Likelihood of Flooding

Goal 5 of the MHMP Chapter on Encinitas is aims to “[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, because of flooding/dam failure” (MHMP 2015:5-94). The goal includes four corresponding objectives and 19 actions to help the City prepare for the impacts of flooding events. Objectives and actions focus on improving local and regional emergency response efforts related to flooding, protecting key City assets susceptible to flooding impacts, educating residents about flooding preparedness, and improving building and development standards to prevent flood risk.

Efforts Related to Sea Level Rise

While the MHMP does not include a specific goal about sea-level rise, Goal 6 does mention sea-level rise: “[r]educe the possibility of damage and losses to existing assets, particularly people, critical facilities/infrastructure, and City-owned facilities, because of coastal erosion/coastal bluff failure/storm surge/tsunami/sea-level rise (MHMP 2015:5-97). The objectives and actions included under this goal will serve to better prepare the City for sea-level rise and its consequences, such as coastal erosion, increased storm-wave run-up, beach loss, and slope failure on coastal bluff faces. Objectives and actions under this goal focus on protecting key City assets susceptible to coastal erosion, better plan and prepare for coastal erosion and storm surge events, and educate citizens about the risks of coastal erosion, coastal bluff failure, storm surge, tsunamis, and sea-level rise.

In 2012, ICLEI published the Sea-Level Rise Adaptation Strategy for San Diego, a regional climate adaptation planning document focused on strategies to prepare the region for sea-level rise. As the report notes, by mid-century the San Diego region will experience “regularly-occurring inundation of certain locations and assets, some of which are being planned and built today” (ICLEI 2012: iv). The report also highlights the most vulnerable aspects to the region as stormwater management, wastewater collection, shoreline parks and public access, transportation facilities, commercial buildings, and ecosystems (ICLEI 2012). Building upon the 2012 report, the San Diego Regional Coastal Resilience Assessment will evaluate the impacts of sea-level rise on coastal Encinitas and provides tailored adaptation strategies to help the City prepare for these impacts. This document will serve to help the City in future sea-level rise planning efforts and help the City become more resilient to the long-term impacts of sea-level rise and climate change.

The City is currently working on a series of Encinitas-specific planning efforts to increase community and local ecosystem resiliency to the impacts of sea-level rise.

Cardiff Beach Living Shoreline Project

In collaboration with the State Coastal Conservancy and the California State Parks, the City is currently working to develop the Cardiff Beach Living Shoreline Conceptual Plan. The plan supports efforts for a local dune restoration project to restore heavily impacted coastal habitat and provide natural sea-level rise adaptation by protecting a vulnerable segment of Cardiff Beach. Currently in the development phase, the plan will provide innovative approaches for climate resiliency and sea-level rise adaptation, buffering the City from storm surge and flooding during extreme weather events.

Figure 5-3: Cardiff Beach, Encinitas, CA

Source: City of Encinitas 2017

U.S. Army Corps of Engineers Coastal Storm Damage Reduction Project

The City of Encinitas and Solana Beach have partnered to bring a 50-year beach nourishment project with the support from the US Army Corps of Engineers and the State Parks and Recreation Department. This project would provide stability and resiliency to the coastline for the next 50 years.

Opportunistic Beach Fill Program

The Opportunistic Beach Fill Program identifies construction project that export sandy beach material and then haul the material to the beach at Moonlight, Cardiff, Leucadia or Ponto State Beach. The City works with developers to conduct monitoring and permitting and share the cost for hauling the material to the beach.

San Elijo Lagoon Restoration Project

The San Elijo Lagoon Conservancy, in coordination with the City and relevant State agencies, will soon begin work on the San Elijo Lagoon Restoration Project. The project consists of selective dredging and filling of the mudflats and salt marsh habitat within the lagoon, intended to improve tidal circulation and restore sensitive habitats currently compromised by surrounding land uses. Once completed, the project will provide continuity of habitats currently threatened by sea-level rise and provide increased adaptive capacity for the surrounding communities during flooding and extreme weather events. This project will add 300,000 cubic yards of material to the beach and nearshore environment which will improve coastal resiliency for years.

Figure 5-4: San Elijo Lagoon near Encinitas, CA

Source: San Elijo Conservancy Website Courtesy of Chris Hoover

5.3 Resiliency and Adaptation Strategies

This section outlines strategies for the City for improving community resiliency and adaptation to the current and future impacts of climate change. These strategies can also be considered for incorporation into the next update of the City's Safety Element of the General Plan, pursuant to the requirements of SB 379 (Statutes of 2016), as well as in future updates to the MHMP to further its climate adaptation efforts. Future planning efforts in the City will use these proposed strategies to better integrate climate adaptation planning efforts into all relevant plans, policies, and programs.

Adaptation strategies are classified into five categories to address the climate change impacts identified in the vulnerability assessment (i.e., temperature, precipitation, flooding, wildfire, and sea-level rise). Each category includes programs and policies to support climate resiliency and adaptation, focusing on specific vulnerabilities and impacts that have the potential to impact the community's populations, functions, and structures. The proposed strategies also have the potential to provide other important benefits to the community, or co-benefits.

Strategies are categorized as follows:

- Prepare for Increase in Temperatures and Extreme Heat
- Prepare for Changes in Precipitation Patterns and Water Supply
- Prepare for Increased Wildfire Risk
- Prepare for Increase Flood Risk
- Prepare for Sea-Level Rise

5.3.1 Prepare for Increases in Temperature and Extreme Heat

Rising temperatures caused by climate change will exacerbate the UHIE and increase the frequency and duration of extreme heat events. The City will take actions to mitigate temperature-related effects and improve heat resiliency to protect its populations, functions, and structures in the short- and long-term. To mitigate the impacts of the UHIE, the City will implement the following strategies which also provide co-benefits to the community.

- **Strategy 1:** Incorporate green infrastructure strategies into new and existing infrastructure to mitigate the effects of the UHIE by reducing the area of heat-absorbing paved surfaces and increasing landscaped area with planted vegetation, including shade trees. Examples of green infrastructure include street trees, climate-appropriate landscaping, green and cool roofs, and heat-reflective surfaces and materials. These actions will decrease instances of heat-related illness, improve air quality, and lower energy costs associated with indoor cooling.

- **Strategy 2:** Promote the use of solar carports on new and existing surface parking lots to mitigate heat absorption and increase shaded areas for the City's population. Implementation priority will be given to City-owned parking lots to serve as example solar carports. Solar carports would additionally provide GHG-reducing co-benefits by increasing distributed solar generation and, if electric vehicle charging stations are added, improving charging accessibility.

- **Strategy 3:** Promote the use of passive cooling design (e.g. appropriate building orientation, shade trees, window shading, cool roofs) and use the California Building Standards Code (CalGreen) voluntary measures for residential and nonresidential buildings to improve energy efficiency. Other energy efficiency measures (e.g. air sealing improvements, whole house fans, energy efficient air-conditioning units) should be encouraged in new development within the City to reduce demand for air conditioning and help reduce energy costs.

The City will pursue the following strategies to protect the City residents from extreme heat events, focusing attention on the vulnerable populations most at risk from these events.

- **Strategy 4:** Conduct outreach to educate City residents on the health risks associated with extreme heat events and strategies to prepare for these events. Alongside general outreach, particular focus should be given to educating populations vulnerable to extreme heat including children and the elderly.

- **Strategy 5:** Coordinate with relevant agencies including, but not limited to, the San Diego County Office of Emergency Services, San Diego Unified Disaster Council, and San Diego Fire Department to better plan and prepare for extreme heat events and the increased demand for emergency services associated with these events. Coordinated efforts should include improving Heat-Health Alert Warning Systems, identifying key vulnerable populations within the City in preparation for heat related events, and coordinating with local health care institutions (e.g. Scripps Memorial Hospital) to increase extreme heat preparedness and resiliency.

- **Strategy 6:** Work with local and regional employers to ensure worker protection measures are in place for extreme heat events. Measures may include assurance of adequate water, shade, rest breaks, and training on heat risks for all employees working in the City.

- **Strategy 7:** Work with local businesses and institutions to provide a network of "Cool Zone" areas (i.e., cooling centers) for vulnerable residents to rest in air-conditioned environments during high temperature periods and heat wave events. Cooling centers can include locations like he Encinitas Library and the Encinitas Community and Senior Center. Work with the local school districts to ensure every school has air conditioning.

- **Strategy 8:** Participate in beach nourishment projects that maintain local wide sandy beaches. Encinitas beaches are considered regional "Cool Zones." By maintaining the beach width, the City will be able to handle larger numbers of coastal visitors, when needed, keeping the public a safe distance from the bluffs.

5.3.2 Prepare for Changes in Precipitation Patterns and Water Supply

The City's reliance on various regional water resources, including the San Diego Water Authority, will remain a critical issue for the City's resilience to drought periods. The City will consider how future supply and demand for water resource in the region may change because of climate change. Considering the potential decrease in regional water resources available to the City due decreases in annual precipitation, the City will implement the following strategies to increase the community's resilience with regards to water supplies.

- **Strategy 1:** Coordinate with local and regional partners (SDWD, OMWD, SDCWA) to support and improve water conservation efforts and programs for City residents. Coordinate with these agencies to provide educational outreach to residents on how best to conserve water and reduce water demand.

- **Strategy 2:** Expand and/or improve the recycled water efforts currently in place at the San Elijo Water Reclamation Facility along with corresponding water conservation efforts to ensure that, when economically viable, all current and future city landscaping can source the majority of landscaping water needs from recycled sources.

- **Strategy 3:** Work with relevant water agencies, including SDCWA, OMWD, and SDWD, to evaluate current and future water supply systems and vulnerabilities and how water resources may be impacted by climate change.

- **Strategy 4:** Continue marketing and outreach program to promote participation in existing water conservation rebate and incentive programs in the region. Current programs for southern California include Water Smart San Diego (SDCWA), SoCal WaterSmart (Metropolitan Water District), and SDWD's free sprinkler nozzle program.

- **Strategy 5:** Expand upon the City's existing Water Efficient Landscape Regulation to promote the use of climate appropriate landscaping (e.g., xeriscaping) to reduce demand for potable water resources among City residents. Promote current funding available through the Save Our Water Turf Replacement Rebate Program sponsored by DWR.

5.3.3 Prepare for Increased Wildfire Risk

Like many communities in the region, the City will likely experience increased wildfire risk in the future. The information gathered in the Vulnerability Assessment has been utilized to develop key strategies for the City to implement regarding the increased wildfire risk as a result of climate change. The strategies focus on key areas within the City that are most vulnerable to wildfire risk, such as residences and businesses that are located in the UWI within the City. The City will implement the following strategies to address increased wildfire risk.

- **Strategy 1:** Coordinate with relevant agencies including OES, the California Department of Forestry and Fire Protection (CAL FIRE), and the Encinitas Fire Department to map and identify current and future land uses, neighborhoods, and infrastructure that are at a high risk of experiencing wildfire impacts.

- **Strategy 2:** Continue to update the MHMP every five years as required by the state to comprehensively plan for current and future wildfire risks within the City and work to implement all strategies in the City's current MHMP.

- **Strategy 3:** Update the Safety Element of the City's General Plan consistent with the Office of Planning and Research (OPR) General Plan Guidelines, which requires adopted safety elements to consider climate change and climate adaptation strategies pursuant to SB 379.

- **Strategy 4:** Work with relevant State agencies, including OES and CAL FIRE, to improve coordination for emergency services related wildfire and related events in the City. Consider the development of a Community Wildfire Protection Plan to increase community resilience too wildfire events.

- **Strategy 5:** Consider new development standards for City residents and businesses within the UWI, such as incorporating defensible space practices into landscape requirements for neighborhoods at increased risk of wildfire. Residential areas that should be considered for new standards include neighborhoods surrounding Lux Canyon, Saxony Canyon, the Manchester Preserve, and Escondido Creek.

5.3.4 Prepare for Increased Flood Risk

As discussed in Section 5.2, the City will experience a slight increase (0.7 inches a year) in average annual precipitation under a Low-Emissions Scenario, and an increase of 3.6 inches a year under a High-Emissions Scenario by 2099. Currently, the large majority of established development and associated infrastructure within the City is outside of the FEMA 100-year flood plain. Considering the noticeable increase in annual average precipitation under the High-Emissions Scenario for 2099, the City should begin planning for increased risk of flooding events. The information gathered in the Vulnerability Assessment has been used to develop specific strategies to help the City and prepare for increased flood risk. The City will implement the following proposed strategies.

- **Strategy 1:** Conduct a comprehensive assessment of all stormwater and wastewater infrastructure in the City and analyze how this infrastructure may be affected or compromised by increased risk of flooding events.

- **Strategy 2:** Coordinate with relevant agencies such as OES and the Encinitas Public Works Department to map and identify all critical facilities and infrastructure that may be compromised by increased flood risk. The City should plan accordingly for upgrades, relocation of facilities and infrastructure or identify beach nourishment projects to better prepare for increased risk of flooding events.

- **Strategy 3:** Coordinate with relevant agencies such as FEMA, OES and the Encinitas Fire Department to better plan and prepare emergency services required for flooding events including evacuation services, flood management services and recovery services.

- **Strategy 4:** Continue local and regional ecosystem restoration efforts that will result in increased climate resiliency for flooding events within the City.

5.3.5 Prepare for Coastal Erosion and Predicted Sea-Level Rise

Coastal erosion and sea-level rise is a significant threat to the community. The City should continue to incorporate coastal erosion and predicted sea-level rise into all planning programs and policies in the future. Consistent with the MHMP, hazard mitigation planning efforts should continue to incorporate the short- and long-term impacts that sea-level rise will have on the City, specifically in areas with development along the coastline. The City should be prepared for catastrophic failures along the coastline and be prepared to work with FEMA on existing conditions reports, failure reports and how to obtain FEMA funding to repair impacts because of flooding. Once completed, the City should use the San Diego Regional Coastal Resilience Assessment, developed by San Diego Foundation and ICLEI, as the guiding document for all planning efforts within the City related to sea-level rise. As discussed previously, sea-level rise may impact the City in several key ways including coastal erosion, cause property damage to development along the coast and cause damage to transportation, electrical, and wastewater infrastructure. The City will implement the following strategies to address risks related to sea-level rise:

- **Strategy 1:** Support and monitor ongoing analysis of sea-level rise data relevant to the City's planning efforts. Continue to incorporate the most up-to-date information on sea-level rise into relevant planning documents including the Safety Element of the City's General Plan.

- **Strategy 2: Develop a Coastal Resiliency Mitigation Report to coordinate FEMA, tsunami mapping and the CoSMoS predictions for sea level rise.** Utilize maps and FEMA Hazus software to estimate potential losses from tsunamis or sea level rise to map and display hazard data and the results of damage and economic loss estimates for building and infrastructure. By estimating losses, it provides a basis for developing mitigation plans and policies, emergency preparedness and response and recovery planning. Additionally, provide assistance to residents currently at risk of coastal erosions in preparing for future impacts.

- **Strategy 3:** Develop a comprehensive outreach strategy to receive stakeholder input and educate residents about sea-level rise and how the community can best prepare for these impacts.

- **Strategy 4:** Continue to implement current efforts focused on beach nourishment, coastal bluff improvements and wetland restoration, prioritizing projects that will mitigate the impacts sea-level rise including coastal erosion and saltwater inundation.

- **Strategy 5:** Coordinate with relevant agencies including FEMA, and OES to prepare and plan for the impacts of coastal erosion, sea-level rise, and coastal storm surge, continuously updating and utilizing the most relevant strategies and guidance provided by relevant agencies and institutions.

- **Strategy 6:** Continue to map critical infrastructure in the City that may be impacted by sea-level rise and work with City's Public Works Department to plan accordingly.

5.3.6 Community Education

While preparing for future climate change is essential to the safety and health of the Encinitas community, it is important to recognize that residents and businesses within the community should also be preparing for climate change. Future safety in the home and the success of a business will, in part, be dependent upon how prepared residents and businesses are for anticipated climate change. The first step in preparation is becoming aware of climate change impacts and how these may affect local neighborhoods, families, children and businesses. The City will develop programs to educate local residents and businesses about climate change and how to prepare at home, at school or in your workplace. Climate change education and outreach should have a particular focus on educating younger generations within the community, through school programs and age-appropriate engagement, as they are the residents that will be most impacted by future climate changes. The City will implement the following strategies to address community education about climate change:

- **Strategy 1:** Work with local community organizations to develop a climate change education outreach program focused on residents.
- **Strategy 2:** Work with local businesses and business organizations to develop a climate change education outreach program focused on local businesses and the economy.
- **Strategy 3:** Work with local schools, school districts and other educational organizations to develop a climate change education outreach program focused on children and future generations.

As shown in Section 5.3, the City will experience a series of considerable climate change impacts by 2050 and 2100. This assessment has shown that increased wildfire risk and sea-level rise are likely the most severe impacts to be experience by the City. Several key areas in the City and surrounding areas, such as the San Elijo Lagoon and State Park, are projected to experience the highest sea-level rise and flooding impacts. Neighborhoods surrounding the City's open space areas, such as Saxony Canyon and the Encinitas Ranch Golf Course, are at increased wildfire risk. Considering the City's coastal geography, sea-level rise and coastal flooding will likely be the most expansive and persistent climate related impact the City will experience over the long term. Based on the foregoing, it is recommended that the City complete a comprehensive coastal vulnerability study to help better understand and provide guidance for future resilience planning efforts in the City.

CITY OF Encinitas

CHAPTER 6

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Green = matched reference
Aqua = missing full reference
Pink = no citation in text

Chapter 2

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CEC 2017a
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A case study of sustainable urban planning principles in Curitiba (Brazil) and their applicability in Shiraz (Iran)

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Abstract

This paper investigates sustainability principles in the city of Curitiba, in Brazil, as a pioneer which has commenced its sustainability journey since the 1960s. Analyzing sustainability principles in Curitiba, the paper aims to study their applicability in the case of Shiraz in Iran. Considering the complexity of physical, social, cultural and environmental systems in urban planning, the research underlines the vitality of contextual studies, integration and implementation strategies in sustainability achievement in urban scale. It shows how and to what extent sustainability principles in a city can be adapted to other contexts. This comparative study benefits from interpretive methods of data collection and analysis based on primary and secondary resources. A theoretical framework of planning based on equity, economy and ecology is being utilized in data collection and analysis. The investigation indicates that Curitiba's sustainability agenda is based on a set of integration and implementation strategies which combine decision making, education, transportation, public welfare, heritage conservation and waste management. It is argued that although every urban environment has its specific opportunities and constraints, still there are many things to learn from others.

Keywords: Sustainable City, Integrated Approach, Curitiba, Shiraz

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1. Introduction

The rapid rate of urbanization after the industrial revolution has caused a tremendous amount of change in the world (UNHS, 2011). Human effort to achieve a higher quality of life harms the environment in local and global scales. Following the global environmental crisis (i.e. global warming, climate change and widespread deforestation), the sustainability agenda has become one of the most controversial topics of the 20th and 21th centuries (UNHS, 2011). So far, there is a consensus that the conventional ways of resource consumption and waste production would not sustain for a long time; the state which originated from human-made changes over the natural landscape (Girardet and Mendonca, 2009). The variety of approaches in different scales towards sustainability makes new opportunities to learn from successful precedents taken towards sustainability achievement.

Cities, as the most compact settlements of people, have a tremendous effect in environmental changes (Girardet and Schumacher, 1999). Although industrial economy in contemporary cities has been replaced by service sector, the rate of resource consumption is still growing up (Lehmann and Crocker, 2012). The predicted 70 percent rate of urbanization and 7 billion world population by 2050 (UNHS 2011) reveals that sustainability of urban space is a key factor in global resilience to forthcoming changes. Cities, like Curitiba (Brazil), Austin (USA), Copenhagen (Denmark), Melbourne (Australia) and Frankfort (Germany) are pioneers to represent some degree of sustainability in urban planning which can be studied in terms of applicability in other cities. The key point is that the proposals need to be contextualized based on local circumstances to become practically applicable.

Using a qualitative and descriptive approach, this paper gives an attempt to review the success story Curitiba (Brazil) in hope of learning sustainability practice for Shiraz (Iran). A descriptive-interpretive approach is chosen to allow further discussions about the applicability of sustainability strategies in the second case of study (Shiraz). The study benefits from primary documentations of two cities as well as secondary resources and descriptive peer-reviewed books and journal articles. In this way, the sustainability principles in Curitiba are being discussed and an adaptive proposal for Shiraz is being analyzed based on its contextual opportunities. The matching process of applying sustainability strategies is a proposal for the city of Shiraz, which addresses long-term sustainability education and practice.

2. Background

2.1. What is a sustainable city?

It is generally accepted that the trilogy of economy, environment and social equity are foremost components of the sustainability concept (Chan and Lee, 2008; Girardet and Mendonca, 2009). World Commission on Environment and Development (WCED) established the definition of sustainable development as "a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (1987). Sustainable principles of urban development are categorized into management, social-economical and ecological subdivisions. Management principles include local government responsibility with better environmental understanding, flexibility of environmental policies and long-term strategic visions. Socio-economical category includes appropriate technology and design, creating adequate environmental indicators, standard regulations, market connectedness, supporting by social acceptability and public participation. Ecological principles contain prevention-led actions, integrated activities, using minimum resources (renewable and recyclable), producing minimum waste, respecting the environmental diversity and expanding local environmental research (Haughton and Hunter, 1994). In this context, Moore (2007) claims that there is a triangular conflict among economy, ecology and equity as key sustainability contributors in terms of strategy achievement. A balance between development, property and resource discourses is required to achieve an integrated sustainability in an urban context. Such a balance has more opportunity to make the city more profitable, fairer and greener for stakeholders, developers and governors (Figure 1).

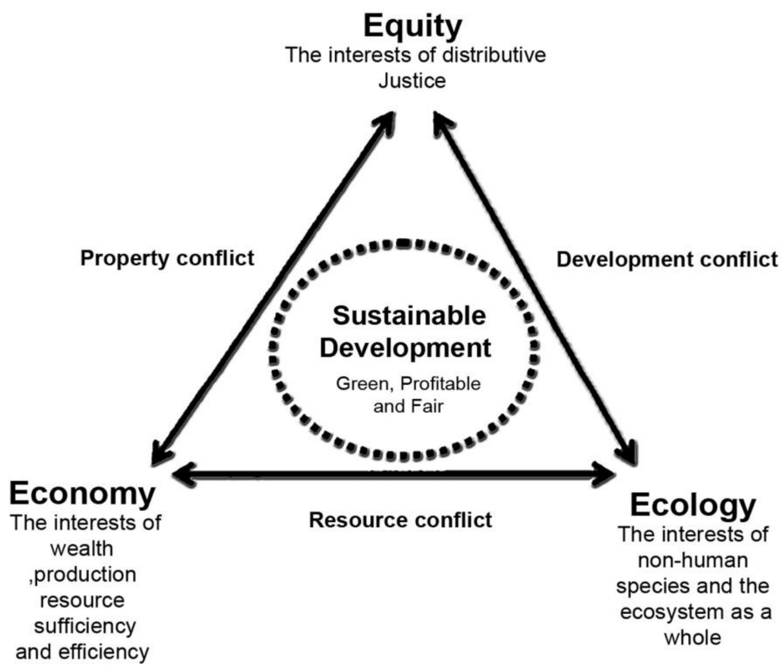

Figure 1. Triangular conflict among key contributors to achieve sustainability (Moore, 2007)

2.2. Approaches to sustainable urban planning

Sustainability notion in urban planning and design is relatively a new subject which has been developed since the 1980s. Traditional theories of reading/designing urban space used to be concentrated on the built environment as a physical matter. "Figure-Ground" theory underlines the values of open spaces and connectedness of urban solids and voids, whilst "Linkage Theory" gives more value to the streets and urban thoroughfares. The "Place Theory", however, has more emphasis on social aspects of the space which are tangled with human activities (Jacobs, 1961; Lynch, 1984; Trancik, 1986). These conventional approaches towards urban planning hardly ever demonstrate explicit visions about sustainability in the urban context.

More recent approaches to urban sustainability, however, highlight environmental and social aspects of urban planning in more details. Among them, two major schools of thinking are New Urbanism and Green Urbanism. However, in practice of urban planning there is not such segregation in the ways of thinking about a city. In the context of cities, a set of localized sustainability and liveability strategies are more visible rather than branding the reality. Local opportunities and constraints of each city need to be addressed in more integrated approach considering the complex urban systems of social, economic and environmental life (Newman and Jennings, 2008). In real situations, transport systems play an important role in both sustainability and liveability of contemporary cities (Newman and Kenworthy, 1999; Tolley, 2003). Social integration is also a key responsibility (Beatley and Newman, 2009) and resource management in closed loops enhances durability and resilience of cities (Beatley et al., 2009; Clark, 2009). The Interrelationship between citizens, transport and amenities are argued as the vital elements of the micro-structure of a sustainable city (Frey, 1999). A sustainable city needs to provide social, economic, and environmental sustainability in an integrated process. Balancing these three basic factors needs an integrated decision making process in which citizens' participation has a fundamental role in sustainability objectives achievement.

3. Case study areas

3.1. Curitiba, a model for a sustainable city

3.1.1. History of Curitiba

Curitiba is the capital city of the Brazilian state of "Parana". It was founded in 1530 as a gold-mining camp and officially became a town in 1812. Its current metropolitan area comprises 26 municipalities with a total population of 3.2 million (IBGE estimate in 2011). The city sits on a plateau at 932 meters above the sea level. It is located 105 kilometers west of the sea port of Paranaguá. The humid Curitiba has a maritime temperate climate. It has flooded areas contribute to its mild and damp winter. The city has a surface of 432.17 km^2 with the population of 1.8 million people.

Curitiba is one of the most reputable cities in terms of sustainability achievements which can be categorized into six integrated subjects: integrated urban planning, effective public transport system, local environmental consciousness, pedestrian and public priority in the city, social justice concentration and local waste management system (Mills, 2006).

3.1.2. Integrated urban planning based on small changes

Since Curitiba was declared as the capital of Parana in 1854, the city has gone through several major urban planning projects to manage uncontrolled sprawl. In 1940s, Alfred Agache, cofounder of the French Society for Urban Studies, had introduced the first city plan. The plan emphasized a star of boulevards, with most of the public services in downtown, an industrial district and sanitation infrastructures (Rabinovitch and Leitman, 1996). In 1964, Jaime Lerner led a team from the Universidad Federal do Parana for urban planning of Curitiba with a number of man objectives including strict controls on urban sprawl, a reduction of traffic in the downtown area, preservation of Curitiba's historical sector, and building a convenient and affordable public transport system based on express buses (Moore, 2007). This plan was adopted in 1968 Instead of a few large-scale planning proscriptions; hundreds of small-scale practical solutions were established to enhance urban qualities.

In 2010 the city was awarded with the "Globe Sustainable City Award'. Integrated urban planning (political, social, environmental, economical, cultural and technical) and implementation of goals by utilizing practical design solutions are key points in this achievement. Curitiba's Master Plan has integrated urban development with transportation and land use planning. It limited the city area growth, whilst have encouraged commercial activities along five transport axes radiating out from the city centre (Rabinovitch, 1992). The city centre was partly closed to vehicular traffic and pedestrian streets were recreated.

Mixed land use based on high density residential buildings is allowed alongside to transport axes. The density limitation of an area is directly based on its availability to public transportation. Linear development along the "arteries" road cause a considerable decrease in downtown movement need as well as providing new opportunities for commercial and light industries to be located near fast transport thoroughfares. A new industrial city was built in the west side of the city near the sea shore where includes low-income public houses as well (Smith and Raemaekers, 1998).

3.1.3. Effective public bus system

The development of Curitiba is twisted with its public transport system which is based on buses. Bus transport system was selected because of its extremely low costs of installation and operation in addition to its fast and easy construction process. From 1974 to 1982, within eight years, the bus transport system was expanded from two express bus lanes to five express axes in addition to inter-district bus lines. The three-part road system in main axes has two one-way streets moving in opposite directions which surround a smaller two-lane street exclusive for express buses (Goldman and Gorham, 2006). Five of these roads form a star that converges near the city centre (Figure 2).

The bus system consists of three types of buses for different functions, distinguished by different colors (red for express, green for inter-district and yellow for conventional buses). In 1980s, the RIT (Rede Integrada de Transporte: Integrated Transport Network) was created, allowing transit between any points in the city by paying just one fare (Moore, 2007). The long express buses are split into three sections and stop at designated elevated tubes with disabled access. People pay for tickets at the bus stop so the urban travels become easier, faster and cheaper. The system is used by 85% of Curitiba's population (Smith and Raemaekers, 1998). It becomes the source of inspiration for many other cities around the world to use their local potentials for transportation instead of costly and time consuming large scale systems.

The population has doubled since 1974, yet car traffic has declined by 30%. The system reduces the fuel consumption and air pollution as well as environmental costs of urban mobility. Roads are categorized in four hierarchical types: structural (main axes), priority (traffic roads), collector (commercial streets) and connector (industrial connection to axes) (Rabinovitch, 1992). They have a hierarchy regarding to public transport accessibility and land use legislation. Urban terminals are built at the end of each express bus lane with social services and smaller terminals which are located every 1400 meters. The innovative and local public transport system is considered as the pioneer of urban development in Curitiba (Goldman and Gorham, 2006).

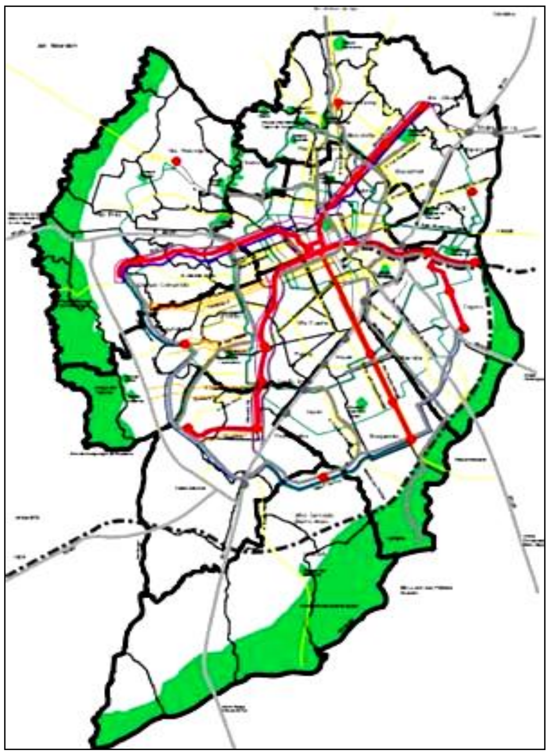

Figure 2. Five basic transport axes in Curitiba and development restrictions (solutions-site.org, 2010)

3.1.4. Local environmental consciousness and citizens' participation

In the early 1970s, when Brazil was welcoming mass industry, Curitiba accepted only non-polluting industries. It also has constructed an industrial district containing a considerable amount of green space that was called "Golf Course". Builders get tax breaks if their projects include green space (Rabinovitch and Leitman, 1996). Curitiba is referred as the ecological capital of Brazil, with a network of 28 parks and tree-planted areas (in 1970, there was less than 1 square meter of green space per person, but in 2010 there were 52 square meters). Citizens' participation has a great role in this greenery development movement (Brendan, 1998). They have planted 1.5 million trees along city streets. It is a highlighted example of citizens' participation in urban environmental sustainability achievement. There is even a local environmental legislation to control industries, which are desired to be located in the industrial city, to serve environmental quality.

In order to achieve the goal of having 52 square meters of green space per inhabitant in 2010, the city has paid careful attention to preserving and improving its green areas. This greenery strategy implementation is closely related to legislations, long term environmental vision and citizens' participation (Goldman and Gorham, 2006).

3.1.5. Local waste management system

Combining waste management systems with social and environmental purposes provides multidiscipline sustainability for Curitiba. In the "garbage that is not garbage" program, 70% of the city's trash is recycled by residents. The city's paper recycling preserves the equivalent of 1,200 trees a day. The purchasing of garbage program (green exchange) focuses on social and environmental benefits. Low-income families, living in areas unreachable by trucks, bring their trash bags to neighborhood centres, where they exchange them for bus tickets, food and agricultural products. This means less litter, less disease and less garbage dumped in sensitive areas such as rivers. It provides a potential job for the poor. There's also a program for children where they can exchange recyclable garbage for school supplies, chocolate, toys and tickets for shows. The innovative 'Purchase of Garbage' program gives the opportunity of trading the waste for bus tickets, food and agriculture instruments to poor citizens who live in limited-access areas of the city (because of Curitiba's topography and high levels of underground water, some areas are not able to have sewage systems and some are not accessible by garbage track collectors). This strategy provides environmental responsibility as well as social and economical promotion for poor citizens (Thomas, 1992). The city environmental and ecological information centre and city botanical garden were established to enhance the local environmental awareness.

Curitiba's sewage treatment system utilizes the local lagoons (located near the river) as a water refreshing system (sewage is recycled in three steps: anaerobic, aerobic and discharging treatment). This system in addition to parallel open air canals is used to control the seasonal floods as well (Brendan, 1998). New lakes in public parks are designed to solve the problem of seasonal flood.

3.1.6. Pedestrian priority and heritage rehabilitation

Refurbishment of the city centre into a heritage realm in the authority of pedestrians has begun in 1970s. Old buildings were allowed to be rehabilitated with new functions, whilst the public squares were empowered by commercial and cultural facilities. Historical urban elements of Curitiba are used as shopping mall, theatre, creativity centre, cultural documentation service, museum; some operate 24 hours, 7 days a week. Downtown area was transformed into pedestrian public space with shops, restaurants and cafes, and the Flower Street (Rua das Flores) which was an urban recreational place (Brendan, 1998). As mentioned formerly, the priority had been given to public transport rather than private cars.

3.1.7. Social justice, quality of life and public health

Improving the quality of life has been a guideline for Curitiba's municipality. Since 1980s the city has begun a project called the Faróis de Saber (Lighthouses of Knowledge). These Lighthouses are free educational centres which include libraries, Internet facilities, and other social resources. Job providing programs and sustainable income policies are followed in the decision making process as well as action plans. The concentration of social programs is on poor citizens to provide social justice. The city's public housing program has built one of the largest plots of available lands as the home for 50,000 poor families called Novo Bairro (New Neighborhood) (Smith and Raemaekers, 1998).

Besides environmental benefits, money raised from selling materials goes into social programs. City employs the homeless and recovering addicted people in its garbage separation plants (Brendan, 1998). Sanitation and waste management programs are developed by utilizing local prescriptions to improve citizens' welfare and social justice. From the Curitiba example it becomes clear that social, environmental and economic solutions can be integrated with holistic approaches to promote the quality of life.

3.2. Shiraz: city of civilization, gardens, and poets

Shiraz is the sixth biggest city in Iran and is the capital of Fars Province. It is located in the southwest of the country on the 'Rudkhaneye Khoshk' seasonal river; 200K m from south seashore of Iran. It is built over a green plain of the Zagros Mountains, 1500 meters above sea level with a moderate climate and regular seasons.

Fars province is the origin of two biggest Persian empires from 550 BC to 630 AD (Achaemenian Empire from 550 BC to 330 BC and Sassanid Empire from 241 AD to 630 AD) and most of historical sites of these two dynasties are located in this area (Gershevitch, 1985). Shiraz has been a regional trade centre since the 8th century AD (the earliest reference to the city is dated on 500 BC). In the 13th century AD, it had become a leading centre of visual arts and publications for three centuries. Shiraz was the capital of Iran (historical Persia) during the Buwayhid dynasty in 11th century AD and the "Zand" dynasty in 18th century AD (Khoobnazar, 2001).

Shiraz has a population of 1.3 million in 2011 (Figure 4). According to an official survey, the shares of the different modes of travel in this city are as follows: private cars and taxis: 66 percent, buses: 19 percent and the other modes: 15 percent which is an unsustainable trend in a longer term. Therefore, the public bus is the main mode of public transportation (Soltani and Esmaeili Ivaki, 2011; Soltani and Marandi, 2011). For the time being, public transportation in Shiraz relies mainly on the bus network and the subway system is not opened yet. The metropolitan area consists of 9 Zones each of which has its own municipal authority. Shiraz historical zone consists of different public spaces and buildings such as bazaar, mosques, schools, houses and palaces as well as traditional squares and streets. Shiraz is known as the city of poets and flowers. It is also considered to be the "city of gardens", due to the numerous gardens and fruit trees existing in the city. Shiraz economy is based on agriculture, electronic industries and trade (crafts and electronics).

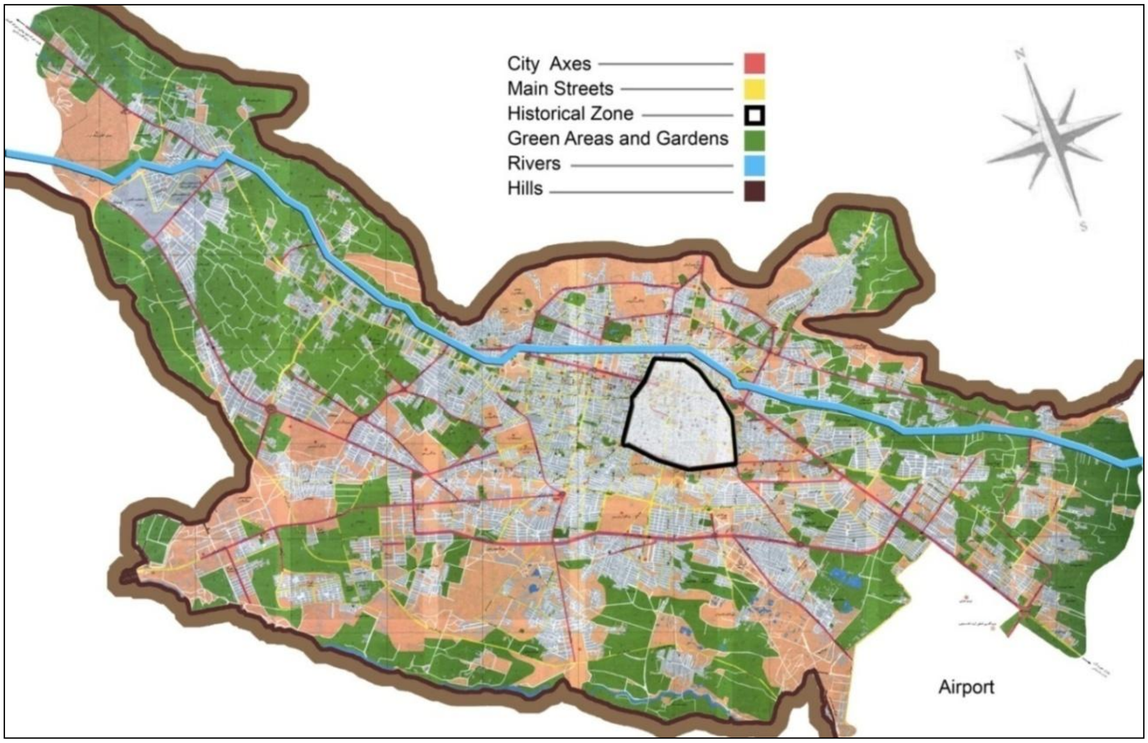

Figure 3. Shiraz urban structure

4. Learning from Curitiba

4.1. Comparative description

Table 1 compares the differences exist between Curitiba and Shiraz in terms of some basic urban and transport characteristics. It sounds that two cities are similar in density level, however, Curitiba has better figures in those items related to sustainability: Green space (per capita), recycled waste, public transport usage.

Table 1. Comparison of Curitiba and Shiraz

City	*Population density (person per hectare)*	*Car ownership (per household)*	*Green space per capita (m²)*	*Recycled waste (percent)*	*Public transport share*
Curitiba	102	0.85	52	70	83
Shiraz	94	0.92	17	3	19

4.2. Integrated sustainability approach

The Integrated sustainability approach based on “social democracy” is the success point of Curitiba.

City sustainability achievement has three dynamic factors: sustainable decision making, environmental sustainability and social sustainability. Shifting the emphasis on transport system or economic is due to the context of each city. City as a unity needs an integrated sustainability approach with comprehensive and continuous long-term planning and practice.

4.3. Applying sustainability principles in Shiraz

Integration of planning process with concentration on local opportunities and small-scale changes are milestones of the proposed system, which aims to apply extracted sustainability Shiraz with the special consideration on its historical zone.

4.3.1. Historic district preservation and regeneration

There are several shortages in infrastructural services (sewage system, gas, etc.) and efficient public transportation especially in Shiraz historical zone. This shortage in addition to social problems and land development policies force original occupants to emigrate from the central zone. They are replaced by occasional resident as well as poor dwellers. These new occupants have not deep relationship with the local heritage and also have low incomes. So the area faces a serious social-economic situation.

There are more than 200 historical houses, 10 palaces, 7 historical gardens, and 30 famous mosques and schools in the historical zone of Shiraz. Although some of them have been used as museums and cultural organization, but the majority of these historical buildings are free of urban functions. Furthermore, the lack of appropriate accessibility affects the daily life.

Utilizing the tourism industry is considered as a multipurpose solution for a number of historical zone problems. In this proposal, historical houses are revitalized as small-scale hotels. Because of special pattern of the historical zone, there is an opportunity to combine a few houses to shape bigger tourist-oriented areas. Bazaar-Vakil is a 2 km sheltered-linear shopping area with the plenty of supporting small productive industries in the heart of the historical zone. It can be rehabilitated and empowered by a few number of small scale acupunctural changes in its entrances. Bazaar shops are mostly owned by original occupants of the old town, and it is an opportunity to utilize Bazaar as an activity generator in urban regeneration and citizens' participation. Tourist Oriented Planning (TOP) provides new job opportunities for occupants, which can lead to more sustainable and vibrant society and local economy.

The existing areas which have not spatial values can be redesigned to serve essential functions. Some related urban organizations such as architectural consultant companies, social welfare institutions, cultural organizations, traditional restaurants, souvenir shops, and small-scale educational centres can be relocated in this zone.

The TOP can be utilized in the whole city. Shiraz has a moderate climate; however, there is only one hour flight to rich Arab countries which have very hot and arid climate. Therefore Shiraz can be a destination for many travelers and this can bring new opportunities for the local economy. On the other hand, Fars province has lots of famous historical sites and natural tourism attractions. These all together make a potential ground for tourism development. They can be considered as great heritage interests to promote local social and economical situations.

4.3.2. Pedestrian-oriented urban design

Shiraz has some problems to serve daily transportation. This causes some urban projects to widen the streets in the central zone. In reality, however, because of private ownership of surrounding properties, the strategy has not been implemented in many cases. Furthermore, the widespread patterns of physical growth have been acted as a motivator to use private cars more. So pedestrian and bike oriented strategies are practical solution for the long term.

In addition to opportunities for people to be connected to the identical built environment, it has some advantages to preserve old buildings from further damages. Car accessibility for emergency usage is available through "needle access". Pedestrian realm of the city is a great opportunity for citizens to reconnect to their history, environmental identity and cultural activities. It represents a different view of life to visitors which is safer, more beautiful and more convenient.

4.3.3. Integrated transport system

Shiraz city transportation needs to be equipped with collective fast modes such as BRT and subway. Construction of "Shiraz Metro System" (train access) has begun in 2002 to decline the traffic congestions and high mobility demand in the whole city. It is estimated to be operational by 2015. The needle-access streets will be connected to two city express lanes which consist of express buses in addition to the metro system. Each express lane will be supported by two slower traffic lines besides.

4.3.4. Environmental preservation, riverside and productive gardens

Shiraz has over 400 hectares of fruit productive inner-city gardens inside its metropolitan area. Most of these gardens are located in North- West of the city in "Ghasr-Dasht" area. A few of these gardens have expensive buildings within them. Lemon and orange trees are traditionally grown in private properties (e.g. Bagh-e-Eram) as well as public areas as. There are also local plantains trees grow up without any special care.

There is a cultural event in each February (Bahman) when people plant trees one month before the spring, the so called "planting ceremony" (jashn-e-derakhtkari). It is suggested that the city municipality must provide some tree plantation in this festival. Such location can be used as public green space and as mentioned formerly if local trees are utilized, they do not need special care to grow.

The city river that is a seasonal waterway has a landscape which needs to be promoted as a linear recreational space for citizens. The city bike line is currently stretched through the river and by some small changes in landscape design and safety promotion, it has potential to improve citizens' health.

4.3.5. Waste management system, agriculture and local industries

Environmental sustainability will not be achieved without separating waste in cities it is suggested that household waste must be separated into four section including food waste, paper waste, plastic waste, and material and glass waste. Food waste can be composed into garden fertilizers; paper waste can be recycled locally in paper industries; plastic waste can be recycled in packaging of goods; metal and glass waste can be reused in related industries (Lehmann and Crocker, 2012).

Shiraz has fertilized soil and is one of agricultural centres of the country. It has numerous food production industries, as well as the potential to improve it further. It is suggested that the waste management system, food production and packaging industries must be taken into consideration in an integrated manner.

The concluding diagram for how/what Sustainability principles in Curitiba can be practiced in Shiraz situation can be like Figure 4.

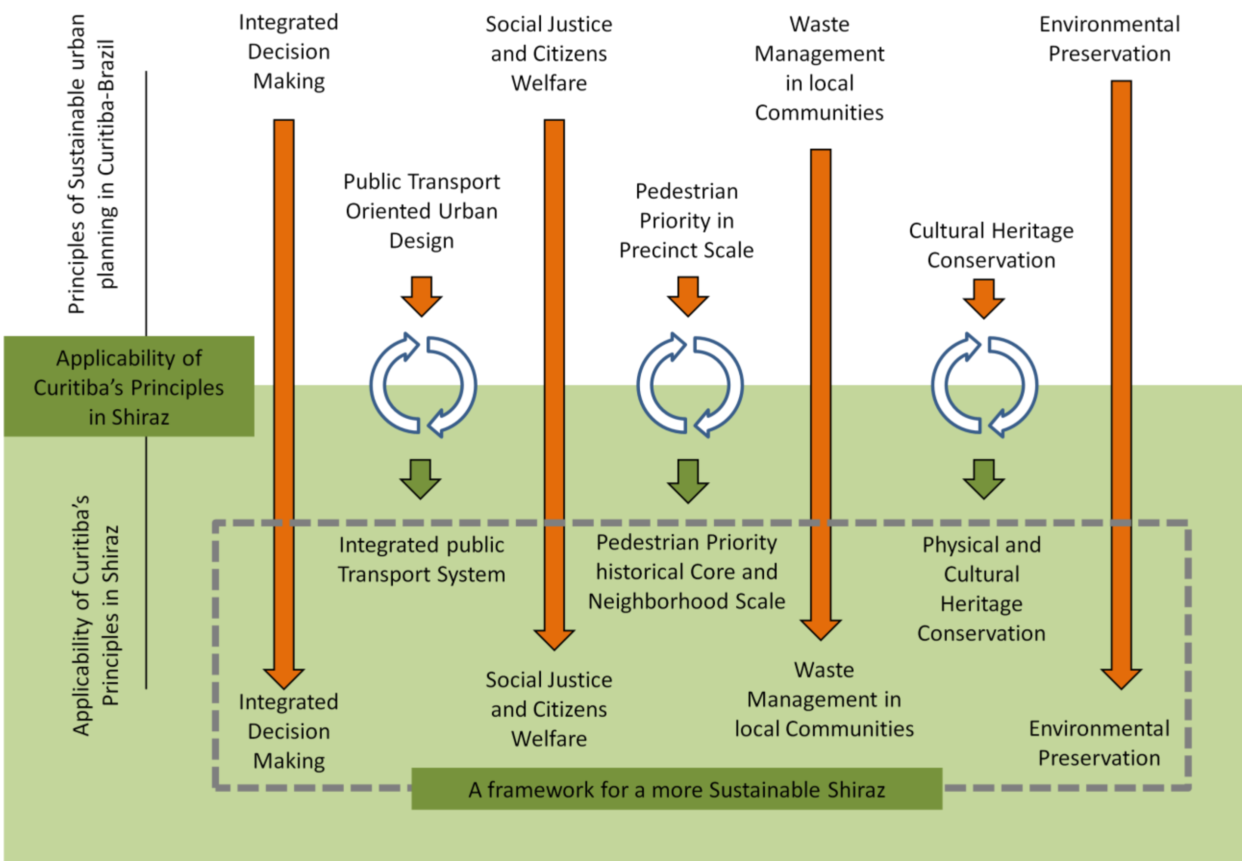

Figure 4. How sustainability principles in Curitiba can be practiced in Shiraz

In Iranian historical cities, because of their unique role in country's urban network and their heritage potentials (monuments, sites, and events), the role of social-cultural aspects are stronger. In practice, all of the sustainability aspects should be considered in an adaptive process. In Shiraz case, because of the specific environmental and building characteristics the sustainability framework was shaped along with tourism industry development. Although this sustainability framework can be applied to other historical areas, but it needs to be localized in each context. Priorities need to be changed due to contextual, social, and environmental specifications. The key points are integration of urban planning and implementation of effective actions.

5. Conclusion

Sustainability of cities can be achieved by balancing four integrated factors: sustainable decision making, sustainable society, sustainable environment and sustainable economy. The balance between these factors is totally related to the context potentials in local, regional and global scales.

Every urban environment has its specific opportunities and constraints, but still there are many things to learn from other cities'. Crucial is to investigate successful principles based on existing precedents, analyze them with the consideration of their local context and moderate them in order to apply in other contexts. In the case of Shiraz, it has developed from a historical core, which arise strong social, cultural and economic opportunities for the city. As such, the practiced sustainability principles in Curitiba need to be moderated to some extent to be able to match Shiraz specific context. It is also vital to consider limitations of case study research findings regarding to generalization and application of findings. Due to complexity of physical, social, cultural and environmental systems in sustainable urban planning, strategic planning for a city needs to inspire from several successful precedents and contextual opportunities and constraints. Implementation of strategies is the other vital criteria which need to be investigated locally.

This paper does open the door to interdisciplinary investigation of sustainability, but generally remains within the limited territory of physical planning. The most interesting hypothesis-"contextually" adapting planning principles appropriated from a unique urban context-is investigated indirectly. In other words, the "principles" behind Curitiba's many success stories are described as physical planning strategies. As a result, the application of Curitiba-like strategies to the context of Shiraz is theoretically limited. Curitiba and Shiraz are both governed and planned by technocracies, their political contexts are different. What emerges from this more critical strand of thinking is that Curitiba is not that different from other Brazilian metropolitan areas (in terms of its spatial and environmental contradictions). Moreover, considering the paper's emphasis on qualitative and context specific analysis, much analysis on actors, institutions and the planning and management framework in the city of Shiraz are possible through further research. These are crucial for a deeper understanding of the possibility of the Curitiba narrative "to travel" to Iran. In other words, it is important to identify the drivers which have positive and/or negative influences on the process in each of the two case studies. The sustainability principles need to be directed according to the identified drivers.

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Community Outreach and Engagement Plan for CAAP Development

Outreach/Engagement Methods	1st	2nd	3rd	Comments
Webinars (virtual)	March 2021	May 2021	?	
Workshops (if in person event are allowed)	June 2021	August 2021	?	
Surveys	March 2021	July 2021	N/A	
Facebook Live Event	June 2021	August 2021	?	
Webpage Education and Content	Ongoing	N/A	N/A	
Presentation to Commissions (Complete Streets, Parks & Recreation, Youth Commissions)	TBD	TBD	TBD	
Council Meeting Updates	TBD	TBD	TBD	