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Facilitating Greenhouse Gas Reduction and Climate Change Adaptation within the Coastal Zone: A Policy Analysis for the California Coastal Commission

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This Masters Project

Facilitating Greenhouse Gas Reduction and Climate Change Adaptation within the Coastal Zone: A Policy Analysis for the California Coastal Commission

By

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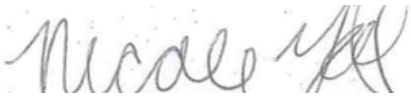	
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Nicole Young 05/14/2019	Stephanie Siehr, Ph.D. 05/14/2019

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Acronyms

AB 32 – Assembly Bill 32

ARB – Air Resources Board

BAAQMD – Bay Area Air Quality Management Division

BCDC – San Francisco Bay Conservation and Development Commission

CAEESP – California Long-Term Energy Efficiency Strategic Plan

CAPCOA - California Air Pollution Officers Association

CARB – California Air Resources Board

CCC – California Coastal Commission

CCI – California Climate Investments

CCS – Carbon Capture and Storage

CEC – California Energy Commission

CEQA – California Environmental Quality Act

CDFW – California Department of Fish and Wildlife

CDP – Coastal Development Permit

CO_2 – Carbon Dioxide

CPUC – California Public Utilities Commission

CSI – California Solar Initiative

DOE – Department of Energy

EIIP – Emissions Improvement Inventory Program

EPA – Environmental Protection Agency

GBCI – Green Business Certification Inc

GCAS – Global Climate Action Summit

GDP – Gross Domestic Product

GGRF – Greenhouse Gas Reduction Fund

GHG(s) – Greenhouse Gases

GRP – General Reporting Protocol

IEPR – Integrated Energy Policy Report

ILFI – International Living Future Institute

IPCC – Intergovernmental Panel on Climate Change

LCA – Lifecycle Analysis

LCP – Local Coastal Plan

LED – Light Emitting Diode

LEED – Leadership in Energy and Environmental Design

NCAR – National Center on Atmospheric Research

NEM – Net Energy Metering

NEPA – National Environmental Protection Act

NOAA – National Oceanic and Atmospheric Administration

NRDC – Natural Resource Defense Counsel

PG&E – Pacific Gas and Electric

SLR – Sea Level Rise

USGBC – United States Green Business Counsel

WRI – World Resources Institute

ZNC – Zero Net Carbon

ZNE – Zero Net Energy

Abstract

California is already experiencing impacts to its coastline due to climate change, and more severe impacts are anticipated if greenhouse gas emissions continue to rise. These climate change impacts are especially strong within the California coastal zone, which falls under the jurisdiction of the California Coastal Commission. The Commission has a history of rigorous environmental protection and is committed to protecting California's coast through proactive planning and regulation, however they will need to initiate coastal policies with ambitious targets to facilitate effective climate change adaptation and mitigation. This study analyzed existing California climate policies and Coastal Commission policies to identify successes and gaps in the Commission's work on climate change. Key findings include successful state funding mechanisms, energy saving state standards and ambitious state greenhouse gas reduction goals, as well as successful coastal adaptation projects and mechanisms throughout California. Findings also demonstrated a gap in the amount of funding currently available for coastal adaptation. Analysis of the Commission's current climate adaptation policy suggests that the agency should amend their coastal act to reflect current pressing climate issues. To strengthen the Commission's mission of protecting the California coastline, this study recommends that coastal developments obtain RELi resilience certification to ensure that coastal development can react to the shocks and stresses of climate change within the coastal zone. This analysis of policy options to strengthen the Commission's climate policy yielded two alternative recommendations. The first recommends using a market mechanism to facilitate greenhouse gas reduction within the coastal zone, while the other recommends the implementation of a regulatory mandate. Both recommendations offer a suggested framework modeled after current California policy that works to facilitate funding for coastal adaption within the California coastal zone.

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1.0 Introduction

The effects of anthropogenic climate change are some of the greatest threats to modern civilization. These effects have been widely studied and documented, but only as of recently are we starting to grasp the true severity of global warming. In the most recent report produced by the UN Intergovernmental Panel on Climate Change (IPCC), scientists found that the world's average temperature is approximately 1°C higher than pre-industrial levels (Allen, M.R., et al., 2018). Scientists predict that if the planet reaches 2°C higher average global temperatures than that of pre-industrial levels, mass numbers of insects, plants, corals, and many other species would not be able to withstand such a substantial change in temperature. The international Paris Agreement and most recent IPCC Special Report recognize that even a 1.5 C temperature increase would likely have disastrous impacts, and they call for accelerated efforts to dramatically reduce greenhouse gas (GHG) emissions within 12 years (Allen M.R., et. all., 2018).

Climate change has a significant impact on abiotic conditions and biota. On-top of the rising atmospheric temperature, climate change will create significant disruption to weather events. There will be longer and more intense drought periods as well as heat waves coupled with changes in precipitation regimes. Hurricanes will become stronger and more frequent and freshwater stored in ice caps and glaciers will continue to melt. Ocean acidification will continue, as the oceans act as large carbon sinks to assist in the storage of excess carbon dioxide (CO_2) affecting ocean pH and carbonate chemistry. Additional impacts to the nearshore environment include changes in salinity, dissolved oxygen concentrations, changes in coastal upwelling and ocean stratification. Lastly, sea level rise will increasingly threaten coastal cities and island nations. (IPCC, 2014).

Thermal expansion of seawater associated with the warming of the world's oceans coupled with the melting of glaciers and ice caps is projected to increase the rate at which the world's sea levels are rising. Coastal, nearshore and estuarine ecosystems are especially vulnerable to this acceleration of sea level rise (Borchet et al., 2018). Sea level rise (SLR) is a large problem in California due to the fact that over 26 million residents of Californians live within coastal counties (NOAA, 2018c). According to the National Oceanic and Atmospheric Administration (NOAA), the two major causes of global sea level rise are thermal expansion

caused by warming of the ocean and increased melting of land-based ice, such as glaciers and ice sheets. The oceans are absorbing more than 90 percent of the increased atmospheric heat associated with emissions from human activity (NOAA, 2018a).

1.1 Greenhouse Gas Emissions

Since the dawn of the industrial revolution, anthropogenic impact has had increasing negative effects on the planet. From transportation inventions, such as the diesel engine and the airplane, to industry expansion, such as the sewing machine and electric lights, fossil fuel-fired activities that were invented during the industrial revolution have had a significant impact on our global environment. Our present-day civilization currently depends upon many if not all of the development that has come from the industrial revolution, and because of this, atmospheric carbon dioxide levels have increased from 280 parts per million to 410 parts per million in the last 150 years alone (NASA, 2019). Figure 1 graphically demonstrates the increase in atmospheric carbon dioxide that has been observed since the beginning of the industrial revolution. As we continue to use fossil fuels and burn coal, we are continually emitting more and more carbon dioxide and associated greenhouse gases into the atmosphere.

The primary chemical compounds that are considered Greenhouse gases include Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N20), Chlorofluorocarbons (CFCs), Carbon Monoxide (CO), Ozone, and water vapor (NOAA, 2018b). Increasing concentrations of greenhouse gases in the atmosphere and associated feedback mechanisms have been driving the temperature of our planet upward. The direct GHG emissions are not nearly as harmful as the associated feedback mechanisms. For example, the warming of the environment reduces permafrost levels in the artic. The melting of the permafrost then reduces the snow cover in the arctic and Antarctic, which are highly reflective of sunlight with an albedo near one. Therefore, the darker surface means more radiation penetrates the soil and is absorbed by it, leading to additional warming (Koten, 2019). As the amount of greenhouse gases in the atmosphere increase, more heat is trapped, warming the atmosphere, land and oceans, causing temperatures to rise. These rising temperatures not only make the planet warmer but has incredibly damaging effects on many aspects of the environment. With rising planetary temperature comes the melting of polar ice caps, oceanic absorption of excess atmospheric CO_2, sea level rise, and extreme weather events.

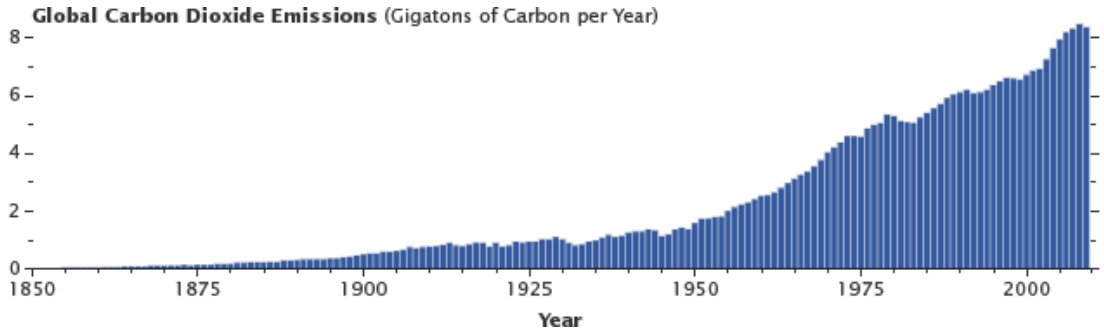

Figure 1: This graph displays the steady increase global CO2 levels since the onset of the Industrial Revolution. Source: NASA.

1.2 Current Climate Change Impacts in California

As greenhouse gas emissions continue to rise, climate change impacts continue to become more and more severe. In 2018, California saw the incredibly devastating effects of climate change through the widespread wildfires that destroyed nearly 1.6 million areas of land (Kasler, 2018). A high rainfall year with abundant growth followed by years of drought create dead and dry vegetation. This then creates excess fuel when fires do start and cause widespread damage. See Figure 2 for a graphical representation of the acres destroyed in California Wildfires over the past 14 years. California has always had an incredibly contentious relationship with water supply, which is due to become even more scarce as climate impacts become more severe. The intensifying droughts coupled with the decreasing mountain snow packs caused by climate change will have a direct impact on California's water supply system. Changes in precipitation and hotter conditions have begun to effect and will continue to have significant negative impacts on California's $43 billion agricultural sector (Davis et al., 2014). Moreover, California will see significant impacts to its existing infrastructure in large cities, such as Los Angeles and San Francisco, as storm surges, high winds, and flooding impact these cities and their existing buildings (Hunt et al., 2011). Finally, climate change impacts will have a substantial impact on overall human health. As California's population grows from 38 million today to an expected 60 million by 2050, citizens of California may be negatively impacted by climate change impacts due to severe storms, extreme temperatures, droughts and fires, increased smog, and sea level rise (Davis et al., 2014). Overall, climate change has the potential to impact nearly all facets of daily life.

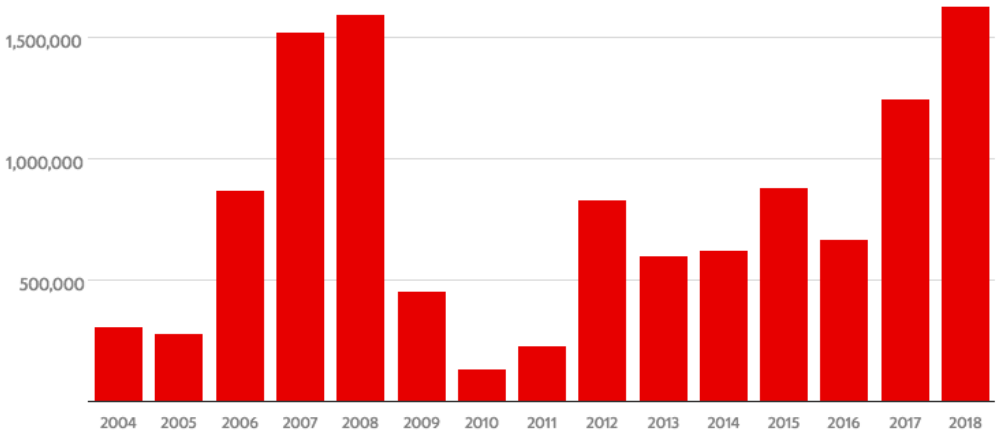

Figure 2: Total acres burned due to wildfires over the past 14 years. Source: The Sacramento Bee

1.3 California's Climate Change Goals

California is known as one of the most environmentally progressive states in the United States. For years, California has maintained its status as a global leader when it comes to environmental protection, further proving that environmental preservation and a thriving economy can occur simultaneously (IEPR, 2018). California has agreed to follow the initiatives laid out in the Paris Climate Agreement, even though the rest of the country has pulled out of the deal. California has a long history of implementing successful and effective climate change policies, and the state has shown flexibility along with adaptability to the changing energy market. California was the first state to adopt and designed a cap-and-trade system at a time when many regions of the world were still only experimenting with concepts such as emissions trading (Bang et al., 2017). Figure 3 graphically demonstrates California's capability to maintain a growing GDP and population while effectively reducing overall GHG emissions.

In 2006, the state of California passed AB 32, known as the California Global Warming Solutions Act. This was marked a watershed moment in California's history due to the fact that this was one of the first laws that mandated a reduction in GHG emissions. AB 32 is a program that takes a "long-term" approach to addressing climate change by requiring the entire state of California to reduce its overall GHG emissions to 1990 levels by 2020. This worked out to a reduction of approximately 15 percent of overall emissions at the 2006 levels (CARB, 2014). The major GHGs addressed in AB 32 include Carbon dioxide (CO^2), Methane (CH_4), Nitrous

oxide (N_2O), Sulfur hexafluoride (SF_6), Perfluorocarbons (PFCs), Hydrofluorocarbons (HFCs), and Nitrogen trifluoride (NF_3). Overall, California has made a commitment to state-wide reduction of GHG emissions as well as decreasing the state's overall reliance on fossil fuels through climate policies, programs, and initiatives.

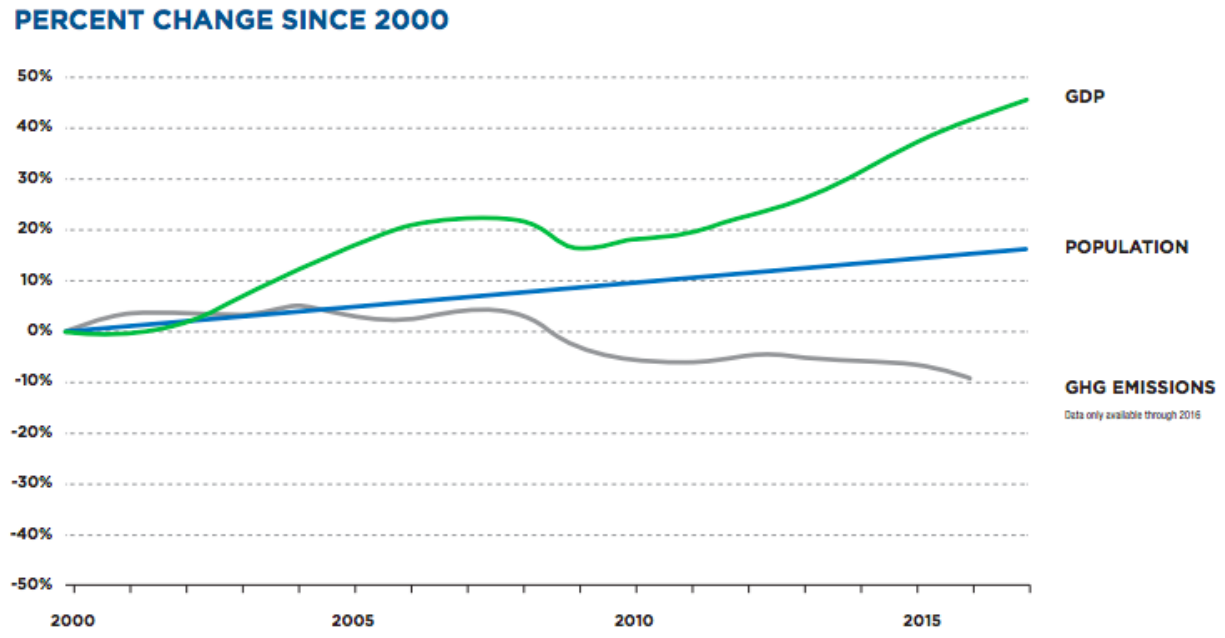

Figure 3: Percent change in California's overall GDP, Population, and GHG emissions. Source: The California Energy Commission

In 2018, the Global Climate Action Summit (GCAS) was held in San Francisco. This summit gathered people from all over the world to discuss growing climate change impacts and deliberate about what can be done to mitigate for these impacts as well as planning how best to adapt to them. Governor Jerry Brown spearheaded the GCAS on the tails of the Paris Climate Agreement, in hopes of establishing ways to limit global warming to well below 2 degrees Celsius (California Energy Commission, 2018). This 3-day summit brought out some of the most innovative and efficient ideas to combat climate impacts. The GCAS helped to inspire a more aggressive and ambitious commitment to addressing climate change impacts before the year 2020. Specifically, the GCAS resulted in over 100 mayors, state/regional leaders, and CEOs committing to carbon neutrality by 2050 in agreement with the Paris Agreement. More than 60 CEOs, state/regional leaders and mayors guaranteed a delivery of a 100 percent zero emission

transportation system by 2030. 38 cities, major businesses, state/regional governments have committed to net-zero carbon buildings. Lastly, nearly 400 investors, committed to increasing their low-carbon investments by approximately 50 percent by 2020 (California Energy Commission, 2018).

1.4 Executive and Legislative Targets

Jerry Brown's 2014 campaign highlighted numerous actions he planned to implement across the state of California to ensure that climate change mitigation and greenhouse gas reduction were of top priority. In his 2015 inaugural speech, he set a goal of 50 percent reliance on electricity derived from renewable sources by 2030. He also set the goal of reducing the release of methane and other pollutants from California's industries by 2030. Lastly, he spoke of managing rangelands, forests, and wetlands so that they can effectively store excess atmospheric carbon (CEC, 2018).

Since then, the Brown administration has made significant strides in their attempts to reduce GHG emissions and switch to renewable energy. On September 8, 2016, Governor Brown signed the Senate Bill 32. This bill put into law a statewide initiative to reduce annual greenhouse gas emissions to at least 40 percent below California's 1990 levels by 2030. This bill was enacted 10 years after the California Global Warming Solutions Act of 2006, which, as previously mentioned, was landmark legislation that aimed to reduce statewide greenhouse gas emissions to 1990 levels by 2020. California is well on its way to meeting the 2020 target, but the new 2030 requirement is more restrictive and requires a significantly higher reduction (CEC, 2018)

Currently, the transportation sector accounts for 50 percent of the state's greenhouse gas emissions and 80 percent of smog-forming pollutants (Exec. Order No. B-48-18, 2018). In January 2018, Governor Jerry Brown signed an executive order to boost the supply of zero-emission vehicles and charging and refueling stations in California. The Governor also proposed an eight-year initiative to continue the state's clean vehicle rebates and spur more infrastructure investments (Exec. Order No. B-48-18, 2018).

More specifically, in September of 2018, Jerry Brown passed Executive Order B-55-18, which was enacted in hopes of eventually achieving net carbon neutrality. In the executive order, Brown states that California has established ambitious targets to reduce carbon emissions 40

percent below 1990 levels by 2030 and 80 percent below by 2050. The order further explains that in order to achieve carbon neutrality, reductions in carbon pollution and removal of carbon dioxide in the atmosphere through environmental sequestration is necessary (Exec. Order No B-55-18, 2018). This executive order highlights the necessity of a restrictive and cohesive greenhouse gas reduction policy.

1.5 The California Coastal Commission

Climate change impacts like sea level rise and its associated adverse effects are a major focus of the California Coastal Commission (CCC). The CCC is a California state regulatory agency that has jurisdiction over activities occurring within the coastal zone of California, an area larger than the entire state of Rhode Island (California Coastal Commission, 2019b). This agency was established through voter initiative in 1972 and was made an official state agency in 1976 when the California Coastal Act was passed. The Coastal Act was enacted to enhance public access to the shoreline, protect coastal natural resources, and balance development and conservation. The CCC enforces this through planning and regulation of coastal development, public participation, education, and effective intergovernmental coordination (California Coastal Commission, 2019b).

Any building, construction, or coastal climate adaptation project that occurs within the coastal zone of California (this involves the use of both land and water) cannot occur without first obtaining a coastal development permit from the CCC. The CCC grants coastal development permits based upon policies and requirements that are stated within the Coastal Act. Specifically, the CCC partners with counties and cities located in the coastal zone to prepare Local Coastal Programs (LCPs). LCPs detail information about the land located within each city and county while providing information on zoning ordinances, maps, and other pertinent land use information. The commission must evaluate and approve any updates to LCPs to ensure coastal resources are being preserved efficiently.

The California Coastal Commission developed both a Residential Adaptation Policy as well as the Sea Level Rise Guidance Document for Local Governments to aid in the development of resilient coastal communities facing adverse impacts caused by sea level rise (Residential Adaptation Guidance, 2018). While the Residential Adaptation Policy Guidance certainly does an excellent job establishing adaptation measures in the face of SLR, there is no

current policy in place to aid in the reduction and overall "slow down" of SLR. A study put out by the National Center on Atmospheric Research (NCAR) concluded that the aggressive steps to cut emissions globally could reduce the amount of sea-level rise by somewhere between 6 and 20 inches in 2100 (Gerald et. all, 2012). This rising of sea levels could have dire impacts on not only land use within the coastal zone of California but could also severely decrease the amount of public access available along the coast of California.

1.6 Adaptation versus Mitigation

Lastly, it is important to distinguish the clear difference between adaptation and mitigation, especially when it comes to climate change and climate change policy. Climate change mitigation encompasses actions that reduce GHG emissions from economic activities or remove GHGs from the environment through means of carbon sequestration (Hritonenko et al., 2016). Examples of this include switching to alternative energy sources, implementing easily accessible public transportation systems, enacting a carbon tax, the cap-and-trade system, and reducing energy losses. Examples of this include switching to alternative, low carbon, energy sources, increasing participation in public transportation systems, enacting a carbon tax, the cap-and-trade system, and reducing energy losses in industrial processes. Climate change adaptation aims to reduce the sensitivity of the economy, society, and the environment to the impacts of climate change and/or increase their resilience to cope with negative changes (Hritonenko et al., 2016). Examples of this include improving flood control measures due to higher intensity storms and changing agricultural practices to account for changes in overall climate. In other words, environmental adaptation describes the steps and activities taken for current climate change issues, whereas mitigation encompasses the actions taken to try and prevent more climate change impacts from occurring. Both adaptation and mitigation measures involve engaging with stakeholders as well as with local and federal government to implement policy frameworks that aim to deal with current climate change impacts or prevent further impacts from occurring (Davis et al., 2014). Figure 4 shows examples of potential projects and programs that could be implemented within the coastal zone. These projects are then shown fall within the mitigation category or the adaptation category.

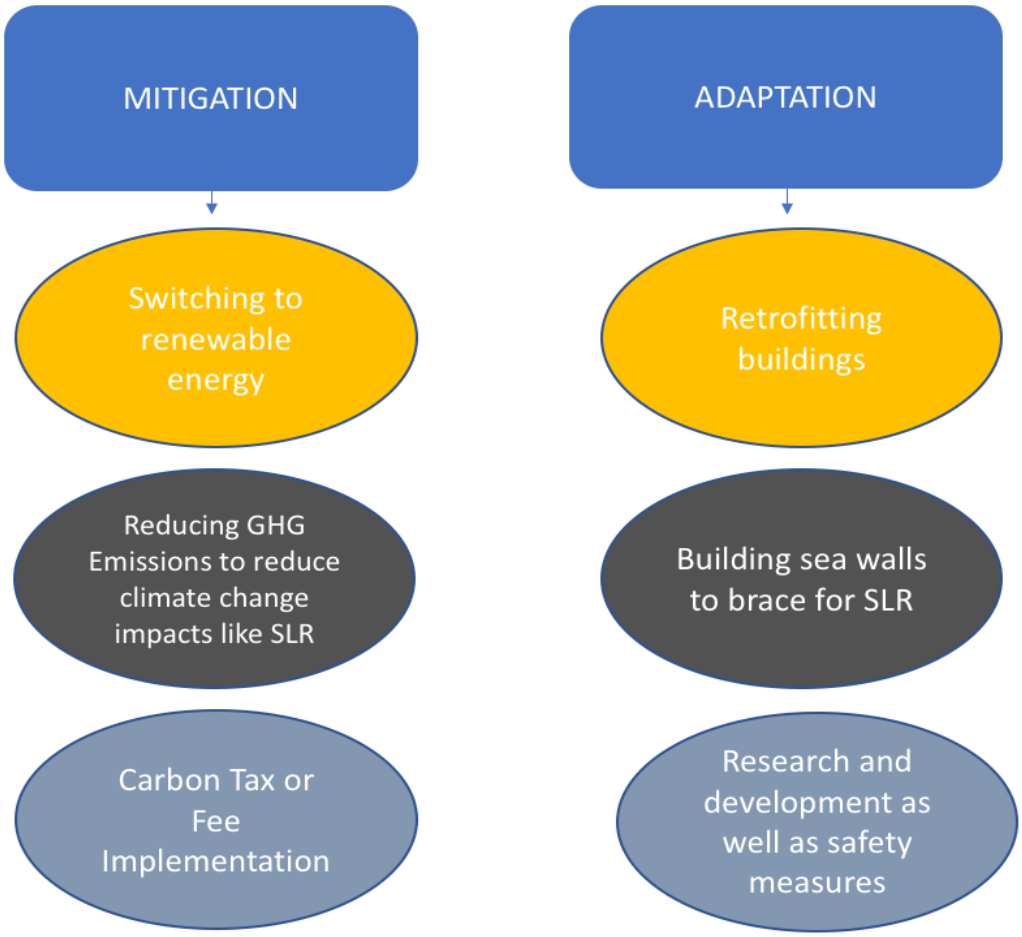

Figure 4: Flow chart demonstrating projects that would be considered adaptation versus projects that would be considered mitigation. Source: Bulletin of the Atomic Scientists

2.0 Research Question and Objectives

There are many policies and programs in place to assist the state of California in reducing their climate change impacts, which is apparent in the outcomes of the Global Climate Action Summit and legislative action. However, bold moves need to be made in regard to implementation of climate change policy within California's state agencies and regulatory bodies. Specifically, the California Coastal Commission could be doing more to assist in facilitating reduction of GHG emissions within the coastal zone and encouraging coastal adaptation. The California Coastal Commission is one of the most stringent agencies in the U.S when it comes to natural resource protection and preservation of resources within the coastal zone of California. The CCC is known for implementing strict policies, programs, and regulations to ensure in the protection of coastal resources. The Coastal Commission should be

the agency setting a precedent when it comes to regulating activities that have adverse effects on coastal resources and environmentally sensitive areas. Greenhouse gas emissions have a direct negative impact on many important natural resources within the coastal zone, and if the CCC can begin to regulate GHG emissions within its jurisdictions, this could lead to other states following in suit. The CCC should prioritize the implementation and funding of coastal adaptation projects that work to actively acclimate California's coastal structures and coastal areas to the onset of climate impacts.

The main goal of this study is to investigate various existing policies and programs with the goal of determining what is working well and what is not working well within each program. This analysis will provide a framework for California state agencies and regulatory bodies to follow in the development of future policies and programs that facilitate greenhouse gas reduction and prevent the global climate from rising. Specifically, this paper proposes four recommendations for the California Coastal Commission to implement at an agency level in regard to reducing greenhouse gas emissions. This paper provides an in-depth literature review and analysis on climate impacts specifically affecting the California Coastal zone. Both a data synthesis and policy analysis have been conducted to analyze the current relevant greenhouse gas policies, programs, and regulations currently in place. Coastal adaptation programs and projects were highlighted in this analysis as well. These programs were then analyzed to determine what is working to facilitate GHG emissions reduction, and what is causing these programs to fall short of aiding in GHG emissions reduction. This paper also analyzes different programs that do not necessarily have anything to do with GHG emissions reduction or climate change adaptation, rather looking at components and mechanisms that could be used towards crafting a policy framework that would successfully regulate and reduce GHG emissions. Finally, this study was conducted in hopes of recommending changes for the CCC to implement within the agency to support the reduction of GHG emissions within the coastal zone as well as coastal adaptation. This analysis was conducted with the goal of developing a successful policy framework recommendation for implementation at the CCC that would not only assist in facilitating GHG emission reduction within the coastal zone but would aid in promoting coastal adaptation projects and programs. The overarching question that this study is attempting to address is:

Research Question

What additional steps can the California Coastal Commission take to reduce GHG emissions associated with coastal development while promoting adaptation within the coastal zone?

Objective: Develop successful recommendations as well as a policy framework for the CCC to implement to help in effectively facilitating GHG emissions reduction as well as coastal adaptation in California.

The following sub-questions were crafted to guide this policy analysis:

Sub-Question 1

What climate impacts is the California coastal zone facing currently?

Objective: Determine prevalent impacts to the California coastline to establish relevance and need for more coastal climate change adaptation within the California coastal zone. Establish recommendations and policies that account for climate change impacts specifically effecting areas within the jurisdiction of the California Coastal Commission.

Sub-Question 2

What pertinent climate policies and programs are currently in place in the state of California?

Objective: Analyze current climate change policies and programs to understand the components of successful or unsuccessful GHG emissions reduction. Review different programs and frameworks that could be used in a future policy framework at the California Coastal Commission.

Sub-Question 3

Why are more greenhouse gas emissions reductions necessary?

Objective: Establish if and why a new GHG policy is necessary since there are many GHG reduction policies and programs in place in the state of California.

Sub-Question 4

What are some potential policy options for stronger climate policy within the coastal zone?

Objective: Analyze various components and mechanisms of current California climate change policies and programs that facilitate GHG emissions reduction efficiently.

The remainder of this paper will provide information on specific climate impacts associated with the California coastline. Next, an in-depth analysis will demonstrate research on various metrics and mechanisms that would facilitate greenhouse gas reduction through policy implementation. A discussion of the most pertinent findings will demonstrate the necessity for this policy at this current time in history. This paper ends with four detailed recommendations for the CCC to implement to further reduce GHG emissions within the coastal zone while promoting coastal adaptation.

3.0 Climate Impacts in the California Coastal Zone

California continues to be an environmental leader in the United States, as they push to make GHG reduction a central tenet. They are in a perfect position to lead when it comes to implementing new coastal commission policy designed to further reduce GHGs and provide funds for SLR adaptation. While the CCC predominantly deals with specific impacts to the coastal zone and does not do as much work with air quality and GHG emissions, there is clearly a push for the CCC to start incorporating GHG reducing projects and programs into their agency. In February of 2018, the state awarded the CCC this grant funding to "implement elements of the Coastal Act that involve planning and regulatory actions that facilitate the reduction of GHG emissions" (Greenhouse Gas Reduction Grant, 2018) The grant states that projects encompassed within this grant include climate adaptation and resiliency, wetlands and watershed restoration, land restoration and forest health, and urban forestry as well as urban greening. More specifically, this grant states that the California Coastal Commission should facilitate GHG reductions by planning and implementing regulatory actions to reduce vehicle miles travelled, concentrating development, supporting green infrastructure and protecting or restoring wetlands, coastal habitats and agricultural lands" (Greenhouse Gas Reduction Grant, 2018). This funding

further demonstrates California's commitment to GHG reduction through state agencies and also demonstrates California's confidence in the CCC to effectively implement GHG reducing adaptation and mitigation measures.

The California Coastal Commission should be the agency setting a precedent when it comes to activities that have adverse effects on coastal resources and coastal areas. Greenhouse gas emissions have a direct impact on many important natural resources within the coastal zone. The biggest side effects of climate change most specifically targeting the integrity of California's coastline are sea level rise and coastal squeeze. The goal of this section is to address sub-question 1 in evaluating the specific impacts affecting the California Coastal Zone due to climate change.

3.1 Sea Level Rise

As sea levels continue to rise due to climate change, areas within the coastal zone will begin to experience additional hazards and stresses. Property damage and threats to public infrastructure from flooding, inundation, or extreme waves, are among the various hazards plaguing California's coasts. Coastal habitats, wetland areas, and environmentally sensitive habitat areas (ESHA) will be threatened as the salty sea water rises and inundates these areas. Habitats are currently blocked from migrating inland as barriers, such as sea walls, have been put in place to reduce the impact of rising seas. Sea level rise poses a major threat to agriculture in the form of flooding or inundation of low-lying agricultural areas. (California Coastal Commission, 2018).

California is one of the largest coastal areas that will be impacted by SLR, as California's coastline stretches approximately 840 miles long (NOAA, 2015). Sea level rise in California is complicated by crustal plate dynamics that are gradually raising the elevation of coastal areas north of Cape Mendocino and causing coastal areas to subside south of the Cape (NRC, 2012). Currently, scientists project that sea levels will rise unevenly. Southern California sea level rise projections from the National Research Council (2012) range from 12 to 61 centimeters by 2050 and 42 to 167 centimeters by 2100 (Davis et al., 2014). Furthermore, Griggs et al. (2017) found that California will face an even greater rise in sea levels compared to other coastal regions due to the ice loss from West Antarctica, which is considered the most vulnerable major ice sheet

from current global warming. For every 30.5 centimeters of SLR experienced around the globe, California is projected to experience 38.1 centimeters of SLR along its coast (Griggs et al. 2017).

The CCC, has prioritized preparing coastal developers for the slow onset of sea level rise. The CCC originally published the Sea Level Rise Policy Guidance, which was adopted for use by the Coastal Commissioners in August of 2015. This document demonstrates SLR through scientific evidence and recommends the best methods for addressing SLR in planning and regulatory actions at the CCC. This document acts as more of a checklist, rather than a specific set of required and mandated actions (California Coastal Commission, 2019). In November of 2018, the CCC adopted a Science Update to the Sea Level Rise Policy Guidance which included more current science and methods. Lastly, the CCC put out the Commission's Draft Residential Adaptation Policy Guidance in 2017, which was done to help provide accessible information on sea level rise adaptation. This guidance also suggests practical land use policy tools to help facilitate planning for resilient shorelines while protecting coastal resources within the coastal zone (California Coastal Commission, 2018).

3.2 Saltwater Intrusion

Saltwater intrusion refers to the process of salty ocean water moving inland and into freshwater aquifers. Once the freshwater and saltwater meet, the freshwater aquifer is no longer suitable for agricultural practices, water supply, or consumption. This phenomenon occurs as the water elevation of the ocean gets higher and forces the saltwater to move further and further inland. While this problem is specifically a man-made problem in most areas of California due to over-pumping, sea level rise is expected to increase the rate of intrusion by sea water (Herberger et al., 2009). As oceans continue to rise, saltwater will gradually move into coastal aquifers, creating additional water insecurity for areas of California that rely on groundwater for their source of freshwater. A switch to alternative water sources will be incredibly costly and can result in more unsustainable alternatives, such as desalination. This will cause a particularly tricky issue for farmers who use groundwater to irrigate their farmland. This could require them to pay more for water coming from elsewhere or might require them to potentially retire their farming land. All of these alternatives require an incredibly large amount of money and funding to properly execute. Specifically, saltwater intrusion into the Sacramento-San Joaquin Delta is

especially worrisome because of the delta's key role in supplying water to both northern to southern California (Davis et al., 2014)

3.3 Coastal Erosion

The combination of sea level rise and increasingly intensified storms is amplifying California's coastal erosion rates (Griggs et al. 2017). California's coastline is especially susceptible to coastal erosion due to the rocky sea cliffs that line the coast. Higher sea levels, larger waves and intense storms are causing intense wave impact along the California coast, and in turn, the land is eroding more rapidly. Coastal erosion can be especially harmful to dunes and sand spits as these areas act as flood protection (Herberger et al., 2009). With erosion slowly causing dunes to erode, this flood protection deteriorates, leaving some areas of California more susceptible to flooding during heavy storms. Coastal erosion can be seen in the town of Pacifica, California. In 2016, a strong storm surge caused a series of strong waves to erode a large section of cliff that housed several apartment buildings. As a result, Pacifica declared a state of emergency, where residents were forced to evacuate their homes. The apartment buildings were later demolished as a result of potentially hazardous living situations. This is a growing problem for residents of Pacifica, as many homes are located along the same cliff edge that the apartments were located along. These homes face the same problem as the apartments in the event of another large storm, which is seemingly inevitable. Pacifica is one of many coastal California cities that are dealing with the effects of climate change in the form of coastal erosion. Scientists predict that a 1.4-meter change in sea-level rise will expedite the rate at which California's coastline is eroding, resulting in a loss of approximately 41 square miles of California's coast by 2100. Within this 41 square mile radius, approximately 14,000 people live in areas at risk of erosion (Herberger et al., 2009). Coastal erosion will require coastal retreat, or the movement of all structures inland. This will be incredibly expensive and will also contribute to displacement of California residents. The retreat from the coast will be an incredibly expensive and difficult endeavor that will require a significant amount of government intervention and funds dedicated to this purpose.

3.4 Coastal Squeeze

The residential adaptation guide that was developed by the CCC in 2017 discusses the fact that, as sea levels rise, beaches and bluffs will be forced to migrate more inland. Maintaining residential development within this "retreat" zone will, in many cases, cause the narrowing and eventual loss of beaches, dunes and other shoreline habitats. This narrowing is often referred to as 'coastal squeeze'. The term coastal squeeze describes the process where rising sea levels and other factors, such as an increase in intense storms, push the coastal habitats closer and closer to land. As this push back of habitat is occurring, there are often areas where shoreline protection or other fixed development prevents the landward migration of the beaches, wetlands, and even the built environment that would have otherwise occurred (Pontee, 2013). It can also occur when the beach migrates up to and underneath elevated structures. Coastal squeeze also refers to the change in width and space of the intertidal zone. A reduction in intertidal surface area can have serious implications on the variety of species who survive in this intertidal area. This low-lying infrastructure and various anthropogenic shoreline protection features can also function as barriers specifically to the inland migration of coastal wetlands (Borchert, 2018). Failure to address impacts related to coastal squeeze has the potential to result in significant conflicts with the Coastal Act, which was enacted for the purpose of protecting California's coastal resources.

4.0 Analysis of Existing Policy

This analysis includes an in-depth review of various different programs and policies that are currently being used to reduce climate change impacts throughout the state California. This section will review the current work being done at state agencies to introduce new policy and regulation in the fight against climate change. This analysis also examines different policy frameworks and program designs to determine what mechanisms are facilitating change. The goal of this analysis is to address sub-question 2 by examining various policies and programs to determine which are currently working well, or not working well. This section will include information about current GHG reduction programs and policies in California. This analysis also dives into potential programs that could be tailored to a GHG reduction policy framework due to the success and implementation within the state. On the other hand, this research also demonstrates GHG reduction programs that are not working or being utilized to the fullest.

Lastly, this section summarizes these findings and demonstrates the need for excess GHG reduction policy, specifically at the California Coastal Commission.

4.1 California's Existing Climate Policies and Programs

California leads the United States, if not the world, in the implementation of greenhouse gas reduction and energy efficiency programs. With ambitious targets including goals of being zero net energy by 2020 and reducing emissions by 40%, the state has implemented aggressive policies and programs to assist in reaching these lofty goals. This section reviews the existing pertinent policies and programs currently in place in the state of California aimed at reducing greenhouse gas emissions. The information below details various California state agencies' current and most relevant climate change policies and programs as well as their corresponding frameworks and mechanisms.

4.1.1 California Air Resources Board

In response to the passage of AB 32 (The California Global Warming Solutions Act of 2006) the California Air Resources Control Board (CARB) worked to comprise a specific Scoping Plan. This plan details California's actions that will work to reduce GHG emissions to that of 1990 levels. The initial plan included a wide variety of actions to reduce GHG emissions such as alternative compliance mechanisms, monetary and non-monetary incentives and market-based mechanisms (California Air Resources Board, 2018c). This initial scoping plan also included a fee regulation to fund this program. The Scoping Plan was updated in 2013 and this update provided ways that further GHG emissions could be reduced through targeted low carbon investments (California Air Resources Board, 2018c). The 2013 update also outlines CARB's climate change priorities for the next five years and showcases the current progress that has been made in attempts of reaching the initial goals set forth in AB 32. Lastly, this scoping plan update identified nine key focus areas where the state of California needs to direct attention towards. These focus areas included energy, transportation, agriculture, water, waste management, and natural and working lands. There was also a strong emphasis on short-lived climate pollutants, green buildings, and the cap-and-trade program (California Air Resources Board, 2018c).

Along with this Scoping Plan, CARB developed the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR) in December of 2007, with additional amendments being added each year since. MRR is applicable to electricity generators, industrial facilities, fuel suppliers, and electricity importers. Each year, CARB publishes a summary of reported GHG emissions and this data is then used by the cap-and-trade program and included in California Greenhouse Gas Inventory (California Air Resources Board, 2018).In addition to establishing the MRR program, CARB has implemented a verification program to assist in this mandatory GHG reporting. This verification program is comprised of verification bodies as well as individual verifiers. CARB evaluates the verifications services and mandates that only CARB-accredited verification bodies provide verification services to reporting entities (California Air Resources Board, 2018).

4.1.2 Bay Area Air Quality Management District

In 2015, the Bay Area Air Quality Management District (BAAQMD) launched a Greenhouse Gas measurement program. This program was developed with the intention to inform and support its climate protection activities. The main goal of the GHG measurement program was to help provide the scientific basis that supports rule-making and policy development for reducing GHG emissions in the Bay Area (Bay Area Air Quality Management District, 2015). In support of this goal, the GHG measurement program has several core objectives which include tracking trends over time in GHG concentrations for the region, evaluating and improving the Air District's regional GHG emissions inventory, evaluating and improving facility-level GHG emissions, providing education to the public about how this region is contributing to climate change, and to create a successful and comprehensive GHG measurement program to serve as a model for other regions (Bay Area Air Quality Management District, 2015).

The BAAQMD has their own Air Quality Guidelines for the California Environmental Quality Act (CEQA) document preparation. In California, CEQA acts as a mandatory statute that requires state and local agencies to identify potential environmental impacts associated with California projects, and requires mitigation when possible. The BAAQMD created specific CEQA guidelines to assist lead agencies in evaluating air quality impacts of projects and plans proposed in the San Francisco Bay Area. These guidelines provide developers with BAAQMD-

recommended procedures for evaluating potential air quality impacts during the environmental review process consistent with CEQA requirements (Bay Area Air Quality Management District, 2017). Within these guidelines, the BAAQMD spells out specific GHG measurement requirements for quantifying GHGs associated with operational GHG emissions. The BAAQMD requires GHG emission quantification and computation through their approved calculation methods. Where operational-related emissions exceed applicable levels set forth by CEQA and the BAAQMD, lead agencies are responsible for implementing all feasible mitigation measures to reduce the project's GHG emissions (Bay Area Air Quality Management District, 2017).

4.1.3 California Energy Commission

The California Energy Commission (CEC) has set specific energy efficiency standards to assist in the conservation of electricity and natural gas. These standards, also known as the California Title 24 Building Energy Efficiency Standards, were designed to help new and existing buildings achieve the maximum amount of energy efficiency throughout the state. These standards include energy conservation measures, green design, construction and maintenance, fire life and safety, and accessibility (California Energy Commission, 2018b). Title 24 was also enacted to help the state avoid the need to invest in building and operating more power plants. Title 24 is managed by the California Energy Commission, as this agency assists in adopting new energy efficiency plans and implements them into current buildings and construction of new buildings. Title 24 covers all new construction of residential and nonresidential buildings as well as any alterations made to preexisting residential and nonresidential buildings. Both hospitals and jails/correctional facilities are exempt from the Title 24 standards. The CEC is required by law to update the Title 24 standards every 3 years as the CEC finds new and relevant ways to save energy and increase electricity supply reliability (California Energy Commission, 2019). The 2019 Standards go into effect starting on January 1st, 2020. The new standards proposed in the 2019 Building Energy Efficiency Standards focus on the mandatory installation of solar panels for all newly constructed low-rise residential buildings, implementing a new Home Energy Rating System (HERS), and updating Indoor Air Quality (IAQ) requirements.

On top of establishing Title 24, the CEC also publishes a document known as The Integrated Energy Policy Report (IEPR). This document is published every two years and provides information on the current implementation of California's clean energy policies as well

as California's response to climate change. The IPCC also provides more detail on the main energy issues and associated analysis being done in the state to combat these issues.

4.1.4 California's Cap-and-Trade System

In the early 2000's, California legislators were looking to implement environmental policies that would be applicable within California's marketplace economy. Californian law makers used European climate change mitigation measures as well as the Kyoto Protocol as a framework to develop the Global Warming Solutions Act (AB 32). The law required California to reduce its GHG emissions to 1990 levels by 2020. The AB 32 Scoping Plan identifies cap-and-trade as one of the main strategies that will assist the state in their reduction of GHG emissions. Through AB 32, CARB was authorized to develop regulations that would help achieve the most cost-effective GHG emission reductions. Through CARB, energy efficient policy programs such as the renewable portfolio standard (RPS) as well as the low carbon fuel standard (LCFS) were established. From this, expert climate scientists and policy analysts at CARB developed a detailed framework for the cap-and-trade program, engaging external experts and stakeholders in the development process. They also worked to engage economists and environmental justice advisors to aid in developing a robust plan that engages all sectors of the California population. The goal of CARBs cap-and-trade program was to establish a set limit for carbon pollution, while providing businesses flexibility to make the lowest-cost reductions first (EDF, 2017). By December 2011, the state's cap-and-trade regulation was approved.

The cap-and-trade program establishes a statutory cap on allowable emissions for large GHG emitting companies, such as oil-refineries, and establishes market mechanisms to price carbon credits or carbon allowances (Rabin et al., 2015). This is done through the distribution of a limited number of these carbon credits to these various companies. Each credit acts as a permit to emit one metric ton of carbon dioxide or the equivalent amount for other GHGs. These companies can then buy, sell or trade their carbon credits (also called allowances) during quarterly auctions. A portion of the revenue produced from these auctions then gets deposited into the Greenhouse Gas Reduction Fund (GGRF).

4.1.5 Zero Net Energy

On Sept. 18, 2008, the California Public Utilities Commission (CPUC) adopted the California Long-Term Energy Efficiency Strategic Plan (CAEESP). CAEESP was established through a year-long collaborative process between all of the regulated public utilities companies under the CPUC's Jurisdiction (i.e PG&E, SCE, SDG&E, and SoCalGas) as well as approximately 500 individuals and organizations. This plan established ambitious goals for the state of California in the development of widespread energy savings. Specifically, the CPUC mandated that all new residential homes built in 2020 will be required to be Zero Net Energy (ZNE). The CPUC defines ZNE as an energy-efficient building where the annual consumed energy is less than or equal to the on-site renewable generated energy (CPUC, 2017). The BAAQMD further defines ZNE as a building that over the course of a year, generates as much electricity onsite as it consumes from the grid (Figure 5). Both the CPUC and the CEC have worked together to develop frameworks for both commercial buildings as well as residential buildings. As the demand for energy is likely to vary, ZNE buildings are connected to the energy grid so that excess energy can be extracted when needed. This also allows for surplus energy to be transferred back to California's energy grid and used elsewhere. The CAEESP also states that all new commercial construction will be ZNE by 2030, and that 50% of commercial buildings will be retrofit to ZNE by 2030. Lastly, the CAEESP established that 50% of new major renovations of state buildings will be ZNE by 2025, and 100% by 2025.

In May of 2018, the CEC adopted the 2019 Building Energy Efficiency Standards, which laid out new and innovative energy efficient codes for California's buildings. Consequently, in December of 2018, the California Building Standards Commission updated the state's building energy efficiency standards to reflect the CEC's changes. These new standards become effective as of January 1, 2020. This new set of standards mandates that all new homes and low-rise apartment buildings install solar panels. California will be the first state in the nation to require solar panel installation for new homes. These new standards will hopefully encourage developers to install on-site energy storage so that residents can use more of their own energy that is made directly at their home. These new building standards are expected to reduce GHG emissions by an amount equivalent to taking 115,000 fossil fuel cars off the road (California Energy Commission, 2018b). Aside from the required solar panel installation, the new building standards will also require newly installed homes to update the thermal envelope standards, ventilation requirements, and nonresidential lighting requirements (California Energy

Commission, 2018b). These new standards will reduce average energy usage by up to 30 percent, predominantly due to upgraded lighting. ZNE helps to reduce overall GHG emissions as all GHG emissions that are produced in the operation of a building are then offset by the building's renewable energy system (aka carbon free energy). Implementation of energy efficiency strategies at a state-wide level can significantly reduce GHG emissions and do so with a net economic savings (California Public Utilities Commission, 2008).

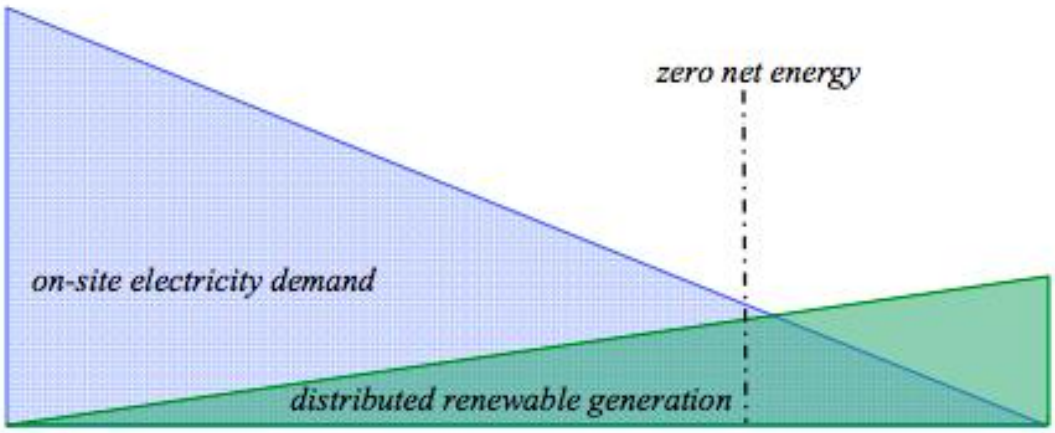

Figure 5: Graphical representation of Zero Net Energy occurring at the point where on-site electricity demand is equivalent to the distributed renewable energy generation. Source: Long Term Energy Efficiency Strategic Plan, CPUC

4.2 Existing Fee Based Programs in California

As shown through previous analysis, one of the biggest incentivizing tools to facilitate actual GHG reduction is the imposition of a fee. This section will analyze two different fee-based programs operating successfully in California. There are many important components of a fee or tax implementation that are important in evaluating and forming a policy framework, such as fee price points, agency administration and appropriate distribution of funds. Both the Greenhouse Gas Reduction Fund as well as the Tobacco Tax have clear and concise frameworks that have led to successful implementation as well as increased funding to beneficial projects throughout the state of California.

4.2.1 Greenhouse Gas Reduction Fund

The Greenhouse Gas Reduction Fund (GGRF) was established in 2012, and since then has allocated more than $8 billion dollars towards GHG emission reduction programs and projects (California Climate Investments, 2018). As previously mentioned, California's cap-and-trade program offers a quarterly auction where companies can purchase allowances from the State, and portions of these proceeds are deposited into the GGRF. These proceeds can change year to year dependent upon how much money is accumulated at the cap-and-trade auction. For example, in fiscal years 2013-2014 and 2014-2015, the cumulative total of auction proceeds was over $900 million. From here, the Legislature and the Governor determine annual appropriations from the GGRF to state agencies and their programs. Specifically, the Legislature distributes the money from the GGRF to administering state agencies that oversee programs working towards overall GHG emission reductions, adhering to the purpose of AB 32, and through the Budget Act (California Climate Investments, 2018). Examples of these administering state agencies include Caltrans, the California Department of Fish and Wildlife, the California Natural Resources Agency, and even the California Coastal Commission. Once the various designated California state agencies receive these funds, they then select various greenhouse gas reduction projects to put the funds towards. To date, the California Coastal Commission has received approximately $3 million to go towards their local coastal program. These state agencies must work with the California Air Resources Board to ensure that the selected projects are meeting specific GHG reduction measurements projects through CARB's specific quantification process (California Air Resources Board, 2016). Lastly, state agencies that are administering these funds must use the Funding Guidelines established by CARB. The California Air Resources Board developed funding guidelines for GGRF in order to provide direction for agencies that administer funds to greenhouse gas reduction projects in the state of California. These guidelines help agencies in the design and implementation of various programs to ensure that they not only facilitate GHG emission reductions and meets statutory requirements, but simultaneously maximizes benefits to disadvantaged and low-income communities. (California Climate Investments, 2018). Figure 6 demonstrates a summary of all of the guiding principles for projects within the GGRF.

The GGRF contributes funding to various California state agencies who are implementing programs and projects that facilitate GHG emissions reduction. These projects aim to help the state reach their climate goals while simultaneously providing benefits to priority

populations. As previously stated, these programs are determined through the legislature and the Governor. Specifically, in 2012, Governor Brown signed three bills into law—AB 1532, SB 535, and SB 1018. AB 1532 requires the GGRF programing maximize economic, environmental, and public health benefits. It also requires the funds to be used as a direct investment toward the most disadvantaged communities and households in the state (Rabin et al., 2015). SB 535 that at least 25 percent of the GGRF investments go to programs that benefit disadvantaged communities, and that at least 10 percent of the investments be spent in disadvantaged communities (Rabin et al., 2015). Lastly SB 1018 established that the GGRF is to receive monetary proceeds acquired during the cap-and-trade auction. SB 1018 also requires that an expenditure record be prepared by the California State agencies that receive money from the GGRF. This report must describe how exactly the appropriated funds from the GGRF will work to facilitate GHG emissions reduction while also implementing the goals laid out in AB 32 (California Air Resources Board, 2018b). These bills were enacted to provide guidance on how the money acquired from the cap-and-trade auction was to be expended. In addition to the guidance from these bills, the 2014 Budget Act (SB 862) mandates that 60% of the GGRF auction proceeds go towards the high-speed rail project (administered by the California High Speed Rail Association), the Affordable Housing and Sustainable Communities (AHSC) program, and the Transit and Intercity Rail Capital Program (TIRCP), and to the Low Carbon Transit Operations Program (LCTOP).

Since the establishment of these Bills, the Legislature and the Governor have both worked to update the requirements mandated in these Bills to reflect current climate needs and stakeholder concerns (California Climate Investments, 2018). The designated projects vary for the different programs and are dependent upon size and scale of the investment (California Climate Investments, 2018). Some examples of the larger scale projects that the GGRF provides funding to include the Low Carbon Transit Program, the Transformative Climate Communities program, the Water Use and Energy Efficiency Program, and the Wetland and Watershed Restoration. Moreover, some of these programs, such as the Climate Change Research Program, actually use funds to preform climate research and research on ways to reduce emissions. This particular program invests in cross-cutting research investments that build community resilience, integrate land use and development considerations, and facilitate the transformation of California communities. The Climate Change Research Program also conducts studies on reducing carbon

emissions through clean energy, adaptation and resiliency (California Air Resources Board, 2019).

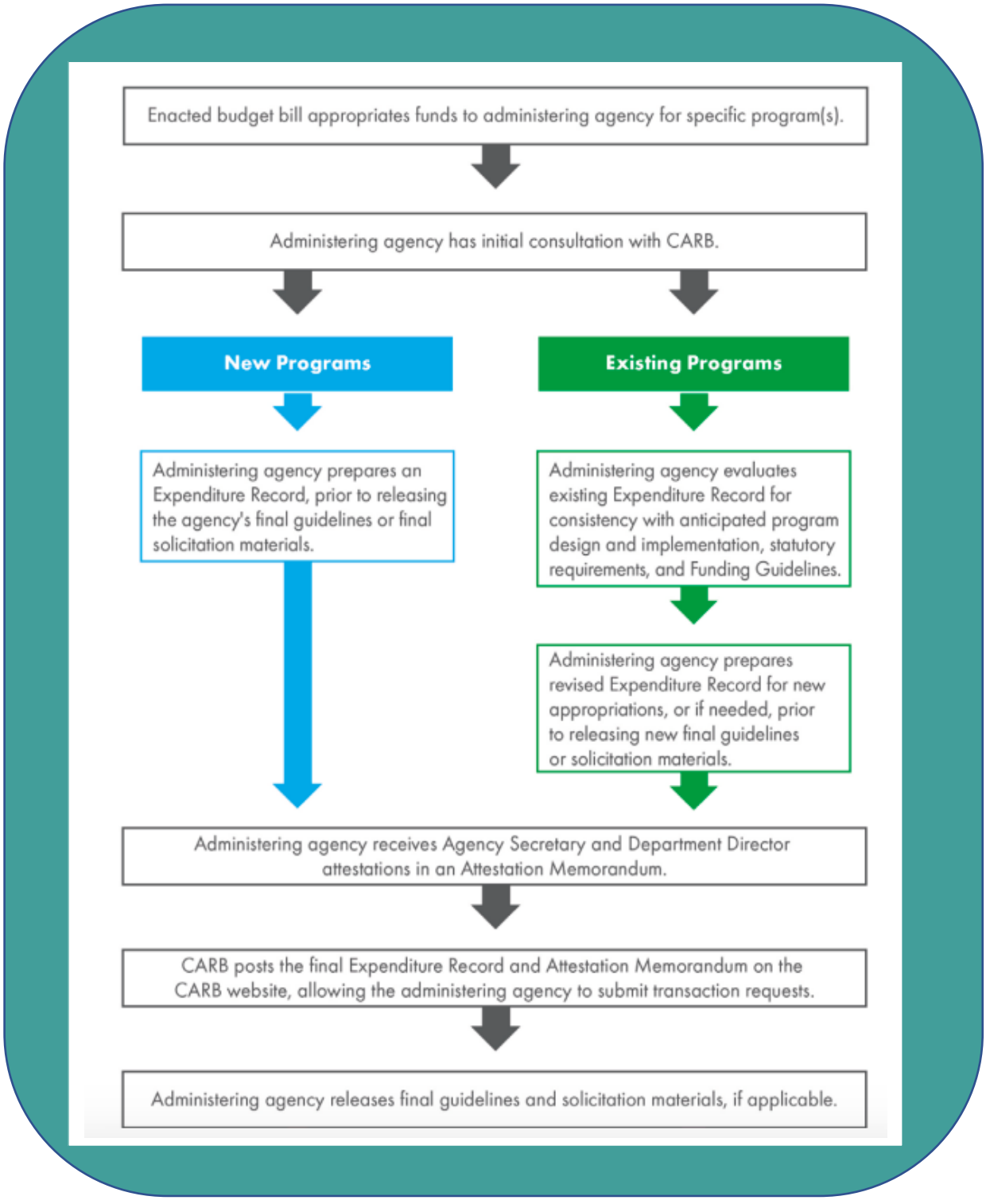

Figure 6: Funding Structure and Guidance for the GGRF. Source: California Climate Investment

4.2.2 California's Tobacco Tax

While researching different California policies and programs currently facilitating change through a mandated tax or fee, Proposition 56, also known as the California Tobacco Tax, was suggested as a potential framework to analyze. While this proposition does not necessarily pertain to GHG emissions reduction, the fee structure and mechanism for reducing cigarette related illness is one that could be applied to a GHG reduction policy framework.

In November of 2016, the state of California passed Proposition 56, which increased the price of a pack of cigarettes by $2.87. As of June of 2017, the state had raised approximately $1.3 billion dollars from the tobacco tax revenue. The money collected from this tax is spent on health care treatment and health research. Specifically, Senate Bill 856 was passed in 2018 that appropriates Proposition 56 funds accumulated throughout the 2018-19 state fiscal year to the Department of Health Care Services for healthcare expenditures. Through the development of Senate Bill 849, Proposition 56, the Medi-Cal Physicians and Dentists Loan Repayment Act Program, was established. This proposition allocated $220 million to a loan assistance program for recently graduated physicians and dentists (California Department of Health Care Services, 2018). Table 1 demonstrates the way that the tax is broken down and deposited into various funds. This tobacco tax has been incredibly successful in deterring citizens from purchasing cigarettes regularly and has also provided funding for programs that otherwise would not have a large influx of money. The same framework used in Proposition 56 could be applied to implementation of a tax or fee for GHG emissions associated with large scale coastal projects.

Agency/Program	Amount Deposited
California Healthcare, Research and Prevention Tobacco Tax Act of 2016	$2.00
California Children and Families Trust Fund	$0.25
Cigarette and Tobacco Products Surtax Fund	$0.25
Cigarette Tax Fund	$0.10
The Breast Cancer Fund	$0.02

Table 1: Fund allocation for Proposition 56. Source: California Department of Health Care Services

4.2 Existing Threshold Based Program in California

Pacific Gas and Energy (PG&E) is a public utility that provides power and electricity to most of Northern California. PG&E has established a monetary rate for customers to pay that goes towards electric distribution and transmission as well as costs of procuring power. This money also goes towards funding public programs such as low-income and energy-efficiency programs. The rate that PG&E charges customers is part of a PG&E's Tier Rate Plan (E-1). The Tier Rate Plan has two different pricing levels, known as "tiers," which are based on how much energy consumers use. The first-tier rate, or baseline rate, is established by customers location in California, their heating source, and the time of year (i.e Summer or winter) (Pacific Gas & Electric, 2019b). Energy that is consumed within the range of this baseline rate charges

customers the lowest possible price for the area they are located within. Once the amount of energy this consumer is using surpasses the threshold of Tier 2, the customer is charged a higher price. This higher price defers dependent upon how much the consumer exceeds their baseline allowance. As shown in Figure 7, this fee can be anywhere between a 101-400% increase from the baseline allowance. In March 2017, the CPUC mandated High Usage Surcharge was introduced to the Tier Rate Plan (E-1) to facilitate mandated energy conservation. If a customer's energy use exceeds the baseline rate more than four times during the month, the customer is then charged a high usage surcharge on top of their bill.

Criticism of this system comes from utility customers who argue that the surcharge fees are incredibly expensive. When customers are required to pay the high usage surcharge, the price of power goes from approximately $0.16 per kWh to $0.33 per kWh (Rabbich, 2016). With almost a 50% increase in price for a penalty fee, customers feel that this is excessive and unnecessary. However, the former PG&E spokesperson, Tamar Sarkissian reassured customers that less than 10% of residential customers will feel the effects of the High Usage Surcharge. This charge was mandated by the CPUC to facilitate energy consumption, and to hold large scale emitters accountable.

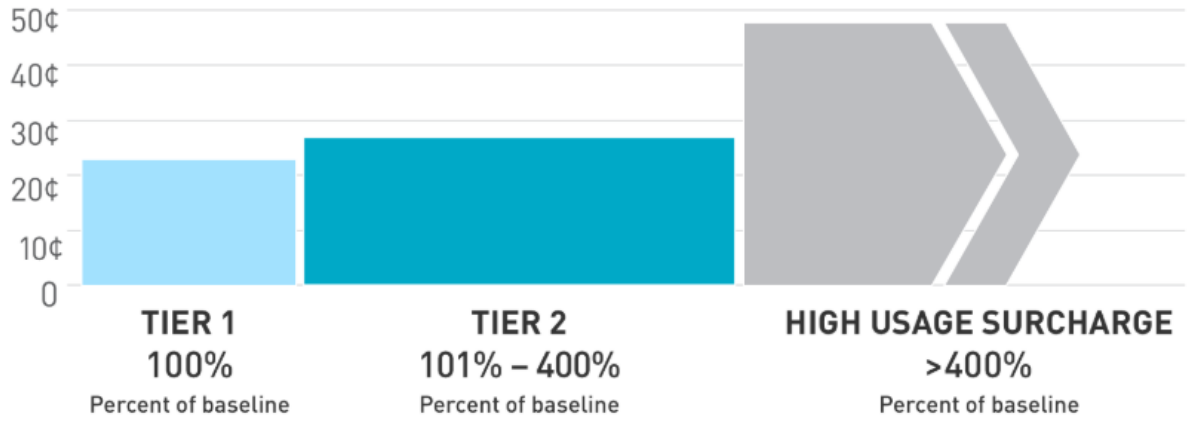

Figure 7: Graphical depiction of PG&E's Tiered Rate Plan (E-1) and overage percentage associated with each group (i.e Tier 1, Tier 2 and High Usage Surcharge). Source: Pacific Gas and Electric.

4.3 Existing Incentive Based Programs in California

The state of California currently has various incentive programs in place to reward customers for reducing their energy use, GHG emissions, and overall environmental impact. This section analyzes a few of these programs and discusses the mechanisms used to insight GHG reduction through incentives. This analysis examines both the advantages and disadvantages of these programs, including which mechanisms seem to be working, and which seem to be falling short. Lastly, this section discusses why California citizens are and are not taking advantage of these incentive programs.

4.3.1 California Solar Initiative and Net Energy Metering

The California Solar Initiative (CSI) was in effect for over a decade and was created in the hopes of developing a self-sustaining solar market by providing money back to home and building owners for the installation of solar panels. This system was set up so that customers would need to first complete an energy efficiency audit, and upon completion, the customer would find a qualified solar installation contractor. From there, consumers can apply for a solar rebate through their solar contractor. The solar system would be installed, and then customers can claim their rebate through an Incentive Claim Form. The CSI program offered solar customers different incentive levels based on the performance of their solar panels, including such factors as installation angle, tilt, and location rather than system capacity alone. This was developed to ensure that California's energy generation was clean energy and that the rebate system was providing incentives to maximize solar energy generation (Go Solar California, 2007). The CSI program was overseen by the CPUC and was funded by electric ratepayers and the CSI-Thermal portion of the program was funded by gas ratepayers. The CSI Program closed on December 31, 2016 due to the fact that the solar energy market created such a drop in the price of solar panel equipment, the incentive program was no longer necessary. The overall consensus was that this program worked incredibly well in regard to California citizens taking advantage of the rebates as well as generating enough energy to significantly reduce reliance on energy sources that utilize fossil fuels. The program helped to create a new energy market while driving down the overall cost of solar energy.

While the CSI program has been discontinued, California still has taken the concept of energy monitoring to create the Net Energy Metering (NEM) program. This program was adopted by the CPUC on January 28, 2016 and is available to customers of three major utilities

groups in California: Pacific Gas and Electric (PG&E), Southern California Edison (SCE) and San Diego Gas and Electric (SDG&E) (California Public Utilities Commission, 2019). This program enables these utility groups to buy and sell energy from renewable energy sources. Specifically, customers who install alternative energy sources that are being used to power their on-site electricity, such as solar facilities, wind, biogas, and fuel cell generation facilities, will be eligible for the NEM program (California Public Utilities Commission, 2019). A net meter then measures the difference between the amount of electricity the system generates throughout the month and the amount of electricity the utility company supplies. The electricity that comes from the renewable system and is used to power the home or building then reduces the amount of money the customer must pay to a utility company every month (Pacific Gas & Electric, 2019a). Also, when the home renewable energy system produces more than that particular home needs, the surplus energy is then exported to the utilities electric grid and used elsewhere. This system seems to be working efficiently and can still provide a financial incentive for renewable energy implementation. This system also cuts down on energy waste by applying unutilized renewable energy to areas that would have previously been powered by non-renewable sources.

4.3.2 LEED Certification Incentive Program at the CCC

The CCC offers a fee reduction for applicants who get their projects LEED Certified. Established in 1993 by the U.S Green Building Council (USGBC), LEED (Leadership in Energy and Environmental Design) is the most widely used green building rating system in the world. (Komurlu et. all, 2015). LEED provides a framework that can be applied to create sustainable, highly efficient, and cost-saving green buildings (Komurlu et. all, 2015). The LEED certificate is available for many different building types and offers a highly efficient way to reduce emissions and reduce adverse environmental impacts associated with the lifespan of many large buildings. There are various different tiers of the LEED Certification, the most recently published system is known as LEED v4.1. The new LEED v4.1 certification claims to be the most inclusive and transparent platform to date, as it is more inclusive with updated referenced standards and allows projects to earn LEED points through building performance monitoring (U.S. Green Building Council, 2019). The USGBC has developed a four-level system for the LEED certification. These different levels each correspond to a specific number of points on a scale with a maximum of 100. These levels include: Certified (40 to 49 points), Silver (50 to 59 points), Gold (60 to 79

points), and Platinum (80 points or more). LEED credits are also awarded based on several categories: Sustainable Site, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design, and Regional Priority (Min Ho Shin et al., 2017).

In August of 2015, the California Coastal Commission adopted a new fee reduction for projects that are certified by the USBGC at the level of LEED Gold or higher. The breakdown of this fee reduction is shown in Table 2. When the applicant files their application with the CCC for the construction of a green building, they submit 60% of the original coastal application fee plus the remaining 40% fee reduction in the form of a letter of credit. After construction, the applicant must submit proof of their LEED Gold or higher certification and the CCC then releases the applicant's letter of credit, returning the 40% fee reduction back to the applicant (California Coastal Commission, 2015).

40% Fee Reduction for Proposed Green Building	Original Fee	Discounted Fee	Savings
Single Family Residence	$4,500	$2,700	$1,800
Subdivision	$25,250	$21,150	$14,100
Duplex	$7,500	$4,500	$3,000
Commercial Construction	$20,000	$12,000	$8,000

Table 2: California Coastal Commission LEED certification. Source: California Coastal Commission

Residential Fees (Single Family)	Silver, Gold and Platinum Level Members	Organizational or Non-members
Registration (1-25 homes)	$150	$225
Registration (>25 homes)	$50	$125
Certification (1 home)	$225	$300
Certification (per batch submittal)	$175 (Plus $50 per home)	$225 (plus $75 per home)
Appeals	$175 per project	$175 per project
Formal Inquiries	$220 per credit	$220 per project

Expedited Review	$1000 per project	$1000 per project

Residential Fees (Multifamily)	Silver, Gold and Platinum Level Members	Organizational or Non-members
Registration	$900	$1,200
Certification (0-49 Units)	$0.035 per sf	$0.045 per sf
Certification (>50 Unites)	$0.030 per sf	$0.040 per sf
Appeals: Complex Credits	$800 per credit	$800 per credit
Appeals: Credits	$500 per credit	$500 per credit
Appeals: Expedited review	$500 per credit	$500 per credit
Expedited Review	$10,000 per project	$10,000 per project

Additional Fees	Silver, Gold and Platinum Level Members	Organizational or Non-members
Registration	Varies based on scope of work (Typically $900 for single family home)	Varies based on scope of work (Typically $1,200 for single family home)
Green Rater Fees	Varies based on scope of work (Typically $1,700 for single family home)	Varies based on scope of work (Typically $1,700 for single family home)
Certification Upon Completion	$225	$300

Table 3: LEED certification costs for single-family and multiple family homes. Source: US Green Building Council.

The LEED certification process is highly effective at improving energy efficiency and cutting GHG emissions associated with buildings, however the certification process itself is can be quite costly and time intensive. Table 3 shows the associated fees for single family and multifamily homes. Many projects that occur within the coastal zone do not cost nearly as much

to construct as the LEED certification fee and corresponding energy efficient project alterations. Overall, the LEED certification has been incredibly successful in implementing new green building standards while helping new and existing development to become energy efficient. However, the current fee reduction system for LEED Certification that is in place at the CCC is currently not being utilized by many applicants and developers.

5.0 Discussion of Existing Policy Performance and Gaps

This section discusses the findings determined in the analysis section. Specifically, why certain programs did not work, and what mechanisms should be avoided. This discussion will be directed towards synthesizing information from the analysis with the goals of the California Coastal Commission. This section will work to answer sub-question 3 and demonstrate the need for further GHG emissions reduction in the state of California.

5.1 California Coastal Commission Mission and Coastal Act Applicability

According to the Coastal Act, the State Air Resources Board and various air pollution control districts throughout California are the primary public agencies with the authority to designate ambient air quality and emission standards as well as air pollution control programs. These agencies can recommend ways that the CCC can assist in the implementation of established air quality programs, and similarly, the CCC can make recommendations of changes for implementation at these agencies (California Coastal Commission, 1976). Section 30404 of the Coastal Act states that the commission should occasionally submit scientific recommendations to assist the agency in carrying out the mission of the Coastal Act in an efficient and effective way. The recommendations may include proposed changes in administrative regulations, rules, and statutes (California Coastal Commission, 1976). This section of the Coastal Act leaves room for suggesting the CCC implement a stringent and strict air quality policy. The CCC permits projects that will be severely impacted by the effects of climate change, and because of this, their air quality standards should be more restrictive and conservative than the pollution standards set for the entire state.

The Coastal Act has many different coastal resource planning and management policies. The subtopics for these policies include public access, recreation, the marine environment, land resources, development, and industrial development. Within each subtopic, there are various

sections that detail what can and cannot be done in regard to projects along the coast (California Coastal Act, 1976). Section 30253, under the development policy, states that there shall be a minimization of adverse impacts associated with any development within the coastal zone. Section 30253 summarizes the need for all new coastal infrastructure and development to be consistent with the established requirements imposed by an air pollution control district or the State Air Resources Board. Section 30253 also states that new developments shall minimize energy consumption and vehicle miles traveled. The Coastal Act also states that new residential, commercial, or industrial development needs to be conducted in ways that will not cause significant adverse impacts to surrounding areas and resources (California Coastal Commission, 1976). This also leaves room for the CCC to suggest a new policy or program with the goal of reducing GHG emissions. Adverse impacts inspired by climate change will result if total GHG emissions are not reduced, and the California Coastal zone will be especially susceptible to these adverse climate impacts. The residents and areas that are adversely affected by climate change are within the coastal zone, and as such the CCC should use section 30253 to achieve any further policy or regulation mandating overall GHG emission reduction.

5.2 Projects happening within CCC

After reviewing the permit applications that went to hearing over the part 6 years, the majority of the projects occurring within coastal zone are residential and single-family home developments. Many of the projects are simply single-family home demolitions and restorations. Projects also include additions to pre-existing buildings and facilities, such as the 2018 addition to the San Francisco West Side Pump Station. Other types of projects that the CCC permits include hotel and apartment development, Caltrans highway restoration, rock revetment and repair, and parking structure development. Some of the larger projects that the CCC permits include desalination plants and large parking structures. Lastly, the CCC permits various coastal adaptation projects such as the wetland restoration, beach nourishment restoration and living shorelines. (California Coastal Commission, 2019a). The “big-ticket” projects in terms of overall GHG emissions (i.e sector-based emissions and consumption-based emissions) are the larger apartment complexes, hotels, and desalination plants. However, projects that are not necessarily thought of when discussing GHG emissions, include the adaptation projects. These projects do

require an EIR to be completed, to account for any adverse air quality impacts, such as pollutants and toxic contaminants.

5.3 Incentives versus Mandates

After conducting an analysis of incentive-based programs in California, it seems that without the right incentives and education, these programs can fail to facilitate the reduction of GHG emissions. This analysis was conducted on a select few programs in California, and it should be noted that there are other incentive-based programs that have been successful in the Environmental field. However, after analyzing the CCC's LEED certification fee reduction, it is apparent that this program is not functioning in a way that is helping to reduce GHG emissions.

First off, there is an absence of education around this new program which creates confusion for applicants and developers who are not informed about what the LEED certification process entrails. There are many different facets and components to the LEED certification process, and for applicants who are not familiar with energy efficient building construction, this can be overwhelming. Aside from a brief snippet on the CCC's website, there is currently no guidance or documentation available for applicants to better explain the process of implementing energy efficient mechanisms and obtaining the LEED certification. Many applicants also do not take advantage of the LEED certification fee due to the fact that the LEED certification process can take longer than the construction itself, as there are many different facets of construction and project planning correlated with the LEED certification.

At the CCC, the LEED certification has not been obtained by applicants not only due to the lack of applicant education, but also due to the fact that it is quite expensive. Often, the cost associated with obtaining the LEED certified can be more than that of the fee reduction. Applicants are not motivated to participate in this program if they are not seeing an actual monetary savings. While there are many environmentally conscious applicants, it is unlikely that applicants will obtain the LEED certification if they are not receiving a monetary benefit as well. As it appears that the certification fees are costing more than the overall savings for applicants, this program is not working to facilitate energy savings and GHG reduction. Lack of education about the LEED certification process coupled with the unbalanced incentive system have caused this fee reduction program to fall to the wayside.

The CSI program, on the other hand, was a successful California program that established clear and concise guidelines for California residents detaining how they could receive a fee reduction for the implementation of solar energy. However, this program soon became inoperable in California as the State's administration, policies, and programs changed. As previously mentioned, starting in 2020, California will mandate that all new residential development must have solar energy. This then leaves no place for an incentive program offering a fee reduction to California citizens who implement solar energy. If incentive programs, particularly clean energy and GHG reduction programs, do not change to reflect the current state policy and legislation, the incentives will thus lose value. Incentive programs are a great idea in theory, however without the mandate or regulation helping to facilitate GHG reduction, the programs tend to fall short.

Mandated fee programs in California, on the other hand, have seemed to foster a higher success rate simply due to the fact that citizens are required to pay a fee to account for adverse impacts. Both the GGRF and Proposition 56 have seen success in reducing adverse impacts either caused by emitting pollutants, or by smoking cigarettes. The GGRF has found a way to funnel money obtained by the cap-and-trade system back into projects and programs that work towards reducing the GHG emissions that cap-and-trade accounts for. The GGRF has created a successful way to hold large emitters accountable for their GHG emissions while actively funding climate adaptation and mitigation projects. While Proposition 56 deals with cigarettes and tobacco rather than GHG emissions, the analysis has shown that this program has created a successful way to deter the use of cigarettes while simultaneously funding programs that work to reduce the negative effects of cigarette and tobacco use. This tobacco tax has been incredibly successful in deterring citizens from purchasing cigarettes regularly and has also provided funding for programs that otherwise would not have a large influx of money.

5.4 Why Another Climate Change Policy?

Many comments and questions about the results of this analysis have been directed towards the necessity of yet another climate change policy or program. If the state is already doing so much to combat the negative effects of climate change, what is the necessity of adding more regulation and restriction for California developers? There are many answers to this question, but

the most pressing and relevant answer is that the state of the environment is currently threatened with the continued rapid increase in global temperature. The IPCC released a special report titled "Global Warming of 1.5 °C" in Incheon, South Korea which stated that human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels. Global warming will likely cause the planet to increase in temperature by approximately 1.5°C (Allen M.R., et. all., 2018). The report also states that the warming from anthropogenic, or human caused, emissions from the pre-industrial period to the present will continue to cause further long-term changes in the climate system, such as sea level rise (Allen M.R., et al., 2018). According to Priyardarshi Shukla who is the Chair of the Global Centre for Environment and Energy at Ahmedabad University, "Limiting global warming to 1.5°C compared with 2°C would reduce challenging impacts on ecosystems, human health, and well-being,". These impacts include stronger storms, more erratic weather, dangerous heat waves, rising seas, and largescale disruption to infrastructure and migration patterns (Leahy, 2018). This report demonstrates that the usual deliberation about political viability and feasibility is no longer working and is not working fast enough. Globally, action needs to be taken at an expedited rate and in an efficient and concise manner targeting climate change impacts. The way which we are doing things, especially the United States, is not proving to be enough to help in saving and preserving our global natural resources and planet. The Paris Agreement, established in 2015, required every country in the world to keep temperatures below 2°C. However, with the current administration pulling the US out of the agreement, along with low-lying island states and others reducing significantly less, global warming is anticipated to warm the planet by 3°C by 2100. The IPCC defined ways to reduce this number and correct the current trajectory, however it requires unprecedented extensive action begin taking place immediately. Some of these solutions include cutting fossil-fuel use in half in less than 15 years and elimination of all fossil-fuels in 30 years. On a large scale, this involves a massive switch from our accustomed and habituated way of life. This call to action demands immediate and effective action, hence the need for more greenhouse gas reduction policies be implemented immediately.

California's coastline fuels the state's economy, specifically though recreation, tourism, and fisheries. Five of California's most heavily populated counties border the Pacific Ocean. In 2015, California's coastal economy generated approximately $662 billion in wages and $1.7 trillion in GDP. The coastal counties of California alone generate a GDP that is only exceeded by 11

countries (NOAA, 2015). Tourism and recreation account for the largest sector of California's coastal income. In 2012, ocean-dependent tourism and recreation generated more than $1 billion of GDP in the California counties of San Mateo, San Francisco, San Diego, Orange, and Los Angeles. California's beaches and ocean-based recreational activities make for an extremely popular travel destination not only for other American citizens, but also for foreign travelers. In 2012, total trip expenditures averaged $4,018 for international visitors (NOAA, 2015). Commercial fisheries are also an incredibly important part of California's overall economy. In 2011, approximately $201 million dollars in revenue came from commercial fishery landings, and more than 120,000 jobs on and off the water were supported by the state's seafood industry (NOAA, 2011).

The Coastal Act prioritizes preservation of public access to the coast and the enhancement of public access wherever possible. By enacting policy to reduce the impacts of climate change, the Coastal Commission would continue to uphold their core values of preserving California's coast and ensuring public access to the coast for future generations. Moreover, building within the Coastal Zone should require an extra fee simply due to the fact that the California Coast is incredibly vulnerable to climate change impacts. The coast of California faces threats that areas inland do not, such as sea level rise, coastal squeeze, coastal erosion and salt water intrusion. Due to these climate impacts, California's coast is slowly receding. The demand for coastal property, business, and tourist lodging has not decreased and as a result, there is not much more space to build within Coastal areas. As more land is being consumed by development as well as climate change impacts, the areas available for new buildings is now incredibly scarce. As with other scarce resources, the price for building in this threatened area should be higher. In terms of this policy, the "price" is in the form of a GHG fee for large scale emitters.

Furthermore, the Coastal Act provides guidance on more specific topics such as energy use and development, wetlands and sensitive habitats, hazards and preservation of sensitive habitats and species. Moreover, the Coastal act also aims to conserve the natural resources within the coastal zone, such as endangered plant and animal species. As threats of inward coastal retreat increase, many endangered plant and animal species will lose their habitat. Most of the California coast will experience an average of 3 to 5 feet of sea-level rise within the current century, which means that a substantial amount of habitat will be lost. Specifically, in the San Francisco Bay and Sacramento-San Joaquin River Delta, species such as salt marsh harvest

mouse, California clapper rail and Suisun thistle are in jeopardy of being trapped between rising seas and shorefront development (Center for Biological Diversity, 2013).

6.0 Analysis of New Policy Options

This section addresses sub-question 4 by detailing potential mechanisms to include in a policy framework that would facilitate removal of GHG emissions from the atmosphere. This analysis explores both successful and unsuccessful mechanism that have been used in the attempts to reduce climate change impacts through emissions reduction, emissions computation and emissions pricing. Specifically, this section covers the analysis of components that are present in current GHG reduction policies and programs, and offers ways to compute, measure and manage GHG emissions. Finally, this section will provide further detail about a program that focuses on resilience for buildings and structures in the face of climate change.

6.1 Carbon Pricing

In California, the state regulates greenhouse gas emissions in two different ways. These include the cap-and-trade program and a Carbon Tax (Bang et. all, 2017). A carbon tax is a fee that sets a price on carbon by placing a tax upon emissions that come from the burning of fossil fuels (coal, oil, and gas). A carbon tax creates a system in which the users of carbon fuels are required to pay for the climate damage caused by releasing carbon dioxide into the atmosphere. If set high enough, it helps to motivate a change to clean energy across the economy, simply by making it more economically rewarding to move to non-carbon fuels and energy efficiency (Hamrick, K., et. all, 2017). The main difference between a carbon tax and the cap-and-trades system is that cap-and-trade "caps" the total level of greenhouse gas emissions and allows those industries with low emissions to sell their extra allowances to larger emitters. By creating supply and demand for emissions allowances, cap-and-trade can establish a market price for greenhouse gas emissions. Both Cap-and-trade and a carbon tax place a price on atmospheric carbon, which helps to hold businesses who are responsible for the influx in emissions responsible. Instead of creating a strict and exact system of which entities should reduce emission, a carbon price establishes an economic penalty and polluters can then decide if they want to reduce their emissions to save money or continue polluting and pay for it.

6.2 Carbon Offsets

Carbon offsets have become a popular method for reducing GHG emissions globally. While carbon offsets differ dependent on the company administering the offsets, the general concept of carbon offsetting involves directly reducing GHG emissions by preventing GHG emission elsewhere. Carbon offsets can be purchased to offset the carbon that an entity emits. Carbon offsets can be generated in many ways, such as by investing money into alternative energy, or by planting trees to capture carbon dioxide. This is a direct "molecule for molecule" way to reduce GHG emissions. For example, someone who fly's often can invest money into a carbon offset company that plants trees in the amazon, thus reducing the GHG emissions associated with their excess flights. Carbon offsets are commonly measured using metric tons and compute the amount of GHG emissions associated with a certain project coupled with the amount of GHGs reduced from an offset project. Essentially, carbon offsets should work to reduce more GHG emissions from entering the atmosphere, so when an entity purchases a carbon offset, that entity is preventing more GHG emissions from entering the atmosphere by investing in a specific offset project. (Duke University, 2009).

When looking into different ways to facilitate GHG emissions reduction, carbon offsetting is one of the most widely used tools for facilitating GHG emissions reduction, as offsets offer an exact molecule for molecule emission reduction. However, after extensive amounts of research and interviews with professionals working in the offset field, this analysis demonstrates that carbon offsetting my not be the most efficient way to reduce GHG emissions. This is due to the lack of administration and oversight within projects, flaws within the offsetting system, carbon measuring error, and constraint on project type.

The concept of planting trees, reducing the use of coal, and saving energy are all great ideas in theory, however the actual execution of these projects often requires more oversight and administration the offset system does not have currently. Carbon Offsets Ltd sells offsets from a South African project that encourages poor households to change their ways in regard to how they fire building. This project teaches poor families how to switch from using coal in cans to make fire and instead encourages them to construct their fires with coal on the bottom to produce less smoke and more heat. This, in theory, will inspire less coal use while maximizing the amount of heat produced. While this is a good concept, there is no one that checks that these people in these South African communities are really building their fires the correct way. No

administration or oversight is provided once these projects are put into place and executed. Without the guidance and accountability, many of these projects end up slipping through the cracks and do not end up offsetting carbon in the long run.

While there is plenty of valuable and positive change that can come from the use and implementation of offsets, it is clear that there are too many variables that can cause the use of offsets to become more detrimental in the long run. The concepts of additionality and leakage that exist within the carbon market and offset system could create long term issues within a policy framework, and lead to legal problems for the CCC. The term "additional" refers to the assurance that the collected offset funds will going directly into programs that support new carbon reduction or offset projects (B. Haya, 2013). In other words, these funds must create means of reducing or offsetting emissions that would not occur if the funding was not provided. Projects which offset carbon, or which are directed towards emission avoidance, that would have happened without the funding are referred to as "Non-Additional". (B. Haya, 2009). An example of this could occur when someone pays into a carbon offset fund that claims it will use the money to prevent deforestation in that Amazon. A problem could occur if the Amazonian landowner never had any intention of clear-cutting his land. This offset money would then be considered a "gift" rather than a tool used to reduce carbon emissions. The landowner would be taking advantage of the offset system to collect money for something they would have been doing anyway. This occurred in the carbon offset market when one of the biggest offset companies in the United Kingdom, known as Climate Care, decided to offer a carbon offset to customers in the form of donating 10,000 energy-efficient lightbulbs to a South African township. They offered these carbon reductions as offsets for customers to pay for, only to discover that a different energy company was giving the exact same lightbulb to these townships for free. In this case, the carbon offset money was going towards a reduction would have happened anyway (Davies, 2007).

Another area of concern would be the concept of leakage. Leakage refers to whether the carbon emissions reduced or mitigated do not, in turn, occur elsewhere (Charles W Schmidt, 2009). This concept of leakage can be demonstrated through the same example used in demonstrating additionality. If the offset money had prevented the Amazonian farmer from clearing the land, that would help to reduce carbon emissions. However, often the logging companies will simply buy the plot next to the plot being preserved. This demonstrates the

concept of leakage, as the offset money simply shifted the deforestation rather than stopping it. While the use of carbon offsets has potential to reduce carbon emissions if done correctly, there are too many areas within the offset system that could lead to an unsuccessful policy and lack of overall greenhouse gas reduction.

There are also issues with preserving forests and land for offsetting carbon, that is inhabited and used by different groups of people. Many areas in the tropical rainforest and other rural areas that provide enough space and fruitful land for vast amounts of tree-planting are currently in use. Some tree-planting projects in Guatemala, Ecuador and Uganda have been accused of disrupting water supplies; evicting thousands of villagers from their land; seizing grazing rights from farmers; cheating local people of promised income; and running plantations where the soil releases more carbon than is absorbed by the trees (Davies, 2007).

Carbon offsetting is a great concept that is appealing to many large-scale carbon emitters, which is molecule for molecule carbon accounting and reduction. Emitters can emit a specific amount of carbon and through offsets, can reduce that exact amount of carbon. This issue with this process is that the inaccuracy in the process of obtaining these measurements. There is often a tendency for land managers or hired consultants to use repeated and unverified simplifications in carbon accounting by taking single values from the literature and applying them to the systems that they are measuring. These values are not uniform and cannot be applied to all projects, thus making these values not applicable. Simply put, not all consultants and land managers have the skillset and training required for correct and concise carbon measurement. In addition to the expense of hiring an outside consulting group or land manager, the proper equipment required for concise carbon calculation is very costly. Direct carbon measurements taken from water, soil, or the atmosphere are typically very labor intensive and require expensive equipment to accurately record data (Bastviken et al., 2015).

In summary, it is a quite costly and labor-intensive process to compute carbon and GHG emissions. Measuring carbon requires costly equipment and highly trained scientists and consultants to obtain accurate information. If the incorrect equipment is being used coupled with an untrained field professional, inaccuracy of data and incorrect management recommendations may come as a result. Due to this, GHG emissions are not always reduced and accounted for when data and management recommendations do not reflect accurate carbon levels.

6.3 Measuring GHG Emissions

The building sector contributes to approximately one third of the combined overall quantity of greenhouse gas emissions. This is due to continued use of fossil fuels throughout the entire construction and operational phase of the buildings life. Tracking, measuring, and computing GHG emissions is a rather complex task, as there are many factors to consider when measuring GHG emissions. To start, emissions migrate all over and do not stay in the same spot that they were originally emitted. Second, there are different phases that involve the release of GHG emissions, especially when computing building construction. When computing the amount of GHG emissions associated with new building construction, emissions created in the manufacture of materials and their transportation, construction activities themselves, and the installation of renewable energy sources must be considered. In addition, greenhouse gas emissions come from post-construction activities such as on-site combustion of fuels for heating and cooking and from the electricity used to provide power for lighting, ventilating, and air conditioning (Mardiana, 2015).

Sector-based emissions inventory refers to the GHG emissions associated with the energy used to power homes, vehicles, as well as emissions associated with the materials in products. These emissions are broad and do not account for emissions that come from local consumption of goods that were produced outside of that specific area (Climate Action Plan, 2015). There is also a substantial release of GHG emissions associated with the energy consumption and chemical processes during the extraction of raw materials, transportation of the materials to the site, construction, maintenance, final demolition as well as all the activities and processes along the supply chain that constitute the building. (Metham et al., 2018). These emissions are referred to as consumption-based emissions inventory, or embodied emissions (Dewolf, 2017). Consumption-based emissions factor in the entire lifecycle of various goods and services. This lifecycle accounts for emissions associated with the preproduction, production, use and eventual disposal of a product. Sector-based inventory only includes GHG emissions associated with the production of goods regardless of who buys them, where they are located in the world, and the processes and emissions associated with delivering that good to the consumer (Climate Action Plan, 2015). The difference between sector-based emissions and consumption-based emissions is displayed in Figure 8.

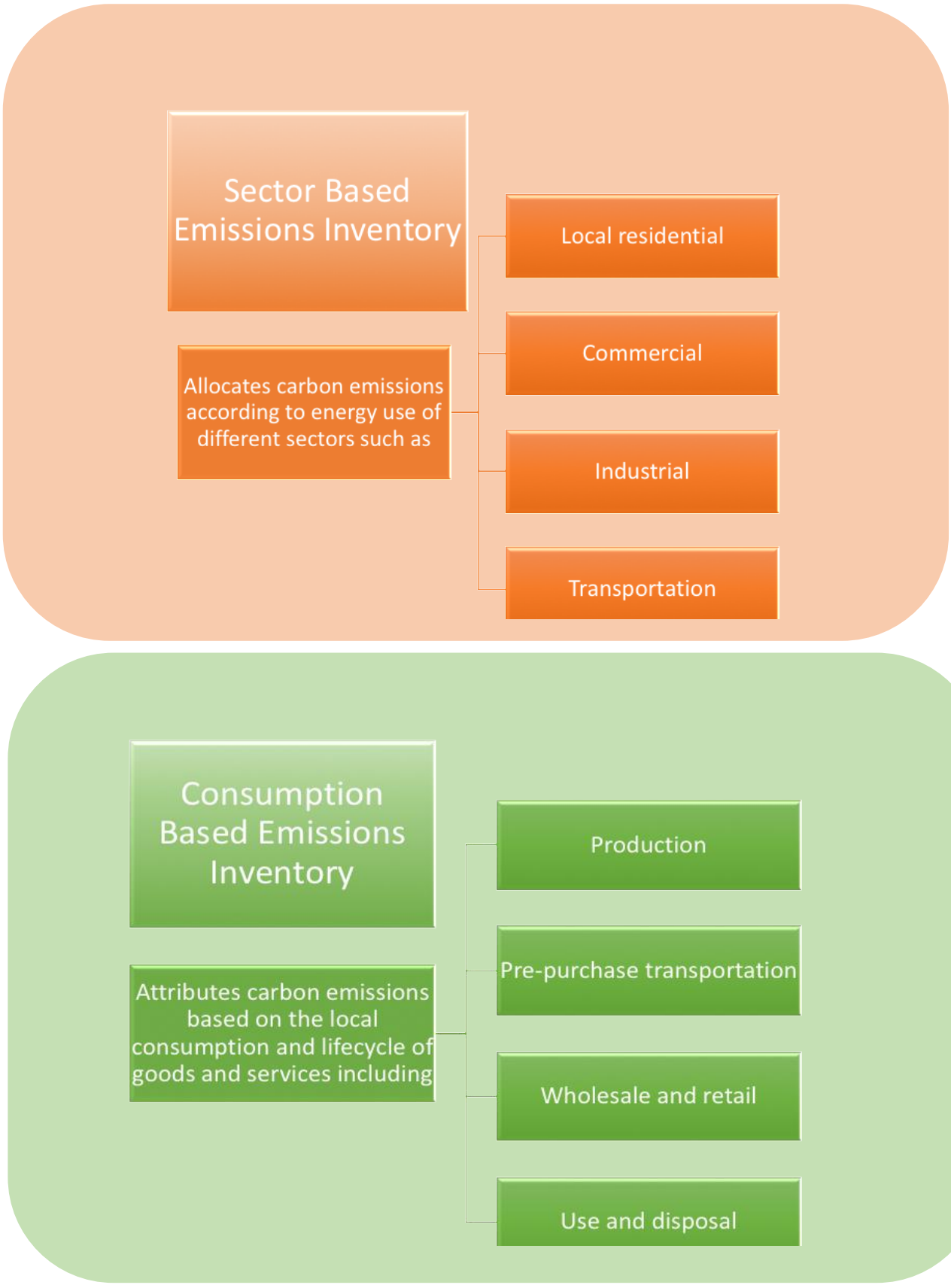

Figure 8: Sector-based emissions inventory versus consumption-based emissions inventory.
Data obtained from the City of Portland

The following sections will provide an analysis on the difference between GHG inventory methodology and GHG registry methodology. This section will also analyze GHG computation tools that are used to compute the amount of pollutants being discharged into the environment. These tools include CARROT, CRSI, EPA's Simplified GHG Emissions calculating tool, the URBEMIS calculating tool developed by ARB, and the CalEEMod.

6.3.1 GHG Emissions Inventory Methodology

There are various different programs and methodologies that are used to measure GHG emissions. Much of the information gathered comes from GHG inventories, which are estimates of both GHG emissions and GHG removals from given sources and sinks in a specific region (EPA, 2010). GHG inventories provide information about GHG emissions within a specific boundary, and follows guidance established by the IPCC, EIIP, and WRI. An example of a widely used GHG inventory system is the California Greenhouse Gas Emissions Inventory, which is maintained by CARB. This program helps to track GHG trends over time to better assess and critique current progress that is being made in reducing GHG emissions. This inventory also provides estimates of anthropogenic GHG emissions within California as well as emissions associated with imported electricity (California Air Resources Board, 2018d).

6.3.2 GHG Emissions Registry Methodology

Another way to compute and track GHG emissions is through a GHG emissions registry. A GHG registry is a database that tracks GHG emissions data supplied by facilities or companies who emit GHGs. Registries can vary in their reporting level requirements, and also may require a third-party verification to be included in the registry data base (EPA, 2010). Registries collect "bottom-up" data from individual emitters, where as a GHG inventory is a "top-down" and comprehensive summary of the total emissions of a specific area (Heilmayr, 2008). Registries can be voluntary or mandatory dependent on what their data will be used for. Voluntary registries collect data from businesses and organizations who are actively seeking out ways to reduce GHG emissions associated with their company or organization. Mandatory registries are typically implemented to track the progress of regulatory programs implemented at a federal, state, or agency level (Heilmayr, 2008).

A GHG registry can be beneficial for assessing individual emitter data. An example of a registry program that was successful in California was the California Climate Action Registry. The California Climate Action Registry was a voluntary non-profit organization that was established in 2001. This registry was a program of the Climate Action Reserve and was overseen by CARB and CEC. The California Climate Action Registry was committed to tracking overall additional GHG emissions as well as overall GHG emissions reduction.

6.3.3 CARROT

The California Registry helped to establish protocols to guide emissions registries and inventories. They also helped to develop an online tool which is known as the Climate Action Registry Reporting Tool (CARROT) (Climate Action Reserve, 2008). CARROT serves as a GHG emissions calculator and reporting software and is used by California registry members, verifiers, and the public. CARROT is a web-based spreadsheet tool that helps participants calculate and report their associated GHG emissions, facilitates certification, enables data tracking, and allows the public to view aggregated reports. CARROT uses built-in emission factors and conversion factors to calculate GHG inventories. Users can input annual energy usage data and CARROT will then calculate the GHG emissions that are associated with that energy use. Web access allows for simultaneous usage by any number of users across states, countries and time zones (California Climate Action Registry, 2009). CARROT was the official emissions computation tool used in the General Reporting Protocol (GRP), which provided guidance for businesses, government agencies, and non-profit organizations to participate in the California Climate Action Registry.

6.3.4 CRSI

The Climate Registry Information System (CRIS) is an online system that is used to measure, report and verify carbon footprints. CRIS offers modules for calculation, reporting, and verification that can support a wide range of activities, such as development and technology use. This program is currently being used by California EPA's state agency reporting program. This program allows users to upload their own information from Excel spreadsheets directly into data tracking tools, such as Energy Star Portfolio Manager (The Climate Registry, 2018). CRSI's

built-in calculation tool will then automatically generate estimated emissions totals based on the data input detailing activities (such as fuel type, technology type, and quantity) (The Climate Registry, 2018). CRIS will then provide emissions summaries in terms of metric tons of individual greenhouse gases. These final reports can then be exported back in Excel or PDF formats, and this information will be verified by a third-party before being uploaded directly into the CRSI reporting platform.

6.3.5 The EPA Simplified GHG Emissions Calculator

The EPA Simplified GHG Emissions Calculator is a calculation tool designed in order to assist low emitter organizations, single family homes, and small business in computing their greenhouse gas emissions. The calculator helps to determine the direct and indirect emissions from all sources at a company when activity data are entered into the various sections of the workbook for one annual period (EPA, 2018b). More specifically, this calculator looks at the direct emissions from onsite combustion and mobile sources as well as the indirect emissions from purchased electricity and steam. The emission factors that are built into this calculating tool are consistent with the EPA Emission Factors Hub, which are pre-set by the federal EPA.

6.3.6 URBEMIS

URBEMIS, or the Urban Emissions Model, is a computer program that was developed in 2007 by the Air Resources Control Board. This model has been used to estimate emissions associated with land development projects in California (ARB, 2011b). Some of these development projects include residential neighborhoods, single family homes, office buildings, and large retail spaces. This program estimates greenhouse gas emissions in both pounds per day and tons per year. The model also uses the Institute of Transportation Engineers' Trip Generation Manual along with the ARB's motor vehicle emissions model to calculate motor vehicle emissions. The "Mobile Source Mitigation Component" of the ERBEMIS model helps to estimate potential vehicle travel and the associated emission reduction benefits from different land use and transportation-related strategies within the project site and in the surrounding area. Some of these strategies include pedestrian and bicycle facilities, public transit facilities, design and mix of land uses, and various other on-site services. The model also has special features to minimize "double-counting" of trips in mixed-use projects that include both residential and non-

residential land uses and to standardize the estimation of stops made on the way to other destinations (ARB, 2011b).

6.3.7 CalEEMod

The California Emissions Estimator Model (CalEEMod) is a statewide land use emissions computer model. This model was designed in hopes of providing a uniform emissions computation program for government agencies, land use planners, and environmental professionals to quantify potential greenhouse gas (GHG) emissions associated with both construction and operational cost (AQMD, 2019). This emissions accounting method measures direct emissions from construction and operation activities, as well as indirect emissions. These indirect emissions include associated GHG emissions from energy use, solid waste disposal, vegetation planting and/or removal, and water use (CalEEMod, 2017). The model was developed for the California Air Pollution Officers Association (CAPCOA) in collaboration with the California Air Districts. Default data such as emission factors, trip lengths, and source inventory have been provided by California Air Districts to account for local requirements and conditions. The model is a comprehensive tool that is used for preparing CEQA and NEPA documents as well as conducting pre-project planning and compliance. This model has California's specific policies and guidelines enabled within the system and therefore could be a great tool for this CCC GHG reduction policy.

6.5 Resilient Design

As climate change continues to intensify storms and weather, the built environment has become more susceptible to disaster. As a result, there has been a push to create more resilient and better adapted buildings and communities. RELi (pronounced rely) is a resilient design rating system for sustainable building and development. RELi integrates various different resilience criteria for next-generation building development and has worked to develop a system of sustainable design. This program defines "resilience" or "resilient design" as the development of buildings and communities that are shock resistant, healthy, adaptable and regenerative through a combination of diversity, foresight, and the capacity for self-organization and learning (Pierce, 2017). RELi was established in 2012 by The Institute for Market Transformation to Sustainability (MTS) and Capital Markets Partnership (CMP) in hopes of better preparing

buildings and communities with strategies and tools to plan for potential emergencies. This program was also enacted to assist in the development of adaptation measures for persistent climate risk mitigation (Holowka, 2017). For example, RELi's program includes plans and strategies for emergencies, such as hurricane preparedness, while also incorporating requirements for overall resilient design, such as energy efficiency (Druliner, 2018). As of Fall 2017, both the US Green Building Council (USGBC) and the Green Business Certification Inc. (GBCI) had adopted the RELi rating system in hopes of creating more resilient infrastructure nationwide.

RELi's has a specific system of requirements and credits that are all calculated to produce a specific score. Specifically, the program has a comprehensive credit catalog that contains a list of over 190 'actions' to select from that can help make almost any development project more resilient. These actions are divided up into eight categories which include: panoramic design, hazard preparedness, hazard adaptation, community vitality, productivity, health, and diversity, energy, water and food, materials and artifacts, and lastly, applied creativity (Pierce, 2017). Each action has a specific number of credits associated with it, which are totaled up at to produce a final credit total. With a total of 300 credits, a building is Certified. Silver status is reached at 350 points, Gold status is reached at 400 points, and Platinum status is achieved at any point total greater than 600 points.

Within this credit system, RELi has certain requirements that overlap directly with requirements that are essential in order to obtain the LEED certification. What seems to work well within the RELi and LEED overlap is that the RELi system has a significant amount of options when it comes to project adaptations. For example, there are certain required adaptations for the RELi certification, such as minimum water efficiency, and minimum energy efficiencies, which are both adopted from the LEED certification process. However, RELi then offers over 20 other additional project adaptations, like solar access, vegetative cooling, alternative sewage management and reduced air pollutant emissions, that are separate from the LEED requirements. RELi offers more attainable project modifications that not only assist in greenhouse gas reduction but help to provide climate change adaptation measures for structures to assist in making them more resilient.

During an interview with Patrizia Kuehn, who is an assistant project manager at Plant Construction Company, she spoke candidly about her personal experience with the RELi

program. Through Ms. Kuehn's time at Plant Construction Company, they have implemented both LEED and RELi into their projects and have had success with both programs. Ms. Kuehn implied that the RELi system was quite easy to use and implement on a project wide level. Specifically, Ms. Kuehn stated that, "When going through schematic design on a project, a client can easily be drawn into the idea of resilience. With various tools to break down the concepts, a project team can identify just a few goals that are most beneficial to the specific conditions of the site or audience. This makes resilience easier to fathom as a concept and much more effective to implement in real time. Not only does it tackle some of the ethical and environmental challenges affecting the area, but also it can save the client money, if these ideas are explored early on" (Kuehn, 2019).

7.0 Policy Recommendations

Based on the information gathered in this analysis, four recommendations have been established for implementation at the California Coastal Commission. These recommendations offer suggestions of programs, policies, and amendments for the CCC to implement with the overall goal of reducing GHG emissions associated with coastal projects while protecting the California coastline. Recommendation 1 and 2 are being recommended in concurrence with Recommendation 3 and 4. However, recommendation 3 and 4 are separate recommendations that are being offered to the CCC, and act as alternative recommendations to each other.

The CCC can make the decision on which recommendation would be most beneficial to the agency and which they feel will be easily implemented agency-wide. Recommendation 3 comes in the form of a market-mechanism based policy framework where recommendation 4 comes in the form of a regulatory mandate. The goal of all of four of the following recommendations is to ensure that the California Coastal Commission is working towards reducing GHG emissions reductions while highlighting the need for coastal adaptation to protect California's coastline. Both recommendation 3 and 4 provide funding options to funnel money towards coastal adaptation projects. The CCC should consider these recommendations with the goal of protecting California's coastline and preserving this area for all California citizens.

7.1 Recommendation 1: Amend the Coastal Act

The first recommendation this analysis has suggested is that the CCC should amend the Coastal Act. As previously stated, the CCC was established in 1972, and the Coastal Act was put into use in 1976. Many of the impacts that are currently affecting the California coastline were either not present 40 years ago or were not exacerbated to the levels at present-day. The Coastal Act should be amended to address the effect that GHG emissions are having on California's coastline. As climate impacts become more severe within the coastal zone, the Coastal Act should work to incorporate new guidance for large development. The Coastal Act should also identify the associated environmental costs that come along with current coastal development. As California's coastal zone continues to recede inland, the Coastal Act should limit the amount of development that can occur in areas that are currently being affected by sea level rise, coastal erosion, and other climate impacts. The Coastal Act should align with California's current climate policies, and incorporate more guidance pertaining to coastal adaptation projects. California is pushing ahead with innovative and aggressive climate change policy, and the Coastal Act does not fully align with current state policy. As a leader in California environmental preservation, the Coastal Act should adhere to current California policy while pushing forward as a leader in fostering climate change initiatives and policies. Lastly, the Coastal Act also must address current and projected impacts California's coastline is facing due to climate change (i.e salt water intrusion, coastal erosion, coastal squeeze, etc.) As California continues implement new policies and regulations surrounding GHG emissions, the CCC needs to work towards catching up and ensuring that California's coastline is preserved and protected against climate change to the maximum extent possible.

7.2 Recommendation 2: Require RELi Certification

As climate change impacts continue to threaten the built environment, developers must account for the fact that these impacts are more intense and prevalent in coastal areas of California. New development and renovations should be required to ensure that structures within the coastal zone are designed to be resilient. A way to ensure that new development is not only equipped to combat climate impacts, but is actively reducing GHG emissions, is to require RELi certification. As stated in the analysis section, RELi uses a credit system, giving the applicant the ability to craft a development that incorporates hazards preparedness, resilient design, and

climate change adaptation to ensure that buildings and communities are better adapted to climate change. RELi utilizes a "panoramic" approach by requiring the developer to analyze and understand the adaptation needs of the project as well as including community stakeholders in the design process (Cohen, 2017). The RELi system was recently adopted by the USGBC and is currently being workshopped to combine the LEED Resilient Design credits with RELi's credits. This new green building certification that accounts for resiliency as well as reducing climate change impacts through reducing GHG emissions associated with new buildings would be a great tool for the CCC to implement. Coastal development should prepare for the negative impacts of climate change and should implement resilient design into their development process. Development within the coastal zone should also require climate change reducing mechanisms, due to the fact that coastlines are receding and the areas to build are becoming scarce. Since the California coast is such a premium place to build, developers should be held accountable for doing as much as possible to combat the climate impacts associated with their development. Requiring structures to be certified through RELi will assist in creating resilient structures along California's coastline to better suit them for climate change impacts.

7.4 Recommendation 3: Greenhouse Gas Fee Policy

This recommendation comes in the form of a greenhouse gas fee policy that the Commission could implement to encourage GHG reduction within the coastal zone. This policy recommendation is based off of a market mechanism that helps to facilitate greenhouse gas emissions by placing a price on GHG emissions associated with coastal development. The greenhouse gas fee policy is comprised of three key components that work towards not only reducing GHG emissions associated with coastal development, but also work to establish a source of funding for coastal adaptation projects in California. The components that make up this policy framework are demonstrated in Figure 9.

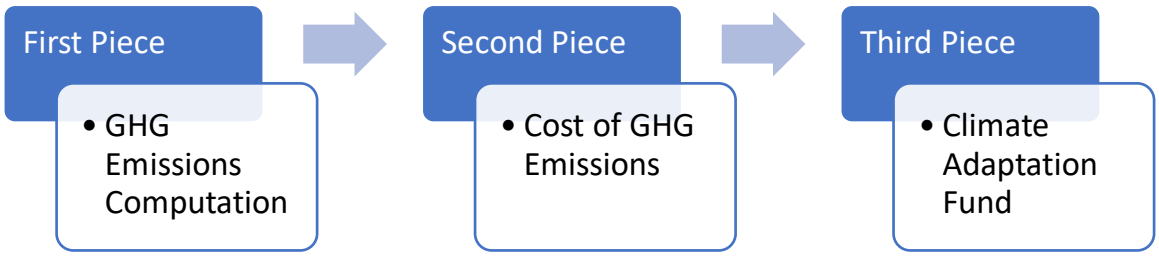

Figure 9: Components of a GHG Fee Policy.

The first piece of this policy recommendation involves the analysis of GHG emissions associated with each project within the coastal zone. Applicants should be required to compute the GHG emissions associated with all aspects of their proposed project. This means that applicants will need to account for both sector-based emissions and consumption-based emissions associated with development. As mentioned in the analysis of GHG emissions computation, there are many different stages of GHG emission release. When originally crafting this policy framework, the greenhouse gases emitted during construction were the only GHGs that were to be included in this policy, as the CCC deals primarily with coastal development and construction. However, after conducting a proper analysis on both sector-based GHG emissions and embodied GHG emissions, it became clear that greenhouse gases are emitted during not only the construction of a building, but also during the entire lifecycle of a structure. Both Dr. Barbara Haya and Dr. Laurie Koten pointed out the potentially negative implications of only accounting for GHG emissions associated with construction. Focusing solely on construction emissions could actually lead to perverse incentives. If this policy only accounted for GHG emissions released during construction, applicants may be tempted to use cheaper materials in the building design that actually lead to a higher GHG emission rates for the entirety of the building lifespan. Consider the use of solar panels and the GHG emissions associated with fabricating them. If the proposed policy framework only focused on the construction phase of development, there would be no incentive to use alternative energy, such as solar and energy efficient insulation, which could eventually lead to a high expenditure of GHG emissions. While this policy ideally

incentivizes energy reduction, the total GHG emissions must be accounted for in the construction and lifecycle of a building. Thus, this policy must account for energy use in the projected lifecycle of a building.

The CCC should establish an appropriate GHG inventory calculation tool that takes all stages of development into account to ensure that all GHG emissions are accounted for. The CCC should look towards tools such as CARROT, CRSI, The EPA Simplified GHG Emissions Calculator, URBEMIS, and CalEEMod to determine which tool can be implemented into the coastal permit application. The appropriate GHG calculation tool will allow applicants to input different materials, construction processes and mechanisms, energy sources, and project metrics to determine the GHG emissions associated with the development. All projects should use a 50-year lifespan when calculating associated GHG emissions to ensure consistency and to account for the potential of climate change impacts. When applicants apply for a coastal permit, they will be required to input information into one of these GHG inventory measurement tools. This then allows the applicant to experiment with different materials, methods, and mechanisms before being charged a fee. This also helps to implement a mitigation component on the front-end of development, as applicants have the choice to use energy efficient, local, and renewable materials to avoid being charged fee.

The CCC should look to the PG&E Tier system as a model for establishing a GHG threshold. As PG&E has done, the CCC should establish an allowable baseline GHG emissions threshold, and once the applicant's GHG emissions have crossed that threshold, they will be required to pay a certain fee. However, the CCC should establish a baseline allowable amount of GHG emissions, and when that baseline is exceeded, the applicant must pay a fee dependent on how much they exceed the baseline. By establishing a baseline, this ensures that small projects, such as a single-family home or small property adjustments, will not be required to pay the same fee as a large parking structure, an apartment complex, or a desalination plant. PG&E has established a Tier 2 and high usage surcharge that charges customers based on the percent in which energy usage was exceeded. The CCC should follow this framework and charge applicants a fee based on the percentage in which they exceed the baseline for allowable GHG emissions per project.

The second piece of this policy framework involves establishing a dollar amount associated with the applicant's GHG emissions. The CCC should place a monetary value on each

ton of CO2 that exceeds the baseline allowance (It is important to note that the term CO_2 and GHG emissions are often used interchangeably). For example, applicants may be required to pay $10 for every ton of CO_2 that exceeds the baseline allowance. The exact numbers and monetary value should be established by the CCC, as they will need to ensure that the value is feasible and that the monetary value fits in with the filling fees laid out in Article 4 of the Fee Regulations for the California Coastal Commission. The implementation of a flat fee per ton of CO_2 would help CCC staff and applicants to calculate and track the associated fee.

The third piece of this framework deals with the allocation of the money obtained in the instatement of this policy. After analyzing the benefits and drawbacks of direct emissions accounting (i.e Carbon offsetting) as well as analyzing the pros and cons of an overall fund (i.e GGRF), this analysis suggests that the establishment of a fund would most effectively and efficiently facilitate GHG emission reduction. As mentioned in the previous section, it is clear that the carbon offsetting system has many flaws that result in potential gaps in consistent GHG emissions reduction. When establishing a fund, there is an ability to choose exactly where the funds go as well as how the funds get dispersed. When funds must go directly into a land-based project, there is then the requirement to follow and measure the carbon capture associated with this project. This is due to the fact the offset system requires direct emissions reduction for all emissions released. This is very limiting in the fact that this restricts the types of projects that can be done with the associated funds. If projects are required to reduce the exact amount of GHG emissions as were released, funds can only be used towards very specific projects. This system does not allow for funding projects that may work to continually reduce GHG emissions in the future. Another benefit of directing money into a fund is that it takes away the costs associated with computing carbon emissions in order to offset them efficiently. As previously mentioned, measuring carbon can be extremely costly due to consulting fees and equipment, and is often laced with error and inaccurate data. By placing money obtained from a GHG fee directly into a fund, more of this money can go towards projects benefiting the adaptation of California's coastline to the impacts of climate change, rather than going towards data collection and consulting fees.

This analysis showcases the benefits of the establishment of a fund, and as such, the money collected from the GHG emissions fee be directed into a climate adaptation fund. The money collected in the fund should go directly towards projects that work to adapt to climate

change issues along the coast. As demonstrated in the analysis, the need for climate adaptation along California's coastline is only going to increase over time. As sea level rise, saltwater intrusion, coastal erosion, and various other climate impacts along the coastline of California continue to escalate, more money is going to be needed to fund these projects. Projects such as wetland restoration and living shorelines will work to naturally sequester carbon while providing a coastal buffer for flooding, reducing coastal erosion impacts, and providing habitat for wildlife (NOAA, 2018a). Raising coastal berms and creating healthy tidal marsh areas can help to create coastal barriers to block out and absorb excess water during intense storms while diffusing intense wave energy. While these projects cannot draw an exact conclusion as to a quantifiable amount of greenhouse gas reduction, they will assist in expanding California's coastal adaptive capacity to withstand climate change impacts.

This adaptation fund will help to justify the need for applicants to pay yet another fee on top of the many fee's that California developers are required to pay. With California's stringent requirements for development, it seems that there will likely be push back from developers who feel that this fee mandate would be overkill. This analysis has demonstrated that the California coastline is an extraordinarily valuable resource that is currently at risk. This area is extraordinarily sensitive and is currently receding due to climate change and associated impacts. As such, applicants who exceed the allowable level of GHG emissions for coastal projects should be required to pay into a fund that allocates money to the development of coastal adaptation projects that further provide protection to the California coastline.

While implementing a new fee on the already heavily taxed and regulated development sector may be daunting for the Commission, more funding is needed to adapt to the climate impacts the California coastline is currently facing. There is simply not enough funding currently available for the amount of coastal adaptation the state needs. Moving urban infrastructure inland is expensive and requires time and other resources. A study put out by the UK National Oceanographic Center found that global sea level rise impacts could cost upwards of $14 trillion. On top of this, adaptation measures to combat climate impacts require funding that is currently unavailable. Many adaptive actions work most efficiently at the local and public scale; however, the public sector often does not have the ability to generate these funds. Due to this, experts and legislators often cite a need for a legal mandate or other top-down institutional support to aid in funding adaptation measures (Moser et al., 2018). With this fee going directly into an adaptation

fund, money can go directly towards coastal adaptation projects that have numerous benefits. More research into the specific adaptation and mitigation projects is necessary to ensure that the funds are going towards projects that are facilitating not only GHG reduction but are also providing adaptation benefits.

In summary, by implementing a GHG fee that charges applicants based on the GHGs associated with the lifespan of the proposed development, the CCC can incentivize applicants to use energy efficient materials and products. Any applicants who choose not to use these materials will then pay a fee that goes towards reducing climate impacts along the California coast.

7.3 Recommendation 4: Require ZNE and ZNC

As an alternative to recommendation 3 which used a market mechanism to reduce GHG emissions in the coastal zone, recommendation 4 involves mandated GHG emission reduction by requiring that all new developments in the coastal zone be both Zero Net Energy and Zero Net Carbon. In addition, the Coastal Commission should place a fee on the emissions associated with construction. The fee will then be used to fund adaptation projects within the coastal zone of California. The elements of this recommendation are demonstrated in Figure 10.

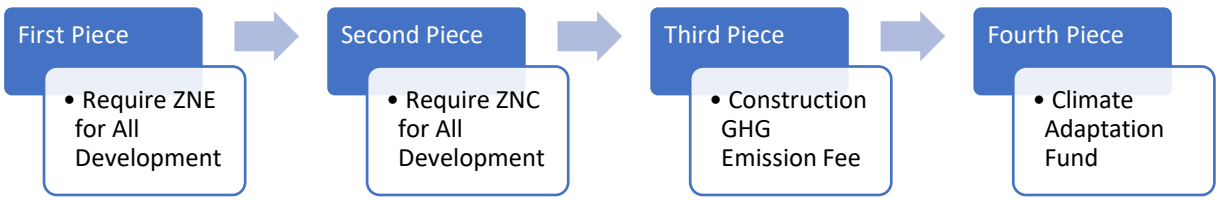

Figure 10: Components of Zero Net Energy and Zero Net Carbon Requirement.

The majority of GHG emissions in urban areas come from the buildings and transportation. In California, the 2016 Air Resources Board GHG inventory estimated that approximately 25% of the states total emissions are attributable to the building sector. About

two-thirds of these emissions come from on-site fuel use and approximately one-third of these emissions come from electricity consumption (Vukovich et al., 2018). As of 2020, California is requiring all newly developed homes to be Zero Net Energy (ZNE). This means that all new homes must consume equal or less energy that they produce on-site. For Commercial buildings, the state has a target of 50% ZNE by 2030 (California Public Utilities Commission, 2018). While this will be a mandate that all new homes must follow starting in 2020 (including homes within the coastal zone), the CCC should require all new development within the coast be upheld to this same standard. This means that both residential and commercial development that occurs within the coastal zone will need to follow the current California standards for ZNE buildings. The CCC should follow the guidelines laid out in the CAEESP as well as the 2019 Building Energy Efficiency Standards when referring applicants to the guidelines for ZNE building requirements. This will assist in the acceleration of California's goals and would ensure that all coastal development has implemented energy efficient infrastructure.

While ZNE standards are helping to reduce energy-related GHG emissions, they do not ensure a 100% reduction of greenhouse gas emissions. Zero Net Carbon (ZNC), refers to a building that is designed to meet all its energy needs from zero-carbon sources. The World Green Building Council (WorldGBC) defines a ZNC building as a highly energy efficient building that is fully powered from on-site or off-site renewable energy sources and offsets (World Green Building Council, 2018). Thus, a ZNC building cannot be a source or a site of GHG emissions throughout its life-span. The International Living Future Institute (ILFI) recently released a ZNC certification process for buildings attempting to achieve a zero-carbon status. ILFI requires that 100% of the operational energy use associated with the project be offset by new on- or off-site renewable energy (International Living Future Institute, 2018). Thus, in addition to the CCC requiring ZNE implementation for all development within the coastal zone, the California Coastal Commission should also require all new development be ZNC as well. Specifically, no GHG emissions would be allowable during the entirety of the life-span of any coastal development. For example, this means that any heating and cooking appliance that burn natural gas must be removed from any buildings constructed within the coastal zone. The CCC should follow the ZNC certification process established by ILFI as well as the Climate Smart San Jose framework to establish a system for regulating and ensuring all buildings are ZNC.

To avoid perverse incentives as mentioned in the analysis section, the CCC should mandate that all applicants compute their GHG emissions associated with construction and materials use. The ILFI system requires all applicants to compute their GHG emissions and pay a flat fee towards an authorized carbon offset company. The CCC should follow the ILFI's lead by using the same computation tools and suggested framework as detailed in recommendation 3. As with recommendation 3, the CCC should make this calculation tool available to coastal developers during the application process. The CCC should then charge a fee for the GHG emissions released during the construction and materials extraction process. The monetary designation for GHG emissions should use the same framework as established in recommendation 3. Rather than using carbon offsets as the ILFI certification framework suggests, the Commission should use the collected fees to pay into the proposed coastal adaptation fund detailed in recommendation 3. Funding adaptation projects will ensure that this overage fee is going directly into adapting to climate change impacts in California. As stated in recommendation 3, the CCC will need to ensure that the fee aligns with the specified filling fees laid out in Article 4 of the Fee Regulations.

Overall, this mandated requirement will ensure that no greenhouse gas emissions are released throughout the entirety of a building's life-span within the coastal zone. Additionally, any emissions associated with building construction or materials extraction will be accounted through the mandated fee. This fee then will go towards promoting coastal adaptation and reducing any adverse climate impacts the construction and materials extraction may have contributed to.

8.0 Conclusion

California has taken steps towards implementing environmental policies and programs to assist in reducing the effects of climate change. The California Coastal Commission is a state agency that has regulatory jurisdiction over the land and water use within the coastal zone of California. The CCC upholds the values and goals set forth in the Coastal Act. These values include protecting and enhancing California's coastal zone, while preserving public access for all citizens. The overarching question this analysis was attempting to answer was what more can the CCC do to reduce greenhouse gas emissions associated with development in the coastal zone and

how can they increase the amount of coastal adaptation projects occurring in California. To answer this overarching question, four sub-questions were established, the first question being what are the current climate impacts plaguing the California coastline? This analysis demonstrated that these impacts include sea level rise, salt water intrusion, coastal erosion, and coastal squeeze. These cumulative impacts cause adverse impacts to not only plants and animals within the coastal zone, but also to the large population that lives and works within the coastal zone of California. The second sub-question was developed to analyze the current relevant climate policies and programs in California. This analysis looked at various state agency policies as well as public utility fee structures and detailed the successes as well as drawbacks associated with each program and policy. The third sub-question aimed to answer the question of why more greenhouse gas emissions reduction is necessary. The analysis demonstrates that while California has made incredible strides in implementing ambitious climate change policies and programs, more needs to be done. Specifically, the threat of climate change to coastal resources is increasing, and the California Coastal Commission should actively work to reduce these climate impacts while preparing California's coast for adverse climate impacts. The final question asks what are some potential policy options for stronger climate policy in the coastal zone? This question was answered by compiling information resulting from the analysis and proposing four different recommendations.

All four of these recommendations suggest that the commission should work towards assisting the California coastline in adapting to the current and projected climate change impacts. By amending the coastal act and requiring all projects obtain the RELi certification, the CCC can ensure the agency is working to protect and enhance the coastal zone due to updated policies and programs as well as strengthening coastal development to prepare for adverse climate impacts. Both recommendation 3 and 4 offer ways for the CCC to regulate the level of GHG emissions associated with coastal development are released. Recommendation 3 uses a market mechanism to establish a price associated with greenhouse gas emissions released during the life-span of all new coastal infrastructure development. The money obtained from the greenhouse gas fees then should go towards promoting coastal adaptation and protecting California's coastline from both immediate climate impacts, as well as the slow onset climate events. Alternatively, recommendation 4 uses a regulatory mandate by requiring all development within the coastal zone be both zero net energy as well as zero net carbon. Using the same framework as proposed

in recommendation 3 for assessing and computing greenhouse gas emissions, this recommendation also requires applicants to calculate the GHG emissions associated with construction and material usage. Applicants will then be required to pay a single fee for these GHG emissions. While the fee will be significantly less than the fee obtained in recommendation 3, the money obtained from the GHG emissions associated with construction and raw material extraction should go into the proposed coastal adaptation fund from recommendation 3.

Overall, this policy analysis has demonstrated the necessity of immediate and accelerated action to reduce GHG emissions within the coastal zone while promoting coastal adaptation. The CCC should strive to ensure that all development within the coastal zone yields the least amount of greenhouse gas emissions possible. The CCC should also work towards funding coastal adaptation projects so that the California's coastal zone is preserved for future generations. As California continues to lead the country in establishing greenhouse gas reduction policies and programs, the California Coastal Commission should implement the following recommendations that this analysis provides to ensure that the coastal zone and encompassed coastal resources are protected from adverse climate impacts.

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