City of Long Beach Climate Action and Adaption Plan: Introduction, Community Context & Climate Science Overview

What is the Climate Action and Adaptation Plan?

The City of Long Beach's Climate Action and Adaptation Plan (Plan) is a comprehensive planning document outlining the City's proposed approach both to address climate impacts to the city and to reduce the city's impact on the climate through reducing greenhouse gas emissions. This Plan will guide the City to best prepare and protect for future climate impacts, while ensuring the City and all its residents and businesses contribute towards both the State of California's climate goals, and global efforts to address the current climate crisis that the world is facing. The role of cities has never been more important, as cities account for over 70% of greenhouse gas emissions globally. The CAAP is an important next step in furthering the City's leadership in sustainability, and Through this Plan the City is demonstrating its continued commitment to and leadership in climate action.

Through addressing both mitigation and adaptation together, the City has been able to consider how actions can synergistically produce multiple co-benefits, including by addressing existing environmental health disparities while improving quality of life and health for all residents. The Plan details the City's first community wide greenhouse gas inventory and climate vulnerability assessment that provided the basis of local data and information from which the actions were developed.

The plan includes a roadmap for implementing new polices, programs, incentives and requirements in the immediate future, as well as longer term actions that will need to be studied further, in line with monitoring how the climate continues to change.

What is climate action? What is climate adaptation? What is Sustainable Planning?

Climate action (sometimes referred to as mitigation) refers to actions taken to address the causes of climate change and reduce the impact we (people) have on the climate system by reducing our future greenhouse gas (GHG) emissions. On the other hand, recognizing that climate change is already taking place, climate adaptation refers to adjusting our behaviors, systems, and infrastructure to reduce the impact climate change impacts like heat waves, worsening air quality, and flooding has on infrastructure, services, and the well-being of the community. In addition to addressing these challenges, the CAAP will enable the City to continue to be on the forefront of sustainable planning. Sustainable planning is about meeting the needs of the present without compromising the future.

Why do we need the CAAP?

According to research compiled by the UCLA Fielding School of Public Health, not only is climate change already impacting our health in Los Angeles County, but it will continue to impact our social, cultural, and natural resources as extreme climate events like heat waves, floods, storms, and droughts become more frequent and powerful. That same meta-study showed that 97 percent of climate experts agree that

humans are causing climate change[1]. Therefore, the CAAP is needed to help reduce future GHG emissions in Long Beach while preparing and protecting the community from climate change.

The CAAP will also help the City to comply with various local, regional, State, and federal regulations to significantly reduce emissions. The City is obligated under the California Environmental Quality Act, AB 32 (The California Global Warming Solutions Act of 2006), SB 375 (The Sustainable Communities and Climate Protection Act of 2008), and various California Executive Orders to do its part to reduce greenhouse gas emissions. Generally, statewide targets aim to reduce emissions to 1990 levels by 2020, 40 percent below 1990 levels by 2030, and 80 percent below 1990 levels by 2050. California Senate Bill 379 requires cities and counties to include climate adaptation and resiliency strategies in their general plans to ensure safety and protection of their communities in the future.

Finally, the CAAP will help the City meet is various climate commitments. In November 2015, Long Beach Mayor Robert Garcia signed an official commitment to the Compact of Mayors (now called the Global Covenant), a global coalition to collectively reduce greenhouse gas emissions and enhance resilience to climate change. In order to comply with Compact requirements, the City of Long Beach must establish a plan for climate action and a plan for adaptation. Additionally, in 2017 Mayor Garcia joined 406 mayors across the United States in pledging to continue the goals of the Paris Climate Agreement to make sustainable changes to limit global temperature rise to well below 2°C, and in 2019 Mayor Garcia encourages the City to achieve a 2045 carbon neutrality goal.

The CAAP is an important next step in furthering the City's leadership in sustainability. Environmental sustainability entails understanding the limitation of our finite resources (e.g., water, fossil fuel, natural gas, etc.), and adopting practices that limit or eliminate waste and pollution. Long Beach has already taken significant green and sustainable approaches to improve the health of residents, businesses, neighborhoods, and the natural environment.

The CAAP will provide a roadmap for Long Beach towards a more environmentally healthy, economically prosperous, and equitable city. It will include a prioritized list of policy, infrastructure, and programmatic needs that lay out a roadmap for reducing the city's carbon footprint and preparing for the impacts of climate change.

CAAP Relationship to the General Plan

The CAAP is being incorporated into the Long Beach General Plan as a mitigation measure of the Land Use Element. Recognizing that the State of California obligates the City to create opportunity for increased housing and jobs to meet the needs of a growing population, the CAAP will provide for new requirements, incentives, and potential policies to ensure more sustainable development.

In order to meet their obligations under state law, local governments may prepare a Plan for Reduction of Greenhouse Gases that is consistent with AB 32 and SB 32 goals. The development of such a plan can be used for the purposes of streamlining GHG analysis for future plans and projects undergoing review pursuant to section 15183.5 of the California Environmental Quality Act (CEQA). CEQA review of subsequent plans and projects that are consistent with the GHG reduction strategies and targets in the

[1] 10 Things Every Public Health Professional Should Know About Climate Change, 2014; retrievable at: http://www.laregionalcollaborative.com/climateandhealth/

plan may take advantage of CEQA streamlining. This approach allows jurisdictions to address GHG emissions at a community-wide level to determine the most effective and efficient methods to reduce GHG emissions, identify the reduction measures that would promote the goals of the General Plan, and employ the reduction measures that have the most co-benefits (for improving mobility and access, local economic development, reducing household and business utility and transportation costs, improving public health, etc.).

Therefore, the CAAP has been included as a mitigation measure to the General Plan Land Use Element update, and the CAAP will be used as the basis for future assessments of consistency with this plan in lieu of project-specific GHG CEQA analysis to entitle future projects. A project-specific environmental document that relies on this plan for its cumulative impacts analysis would identify specific reduction measures applicable to the project and how the project incorporates the measures. If the measures are not otherwise binding and enforceable, they must be incorporated as mitigation measures, project conditions of approval, or some other mechanism to ensure implementation.

Each of the actions described in the CAAP provides details on implementing the GHG reduction strategies, including the party or parties responsible for implementation, including those that apply to the City itself. For each action that is related to development projects, the City will determine: (a) the project is consistent; (b) the project with conditions would be consistent ; (c) the strategy is relevant for new development, but not the subject project; or (d) the project includes one or more replacement strategies that would be equally or more effective in reducing GHG emissions and such replacement strategy or strategies are not included in the CAAP or required by any other regulation, standard, design criteria, or other existing requirement. See Chapter 8 (Implementation and Monitoring) for a more detailed explanation of project compliance with the CAAP.

To meet the standards of a qualified GHG reduction plan, Long Beach's CAAP must achieve the following criteria (which elaborate upon criteria established in State CEQA Guidelines Section 15183.5[b][1]):

- Complete a baseline emissions inventory and project future emissions
- Identify a community-wide reduction target
- Prepare a CAP to identify strategies and measures to meet the reduction target
- Monitor effectiveness of reduction measures and adapt the plan to changing conditions
- Adopt the CAP in a public process following environmental review

The CAAP addresses each of these recommended plan elements as summarized below.

Chapter 7 GHG Inventory) presents the 2015 base year emissions inventory and forecasts.. Chapter 7 also presents the City's 2030 2045 aspirational goal. Chapter 7 contains 3 sub-sections, one for each CAAP focus area, that describe the reduction actions that will be implemented to achieve the GHG targets. A fourth section is included that presents a menu of additional strategies to augment these, if needed. Chapter 9 (Implementation and Monitoring) describes the City's process for monitoring, evaluating, and revising the CAAP to ensure that the estimated strategy reductions do occur to support target achievement.

In addition to CEQA streamlining, the CAAP is included as part of the General Plan in order to meet requirements of Senate Bill 379 (SB379), which requires cities and counties to include climate adaptation and resiliency strategies in their general plans to ensure safety and protection of their community.

Incorporating the CAAP into the General Plan is important because the City Council and Planning Commission use the goals and policies of the general plan as a basis upon which to make decisions, determine long-term objectives, generate and evaluate budgets, plan capital improvements, and prioritize tasks.

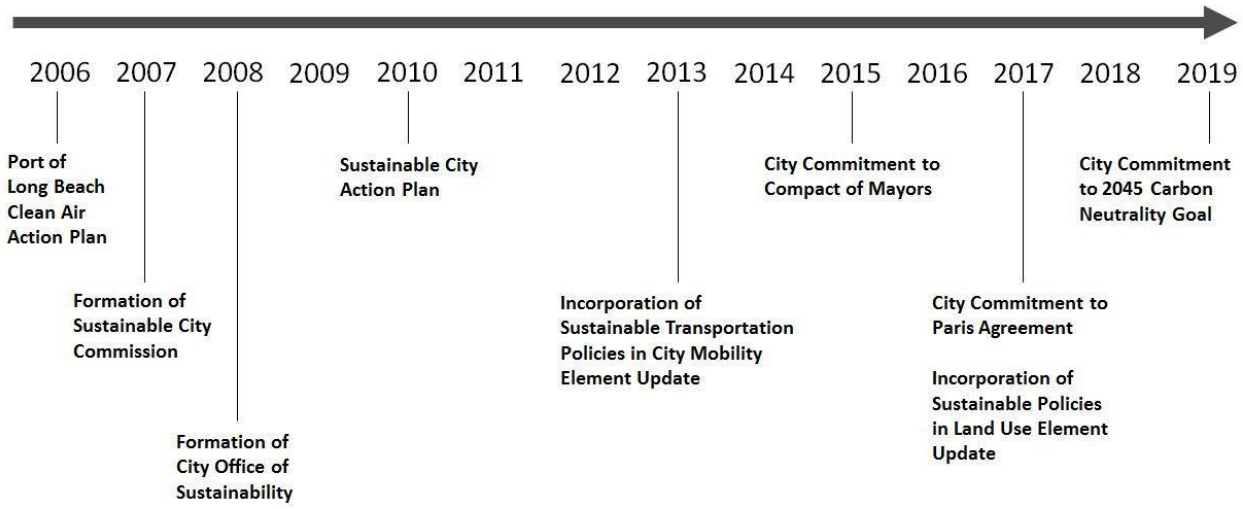
What is our Community Vision and Mission for the Plan?

The vision of the Long Beach CAAP is to create a more sustainable, resilient and equitable city by addressing climate change in a way that addresses existing environmental health disparities while improving health, quality of life, and enhancing economic vitality throughout Long Beach.

The CAAP process has been driven by a mission to:

- **Create** an inclusive, community-centered planning process to engage the Long Beach community broadly and with attention to those most affected by climate change, including low income and people of color, youth and older adults.
- **Communicate** climate change impacts in Long Beach by meeting residents and community members where they already gather, such as community events, cultural festivals, senior centers, schools, etc.
- **Build Capacity** to co-define solutions and priorities to inform the CAAP.
- **Collaborate** with internal (City departments) and external stakeholders (community members, business community, neighborhood associations, scientific community, etc.).
- **Commit** to ensure the Long Beach community and physical assets are better protected from the impacts of climate change.

The CAAP builds upon a history of local sustainability accomplishments in Long Beach:



Long Beach has already taken significant green and sustainable approaches to improving the health of residents, businesses, neighborhoods and the natural environment. Long Beach was one of the first cities to create a Port Clean Air Action Plan (2006), a Sustainable City Commission (2007), an Office of Sustainability (2008), a Sustainable City Action Plan (2010), and a commitment to the Compact of Mayors (2015). As a result, the City has been in the process of incorporating sustainability into all major policies

to build resilience and ensure Long Beach thrives for the next 100 years and beyond. The City has also focused on creating sustainable land use and transportation systems. Adopted in 2013, the City's Mobility Element focuses on providing active transportation options throughout Long Beach neighborhoods. The City has made significant investments in bicycle, pedestrian, and transit-supporting infrastructure in recent years. The City's General Plan Land Use Element update supports this progress by promoting land use patterns that concentrate intensity around transit and promote active transportation through the proper mix of uses and careful urban design. In 2017, Mayor Garcia joined 406 mayors across the United States in pledging to continue the goals of the Paris Climate Agreement to make sustainable changes to limit global temperature rise to well below 2°C, and in 2019 Mayor Garcia encourages the City to achieve a 2045 carbon neutrality goal.

Plan Goals:

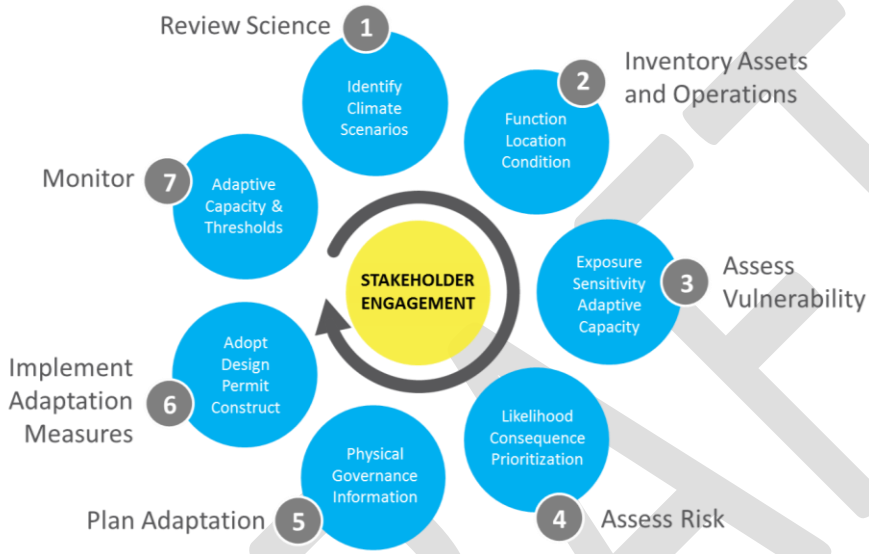
Based on community input throughout the CAAP development process, the following CAAP goals were established:

- Distinguish Long Beach as a leader in climate mitigation and adaptation planning
- Be inclusive of the entire community while prioritizing vulnerable and disproportionately impacted populations
- Create a healthier community by addressing climate change
- Consider social, environmental, and economic co-benefits holistically
- Empower young people to be leaders in creating a most sustainable community
- Invoke personal sense of responsibility among residents and businesses
- Be an actionable plan (right balance of innovation and practicality)

How was the Plan Developed?

The Plan has been developed in partnership by the City and the community over two-and-a-half years, following the steps outlined below for the climate mitigation planning and climate adaptation planning processes respectively. Community and stakeholder engagement has been integral throughout this process and is described further below.

Climate adaptation process



- **1+2+3 Review Science, Inventory and Assess Vulnerability**: Critical city assets were assessed for vulnerability to sea level rise, precipitation, wildfire and extreme heat, see chapter 5 for further details.
- **4 Assess Risk:** Once vulnerabilities had been identified, the economic consequence of those impacts was assessed in line with state requirements, see chapter 5 for further details.
- **5 Plan Adaptation**: With input from stakeholders, the community and City departments, a long list of actions was developed to adapt critical assets and neighborhoods to climate impacts. These were then prioritized using community and city input, in line with a set of performance criteria / guiding principles developed for the actions. See chapter 6 for the full set of actions selected for the plan.
- **6 Implementation**: For short term actions, initial implementation steps have been identified. These can be found as part of each action write up in chapter 6.
- **7 Monitor**: Given the evolving nature of climate science, and observed changes, the City will monitor updates on a regular basis as well as performance of early implementation measures, see chapter 8 for more details.

Climate mitigation process

- **1+2+3: Greenhouse Gas Inventory, Forecast of Projected Emissions, and Reduction Target:** The City carried out its first GHG inventory for this Plan to understand which sectors will need to be focused on. See chapter 5 for further details
- **4: Analysis of Existing Actions:** The City reviewed all current existing actions and initiatives that are contributing to mitigation and adaptation to understand the baseline to build from.
- **5. Action Development**: With input from stakeholders, the community, and City departments, a long list of actions was developed that could provide GHG reductions. These were then prioritized using community and city input, in line with a set of performance criteria/guiding principles developed for the actions. See chapter 7 for the full set of actions selected for the plan.
- **6. Strategy Implementation**: For short term actions, initial implementation steps have been identified. These can be found as part of each action write up in chapter 7.
- **7. Monitoring and Measuring**: Performance towards the City's GHG reduction target will be monitored in part by regular GHG inventories, the next of which is scheduled for 20XX. Further details can be found in chapter 8.

Stakeholder Engagement

Stakeholder engagement was key to the process and had two main components – firstly, working with a series of stakeholder working groups, and secondly, extensive public outreach.

Stakeholder Working Groups – Incorporating local expertise

- **Scientific Working Group** was convened three times to validate the project methodology and to provide feedback and input on local data as well as review results and early actions. The Scientific Working Group included 13 independent experts from California State University Long Beach, Long Beach Community College, University of California Los Angeles, the Aquarium of the Pacific, South Coast Air Quality Management District, and RAND Corporation.
- **Business Working Group** was convened twice to provide input on their climate-related concerns, existing actions and future opportunities. The group included approximately 30 attendees from 24 businesses including architecture, engineering, utilities, sustainability consultants, and various other local businesses. Firms represented included firms large and small, global and local, and consultation with business association leaders and the Chamber of Commerce.
- **Community Working Group** was convened twice to provide input on the public engagement approach, climate related concerns and actions. The group included about 20 representatives from local community groups.

Public Outreach – Listening to You

In addition to the stakeholder working groups, the proposed CAAP has also been informed by an extensive public engagement process, which included reaching over 8,500 residents at nearly 50 outreach events, consisting of community meetings, open houses, resource fairs, and expert panel discussions hosted throughout the City. As a part of this outreach process, staff has held various CAAP presentations and activities in collaboration with the City Council offices and other community partners. The City made a concerted effort to give Long Beach residents a variety of opportunities to shape the CAAP while learning together about local climate science projections and climate change vulnerabilities in Long Beach. The City is very grateful for the interest and input from all those that participated!

- Open House #1 and Sustainability Resource Fair (Attendees: 98 signed in)
    - On June 2, 2018 at Martin Luther King Jr. Park the City hosted the first public workshop for the CAAP. At the event, staff shared detailed presentations on the results of the Long Beach greenhouse gas inventory and vulnerability assessment. Attendees had the opportunity to weigh in on CAAP goals, priorities, and approaches. In addition, the workshop included a free Sustainability Resource Fair which featured:
        - Sustainability resources and information from various City departments and public agencies
        - Augmented reality mobile games
        - Garden tours of the Long Beach Peace Garden
        - Free health resources including dental screenings and blood pressure readings

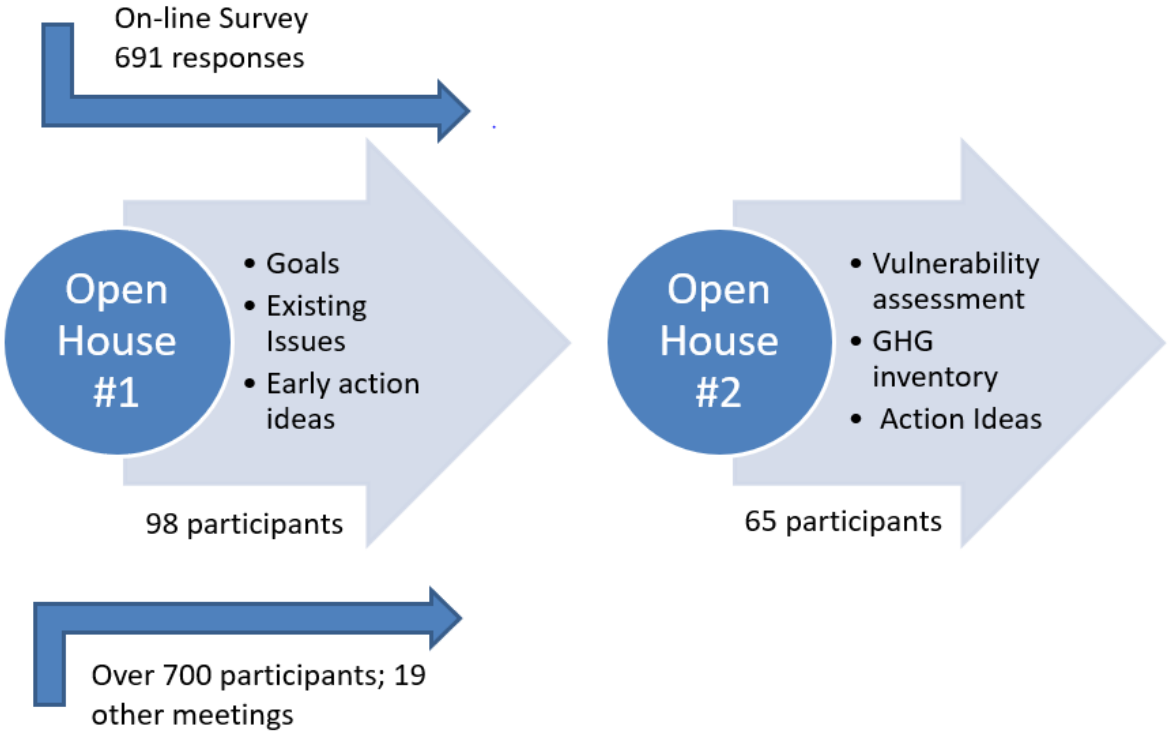
- Engaging Emerging Leaders

- Recognizing that young people will be most impacted by climate change in the long term, the City partnered with youth programs and local schools across Long Beach to engage youth and emerging leaders in developing the CAAP. As part of this effort, the City partnered with California State University, Long Beach (CSULB), Long Beach City College (LBCC), Long Beach Unified School District (LBUSD), St. Anthony's High School, Youth Leadership Long Beach, and Aquarium of the Pacific youth volunteers:
  - For the 2018 Climathon Challenge at CSULB, the challenge focused on solutions to create sustainable housing specifically solutions that will help meet the objectives set in the City's CAAP. As part of the challenge, staff provided detailed presentations on the CAAP and climate change impacts likely to impact Long Beach in addition to a broad overview of sustainable housing in the City.
  - In January 2019, the City partnered with Youth Leadership Long Beach to host a field trip to City Hall with the theme of "Government, Public Service, and Sustaining our City." In addition to the career forum, presentations from department directors and staff, and a mock City Council debate, the day-long field trip included a presentation on the CAAP and interactive activities to provide feedback. In February 2019, the City partnered with local organizations (including Studio One Eleven, Aquarium of the Pacific, and the Institute for Innovation and Entrepreneurship (IIE) at CSULB) as part of a Leadership Long Beach Community Day.
  - On Earth Day 2019, staff presented on the CAAP to the Long Beach City College – Environmental Movement Action Club.
  - In April 2019, City staff partnered with the Aquarium of the Pacific youth volunteers to share more information about the CAAP and to host a community conversation on how the students have experienced climate change in their community, what climate action in Long Beach looks like to them, and what the City should do to address climate change impacts.
  - In May 2019, City staff participated in the Long Beach Unified School District's Annual Science & Engineering Fair both as project reviewers and as an exhibitor to share climate impacts to Long Beach with the community. Student projects designated as an "Environmental Innovation" from the Science & Engineering Fair will be featured at LB ClimateFest.
  - Over the 2019 spring semester, City staff partnered with St. Anthony's High School's AP Environmental Science class. As part of the final project for the class, students worked on a group project that will featured at LB ClimateFest. The project prompts were:
    - Project 1. Create a video that shows how climate change has impacted your community based on local science (extreme heat, air quality, flooding, power outages, green jobs, etc.).
    - Project 2. Develop, conduct, and present a campaign to engage local community with solutions to vulnerability assessment and climate stressors.
    - Project 3. Develop, present, and lead a youth-led half day summit for local middle school and high school students around topics related to the CAAP.
    - Project 4. Create a marketing campaign through social media, mass emails, and newsletters for city-wide distribution.
- Multi-lingual outreach and reaching communities most vulnerable to climate change impacts

  - As part of the CAAP outreach process, City staff set out to create an inclusive, community-centered planning process to engage the Long Beach community broadly with attention to those most vulnerable to the negative consequences of climate change. In doing so, City staff conducted multi-lingual outreach with communities most vulnerable through partnerships with Latinos in Action, United Cambodian Community, Habitat for Humanity of Greater Los Angeles, Long Beach Alliance for Food and Fitness, the YMCA of Greater Long Beach, and other environmental justice organizations. Staff continues to evaluate engagement approaches to be more co-creative, linguistically and culturally appropriate to further strengthen relationships between the City and local communities. Translation services were available at all CAAP public workshops and events.
- Panel: Sea Level Rise in Long Beach and What Residents Can Do to Prepare
  - On January 14, 2019 at Best Wester Golden Sails, the City hosted a panel discussion on Sea Level Rise in Long Beach and What Residents Can Do to Prepare, which featured Jerry Schubel, PhD from the Aquarium of the Pacific and Jeff Jeannette, AIA from Jeannette Architects. The presentations and panel discussions covered sea level rise and the local projections for Long Beach, strategies for adapting homes to sea level rise flooding, and what the City is doing to develop a CAAP. The event drew over 300 attendees.
- Panel: Extreme Heat in Long Beach: Staying Safe & Solving Climate Change
  - On March 30, 2019 at Silverado Park, the City hosted a panel discussion in partnership with community partners on Extreme Heat in Long Beach: Staying Safe & Solving Climate Change. The panel discussion included representatives from Long Beach Gray Panthers, Long Beach 350, Citizens Climate Lobby, Aquarium of the Pacific, Long Beach Fire Department, and Long Beach Health & Human Services Department. The panels focused on how extreme heat from climate change impacts older adults, children, and other vulnerable populations, strategies to keeping residents safe and healthy during extreme heat waves, as well as the CAAP and broader solutions to climate change.
- Open House #2 and Sustainability Resource Fair (Attendees: 135 signed in)
  - On January 26, 2019 at the Michelle Obama Neighborhood Library, the City hosted the second public workshop for the CAAP. This event was focused on engaging the community on potential mitigation measures and adaptation strategies for consideration in the plan. As part of the event, a free Sustainability Resource Fair was hosted in the Learning Garden at the library. The fair featured sustainability and community resources from various City departments.
- Connecting with the Faith Community and Neighborhood Groups (Temple Israel)
  - As part of the Neighborhood Climate Action Fair on February 10, 2019, the City co-hosted a free event in partnership with the Temple Israel Long Beach and Belmont Heights Neighborhood Association which featured climate change experts, activists, and community groups. In addition, staff presented at various neighborhood association meetings and community meetings to further share about the CAAP.
- Intersection between climate change impacts and emergency preparedness (
  - Through various CAAP outreach events, the City has further communicated the intersection between climate change impacts and emergency preparedness. In September 2018, staff hosted a booth at the annual Ready Long Beach, a citywide outreach effort promoting emergency preparedness and readiness to the whole community. The event drew thousands of attendees from all social-economic, ethnic, age, and gender groups. In May 2019, the CAAP team presented at the monthly meeting

of the Long Beach Fire Department's Community Emergency Response Team (CERT). In addition to a presentation on the CAAP, the session included a breakout activity on emergency scenarios related to heat, air quality, flooding, and sea level rise. Drawing from their CERT training, participants discussed how to keep their families and communities safe in the event of an emergency and generated ideas for addressing climate change. Through various CAAP outreach, staff has also connected with community members to collect their stories and experiences about how climate change has already impacted them. Examples includes stories about the July 2015 Downtown Long Beach power outages and January 2017 storm events.

- Meeting people where they are (local farmers markets, community events, neighborhood associations etc)
    - As part of the CAAP outreach process, intentional effort was made to engage directly with Long Beach residents and community members at places they already gather such as cultural festivals, senior centers, community events, neighborhood associations, local farmers markets, and summer programs.
- Online Outreach & Other Resources
    - In addition to in-person outreach, staff connected with residents all across Long Beach through social media (Facebook, Twitter, Instagram, and Linkedin) with #CAAPLB and #ClimateActionLB.
    - E-newsletters to showcase updates and upcoming events related to the CAAP
    - Billboard Ads for Open House #2 and LB ClimateFest
    - Website landing page (www.lbds.info/climateactionlb), which included general information about the CAAP in addition to several assessments and analyses that were conducted.
    - Informational animated videos were created to further explain what is the CAAP and why the City is developing one:
        - Tacking Climate Change in Long Beach
        - Preparing for Extreme Heat in Long Beach
    - Brochures, infographics, and tips on staying safe and healthy during extreme weather events were created for tabling events.
    - Tchotchke/Giveaway Items, including branded tote bags, metal straws, and CAAP caps



How does the CAAP relate to other City Plans?

Many City plans touch on issues that are covered in this Plan, and all City Departments worked closely with the City's Planning Bureau? to ensure alignment as part of the Plan development process. The table below identifies these relationships and synergies. Each department will continue to work with the City's Planning Bureau during the implementation of the Plan to ensure efficient progress towards joint goals.

Org	Plan	Date	Summary/Connection
City of Long Beach	Sustainable City Action Plan	2010	Target reductions and implementation steps for municipal and private buildings, municipal vehicles, solid waste, and water use
City of Long Beach	General Plan – Mobility Element	2013	Complete streets and multimodal transportation policies have potential to reduce GHG emissions from private vehicles
City of Long Beach	General Plan – Land Use Element	2018	Addressing and adapting to climate change is one of the stated goals of the element. Will directly and indirectly reduce GHG emissions though transit-oriented development and mixed-use development, increased active transportation,

			promotion of green technology, and sustainable development
City of Long Beach	Hazard Mitigation Plan	2017	Details the City's vulnerability to earthquakes, floods, windstorms, tsunamis, public health crises, technological disasters, and drought along with strategies to mitigate disasters before they strike.
Port of Long Beach	Clean Air Action Plan	2017 (Update)	Defines Port-related GHG and pollutant emissions reductions targets for 2020 and 2050. Implementation steps include incentive programs for efficient ships, shore power, ban on pre-1989 trucks, energy efficiency standards for locomotive engines and tugboats
Port of Long Beach	Climate Adaptation and Coastal Resiliency Plan	2016	Vulnerability assessment and adaptation strategies to protect Port assets from future climate stressors including extreme heat, storm surge, and sea level rise

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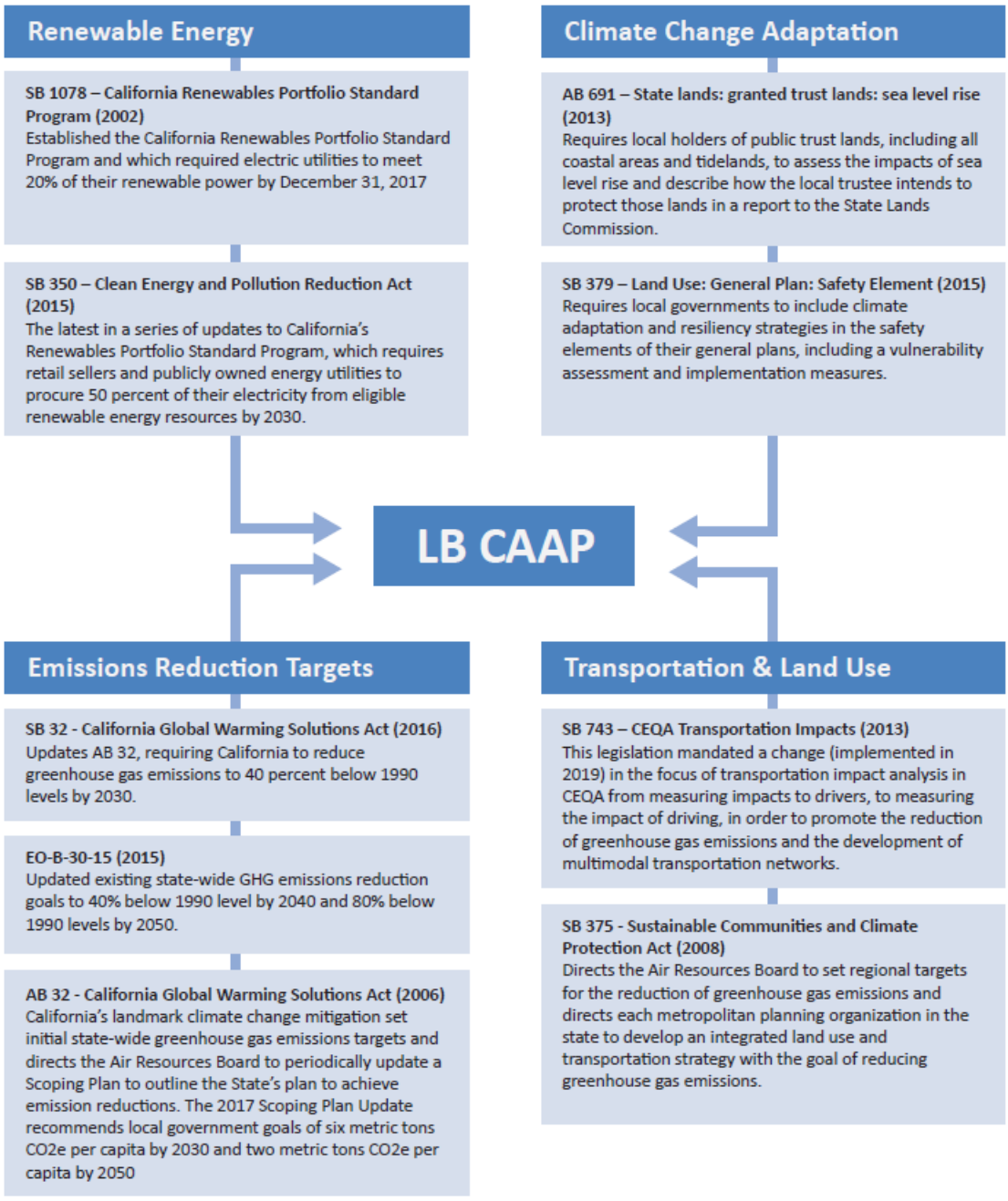
How does the CAAP align with state policies?

Part of the driver behind the Plan is to align with the various existing State policies guiding cities on how they can contribute to the overall State goals around climate. The key policies are highlighted below.



Understanding Climate Change in Long Beach: Community Context & Climate Science Review

Introduction

Preparing Long Beach for climate change presents both daunting challenges and extraordinary opportunities. It will require changes to many things we take for granted—how we power our homes, how we get around, how businesses and industry are run, how and where buildings get built, what we consume, and what we throw away.

But rather than just an inconvenient necessity, adapting Long Beach to climate change and reducing our contribution to its causes also presents an unprecedented opportunity to tackle head on the problems of inequality our community faces today. Through implementing a coordinated response to climate change, we can address public health disparities, improve equity, foster economic opportunities, and realize a vision of Long Beach where everyone has the opportunity to live in thriving communities built on sustainability and resilience.

This chapter begins with a brief explanation of the science behind climate change and summarizes the local impacts that are expected in Long Beach. It highlights the City's primary vulnerabilities, including communities that are particularly vulnerable due to socioeconomic, racial and environmental health disparities. Finally, it concludes with a discussion of the economic, social, and environmental co-benefits associated with climate change adaptation and mitigation.

The Causes of Climate Change

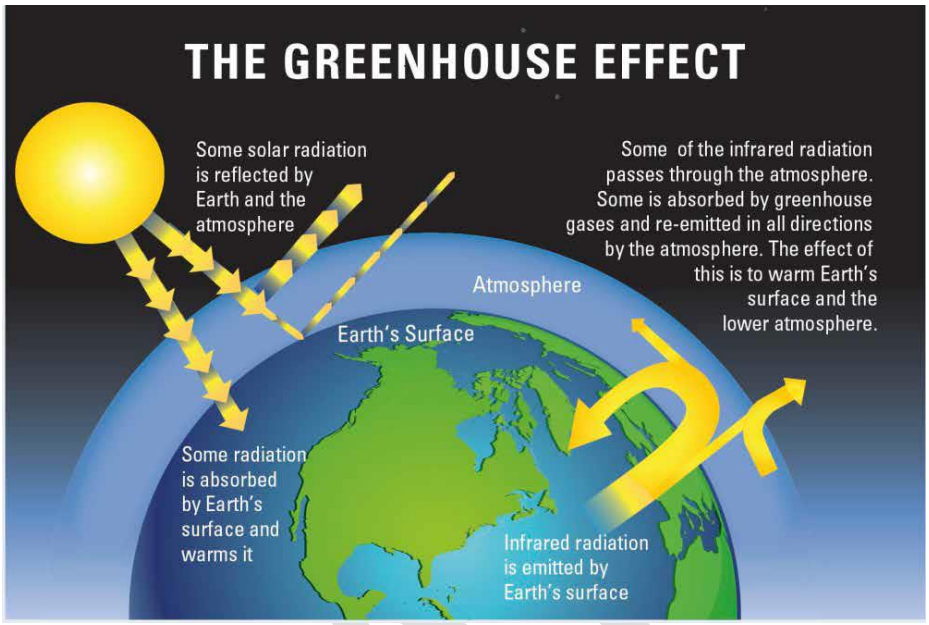
The earth's habitable climate is maintained by the Greenhouse Effect – a blanket of gases that trap heat in the atmosphere and keep surface temperatures relatively stable. Greenhouse gases trap warmth generated from solar radiation, much like how a car, or a greenhouse, heats in the sun.

If it were not for these gases, the earth's surface would be frigid and we would have no air to breathe. However, since the Industrial Revolution in the mid 1800's, due to human activities such as the burning of fossil fuels and the conversion of natural lands into agriculture and settlements, additional greenhouse gases are being released into the atmosphere at an unprecedented rate.

Major greenhouse gases include:

- **Carbon Dioxide (CO_2)** – generated from the burning of fossil fuels or organic matter;
- **Nitrous Oxide (N_2O)** – a byproduct of the burning of fossil fuels and the fertilization of crops;
- **Methane (CH_4)** – created from the decomposition of waste and off-gassing from livestock;
- **Chlorofluorocarbons (CFCs)** – originally released into the atmosphere as refrigerants, propellants, and cleaning solvents. Although they are now illegal under international law due to their impact on the ozone layer, past emissions will remain in the atmosphere for a several years to more than a thousand years depending on the CFC.
- **Hydrofluorocarbons (HFCs)** – now used as a substitute for CFCs because they do not contribute to ozone depletion, but they do contribute to global warming;

- **Perfluorocarbons (PFCs)** and **sulfur hexafluoride (SF6)** – byproducts of industrial processes including aluminum production



Local Climate Change Projections and Vulnerabilities

As part of the CAAP process, the most up to date science and local climate projections for three primary climate change stressors (extreme heat, sea level rise, and precipitation) and two secondary stressors (air quality and drought) were reviewed (see Appendix for full Long Beach Climate Stressors memo available at http://www.lbds.info/climateactionlb/resources_n_documents.asp with direct link: http://www.lbds.info/civica/filebank/blobdload.asp?BlobID=7282). Primary climate change stressors are first-order local conditions that are directly affected by changes in global atmospheric and oceanic temperatures. Secondary climate stressors are conditions affected by complex interactions between primary variables and other factors.

The City also carried out a Climate Vulnerability Assessment, which explored how climate stressors predicted for Long Beach will impact different types of city assets. The study assessed vulnerability based on the following categories:

- Public Health
- Housing and Neighborhoods
- Buildings and Facilities
- Parks and Open Space
- Transportation Assets
- Energy Assets
- Stormwater Assets
- Wastewater Assets
- Portable Water Assets

The vulnerability assessment is attached as an Appendix and is available on the CAAP website (direct link: http://www.lbds.info/civica/filebank/blobdload.asp?BlobID=7362)

Key information from both the Climate Science Memo and Climate Vulnerability Assessment are summarized below, organized by climate stressor. It is important to note that the science of understanding climate change is being continuously revised, as climate models and projections are improved and updated with new data and observations. The outputs from these climate models will inform future updates of this Plan. These revisions improve our understanding of what impacts we can expect in the future. However, this does not mean that there is uncertainty around whether there will be impacts, or whether human activity is a major contributing factor, but rather the timing and extent of impacts.

Existing Environmental Health Burdens and Climate Change

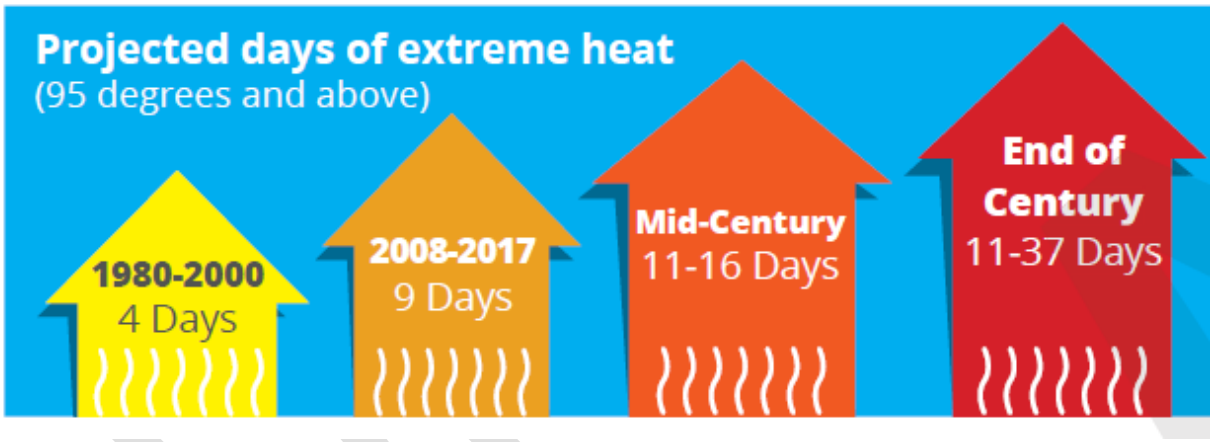
Though climate change will impact the entire City of Long Beach, some communities within Long Beach already experience disproportionate environmental health burdens today. Long Beach is very diverse, which can be a source of strength, vibrancy, and resilience. However, it also has racial and economic disparities that are manifested spatially across the city. Tools such as CalEnviroScreen help identify California communities that are most affected by many sources of pollution, and where people are often especially vulnerable to pollution's effects. For Long Beach, CalEnviroScreen shows how Central, West and North Long Beach have some of the highest pollution impacts in California, with many areas being worse off than 95 percent of the state. Unfortunately, it is not a coincidence that the communities that live in these areas tend to be lower income communities of color.

Low income people and communities of color are more likely to live in areas with poor air quality, in regions with little green space, and along the Los Angeles River channel where urban flood risk may increase. This geography of differentiated risk is due to socioeconomic inequality caused by historic racial and economic injustices, such as discrimination in education, housing, employment, education, local political representation, and access to resources. Low income communities of color were historically excluded from neighborhoods with less environmental pollution and greater public investment, and still today in Long Beach, low income communities of color are concentrated in the portions of the city with the worst air quality and environmental health metrics. these same communities with the highest environmental health burdens today also have the highest social vulnerability to climate change (see Geography of Combined Social Vulnerability later in this section). When reviewing the below summary of how future climate change is projected to impact Long Beach, it is important to consider these existing environmental health burdens and social vulnerabilities to climate change. In addition to the need to prioritize communities with existing environmental health burdens as well as communities most vulnerable to the impacts of climate change, there are lessons in resiliency to be shared from how marginalized communities have withstood the combined effects of segregation and pollution to adapt and prepare for changing conditions. As Long Beach prepares for an uncertain climate future, the City must lift up and learn from marginalized people and places to make sure all communities can thrive.

Extreme Heat

Trends and Projections

Long Beach's pleasant Mediterranean climate is expected to warm considerably in the coming decades, and the region will experience a greater number of extreme heat days (>95°F). Cal-Adapt predicts that average annual temperatures in the Los Angeles region will increase 3-4°F by mid-century and 3-8°F by end-of-century (Sun et al. 2015). The average number of extreme heat days each year has already increased from the baseline average of 4 extreme heat days per year in 1980-2000 (Sun et al. 2015), to the average 9.2 extreme heat days per year recorded between 2008-2017 (www.usclimatedata.com). Extreme heat days are projected to increase from 4 even more by mid-century, to 11-16 days per year by end-of-century and 11-37 extreme heat days per year (Sun et al. 2015). Heat waves will occur more frequently, be longer-lasting (Cayan et al. 2009), and more humidity will mean less cooling at night (Gershunov and Guirguis 2012). These changes will have wide impacts to Long Beach's environment, infrastructure, and residents. Extreme heat will also disproportionately affect already vulnerable populations, including the elderly and infants, who are more vulnerable to the health impacts of extreme heat, and low-income or English as a second language households, who are less likely to have access to resources to cope.



Key Vulnerabilities

Of all climate stressors Long Beach will face, extreme heat is expected to be the greatest health threat to the largest number of residents. Analysis of census population data (from 2010) and the Climate Smart Cities Los Angeles heat vulnerability zone indicate that approximately 275,000 residents of Long Beach live within the high vulnerability areas. Extreme heat events can increase heat-related mortality, cardiovascular-related mortality, respiratory morality, and increase hospital admission and emergency department visits. Particularly vulnerable populations include children, the elderly, people with respiratory diseases, people with physical disabilities, and those who work outdoors (CDPH 2012; CNRA 2014). (See section on Climate Change, Public Health, and Health Equity for details on geographic vulnerabilities to extreme heat in Long Beach)

Increased electricity demand for air conditioning during heat waves can cause power outages, which can put vulnerable populations at even higher risk and cause traffic disruption due to traffic lights losing

power. Heat-related power outages are already commen in Southern California. In the summer of 2015, Long Beach residents experienced four separate power outages. In July 2015, high temperatures may have been a factor in equipment failures that caused two powers outages in downtown Long Beach that left thousands of residents and businesses without power for days. The power outage stranded people without medical devices, refrigeration, air conditioning or elevator service during a period of high temperatures. This was particularly challenging for seniors living in high-rise apartments (KPCC 2015).

Low income residents, who already spend a higher proportion of income on utilities, will be hit hardest by increased power bills. They are also more likely to live in substandard housing with inefficient insulation or without air conditioning at all. Roads can be damaged by asphalt, softening when temperatures remain over 100°F without cooling at night, particularly in areas with high truck traffic (USDOT 2012).

Sea Level Rise

Trends and Projections

Sea level rise is already occurring off of Long Beach, and is projected to accelerate over the coming decades. Analysis of historic sea levels at the nearest NOAA tide gauge in Los Angeles indicates a long-term trend of sea levels rising at approximately 0.96 mm per year from 1923 to 2016.

[King Tide Photo]

The projections for future sea level rise considered in this CAAP are from the National Research Council's "Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future" (NRC 2012), which represented a synthesis of the best available sea level rise science when the CAAP planning process began in 2017.

Note that the Ocean Protection Council's (OPC) new sea level rise guidance document was adopted in March 2018. Not only were the OPC (2018) SLR projections not yet available at the time of the vulnerability assessment, but the SLR projections from NRC (2012) show higher potential SLR for near-term planning horizons (2030 and 2050). Given the differences in projections, it was determined that for the sake of being conservative in developing a plan to preserve life and property, that the more aggressive forecast should be utilized.

Best practices in climate change adaptation planning, as recommended by the State of California Sea Level Rise Guidance (OPR 2018), are to use worst-case projections for midcentury and to use a range of mid to worst case projections for end-of-century, because uncertainty increases further in the future.

NRC 2012 indicates that sea levels in Southern California are expected to rise between 5.0" and 23.9" by mid-century (2050) and between 17.4" and 65.6" by end-of-century (2100) (NRC 2012). The CAAP's sea level rise vulnerability assessment matched these ranges to available sea level rise inundation model data from the Coastal Storm Modeling System (CoSMoS) to understand what portions of the City are expected to be at risk, and when. The City used inundation scenarios of 11" SLR for 2030, 24" for mid-century and both 37" and 66" for end-of-century.

The projected increases in mean sea level will also result in secondary impacts – higher storm tides, more extensive inland flooding, and increased coastal erosion during storm events. Evidence of these impacts is already being felt in Long Beach.

Key Vulnerabilities

For the low lying coastal communities of Long Beach, permanent inundation from sea level rise, as well as increased risk of temporary flooding from king tides and storm surges, will become a very real threat in the near future. Approximately 1.3 million square feet of buildings in Long Beach could be exposed to annual king tides by 2030. Approximately half of these buildings are residential (624,100 square feet) and half are commercial (689,600 square feet). These buildings are primarily located in Marina Pacifica and along Shoreline Drive south of Ocean Boulevard. An additional 9.5 million square feet of buildings, primarily residential, are exposed to flooding from a 100-year storm surge by 2030. These buildings are primarily located in Naples Island, Belmont Shore, and the Peninsula. By 2050, up to 8.4 million square feet of buildings could be exposed to annual king tide flooding.

City infrastructure exposed to flooding from king tides by 2030 includes a solid waste facility, 17 city parks, four miles of roads, a natural gas power generation station, and 18 storm drain outfalls, which could cause inland urban flooding if they are inundated during a rain storm. Sea level rise will also cause increased erosion to, and possibly the loss of, the City's beaches, which are central to the lifestyle, culture, and economy of the Long Beach community. Projections anticipate widespread daily high tides by 2100 under the no action scenario.

Precipitation

Trends and Projections

Climate change will also have a substantial impact on local precipitation patterns. Cal-Adapt, the State of California's official synthesis of the latest climate models, predicts a 6-11 percent increase in average annual precipitation in Long Beach by mid-century and a 1-25 percent increase by end-of-century (Cal-Adapt 2017). The wide range in the projections is because local climate is influenced by a wide variety of factors.

Changes in average annual precipitation are only half the story. The impacts that will have the most consequences for day-to-day life in Long Beach will be increased intensity of rain events leading to greater flood risk (CEC 2012; Pagan et al. 2014), and high variability year to year variability, which will impact the availability of fresh water (Berg et al. 2015; Pierce et al. 2011).

[Map of 100-yr and 500-yr Flood Zones]

Key Vulnerabilities

For this CAAP, exposure to riverine flooding was assessed based on the Federal Emergency Management Agency's (FEMA) 100 and 500-year riverine floodplains. These FEMA floodplains serve as proxies for areas that may be at risk to increased exposure to riverine flooding in the future. In general, 100-year flood flows along the primary riverine waterways and are contained within their channels by existing levees. However, the 500-year floodplain, which represents a scenario that will become more likely in

the future due to increased intensity of precipitation events, covers a much larger area, including certain disadvantaged populations along the Los Angeles River. Within the 500-year flood plain are two hospitals, 11 fire stations, one police station, 96 schools, 600 miles of roads, 26 power substations, over 20 wastewater pump stations, and 20 potable water facilities.

Urban flooding during precipitation events is already a problem in Long Beach, with extreme events today providing an example for what may become more common in the future, with more intense precipitation events projected. In January 2017, severe rainstorms overwhelmed storm drains and resulted in widespread flooding of streets and homes.

Images of flooding during January 2017 extreme precipitation events (source: twitter.com)

Drought

Trends and Projections

Changes in drought patterns are a secondary climate stressor that will be influenced by changes in temperature and precipitation. Due to the projections for these stressors described above, the Los Angeles region is expected to experience an overall drying trend with longer and more frequent droughts (CEC 2012; Pierce et al. 2011).

Key Vulnerabilities

Higher temperatures will lead to drier soils and drier vegetation in natural areas (Pagan et al 2015) which will increase local wildfire risk. Water demand for irrigating planted areas will also increase unless there is a major shift towards planting drought-tolerant species. In addition to regional drying, reduced snowpack in the Sierra Nevada and snowmelt runoff earlier in the season will threaten Long Beach's water supply (CEC 2012; Pagan et al 2015).

Air Quality

Trends and Projections

Air quality is another secondary climate stressor that will be influenced by changes in weather and other factors. Despite air quality improvements in the past three decades made through concerted efforts and increased regulation, higher temperatures will increase air pollution formation (CNRA 2014). Absent

further air pollution reduction efforts, by end-of-century, the number of days violating air quality standards in L.A. region could increase by 25-80 percent due to warming (CEC 2006). Higher temperatures, precipitation change, and increasing CO_2 concentrations are also expected to increase pollen and some airborne allergens. An increase in wildfires, even far from Long Beach, could worsen air quality, as evidenced by the dangerous air quality levels in the Bay Area during the Camp Fire in 2018. Increased energy consumption in the region due to greater demand for air conditioning could also negatively impact air quality (CEC 2006).

Key Vulnerabilities

Air quality is especially relevant as a secondary climate stressor in Long Beach, as there are several sources that impact local air quality, including the 710 and 405 freeways, refineries, the Port of Long Beach, and major industrial sources (AOP 2015) that impact thousands of people. People who are especially sensitive to poor air quality include the young, elderly, those who have existing respiratory conditions, and those who work outside. Air quality in Long Beach is considerably worse near the Port and major freeways, and near concentrations of low-income residents and communities of color due to historic patterns of marginalization and disinvestment. An in-depth discussion of inequities in exposure to climate change induced hazards is included in the following section.

Climate Change, Public Health, and Health Equity

Increased extreme heat events, flooding, and worsened air quality may negatively affect human health. While all people are vulnerable to the impacts of climate change, the degree of vulnerability is a function of demographic, socio-economic, health, and place-based conditions that influence an individual or community's sensitivity to environmental change. Factors, such as age, race, income, and existing health conditions affect the ability of an individual or community to prepare, respond to, and recover from an extreme weather event or climate stressor.

Long Beach is very diverse, which can be a source of strength, vibrancy, and resilience. However, it also has racial and economic disparities that are manifested spatially across the city. Low income people and communities of color are more likely to live in areas with poor air quality, in regions with little green space, and along the Los Angeles River channel where urban flood risk may increase. This geography of differentiated risk is due to socioeconomic inequality caused by historic racial and economic injustices, such as discrimination in education, housing, employment, education, local political representation, and access to resources. Low income communities of color were historically excluded from neighborhoods with less environmental pollution, and still today in Long Beach, low income communities of color are concentrated in the portions of the city with the worst air quality and environmental health metrics.

These structural inequalities not only increase the risks that people will suffer climate-related impacts, they also reduce their ability to cope with and respond to climate stressors. Low income residents are also more likely to live in housing with substandard insulation, inefficient air conditioning, or no air conditioning at all, and to be cost-burdened renters without alternative housing choices. As

temperatures increase, they will need to spend more of their limited income on utility bills. Low income seniors and children with limited mobility are particularly at risk during heat waves. Flooding is more disruptive for low income residents, who are less likely to have low deductible insurance or emergency savings to cover the costs of repairs.

Low income residents and communities of color are more likely to live in areas of the city with little green space. Data from the Climate Smart Cities Los Angeles tool on modeling of the urban heat island effect indicates that North and West Long Beach are more susceptible to high surface temperatures and air pollution. The amount of green space varies considerably across Long Beach with Central, West, and North Long Beach having the lowest amount (CLB DHHS 2013).

The following are some key considerations with regards to vulnerable populations in Long Beach.

Communities of Color

A majority of Long Beach residents are people of color. As of the 2010 census, the population is 41 percent Hispanic / Latino, 13 percent Black or African American, 13 percent Asian, and 1 percent Native Hawaiian or Pacific Islander (CLB DHHS 2013). Communities of color in Long Beach already experience health disadvantages. For example, the Black or African American community in Long Beach has the highest rates of hospitalization for heart disease, diabetes, and asthma compared to other races/ethnicities. The Asthma hospitalization rate for Black or African American residents, which is directly impacted by poor air quality, is nearly three to four times that of the other races/ethnicities (CLB DHHS 2013). In Long Beach, lack of access to health insurance is highest among those identifying themselves as Hispanic or Latino (31.8 percent) followed by Black or African American (19.8 percent), Asian (19.2 percent), and White (11.0 percent) respondents (CLB DHHS 2013).

Age

Elderly populations can be more vulnerable to extreme weather and climate stressors. They may be less able to evacuate as a higher proportion do not drive and may rely on public transportation. They may also have pre-existing health conditions that can be exacerbated by climate stressors. In Long Beach, almost 40 percent of people over the age of 65 report a disability compared to 10 percent of the overall Long Beach population. Children are also disproportionately impacted by certain climate change effects including extreme heat and air pollution. Central, West and North Long Beach have disproportionately younger populations, with the largest and highest percentages of children living there compared to other parts of the city.

Language

Non-English speakers may struggle to communicate with service providers and experience difficulties making use of preparedness, response, and recovery resources. In Long Beach, 34 percent of households speak Spanish at home and 10 percent speak Asian or Pacific Islander Languages at home. In Long Beach, English proficiency varies by age with people over the age of 65 most likely to report speaking English “not well” or “not at all” (38 percent) (CLB DHHS 2013).

Income

Low income communities face disproportionately higher rates of poor health outcomes, greater obstacles to achieving good health, and are more likely to live in neighborhoods with higher environmental health burdens (LADCP 2015). Income varies across race and ethnic groups, with people of color having lower incomes and wealth than White communities. Black or African American and Hispanic or Latino households had the lowest median incomes, about $10,000 less than the overall median income in Long Beach (CLB DHHS 2013). Median income also varies by neighborhood, with higher incomes in the East and Southeast and lower incomes in the North, West Central, and Southwest. In addition, approximately 19.1 percent of all residents in Long Beach live below the poverty line, which is 26 percent higher than the statewide poverty rate (ACS, 2017, Table DP03).

Geography of Combined Social Vulnerability

The Climate-Smart Cities Los Angeles Project, with a Technical Advisory Team that included public health experts, local academic and research institutions, and community leaders, developed a GIS decision support tool that includes a social vulnerability index comprised of ten indicators. This index is based primarily on the Environmental Protection Agency's EJSCREEN definition of demographic factors that indicate a community's potential susceptibility to environmental stressors. These factors include people of color, low income, educational attainment less than a high school degree, linguistic isolation, population under 5, and population over 64. The index includes three additional characteristics, which were added based on recommendations from the Technical Advisory Team: unemployment, asthma, and low birth weight.

The Southeastern Long Beach neighborhoods, which are most susceptible to sea level rise and flooding, exhibit many demographic factors that make them less at risk to the health impacts of climate change (higher income, lower rates of respiratory disease, higher share of residents that identify as white), but also have a higher share of elderly residents, which can be more vulnerable during flood events due to limited mobility.

North, Central, and West Long Beach have the lowest amounts of greenspace and high urban heat island effect, which can further stress existing health conditions during extreme heat events. West and North Long Beach have poor air quality and high levels of hospitalizations for asthma.

Opportunities

While responding to climate change presents pressing challenges, addressing these vulnerabilities represents an opportunity to tackle issues and systemic inequities that residents face today. Climate adaptation and mitigation actions will have a wide array of co-benefits, including improved air quality, improved access to green space, and the potential for sustainable economic growth and job opportunities for all income and education levels. Policies that seek to improve environmental justice outcomes for Long Beach's most vulnerable will also lead to better outcomes for all residents.

Public Health Co-Benefits

As described in the previous section, differences in health outcomes between residents are often a result of socioeconomic and racial inequities. Addressing these issues now will increase our community's resilience in the future, and vice versa, actions taken to reduce our contribution to climate change will also address public health problems now.

Urban greening, which will reduce the impact of future extreme heat events on residents in areas that are currently threatened by the urban heat island effect, has a myriad of benefits for current residents. Proximity to green space improves mental health by reducing stress and anxiety, improves physical health by providing recreation space, and increases community cohesion by creating pleasant public spaces for social interaction and gatherings. Increased urban tree canopy also helps address local air pollution by absorbing particulate matter from the air.

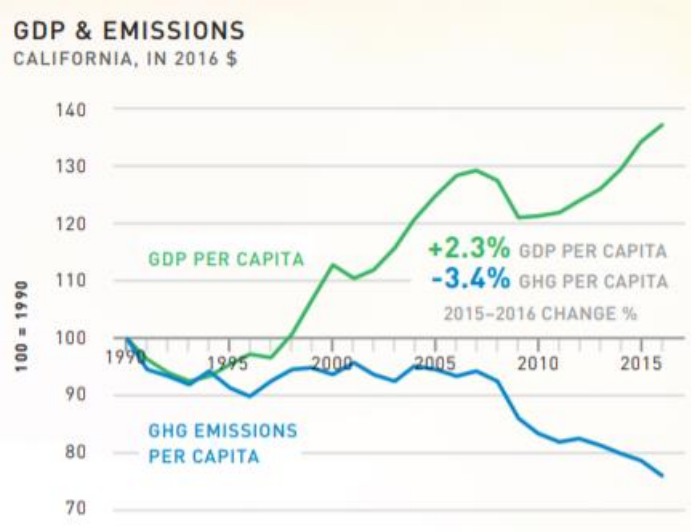
Policies that seek to reduce carbon emissions in the transportation sector can also positively address health in a variety of ways.. Investments in public transit and walkable, bikeable neighborhoods increase mobility and accessibility, lead to more active and health communities, reduce vehicle miles traveled, and improve air quality. Similarly, expanding electric vehicle (EV) infrastructure also leads to a reduction in transportation emissions and improved air quality as more EVs take to our roads.

Building efficiency, building decarbonization, and increasing electricity generation from renewable sources will also improve local air quality.

In addition to directly addressing public health disparities, climate adaptation and mitigation actions have the potential to spur economic development, expand access to economic opportunity, and mitigate income inequality, thereby directly addressing one of the underlying causes of public health disparities. A discussion of the economic benefits of climate change adaptation mitigation is included in the next section.

Economic Opportunities

A common misconception is that addressing climate change and reducing greenhouse gas emissions will harm economic growth. Evidence in California contradicts this perception. When the State of California passed AB 32 in 2006, many were skeptical that the state could reach its ambitious climate goals without sacrificing economic growth. Ten years later, not only did California reach its goal of reducing emissions to 1990 levels by 2020 four years early, but did so while achieving one of the largest economic expansions in state history (Next10, 2018). Studies conducted by CARB show that economic growth will not need to be compromised to achieve the state's goal of an 80 percent reduction in greenhouse gas emissions below 1990 levels by 2050 (CARB 2014).



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board, California Greenhouse Gas Inventory – by Sector and Activity; Bureau of Economic Analysis, U.S. Department of Commerce; U.S. Census Bureau. NEXT 10 / SF - CA - USA

The State of California is making considerable investments to drive technological innovation and the decarbonization of the economy. These policies, along with the local actions recommended in the following sections, present an enormous opportunity for Long Beach to promote sustainable economic development through infrastructure projects, innovation and deployment of new technologies, and the creation of green jobs for a variety of backgrounds and education levels.

Increased economic opportunities are already emerging as investments are directed towards meeting the State's goals. Building efficiency retrofits, decarbonization of energy generation, the construction of high performance buildings, rooftop and community solar deployment, and transit infrastructure are all examples of market responses to climate change that taking advantage of current technologies to create jobs today.

Addressing climate change not only creates job opportunities, it helps residents and businesses save money on utilities and transportation, which can be redirected into other areas of the economy. More fuel efficient vehicles and public transportation will also help Long Beach residents reduce their transportation costs.

Works Cited

Berg, Neil, Alex Hall, Fengpeng Sun, Scott Capps, Daniel Walton, Baird Langenbrunner, and David Neelin. "Twenty-First-Century Precipitation Changes over the Los Angeles Region*." Journal of Climate J. Climate 28.2 (2015): 401-21. Web. California Energy Commission (CEC). 2006. "Our Changing Climate: Assessing the Risks to California." A Summary Report from the California Climate Change Center.

California Air Resources Board (CARB), 2014: First Update to the Climate Change Scoping Plan, May 2014.

California Energy Commission (CEC). 2006. "Our Changing Climate: Assessing the Risks to California." A Summary Report from the California Climate Change Center.

California Energy Commission (CEC). 2012. Our Changing Climate: Vulnerability & Adaptation to the Increasing Risks from Climate Change in California. A Summary Report on the Third Assessment from the California Climate Change Center. CEC-500-2012-007.

Cayan, D., M. Tyree , M. Dettinger, H. Hidalgo, T. Das, E. Maurer, P. Bromirski, N. Graham, R. Flick. 2009. "Climate Change Scenarios and Sea Level Rise Estimates for the California 2008 Climate Change Scenarios Assessment. March 2009. CEC-500-2009-014D.

City of Long Beach Department of Health and Human Services (CLB DHHS) 2013. Community Health Assessment. Available at: http://www.longbeach.gov/health/media-library/documents/planning-and-research/reports/community-health-assessment/community-health-assessment/

Gershunov, Alexander and Guirguis, Kristen. 2012. "California heat waves in the present and future." *Geophysical Research Letters,* Vol 39 L19710, 2012.

Los Angeles Department of City Planning (LADCP), 2015. "Plan for a Healthy Los Angeles: A Health and Wellness Element of the General Plan.

National Research Council (NRC). 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Prepared by the Committee on Sea Level Rise in California, Oregon, and Washington and the National Research Council Board on Earth Sciences and Resources and Ocean Studies Board Division on Earth and Life Studies.

Pagan, B., J. Pal, C. Gao, J. Reichenberger, D. Kendall, M. Ashfaq, D. Rastogi, S. Kao, B. Naz, J. Schubel. 2015. "City of Long Beach Climate Resiliency Assessment Report Appendix A. Drought Report.

Pierce, David., D. Cayan, B. Thrasher. 2014. Statistical Downscaling Using localized Constructed Analogs (LOCA). *American Meterological Society.*

Sun F., Walton DB., Hall A. 2015. A Hybrid Dynamical – Statistical Downscaling Technique, Part II: End-of Century Warning Projections Predict a New Climate State in the Los Angeles Region. *Journal of Climate,* 28(12): 4618-4636.