National Park Service
U.S. Department of the Interior

CLIMATE*Friendly* PARKS

Golden Gate National Recreation Area

2016 Climate Change Action Plan

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Golden Gate National Recreation Area
Climate Change Plan Update

2016

Golden Gate National Recreation Area as a Climate Friendly Park

A message from the Superintendent

As stewards of the Nation's most valued public lands, the National Park Service takes seriously its responsibility to reduce and manage the effects of climate change on our parks. This requires an understanding of the challenges we expect to face and strategies for responding. We recognize that decisions we make now will impact how we are able to respond to the predicted effects of sea level rise and other climate impacts in the future.

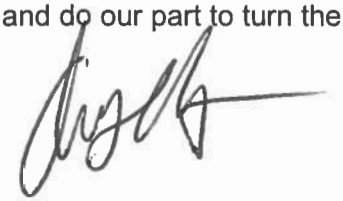
Golden Gate National Recreation Area (GGNRA) became a Climate Friendly Park in 2008 when we completed our first Climate Change Action Plan, joining a network of national parks that are putting climate friendly behavior at the forefront of sustainability planning. Our 2008 Action Plan included an initial emissions inventory and committed to three major actions: reduce our emissions, educate park staff, visitors, and community members about climate change actions they can take, and adapt our planning and management to the effects of climate change on our park. We also set an ambitious goal of achieving carbon-neutral park operations by 2016, the Centennial of the National Park Service, through a combination of reduced emissions and purchasing carbon-offsets.

While today we have not yet achieved carbon neutral park operations, we have made great strides in reducing our emissions, and this updated Climate Change Action Plan reviews the actions we have taken and how these reflect in our carbon footprint.

But the urgency to address climate change is stronger than ever, and this updated Action Plan seeks to make the park's climate change response even more robust as we head into the Park Service's second century.

We feel more confident than ever that we can achieve carbon neutral park operations through additional reductions in our carbon footprint and the purchase of carbon offsets. We have set a new goal for carbon neutral park operations by 2020, and this plan lays out a method for achieving this.

Most importantly, we hope to use our efforts as an example not only for other national parks but also for our visitors and the surrounding community. In this way we hope to amplify our impact and do our part to turn the tide against climate change.



Aaron Roth

Acting General Superintendent, Golden Gate National Recreation Area

Introduction

This plan is an update from the original *Golden Gate National Recreation Area Climate Change Action Plan 2008*. The purpose of this plan is to outline the accomplishments of the Golden Gate National Recreation Area since 2008 related to climate change and set new goals for the park in the future. As with the previous report, this plan provides detailed guidance for the Golden Gate National Recreation Area (GGNRA or the park) to become a carbon neutral park and to adapt to changes the park may experience due to a changing climate. This Action Plan lays out the principles and process by which the park will adapt to climate change and reduce its net emissions of greenhouse gases (GHGs) (including those of its visitors) to the point that it is no longer a contributor to global warming. And the park recognizes that educating our staff and visitors is an integral part of implementing solutions to climate change.

Progress since 2008 Climate Change Action Plan

The original plan was written in 2008. Since that time GGNRA has made progress in many areas (see Appendix A). Highlights of the park's actions include:

- Implemented energy conservation efforts such as adding LED lighting, insulating buildings, and installing efficient heating
- Added solar photovoltaics on the park headquarters building and on Alcatraz Island
- Joined Marin Clean Energy's Deep Green program in 2011 and CleanPowerSF's SuperGreen program in 2016
- Installed electric vehicle chargers for both NPS fleet vehicles and visitors in multiple park locations
- Expanded the Muir Woods Shuttle to decrease vehicle traffic to Muir Woods
- Improved solid waste diversion through increased composting in both Marin and San Francisco Counties
- Participated in multiple planning efforts related to climate change adaptation, such as in Marin County and at Ocean Beach and Crissy Field
- Incorporated climate change into GGNRA' s Interpretive Plan
- Added outdoor exhibits and provided increased interpretive programming related to climate change
- Conducted a series of trainings for staff, volunteers, and visitors related to GGNRA's climate change efforts
- Participated in the launch of Bay-CLIC (Bay Area Climate Literacy Impact Collaborative) to bring together informal educators on climate change education

The Challenge of Climate Change

The greenhouse effect is a natural phenomenon that keeps the earth's temperature stable at an average of 60° F. Without this natural process that traps some solar heat energy, our planet would be uninhabitable at an average temperature of 14° F (*Climate Change 2007: The Physical Science Basis*). However, human actions are disturbing the balance of the system through over-production of large amounts of two main greenhouse gasses (GHGs): carbon dioxide (CO_2) and methane (CH_4). The increase in GHGs is causing an overall increased warming of the planet, commonly referred to as global warming. The term "climate change" describes the variable consequences of global warming over time.

Average global temperatures on the Earth's surface have increased about 1.1° F since the late 19th century. Most of the warming has occurred since the 1970s due to drastically increasing GHG emissions (Figure 1). The 20 warmest years having occurred since 1981, with all 10 of the warmest years occurring in the past 12 years (*NASA Climate Change: Vital Signs of the Planet)*. The leading cause of this warming is the buildup of GHGs in the atmosphere.

"I believe climate change is fundamentally the greatest threat to the integrity of our national parks that we have ever experienced."

- Jonathan Jarvis, National Park Service Director, September 2010

Carbon dioxide (CO_2) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions.

The continued addition of CO_2 (Figure 2) and other GHGs to the atmosphere will raise the Earth's average temperature even more rapidly in the next century; without action, a global average warming of 4-7° F by the year 2100 is considered likely. Rising global temperatures, especially at the poles, will further raise sea level and affect all aspects of the water cycle, including snow cover, mountain glaciers, timing of spring runoff, water temperature, ocean currents and upwelling, salinity levels of inland coastal waters, and aquatic life. Climate change is also expected to affect human health, alter crop production, animal habitats, and many other features of our natural and managed environments.

The *Synthesis Report (SYR)* published in 2015 provides the latest assessment of climate change by the Intergovernmental Panel on Climate Change (IPCC). "SYR confirms that human influence on the climate system is clear and growing, with impacts observed across all continents and oceans. Many of the observed changes since the 1950s are unprecedented over decades to millennia. The IPCC is now 95 percent certain that humans are the main cause of this century's accelerated global warming. In addition, the SYR finds that the more human activities disrupt the climate, the greater the risks of severe, pervasive and irreversible impacts for people and ecosystems, and long-lasting changes in all components of the climate system. The SYR highlights that we have the means to limit climate change and its risks, with many solutions that allow for continued economic and human development. However, stabilizing temperature increase to below 2°C relative to pre-industrial levels will require an urgent and fundamental departure from business as usual. Moreover, the longer we wait to take action, the more it will cost and the greater the technological, economic, social and institutional challenges we will face." (Pachauri et al., 7).

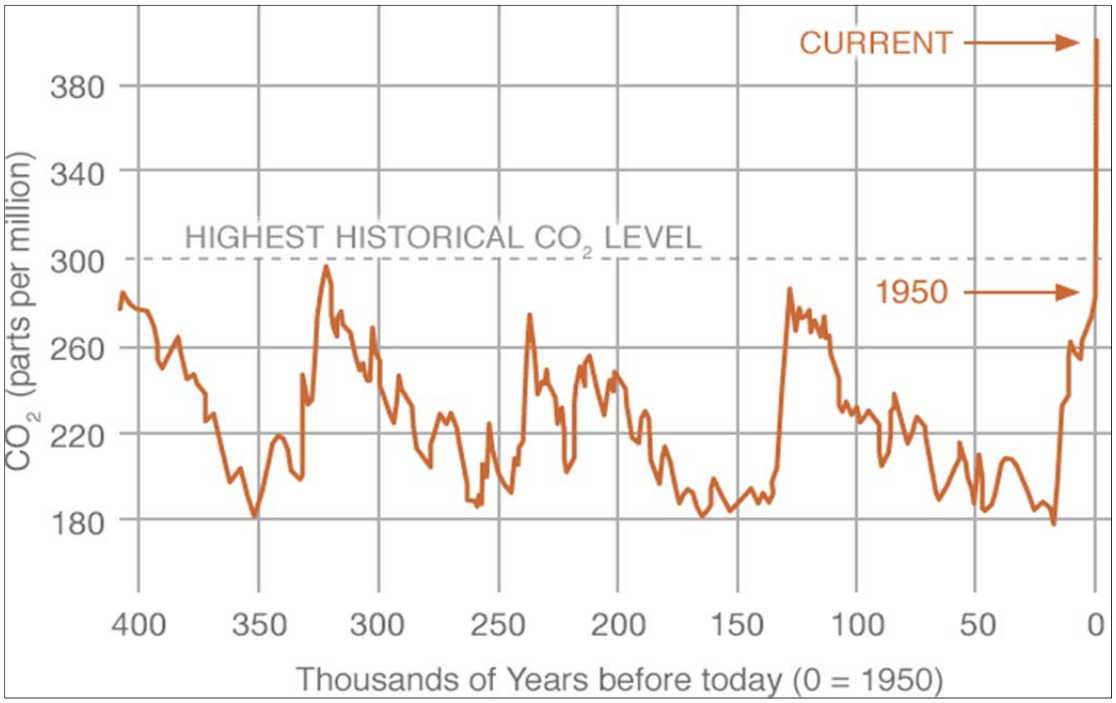


Figure 1: The comparison of atmospheric samples contained in ice cores and more recent direct measurements provides evidence that atmospheric CO_2 has increased since the Industrial Revolution.

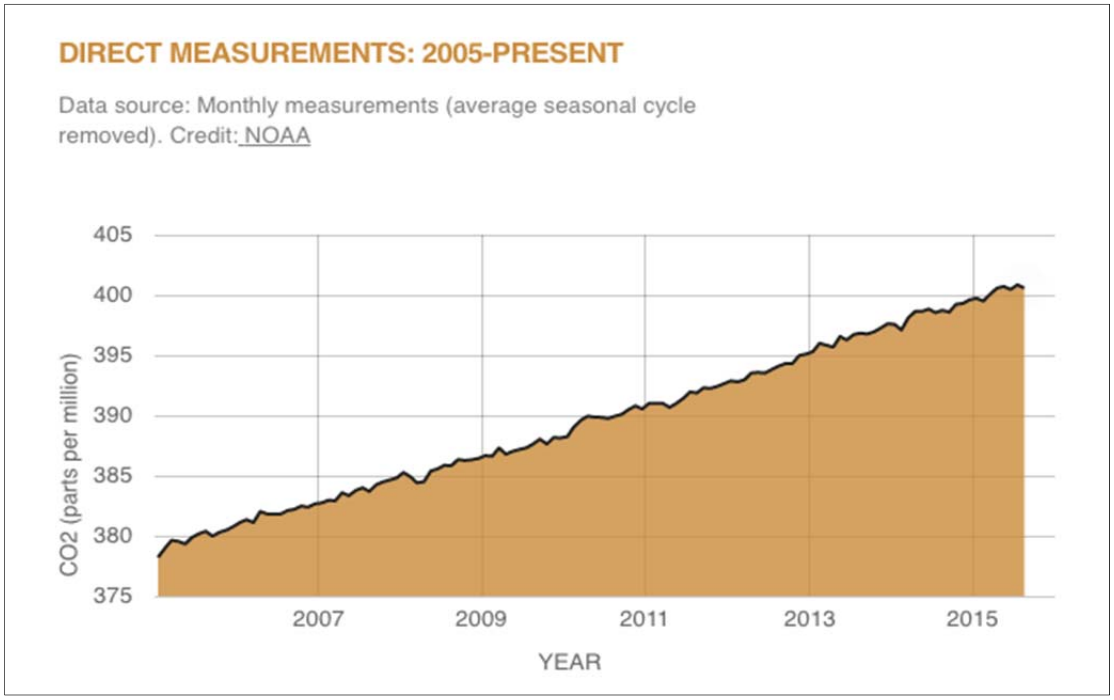


Figure 2 represents atmospheric CO_2 levels in recent years, with average seasonal cycle removed. According to NASA, the latest CO_2 measurement made in June 2016 was 404.48 ppm (parts per million).

Predicted Impacts of Climate Change

Climate change will have different impacts around the world, with the one common feature that climate will become more unpredictable and weather patterns will change from historic ranges.

The following impacts are those that will most likely affect GGNRA:

Sea level rise. Global sea level has risen by about 8 inches since reliable record keeping began in 1880. It is projected to rise another 1 to 4 ft. (30 - 122 cm) by 2100. This is the result of added water from melting land ice and the expansion of seawater as it warms (Figure 3).

In the next several decades, storm surges and high tides could combine with sea level rise and land subsidence to further increase flooding in many regions, impacting resources and infrastructure.

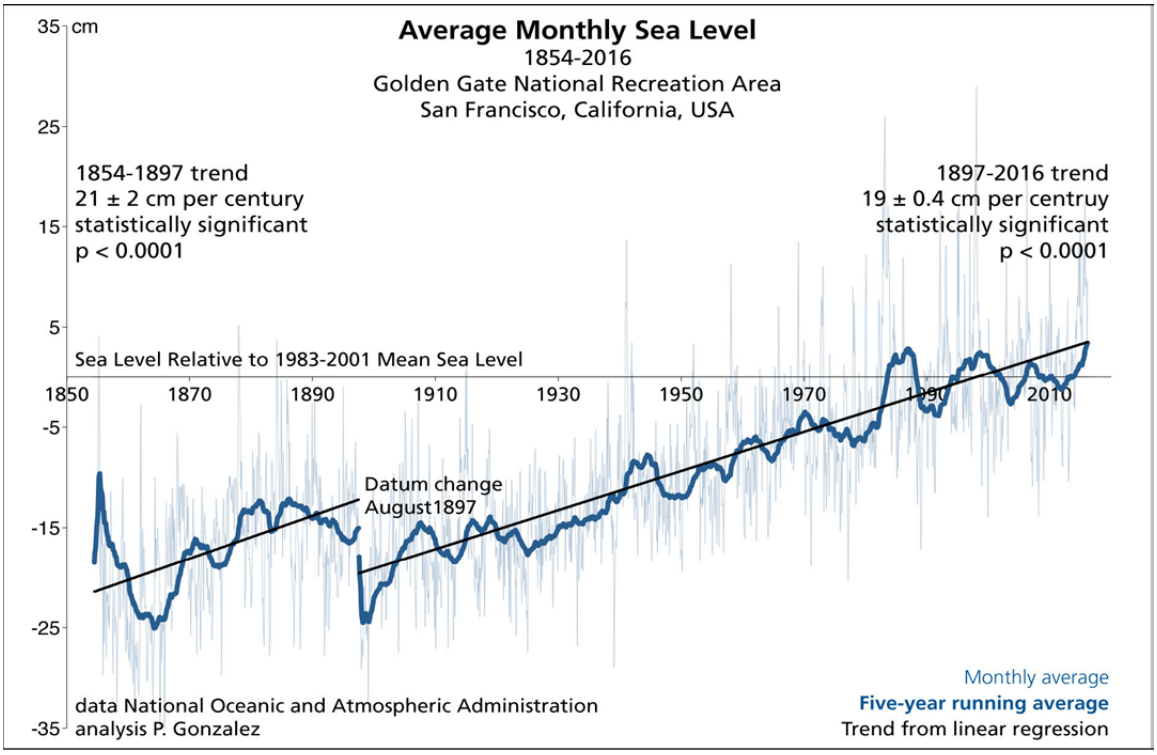


Figure 3 depicts the statistically significant rate of sea level rise since 1854

Global temperature rise. All three major global surface temperature reconstructions show that Earth has warmed since 1880. Most of this warming has occurred since the 1970s, with the 20 warmest years having occurred since 1981 and with all 10 of the warmest years occurring in the past 12 years. Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, uniform or smooth across the country or over time but will continue an overall upwards trend.

Warming oceans. The oceans have absorbed much of this increased heat, with the top 700 meters (about 2,300 feet) of ocean showing warming of 0.302 ° F since 1969. This seemingly small increase could have significant impacts on fisheries, coral reefs, and other ecosystems that are adapted to a very stable temperature.

Extreme events. The number of record high temperature events in the United States has been increasing, while the number of record low temperature events has been decreasing since 1950. The U.S. has also witnessed increasing numbers of intense rainfall events.

More droughts and heat waves. Droughts in the Southwest and heat waves (periods of abnormally hot weather lasting days to weeks) everywhere are projected to become more intense, and cold waves less intense everywhere.

Summer temperatures are projected to continue rising, and a reduction of soil moisture, which exacerbates heat waves, is projected for much of the western and central U.S. in summer. By the end of this century, what would have been once-in-20-year extreme heat days (one-day events) are projected to occur every two or three years over most of the nation.

Wildfire. Under high emission scenarios, climate change may increase potential burned areas 50% to 100% in some parts of GGNRA along the Peninsula and in Point Reyes National Seashore by 2085 (qtd. in Gonzalez 10).

Ocean acidification. Ocean Acidification is also the result of increased CO_2 in the atmosphere. It occurs when carbon dioxide gas is absorbed by the ocean and reacts with seawater to produce acid. Although CO_2 gas naturally moves between the atmosphere and the oceans, the increased amounts of CO_2 gas emitted into the atmosphere has been increasing the amount of CO_2 absorbed by the ocean, resulting in seawater that is more acidic. (*Integrated Ocean Observing System: Introduction*). "This leads to higher acidity, mainly near the surface, which has been proven to inhibit shell growth in marine animals and is suspected as a cause of reproductive disorders in some fish." *(National Geographic: The Ocean*). The amount of carbon dioxide absorbed by the upper layer of the oceans is increasing by about 2 billion tons per year.

San Francisco Bay salinity. San Francisco Bay is vulnerable to increased salinity under climate change. Projected warmer winter temperatures in the Sierra Nevada could decrease winter snowpack, increase winter runoff, decrease spring and summer runoff, reduce spring and summer freshwater inflows into San Francisco Bay, and increase salinity in the Bay 3 to 5 g per kg of water by 2100 AD (qtd. in Gonzalez 14). Changes in salinity lead to effects on water quality and wildlife species habitat.

Changes in precipitation patterns. Average U.S. precipitation has increased since 1900, but some areas have had increases greater than the national average, while some areas have had decreases. More winter and spring precipitation is projected for the northern United States, and less for the Southwest, over this century. Projections of future climate over the U.S. suggest that the recent trend towards increased heavy precipitation events will continue, leading to more serious flooding. This trend is projected to occur even in regions where total precipitation is expected to decrease, such as the Southwest.

Species-specific impacts. A recent report by Patrick Gonzalez, Principal Climate Change Scientist for Natural Resource Stewardship and Science with the National Park Service describes many impacts to species found in GGNRA. See *Climate Change in the National Parks of the San Francisco Bay Area, California, USA* (Gonzalez, July 11 2016).

All of these impacts will change the ecosystems of the Bay Area as well as the human environment that residents have grown accustomed to. Species, park visitors, and land managers will have to adapt to a new and unknown future.

Goals and Objectives of GGNRA's Climate Change Action Plan

This Climate Change Action Plan outlines three major actions that the park will undertake to address climate change. These actions build on those proposed in the 2008 Action Plan:

Action 1: Reduce GHG emissions resulting from activities within and by the park

Action 2: Plan for and adapt to future impacts of climate change

Action 3: Increase climate change education and outreach

The first action identifies how Golden Gate National Recreation Area can reduce GHG emissions from park operations and visitation. This plan presents the park's emission reduction targets and associated reduction actions designed to achieve the park's emission reduction goals.

Overall, Golden Gate National Recreation Area aims to operate the park in a carbon neutral manner by 2020 by implementing emission reductions, mitigation actions, and carbon offset strategies as further mitigation.

The second action is to adapt to the impacts of climate change and build resiliency in the park by searching for solutions on how to support the park's natural and cultural resources and facilities and help them confront climate change issues.

The third action is to educate park staff, visitors and the public about climate change and encourage everyone to reduce their GHG emissions. By creating an impact beyond park boundaries we will be able to amplify these reductions in GHGs and thus our contribution to climate change.

Each action has multiple Goals, Objectives, and Implementation Activities that will help the park make progress with this Action Plan. While the plan does not provide detailed instructions on how to carry out each of the proposed measures, the 5-Year Implementation Activities in Appendix B will serve as next steps.

In order to ground this action plan in the latest science and policies, the park will keep abreast of guidance and policies set forth at the Federal, State, and Local level and incorporate these into park planning. A list of existing policies and resources is included in Appendix C.

Contributors to Greenhouse Gas Emissions at GGNRA

In order to enact Action 1 of the Climate Change Action Plan, reducing GHG emissions resulting from activities within and by the park, it is necessary to perform GHG emissions audits annually.

Naturally occurring GHGs include CO_2, CH_4, N_2O, and water vapor. Human activities (e.g., fuel combustion, waste generation) lead to increased concentrations of these gases (except water vapor) in the atmosphere.

Golden Gate National Recreation Area has GHG emissions from three contributors: 1) emissions from park operations; 2) emissions from concessioner and Park Partner operations (non-profits that utilize park buildings); and 3) visitor emissions. Currently the Park Partner operations are very difficult for us to quantify (for example they receive separate utility bills) and are therefore excluded from the following evaluation.

Diesel used for Alcatraz generators and the Alcatraz ferries was not included in the GHG inventory. Alcatraz Cruises has been offsetting the emissions from this diesel by purchasing Renewable Energy Credits (RECs) and Carbon Offsets. Graphs and charts of the park's emissions including the Alcatraz diesel can be found in Appendix D.

The emissions from each contributor are divided into three sectors:

- **Energy** (diesel and propane generators, furnaces, dryers, hot water heaters, purchased electricity)
- **Transportation** (miles traveled by park fleet, visitor vehicles, Muir Woods Shuttle, and the Alcatraz Ferry and associated emissions from combustion)
- **Waste** (incorporates the emissions from offsite wastewater treatment and municipal solid waste decomposition)

The CLIP Tool

The GHG emissions inventory was completed using the Climate Leadership in Parks (CLIP) tool. The CLIP tool was developed under the Climate Friendly Parks initiative between NPS and the Environmental Protection Agency (EPA), with the purpose of enabling park personnel to complete GHG inventories and then use the tool to track future progress. By enabling parks to develop their own inventories and action plans, the EPA and NPS hope to expand the Climate Friendly Parks program to many more parks than would otherwise be possible. The CLIP tool converts emissions of various GHGs into a common "metric tons of carbon dioxide equivalent" ($MTCO_2E$) unit, which provides a basis for comparison between gases and simplifies reduction tracking.

Greenhouse Gas Emissions at GGNRA

GHG emissions result from the combustion of fossil fuels for energy (e.g., boilers, electricity generation) and transportation purposes, the decomposition of waste and other organic matter, and the volatilization or release of various other sources (e.g., fertilizers and refrigerants). This section highlights the overall results from the CLIP tool; Appendix D describes the process in more detail and breaks out the GHG emissions by type (CO_2, methane, etc).

The overall trend is that GGNRA has reduced its GHG emissions since 2009; however, the Park will continue to monitor and take action on certain sectors that have seen recent upticks, mainly transportation.

In 2015, Golden Gate National Recreation Area's GHG emissions totaled 34,567 metric tons of carbon dioxide equivalent ($MTCO_2E$). As Figure 4 demonstrates, the majority of these emissions are due to visitors. The park receives approximately 15 million visitors per year, generating an estimated 88 million vehicle miles travelled. This accounts for a majority of the park's emissions – totaling 94 percent of emissions. As Figure 5 and Table 1 demonstrate, the largest source of Golden Gate National Recreation Area's emissions is transportation – totaling 33,184 $MTCO_2E$. For the reasons previously discussed, the majority of emissions attributed to transportation are due to visitor travel – totaling 32,435 $MTCO_2E$.

Figure 6 presents emissions from Park Operations, excluding visitor emissions. There is a much more even split of emissions by sectors within Park Operations due to the removal of visitor transportation emissions.

Figure 7 presents emissions from Park Operations from 2009-2015 and is broken down by sector. Energy emissions have been on a rapid descent due to joining Marin Clean Energy, installing solar on Alcatraz, and the offsetting the remainder of the emissions from the Alcatraz diesel generators. Transportation emissions have slightly increased as the park has grown, which requires more vehicles being added to the park's fleet. Waste emissions have also slightly increased due to an increase in visitation to the park. Most of the landfilled waste comes from public collection sites.

Figure 8 presents the total greenhouse gas emissions from the park from 2009-2015. This graph shows an overall downward trend over the years due to the adoption of a variety of sustainability initiatives such as those described in Appendix A.

Park access to the information required to inventory the Park Partners and most concessionaires is limited. Ideally, they will engage in their own climate change analysis and be able to provide the park with their emissions tracking information in the coming years so that the Park can include that information in future updates to this plan.

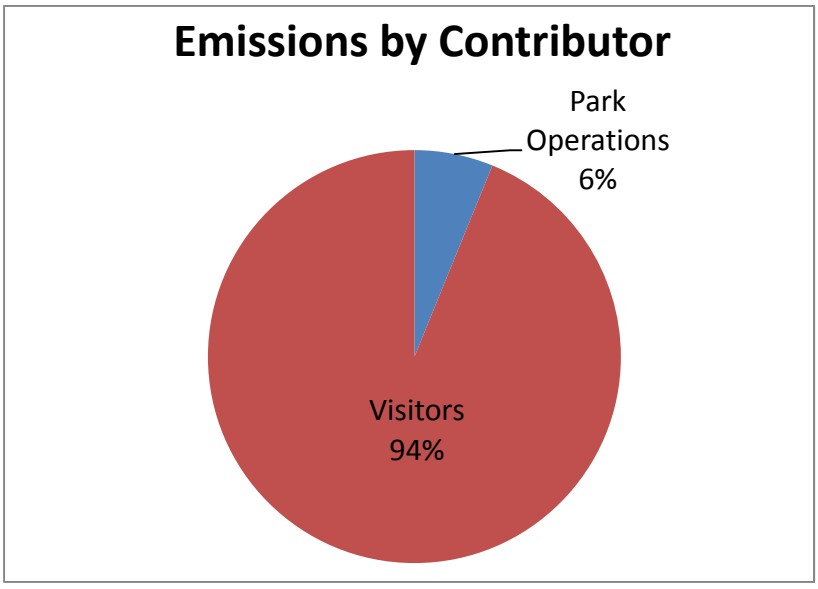


Figure 4: Golden Gate National Recreation Area's 2015 Greenhouse Gas Emissions by Contributor

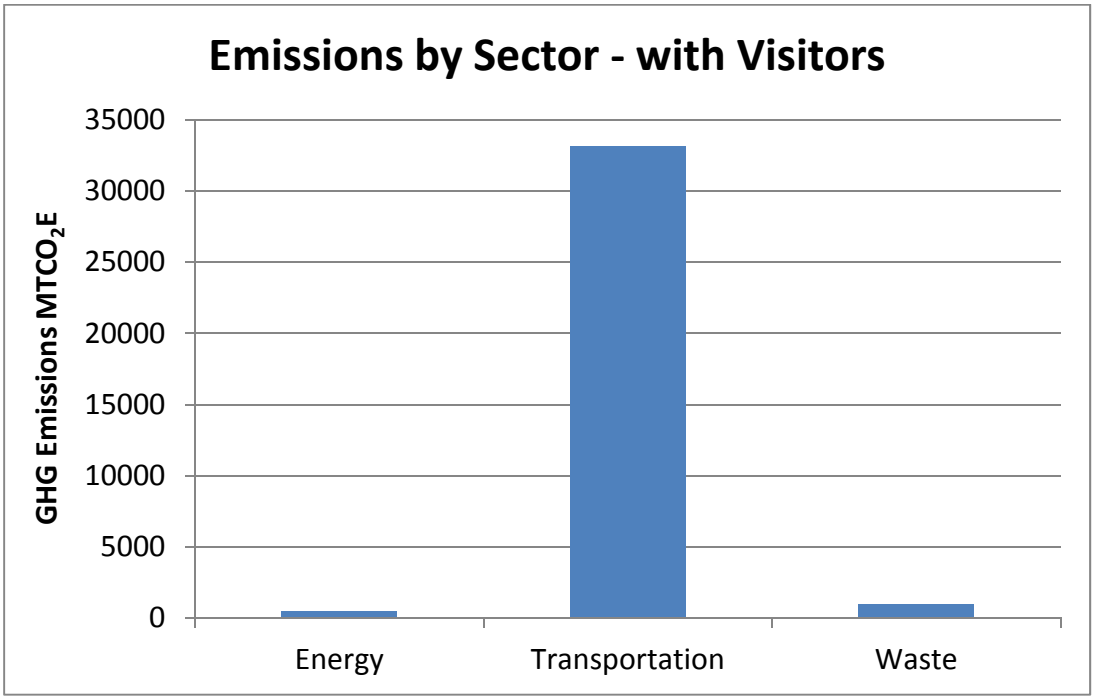


Figure 5: Golden Gate National Recreation Area's 2015 Greenhouse Gas Emissions by Sector

	Park Operations	Visitors	Total
Energy	445	NA	445
Stationary Combustion	159	NA	159
Purchased Electricity	286	NA	286
Transportation	749	32,435	33,184
Mobile Combustion	749	32,435	33,184
Waste	937	NA	937
Solid Waste Disposal	936	NA	936
Wastewater Treatment	1	NA	1
Total Emissions	**2,132**	**32,435**	**34,567**

** Totals may not sum due to rounding*
NA – Not Applicable. Visitor waste disposal and wastewater treatment are attributed to Park Operations and Alcatraz according to according to authority over disposal sites.

Table 1: Golden Gate National Recreation Area's 2015 Greenhouse Gas Emissions by Sector, Source, and Park Unit

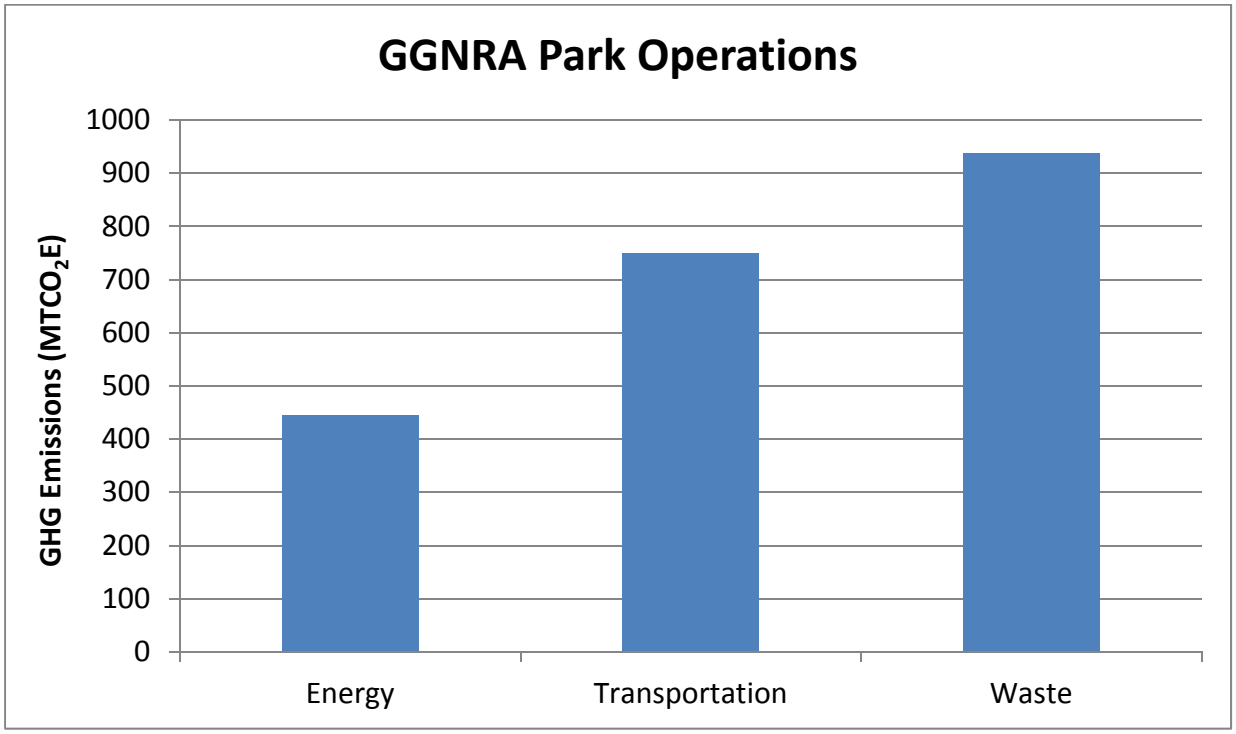


Figure 6: Golden Gate National Recreation Area's 2015 Greenhouse Gas Emissions by Park Operations Sector

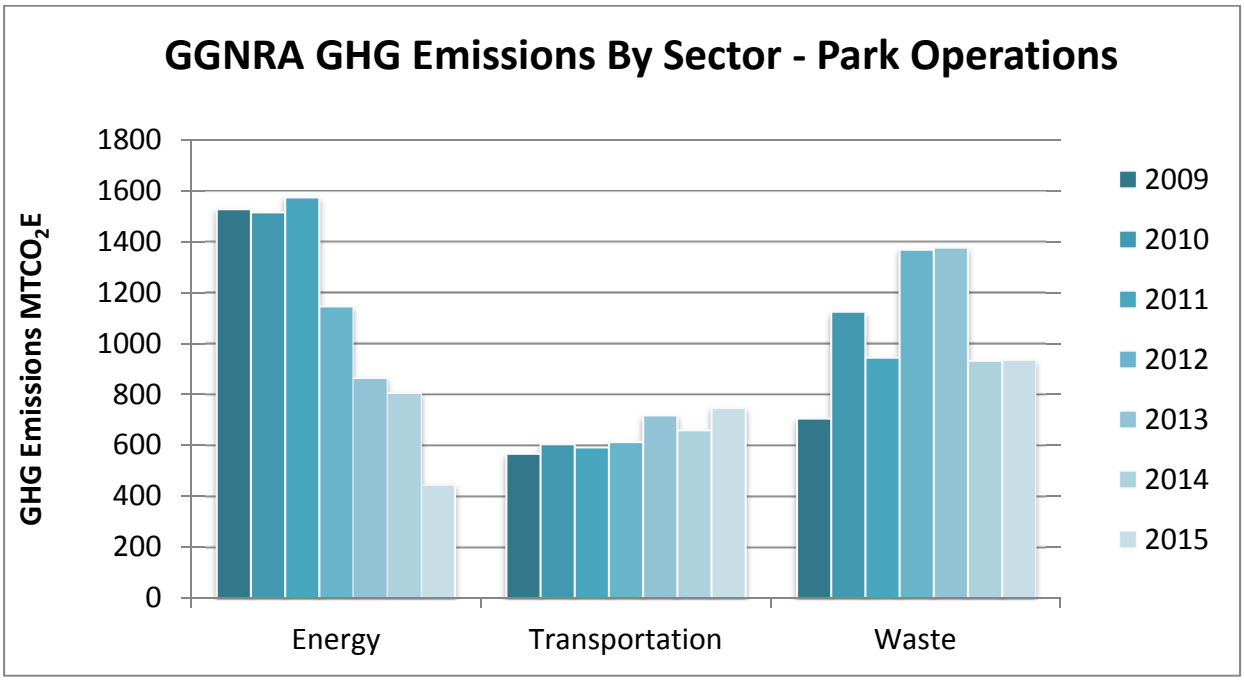


Figure 7: Total GGNRA Greenhouse Gas Emissions from 2009-2015 by Sector

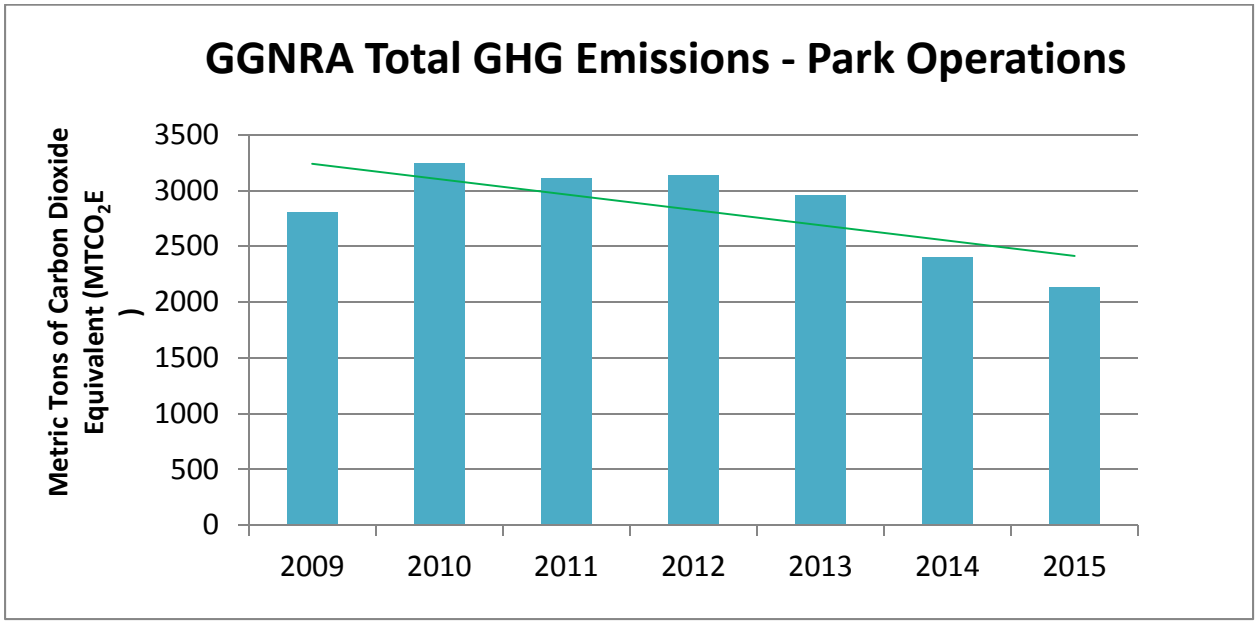


Figure 8: Total GGNRA Greenhouse Gas Emissions from 2008-2015

How Golden Gate National Recreation Area is Responding to Climate Change

The following goals and objectives have been updated from the 2008 Action Plan. The park's Green Team, along with members of an ad-hoc Climate Change Task Force, developed these new goals to reflect the latest science, policies, and local initiatives. Appendix B includes a 5-Year Implementation Plan that describes the next steps the park can take to implement these goals. The park's Green Team will consult this implementation plan during the annual update of the Environmental Management System to ensure that progress is being made to reduce the park's carbon footprint and expand education and outreach activities.

Action 1: Reduce GHG Emissions Resulting from Activities within and by the park

Golden Gate National Recreation Area has the goal of operating in a carbon neutral manner by 2020. This goal will be met first by reducing GHG emissions at the park in the Transportation, Energy, and Waste Management sectors. To further ensure GGNRA meets its goal, the park will supplement these mitigation actions with carbon offset strategies.[1]

Transportation Management

Emissions from transportation are a large contributor to the park's carbon footprint, especially from park visitors. The following goals and objectives were developed to meet the park's transportation emission reduction goals:

1 Reduce petroleum consumption by NPS vehicles and equipment

a. Increase the average miles-per-gallon (MPG) of the park fleet
b. Continually optimize fleet technology to utilize high-efficiency and low-emission vehicles
c. Increase efficiency of equipment and promote efficient use

2 Reduce impact of visitors' personal occupancy vehicles

a. Expand and enhance shuttle services throughout the park
b. Work with public transportation agencies to maximize transportation options to the park
c. Encourage more efficient visitor vehicle use by such means as charging for parking or offering free or subsidized entry and parking for low-emission vehicles or carpools
d. Promote strategies to reduce idling by park visitors
e. Promote biking and walking to the park

[1] In order to meet this goal by 2020, GGNRA staff will evaluate which inputs will be included in the amount to be offset. For example, we are currently not measuring staff travel outside the park (such as air travel) which we could add to our Park Operations number before we calculate the amount of offsets needed.

3 Improve transportation options for staff of NPS, park partners and concessioners

a. Increase employee options and incentives to use alternative transportation to/from work
b. Promote alternative work schedules and telework policy to reduce commuting times
c. Pursue opportunities to create carpools and shuttles for park staff

Energy Use Management

The park has made the most strides to date in reducing emissions from energy generation, in large part from purchasing 100% renewable electricity through our energy provider. The following goals and objectives will allow for further reductions in energy use, thus decreasing the need to offset electrical use:

4 Promote energy efficiency and energy conservation in NPS-occupied facilities

a. Include energy efficiency in early project scoping
b. Install energy-efficient lighting, lighting-control devices, and EnergyStar rated appliances
c. Maximize electric fuel sources over propane and natural gas
d. Audit NPS buildings to determine highest energy users
e. Work with park partners and concessionaires to reduce energy use

5 Utilize 100% clean energy through on-site generation or purchase from a renewable energy provider

a. Increase the overall percentage of renewable energy at Alcatraz Island by lowering energy demand and optimizing the solar system.
b. Actively seek compatible renewable energy projects within the park boundary
c. Offset electrical generation with 100% renewable energy

Waste Management

The connection between waste and GHG emissions may not be obvious. However, waste management—in the form of source reduction and solid waste reduction—can dramatically reduce GHG emissions. The less we consume in terms of products and packaging, the less energy is used and fewer GHGs are emitted. Additionally, reducing the amount of waste sent to landfills reduces methane (CH_4) emissions caused by decomposition. Even recycling leads to GHG emissions, so reduction in materials overall benefits.

Diverting or reducing the park's waste stream through overall reduction of materials, increased recycling efforts and waste management procedures will reduce the amount of waste sent to landfills, which are the largest human-generated source of CH_4 emissions in the United States. The following strategies were developed to meet the park's waste emission reduction goal:

6 Reduce waste through composting and recycling

a. Achieve 75% diversion rate through recycling and composting
b. Train all park staff on recycling and composting
c. Improve recycling and composting in public areas

7 Promote Green Purchasing to reduce sources of waste

a. Provide resources and trainings to NPS staff
b. Emphasize reducing packaging materials as a source reduction goal
c. Share green purchasing successes with park partners and visitors

8 Reduce the amount of wastewater sent to wastewater treatment plants and septic systems

a. Decrease amount of wastewater treated

Action 2: Plan for and Adapt to Future Impacts of Climate Change

While it is crucial to reduce the park's impact on climate change, it is also important to recognize the fact that certain effects of climate change may be inevitable, and the park should start planning and monitoring for them now.

Many of these actions will require outside funding, which the park will actively seek in order to engage outside scientific expertise to inform the adaptation planning process.

Adaptation Planning and Collaboration

1 Integrate adaptation planning and management into park policies and projects

a. Analyze potential climate change impacts to park resources and adaptively apply the information to improve planning, resource conservation, and visitor experience
b. Adopt the principles of Climate Smart Conservation (CSC) for all actions taken in GGNRA. Emphasize the four key elements of CSC:
   - acting with intentionality
   - manage for change, not just persistence
   - reconsider goals, not just strategies
   - integrate adaptation into existing work

2 Enhance collaboration between park service staff and other public agencies

a. Collaborate as a key stakeholder and land manager in cross-jurisdictional climate-smart adaptation planning and implementation efforts on natural resources, cultural resources, park facilities and operations
b. Collaborate with other agencies, partners, and scientists to develop, test, and apply climate change models and other climate change tools to park activities
c. Partner and present at regional and national conferences on climate adaptation

Science-Informed Decisions

3 Use the best available scientific data and knowledge related to climate change to inform and guide park policies, decisions and project designs

a. Using the best available science, conduct assessments of vulnerability to climate change impacts of key park resources, projects and sites
b. Use existing integrated data systems to promote sharing of climate change data and information with other agencies and the public

Natural Resources

4 Increase the adaptive capacity of ecosystems and landscapes within and adjacent to park boundaries

a. Use climate change adaptation planning tools to conduct ecosystem vulnerability assessments to develop climate-smart adaptation actions
b. Restore and expand priority habitats to increase connectivity to existing habitat areas both within and adjacent to the park
c. Adaptation strategies should maximize natural shoreline values and processes and avoid additional shoreline armoring

Cultural Resources

5 Establish preservation plans for all threatened cultural resources

a. Prioritize cultural resource adaptation projects that combine established management tools with newer methods, such as vulnerability assessments

6 Fully document all threatened cultural resources

a. Work with partners to increase scientific understanding of climate change and its effects on cultural resources

Park Facilities and Park Operations

7 Develop and implement park-specific strategies to address vulnerability risks to park facilities and park operations

a. Plan for the physical effects of climate change, particularly sea level rise and accelerated erosion, in managing park facilities and park operations
b. Protect recreational areas in ways consistent with NPS policy and park goals, including managed retreat and relocating facilities
c. As needed, adjust park operations procedures to reduce increasing impact on park facilities resulting from visitor use

Action 3: Increase Climate Change Education and Outreach

Climate change is a complex issue that the park can help communicate to the public. A better understanding of the problem and the benefits of reducing GHG emissions can motivate staff, visitors, and community members to incorporate climate friendly actions into their own lives. Combined with park reductions in emissions, the greatest potential impact that Golden Gate National Recreation Area can have on mitigating climate change is through public education. Thus, the park staff sees public education as an end goal of any climate initiative.

Park Staff

1 Create climate change awareness in all park staff including the Golden Gate National Parks Conservancy

a. Develop content for general park staff that raises awareness-levels regarding climate change
b. Provide a common information repository that is accessible to park staff

2 Provide incentives for park staff to undertake action on climate change solutions

a. Prioritize projects that incorporate sustainability and provide the opportunity to showcase park actions
b. Coordinate messaging on climate change and sustainability projects that emphasizes solutions
c. Find ways to motivate staff to act at work and home and to reward action and make it enjoyable

Visitors

3 Provide up-to-date climate change resources to staff that engage with the public, such as interpreters and volunteer coordinators

a. Provide current scientific information and research on climate change relevant to our region and more broadly
b. Provide opportunities to learn specific techniques and best practices for climate change interpretation and education

4 Continue to provide climate change interpretation and education through existing channels and identify new opportunities to interpret climate change

a. Maintain the public GGNRA website to incorporate climate change resources
b. Provide information about climate change and solutions on social media
c. Develop park-specific interpretive materials for visitors
d. Maintain and improve park exhibits that interpret climate change

5 Encourage visitors to reduce greenhouse gas emissions

a. Provide messaging about sustainable solutions to visitors and encourage them to take part

Local/Regional Organizations

6 Participate in and play a leadership role in community, regional and national efforts

a. Maximize opportunities for the park's voice to be present in community discussions on climate change
b. Collaborate with regional and national organizations related to climate change
c. Focus on working with organizations that have educational programming
d. Encourage park partners, neighbors, and supporters to address climate change in their homes, organizations, and daily actions.

Next Steps: Evaluating Progress and Identifying Areas for Improvement

By taking the actions established above, Golden Gate National Recreation Area plans to achieve carbon neutral park operations. Achieving this goal will require an ongoing commitment by the park, which may include subsequent emission inventories, additional mitigation actions, and re-evaluation of goals.

The park commits to these follow-up steps:

- Perform annual emission inventories to evaluate progress toward goals stated in this action plan
- Follow the guidelines of the action plan as well as of the Implementation Workplan (Appendix B) that details how these goals will be implemented
- Develop additional emission mitigation actions beyond those listed in this plan
- Review the progress of this plan annually through the Environmental Management System
- Present progress on this plan annually to the park's Leadership Team

Conclusion

Golden Gate National Recreation Area has a unique opportunity to serve as a model for approximately 14.5 million visitors annually (*Golden Gate National Recreation Area: Park Statistics)*. This report summarizes the operational actions the park commits to undertake to address climate change. Specifically, the park realizes its ability to educate the public and serve as a valuable model for citizens. By seriously addressing GHG emissions within the park and sharing its successes with visitors, Golden Gate National Recreation Area will help mitigate climate change far beyond the park's boundaries.

This Action Plan also serves as an important enhancement mechanism for the park's established Environmental Management System (EMS). Realistic environmental commitments created by Golden Gate National Recreation Area staff and approved by the park's Superintendent will significantly reduce the park's GHG emissions in the coming years. The mitigation actions included in this plan have been developed in order to be directly transferable to the park's EMS. Golden Gate National Recreation Area's Action Plan thus provides an effective way to meet EMS goals.

The National Park Service faces an uncertain future due to the possible effects of climate change. However, by seriously addressing climate change impacts and reducing emissions, Golden Gate National Recreation Area will reduce its contribution to the problem while setting an example for its visitors. The strategies presented in this Action Plan will help the park continue its leadership in climate change response.

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Appendix A (Summary of Progress Since 2008 Action Plan) and Appendix B (5-Year Implementation Workplan) available on request

Appendix C: Background Information - Laws and Regulations

Federal Policies, Executive Orders and NPS Directives

Federal policy has emphasized sustainable practices for many years, and has increasingly incorporated climate change into Executive Orders and park policies:

Federal Policies

The President's Climate Change Action Plan (June 2013)

"...President Obama is putting forward a broad-based plan to cut the carbon pollution that causes climate change and affects public health. The plan, which consists of a wide variety of executive actions, has three key pillars: (1) Cut Carbon Pollution in America, (2) Prepare the United States for the Impacts of Climate Change, (3) Lead International Efforts to Combat Global Climate Change and Prepare for its Impacts.**"**

Executive Order 13653 - Preparing the United States for the Impacts of Climate Change Issued by Barack Obama (November 1, 2013)

This executive order is issued with the purpose of preparing "the Nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience".

Executive Order 13693 - Planning for Federal Sustainability in the Next Decade Issued by Barack Obama (March 19, 2015)

This executive order is issued for federal agencies and provides planning for reaching sustainability goals and reducing direct greenhouse gas emissions by at least 40% over the next decade.

Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews (August 1, 2016)

"The Council on Environmental Quality (CEQ) issues this guidance to assist Federal agencies in their consideration of the effects of greenhouse gas (GHG) emissions and climate change when evaluating proposed Federal actions in accordance with the National Environmental Policy Act (NEPA) and the CEQ Regulations Implementing the Procedural Provisions of NEPA (CEQ Regulations). This guidance will facilitate compliance with existing NEPA requirements, thereby improving the efficiency and consistency of reviews of proposed Federal actions for agencies, decision makers, project proponents, and the public. The guidance provides Federal agencies a common approach for assessing their proposed actions, while recognizing each agency's unique circumstances and authorities."

Department of the Interior Policies

Secretarial Order NO 3289 (September 14, 2009)

"This order establishes a Department-wide approach for applying scientific tools to increase understanding of climate change and to coordinate the effective response to its impacts on tribes and on the land, water, ocean, fish and wildlife, and cultural heritage resources that Department manages.**"**

Department of the Interior Manual Part 523 (December 20, 2012)

Chapter 1 - Climate Change Policy "establishes Departmental policy and provides guidance to bureaus and offices for addressing climate change impacts upon the Department's mission, programs, operations, and personnel."

Department of the Interior Climate Change Adaptation Plan (2014)

This Plan "highlights the challenges posed by climate change and provides an important update to the Department's efforts to identify priorities that are necessary to construct a comprehensive framework that meets this challenge head-on."

National Park Service Programs and Policies

Programs

Climate Change Response Program

The Climate Change Response Program is a cross-disciplinary program that provides guidance, training, technical expertise, project funding, and educational products that support actions to preserve the natural and cultural resources and values of the National Park Service.

Climate Friendly Parks Program

The Climate Friendly Parks Program is one component of the National Park Service Green Parks Plan, an integrated approach to address climate change through implementing sustainable practices throughout park operations.

Policies

NPS Management Policies (2006)

The NPS Management Policies, revised in 2006, outlines the laws, regulations, and policies that pertain to work in National Parks. These policies were first to address sustainability and climate change.

"In protecting park resources and values, the Service will demonstrate environmental leadership and a commitment to the principles of sustainability and asset management in all facility developments and operations. This commitment will be made obvious to the public in the choices and decisions that are made, and through appropriate educational opportunities.

"The unique qualities of the national parks—qualities that highlight, for example, America's diverse heritage and the principles of democracy—are what make them relevant. These qualities will be used to advantage in educating Americans and visitors to America about topics such as the civic experience of our country; the complex, diverse ecology of our nation and the world; and the influence of global climate change."

Director's Order #13A: Environmental Management Systems (January 1, 2009)

"This Director's Order, together with accompanying Reference Manual (RM) 13A, provides guidance for implementing Environmental Management Systems at the facility and organizational levels Servicewide… The purpose of this Order is to provide the foundation for

implementing a Servicewide EMS approach to guide environmental decision-making and actions at all levels."

Climate Change Response Strategy (September, 2010)

"The NPS Climate Change Response Strategy provides direction to our agency and employees to address the impacts of climate change. It describes goals and objectives to guide our actions under four integrated components: *science*, *adaptation*, *mitigation*, and *communication*… As climate change is likely to create conditions and ecosystems unlike any found today, upholding our mission may require updating interpretations of policy, mandates, and approaches to resource stewardship. This is an ambitious coordinated strategy to understand, communicate, and respond to the impacts of rapid climate change."

Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings (2011)

"The Illustrated Guidelines on Sustainability for Rehabilitating Historic Buildings replaces the chapter on "Energy Conservation" in the Illustrated Guidelines for Rehabilitating Historic Buildings published in 1992. ...These guidelines offer specific guidance on how to make historic buildings more sustainable in a manner that will preserve their historic character and that will meet The Secretary of the Interior's Standards for Rehabilitation."

Director's Order #12 (2011) and NPS NEPA Handbook (2015)

The updated guidance on NEPA (National Environmental Policy Act) requires that climate change be considered in environmental planning. In particular, the 2015 Handbook states "You should address issues related to climate change, when applicable. There are two distinct ways that climate change may be relevant to an impact analysis: 1) an action's contribution to climate change through GHG emissions; and 2) the implications of climate change effects on an action and its environmental impacts."

A Call to Action (August 25, 2011, as updated in 2012, 2013, 2014)

"A Call to Action charts a path toward that second century vision by asking our employees and partners to commit to concrete actions that advance the mission of the Service." The plan anticipates creating "a new basis for NPS resource management to inform policy, planning, and management decisions and establish the NPS as a leader in addressing the impacts of climate change on protected areas around the world."

Revising Leopold: Resource Stewardship in the National Parks (2012)

"The current [Science] committee has responded to the charge given to it by the NPS and its National Park System Advisory Board—to revisit the Leopold Report—by answering three contemporary and expanded questions framed as in the original report: 1) What should be the goals of resource management in the National Park System? 2) What policies for resource management are necessary to achieve these goals? 3) What actions are required to implement these policies?**"**

Applying National Park Service Management Policies in the Context of Climate Change (March 6, 2012)

"This memorandum addresses emergent questions regarding the influence of climate change on the guiding principles of park natural resource management.**"**

Climate Change Action Plan (2012-2014)

This *Climate Change Action Plan*, issued after *Climate Change Response Strategy*, provides guidance for planning and responding to climate change today and in the future and is intended for internal use by NPS workforce. The Action Plan is divided into three sections: (1) *Content for Action*, (2) *Identifying Near-Term Priorities*, and (3) *Preparing For New Challenges And Opportunities*.

Green Parks Plan (April, 2012)

The Green Parks Plan (GPP) provides planning for sustainable management of NPS operations. One of the most significant components of the GPP is to educate park staff, visitors and community partners about climate change and sustainability. The Plan presents nine strategic goals that focus on the environment and human well-being. The following goals are: (1) *Continuously Improve Environmental Performance,* (2) *Be Climate Friendly and Climate Ready,* (3) *Be Energy Smart*, (4) *Be Water Wise,* (5) *Green Our Rides,* (6) *Buy Green and Reduce, Reuse, and Recycle,* (7) *Preserve Outdoor Values*, (8) *Adopt Best Practices,* (8) *Adopt Best Practices*, (9) *Foster Sustainability Beyond Our Boundaries*.

Scenario Planning Handbook (July 2013)

"This handbook describes the five-step process for developing multivariate climate change scenarios taught by the Global Business Network (GBN) during a series of training workshops hosted by the National Park Service in 2010 and 2011. The authors created this guide as a reference for workshop participants who possess some familiarity with scenario planning. The process featured in this manual is not a definitive method for building climate change scenarios, since many valid methods exist to develop climate change scenarios. The technique presented here is just one effective and proven approach.**"**

NPS Climate Change Communication Guide (2014)

"This Climate Change Communication Guide has been designed to help National Park Service staff at all units within the National Park Service engage visitors in conversations about climate change impacts and actions. The Guide is not meant as a "how to," but rather as an aide to interact with a variety of audiences. Research has suggested that the National Park Service is a trusted source of information - making your role exceptionally valuable in communicating the consequences of climate change at your park and on the wider park system."

Climate Change and Stewardship of Cultural Resources (February 2014)

"This policy memorandum provides guidance and direction regarding the stewardship of cultural resources in relation to climate change. It follows March 6, 2012, memorandum, *Applying National Park Service Management Policies in the Context of Climate Change*, which addressed the implications of climate change on the guiding principles of National Park Service (NPS) resource management."

Addressing Climate Change and Natural Hazards for Facilities Policy and Handbook (January, 2015)

"This Policy Memorandum provides guidance on the design of facilities to incorporate impacts of climate change adaptation and natural hazards when making decisions in national parks.**"**

"The Level 3 Handbook and the questions within are designed to support your park in planning and designing facilities that evaluate and respond to existing and projected climate change impacts and natural hazards.**"**

Pacific West Region Policies

NPS Pacific West Region Directive PW-047 (October 31, 2006)

PWR Directive PW-047 outlines the following goals, among others:

A. On-Site generated renewable energy.

1. Electricity, off-grid power: The conversion to renewable sources of electricity (photovoltaic, wind) is encouraged as methods to eliminate generators as primary sources of electricity.

2. Electricity, on-grid: The addition of renewable sources of electricity (photovoltaic, wind) is encouraged as methods to reduce the grid load of park facilities. This supports the greater goal of reducing source pollution at electrical production facilities using fossil fuels. Net-metering shall be pursued as permitted by state regulations.

3. Non-electrical energy: Renewable energy thermal projects (solar thermal and geo-thermal only when acceptable under the park's resource management mission and preferably outside park boundaries) are encouraged as alternatives to fuel oil fired or other air quality degrading sources of heat.

B. Purchased renewable energy: Purchasing Green Power (i.e., wind, solar, geothermal, biomass) as allowed through the local electric company is encouraged when on-site renewable energy systems are not feasible. As an alternative method, purchasing Green Power Tags is permitted.

State and Local policies and programs

The Park is located in a state that has taken an active role in addressing global warming, and neighboring local governments are leading the way in sustainability. The Park can maximize its effectiveness by incorporating the goals of these agencies into its planning.

San Francisco's Climate Action Plan (2004)

San Francisco's Department of the Environment and Public Utilities Commission completed a Climate Action Plan in 2004. The reduction target established in this plan is 20% below 1990 levels by 2012.

California Global Warming Solutions Act of 2006 (AB32)

California has committed to reducing its global warming emissions to 2000 levels by 2010 (11% below business as usual), to 1990 levels by 2020 (25% below business as usual), and 80% below 1990 levels by 2050.

California Climate Adaptation Strategy (CAS)

"In 2009, California adopted a statewide Climate Adaptation Strategy (CAS) that summarizes climate change impacts and recommends adaptation strategies across seven sectors: Public Health, Biodiversity and Habitat, Oceans and Coastal Resources, Water, Agriculture, Forestry, and Transportation and Energy. The 2009 CAS was the first of its kind in the usage of downscaled climate models to more accurately assess statewide climate impacts as a basis for providing guidance for establishing actions that prepare, prevent, and respond to the effects of climate change."

The California Natural Resources Agency, in coordination with other state agencies, was planning to update the Climate Adaptation Strategy. This update would augment previously identified strategies in light of advances in climate science and risk management options. The update was planned for release to the public as a draft for comment by the end of 2013.

Executive Order S-13-08 by the CA Governor

"This Executive Order requests that the National Academy of Sciences (NAS) convene an independent panel to complete the first California Sea Level Rise Assessment Report and initiate an independent sea level rise science and policy committee made up of state, national and international experts."

Coastal Conservancy Projects and Programs

The Coastal Conservancy is actively supporting hundreds of projects along the coast and around the San Francisco Bay Area. Learn more about our projects and programs.

Coastal Conservancy Climate Change Policy (June 4, 2009; revised on November 10, 2011)

The Policy "describes the strategies and actions that the Conservancy will use to address climate change and states the Conservancy's intention to collaborate with other agencies and entities to develop, support, and implement climate change adaptation plans, strategies, and projects. It further describes the Conservancy's interest in funding certain types of climate change research and pilot or demonstration projects for innovative adaptation approaches that support the Conservancy's work."

Coastal Conservancy Climate Ready Program (2013)

"In 2013, the Coastal Conservancy launched its Climate Ready Program to help California's communities prepare for the effects of climate change and mitigate its causes. Through the program, the Conservancy supports construction and planning projects that:

(1) help communities prepare for sea level rise, beach and bluff erosion, extreme weather events, flooding, and rising temperatures
(2) protect water quality, wildlife habitats, farmland, working forests, and recreational lands
(3) reduce greenhouse gas emissions and capture greenhouse gases from the atmosphere."

San Francisco Bay Area Conservancy Program Projects

"The San Francisco Bay Area Conservancy Program undertakes projects to improve public access to the bay, coast, ridgetops, and urban open spaces; to protect, restore, and enhance habitat, watersheds, scenic areas, and open space; and to provide open space and natural areas that are accessible to urban populations for recreational and educational purposes."

BCDC Bay Plan Amendment: Climate Change Policies (October 6, 2011)

"BCDC has developed a draft report that analyzes vulnerabilities to climate change in the Bay and on the shoreline and recommended new and updated San Francisco Bay Plan Findings and Policies. The Commission is schedule to vote on the policy recommendations in late 2009 or early 2010. Once adopted by the Commission, the new policies will likely affect design and siting requirements for some projects requiring permits from BCDC, and staff will develop

guidance for applicants on the changes. Check BCDC's website for updates on the status of this amendment process."

Joint Policy Committee: Regional Agency Adaptation Program

"The San Francisco Bay Joint Policy Committee (JPC), a partnership of four Bay Area regional agencies (Association of Bay Area Governments (ABAG), Bay Conservation and Development Commission (BCDC), Bay Area Air Quality Management District and Metropolitan Transportation Commission), recognizes that tackling complex climate-related problems and overcoming adaptation planning barriers should not fall immediately to individual local governments. The JPC agencies have established a Regional Climate Change Adaptation Program. ABAG and BCDC jointly lead the Program and have articulated a set of tasks for the Program over the next three years that will set the stage for developing and implementing a regional adaptation strategy."

Adaptation Assistance Program (AAP)

"The long-term goal of the AAP is to help San Francisco Bay Area communities succeed in achieving coordinated and region-wide adaptation to climate change impacts. The AAP contributes to this goal by building capacity within local governments to assess climate change issues, and to plan for and implement adaptation strategies. Based on input from local government staffs and elected officials, as well as research on barriers to adaptation planning in California's local governments, BCDC identified the following objectives for achieving this program goal…"

Climate Ready Estuaries (CRE) Program

"The San Francisco Estuary Project (SFEP), a Climate Ready Estuaries (CRE) Program partner, is working with the US EPA on a pilot project to assess key vulnerabilities of the San Francisco estuary system to climate change impacts. The assessment will take advantage of significant work that is already underway in the region, particularly on sea level rise, to support further analysis of climate drivers and ecosystem effects. The focus of the pilot project in San Francisco Bay is to better understand the impacts of climate change to salt marsh habitat in the context of current climate drivers and stressors to this habitat type."

Our Coast Our Future

"Our Coast, Our Future (OCOF) is a collaborative, user-driven project focused on providing coastal California resource and land use managers and planners locally relevant, online maps and tools to help understand, visualize, and anticipate vulnerabilities to sea level rise and storms."

California's Flood Future: Recommendations for Managing the State's Flood Risk (November 2013)

"This report, California's Flood Future: Recommendations for Managing the State's Flood Risk (Flood Future Report) presents an overview of the flood threats facing the state, approaches for reducing flood risk, and recommendations for managing California's flood risk. The Flood Future Report is the first statewide report to be developed through collaboration between the California Department of Water Resources (DWR) and the United States Army Corps of Engineers (USACE)."

IRWMP Shoreline Resilience Program Overview and Proposal (March 2014)

"The Bay Area Regional Shoreline Resilience Program (Resilience Program) is an innovative and integrated suite of multi-benefit shoreline flood protection, habitat restoration, wastewater and sediment reuse projects that will demonstrate proactive solutions to climate change in the region. The 2014 Bay Area Integrated Regional Water Management Plan (BAIRMWP) highlights climate change, and in particular sea level rise, as one of the region's key challenges, along with environmental management and use of recycled water (Sec. 1.4); the plan prioritizes sea level rise and coastal flooding as the highest priority vulnerabilities for the region to address (Sec. 16.4). The Resilience Program will address these vulnerabilities at a regional scale…"

Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco (July 11, 2014)

"This Guidance presents a framework for considering sea level rise within the capital planning process for the City and County of San Francisco (CCSF). The Guidance also outlines some key issues related to sea level rise adaptation planning; however, specific adaptation strategies and approaches are not provided."

Bay Area Climate Asset Map (updated in November, 2014)

"The purpose of the asset mapping exercise was to provide Bay Area adaptation stakeholders with a better understanding of the key projects and programs underway in the region. This basic mapping is the first step towards identifying strengths and weaknesses in the Bay Area climate adaptation system. Future growth can be built on the successful projects described in these pages while gaps in various sectors will help to target the need for new programs and approaches."

Golden Gate National Recreation Area Planning Documents

Environmental Management System

An Environmental Management System (EMS) provides us with a tool to achieve environmental stewardship and leadership. An EMS is to include "measurable environmental goals, objectives, and targets that are the subject of review and that are updated annually." Its purpose is to help ensure compliance with regulatory requirements and a commitment to pollution prevention, waste reduction, sustainable planning, environmentally preferable purchasing, and the incorporation of environmental best management practices.

The Park completed its first EMS in December 2005 as required by Executive Order 13148, and has updated the targets annually since that time. The park's Green Team consists of representatives from most park divisions. This Climate Change Action Plan is intended to complement the EMS, and future updates to the EMS will include objectives and measurable goals specified in the Climate Change Action Plan.

2015 General Management Plan

From Volume I:

"Since the establishment of Golden Gate National Recreation Area, it has doubled in size and a better understanding of natural and cultural resources and recreational uses has been gained. Thus, a new management plan is needed to guide management for the next 20 years.

The purpose of a general management plan / environmental impact statement (GMP/EIS) is to set forth a basic management philosophy for a park and to provide a framework for future decision making… The Final General Management Plan / Environmental Impact Statement describes three action alternatives for managing Golden Gate National Recreation Area and Muir Woods National Monument… The potential impacts of implementing the various alternatives were analyzed in six broad topic areas: natural resources; cultural resources; visitor use and experience; the social and economic environment; transportation; and park management, operations, and facilities. Natural resources included both physical and biological resources. Cultural resources included archeological, ethnographic, and cultural landscape resources; historic structures; and park collections...

Once the planning process is completed, the selected alternative will become the new management plan for the park and will be implemented over the next 20 years. It is important to note that all of the actions recommended for approval in the final plan will require more detailed study and implementation planning…

The last general management plan for Golden Gate National Recreation Area and Muir Woods National Monument was completed over 30 years ago. Generally, the overall need for a new general management plan includes the following:

- Since the 1980 plan, climate change is better understood and its effects more evident on both ecological systems and cultural resources. The general management plan examines the potential impacts of climate change on park operations and visitor use and identifies direction and management actions to guide efforts to create a more resilient park.
- How visitors access the park continues to evolve as local transportation infrastructure changes. Strategies that were identified in 1980 continue to be explored. The general management plan identifies new ideas and techniques that address sustainable options for park access and strategies to reduce traffic congestion around and within the park."

Appendix D: Background Data from CLIP Tool

The CLIP tool guides park personnel through the various steps involved in estimating emissions, automates calculations, and generates summary reports and reduction targets. The conversion of a GHG to $MTCO_2E$ is based upon how strongly that particular gas contributes to the greenhouse effect, and how many tons of carbon dioxide emission would have the same effect.

The park has been using the CLIP tool to calculate GHG emissions since 2008. The CLIP tool was updated in 2016, using data from October 2014 - September 2015 in order to calculate the park's emissions for the fiscal year 2015. All of the data below pertains to that same time period.

General Information:

Employee population: 310

Visitor population: 14,888,537

Length of peak season: 12 months

Average visitor stay: 1 day

Stationary Combustion:

The amounts of natural gas, diesel fuel and propane used by the park were determined based on billing information and meter readings for NPS occupied buildings. The park used 1,864,900 cubic feet of natural gas, 23,675 gallons of diesel fuel, and 9,905 gallons of propane. The diesel for Alcatraz generators, however, was not included in the CLIP tool, since the emissions from it were offset by Alcatraz Cruises purchasing RECs and Carbon Offsets.

Purchased Electricity:

The amount of electricity purchased by the park was determined based on bills from PG&E. The park also purchased 100% renewable energy from Marin Clean Energy, but that energy was not included in the CLIP tool since it is emission free. The park purchased 824,142 kWh of energy from PG&E for NPS occupied buildings in San Francisco in 2015.

Mobile Combustion:

Mobile combustion was divided into two categories, Park Operations and Visitors.

Park Operations:

The park documents how many gallons of fuel are purchased for each of its fleet vehicles. The breakdown of fuel use by vehicle type is as follows:

Gasoline Cars [Cell P34]: 4,385 gallons

Gasoline Trucks [Cell P182]: 66,525 gallons

Hybrid Cars [Cell P196]: 1,412 gallons

Hybrid Trucks [Cell P202]: 1,226 gallons

Diesel Trucks [Cell P16]: 747 gallons

Diesel Heavy Duty [Cell P13]: 1,348 gallons

Non-road heavy duty equipment used by the park was also considered in the park's mobile combustion emissions. The park used 612 gallons of gasoline and 6,585 gallons of diesel for off-road purposes.

Visitors:

The visitor mobile combustion emissions were based on a variety of estimates and assumptions. The park keeps track of the number of vehicles that come to certain locations within the park every day. The number of vehicles visiting each location was multiplied by the estimated miles traveled to each location. It was estimated that park visitors in total traveled 88,507,196 miles while visiting the park. This included visitors riding the shuttle to and from Muir Woods. Another aspect of visitor mobile combustion emissions is the diesel used by the Alcatraz ferries. Alcatraz Cruises determined that they used 109,545 gallons of diesel for the ferries. However, this number was not included in the CLIP tool since Alcatraz Cruises offset the emissions by purchasing RECs and Carbon Offsets.

Wastewater Treatment:

The amount of wastewater the park sent to have treated was determined based on sewer bills. The park sent 848,547 gallons of wastewater to be treated. For this analysis, due to the complexity of working with multiple treatment plants, it was assumed that all of the wastewater was treated aerobically.

Municipal Solid Waste Disposal and Incineration:

The park monitors the waste generated on park property and determines what is sent to landfill, what is recycled, and what is composted. Only the waste that is sent to the landfill is considered in the CLIP tool. The park sent 1,116 tons of solid waste to landfills in FY15, none of which was incinerated.

Additional Emissions Results:

Table 2 further breaks down the Park's total emissions, showing the amount of each type of GHG emitted. Again, all of these amounts have been converted into the uniform unit of metric tons of carbon dioxide equivalent ($MTCO_2E$).

Emission Results by Gas and Park Unit ($MTCO_2E$)

Park Unit	CO2	CH4	N2O	HFC	Total Emissions
Park Operations	1,186	937	9	0	**2,132**
Visitors	31,678	37	720	0	**32,435**
Total	**32,864**	**974**	**729**	**0**	**34,567**

Table 2: Emission results by gas and park unit

Data Including Alcatraz Diesel:

As is previously stated, the diesel used for the Alcatraz generator and the Alcatraz ferries was not included in the CLIP tool since it was offset due to the purchasing of RECs and carbon offsets. However, we made a separate CLIP tool document, which included the Alcatraz diesel

data in order to see the reduction of emissions due to these offsets. The figures below show the effects the offsets had on visitor emissions and on park operations emissions.

Figure 9 shows the impact the ferry diesel had on transportation emissions, as well as the impact the Alcatraz generator diesel had on energy emissions. This graph includes emissions from both park operations and visitors. Figure 10 shows the impact of the diesel generator more as this graph only looks at park operations.

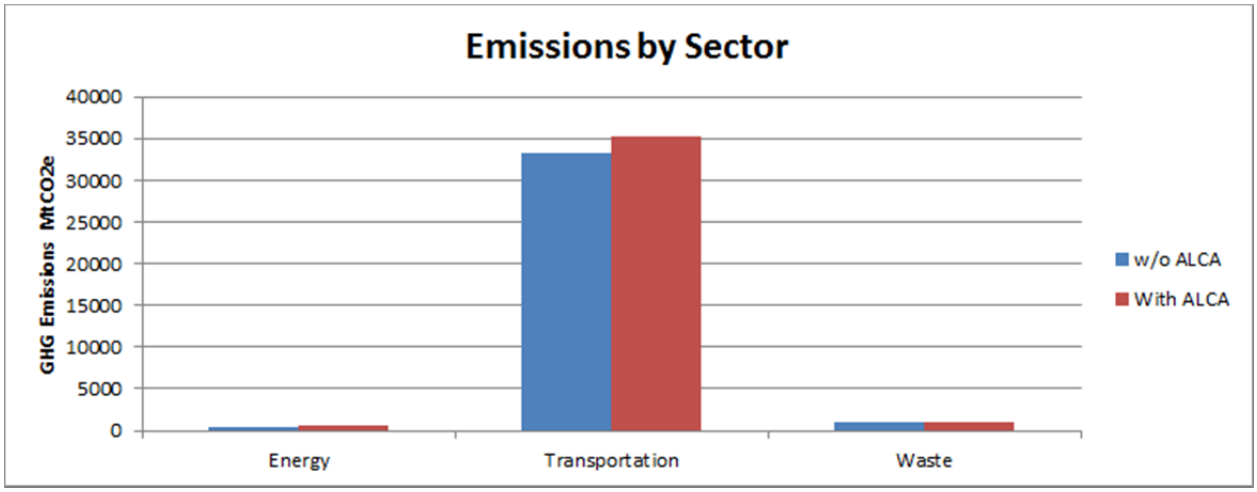

Figure 9: Greenhouse Gas Emissions by sector, including visitors

Change GOGA to GGNRA in the graph below

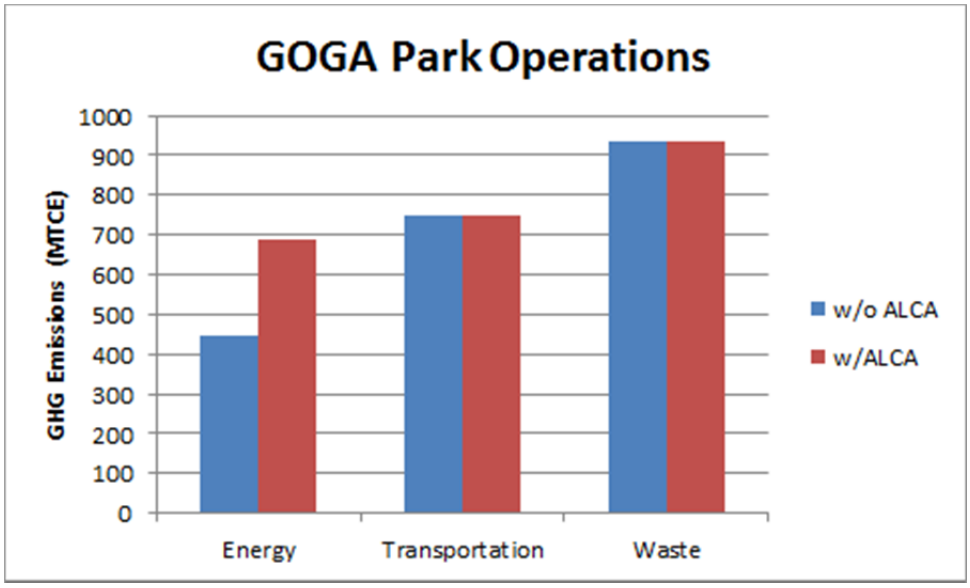

Figure 10: Greenhouse Gas Emissions by sector, park operations only