Acadia National Park's Carbon Footprint Analysis

An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

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Abstract

This paper discusses the carbon footprint of Acadia National Park for the 2018 calendar year. In the paper, the work completed to collect emission data throughout the park is demonstrated. This 2018 carbon footprint was benchmarked against a published study conducted by Worcester Polytechnic Institute students in 2016, and against an average Climate Friendly Park. Moreover, the park's administration was provided with effective and sustainable recommendations to monitor and reduce the park's carbon footprint. The recommendations focused on the monitoring of the park's emissions, the park's vehicle fleet, purchased electricity, and mobile emissions.

Acknowledgments

The project received significant support and assistance to reach its goals. The project members would like to acknowledge the individuals who aided in the completion of this project.

We would like to start by thanking our valuable professors at Worcester Polytechnic Institute. First, our project advisor, Prof. Frederick Bianchi, who helped us arrive at Acadia National Park prepared and ready. Prof. Bianchi also provided his support during the project by helping us settle in Bar Harbor, ME, and provided us with suggestions, recommendations, and comments on our work. Second, we would like to thank Prof. Thomas Balistrieri, our social sciences professor, who helped immensely in the preparation process and identifying our goals. Lastly, we would like to express our appreciation for Prof. Jennifer Wilcox, a chemical engineering and carbon capture professor, who helped us understand the recent advancements in carbon capture and climate change research and provided us with valuable ideas that we employed while in the park.

Next, we would like to mention the great support we received from Acadia National Park's employees and concessioners. To start, we would like to thank Heather Cooney, an administrative assistant in the maintenance division, who helped us acquire an extensive portion of the data we required to run our analysis of the carbon footprint. We would also like to thank Dr. Abraham Miller-Rushing, the science coordinator at Acadia National Park, who gave us our research permits and suggested park employees to contact. We would like to also mention the following individuals for providing specific data: Keith Johnston, Bob Bechtold, Dan Rich, and Paul Murphy.

We would also like to mention the support received from National Park Service personnel, Julie McNamee, who helped us in acquiring the CLIP tool and provided great support during out work.

Finally, the project was significantly influenced by the help of Worcester Polytechnic Institute students, Jack Hogan and James Plante, who provided us with their vehicle usage application, Nicholas Hollander, who provided technical support when analyzing data, and Maryia Hancharova, who aided in editing this paper.

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Executive Summary

Our world today faces the complex problem of climate change. The rise in temperature is concerning governments and citizens around the world. Acadia National Park's administration was concerned after the carbon footprint analysis completed in 2016 by Fields, Gao, Goodale, Kirch, & Lin that asserts that the park's emissions are excessive when compared to other parks. Our project was conducted to produce an updated carbon footprint analysis to assess the park's greenhouse gas emissions and provide recommendations to monitor and reduce them.

The work started by collecting the data needed to run the Climate Leadership in Parks (CLIP) tool. The CLIP tool is a sophisticated Excel spreadsheet developed by the National Park Service to help parks assess their carbon footprint. The data categories studied were mobile combustion, purchased electricity, stationary combustion, solid waste, wastewater, refrigeration, and fertilizer application. Most of this information is already tracked by the park and only needed to be collected. The scope of this study also included the park's visitors and registered concessionaires. The visitor data was adapted from the National Park Service's Integrated Resource Management Application (IRMA). Also, various regions of the park were visited for 6 weeks to observe park operations and sources of emissions. After collecting the data necessary for the CLIP tool, it was run to assess the current situation in the park. In order to have a clear view of the park's current situation regarding greenhouse gas emission, the data acquired from the CLIP tool was compared to the study conducted in 2016. To assess Acadia's position among other parks, its carbon footprint was compared to the footprint of the average Climate Friendly Park (CFP).

Figure 1 displays the emissions by sector for the 2018 calendar year. As shown in Figure 2, the Metric Tons Carbon Dioxide Equivalent (MTCO2E) emissions in Acadia National Park increased by 17%. In Figure 3, it is clear ANP emits significantly more than an average CFP. These results may be partially because Climate Friendly Parks range from small national monuments with almost no facilities to Great Smoky Mountains, the most visited national park.

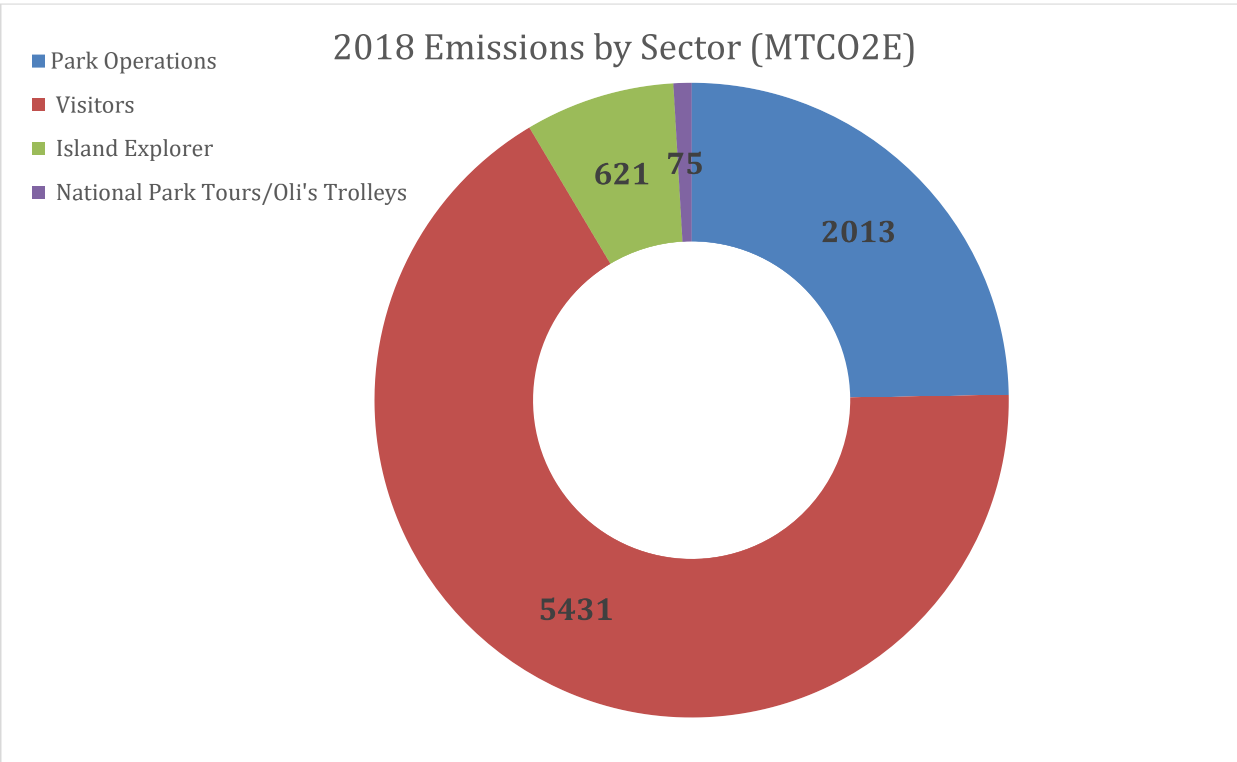


Figure 1 shows the park emissions by sector

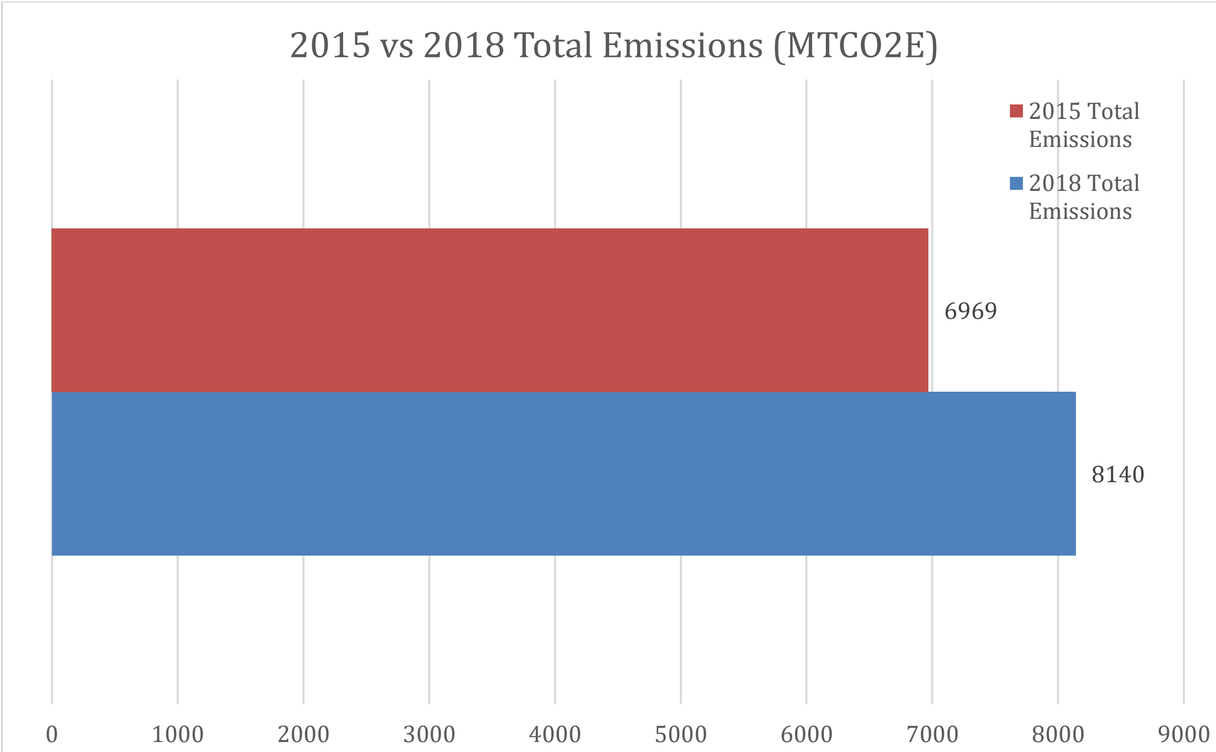


Figure 2 shows the total emissions from 2015 and 2018

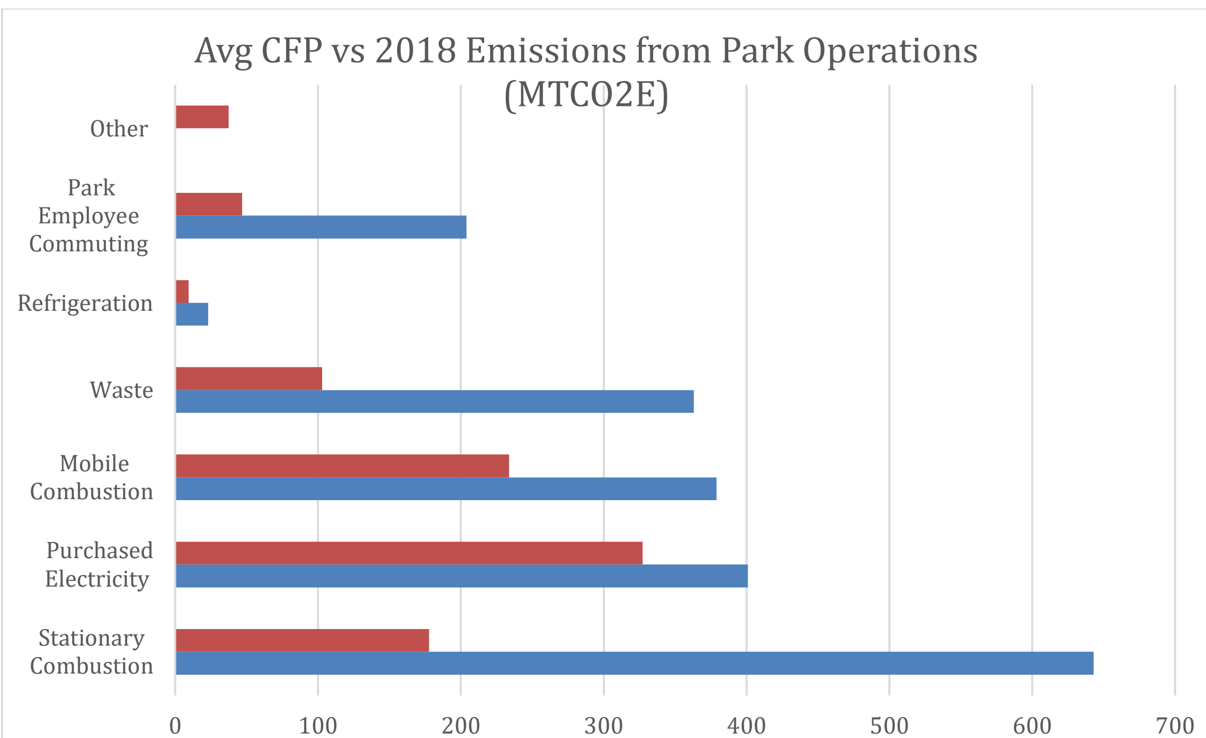


Figure 3 shows the emissions by sector of Acadia vs the average CFP

The park could reduce emissions further and this starts by monitoring its carbon emissions monthly. To clarify the current situation to the park administration, the numbers collected from the CLIP tool were presented in succinct graphs and figures. In addition, multiple suggestions were presented to the park's employees and administration to lower greenhouse gas emissions and to save money.

- First, the park can use a vehicle tracking application to monitor the usage of their vehicle fleet and make necessary changes as they arise.
- Second, it was demonstrated to the park that a behavioral change among employees could result in the park reducing its energy usage.
- Lastly, it was recommended that the park's administration apply to become a Climate Friendly Park. The necessary milestones and the importance of becoming a CFP are explained in Section 5.

To sum up, this project analyzed the carbon footprint of Acadia National Park and developed recommendations to monitor and reduce the park's emissions. Although our project's findings and recommendations are important, the park's emissions will not improve until the change comes from within.

1.0 Introduction

There is a problem in the world with the level of greenhouse gas emissions. Effects can be seen everywhere from rising sea levels to extreme weather to shifts in animal migration. This has led to many countries establishing GHG standards to reverse or mitigate the effects of climate change. Some examples are the Kyoto Protocol and the Paris Accord, which laid out guidelines for countries' emission levels. The United States government has also attempted to lower its GHG emissions through bills and executive orders such as EO13693, which set targets for reducing the carbon footprint of federal agencies by 2025 (The Environmental Protection Agency, 2018).

The US National Parks Service (NPS) has made attempts to lower the emissions of the areas they manage. NPS released the Green Parks Plan, which details NPS' aim toward sustainability through ten categories and educates the park employees and visitors on climate change and sustainability. Another related program is the Climate Friendly Parks (CFP). The main goals of this program are to measure the greenhouse gas emissions of the parks, educate the staff and visitors on climate change, and create an action plan to lower emissions. To be considered a Climate Friendly Park, a park is required to achieve certain milestones. This includes an application, a greenhouse gas inventory, workshop, and the creation of an action plan. More than 120 National Parks are members of the CFP program (The National Park Service, 2019).

Acadia National Park (ANP), located in Bar Harbor, Maine, has determined that the greenhouse gas emissions within the park are too high. The most recent data suggests that ANP produces more than two and a half times the amount of emissions as compared to an average CFP (Fields, Gao, Goodale, Kirch, & Lin, 2016). These emissions contribute to the recent storm surges and loss of biodiversity in the ocean and on land. The high level of emissions is due to many factors such as a large amount of purchased electricity and mobile combustion created by the park. Recently, the park developed a new transportation plan that will be implemented in 2020. Our data on mobile combustion will set a baseline that will allow the park to see how the transportation plan affects emission levels. Moreover, the project's findings will help develop sustainable and practical recommendations to reduce carbon emissions coming from mobile combustion. Since the park's vehicle fleet is updated annually, we believe our recommendations will result in a direct reduction of the carbon footprint in the park.

One of the factors contributing to Acadia's carbon footprint that was not studied by Fields, Gao, Goodale, Kirch, and Lin in 2016 were the effects of the park's vehicle fleet. As a result, the types of vehicles owned by the park have not been selected with their emissions as a priority. Another aspect of the fleet that has not been studied is its utilization. There are likely places where rangers are using full size pickups for jobs that could be accomplished with smaller cars, electric golf carts, or UTVs.

This project's mission was to complete a full carbon footprint analysis based on NPS standards and develop recommendations to sustainably reduce carbon emissions. The first objective was to collect the data required by the NPS CLIP tool to complete a carbon footprint. The second objective was to generate a carbon footprint report for the entire park using the CLIP tool. The third objective was to assess the usage and emissions of park operations. The fourth and final objective was to analyze the results of this assessment and offer a set of recommendations.

2.0 Background

This section will present research findings that will help us understand and develop the analysis of Acadia's carbon footprint. It includes information about the National Park Service and Acadia National Park. It explains the effects of climate change on different scales. It also describes, in detail, the methods and tools that will be used to complete the study.

2.1 Introduction to the National Park Service

The National Park Service (NPS) was initiated on August 25, 1916, by the Organic Act signed by President Woodrow Wilson. The Organic Act made the NPS a federal bureau in the Department of the Interior responsible for 35 national parks and monuments at that time. The act states that future national parks and monuments will be the responsibility of the NPS (The National Park Service: What We Do, 2019).

As mentioned earlier, at the time of creating the NPS there were only 35 national parks and monuments. Today, there are more than 400 national parks spread around the 50 states, covering 84 million acres. To maintain the parks and to accommodate more than 330 million visitors each year, the NPS employs 20,000 people. The mission statement of the NPS is "The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world." (The National Park Service: What We Do, 2019).

2.2 Introduction to Acadia National Park

In 1916, President Woodrow Wilson created the Sieur de Monts monument which was the first name of Acadia National Park. Sieur de Monts monument was only 6,000 acres donated by George B. Dorr who fought to preserve the land of Acadia. Dorr wanted Sieur de Monts monument to acquire national park status, so he worked to obtain more lands by convincing property owners to donate their land to the federal government. Dorr's efforts paid off and in 1919, President Wilson signed the act creating Lafayette National Park which was the second name for Acadia National Park. The name Lafayette National Park was changed to Acadia National Park in 1929 (Foundation Document: Acadia National Park, 2016).

Acadia National Park (ANP) today covers over 47,000 acres and most of the land was donated. Currently, more than 3.5 million visitors visit ANP annually, it is the seventh most visited national park in the U.S. Visitation is highest in July, August, and September because of the beautiful weather. ANP is known for its stunning attractions such as Park Loop Road, Cadillac Mountain, and Sand Beach. Visitors can enjoy hiking, swimming, camping, and sightseeing. The park is also inhabited by diverse species of plants and animals (Foundation Document: Acadia National Park, 2016).

2.3 Climate Change on a Global Scale

Climate change has been a heavily debated issue for the past 30 years. Svante Arrhenius first calculated the levels of carbon dioxide (CO2) from human emissions in 1896 (Discovery of Global Warming). In recent years, as countries all around the world continue to develop and industrialize, concern for CO2 emissions continues to rise. Below is a graph depicting the rise in CO2 levels over the years.

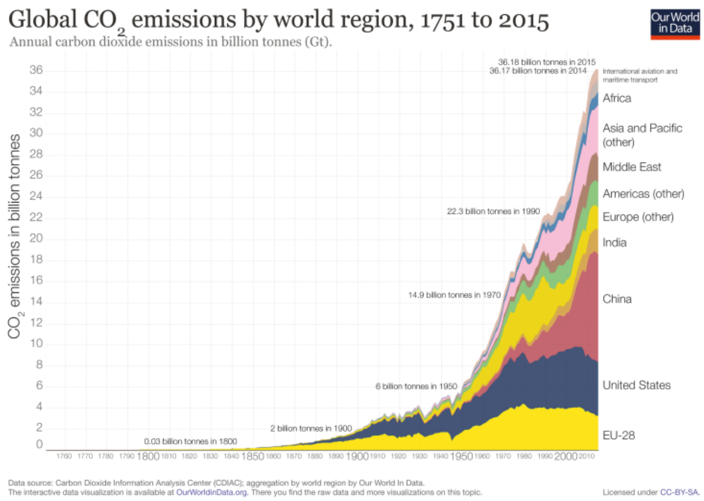


Figure 4 depicts the rise in emissions and includes specific regions (Ritche & Roser, 2017).

Climate change is a natural process that occurs on a planet throughout its life. Earth has gone through ice ages and times of warmth. Earth has left an ice age and is now entering a period of warmth. It is natural for the global temperature to rise. However, the rate at which the temperature is rising is extremely alarming. The average global temperature has increased by 1.4 degrees Fahrenheit since 1880. Two-thirds of that warming has occurred since 1975 (Ritche & Roser, 2017).

2.3.1 Consequences of Climate Change.

One degree may seem like an insignificant rise, but it only took one to two-degree drop for the Earth to undergo an ice age (World of Change: Global Temperatures). Some consequences of climate change are ice melt, extreme weather, a shift in migratory patterns, and a change in the cycles of plants.

Ice melt from glaciers has led to an increase in sea levels. This is especially alarming for low lying coastal areas. Global sea levels could rise as much as three feet by 2100 (Bradford & Pappas, 2017). Weather is also becoming more severe. More intense storms are occurring at a greater frequency. There are many factors behind this, but climate change as a result of human action is a significant one (Extreme Weather). Due to changes in temperature, animals are migrating earlier and going further north. This can cause encroachment on other species and a lack of food. Plants are also changing the time at which they bloom. Trees are holding on to their leaves longer as well (Bradford & Pappas, 2017).

2.3.2 Actions taken thus far.

Recently, as the consensus converged on humans being the main cause of climate change, governments and organizations have decided something needs to be done to curb humanity's impact. The Kyoto Protocol was the first major document aimed at reducing greenhouse gas emissions. Almost all countries ratified the treaty except for the United States. Overall it was not very successful as emissions still rose, but it was a step in the right direction (Henson, 2011). Other treaties have been signed since and it seems the world is starting to move in the right direction. Globally, emissions are still rising, but many countries including the European Union and the United States have taken steps to lower their carbon footprint in recent years. This was accomplished through the use of renewable energy and natural gas (Zulinski, 2018). However, more needs to be done to halt the damage Earth is facing due to the current emission levels.

2.4 Climate Change in the United States

In Figure.5 we can see that the United States (U.S) is one of the highest contributors to carbon dioxide (CO_2) emissions in the world. Aisch (2018) asserts that the concentration of CO_2 is increasing significantly both in the air and the water in the U.S. until 2014. The period from 2015 to 2017 showed a small decrease that later reversed in 2018 (Brumfiel, 2019). The traces of CO_2 from the previous decades were determined using air bubbles trapped in ice. Moreover, Lafrancois (2012) asserts that this increase in CO_2 emissions came with the development of energy sources and industrialization in the US. According to the graph above by Lafrancois

(2012), most of the CO_2 emissions in the U.S. comes from the use of fossil fuels as a source of energy in electricity generation and transportation combustion.

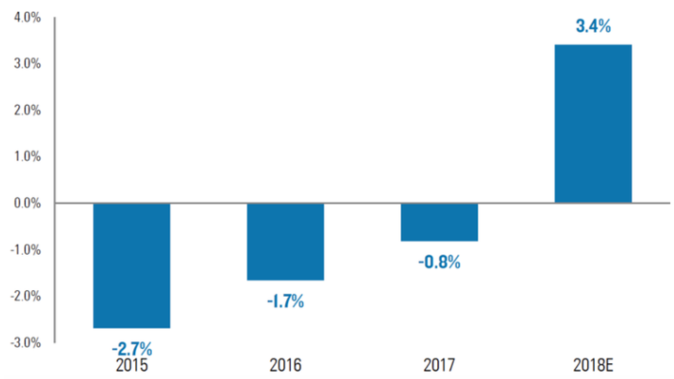


Figure 5 showing the level of emissions in the U.S. from 2015 to 2018 (Brumfiel, 2019).

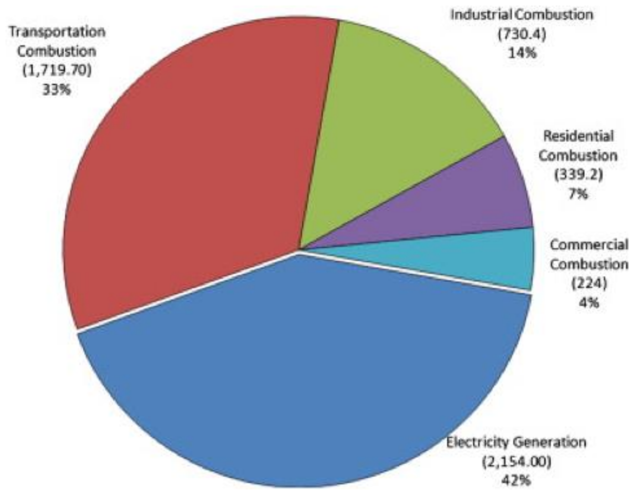


Figure 6 by Lafrancois (2012) shows us the sources of CO2 emissions in the U.S., 2009

2.4.1 Future consequences in the United States

The continuously increasing emissions of CO_2 become trapped in Earth's atmosphere leading to an increase in the temperature of our planet. This increase will result in thermal expansion of water and melting glaciers around the world (Nunez, 2019). Thus, the U.S. will face rising sea levels, flooded islands, deaths and destruction to the habitats on the islands (Shirley, Jones, & Kammen, 2012). The rising temperatures will lead to problems such as an increase in wildfires. (Romps, Seeley, Vollaro, & Molinaro, 2014). Daily (2012) asserts that by 2050 the rate of wildfires would increase by 50% and would affect all of the areas in the western US. The increase in CO_2 emissions leads to more air pollution that negatively impacts the health of humans, animals, and plants (Longstreth, 1999).

2.4.2 Actions taken thus far

The United States Environmental Protection Agency (EPA) is working to help decrease the significant pace of CO_2 emissions in the US. The first step in their plan is a continuous data collection of the emission levels. This data collection aims to help leaders in the U.S. track CO_2 emissions and discover opportunities to reduce it. An example of the EPA data collection is The Inventory of U.S. Greenhouse Gas Emissions and Sinks that has been publishing data about GHG emissions since 1990. The second step is reducing emissions by using natural and renewable sources of energy. For example, the EPA's vehicle greenhouse gas rules will remove six billion metric tons of GHG emissions by 2025. The third step is running an economic analysis against the current policies regarding climate change. The goal of this analysis is to determine the cost efficiency of a proposed policy. For example, the EPA will look at the cost of coal and the issues that arise from burning fossil fuels like extreme weather compared to switching to solar power. The fourth step is supporting researchers in the field of climate change to advance the science regarding this issue. This support is seen through the U.S. Global Change Program and the Intergovernmental Panel on Climate Change. The fifth step is partnering internationally to share experiences regarding this issue. The sixth step is the collaboration with states and local municipalities through the EPA's State and Local Climate and Energy Program. The goal is to promote the use of clean energy and raise awareness of this issue. The seventh, and final, step is working with managers of businesses in different areas to help them adapt to this issue and prepare to face it. For example, the EPA's Climate Ready Water Utilities programs help seaside workers adapt to the changes occurring due to climate change (What EPA Is Doing about Climate Change, 2016).

2.5 Climate Change in National Parks

Climate change influences the National Park Service as well as the parks they protect. At the end of 1999, the National Park System Directory Board was asked to develop a 21st century plan for the National Park Service (NPS). Through the latter part of the 20th century, the NPS made an attempt to keep the parks people-friendly, often at a cost to the park's ecology. Animal populations were manipulated to encourage those preferred by tourists and wildfires were quelled leading to a buildup of underbrush and dead wood. The board felt that given the growing impact of climate change on natural spaces, it was time for the NPS to conserve those natural spaces and educate the public on their importance (The National Park System Advisory Board, 2001).

2.5.1 Green Parks Plan.

The main objectives for the NPS's conservation efforts are laid out in the Green Parks Plan (GPP). The original GPP was written in April of 2012 setting aggressive goals to reduce the GHG emissions of the NPS. It was later updated in 2016 to reflect new requirements to cut emissions from all federal agencies. The plan lists 10 goals for reducing the environmental impact of all of the park facilities. Some of the objectives include reducing emissions and facility electricity use by 36% and emissions from visitors by 23% by 2025 (Green Parks Plan, 2016).

2.5.2 Climate Friendly Parks.

The National Park Services commitment to conservation includes an action plan for reducing the parks' environmental impact. The conservation effort is supported by the Climate

Friendly Parks (CFP) Program. The CFP provides a set of milestones and educational materials for parks seeking to reduce their carbon footprint. The steps for becoming a CFP member park include a greenhouse gas inventory (GHG) to develop a baseline for the park. After GHG standards are established, the CFP provides training for park staff and stakeholders about how the park utilizes its resources. The park is then required to create a plan about how it will work to reduce its carbon emissions and educate its visitors about climate change. More than one-quarter of the parks run by the National Park Service have become members of the CFP Program (The National Park Service, 2019).

2.5.3 Climate Leadership in Parks Tool.

The Climate Leadership in Parks (CLIP) tool is used by the National Park Service to quantify the GHG emissions for the Climate Friendly Parks. The tool uses data like electricity usage, amount of different fuels burned, and waste produced. Moreover, the tool is a spreadsheet that uses Microsoft Excel macro to process the data. All of those emissions sources are converted to metric tons of carbon dioxide equivalent (MTCDE). MTCDE is a way of comparing many different types of GHG emissions by quantifying their impact in terms of tons of CO2. The tool then generates a report showing the contributions of each sector of the park's operations. Performing an analysis with the CLIP tool is an essential step in becoming a CFP member park. It shows how the current analysis compares to other member parks.

2.6 Climate Change in Acadia National Park

Acadia has already fallen victim to climate change, it has been affected in some positive ways, but mostly negative ones. The positive is that Acadia has experienced more hot days and fewer cold nights. There has also been a longer warm season. These weather changes have extended peak visitation from the beginning of September to October (Star et al., 2015). With an increased number of visitors comes more money flowing into the park and surrounding areas. Visitors spent 284 million dollars in 2017, while in 2013 they only spent 191 million dollars (Visitor Spending Effects, 2018). This could be partially attributed to the longer warm season.

There are also a lot of negative side effects of climate change in Acadia National Park. One prevalent issue is flooding. There has been more frequent and intense rainfall which has led to the damage of infrastructure in the park. With climate change comes a rise in sea levels. Acadia National Park is mainly located on one island. Some areas of the park could become fully submerged if sea levels rise significantly. Many of the most popular areas of the park are on the coast. If these areas become submerged, fewer tourists may visit Acadia. The warm weather has also allowed new species to inhabit Acadia. This has also caused the spread of Lyme disease among people. Lastly, ocean acidification from carbon dioxide being absorbed into seawater has been hurting the lobster industry. This could lead to the loss of jobs and a loss of money for the Maine economy (Acadia National Park Climate Change Workshop, 2016).

2.7 Amazon Mechanical Turk

Amazon Mechanical Turk (MTurk) is a crowdsourcing tool that allows researchers and companies to contract out specific tasks to a global labor pool. The tool can be used by researchers and companies in various ways such as validating data, conducting surveys, and categorizing data. The tool aims to aid businesses and researchers by breaking down a large and time-consuming task into smaller tasks that could be conducted by the workforce in the tool. The MTurk performs tasks in a cost-efficient and flexible manner. Moreover, the tool hopes to achieve machine learning for its tasks to make them fully automatic in the future with the hope that it will lower costs and increase efficiency.

The MTurk is simple to use due to its flexible interface that allows the researchers and companies to integrate the application programing interfaces easily.

Figure 7 explains how the Mturk works.

As shown in Figure 7, the process of using the tool starts when businesses or individuals publish a task that they want the labor pool to complete. The businesses or individuals can specifically ask for people who have experience and skills in the field of their tasks.

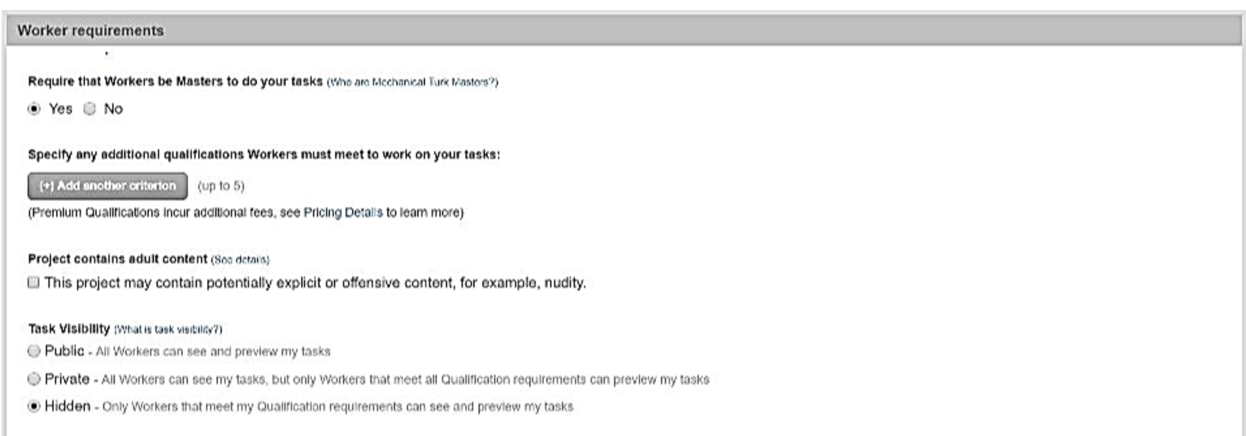


Figure 8 shows the options for individuals or businesses they can choose for the workers.

Moreover, the individuals and businesses specify the price for the tasks based on the difficulty and how much time it takes. Lastly, the workers from the labor pool choose the tasks that they want to complete and begin working on it.

3.0 Methodology

This project's mission was to complete a full carbon footprint analysis based on NPS standards and develop recommendations to sustainably reduce carbon emissions. The first objective was to collect the data required by the NPS CLIP tool to complete a carbon footprint. The second objective was to generate a carbon footprint report for the entire park using the CLIP tool. The third objective was to assess the usage and emissions of park operations. The fourth and final objective was to analyze the results of this assessment and offer a set of recommendations.

3.1 CLIP Tool Setup

The CLIP tool requires four setup steps. The first step is to select the park to be inventoried; in this case, that would be Acadia National Park. The second step is to select the emissions inventory year. Step three is to select the sectors of the park that will be inventoried. For this inventory park operations, visitors, and the following concessioners: Island Explorer Buses, National Park Tours, and Oli's Trolleys. The only sector that was omitted was the "other permitted activities" as no major emissions could be identified that fit this category. Step four requires selecting the types of emissions that will be inventoried: stationary combustion, purchased electricity, mobile combustion, fertilizer application, wastewater treatment, municipal solid waste disposal, refrigerant use, park employee commuting, and other GHG sources (See Figure 6).

The following page of setup information establishes data about ANP's population. It requests the annual visitation numbers from 1989 until the current inventory year. The number of full-time and seasonal employees for the park and its concessionaires is also entered at this point.

The current employee population (2019) was obtained from Christie Anastasia, ANPs Public Affairs Specialist, they included 93 full time employees and 106 seasonal employees.

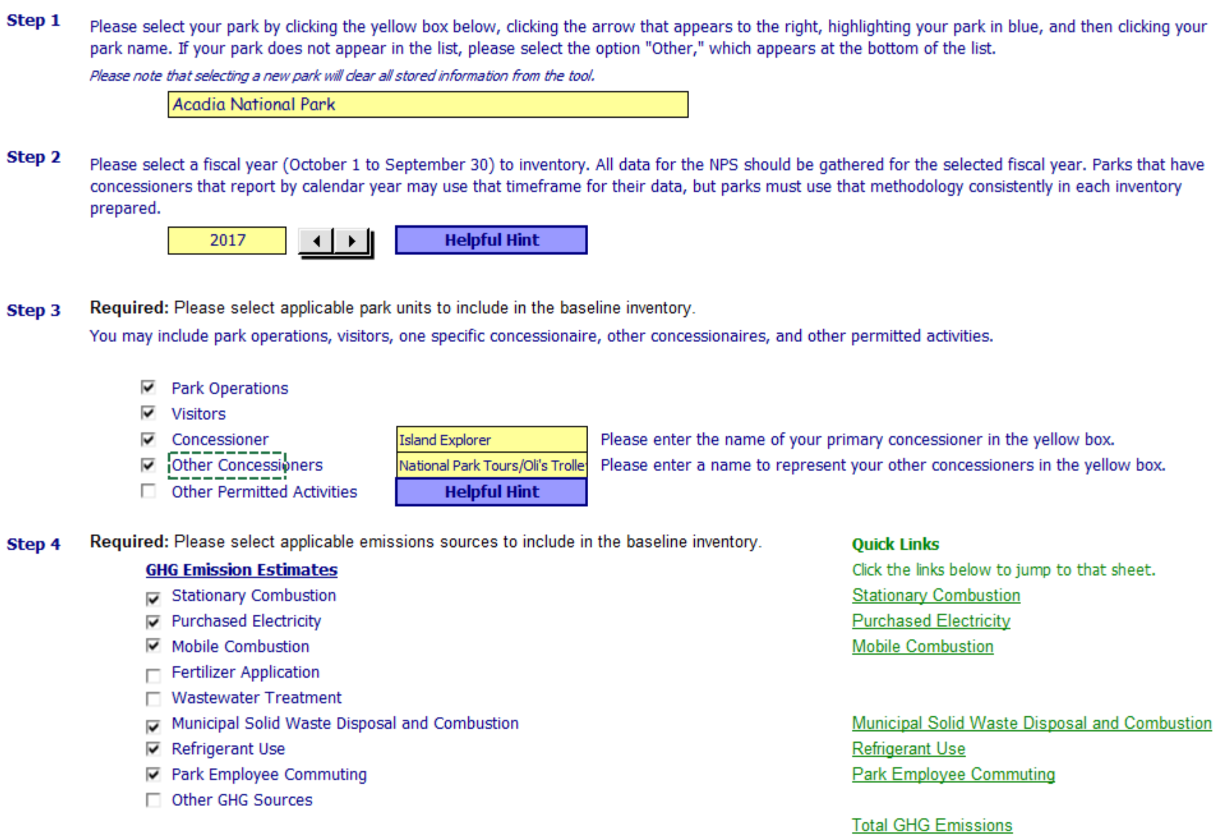


Figure 6 shows the initial setup page for the CLIP tool

3.2 Stationary Combustion

Stationary combustion includes emissions sources that are not self-propelled. For example, heating systems, chainsaws, and generators would all be considered stationary combustion. Three fuels are used for stationary combustion in the park, gasoline, diesel, and propane. Heather Cooney provided us with the gallons of heating oil (18,529.6), diesel (8868.54), and gas (34,787.30) used in stationary combustion. Heating oil and diesel fuel have equivalent emissions and were both entered as diesel. Dan Rich, Supply Technician, provided the number of gallons of propane used (9,516.2 gallons).

3.3 Purchased Electricity

Purchased electricity was considered next by the CLIP Tool. Heather Cooney provided the electricity in kWh for all the buildings in the park. The total electricity purchased for the 2018 calendar year was found by summing up the readings from all the separate meters (1,471,468.95 kWh).

3.4 Mobile Combustion

Next, Cooney provided spreadsheets containing the number of gallons of gas and diesel used for individual park vehicles that were fueled on site. Park vehicles include sedans, dump trucks, lawn mowers, etc. Also, Cooney provided receipts for the gas purchased when vehicles were traveling to other locations. By adding the regular fuel and diesel, the total amount of fuel used in the 2018 calendar year was found. The park used 9,592 gallons of diesel and 31,893 gallons of regular gasoline.

3.4.1 Calculations for Visitor's Vehicles

There are several methods in the CLIP Tool for estimating the emissions produced by visitor's vehicles. The first is to estimate the amount of fuel consumed directly. While this option makes sense for the park's mobile emissions, it is impractical to calculate for the visitor's emissions. The second option is to estimate the number of miles traveled by vehicles in the park. While this is somewhat easier to calculate, the amount of fuel burned is the value that determines the amount of carbon emissions.

The first step in determining the amount of fuel burned is to estimate the number of cars. The information on the exact number of visitor vehicles was not publicly available. However, the number of visitors is calculated based on the number of vehicles and the methodology for that calculation is published on IRMA. The calculation was reversed to find the number of cars. First, the number of monthly visitors was divided by the vehicle expansion number. It was then divided by the person-per-vehicle multiplier. This would give the number of vehicles in the park for one month. The process was repeated for all 12 months in 2018 and summed together. The total was 448,124 vehicles (ANP Public Use Counting and Reporting Instructions, 2017). It was estimated by Fields, Gao, Goodale, Kirch, & Lin that on average a car drives about 27 miles (the approximate length of Park Loop Road) while in ANP. For the purposes of this study that estimation was maintained for consistency. This yielded a total of 12,099,358 miles driven in 2018.

The next step in determining the gallons of fuel burned required considering the efficiency of the vehicles that drive through the park. The CLIP Tool has built-in estimates for the percentage of different types of vehicles to use as a baseline. Because Acadia is such a unique park, it was important to see if that vehicle breakdown was accurate.

3.4.2 Mechanical Turk

One of the other WPI projects happening concurrently with this one was a team using a webcam to assess parking lot usage. The photos from their camera captured a large amount of data about the types of cars used in the park. In order to convert that data into a usable form, Amazon’s Mechanical Turk was employed to identify vehicle types in the pictures. The respondents were asked to classify vehicles into the following categories; car, SUV/van, truck, bus/trolley, and other motor vehicles (See Figure 6).

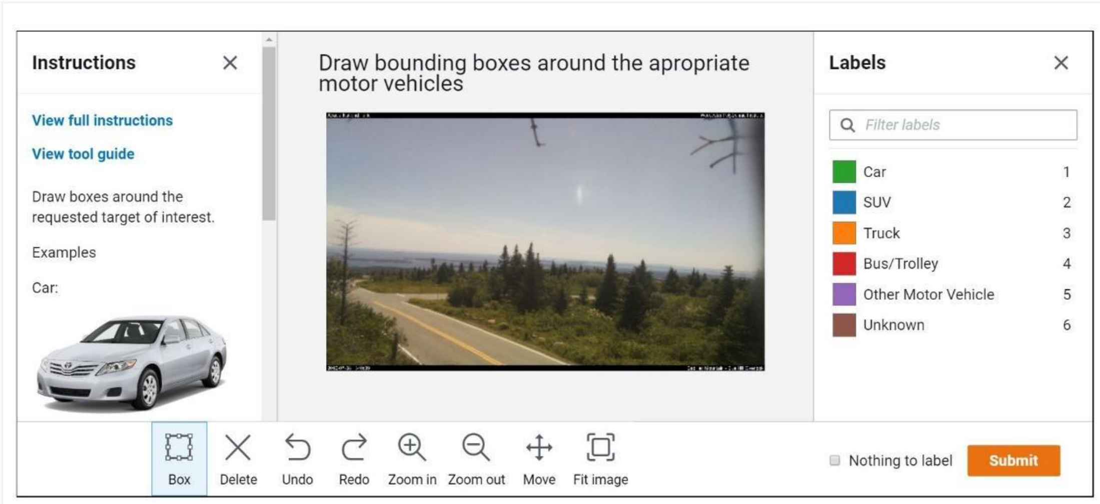


Figure 7 depicts an example of what a Mechanical Turk worker would see for this project

In order to validate the MTurk data, two test batches were used. Both batches consisted of the same 50 photos taken by the webcam. The first was sent out with no specific worker requirements. The second batch was sent out requiring “Master” workers. The first set of images was completed faster, within 10 minutes of being published. However, the quality was less than desired, showing a 16% failure rate. The images analyzed by master workers took nearly a day to be completed but were nearly all deemed satisfactory.

The final sample of 1200 photos was selected for 9:00AM until 5:00PM on the four-day weekend around the fourth of July 2019. This was deemed to be one of the busiest periods for the park and would yield the most vehicles. The MTurk data provided a total of 854 vehicles that broke down into the following categories; 331 cars, 447 SUVs, 53 trucks, 6 buses, and 15 motorcycles.

3.4.3 Island Explorer, National Park Tours, and Oli’s Trolleys

Besides the emissions of the park, the emissions of concessionaires and buses that ran in and around the park were collected. Paul Murphy, from Downeast Transportation, was contacted and he provided us with the gallons of propane that the Island Explorer buses used in 2018 (105,581). Next, the National Park Tours and Oli's Trolleys were contacted to acquire their total gallons for 2018 and fuel type. National Park Tours responded that they used about 2,800 gallons of diesel fuel. Oli's Trolleys did not respond to our requests. It was assumed that Oli's Trolleys fuel consumption is fairly consistent from year to year and the fuel numbers from Fields, Gao, Goodale, Kirch, & Lin's 2016 study was used. The total number of gallons in 2016 was 5,169. Oli's Trolleys had five gasoline trolleys and one diesel, so they assumed that one-sixth of that was diesel (861) and the rest was gasoline (4,307).

3.5 Fertilizer Application and Wastewater Treatment

After speaking with multiple park employees, it was confirmed that the park does not use fertilizers, because of concerns of runoff into public drinking water. Therefore, fertilizer application was omitted from the CLIP Tool.

Most of the park's buildings are in remote areas that are not attached to a municipal sewer system. Therefore, these buildings have septic tanks, which are not evaluated in the CLIP Tool. Thus, gallons of wastewater treated was entered as zero.

3.6 Solid Waste Disposal

Tons of solid waste disposed was provided by Bob Bechtold, Occupational Safety & Health Program Manager. In 2018, the park disposed of 804.6346 tons of waste. However, 66.93% of this waste was diverted, or recycled. Only 266.0927 tons of solid waste went to a landfill.

3.7 Refrigeration and Air Conditioning

The first source of refrigeration in the park is the building's air conditioning systems. Since there have been no major changes in the park's buildings since 2016, the air conditioning inventory form Fields, Gao, Goodale, Kirch, & Lin's report was used.

The other source of refrigerant that is considered by the CLIP tool is R-134a from vehicle air conditioning systems. Refrigerant from air conditioning systems slowly leaks over time, so the CLIP tool does not take into account the visitor's cars, only cars that spend most of their working life in the park. Using the ANP's vehicle fleet inventory, provided by Keith Johnston, the number of heavy-duty trucks, light duty trucks and SUVs, and cars was obtained. The CLIP tool then uses those numbers to estimate the amount of refrigerant that will leak from the system over time.

Since the Island Explorer buses spend most of their lives in the park, it was determined that it was important to include them in the refrigeration inventory. The CLIP tool does not have a data field for buses under the refrigeration section. To compensate for this, the amount of R-134a in the bus air conditioning systems (6.5kg) was collected from its data sheet (Revo, 2016), then the average amount of R-134a in a heavy-duty truck was determined to be 0.75kg (Ford, 2011). Using those values, the number of trucks required to make one bus was obtained and the number of buses was scaled up by that amount.

3.8 Employee Commuting

An important part of the carbon footprint is assessing the impact from employee commuting. ANP employs nearly 200 people during peak season. Data on the emissions from their trips was collected using a survey. The survey asked employees for the method they use to get to work, how many miles they commute, if they carpool, and what type of car they drive.

The survey was distributed to employees via an online platform called Survey Monkey. It collected the answers from the users and provided us with charts and figures that were helpful in analyzing the data. A copy of the survey appears in Appendix B.

3.9 Acadia Vehicle Use App

One of the goals of the project was to improve the way Acadia uses its fleet of vehicles. One of the best ways to do this was determined to be a phone application that could track a vehicle's trip, its type, and the reason for use. The idea for using the application came after reviewing Joseph Hogan and James Plante's (Visitor Tracking, 2019) study in Acadia National Park. The same application used in their study was used to serve our purpose of tracking ANP's vehicle fleet. Thus, the authors of the study were approached, and they developed a version with small changes in the graphics, interface, and the survey questions in the application. The survey questions, contained in the app, were targeted to assess the way in which certain vehicles are used. This type of information will help the park to identify when inefficient vehicles, such as heavy-duty trucks, are being used unnecessarily. It will also help the park to better identify vehicles that are most used so they can be replaced with newer, more efficient, versions.

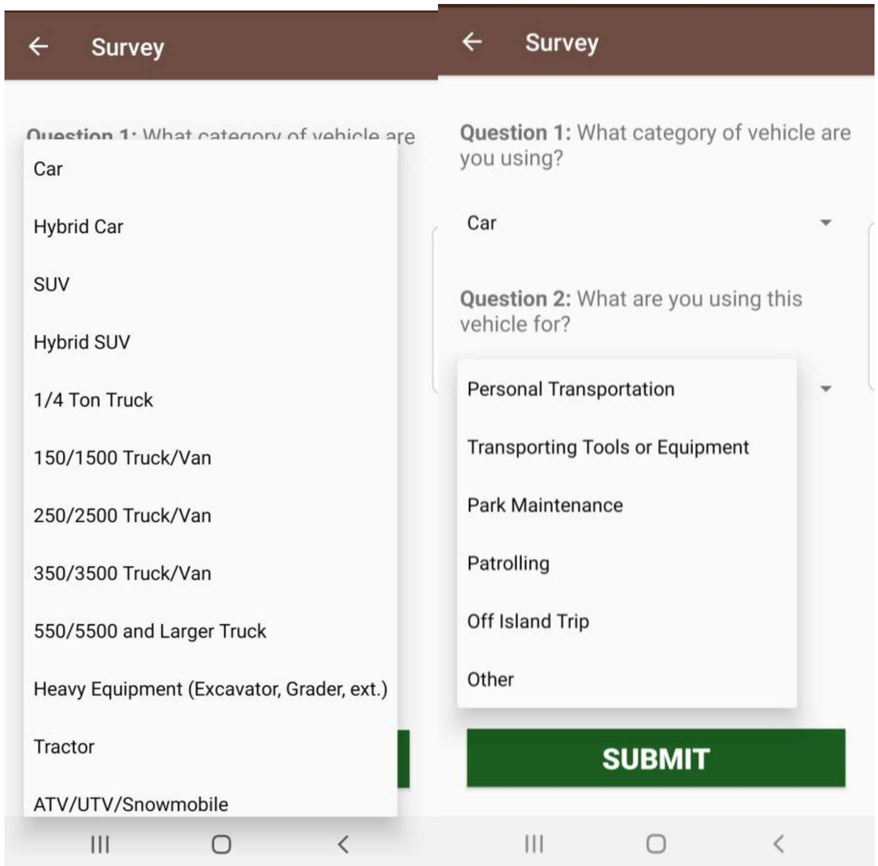


Figure 9 shows the vehicle tracking application survey questions

3.10 Calculating the Cost and Amount of CO_2 Emitted in the Air for Computers

First, the number of computers left operating in the park was assumed to be 10 computers based on the number of offices and gift shops. After that, the hours of operation were obtained in order to calculate how much time the computer was unnecessarily left on using the following equation:

$$Duration = (Time\ of\ Closing - Time\ of\ Opening) * (Number\ of\ Computers)$$

After that, the cost of 1 kWh of electricity was acquired using the park's electricity bills provided by Heather Cooney and the following equation:

$$\$\ of\ 1\ kWh = \frac{Total\ Cost\ in\ \$\ in\ 2018}{Total\ kWh\ Used\ in\ 2018}$$

Next, the consumption of an average desktop computer (161.5 Watts/hr) was acquired using Michael Bluejay's study (2005). Lastly, the conversion from 1 kWh to $MTCO_2$ equivalent was acquired from the CLIP tool and the cost and emissions were calculated using the following equations:

$$Cost\ of\ Leaving\ Computer\ Running = kWh\ Used\ By\ Computer * Cost\ of\ 1\ kWh * Duration * Period\ Wanted$$

$$CO2\ Emitted = kWh\ Used\ By\ Computer * Coversion\ from\ kWh\ to\ MTCO2 * Time\ Lift * Period\ Wanted$$

3.11 Calculating the Cost and Amount of CO_2 Emitted in the Air for Idling

First, the number of cars idling in the park and the duration idling was estimated using observations by the group members. Second, the prices for both gasoline and diesel were acquired from the spread sheets provided by Cooney. Third, the gallons of diesel and gas consumed were obtained by a research study conducted by (EcoMobile, 2015). Finally, the conversion factor for highway cars was obtained from the CLIP tool.

$$Cost\ of\ Idling = Amount\ of \frac{Gallons}{hr} * Cost\ of\ Gallon * Hours\ of\ Idling$$

$$CO2\ Emitted = Conversion\ Factor\ \frac{Lbs\ of\ CO2}{Gallons} * Amount\ of \frac{Gallons}{hr} * Hours\ of\ Idling$$

4.0 Analysis and Results

In this section, the results of the CLIP Tool were analyzed by sector. The information was then compared to the results of the 2016 CLIP Tool analysis. The results were then compared to the emissions of an average Climate Friendly Park. Lastly, the expected emissions savings from the Transportation Plan were examined.

4.1 Results of the CLIP Tool Analysis

After compiling the data for the CLIP Tool, the program was run. The information that was inserted in the CLIP Tool can be seen in Appendix A. The following subsections of 4.1 breakdown emissions by sector.

4.1.1 Park Emissions

Park operations made up about 25% of the total emissions. The sectors that contributed the most to park operation emissions were stationary combustion, electricity, mobile combustion, and waste. Maine suffers harsh winters, which partially explains the high number for stationary combustion. Heating oil is considered in stationary combustion, which the park uses heavily, along with the fuel for items like generators and chainsaws. Park employee commuting accounted for 10% of all park emissions.

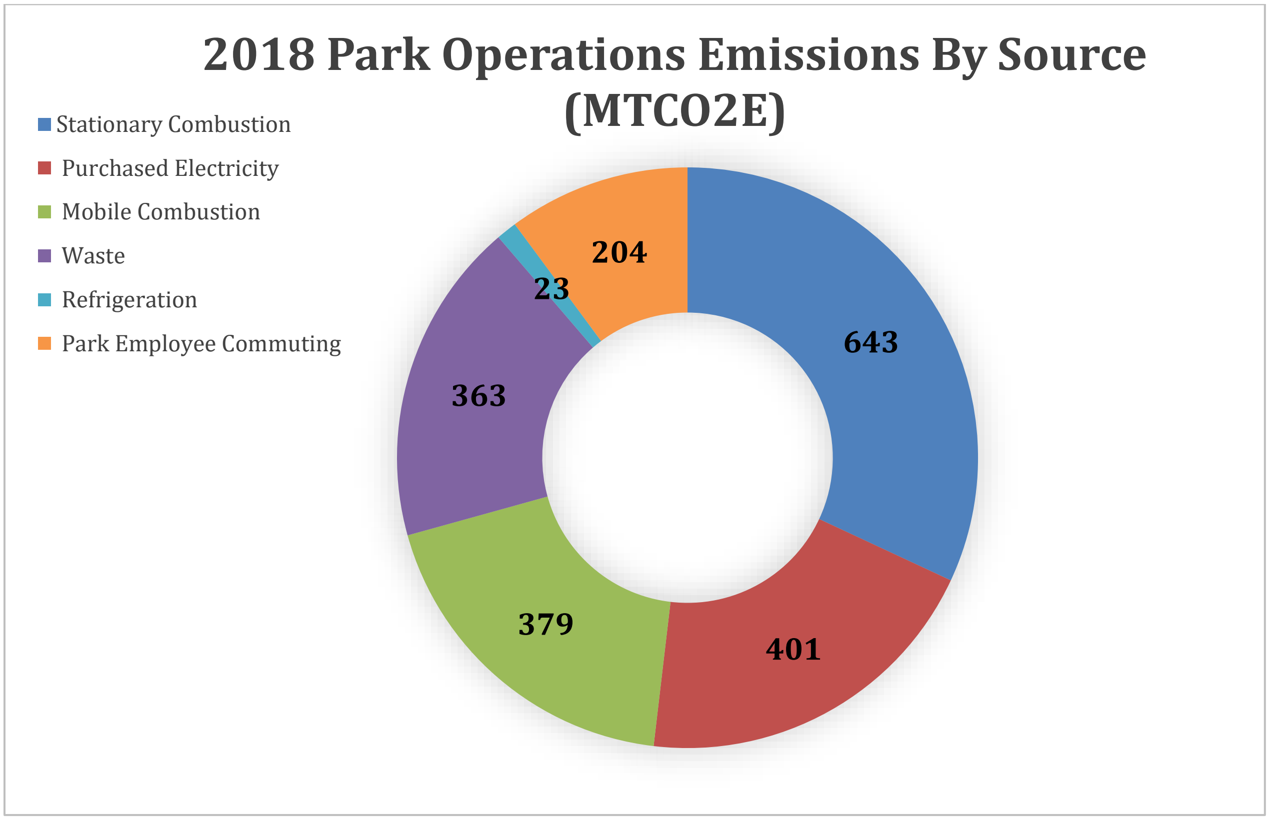


Figure 10 shows emissions by park sector

4.1.2 Visitor Emissions

Visitors contribute to the majority of the emissions. About 67% of the total emissions came from visitors. This is due to the huge number of private vehicles driven by visitors. ANP is considered a "driving park" by many, so it makes sense that the bulk of emissions came from visitors driving to many of the famous destinations around the park. Based on an extrapolation of a graph on page 110 of the Transportation Plan, it is estimated that the number of private cars in the park is going to decrease by 20% without the number of visitors falling. Figure 10 below will serve as a baseline to quantify the emissions increase for the Island Explorer and the emission decrease from visitors as more use buses.

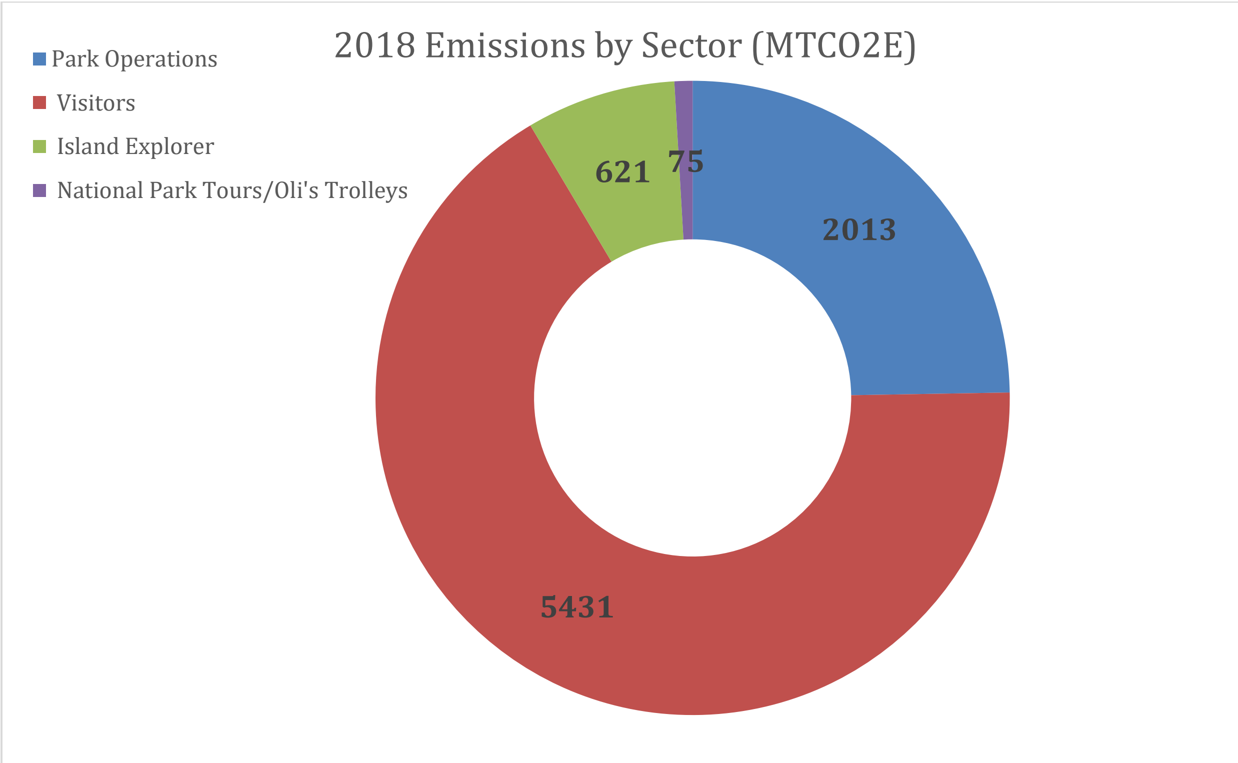


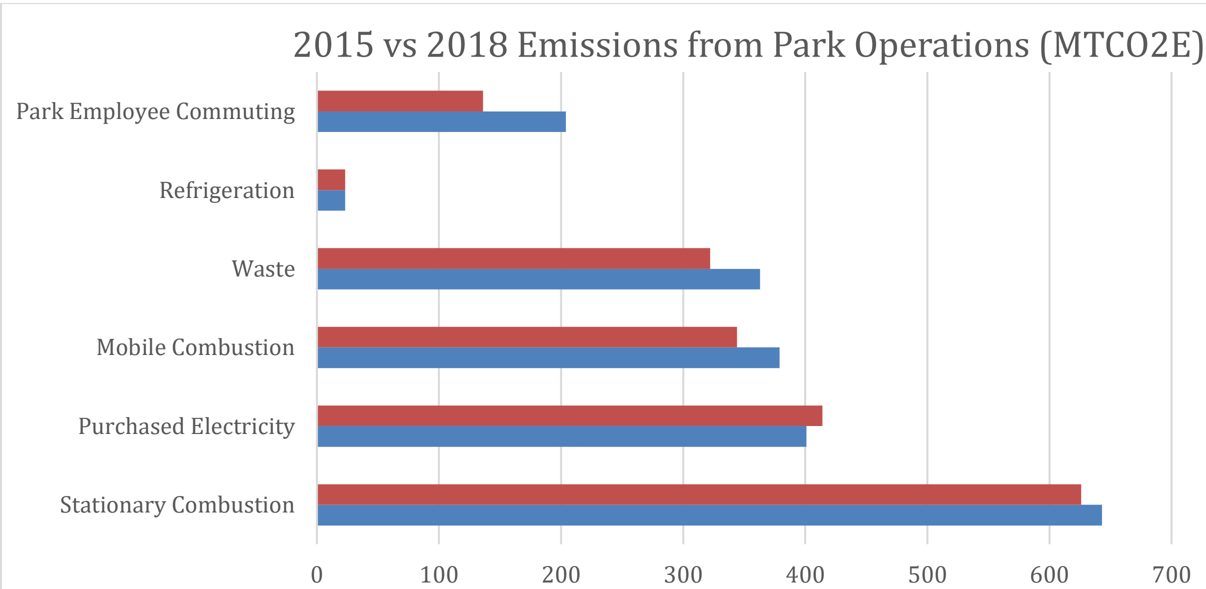
Figure 11 shows the emissions for each sector of the park in 2018

4.1.3 Island Explorer and Concessionaires

The Island Explorer and concessionaires made up a relatively small portion of emissions; about 9%. Within this 9% most of those emissions came from the Island Explorer buses. The Island Explorer has many more buses and run far more frequently than the concessionaires. The data in this analysis could be used as a baseline as it is the last year before more Island Explorer buses are introduced.

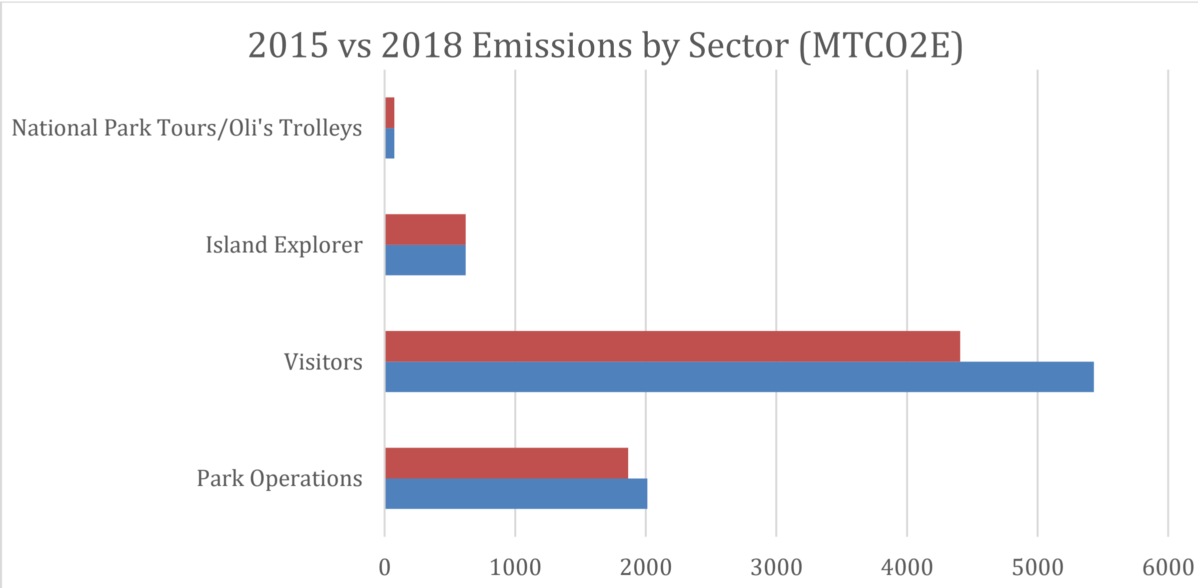
4.2 Comparison to the 2016 Study

Doing multiple carbon footprints over time helps to establish trends in energy use. When this is viewed alongside the analysis done by Fields, Gao, Goodale, Kirch, & Lin in 2016, it becomes a second data point. Since the number of visitors has increased by about 25% in the last three years, the emissions have also increased. Even with the increased usage, the park has managed to prevent its emissions from increasing at the same rate. In 2015, the total emissions were 6,969 $MTCO_2E$ and in 2018 the number increased to 8,140 $MTCO_2E$, showing only about a 15% increase in overall emissions.



	Stationary Combustion	Purchased Electricity	Mobile Combustion	Waste	Refrigeration	Park Employee Commuting
2015	626	414	344	322	23	136
2018	643	401	379	363	23	204

Figure 12 shows the differences in the 2015 and 2018 emissions



	Park Operations	Visitors	Island Explorer	National Park Tours/Oli's Trolleys
2015	1865	4408	621	75
2018	2013	5431	621	75

Figure 13 shows the emissions by sector between 2015 and 2018

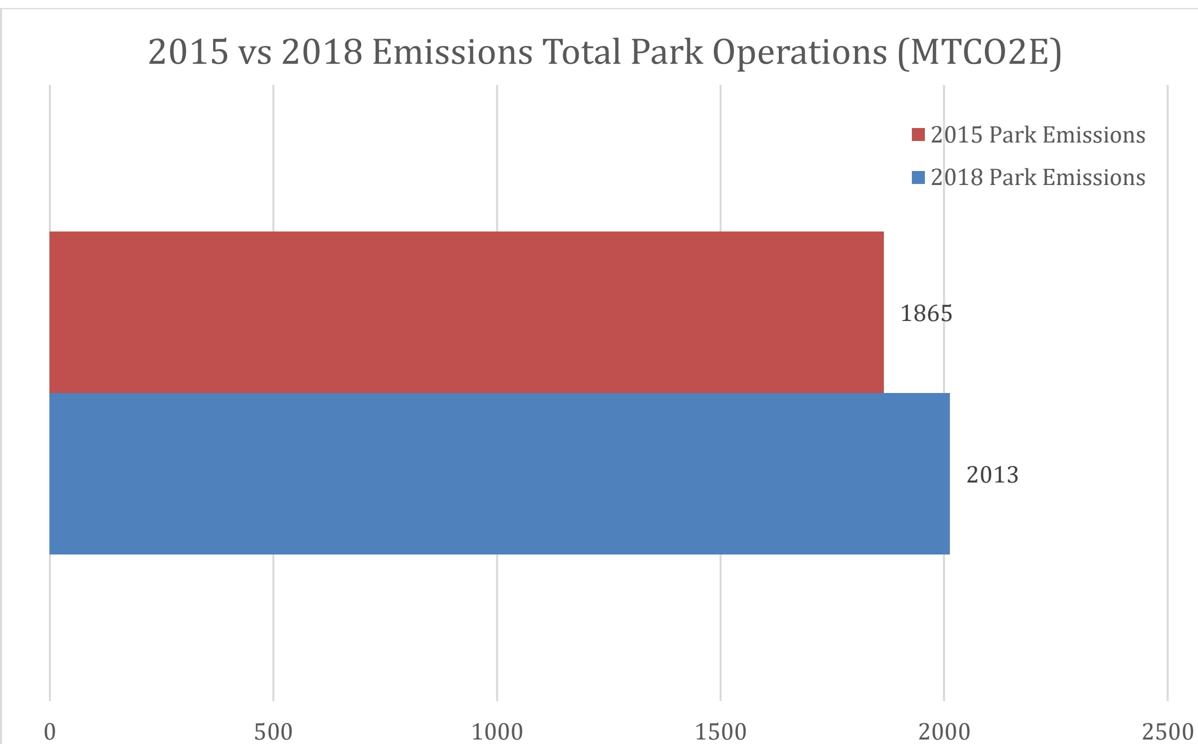


Figure 14 shows the differences in the total park operations

The number of fulltime employees has increased significantly since 2015. In 2015, there were 46 fulltime employees, while in 2018, there were 93 fulltime employees. This increase can be a reason why park operation emissions have risen in the last three years.

4.2.1 Adaptations of the 2016 Study

The current project group is thankful to the 2016 WPI Carbon Footprint Analysis project group for sharing their data and results that was a base for our study. However, after processing our data in the CLIP tool, some of their numbers were deemed not accurate due to the new information discovered. Based on that, our group decided to rerun their data in the CLIP tool while changing the following numbers acquired from Heather Cooney for the fiscal year of 2015: the number of visitor cars in the park, purchased electricity, and wastewater treatment. The number of visitor's cars in the park estimation made by the 2016 team was inaccurate because the group took the total visitation in 2015, and simply divided by three. In section 3.6.1, the correct way to estimate cars in the park was discussed in depth. By using the formula in 3.6.1, it was calculated that there were about 363,692 cars in 2015. Next, the purchased electricity data used in 2016 was calculated by dividing the total price paid by the average price for 1 kWh in Bar Harbor, ME. However, this did not account for the maintenance, and transfer fees on top of the base price of electricity. The new number was found to be 1,520,601 kWh. Lastly, wastewater treatment should be excluded from the data analyzed in the CLIP tool because the park's buildings all have septic tanks and leech fields. The CLIP tool does not account for this method of wastewater treatment, so there is no reason for it to be included.

4.3 Comparison to Average CFP

Although ANP emits more carbon dioxide than an average CFP, it also has a greater number of visitors. ANP is the 7th most visited national park in the U.S. and the number of visitors has been increasing rapidly in the past few years (The National Park Service, 2019). In 2015, there were about 2.8 million visitors while in 2018, there were 3.5 million. This increase in visitors has led to a need for more fulltime employees. In addition to more employees, the park must deploy more resources to handle the crowds. These two factors contribute to the park's elevated emissions.

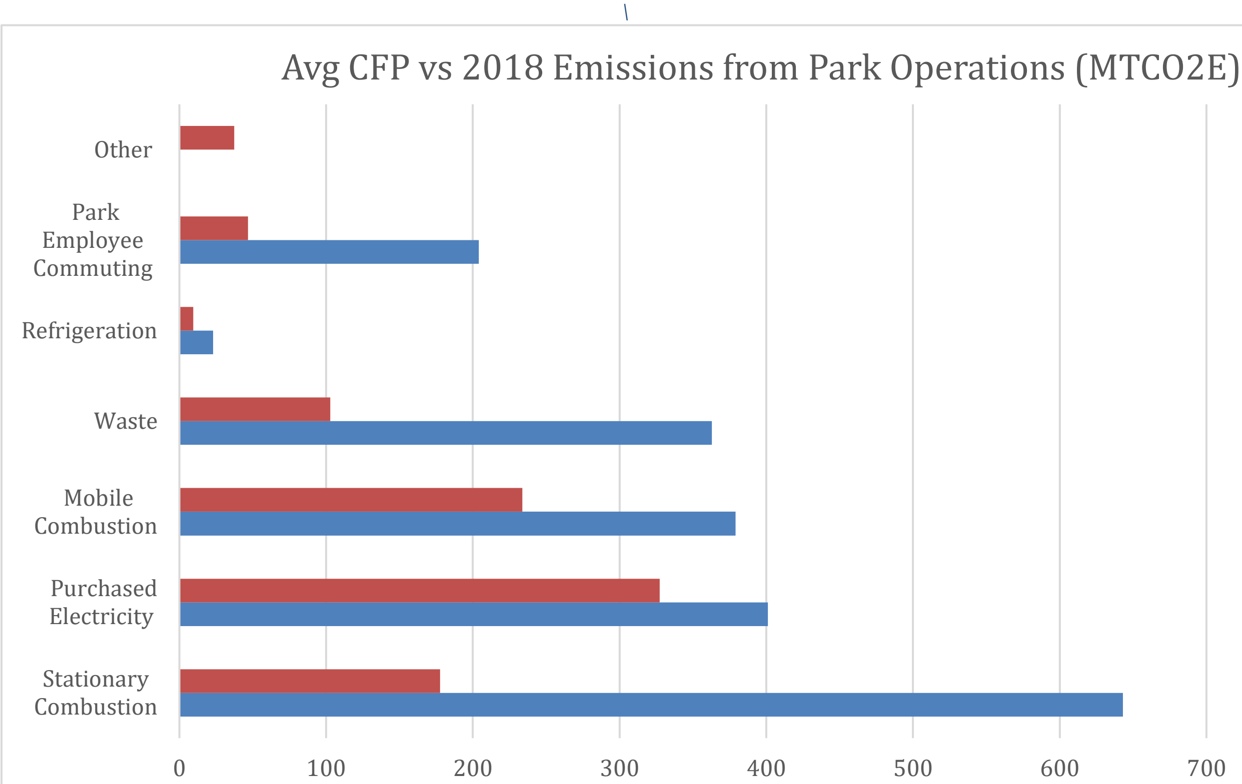


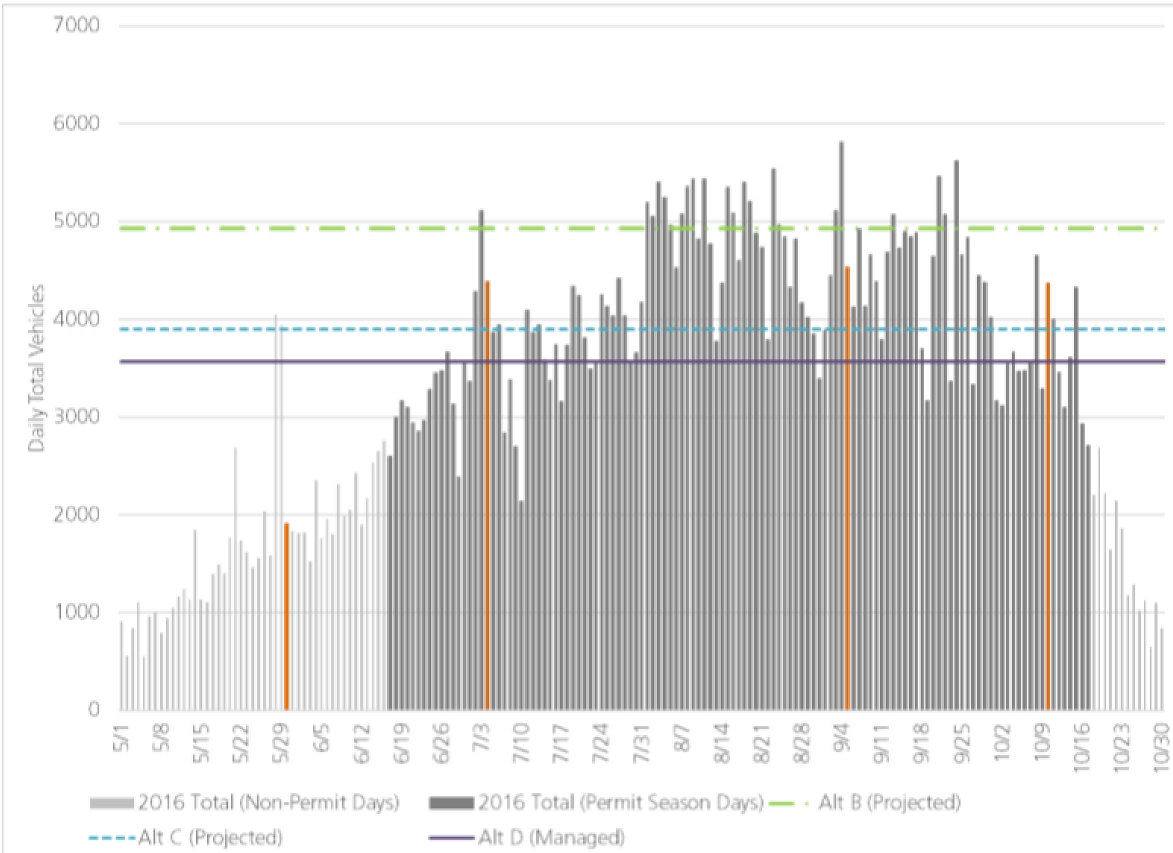
Figure 15 shows the comparison of Acadia to the average CFP

According to the CLIP tool, an average Climate Friendly Park emits 935 MTCO_2E yearly from park operations. ANP's emissions from park operations was 2,013 MTCO_2E. Thus, Acadia National Park emits 115% more than an average CFP.

All of Acadia's emissions sources are higher than the average CFP, the sources that show the greatest difference are stationary combustion and solid waste. ANP's emissions from stationary combustion was 643 MTCO_2E while an avg CFP park emits 177.65 MTCO_2E. Also, ANP emits 363 $MTCO_2E$ from solid waste disposal and an avg CFP emits 102.9 $MTCO_2E$. There could be many reasons why these numbers are so much higher for Acadia. One reason for the stationary combustion being high is that heating oil falls in this category. In addition to park headquarters, there are a number of other buildings that are used for housing employees. Heating this many individual buildings during Maine's harsh winters consumes more than average amounts of heating oil. In addition, there is no distinction made between solid waste generated by park operations and visitors. Since Acadia is the seventh most visited national park, the waste contribution from visitors is significantly higher than average.

4.4 Effects of the Transportation Plan

This study took place on the verge of ANP implementing its new Transportation Plan that seeks to reduce visitor congestion in the park. Since visitors are the single biggest contributor to the carbon footprint, it was deemed important to try to assess the effects of the Transportation Plan. The Plan will implement a reservation system for guests entering the busiest areas of the park during peak season. This would reduce the number of people who arrive at those locations by private car. The plan estimates that there would be a 21% decrease in private vehicle traffic to Cadillac Mt. summit and a 24% reduction to the Ocean Drive Corridor, the section of Park Loop Road past the Otter Cliffs parking area (Acadia National Park Final Transportation Plan). The plan does not estimate a specific number of vehicles to the main section of Park Loop Road, near Sand Beach, but Figure 16 shows there will be a reduction (see the blue dotted line). Therefore, it was estimated for this study that there would be 20% fewer visitors arriving by private vehicle after the implementation of the Transportation Plan. The emissions reduction is shown in Figure 17. It was assumed that Acadia's total visitation would not be reduced, so in this scenario, the number of Island Explorer buses was increased to accommodate them. Moving those people from private vehicles to the Island Explorer buses would require a 46% increase in the service: that increase in emissions is shown in green of Figure 17. Even with the increased bus traffic this would still lead to a 13% decrease in emissions to transport visitors around the park.



**Federal holidays denoted by orange bars.*

Figure 16 shows the estimated reduction of cars on Park Loop Road based on different planned scenarios (source: Acadia National Park Final Transportation Plan)

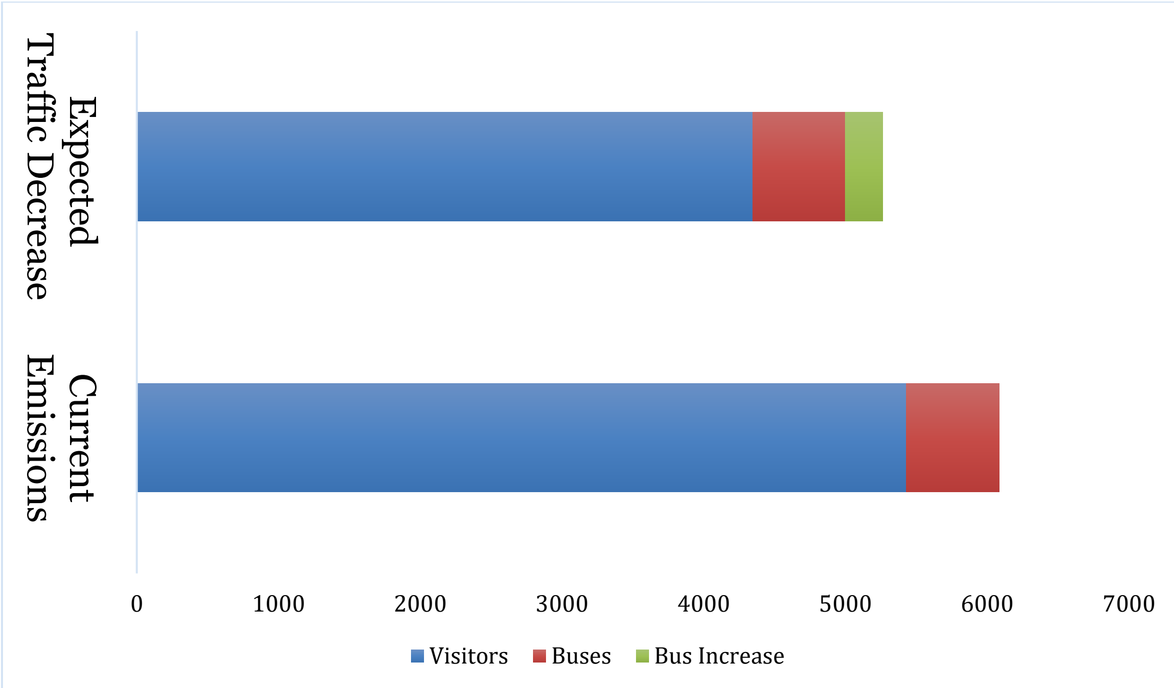


Figure 17 shows the emissions reduction expected due to the transportation plan

Overall, the Transportation Plan should result in a net reduction of emissions from current levels. The estimate in Figure 17 includes a significant amount of supposition as much is still unknown. The Transportation Plan includes the addition of more traffic counting facilities that will help to improve visitor use data. If ANP also proceeds with the qualitative data collection methods outlined in the following section, they would be able to drastically improve this estimate.

5.0 Recommendations and Conclusion

After analyzing ANP's carbon footprint, we developed a list of recommendations that we believe is going to help the park reduce and monitor its emissions. The recommendations were developed to be sustainable, efficient, and viable. Moreover, the recommendations focused on the importance of the continuous monitoring of the park's carbon footprint and improving the quality of the data processed.

5.1 Monitoring the Carbon Footprint of the Park

For the purposes of this study, the CLIP tool was used to generate a complete carbon footprint for an entire year. While it is intended to be used annually, it can be used to do smaller, more frequent studies. All the factors that contribute to the emissions that come directly from park operations are already recorded for billing purposes. It is therefore recommended that the park take steps to monitor their emissions on a monthly basis in order to better understand how the park uses energy.

Frequent data collection and analysis will help ANP staff to identify trends and sources of wasted energy. According to a study done by Leygue, Ferguson, and Spence in 2017 on the psychology of saving energy in the workplace, employees are most likely to be more mindful of conserving energy when they are reminded of the impact on the environment. Data visualization from the CLIP tool would be an effective way to remind ANP staff if the importance of saving energy. With Acadia's emissions monitored monthly, the staff will see the direct impact of their changes.

5.1.1 Qualitative Data Improvements

There are several steps the park could take to improve the data collected for the CLIP tool. Emissions data involving the park's visitors, the biggest sector of emissions, was subject to several assumptions. The first assumption is about the total number of vehicles. Since ANP is spread across Mt. Dessert Island, there is no single entrance point. To account for this, ANP staff have a calculation that extrapolates the total number of vehicles based on the number that pass through the Sand Beach entrance. The second assumption, and the one that has the greatest potential for error, is the distance that vehicles drive through the park. For this study it was assumed that vehicles drove 27 miles, which is one circuit of Park Loop Road, but there is no objective data to support this estimate. The third assumption is in converting the vehicle miles traveled to gallons of fuel burned. Getting an accurate estimate of fuel burned requires information on the efficiency of those vehicles.

The Transportation Plan will include improvements to ANP's car counting system as well as more controlled entrances to the park. These steps should vastly improve the accuracy of the vehicle estimates.

Using the Visitor Tracking application developed by Plante and Hogan in 2019, ANP is able to develop an improved estimate of the average mileage driven by the visitors in the park. The application is designed to track the visitors and at a certain speed, the application starts tracking the visitor as an automobile, rather than a pedestrian. Analyzing the data generated from tracking automobiles will increase the accuracy of visitor emissions.

Another tool that could optimize the estimation of visitor emissions is the webcam developed by Hollander, Yang, and Zhu in 2019. This webcam is designed to monitor traffic congestion. The pictures taken by the webcam could be analyzed to know the percentages of each different automobile type explained in methodology 3.4.2. Hollander, Yang, and Zhu recommend that ANP implement a series of webcams across the park. The authors further recommend that the cameras have automatic vehicle recognition capability. This vehicle recognition data could be used to assess the percentages of different vehicles within the park.

5.2 Shift of Mindset

During this study, several behaviors exhibited by park staff that waste energy were observed. Two of such behaviors were leaving computers on after business hours and unattended park vehicles idling.

Figure 18 shows computers running at the Cadillac Mountain Gift Shop when the shop is closed (2:00AM).

The previous behaviors increase CO_2 emissions and the cost of operations. For example, an average desktop computer consumes 161.5 watts/hr while not in sleep mode as shown in

Figure 18 above. The cost of 1 kWh in the park is $0.16 according to Heather Cooney. Also, 1 MWh produces 597.2 Lbs CO_2 equivalent/hr.

Table 1 shows how much it costs to run computers when shops are closed.

Time	Cost ($)	Lbs CO_2 Emitted
Month	$13.8	51.4
Year	$165.4	617.3
5 Years	$827	3,086.5

Table 1 shows our estimate for the costs and lbs of CO_2E emitted for leaving 10 computers working every weekday for 16 hours without using it. Also, we estimated that computers were left working during 24 hours on weekends.

A car idling for more than 10 seconds consumes more fuel and emits more CO_2 to the air than restarting the car's engine (Natural Resources Canada, 2016). A gasoline car emits 2.3-kilogram CO_2/ Liter of gasoline, idling a midsized gasoline car consumes 2.1-2.4 liters of gasoline/hr (Raturi, 2018). A diesel car emits 2.7-kilogram CO_2/ Liter of diesel, idling for an average diesel park ranger car consumes 1.9 liters of diesel/hr (EcoMobile, 2015). Thus, idling is both financially and environmentally irresponsible.

Table 2 shows how idling for a gasoline car costs, emits CO2.

Time	Cost ($)	Lbs CO_2 Equivalent
Month	$28.8	62.4
Year	$345.6	748.8
5 Years	$1728	3744

Table 3 shows how idling for a diesel car costs, emits CO2.

Time	Cost ($)	Lbs CO_2 Equivalent
Month	$28	61
Year	$336	732
5 Years	$1680	3660

Table 2 and 3 shows our estimate for leaving 10 cars idling. The 10 cars were estimated to be idling for 30 minutes every week.

To help the park employees shift their mindset, it is suggested that the park administration send an email to all employees explaining how minor actions like turning off cars and electronics can save energy and reduce emissions. Leygue, Ferguson, and Spence suggest, in their 2017 paper, that the best way for an employer to approach energy savings is to relate it to the environmental impacts. Employees are much more likely to look favorably on helping the environment than helping their employer save money. Also, adding stickers to workplaces that state “turn off your computer when you are done”, “turn off the lights when exiting”, or “idling is not recommended”. According to Rea (1987), adding stickers decreased electricity usage by 15% in a private company.

Figure 19 shows an example for a sticker that could be used above light switches.

5.3 Acadia Vehicle Use Study Application

The purpose of the app is to improve vehicle usage in the park. The proof of concept for the app comes from Joseph Hogan and James Plante's app (Visitor Tracking in Acadia National Park, 2019). The app works by tracking the route that employees take and records his/her answers to the survey in the app. The purpose would be to collect data on how different vehicles are used. For example, a heavy-duty truck being used to shuttle rangers around the island is a waste of fuel when a hybrid vehicle was available for use instead. The application will collect data on what vehicle was driven, what it was used for, and how far it went. Therefore, it could help the park make better decisions in the future by informing the employees to use specific categories for specific usages. Also, it could help the park make more efficient decisions regarding any changes or additions to their vehicle fleet.

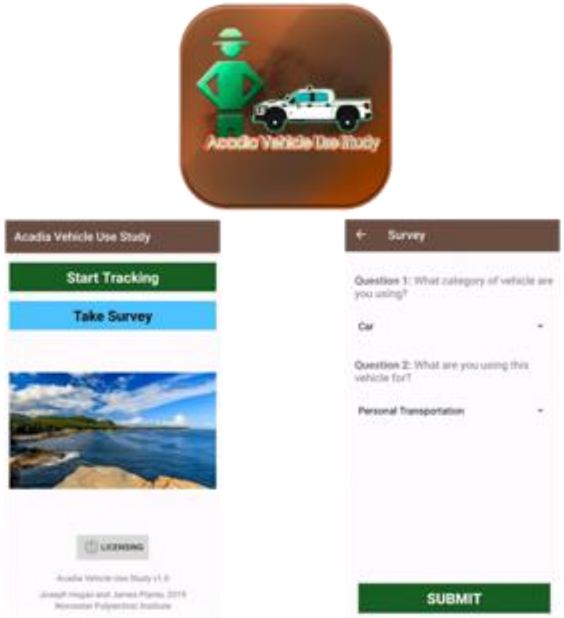


Figure 20 shows the interface and the logo of the app.

Although the application can be used today, it still needs technical development. First, the app only works on Android operating systems. Second, it is not on the android market, which makes it hard for rangers to download. Thus, it is suggested to develop the application further and list them on the Android and Apple official application stores.

5.4 Becoming a CFP

In order for a park to be a Climate Friendly Park, it must complete the following four milestones:

1. To start the process, an application must be submitted.

   Application can be done using the following link:

   https://www.nps.gov/subjects/climatechange/cfpprogram.htm

2. Develop a GHG gas emissions inventory. In other words, conduct a carbon footprint analysis in the park. The data contained in this report could be used for that purpose.

3. Conduct a CFP workshop or webinar for the staff, stakeholders, and concessionaires to learn more about the impacts of climate change and discuss plans to reduce the carbon footprint of the park.
4. Write an action plan on how the park will reduce emissions and lay out an initiative for educating visitors.

These milestones are achievable by the park employees. Our project serves as milestone 2 and helps in showing the way to gather and run the CLIP tool. Also, our project findings can be used to aid in milestones 3 and 4.

5.5 Conclusion

In summary, it is clear that Acadia National Park recognizes that climate change is a serious issue globally. Furthermore, they understand that the park could operate in a more environmentally and fiscally responsible manner. In this paper, a background on climate change and tools used by the group were presented. The methodologies used to gather data and analyze results were put forth. Next, the results of the CLIP Tool were interpreted. Lastly, recommendations for the park were discussed. Although the project’s findings and recommendations are important, the park’s emissions will not improve until the change comes from within.

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Appendices

Appendix A: CLIP Tool Inputs

Stationary Combustion Emissions Calculator

Current calculations: **Park Operations**

2) If your park has already reported consumption of fuels for stationary combustion in facilities through NPS's Financial and Business Management System (FBMS), consumption should automatically appear in the yellow cells below. If the cells are blank or if you have reason to revise the pre-populated value(s), you may manually enter the appropriate value(s) into the yellow cells below. If after clicking the "Store Results" button in Step 3 below you decide to restore the default pre-populated value(s), re-click "Select" next to "Park Operations" in Step 1 and then click the "Restore Defaults" button in Step 2.

Fuel Use

DATA INPUTS [Restore Defaults]

EMISSION RESULTS — Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)

	Fuel	Consumption	Unit	CO_2	CH_4	N_2O	Total
	Natural Gas	-	cubic feet	0.0	0.0	0.0	**0.0**
Edited >>	Diesel Fuel	43,401	gallons	440.3	1.5	1.1	**442.9**
Edited >>	Propane	9,516	gallons	54.8	0.2	0.2	**55.2**
	Biodiesel		gallons	0.0	0.0	0.0	**0.0**
	Kerosene	-	gallons	0.0	0.0	0.0	**0.0**
	Wood	-	cords	NA	0.0	0.0	**0.0**
	Coal	-	short tons	0.0	0.0	0.0	**0.0**
	Other [Factors]		million Btu	0.0	0.0	0.0	**0.0**
			Total	495.1	1.7	1.2	**498.1**

Please click this button to enter specific factors for the "other" fuel

3) Press the 'Store Results' button to save emission estimates for Park Operations. Note that saving results will clear the data you have entered, but the emission results are saved in the table below. [Store Results]

4) Once you have saved your results, please repeat Steps 1-3 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

Purchased Electricity Emissions Calculator

Current calculations: **Park Operations**

2) If your park has already reported purchased electricity data through NPS's Financial and Business Management System (FBMS), consumption should automatically appear in the yellow cell below. If the cell is blank or you have reason to revise the pre-populated value, you may manually enter the appropriate value into the yellow cell below. If after clicking the "Store Results" button in Step 3 below you decide to restore the default pre-populated value, re-click "Select" next to "Park Operations" in Step 1 and then click the "Restore Default" button in Step 2.

Electricity Purchased

DATA INPUTS [Restore Default]

EMISSION RESULTS — Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)

	kilowatt-hours (kWh)	CO_2	CH_4	N_2O	Total
Edited >>	1,471,469	400.6	0.0	0.0	**400.6**

3) Press the 'Store Results' button to save emission estimates for Park Operations. Note that saving results will clear the data you have entered, but the emission results are saved in the table below. [Store Results]

4) Once you have saved your results, please repeat Steps 1-3 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

	DATA INPUTS		FACTORS		EMISSION RESULTS			
	Data	Units	Factors	Units	Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)			
Highway vehicles			Click here for default MPGs					
Fuel consumption					CO_2	CH_4	N_2O	Total
Gasoline			AVG MPG					
Car	31,893	gallons	22.15	mpg	274.1	0.3	5.3	279.7
Light Truck, SUV, Minivan		gallons	17.69	mpg	0.0	0.0	0.0	0.0
Bus		gallons	6.90	mpg	0.0	0.0	0.0	0.0
Heavy Duty Vehicle		gallons	7.61	mpg	0.0	0.0	0.0	0.0
Motorcycle		gallons	50.00	mpg	0.0	0.0	0.0	0.0
Diesel								
Car	9,592	gallons	19.52	mpg	96.6	0.0	0.1	96.7
Light Truck, SUV, Minivan		gallons	15.59	mpg	0.0	0.0	0.0	0.0
Bus		gallons	6.90	mpg	0.0	0.0	0.0	0.0
Heavy Duty Vehicle		gallons	7.23	mpg	0.0	0.0	0.0	0.0
				Highway Vehicles Total	370.7	0.3	5.3	376.4

Non-road equipment			CO_2	CH_4	N_2O	Total
Fuel consumption						
Agriculture						
Motor Gasoline		gallons	0.0	0.0	0.0	0.0
Diesel Fuel		gallons	0.0	0.0	0.0	0.0
Construction and Industrial						
Motor Gasoline		gallons	0.0	0.0	0.0	0.0
Diesel Fuel		gallons	0.0	0.0	0.0	0.0
Other (e.g., snowmobiles)						
Motor Gasoline	217	gallons	1.9	0.0	0.0	1.9
Diesel Fuel		gallons	0.0	0.0	0.0	0.0
		Non-Road Equipment Total	1.9	0.0	0.0	1.9

Watercraft			CO_2	CH_4	N_2O	Total
Fuel consumption						
Motor Gasoline		gallons	0.0	0.0	0.0	0.0
Diesel Fuel	216	gallons	2.2	0.0	0.0	2.2
		Watercraft Total	2.2	0.0	0.0	2.2
		Mobile Emissions Total (Highway + Non-road + Watercraft)	374.7	0.3	5.4	380.4

4) Press the 'Store Results' button to save emission estimates for Park Operations. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

Store Results

5) Once you have saved your results, please repeat Steps 1-4 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

Mobile Combustion Emissions Calculator
Current Calculations: **Visitors**

2) Please select whether you'd like to estimate emissions for highway vehicles, non-road vehicles and equipment, and/or watercraft. If you'd like to estimate emissions for highway vehicles, please select one box each in (A) and (B).

Highway vehicles

A) Please select one of the options below:

- ☐ I'd like to estimate emissions using data on fuel consumption.
- ☑ I'd like to estimate emissions using data on vehicle miles traveled.

B) Please select one of the options below:

- ☑ I'd like to estimate emissions for vehicles running on diesel and gasoline only.
- ☐ I'd like to estimate emissions for vehicles running on diesel, gasoline, and alternative fuels.

Total Miles **Calculate By Vehicle**

Non-road vehicles and equipment

- ☐ I'd like to estimate emissions for non-highway equipment using data on fuel consumption.

Watercraft

- ☐ I'd like to estimate emissions for watercraft using data on fuel consumption.

3) In the yellow cells, enter your activity data. If entering information for highway vehicles, you may click on the blue button to use default MPG factors.

	DATA INPUTS		FACTORS		EMISSION RESULTS			
	Data	Units	Factors	Units	Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)			
Highway vehicles **Vehicle miles traveled**			Click here for default MPGs		CO_2	CH_4	N_2O	Total
Gasoline								
Cars	4,733,900	miles	22.15	mpg	1,836.8	2.1	32.8	**1,871.6**
Light Trucks and SUVs	7,150,900	miles	17.69	mpg	3,474.1	4.3	43.7	**3,522.0**
Buses		miles	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy-Duty Vehicles		miles	7.61	mpg	0.0	0.0	0.0	**0.0**
Motorcycles	214,530	miles	50.00	mpg	36.9	0.4	0.4	**37.7**
Diesel								
Cars		miles	19.52	mpg	0.0	0.0	0.0	**0.0**
Light Trucks and SUVs		miles	15.59	mpg	0.0	0.0	0.0	**0.0**
Buses		miles	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy-Duty Vehicles		miles	7.23	mpg	0.0	0.0	0.0	**0.0**
				Highway Vehicles Total	**5,347.7**	**6.7**	**76.9**	**5,431.4**
				Mobile Emissions Total (Highway + Non-road + Watercraft)	**5,347.7**	**6.7**	**76.9**	**5,431.4**

4) Press the 'Store Results' button to save emission estimates for Visitors. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

Store Results

5) Once you have saved your results, please repeat Steps 1-4 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

Mobile Combustion Emissions Calculator
Current Calculations: **Island Explorer**

2) Please select whether you'd like to estimate emissions for highway vehicles, non-road vehicles and equipment, and/or watercraft. If you'd like to estimate emissions for highway vehicles, please select one box each in (A) and (B).

Highway vehicles

A) Please select one of the options below:

- [x] I'd like to estimate emissions using data on fuel consumption.
- [ ] I'd like to estimate emissions using data on vehicle miles traveled.

B) Please select one of the options below:

- [ ] I'd like to estimate emissions for vehicles running on diesel and gasoline only.
- [x] I'd like to estimate emissions for vehicles running on diesel, gasoline, and alternative fuels.

Non-road vehicles and equipment

- [ ] I'd like to estimate emissions for non-highway equipment using data on fuel consumption.

Watercraft

- [ ] I'd like to estimate emissions for watercraft using data on fuel consumption.

3) In the yellow cells, enter your activity data. If entering information for highway vehicles, you may click on the blue button to use default MPG factors.

	DATA INPUTS		FACTORS		EMISSION RESULTS			
	Data	Units	Factors	Units	Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)			
Highway vehicles			Click here for default MPGs					
Fuel consumption					CO_2	CH_4	N_2O	Total
Gasoline			AVG MPG					
Car		gallons	22.15	mpg	0.0	0.0	0.0	**0.0**
Light Truck, SUV, Minivan		gallons	17.69	mpg	0.0	0.0	0.0	**0.0**
Bus		gallons	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy Duty Vehicle		gallons	7.61	mpg	0.0	0.0	0.0	**0.0**
Motorcycle		gallons	50.00	mpg	0.0	0.0	0.0	**0.0**
Diesel								
Car		gallons	19.52	mpg	0.0	0.0	0.0	**0.0**
Light Truck, SUV, Minivan		gallons	15.59	mpg	0.0	0.0	0.0	**0.0**
Bus		gallons	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy Duty Vehicle		gallons	7.23	mpg	0.0	0.0	0.0	**0.0**
Liquefied Petroleum Gas								
Car		gallons	16.33	mpg	0.0	0.0	0.0	**0.0**
Trucks and SUVs		gallons	16.33	mpg	0.0	0.0	0.0	**0.0**
Bus	105,581	gallons	5.36	mpg	552.0	1.5	25.3	**578.9**
Heavy Duty Vehicle		gallons	5.36	mpg	0.0	0.0	0.0	**0.0**
Compressed Natural Gas								
Car		gallons*	22.49	mpg	0.0	0.0	0.0	**0.0**
Trucks and SUVs		gallons*	22.49	mpg	0.0	0.0	0.0	**0.0**
Bus		gallons*	4.27	mpg	0.0	0.0	0.0	**0.0**
Heavy Duty Vehicle		gallons*	7.38	mpg	0.0	0.0	0.0	**0.0**
Methanol								
Car		gallons	16.26	mpg	0.0	0.0	0.0	**0.0**

Mobile Combustion Emissions Calculator

Current Calculations: **Island Explorer**

2) Please select whether you'd like to estimate emissions for highway vehicles, non-road vehicles and equipment, and/or watercraft. If you'd like to estimate emissions for highway vehicles, please select one box each in (A) and (B).

Highway vehicles

A) Please select one of the options below:

- [x] I'd like to estimate emissions using data on fuel consumption.
- [ ] I'd like to estimate emissions using data on vehicle miles traveled.

B) Please select one of the options below:

- [x] I'd like to estimate emissions for vehicles running on diesel and gasoline only.
- [ ] I'd like to estimate emissions for vehicles running on diesel, gasoline, and alternative fuels.

Non-road vehicles and equipment

- [ ] I'd like to estimate emissions for non-highway equipment using data on fuel consumption.

Watercraft

- [ ] I'd like to estimate emissions for watercraft using data on fuel consumption.

3) In the yellow cells, enter your activity data. If entering information for highway vehicles, you may click on the blue button to use default MPG factors.

	DATA INPUTS		FACTORS		EMISSION RESULTS			
	Data	Units	Factors	Units	Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)			
Highway vehicles			Click here for default MPGs					
Fuel consumption					CO_2	CH_4	N_2O	Total
Gasoline			AVG MPG					
Car		gallons	22.15	mpg	0.0	0.0	0.0	**0.0**
Light Truck, SUV, Minivan		gallons	17.69	mpg	0.0	0.0	0.0	**0.0**
Bus	4,307	gallons	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy Duty Vehicle		gallons	7.61	mpg	0.0	0.0	0.0	**0.0**
Motorcycle		gallons	50.00	mpg	0.0	0.0	0.0	**0.0**
Diesel								
Car		gallons	19.52	mpg	0.0	0.0	0.0	**0.0**
Light Truck, SUV, Minivan		gallons	15.59	mpg	0.0	0.0	0.0	**0.0**
Bus	3,661	gallons	6.90	mpg	0.0	0.0	0.0	**0.0**
Heavy Duty Vehicle		gallons	7.23	mpg	0.0	0.0	0.0	**0.0**
Highway Vehicles Total					**552.0**	**1.5**	**25.3**	**578.9**
Mobile Emissions Total (Highway + Non-road + Watercraft)					**552.0**	**1.5**	**25.3**	**578.9**

4) Press the 'Store Results' button to save emission estimates for Island Explorer. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

Store Results

5) Once you have saved your results, please repeat Steps 1-4 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

Landfilled Waste Emissions Calculator
Current Calculations: **Park Operations**

2) Calculate your emissions from waste disposal by answering the questions below.

How many short tons of waste did Park Operations send to a landfill in 2017?

266 short tons (2,000 lbs)

Does your park own or operate the landfill? no

EMISSION RESULTS

Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$)			
CO_2	CH_4	N_2O	Total
0.0	270.3	0.0	**270.3**

Does the destination landfill practice methane flaring or use landfill gas to produce energy through a landfill gas to energy (LFGTE) project? If so, please select either option from the dropdown list in the pale yellow cell below. If not, please select 'No Methane Flaring.'

No Methane Flaring

How many short tons of waste did Park Operations incinerate in 2017?

short tons

3) Press the 'Store Results' button to save emission estimates for Park Operations. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

Store Results

4) Once you have saved your results, please repeat Steps 1-3 to calculate emissions for a different park unit. When all desired park units have been completed, click on the "Next Sheet" button at the top.

Refrigerant Use Emissions Calculator
Current Calculations: **Park Operations**

2) Enter the number of refrigeration and air conditioning units that run on the indicated types of coolant.

Stationary Refrigeration & A/C Use

Refrigeration and A/C Type	**NUMBER OF EACH UNIT** Coolant (CFCs such as CFC-12 and HCFC-22 do not need to be entered) HFC-134a	R-410	**EMISSION RESULTS** Metric Tons of Carbon Dioxide Equivalent ($MTCO_2E$) HFC-134a	R-410	Total
Refrigerated Appliances	51		0.1		**0.1**
Air Conditioning					
Window Units				0.0	**0.0**
Residential Unitary				0.0	**0.0**
Small Commercial Unitary			0.0	0.0	**0.0**
Large Commercial Unitary			0.0	0.0	**0.0**
Packaged Terminal A/C			0.0	0.0	**0.0**

Mobile A/C Use

3) Enter the number of vehicles with air-conditioners for each vehicle type.
4) If the vehicle breakdown is not known, you may alternately enter the total number of vehicles into the yellow cell and click on 'Calculate by Vehicle.' The tool will automatically fill in the yellow cells based on default vehicle distribution.

DATA INPUTS

Optional Default Distribution
Total Vehicles ____ vehicles **Calculate By Vehicle**

Vehicle Type		**Units**
Gasoline Cars	9	vehicles
Gasoline Trucks and SUVs	83	vehicles
Heavy Duty Gas Vehicles	13	vehicles
Diesel Cars		vehicles
Diesel Trucks and SUVs	8	vehicles
Heavy Duty Diesel Vehicles	23	vehicles
Motorcycles	-	vehicles (not included in emission calculations)

AGE DISTRIBUTION

Vehicles by Age	**Population**
After 1993	117
1993	2
1992	2
Before 1992	15
Total	136

EMISSIONS ($MTCO_2E$)

HFC	**Total**
22.2	**22.2**
0.3	**0.3**
0.1	**0.1**
0.0	**0.0**

5) Press the 'Store Results' button to save emission estimates for Park Operations. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

Store Results

6) Once you have saved your results, please repeat the above steps to calculate emissions for a different park unit. When all desired park units have been completed, click on the 'Next Sheet' button at the top.

Refrigerant Use Emissions Calculator

Current Calculations: **Island Explorer**

2) Enter the number of refrigeration and air conditioning units that run on the indicated types of coolant.

Stationary Refrigeration & A/C Use

Refrigeration and A/C Type	NUMBER OF EACH UNIT: HFC-134a	NUMBER OF EACH UNIT: R-410	EMISSION RESULTS (MTCO$_2$E): HFC-134a	EMISSION RESULTS (MTCO$_2$E): R-410	EMISSION RESULTS (MTCO$_2$E): Total
Refrigerated Appliances			0.0		**0.0**
Air Conditioning					
Window Units				0.0	**0.0**
Residential Unitary				0.0	**0.0**
Small Commercial Unitary			0.0	0.0	**0.0**
Large Commercial Unitary			0.0	0.0	**0.0**
Packaged Terminal A/C			0.0	0.0	**0.0**

Coolant (CFCs such as CFC-12 and HCFC-22 do not need to be entered)

Metric Tons of Carbon Dioxide Equivalent (MTCO$_2$E)

Mobile A/C Use

3) Enter the number of vehicles with air-conditioners for each vehicle type.

4) If the vehicle breakdown is not known, you may alternately enter the total number of vehicles into the yellow cell and click on 'Calculate by Vehicle.' The tool will automatically fill in the yellow cells based on default vehicle distribution.

DATA INPUTS | **AGE DISTRIBUTION** | **EMISSIONS (MTCO$_2$E)**

Optional Default Distribution

Total Vehicles ______ vehicles [Calculate By Vehicle]

Vehicle Type	Data Input	Units
Gasoline Cars		vehicles
Gasoline Trucks and SUVs		vehicles
Heavy Duty Gas Vehicles	260	vehicles
Diesel Cars		vehicles
Diesel Trucks and SUVs		vehicles
Heavy Duty Diesel Vehicles	-	vehicles
Motorcycles		vehicles (not included in emission calculations)

Vehicles by Age	Population	HFC	Total
After 1993	216	41.3	**41.3**
1993	5	0.7	**0.7**
1992	5	0.3	**0.3**
Before 1992	33	0.0	**0.0**
Total	260		

5) Press the 'Store Results' button to save emission estimates for Island Explorer. Note that saving results will clear the data you have entered, but the emission results are saved in the table below.

[Store Results]

6) Once you have saved your results, please repeat the above steps to calculate emissions for a different park unit. When all desired park units have been completed, click on the 'Next Sheet' button at the top.

Miles Traveled by Commuting Type	632,989	196,376	45,548	0	38,799	0	913,713	Miles
CO2 Emissions by Commuting Type	173	31	0	0	0	0	204	MTCO2E

*Other modes of travel are assumed to be non-emissive

What percentage of the employee population participated in the survey? 15% %

Please note that the CFP Program requires that 75% of the allotted, full-time employee population participate in the commuting survey.
Please note that the survey participant population will be used to approximate emissions and miles traveled for all park staff.

Survey Inputs

Store Results

Employee Name	Year	In your normal routine, how many days/week did you commute to work during the inventory year (Please enter a value between 1 and 7)?	How many potential commuting days do you think you missed during the inventory year (estimate considering unexpected tele-commuting, business travel, sick, vacation)?	How far is your commute to and from work (total round-trip in miles)?	Many people use multiple modes of travel in a single commute, or different modes on different days. What percentage of your commuting do you do in the following modes? (e.g., 80% Train and 20% Bike would be entered as "80" and "20" for those modes, respectively). Please note that the Total can not exceed 100%.										If you drive, what kind of vehicle do you drive?
Clear Survey Data					Automobile (solo)	Carpool (+1 person)	Carpool (+2 people)	Carpool (+3 people)	Carpool (+4 or more)	Bus	Train	Bike/Walk/Run	Other	Total	Select One
1 [illegible]	2017	5	0	30	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Small Gasoline Car
2 [illegible]	2017	5	20	25	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Diesel Car
3 [illegible]	2017	4	3	146	25.00%	75.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
4 [illegible]	2017	4	0	6	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
5 [illegible]	2017	5	60	66	60.00%	40.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Gasoline Light Truck
6 [illegible]	2017	5	0	12	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Gasoline Light Truck
7 [illegible]	2017	5	8	7	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Large Gasoline Car
8 [illegible]	2017	5	5	15	90.00%	10.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Small Gasoline Car
9 [illegible]	2017	5	1	10	60.00%	29.00%	0.00%	0.00%	0.00%	1.00%	0.00%	10.00%	0.00%	100%	Medium Gasoline Car
10 [illegible]	2017	5	5	12	19.00%	1.00%	0.00%	0.00%	0.00%	0.00%	0.00%	80.00%	0.00%	100%	Hybrid Car
11 [illegible]	2017	5	125	9	95.00%	5.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Hybrid Car
12 [illegible]	2017	5	0	15	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
13 [illegible]	2017	5	35	14	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Gasoline Light Truck
14 [illegible]	2017	5	30	6	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Gasoline Light Truck
15 [illegible]	2017	4	10	30	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Small Gasoline Car
16 [illegible]	2017	5	20	16	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Gasoline Light Truck
17 [illegible]	2017	5	0	9	95.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.00%	0.00%	100%	Small Gasoline Car
18 [illegible]	2017	5	60	10	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Small Gasoline Car
19 [illegible]	2017	5	5	10	95.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.00%	0.00%	100%	Gasoline Light Truck
20 [illegible]	2017	5	15	14	80.00%	0.00%	0.00%	0.00%	0.00%	10.00%	0.00%	10.00%	0.00%	100%	Medium Gasoline Car
21 [illegible]	2017	3	50	30	67.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.00%	0.00%	100%	Medium Gasoline Car
22 [illegible]	2017	5	75	51	55.00%	0.00%	0.00%	0.00%	0.00%	45.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
23 [illegible]	2017	5	25	10	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
24 [illegible]	2017	4	10	8	10.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	90.00%	0.00%	100%	Medium Gasoline Car
25 [illegible]	2017	5	7	6	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
26 [illegible]	2017	5	3	36	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
27 [illegible]	2017	5	1	4	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Medium Gasoline Car
28 [illegible]	2017	5	8	20	45.00%	10.00%	0.00%	0.00%	0.00%	44.00%	0.00%	1.00%	0.00%	100%	Small Gasoline Car
29 [illegible]	2017	5	30	6	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100%	Small Gasoline Car

Appendix B: Commuter Survey

This first survey is directly copied from the CLIP tool provided by the NPS. It ascertains the modes of transportation used by the park employees to commute to work.

Exit this survey

NEW: Climate Friendly Parks Commuter Survey for CLIP Tool

1. Commuter Survey

100%

* **1. Park Name**

* **2. Employee Name**

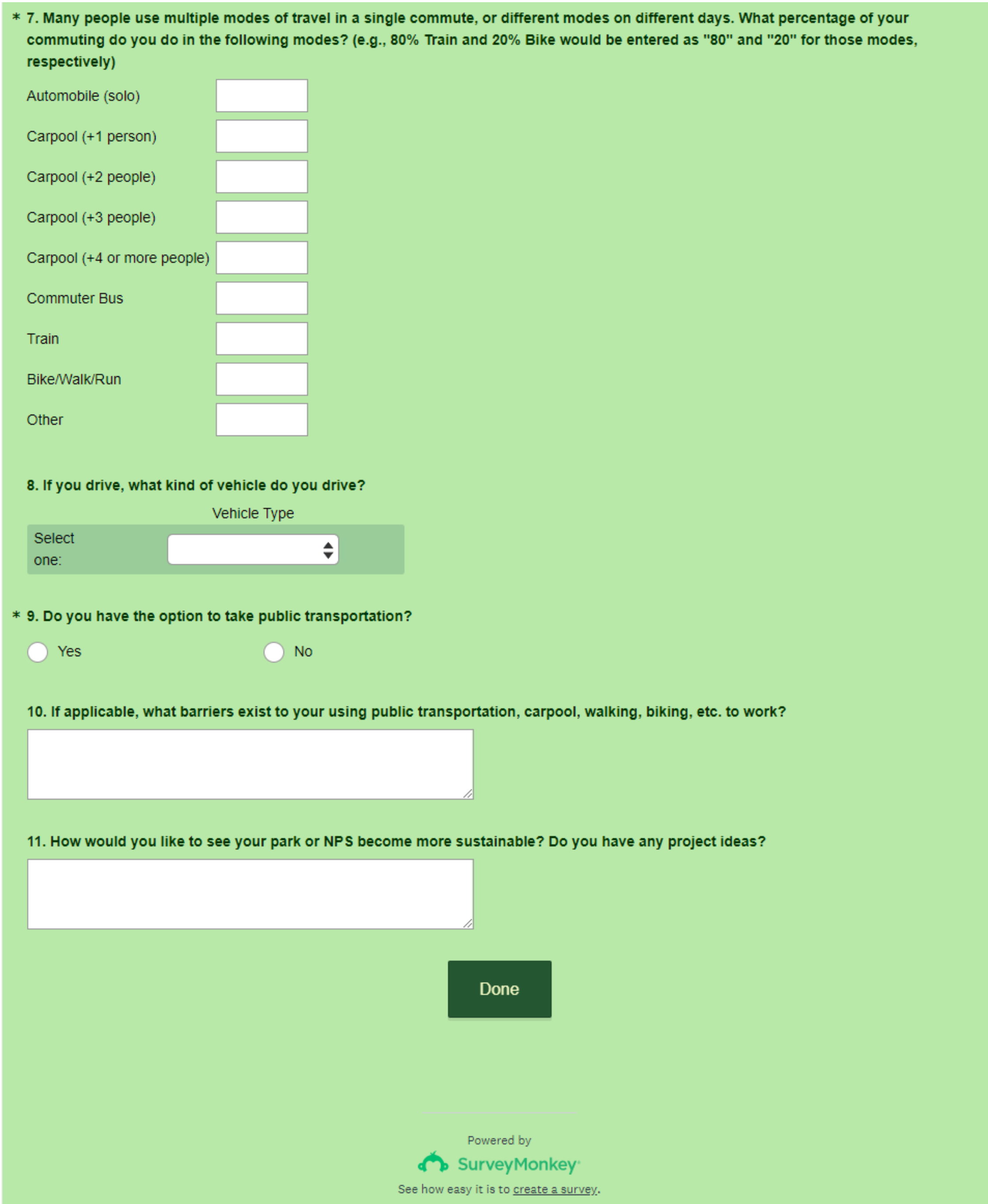
* **3. Inventory Year**

* **4. In your normal routine, how many days/week did you commute to work during the inventory year?**

- 1
- 2
- 3
- 4
- 5
- 6
- 7

* **5. How many potential commuting days do you think you missed during the inventory year (estimate considering unexpected telecommuting, business travel, sick, vacation)?**

* **6. How far is your commute to and from work (total round-trip in miles)?**



* 7. Many people use multiple modes of travel in a single commute, or different modes on different days. What percentage of your commuting do you do in the following modes? (e.g., 80% Train and 20% Bike would be entered as "80" and "20" for those modes, respectively)

Automobile (solo)
Carpool (+1 person)
Carpool (+2 people)
Carpool (+3 people)
Carpool (+4 or more people)
Commuter Bus
Train
Bike/Walk/Run
Other

8. If you drive, what kind of vehicle do you drive?

Vehicle Type
Select one:

* 9. Do you have the option to take public transportation?

Yes
No

10. If applicable, what barriers exist to your using public transportation, carpool, walking, biking, etc. to work?

11. How would you like to see your park or NPS become more sustainable? Do you have any project ideas?

Done

Powered by
SurveyMonkey
See how easy it is to create a survey.

Appendix C: Employee Suggestions

More opportunities for carpooling
Remove all desk top computers and replace them with workstations. No need to keep 300

computers running 24/7/365 for a possible update, when a centralized server can accommodate 20-50+ computing work stations!!! It is ridiculous that a computer "needs" to be running constantly when it is only used for a few hours a week. A centralized work station protocol will not only save electric costs, but also tighten up computer security and bring many Parks into computer compliance.
Solar panels, recycling program, and compost.
More restrictions on the number of vehicles allowed into the park and more Island Explorer type shuttle services to accommodate the increase in visitors requiring transportation.
More sustainable in terms of transportation? I have lots of ideas, but most of them will take awhile to be implemented due to lack of resources (people, money,, time). Our park vehicles should all be hybrids or electric. All our lights should be on timers. We should have a changing room with more lockers for active transportation, we should have a secure covered area for bicycles, we should have buildings with proper insulation. we should have more electric charging stations in the park, we should use ebikes to get back and forth to our visitor center instead of automobiles, all our practices should be as green as possible. That may take some time. We should move toward zero landfill.
We have shuttle buses that help greatly and do decrease my automobile use on days off and occasionally very occasionally on work days.
-expanded bus schedule (esp. some earlier pick-ups) and of location stops (which I think is part of upcoming transportation plan) -cut off/discontinue regular car access to certain locations
It would be great if the state and town roads had wider shoulder/biking lanes (I know ANP can't directly make this happen, but could try and influence if they already aren't)

Better public transportation options and better bike lanes along roads to office. More buses for visitors. More energy efficient buildings
An organized ride-share would be beneficial
Variable work schedule that does not work with public transportation schedules
more incentives to bike to work
Solar, wind, and geothermal projects in NPS buildings.
maybe a more Park Employee-specific Island Explorer bus schedule? runs closer to 7am and 3:30pm at points that are easy to drive/park in around the island. Not confident employees would use them to make it worth it, though. Bottle Redemption in the campgrounds! Even if it's just donate-able to Scouts.
Take home patrol vehicles
Yes, bike paths on the roadways and bike stands for locking bikes at trail heads.