# Climate Leadership in Public Places (CLIPP) Tool: Helping National Parks Quantify and Reduce Greenhouse Gases

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**Abstract**

The U.S. Environmental Protection Agency and the National Park Service are unveiling the Climate Leadership in Public Places (CLIPP) tool, the latest addition to the Climate Friendly Places (CFP) program. This tool assists national parks and other public places in developing comprehensive greenhouse gas (GHG) and criteria air pollutant (CAP) inventories, as well as identifying and quantifying potential reductions through various mitigation and outreach strategies.

The CFP encourages GHG and CAP emission mitigation through education and demonstration of climate friendly activities in the national parks. Recognizing that the national park system is an excellent resource for educating a large number of people about GHG and CAP emissions and mitigation, the CFP program seeks to educate park personnel on emission sources, ways to reduce emissions, and outreach strategies for educating the millions of people that visit the national parks each year. The program encourages parks to take actions to reduce in-park emissions while simultaneously ramping up climate change education and outreach efforts.

One of the first steps in signing on to the Climate Friendly Parks program is for parks to develop a comprehensive inventory of GHG and CAP emissions. Because park-specific inventories can be very labor-intensive endeavors, EPA and NPS funded the development of the CLIPP tool. CLIPP helps parks develop an emissions baseline that forms the backbone of their plan to reduce emissions. The baselines will include emissions from all relative sectors, such as transportation, electricity use, and forestry. At the end of one year, the park can evaluate how much its actions have reduced baseline emissions. CLIPP also assists parks in identifying mitigation strategies and quantifying the potential emission reductions from these strategies. The emissions baseline and mitigation strategies developed in CLIPP can then be used as a basis for a report to the park superintendent on setting reduction goals, budgets, and taking actions.

CLIPP was specifically designed to be easy-used by a general audience, while still producing high-quality estimates. This paper discusses the main features of CLIPP that are intended to maximize usability, transparency, and accuracy, and also provides an overview on using the tool.

## Introduction

*Overview of the Climate Friendly Places Program*

As part of the National Park Service's (NPS) Green Parks Partnership Program, NPS and the Environmental Protection Agency (EPA) have established the Climate Friendly Places program. This partnership encourages and assists national parks in developing comprehensive strategies to reduce their greenhouse gas (GHG) and criteria air pollutant (CAP) emissions. Furthermore, participating parks commit to educating the public about actions the park is taking to mitigate its GHG and CAP emissions and why these actions are being taken. While the Climate Friendly Places program currently focuses solely on national parks and recreation areas, EPA plans to expand the program to include other entities such as state and local parks, refuges, schools and universities, zoos and aquariums, and science museums.

The primary goals of the Climate Friendly Places program are as follows:

- **Educate** the participating entity's personnel on the science and impacts of climate change and air pollution. This goal is first achieved through workshops and/or another means of internal education of the entity's choosing; and, second, by preparing a GHG and CAP emissions inventory that serves to establish a baseline from which to gauge an entity's progress in carrying out emissions mitigation.
- **Mitigate** GHG and CAP emissions through the implementation of an action plan in partnership with the Climate Friendly Places program. The action plan serves as a guide for reducing emissions and providing examples to the public on how to address climate change and air pollution in their own communities. For national parks, CFP program staff provide expertise on integrating the action plan into an Environmental Management System (EMS) framework.
- **Communicate** to the general public the importance of addressing the issues of climate change and air pollution. This goal can be carried out by highlighting the mitigation actions an entity is taking and why it is taking them.

By taking steps to increase resource conservation and become more energy efficient, national parks and other entities serve as examples to the public of what can be done at the community, corporate, and household levels to reduce greenhouse gas and criteria air pollutant emissions in an economically viable fashion. Since millions of people visit the national parks each year, the national park system provides an excellent resource for educating a large number of people about GHG and CAP emissions as well as the mitigation of these emissions.

*Purpose of the Climate Leadership in Public Places (CLIPP) Tool*

One of the first steps in signing on to the Climate Friendly Parks program is for parks to develop a comprehensive inventory of GHG and CAP emissions. This inventory has several purposes. First, it educates park personnel on the quantity and nature of their park's emissions. Second, it enables them to identify the activities that are primarily

responsible for the park's emissions, so that personnel can determine which mitigation activities will be most effective in reducing emissions. Finally, it provides park personnel with a baseline against which they can assess the impact of their mitigation activities.

Creating meaningful inventories is a resource-intensive process. Each inventory has required the involvement of a group of individuals specifically trained in development of inventory, and it takes several months to complete each inventory. The time, money, and expertise necessary to complete these inventories have thus far limited the expansion of the CFP program. Since 1993, only three inventories have been completed. Removing these barriers would allow the CFP program to expand to many more public places.

To this end, EPA and NPS funded the development of the CLIPP tool. The Climate Leadership in Public Places (CLIPP) tool provides a streamlined and easy-to-follow framework for National Parks to create an inventory of GHG and CAP emissions, as well as a way to identify potential mitigation options. Park personnel are asked to gather a variety of activity data (e.g., annual amount of electricity purchased, gallons of fuel consumed, etc.) and then to enter this data into the tool. All calculations are automated, and once data has been gathered, a complete inventory can be produced within a matter of hours. The CLIPP tool also has built-in features to help park personnel identify potential mitigation options and develop an action plan for reducing emissions.

The CLIPP tool can easily be distributed to many national parks and other public places, and the easy-to-use, Excel-based designed ensures that it can be used by a wide audience. By enabling personnel to complete their own inventories, the CFP program can now help even more public places learn about and reduce their GHG and CAP emissions.

*Overview of the CLIPP Tool*

The CLIPP tool is designed to inventory GHG and CAP emissions that occur from activities within park boundaries. The GHGs that are estimated include carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. The criteria air pollutants included in the inventory are sulfur dioxide, nitrogen oxides, volatile organic compounds, particulate matter ($PM_{10}$, $PM_{2.5}$), and carbon monoxide.

CLIPP contains several features to enhance its usability. Cells are color-coded to help users quickly identify cells in which to input data. "Helpful Hints" are present throughout the tool to provide users with additional information in more complicated sections. Step-by-step directions are included directly within the tool so users do not necessarily need training before using CLIPP. Additionally, navigational buttons automatically take the user through the tool, step-by-step, to help make using the tool easy.

CLIPP also seeks to educate the user on GHG and CAP emissions. Text boxes throughout the tool explain the different emissions, and discuss how certain activities

contribute to emissions. Users also have the option to view calculation methodology, emission factors, etc. in case they wish to learn more about estimation procedures.

The CLIPP tool is divided into three sections, a GHG emissions inventory, a CAP emissions inventory, and a mitigation options section. The tool evaluates the full spectrum of emissions-producing sectors. Sectors included in the GHG emissions inventory are stationary combustion, purchased electricity, mobile combustion, fertilizer application, wastewater treatment, refrigeration, forestry, waste, and petroleum and natural gas activities. Only a subset of these sectors contributes to CAP emissions and include stationary combustion, mobile combustion, and wastewater treatment. Additional sectors within the CAP emissions inventory including domestic burning (campfires, wood stoves, etc.), wildfires, prescribed burning, asphalt paving, consumer solvent use, and architectural surface coatings. The inclusion of all of these source categories provides a thorough inventory of emissions for the national parks. CLIPP also covers all units within the national park that contribute to emissions. Park units typically included are park operations, visitors, primary park concessionaire, other concessionaires, and other permitted activities within park boundaries (e.g., mining, oil drilling, etc.).

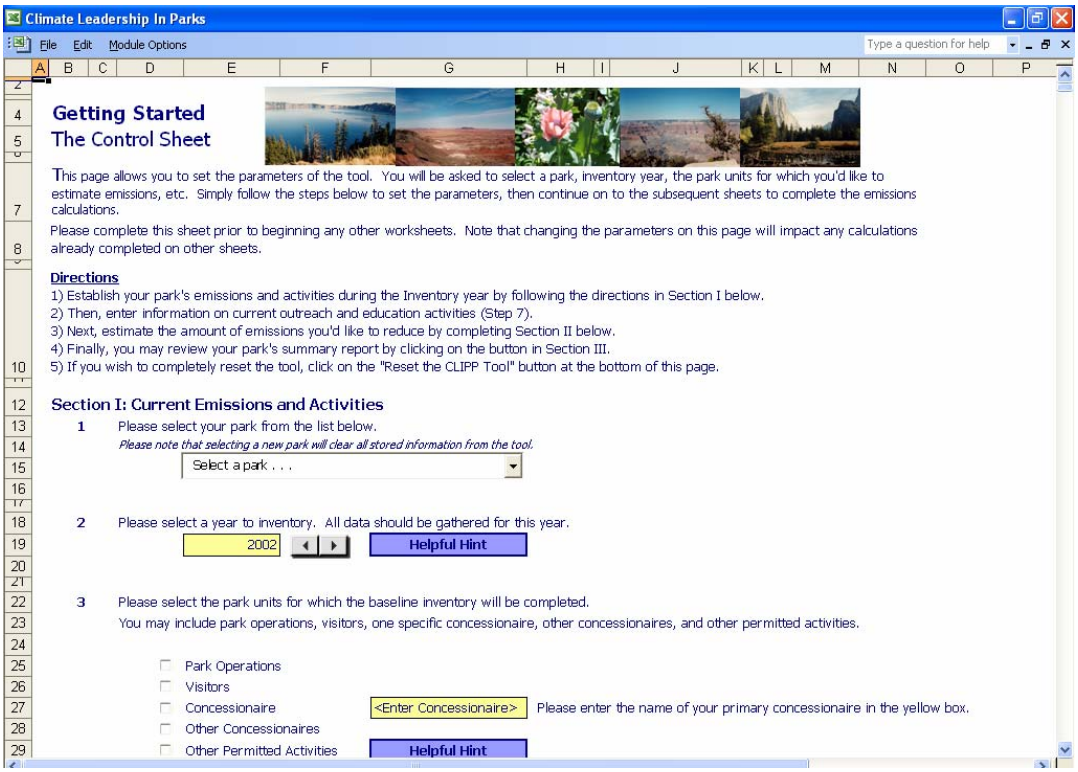
**Using the CLIPP Tool**

*Getting Started*

The CLIPP tool begins at a welcome page that provides introductory information about the tool, the setup of the tool, background information on GHG and CAP emissions, and navigation instructions. From this welcome page, users can either view a list of all data required to complete the inventories, or proceed directly to the control sheet to begin entering data about their park.

The control page allows the user to customize the inventory to their park. To generate emission estimates, the user chooses the year to inventory, which park units to include, which GHG sectors to include, and which CAP sectors to include (Figure 1). After making these initial decisions, the user follows the instructions provided and can navigate through the selected data input pages of the inventory. The control sheet also allows the user to access previously saved versions of their inventory. This feature is useful if they want to review the current summary of emissions and potential reductions, or want to enter data on park outreach and education efforts or current mitigation efforts.

**Figure 1: Control Sheet**

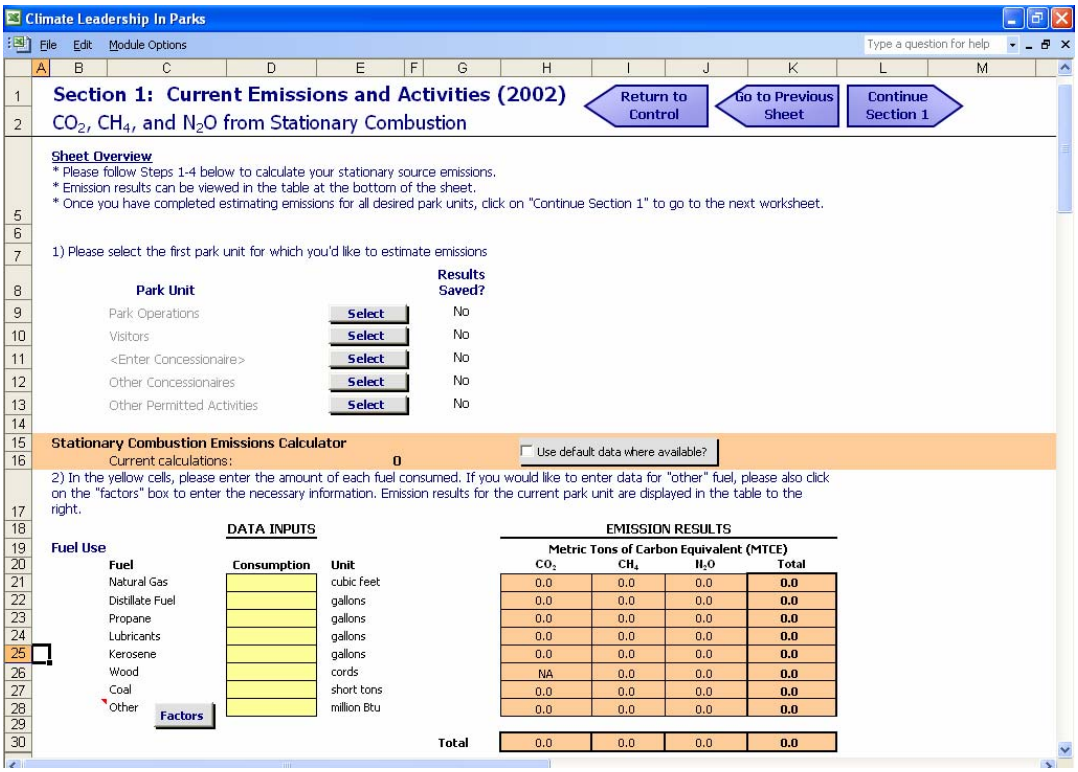



From the control sheet, the user moves to a general information sheet where information on the employee and visitor population, the length of the peak season, and the average length of the visitor stay are requested. This information is used throughout the calculations in the tool for multiple sectors.

*GHG Emissions Inventory*

After completing the general information sheet the user begins to move through the GHG emission inventory (section 1) and enter data necessary to calculate emissions. For example, Figure 2 shows part of the stationary combustion sheet where data on fuel use is required. This figure also shows the navigation buttons at the top of the sheet to help the user move through the tool. At any time, the user can return to the control sheet to make necessary changes, go to the previous sheet to check their data, or continue section 1 and move through to the next inventory sector.

**Figure 2: Stationary Combustion Sector: GHG Emission Inventory**




The data required to calculate emissions from the stationary combustion sector are fuel consumption by stationary equipment (e.g., heaters, generators, stoves). The underlying methods that the tool uses to calculate the emissions come from the Intergovernmental Panel on Climate Change (IPCC) 1997 document, *Revised 1996 Guidelines for National Greenhouse Gas Inventories*. To calculate $CO_2$ emissions, fuel consumption is multiplied by the appropriate heat content, carbon content, and fraction oxidized values for each fuel type. To calculate $CH_4$ and $N_2O$ emissions, fuel consumption is multiplied by heat content values for each fuel type, converted to net calorific values, and multiplied by fuel and gas specific emission factors.

The purchased electricity sector portion of the inventory follows the stationary combustion sector. On this worksheet, the amount of electricity purchased, in terms of kWh, is used to calculate emissions. Purchased electricity generates $CO_2$ emissions, which is a product of kWh, pounds of carbon per kWh, and the amount of electricity lost during transmission and distribution. Figure 3 shows a screen shot of the lower half of the purchased electricity page. The summary table is depicted, which is available on each sector page and provides an overview of the emissions calculated for that sector thus far. When the user resets the sheet to enter inputs from another park unit, the emissions data are saved.

**Figure 3: Purchased Electricity: GHG Emission Inventory**

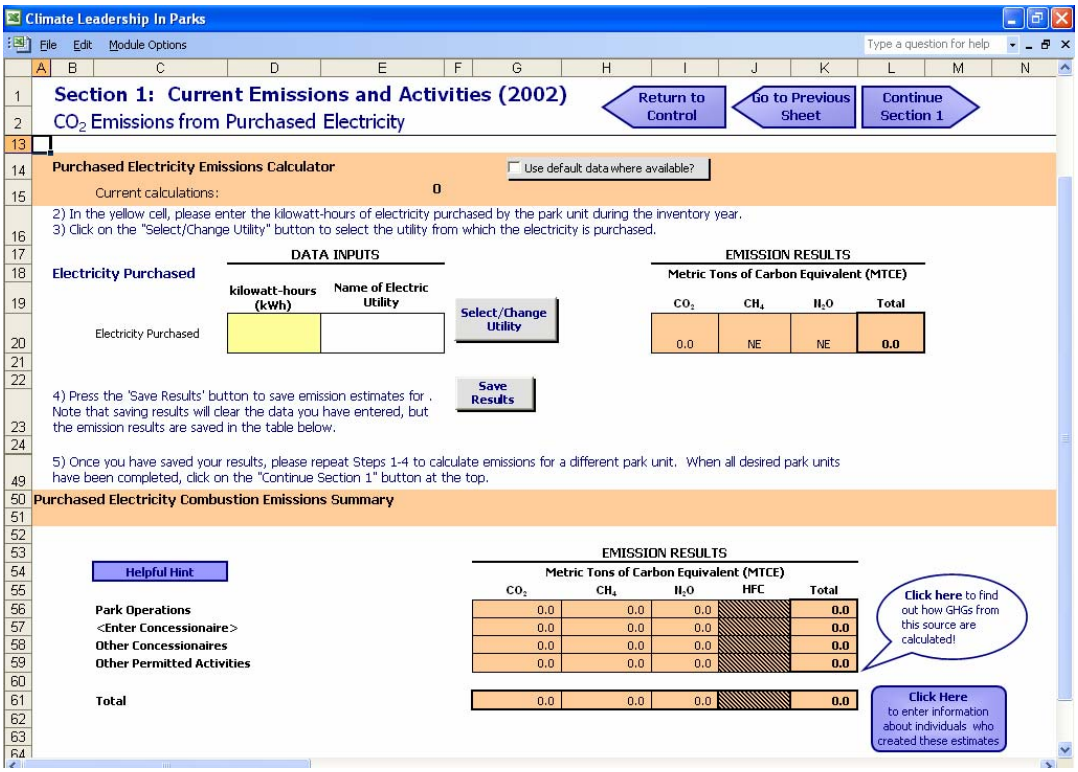
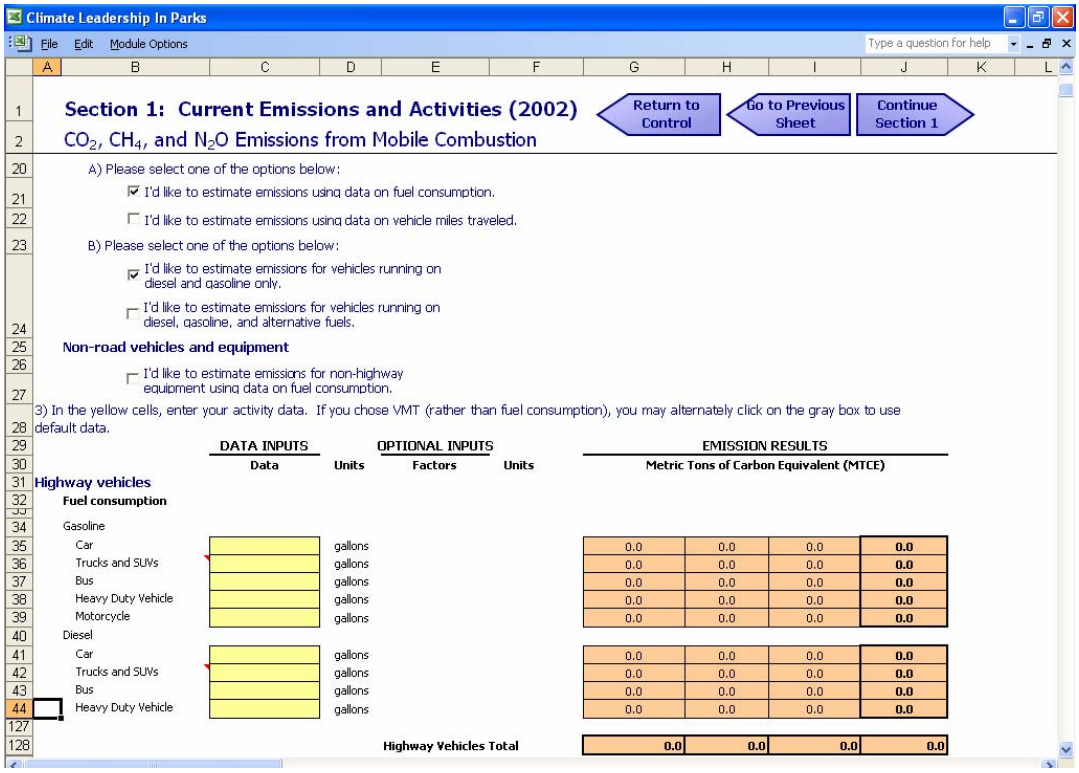



Figure 3 also shows three types of information buttons located throughout the tool. First is the helpful hint button, which gives the user helpful information or tips about the table, and data requested. Second is the "Click here to find out how GHGs from this source are calculated" button. This button takes the user to a sheet that details methods for calculating emissions, provides references for the methods used, presents the appropriate emission factors, and displays conversion factors used in the emission calculation. This button provides information to the user that is specific to the inventory sector they are working on. Third is the "Click here to enter information about individuals who created these estimates" button. This button takes the user to a worksheet where they can enter the name, title, and contact information for the person or persons who gathered data, estimated emissions, or estimated reductions from mitigation options. This information is useful in identifying contact information of key personnel that have knowledge about specific sectors and people to involve in future emission estimates.

Following the purchased electricity sector is the mobile combustion sector. The mobile combustion worksheet calculates emissions from the use of highway vehicles, non-road vehicles, and non-road equipment. For this sector, default data are available if the user chooses to estimate emissions using data on vehicle miles traveled rather than fuel consumption. Figure 4 shows an example of the mobile combustion worksheet if the

user selects to enter data based on fuel consumption. The methods for calculating emissions from mobile combustion are derived from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2002*.

**Figure 4: Mobile Combustion: GHG Emission Inventory**




Next in the tool are estimates of $N_2O$ emissions from fertilizer use. If the user does not have fertilizer use, he/she can choose to not select this source on the control sheet and skip this section. The data needed to calculate emissions from fertilizer use are total amounts of synthetic, organic, and manure fertilizer used (seen in Figure 5). The $N_2O$ emission estimates are a product of the amount of each type of fertilizer, the corresponding percentage of nitrogen content, and the volatized amount of nitrogen that becomes $N_2O$. The method for this source is from IPCC 1997, *Revised 1996 Guidelines for National Greenhouse Gas Inventories*.

Wastewater treatment is the next sector in the CLIPP tool, which requires data on gallons of sewage treated, percent of wastewater that is treated aerobically, the amount of $CH_4$ recovered at the wastewater treatment plant, and the total amount of wastewater treated at the plant. Methodology for this sector is based on IPCC 2000, *IPCC Good Practice Guidance*, but incorporates adjustments from UNEP 2004 and EPA 2002. The adjustments generate coefficients for BOD per gallon of wastewater and protein per gallon of wastewater. Since wastewater is usually not treated within the park and the park

**Comment:** What are these referring to? Are we going to include a complete Reference section?

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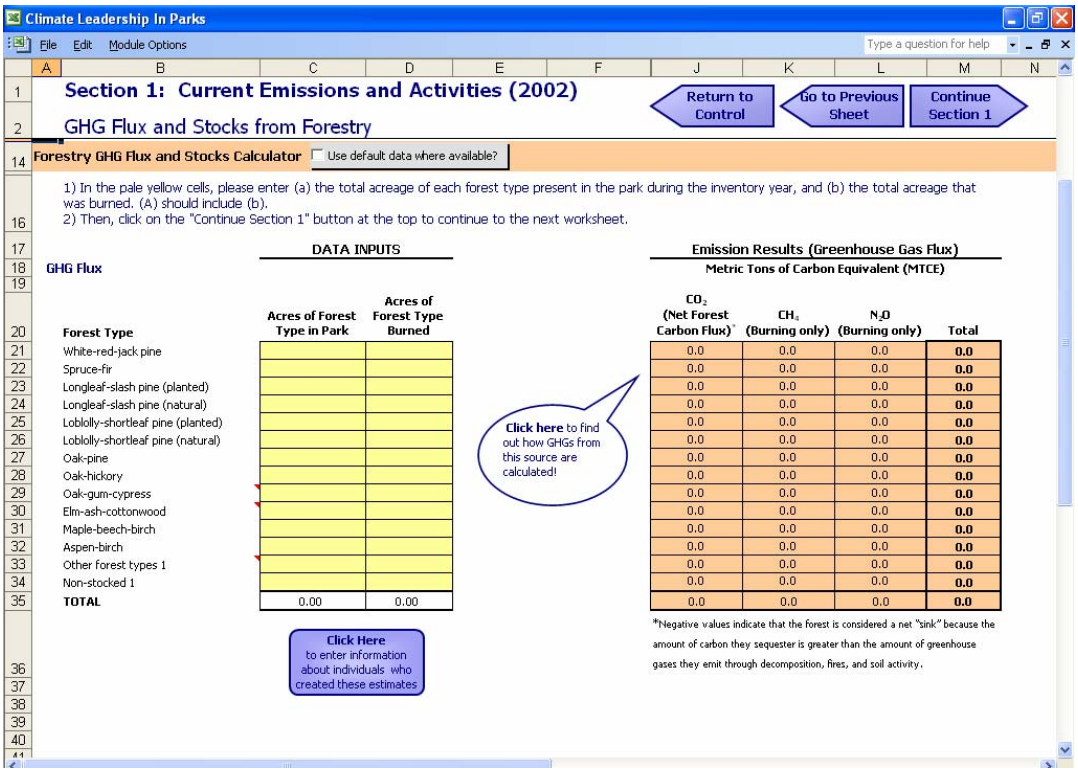
has little control over how emissions from this sector are managed, this sector could be excluded from a park's inventory. It should be included, however, if wastewater treatment occurs on-site.

The waste sector is the next portion of the Inventory the user must complete. This worksheet required information on the amount of waste sent to the landfill within the inventory year, whether the destination landfill practices methane flaring, and the amount of waste incinerated in the inventory year. Since waste in landfills decomposes over a 30-yr period, the $CH_4$ emissions estimates for landfilling are a result of the 30-yr waste-in-place scenario for the park unit. The estimates take into account emission reductions at the landfill due to landfill gas projects. The resulting $CH_4$ emissions from this sector are from landfilling, while the $CO_2$ and $N_2O$ are a result of incineration activities.

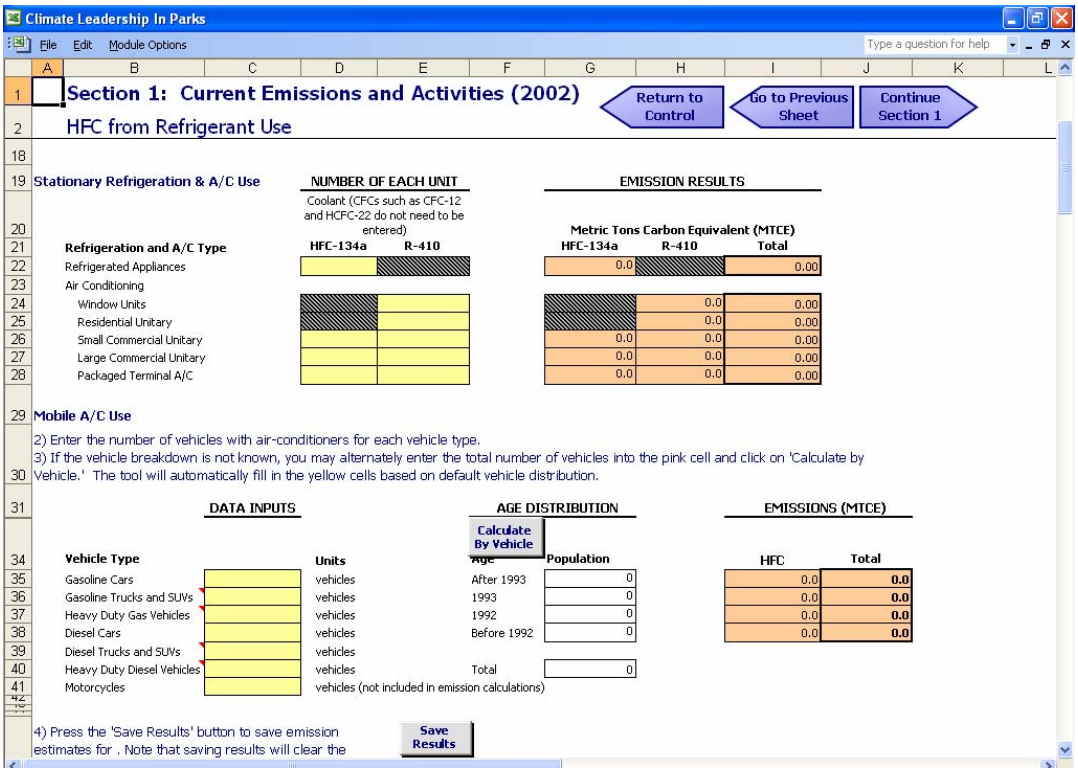
The forestry sector is next in the CLIPP tool and requires the user to input information on the acres of each forest type within the park, and the acres of forest type burned as seen in Figure 5. The forest type is automatically populated based on the park that is selected on the control sheet. The emission estimates for $CO_2$ are based on forest type and take into account the average annual change of carbon. The emission estimates for $N_2O$ and $CH_4$ are for burning only and incorporate the average tree carbon density value and an emission factor for dry matter combusted in forest fires. The methodology for $CO_2$ estimates are based on *Good Practice Guidance for Land-Use, Land-Use Change and Forestry 2003* while the $N_2O$ and $CH_4$ estimates are based on methodology developed by Richard A. Birdsey and George M. Lewis.

**Figure 5: Forestry: GHG Emission Inventory**




The refrigeration and air conditioning sector estimate the hydrofluorocarbon emissions in terms of metric tons of carbon equivalent. Emissions from refrigerated appliances, stationary air conditioning units, and motor vehicle air-conditioning units are due to the gradual leaking of coolants contained in the devices. The age distribution for various vehicle types is also taken into consideration, seen in Figure 6. The methodology for estimating emissions from this sector were derived from *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2002* and the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*.

**Figure 6: Refrigeration and Air Conditioning Use: GHG Emission Inventory**




Methane emissions from petroleum and natural gas activities are estimated in the next section of the CLIPP Tool. These emissions occur during the production, storage, transportation, and distribution of oil and natural gas and result from releases during normal operations (i.e. emissions associated with venting and flaring), chronic leaks or discharges from process vents, emissions during routine maintenance, and emissions resulting from upsets and accidents. Each activity within this category has an emission factor unique to the natural gas or petroleum process taking place.

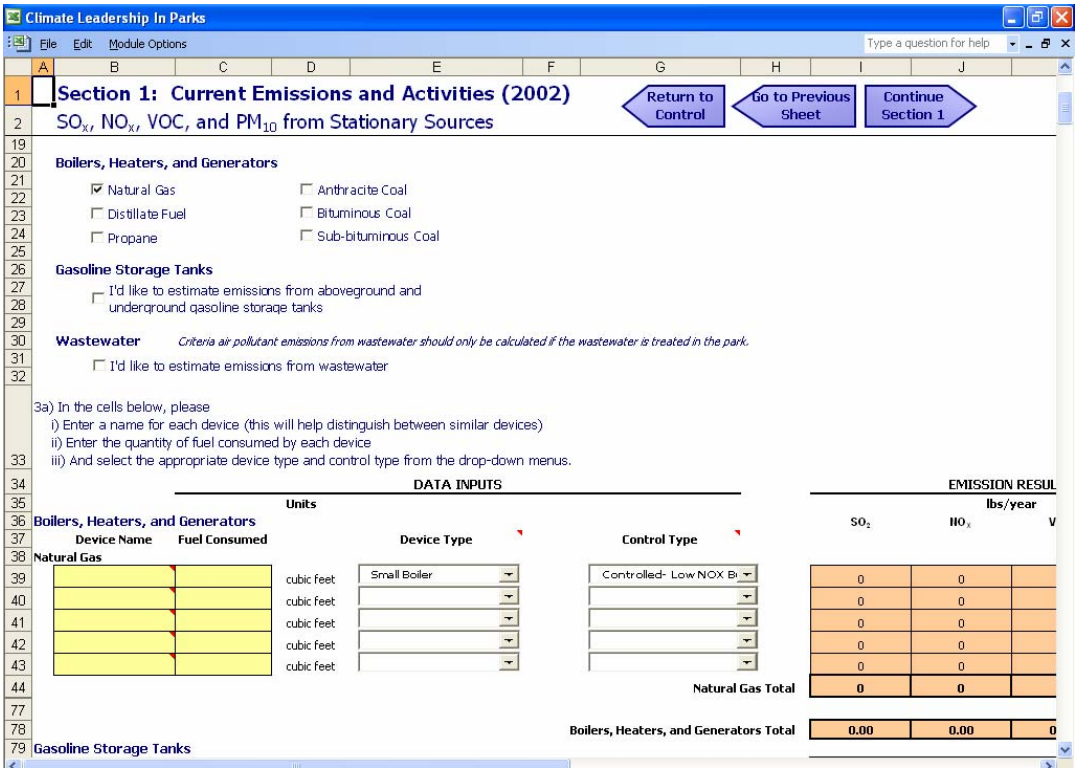
*CAP Emissions Inventory*

After completing the GHG emissions inventory, the user will be directed to complete a CAP emissions inventory (if selected initially from the Control sheet). The CAP emission estimates include stationary combustion, mobile combustion, and area sources. Subsectors within the CAP emissions inventory include wastewater treatment, gasoline storage tanks, domestic burning (campfires, wood stoves, etc.), wildfires, prescribed burning, asphalt paving, consumer solvent use, and architectural surface coatings.

CLIPP estimates stationary CAP emissions for boilers, heaters, generators, gasoline storage tanks, and wastewater treatment. The sources that consume fossil fuels

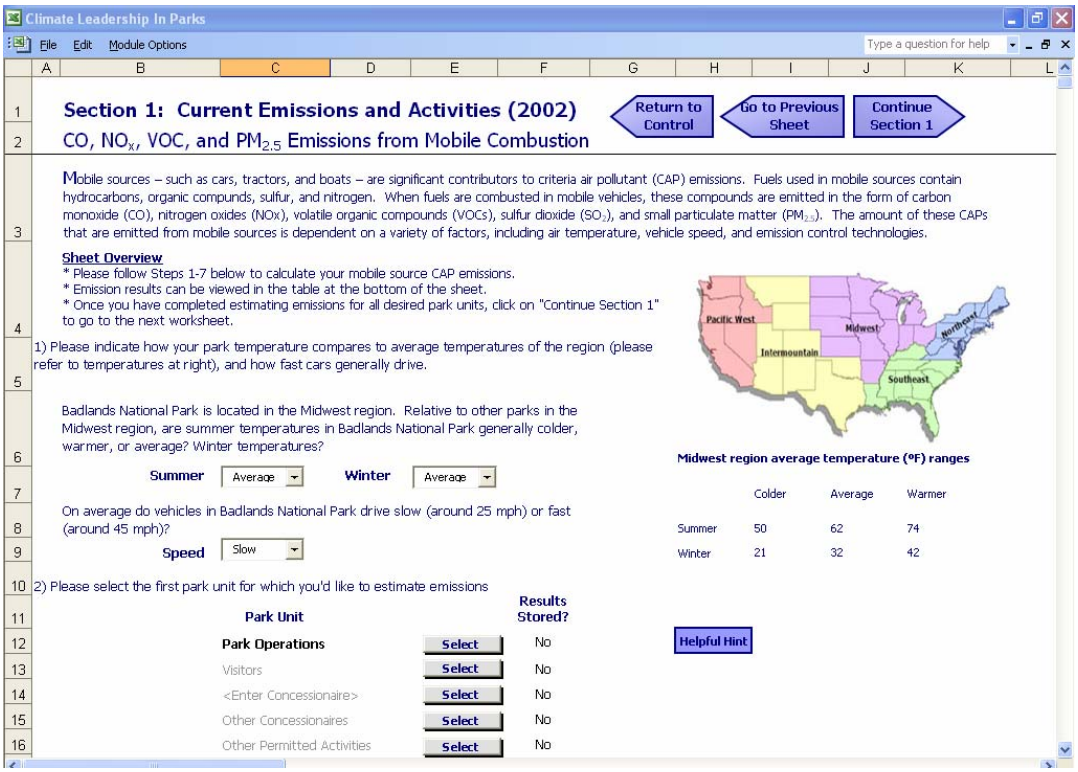
(i.e. boilers, heaters, and generators) generate emissions due to the combustion of natural gas, propane, and coal. The user has the option of selecting both the type of device and the control technology available for that particular device (see Figure 7). VOC emissions resulting from gasoline storage tanks are driven by the quantity of gasoline throughput and the gasoline tank size. VOC emissions from wastewater treatment are dependent on the gallons of wastewater treated. CAP emissions from these stationary sources are calculated based on the methodologies presented in the *Compilation of Air Pollutant Emission Factors, Volume 1*.

**Figure 7: Stationary Combustion: CAP Emission Inventory**



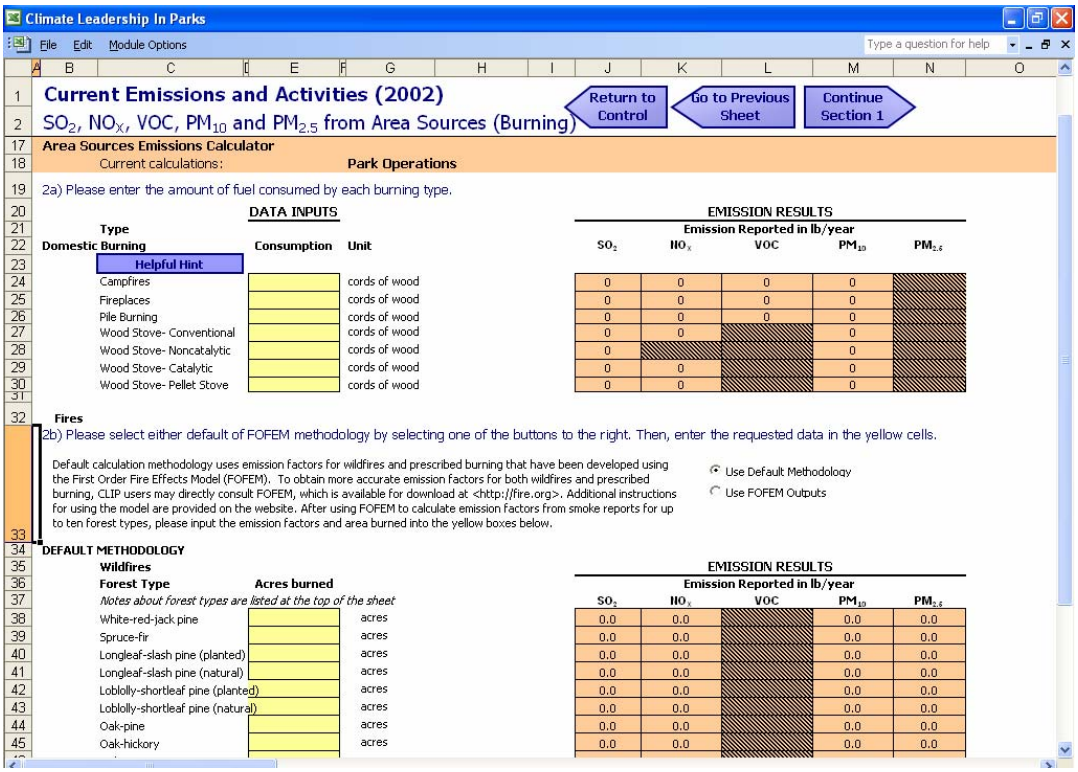

Mobile CAP emissions are estimated for highway vehicles, non-road vehicles, equipment, and marine vessels. CAP emission estimates from highway vehicles, (similar to GHG emissions estimates), can be estimated based on either fuel consumption or vehicle miles traveled. The calculations are dependent on the emission factors – developed by John A. Volpe National Transportation Systems Center using Mobile 6.2 – and take into account the average summer and winter temperatures, along with the average speed of vehicles traveling within the park see Figure 8. Emissions from non-road vehicles, equipment, and marine vessels are based on the hours per year the equipment is in use, the emission factor, and the load for the equipment type. The methodology for determining emissions from these three sources was derived from *The U.S. National Park Service Air Emissions Inventory*.

**Figure 8: Mobile Combustion: CAP Emission Inventory**




Emissions resulting from area sources are divided into two categories: burning sources and other sources. Emissions resulting from burning sources include domestic burning (i.e. campfires, fireplaces, pile burning, and woodstoves), prescribed burning, and wildfires (Figure 9). Domestic burning emissions incorporate the wood consumption and the appropriate emission factor for the domestic burning activity. The methodology and emission factors for these estimates were based on *The Compilation of Air Pollutant Emission Factors, Volume 1*. The user has the option for prescribed burning and wildfires to either use a default methodology (previously developed using the First Order Fire Effects Model (FOFEM)) or to visit the online version of the model to customize emission factors for the park from smoke reports for up to ten forest types.

**Figure 9: Stationary Combustion: CAP Emission Inventory**




Other area source (or non-burning) activities include asphalt paving, consumer solvent use, and architectural surface coatings. Using asphalt to pave roads, the use of cleaning products, and the use of architectural surface coatings result in the emissions of VOC. The emission factors and methodology for asphalt paving and architectural surface coatings are based on *The Compilation of Air Pollutant Emission Factors, Volume 1*, while the *Emissions Inventory Improvement Program (EIIP) Guidelines 2003* were used for consumer solvent emission estimates.

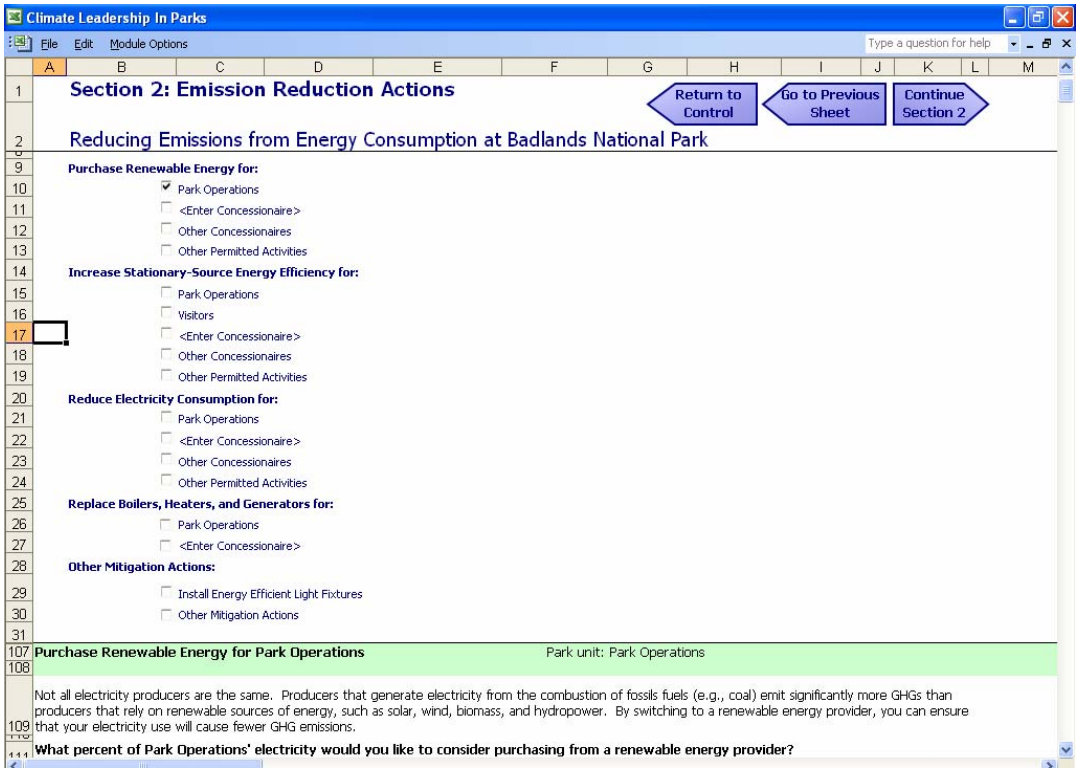
*Mitigation Actions*

The mitigation section is the next part of the CLIPP tool in which the user will be able to explore options for reducing park emissions in the following sectors: Energy, Transportation, Land Use and Agriculture, Waste, and Area Sources. Within each sector, the user has the option of selecting various actions within each park unit that will reduce emissions.

The energy mitigation sector presents emission reduction actions such as purchasing renewable energy, increasing stationary source efficiency, reducing electricity consumption, and installing energy efficient light fixtures (Figure 10). The user also has the option of accounting for other GHG and CAP emission reducing activities that are not

provided within the section. These resulting emission savings are based on current emissions estimates and either the proposed percent increase in energy efficient products or decrease in fuel consumption.

**Figure 10: Energy Mitigation: Mitigation/Outreach**




The transportation mitigation sector presents emission reduction actions such as reducing vehicle idling, restricting visitor access to roadways, encouraging visitors to use alternative forms of transportation, and reducing vehicle idling. The user also has the option of accounting for other GHG and CAP emission reducing activities that are not provided within the section. The emissions reductions are based on current emission estimates and either the proposed percent reduction in vehicle idling, the reduced mileage of roads that are available to visitors, and the percent reduction in driving among visitors due to the use of public transportation (i.e. shuttle buses).

The land use mitigation sector presents emission reduction actions such as reducing fertilizer application, planting trees, and reducing mowing in idle open space. The user also has the option of accounting for other GHG and CAP emission reducing activities that are not provided within the section. The emissions reductions are based on current emission estimates either the percent reduction in fertilizer application, the increase in acreage of trees that are planted, or the gallons of gasoline saved by the reduction in mowing in idle open space.

The waste mitigation sector presents emission reduction actions such as composting yard trimmings and food scraps, increasing recycling programs, and reducing paper usage. The user also has the option of accounting for other GHG emission reducing activities that are not provided within the section. The emissions reductions are based on the amount of current waste generated for specific types of materials, and either the percent currently composted or recycled versus the percent composted or recycled in future years. Reducing emissions from paper consumption involves applying a percent reduction in paper use to the current paper use within the park.

The area sources mitigation sector presents emission reduction actions such as decreasing the number of fires in campsites and fireplaces, reducing solvent use, and reducing wood stove fuel consumption. The user also has the option of accounting for other CAP emission reducing activities that are not provided within the section. The emissions reductions are based on the current amount fires and solvent use and the percent reduction for each action.

*Outreach and Pledge*

The outreach portion of the CLIPP tool enables the user to assess potential impacts of outreach activities on emission reductions. The outreach activities involve park employees, park partners, visitors, and the surrounding community. The purpose of the outreach section is to estimate the percentage of people that will change their behavior to help reduce emissions once they have received information regarding GHG and CAP emissions.

The Climate Friendly Parks Pledge is the final step in completing the Inventory. This pledge provides a summary of the park's emissions, mitigation actions, and outreach plans. There is also an area where the user can establish a supervisor and targeted completion date for each of the mitigation options. The pledge offers proof as to the completion of the CLIPP Tool and the commitment to become a Climate Friendly Park.

**Conclusion**

With the development of the CLIPP tool, EPA and NPS have significantly reduced the barriers to participation in the Climate Friendly Places program. CLIPP will hopefully encourage many more parks to develop GHG and CAP inventories, identify and implement mitigation options, and educate their visitors about emissions and mitigation. Through visitor education, and by setting an example, parks will help encourage emission reduction activities among the general public. The impacts of these activities could be far-reaching.

While the Climate Friendly Places program is currently focused on national parks, EPA hopes to soon expand it to include schools, zoos, science museums, and state/local recreation areas. CLIPP will help facilitate this expansion of the program by providing personnel with the tools necessary to complete their own inventories.